

**Bangor University**

## **DOCTOR OF PHILOSOPHY**

### **Effects of Eudaimonic Framing Upon the Self-Regulation of Healthy Lifestyle Behavior and Alleviation of Noncommunicable Disease**

Willmot, Rhiannon

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**Effects of Eudaimonic Framing Upon the Self-Regulation of Healthy Lifestyle  
Behaviour and Alleviation of Noncommunicable Disease**

**Rhiannon Amy Willmot**

**School of Psychology**

**June 2019**

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## Thesis Summary

Behaviourally determined health conditions known as non-communicable diseases are responsible for almost 70% of global mortality, and drastically reduce quality of life. They arise as a consequence of physical inactivity, poor diet, alcohol misuse and substance abuse; behaviours which frequently co-occur and are socioeconomically patterned. As such, a vast majority of noncommunicable disease is preventable and the proactive tackling of health risk behaviour is a public health priority.

The behavioural profile underlying noncommunicable disease is characterised by impulsivity, whereby immediate rewards (e.g. unhealthy food, alcohol) are prioritised over long-term goals (e.g. reduced risk of obesity and liver disease). Consequently, healthy lifestyle behaviour requires both the capacity and desire to regulate impulsive responses. However, the extent to which individuals personally identify with motives for healthy action is a critical determinant of their conscious effort, and automatic responses to environmental cues also influence behavioural outcomes. Current alleviative strategies include information-based campaigns and implicit choice architecture. However, both methods are hindered by the impediments of self-regulatory deficit and practical implementation respectively. Difficulties in intervention are further compounded by psychological reactance; the presentation of oppositional responses to authoritative instruction.

Resultantly, novel approaches are required to recalibrate attention away from immediate gratification and toward distal goals. The most effective interventions will attenuate impulsivity, promote volitional engagement with physical health, and be widely scalable. The positive health paradigm suggests identifying and living in accordance with important life goals, or *eudaimonia*, leads to greater investment in one's physical health, and may accentuate healthy environmental cues. Furthermore, positive psychology presents philosophical synergy with these objectives, given its *raison d'être* to create holistic wellbeing at the population-level. However, little empirical research has addressed the role of eudaimonic framing in motivating physically healthy action.

Accordingly, this thesis aimed to investigate how principles of positive health can be applied to alleviate the behavioural antecedents of noncommunicable disease. For ease of reference, a thesis glossary is presented herein. Chapter 1 presents the research philosophy and a detailed literature review. Chapters 2 and 3 explore how amplifying forms of eudaimonic wellbeing can promote the incentive salience and cognitive accessibility of physical health cues. Specifically, Chapter 2 involves the design and evaluation of a brief daily journaling intervention to promote



perceptions of meaning in life amongst higher education students and a community sample. In Chapter 3, variation in the mental representation of psychological distance upon eating and exercise decisions is assessed. Chapter 4 considers how factors identified in laboratory settings translate to daily life, by exploring the success of an international physical activity initiative known as *parkrun*. Strengths, limitations and future directions of this work are discussed in Chapter 5. Globally, results suggest the value of eudaimonic constructs in promoting physical health outcomes, and substantiate theory regarding the motivational properties of goal internalisation in successful behaviour change

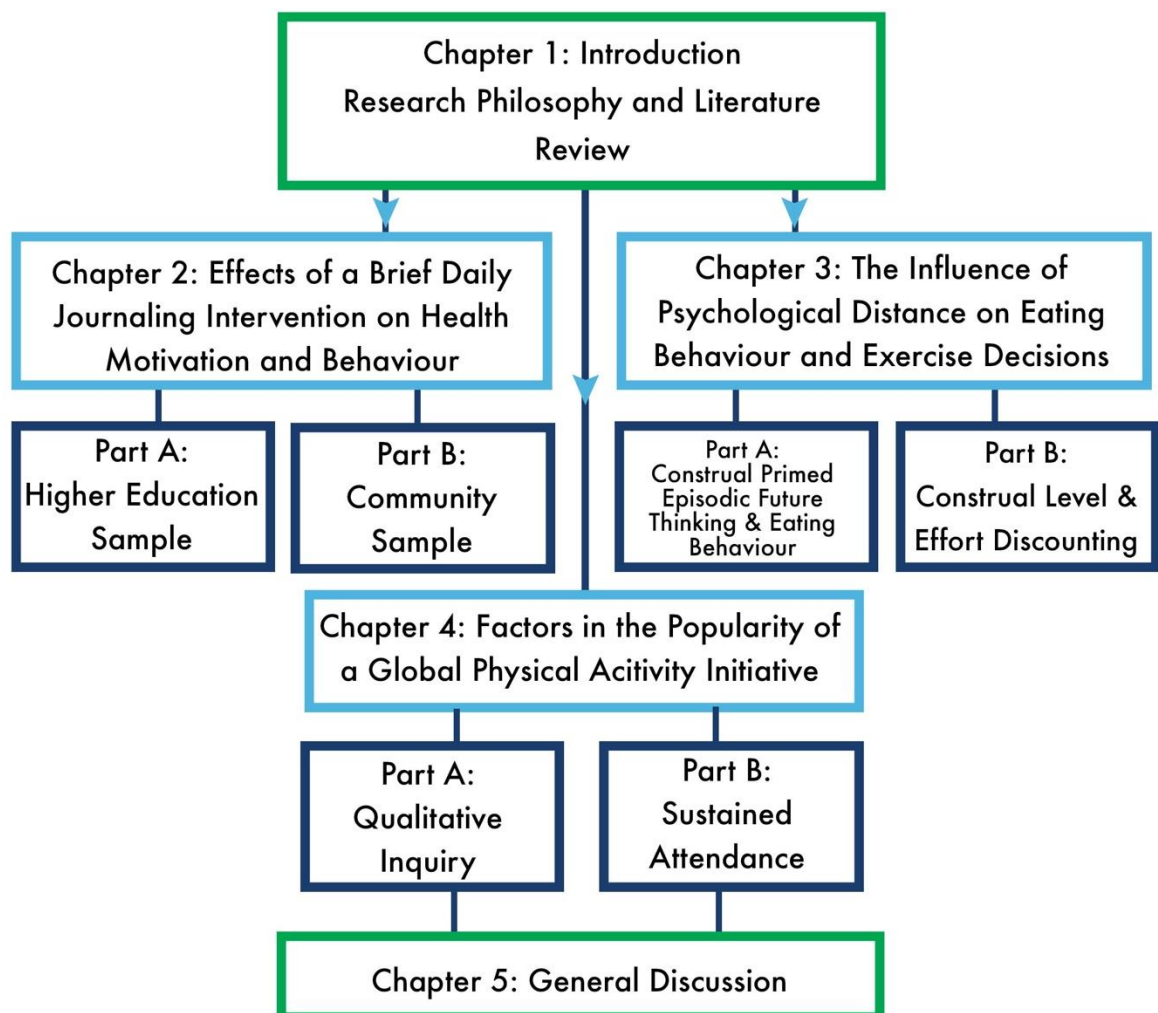


Figure 1. Schematic to depict thesis components and structure.

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## Thesis Glossary

Term	Definition
Beneficence	<i>A sense of prosocial impact which arises from connecting with other people and superordinate causes.</i>
Biases	<i>Mental representations which are in some way distorted compared to objective reality and influence cognition or behaviour.</i>
Approach	The disproportionate and automatic direction of appetitive behaviour toward stimuli.
Attentional	The disproportionate direction of attention toward stimuli. Disorients mental representation.
Choice Architecture	Environmental restructure which either: - supports system I processes in making a healthy-choice - impedes system I processes, so that system II processes can direct behaviour.
Construal level	Mental representation of objects according to binary feature categories and as a function of psychological distance.
Abstract	Characterised by high-level, invariant, core features. (e.g. purpose behind activity). Associated with greater psychological distance.
Concrete	Characterised by low-level, transient, specific features. (e.g. actions required to complete activity). Associated with lesser psychological distance.
Discounting	Subjective devaluation.
Delay, Temporal	Delayed rewards are subjectively devalued in relation to immediately available options. Also described as temporal discounting.
Effort	Effort costs are perceptually reduced in response to subjective valuation of associated rewards.
Dual Process Theory	Choice is a product of interaction between two decision-making systems.
System I	Operates in response to environmental triggers, specialised for intuitive, emotional processing.
System II	Responsible for rational and long-term planning. Resource-limited.
Ego-Depletion	A psychological state in which system II resources are diminished and self-regulation is more difficult.
Episodic Future Thinking	The experience of prospective scenarios via mentally projecting oneself into the future.

Futurelessness	The conscious pursuit of immediate rewards due to perceptions of future planning as unimportant or futile.
Health Behaviour	
Health Risk	Behaviour that presents risk physical health e.g. exposure to hazardous substances.
Wellness	Behaviour that promotes physical health and prevents disease e.g. vitamin consumption.
Impulsivity	The tendency to select immediately available options over delayed rewards, difficulty inhibiting action and reduced ability to tolerate delay.
Incentive Sensitisation	An process via which environmental stimuli become highly salient as a result of repeated association between cue and reward. Results in attentional and approach biases.
Internalisation	The integration of extrinsic objectives amongst one's sense of self. An understanding of the personal relevance of tasks and behaviours.
Meaning in Life	Perception of engagement in purposeful activity which contributes toward long-term goals and benefits other people or causes.
Motivation	Goal-directed energy for action.
Autonomous	Behaviour is an expression of choice and freedom. Driven by identified regulation.
Controlled	Behaviour is a result of extrinsic contingency or pressure. Driven by external and introjected regulation.
Noncommunicable Disease	Lifestyle driven health conditions which primarily arise as a result of physical inactivity, poor diet, tobacco use and alcohol harm.
Priming	Exposure to one stimulus influences response to a subsequent stimulus without conscious guidance or intention.
Psychological Distance	Perceived distance between the self and object representations which cannot currently be experienced. Comprised of: spatial; geographical distance, social; self vs. stranger, hypothetical; likelihood of occurrence, temporal; time-based distance.
Psychological Reactance	Display of oppositional attitudes or behaviours in response to authoritative instruction.
Time Perspective	The extent to which people consider the temporal consequences of action when making decisions.

Self-Regulation	The ability to engage in distal goal-directed action and resist immediate temptation. Management of thoughts and behaviour across dual-process systems.
External	Behaviour is regulated by extrinsic contingencies (reward, punishment)
Identified	Behaviour is perceived as personally important and motives are internalised.
Intrinsic	Behaviour is inherently enjoyable.
Introjected	Behaviour is motivated by social pressure but motives are not internalised.
Self-Determined Needs	Universal and innate drives, for which a threshold level is necessary to derive wellbeing. A foundation of eudaimonia.
Autonomy	The ability to live in accordance with one's personal values.
Competence	The desire to master skills and effectively bring about outcomes.
Relatedness	The inclination to foster and maintain social connections.
Self-Transcendent	Provides beneficial consequences which extend beyond the immediate self.
Wellbeing	The regular experience of positive affect, attainment of important goals, ability to relate well with others and derivation of engagement and meaning from life.
Eudaimonic	Cognitive. Life satisfaction derived from activity aligned with long-term goals and self-determined needs.
Hedonic	Affective. Presence of positive emotions and absence of negative emotions.

## Thesis Context

### The Fable of the North Wind and the Sun

*“High above the Earth, the North Wind boasted of great strength, whilst the Sun argued there was greater power in gentleness. Far below them, a traveller made his way down a winding road, wearing warm, winter clothes. The Wind and the Sun decided to settle their dispute by determining who could cause the traveller to remove his coat. As the Sun retired behind a cloud, the Wind began to blow. Birds clung to the trees, and the world was filled with dust. But the harder the Wind blew, the tighter the shivering man clung to his coat. Then, the Sun came out and warmed the frosty ground. Soon, the man felt so hot he took off his coat and sat down in a shady spot.”*

**(Aesop, Grimm, Grimm, & Andersen, 1909).**

The essence of this tale is that persuasion is more effective than severity; a message which is both supported by empirical evidence, and applicable to the global crisis of lifestyle health. For too long, governments and policymakers have relied exclusively upon authoritarian strategies to direct health behaviour. Recently, techniques which influence choice via altering the environment have gained traction. However, both methods have struggled to reduce modifiable risk behaviour, and so the current research presents an alternative approach. Drawing upon the positive health paradigm, this thesis examined how maximising pre-existing human qualities can support the salience of physical health. Due to the very broad nature of themes which comprise this work (wellbeing, health behaviour) the following literature review is constructed as a narrative appraisal, rather than exhaustive analysis, of the most pertinent topics and concepts.

## Chapter One

### Introduction

#### 1.1 Noncommunicable Disease

Despite prolonged and targeted intervention, lifestyle driven health conditions known as noncommunicable diseases (NCDs) remain a significant threat at both the societal and individual level. Health problems classified as NCD include cardiovascular disease, type II diabetes mellitus, chronic respiratory diseases and some cancers (World Health Organisation; WHO, 2014). Despite the detrimental impact of NCD on quality and length of life, associated health conditions are driven by modifiable behavioural risk factors. These are smoking, unhealthy diet, physical inactivity and alcohol misuse (WHO, 2011). In 2008, 63% of all deaths globally were linked to NCD (King et al., 2015), a figure which rose to 68% in 2014 (WHO, 2014). More than 40% of these deaths were premature, occurring before 70 years of age (WHO, 2014). Physical inactivity and obesity are viewed as a global pandemic, with 23% of adults and 80% of adolescents (11-17 years) insufficiently active (undertaking less than 150-min per week of moderate-intensity physical activity; Andersen, Mota, & Di Pietro, 2016; Pedersen, 2009). Fifty-two percent of adults are classified as overweight or obese (Arena, McNeil, Sagner, & Hills, 2017). Global patterns of sedentary behaviour are well above desirable levels (Young et al., 2016) and the combined influence of low physical activity and nutritional intake has resulted in a doubling of obesity rates since 1980 (Arena et al., 2017). Equally, tobacco use continues to present a substantial contribution to global ill health, with one billion regular smokers worldwide (Beaglehole et al., 2011). Smoking rates have reduced in some high-income countries, however are rapidly rising in many low- and middle-income regions, with a prevalence of over 25% amongst adolescents in some areas (Freeman & Chapman, 2010; Wiist, 2010; Wilson, Guillaumier, George, Denham, & Bonevski, 2017). Lastly, global alcohol consumption levels were estimated at 15g of pure alcohol per person per day in those aged 15 years and over in 2010 (WHO, 2014) and continue to represent harmful consumption in terms of both volume and patterning (Ng, Sutradhar, Yao, Wodchis, & Rosella, 2019).

#### 1.2 Physical Health Impact

Noncommunicable diseases are the major cause of death and disability worldwide, with one in 10 premature deaths from cardiovascular disease and one in six all-cause deaths attributed to

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physical inactivity (Lee et al., 2012; Yusuf et al., 2004). Evidence indicates 3.4 million deaths are caused by excess body mass, and that one in seven premature deaths could be prevented if obesity were eliminated (Di Angelantonio et al., 2016; Popkin, Adair, & Ng, 2012). Indeed, sugar-sweetened beverages alone are causally linked to 184,000 deaths globally as a consequence of diabetes, cardiovascular disease and cancer (Singh et al., 2015). Likewise, alcohol misuse accounts for more than 1.8 million deaths globally and leads to heightened mortality risk from a variety of different causes across disability, disease and injury (Rehm et al., 2018). There is a direct link between high alcohol consumption and multiple cancers, as well as liver cirrhosis and pancreatitis (Irving, Samokhvalov, & Rehm, 2009; Rehm et al., 2010). Moreover, 15,000 people die each day from tobacco-related diseases (Wilson et al., 2017), with both active and passive smoke exposure responsible for associated harm (Öberg, Jaakkola, Woodward, Peruga, & Prüss-Ustün, 2011).

### 1.3 Economic Impact

The human toll exacted by noncommunicable disease should be reason enough to act. However, NCDs also undercut productivity and boost healthcare outlays, presenting staggering economic costs. These are projected to increase over the next two decades in line with a growing ageing population (Bloom et al., 2012). The global impact of NCD in lost gross domestic product is estimated to reach US\$47 trillion between 2011 and 2025 (Daar et al., 2007), representing enough money to eradicate two dollar-a-day poverty among 2.5 billion people (Bloom et al., 2012). Insufficient physical activity is thought to cost healthcare systems US\$53.8 billion worldwide, contribute to a US\$13.7 billion loss in productivity and require US\$13.4 million to support associated disability (Ding et al., 2016). Healthcare expenditure on smoking-attributable diseases totalled US\$422 billion in 2012, accounting for 5.7% of global health expenditure, whilst productivity-loss related costs were calculated at US\$1014 billion (Goodchild, Nargis, & Tursan d'Espaignet, 2018). The global economic impact of obesity was estimated at US\$20 trillion in 2014 (Tremmel, Gerdtham, Nilsson, & Saha, 2017) with substantial evidence suggesting the full financial burden of obesity accrues to society through lower returns on education (Datar, Sturm, & Magnabosco, 2004; Mosuwan, Lebel, Puetpaiboon, & Junjana, 1999), decreased household income (Cawley, 2004; Kraut, Walld, Tate, & Mustard, 2001), increased premature retirement (Cawley & Danziger, 2005) and higher dependence on welfare (Yach, Stuckler, & Brownell, 2006). If current trends continue, the estimated total cost of obesity by 2050 is £9.7 billion in the UK alone (Morgan & Dent, 2010). The net global impact of consequences from alcohol misuse including injury, violence, crime, and chronic



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conditions is unknown, however was estimated at US\$ US\$249 billion in the U.S. (Sacks, Gonzales, Bouchery, Tomedi, & Brewer, 2015) and £21 billion in England and Wales (Bhattacharya, 2017).

In light of these stark economic implications and increasingly strained public finances, evidence suggests the importance of investing in scalable and preventative strategies (WHO, 2014). Specifically, Bloom et al. (2011) posit creating population-level versions of successful individual-based treatments, such as post-stroke counselling, represent the most cost-effective techniques. Equally, Ebrahim et al. (2013) state understanding how to alleviate noncommunicable disease in high-income countries can prevent the emergence of a more significant problem in low- and middle-income regions. Collectively, developing population-level, replicable and preventative solutions to NCD-related behaviour is key to global health promotion.

### 1.4 Psychosocial Impact

In addition to the degradation of physical health, modifiable NCD risk behaviours have distinct psychosocial consequences. For example, obesity is linked to depression and anxiety in adults (Scott et al., 2008) and in children (Small & Aplasca, 2016). This relationship is indicated as bi-directional, with evidence documenting an 18% increase in depression risk for those for those classified as obese, in comparison to those with a healthy weight (Mannan, Mamun, Doi, & Clavarino, 2016). Alcohol misuse and mental disorders are also highly co-morbid, and there is evidence of a causal relationship between alcohol misuse and depression (Jané-Llopis & Matytsina, 2006). Fifty-two percent of participants reported developing alcohol dependence before depression in one investigation (Gratzer et al., 2004) and the WHO estimate 10% of major depression is the result of heavy alcohol consumption in North America, the Russian Federation and Europe (Ezzati, Lopez, Rodgers, Vander Hoorn, & Murray, 2002). Nicotine dependence is also associated with psychiatric co-morbidity, however there is less evidence to suggest smoking causes mental disorder (Jané-Llopis & Matytsina, 2006). Physical activity serves a variety of protective functions against mental ill-health and can help to manage psychopathology (Paluska & Schwenk, 2000). For example, increased exercise reduces stress (Calogiuri et al., 2015), increases positive affect (Barnes, Coombes, Armstrong, Higgins, & Janelle, 2010), decreases anxiety (Mochcovitch et al., 2016) and can halt or reverse the incline of depression (McPhie & Rawana, 2015). Sedentary behaviour and related activity such as screen time are related to low self-esteem, depression and psychological distress (Hoare, Milton, Foster, & Allender, 2016). However, programmes to promote exercise in previously sedentary

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individuals have observed benefits to both mental health and life satisfaction (Bowen et al., 2006; Martin, Church, Thompson, Earnest, & Blair, 2009).

### 1.5 Noncommunicable Disease Clusters and Socioeconomic Health Inequalities

It is important to note that the behavioural antecedents of noncommunicable disease appear in clusters. Poor diet and physical inactivity typically co-occur, as do tobacco use and poor diet, and tobacco use and alcohol misuse (Meader et al., 2016; Prendergast, Mackay, & Schofield, 2016; Zwolinsky, Raine, & Robertson, 2008). Traditionally, empirical investigation has investigated distinct forms of NCD in silo (Fortin et al., 2006; Parekh & Barton, 2010). Whilst this approach is valuable for understanding the epidemiology of individual conditions, it less accurately reflects the experience of patients who acquire multiple illnesses (Wilson et al., 2017), and does not cater for the design of interventions which target numerous forms of NCD. Furthermore, modest changes to multiple health harming behaviours can achieve greater impact than substantial modification in one domain (Arena et al., 2017). For example, improving diet and increasing physical activity levels collectively contributes to more balanced energy intake and reduced likelihood of obesity and diabetes (Schutz, Byrne, Dulloo, & Hills, 2014). As such, interventions should avoid the segregation of behaviours which commonly occur together. This approach aligns with recommendations from the WHO, which state a comprehensive plan across NCD risk-factors is necessary to achieve related targets (WHO, 2014).

Furthermore, the co-occurrence of NCD risk behaviour is most apparent in socioeconomically deprived communities, and leads to the perpetuation of disparity in health related life outcomes (Chiolero et al., 2006; Pepper & Nettle, 2014). Socioeconomic gradients are observed in diet quality (Brennan, Henry, Nicholson, Kotowicz, & Pasco, 2009; Everson, Maty, Lynch, & Kaplan, 2002), physical activity (McLaren, 2007; Jane Wardle, Waller, & Jarvis, 2002), alcohol consumption (Daniel et al., 2009; Fone, Farewell, White, Lyons, & Dunstan, 2013) and tobacco use (Kotz & West, 2009; Legleye, Khlal, Beck, & Peretti-Watel, 2011). As a consequence, some theorists have claimed noncommunicable disease develops primarily as a result of financial constraint (Zimmet, 2000; Ziraba, Fotso, & Ochako, 2009), drawing upon evidence that socioeconomic deprivation restricts access to high-quality food and the ability to exercise (Darmon & Drewnowski, 2008; Wylie-Rosett & Jhangiani, 2015). However, given health damaging behaviours such as smoking and excessive alcohol consumption require active expenditure, it is clear personal finance is not the only factor to

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underly the socioeconomic patterning of noncommunicable disease.

An alternative explanation for both the clustering of modifiable risk behaviour and the amplification of this phenomenon in socioeconomically deprived communities is that certain psychological processes underly multiple behavioural responses. For example, maladaptive action toward alcohol, cigarettes, unhealthy food and physical inactivity collectively represent *impulsivity*, or the devaluation of long-term outcomes in favour of immediate reward. The contextually appropriate response hypothesis (Pepper & Nettle, 2017) describes how future devaluation is more likely to occur in impoverished situations, because those living in poverty have less influence over life outcomes and thus do not prepare for a future which is uncontrollable. As such, the heightened prevalence of health risk behaviour in socioeconomically deprived communities may represent the amplification of impulsive tendencies shared by a majority of the population. Accordingly, the role of impulsivity in self-regulation is discussed more broadly below.

### **Summary One: Reversing the Trajectory of Noncommunicable Disease**

Given the preventable nature and combined impact of NCD, Hollands et al. (2013, pg. 1) describe lowering the prevalence of risk behaviours as “*one of the most important global health challenges of the 21st century*”. In parallel, WHO member states have committed to reducing the harmful use of alcohol, insufficient physical activity and smoking, as well as halting the rise of diabetes, obesity and hypertension by 2025 (WHO, 2014). In order to develop preventative and population-level strategies which achieve these goals, it is essential to understand the root causes of modifiable risk behaviour.

### **2.1 Causes of Noncommunicable Disease**

Noncommunicable disease is a multifactorial problem, which is driven by genetic, environmental and behavioural factors (Bousquet et al., 2011). For example, inflammation, immune responses and remodelling contribute to the initiation and persistence of NCD (Spinetti, Kraenkel, Emanuelli, & Madeddu, 2008), as do the *in utero* environment (Simeoni & Barker, 2009; Svanes et al., 2010) and fetal gene expression (Thornburg, Shannon, Thuillier, & Turker, 2010). However, behavioural responses to cues of alcohol, food, cigarettes and physical effort are critical in determining the eventual results of genetic predisposition (Spinetti et al., 2008). Therefore, successful behavioural change is core to the elimination of noncommunicable disease. As one

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contribution in a holistic approach to NCD prevention, the most relevant psychobehavioural issues underlying modifiable risk behaviours are subsequently discussed.

### 2.2 Behavioural Causes: Dual Processes of Self-Regulation

The behavioural profile which results in noncommunicable disease is characterised by the preference of immediate gratification (e.g. alcohol, calorie-dense food) over long-term health outcomes (French, Story, & Jeffery, 2001; Parry, Patra, & Rehm, 2011). This tendency is captured in the concept of impulsivity; which also references difficulties in the inhibition of actions and reduced ability to tolerate delay (de Wit, 2009). The dual-process model of self-regulation (Metcalf & Mischel, 1999) explains how impulse-control results from the interaction of two decision-making networks known as *system I* and *system II*. System I operates in response to environmental triggers, and is specialised for intuitive emotional processing (Zajonc, 1980). Alternatively, system II represents more complex spatiotemporal and episodic thought, and is responsible for long-term planning (Metcalf & Jacobs, 1988). Whilst both processes can work in concert, impulsive action is most apparent in situations of motivational conflict, whereby self-control is necessary to override instinctive responses and to regulate thoughts and behaviour (Metcalf & Mischel, 1999; Vohs et al., 2008). Research has shown system II is dependent on a limited resource akin to an energy or strength (Hagger, Wood, Stiff, & Chatzisarantis, 2009), the dwindling of which results in a state known as *ego-depletion* (Vohs et al., 2008). Conversely, system I responses are unaffected by repeated use. In states of ego depletion, system II processes are less effective in restraining the impulsive drives of system I, and thus repeatedly exerting self-control or experiencing stress impedes effortful and reflective planning (Metcalf & Jacobs, 1988; Vohs et al., 2008). Individuals experiencing ego depletion are also more sensitive to environmental influences, such as immediate temptations (Bruyneel, Dewitte, Vohs, & Warlop, 2006; Hofmann, Strack, & Deutsch, 2008; Salmon, Fennis, de Ridder, Adriaanse, & de Vet, 2014). Given system I is driven to pursue instantly gratifying objectives, choices driven by emotional responses to environmental cues result in unhealthy behaviour. In contrast, the ability to resist instant gratification enables action that is aligned with one's long-term goals (Baumeister, Gailliot, DeWall, & Oaten, 2006; Hofmann, Friese, & Strack, 2009). Accordingly, difficulties in impulse inhibition are associated with greater alcohol consumption, poorer dietary intake and tobacco use (Hofmann et al., 2009; Maas, De Ridder, De Vet, & De Wit, 2012; Yakir et al., 2007), whereas stronger impulse-control is related to healthy food choice, less binge eating, lower alcohol intake and greater physical activity (Maas et al., 2012; Tangney, Baumeister, & Boone, 2004; Wills, Isasi, Mendoza, &

Ainette, 2007).

### 3.1 Promoting Adaptive Decision-Making

Effective self-regulation across the dual decision-making systems is one component of preventing noncommunicable disease. This process requires four essential elements; [1] motivation to maintain physical health, [2] engagement in goal-directed action, [3] avoidance of distracting temptations, and [4] adjustment of behaviour in response to the continued assessment of progress (Baumeister et al., 2006; Terry & Leary, 2011). Effects of motivational quality and situational cueing in directing these processes are discussed below.

### 3.2. Motivation

Motivation is important not just in presence but also in quality (Ryan & Deci, 2000). This is because distinct forms of motivation are differentially influenced by ego-depletion, and therefore dictate the likelihood of impulsive behaviour (Muraven, 2008). Furthermore, one's underlying motivation can implicitly effect system I responses via altering susceptibility to tempting environmental cues (Robinson & Berridge, 1993).

Organismic integration theory (Ryan, 1992) argues all humans are inclined to develop an integrated sense of self by aligning externally imposed objectives with personal goals. For example, students seek to identify the purpose of academic tasks, and dieters are more successful and happy when they can rationalise required eating behaviour (Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004; Ryan, 1992). The process of personally identifying with extrinsic requirements is known as *internalisation*, and is particularly relevant for many health behaviours which are not inherently interesting or enjoyable (Vansteenkiste, Niemiec, & Soenens, 2008). Considerable variation in the extent to which internalisation functions successfully is dependent on environmental factors (Reeve, Jang, Hardre, & Omura, 2002), and dictates the experience of motivation as one of two superordinate forms; *controlled* or *autonomous*.

#### 3.2.1 Controlled Motivation

Behaviours pursued under controlled motivation are perceived as non-volitional and as the result of pressure from an external source (Vansteenkiste et al., 2008). Controlled motivation is either driven by social influence (*introjected regulation*) or extrinsic consequences (*external*

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*regulation*). When acting under introjection, humans are motivated to gain pride and self-esteem, or to avoid feelings of guilt and shame (Vansteenkiste et al., 2008). Individuals experiencing introjection understand the importance of an activity to wider society, however this is not a value that strongly resonates with the self (Ryan, Rigby, & King, 1993). Moreover, external regulation describes behaviour that is dependent on the delivery of a tangible reward or avoidance of punishment (Deci & Ryan, 1985). This can evoke a powerful source of motivation, however one which persists only for the duration of contingency receipt (Skinner, 1971).

Critically, controlled motivation is linked to ego-depletion (Deci & Ryan, 2008; Pelletier, Fortier, Vallerand, & Brière, 2001) which manifests in decreased task persistence, performance and satisfaction (Deci & Ryan, 2008; Koestner et al., 2008; Nix, Ryan, Manly, & Deci, 1999). The interpersonal pressure of introjection is energy-depleting, and only predicts short-term persistence (Pelletier, Fortier, Vallerand, & Brière, 2001). Equally, external incentives can act as an indicator of difficulty or monotony, diminishing positive task perceptions and impairing goal pursuit (Gneezy & List, 2006; Meier, 2006). Collectively, controlled forms of motivation represent a brittle resource, which is more susceptible to disruption from system I processing. As a consequence, behaviour motivated by controlled motivation is unlikely to be sustained, particularly in settings devoid of extrinsic incentives or social pressure (Koestner et al., 2008).

### 3.2.2 Autonomous Motivation

Autonomously motivated behaviour is viewed as an expression of choice and freedom, which provides a vitalising rather than depletive effect (Muraven, 2008; Muraven, Gagné, & Rosman, 2008). Perceptions of volition enable the internalisation of motives, which in turn act as a pivotal mediator of engagement. Indeed, recognising the potential value of specific behaviour enables harmonious commitment and even enjoyment to develop from initially unattractive activities (Ryan, 1992). This enriches the manner in which an individual approaches and pursues tasks, promoting performance (Amorose & Anderson-Butcher, 2007; Miserandino, 1996; Vansteenkiste et al., 2008), commitment (De Baerdemaeker & Bruggeman, 2015; Williams, Grow, Freedman, Ryan, & Deci, 1996) and persistence (Deci & Ryan, 2000; Vallerand & Blissonnette, 1992). Autonomous motivation is related a number of positive health outcomes including smoking cessation (Noh, Lee, & Choi, 2016; Williams, Cox, Kouides, & Deci, 1999; Williams et al., 1999), weight management (Ng, Ntoumanis, & Thøgersen-Ntoumani, 2014; Silva et al., 2011) and physical activity (Teixeira, Carraça, Markland, Silva,

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& Ryan, 2012; Weman-Josefsson, Lindwall, & Ivarsson, 2015). Autonomously motivated individuals are also more resilient to setbacks (Brooks, Brooks, & Goldstein, 2012) and generally happier (Downie, Koestner, ElGeledi, & Cree, 2004; Nix et al., 1999).

### 3.3 Situational Cueing

In addition to high-quality motivation, the successful self-regulation of modifiable NCD risk behaviour requires engagement in goal-directed action and avoidance of immediate temptation. This is substantially determined by the salience of environmental cues, which are a long-established influence upon behaviour (Skinner, 1938). Incentive sensitisation theory (Robinson & Berridge, 1993) describes how repeated associations between cue and reward lead to the attribution of incentive salience, whereby they afford greater attention (*attentional biases*), trigger or elevate craving, and stimulate compulsive pursuant attempts, (*approach biases*; Berke & Hyman, 2000; Carter & Tiffany, 1999; Hyman, Malenka, & Nestler, 2006). The pairing of cue and reward in this way facilitates stimulus-bound behaviour, producing habitual and low-effort responses to conditioned stimuli (Robinson & Berridge, 2008; Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013).

Originally developed to model addictive behaviours, the role of attentional and approach biases in substance craving and consumption is well-documented (Berridge, 2009; Field & Cox, 2008; Field, Munafò, & Franken, 2009). Hypersensitivity to particular cues can also direct behaviour in a variety of other domains. For example, individuals who are hungry are more likely to attend to and consume highly-calorific food (Stockburger, Schmälzle, Fleisch, Bublatzky, & Schupp, 2009; Wansink, 2004), whilst participants who are primed to feel powerless systematically overestimate the size of objects associated with the restoration of power (Dubois, Rucker, & Galinsky, 2010). Attentional and approach biases are specifically implicated in the consumption of unhealthy food (Havermans, Giesen, Houben, & Jansen, 2011; Nijs, Muris, Euser, & Franken, 2010; Veenstra & de Jong, 2010; Werthmann et al., 2011); alcohol (Ernst et al., 2014; Palfai & Ostafin, 2003; Sharbanee, Stritzke, Wiers, & Macleod, 2013; Wiers, Rinck, Kordts, Houben, & Strack, 2010) and tobacco (Bradley, Field, Mogg, & De Houwer, 2004; Bradley, Field, Healy, & Mogg, 2008).

Unique differences in incentive sensitisation explain why some individuals are particularly susceptible to certain cues, and thus struggle to self-regulate behaviour. The implicit nature of this mechanism also clarifies why many people continue to engage in NCD risk activity, despite realising its destructive impact (Marteau, Ogilvie, Roland, Suhrcke, & Kelly, 2011). The disproportionate and



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global allocation of attention to proximal stimuli is described as a present-oriented time-perspective (Kubovy, 1999) and can be indexed via delay discounting, whereby delayed rewards are subjectively devalued in relation to immediately available options (Rachlin & Green, 1972). Delay discounting paradigms capture the relationship between impulsive tendencies and multiple health behaviours (Bickel & Marsch, 2001; Critchfield & Kollins, 2001), suggesting inter-temporal preference as a process which occurs across a range of impulsive action (Bickel, Jarmolowicz, Mueller, Koffarnus, & Gatchalian, 2012). For example, individuals who heavily discount future objectives are more likely to develop disorders of alcohol dependence and substance abuse (de Wit, 2009), have a higher body mass index (Manwaring, Green, Myerson, Strube, & Wilfley, 2011; Nederkoorn, Braet, Van Eijs, Tanghe, & Jansen, 2006; Weller, Cook, Avsar, & Cox, 2008) and display greater preference for sedentary activity (Manwaring et al., 2011). Other research indicates individuals with substance disorders are more likely to engage in pathological gambling if they demonstrate steep temporal discounting (Petry, 2001), and adolescent smokers with high discount rates are more likely to be obese (Fields, Sabet, Peal, & Reynolds, 2011). Critically, Radu, Yi, Bickel, Gross, and McClure (2011) demonstrate the extent to which humans attend to and approach present-oriented cues is responsible for individual differences in discount rate, which can prompt engagement in multiple maladaptive health behaviours (Bickel, Jarmolowicz, Mueller, et al., 2012). This explains the occurrence of clustering in noncommunicable disease, and suggests techniques to recalibrate attention toward longer-term objectives are essential in NCD alleviation.

### **Summary Two: Self-Regulation in Theory and Practice**

Theories of self-regulation suggest autonomous motivation and adaptive responses to environmental cues are essential for managing the dual systems of decision-making. However, the extent to which previous health promotion efforts have aligned with or achieved this goal is limited. Identifying causal factors in the failure of these strategies to evoke sufficient behavioural change can support the design of future initiatives. Thus, a brief overview of problems and complications in previous approaches to modifying health behaviour is presented below.

#### **4.1 Previous Healthcare Intervention**

Given impulsive tendencies result from an impaired capacity to exert rational control over emotional instincts, traditional approaches to health promotion have typically aimed to foster enhanced levels of self-control. These methods align with frameworks that target system II processes



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as a means of behavioural change, including the theory of planned behaviour (Conner, Norman, & Bell, 2002; Norman, Conner, & Bell, 1999, 2000), the health belief model (Rosenstock, 1990) and protection motivation theory (Bandura, 2004). However, a substantial body of research demonstrates this approach as largely ineffective (Herman & Polivy, 2011; Marteau et al., 2010; Michie, Abraham, Whittington, McAteer, & Gupta, 2009; Webb & Sheeran, 2006), and presents two explanatory accounts. Firstly, information and skill-based campaigns make individuals aware of the logical need to change, yet fail to facilitate high-quality, sustained regulation in the pursuit of physical health (Webb & Sheeran, 2006). Moreover, cognitive models over-estimate the human capacity to override impulsive tendencies, given the majority of health related decisions are made in states of ego-depletion when self-control is low (Bargh, 2002; Wansink & Sobal, 2007). Indeed, evidence indicates many individuals recognise the health harming impact of NCD risk behaviour, yet fail to modify their way of life before undesirable consequences emerge (Marteau et al., 2010; Webb & Sheeran, 2006).

### 4.1.1 Cognitive Models

Traditional approaches to behaviour change known as *cognitive models* (Dolan et al., 2012) have targeted system II processes, presuming individuals make consistently rational choices regarding their physical health. The limited efficacy of these methods is explained in terms of the human tendency to discount long-term rewards in favour of immediate incentives (Bickel, Jarmolowicz, Mueller, et al., 2012; Metcalfe & Mischel, 1999). Cognitive models can be further impaired by issues of controlled motivation (Teixeira et al., 2012) psychological reactance (Dillard & Shen, 2005; Herman & Polivy, 2011; Michie et al., 2009) and futurelessness (Pepper & Nettle, 2014).

#### 4.1.1.1 Controlled Motivation

The manner in which health promotion campaigns are construed to the general population can strongly impact their success (Arena et al., 2017), and initiatives which evoke controlled motivation are generally witnessed as unsuccessful. For example, attempts to induce guilt via emphasising the consequences of tobacco use on family members fail to inspire lasting change, and can even lower intentions to quit amongst populations with low self-efficacy and income (Evans-Polce, Castaldelli-Maia, Schomerus, & Evans-Lacko, 2015; Kim, Cao, & Meczowski, 2018). Equally numerous studies have demonstrated participants offered financial incentives for weight-loss failed to maintain reduced body-weight post-intervention (Burger & Lynham, 2010; Patel et al., 2016), with

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further work documenting extremely high attrition from incentivised programmes (Cawley & Price, 2013). As a whole, empirical evidence suggests the use of extrinsic incentives in motivating health behaviour is inconsistently effective initially, and often fallible in the long-term (Lynagh, Sanson-Fisher, & Bonevski, 2013).

### 4.1.1.2 Psychological Reactance

Messages which generate controlled forms of motivation are also more likely to evoke psychological reactance; a further challenge facing the development of effective health communication (Miller, Lane, Deatrick, Young, & Potts, 2007). In this instance, authoritative or instructive messages threaten an individual's sense of freedom, and motivate attempts to reinstate one's autonomy in response (Brehm, 1966). Psychological reactance has frequently been implicated in the failure of unsuccessful persuasive campaigns (Martin Fishbein, Hall-Jamieson, Zimmer, von Haeften, & Nabi, 2002; Guttman, Kegler, & McLeroy, 1996; Hornik, Jacobsohn, Orwin, Piesse, & Kalton, 2008) and manifests affectively, cognitively and behaviourally in resistance, anger and counterarguments (Brehm, 1966; Dillard & Shen, 2005; Miller, Lane, Deatrick, Young, & Potts, 2007). In some situations, health messages can even cause the behaviours they try to prevent. For example, reactive responses include derogating the message source (Hamilton, 1998; Miller et al., 2007), and reporting the prohibited behaviour as more enticing (Hammock & Brehm, 1966; Trump, 2016).

### 4.1.1.3 Futurelessness

A further complication in the efficacy of health promotion initiatives is the concept of *futurelessness*. This term describes how exposure to uncontrollable health risks such as violence, crime and poor housing results in the perception of future planning as unimportant and futile (Brezina, Tekin, & Topalli, 2009). Behavioural health promotion strategies are often based on the assumption that information on the negative consequences of risky action will motivate individuals to change (Baum & Fisher, 2014). However, this approach fails to acknowledge not all populations are motivated to prolong their lifespan, or perceive distal health objectives as highly salient (Daugherty & Brase, 2010a; Resnicow et al., 2012). As a contextually appropriate response to dangerous living environments, individuals experiencing futurelessness deliberately pursue immediate rewards, rather than long-term outcomes which may never be realised (Pepper & Nettle, 2017).

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Cognitive health promotion approaches are particularly unsuccessful amongst individuals of low socioeconomic status (Alvaro et al., 2011; Layte & Whelan, 2009). In fact, some evidence suggests this approach can even entrench or exacerbate inequality in health behaviour (Baum, 2007; Baum & Fisher, 2014). Futurelessness provides one explanation for this phenomenon, given those living in poverty are more likely to experience uncontrollable health risks (Bolte, Tamburlini, & Kohlhuber, 2010; Shaw, Tunstall, & Dorling, 2005). Exposure to this kind of stress can also increase engagement in risky health behaviour as a means of relief (Krueger & Chang, 2008), suggesting instantly gratifying stimuli may be consciously pursued, despite knowledge of associated harm. Importantly, risky behaviour moderates the relationship between stress and mortality in socioeconomically deprived communities (Krueger & Chang, 2008), potentially because this population has fewer resources to maintain their health, or effectively cope with adversity (Birch, Jerrett, & Eyles, 2000; Pampel & Rogers, 2004). Therefore, effective health promotion strategies must identify how to enhance the perceived and immediate value of healthy behaviour, and acknowledge some risky activity results from the desire to self-medicate in response to stress.

### 4.1.2 Contextual Models

The failure of cognitive models in health promotion has given rise to a contextual approach which has gained traction in academia and in policy (Dolan et al., 2012; Hollands et al., 2013). Contextual models recognise many behaviours are the product of automatic responses to situational cues, and thus aim to adapt the environment in which decisions are made, a predominant example of which is *choice architecture* (Thaler & Sunstein, 2009).

#### 4.1.2.1 Choice-Architecture

Choice architecture utilises universal and innate mechanisms of decision-making in order to shift the average incidence of risk behaviour. Strategies of choice architecture either support system I to recalibrate automatic choices as healthier options (e.g. altering the size and shape of plates to implicitly reduce food intake; Rozin et al., 2011), or inhibit of system I to allow system II processes to dominate decision-making (e.g. placing unhealthy refreshments further away from customers to impede impulsive selection; Rozin et al., 2011). As such, choice architecture additionally lowers the likelihood of psychological reactance given it targets implicit psychological processes over conscious persuasion (Thaler & Sunstein, 2009). However, a fundamental problem of this approach is that the ability to environmentally influence system I processes extends only to settings that can be

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externally manipulated (Forwood, Ahern, Hollands, Ng, & Marteau, 2015). This phenomenon parallels that of external regulation, whereby extrinsic contingencies must be continually presented in order to influence behaviour. Indeed, Marteau et al. (2011) and Hollands et al. (2013) indicate there is little evidence to suggest choice architecture is successful in the long-term, and express concerns over cost-effectiveness and legislative requirements of related interventions. Consequently, although attempts to automatize healthy decision-making hold strong value, choice architecture alone cannot achieve pervasive change if individuals lack the desire to live healthily in contexts which cannot be externally influenced, such as the home (Forwood et al., 2015). Paradoxically, those least motivated to improve their physical health are typically those who also stand to benefit most from intervention (Seifert, Chapman, Hart, & Perez, 2012). Thus, in order to cultivate behaviour change that endures across settings and caters for those who demonstrate the greatest need, cognitive motivations cannot be completely excluded from the design of health promotion strategies.

### **Summary Three: Issues in Previous Health Promotion Initiatives**

The extent to which individuals internalise reasons for acting can have a profound implication upon their motivational quality and subsequent self-regulatory capacity (Vansteenkiste et al., 2008). The relative salience of environmental cues is also critical in dictating whether behaviour is aligned with the short or long-term consequences of action (Robinson & Berridge, 2008). These insights have not been effectively integrated amongst previous health promotion, leading to initiatives which are compromised by the fallibility of cognitive control (Metcalf & Mischel, 1999; Vohs et al., 2008) psychological reactance (Burrow & Spreng, 2016), and futurelessness (Pepper & Nettle, 2014). Alternatively, pre-existing strategies to bypass conscious engagement are reliant upon environmental restructure, which can be costly, and is situationally restricted (Marteau et al., 2011). In response, the next section reviews theories of positive psychology and positive health, to explore the role of strengths-based approaches in facilitating physical health behaviour.

### **5.1 Positive Psychology**

Psychological approaches have historically operated within the confines of the illness ideology, and focused upon alleviating factors which precipitate and maintain disease (Seligman & Csikszentmihalyi, 2014). Whilst this philosophy represents strong value in treating pathological disorder, it neglects the importance of building resilience to enhance overall wellbeing. In answering this need, positive psychology urges researchers to adopt a more holistic perspective of health, and

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to develop pre-existing human strengths (Gable & Haidt, 2005). Equally, positive psychology aims not to deny distressing or unpleasant experiences, but to integrate these factors amongst human assets, evoking resilience to adversity and enabling constructive growth (Wong, 2013). This approach therefore entails a shift in emphasis upon treating disease symptomatology, to promoting the holistic functioning of societies and individuals (Ryff et al., 2006). As such, positive psychology targets those in or at risk of poor health, as well as those classified as 'healthy', to encourage the maintenance or enhancement of psychological wellbeing (Seligman, 2004).

### 5.2 Defining Psychological Wellbeing

Multiple frameworks have been generated in an attempt to define psychological wellbeing. The most comprehensive of these incorporate both feeling and functioning to describe a state in which individuals experience high levels of positive emotion, are able to achieve personally important goals, socially relate to others and derive engagement and meaning from life (Diener et al., 2010; Huppert & So, 2013; Seligman, 2011). Affective and cognitive components of wellbeing are delineated as *hedonia* (defined as the presence of positive emotions and absence of negative emotions) and *eudaimonia* (defined as life satisfaction, working toward long-term goals; Diener, Suh, Lucas, & Smith, 1999).

Hedonic forms of happiness are associated with the attainment of psychological and physiological pleasure (Kubovy, 1999). Accordingly, hedonic wellbeing paradigms aim to maximise pleasure and minimise pain (Schwarz, Diener, & Kahneman, 1999). Hedonia is an intensely pleasurable sensation and often, though not exclusively, results from sources of instant gratification (Peterson, Park, & Seligman, 2005). Consequently, hedonic experiences are short lived and susceptible to adaptation (Waterman, 1999). This phenomenon is captured in theories of the *hedonic treadmill* (Brickman & Campbell, 1971; Carver & Scheier, 1990) whereby individuals systematically develop tolerance to activities or objects which once provided satisfactory gratification. As such, increasing amounts of hedonic stimuli are needed to achieve the same degree of pleasurable reaction (Diener, Lucas, & Scollon, 2009).

In compliment to hedonic pleasure, eudaimonia is characterised as a less acute but more sustainable form of happiness, which results from fulfilling one's ultimate potential (Deci & Ryan, 2000). Eudaimonic wellbeing arises as a product of identifying one's virtues, cultivating them and living in accordance with them (Waterman, 1993). Eudaimonic experiences are therefore considered

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to represent an expression of the authentic self, and enable the capacity for personal growth and development (Waterman, 1993). *Self-determination theory* (Deci & Ryan, 2000) specifies the processes by which individuals derive their core values and monitor personal development, arguing all humans are driven to satisfy three fundamental and innate needs which are essential for psychological growth (Ryan & Deci, 2000). These are: [1] autonomy, the freedom to define and live in accordance with one's personal values; [2] competence, the desire to master skills and effectively bring about outcomes; and [3] relatedness, the inclination to foster and maintain social connections (Deci & Ryan, 2000).

### 5.3 Positive Health Paradigms

Positive psychology forms part of a broader paradigm known as *positive health* (Seligman, 2008), which amalgamates physical, mental and social functioning into a broad view of human wellbeing. The concept of positive health was first articulated by the WHO in 1948, and a quantitative approach to measuring holistic wellbeing was developed in 1972 (Breslow, 1972). However, implementation of this approach in public policy has been largely lacking, and empirical interest in the positive health paradigm has revived only relatively recently (Prendergast et al., 2016). Much of the work following this resurgence has considered the development and evaluation of positive psychology interventions, which encourage individuals to develop feelings, cognitions or behaviours primarily associated with psychological wellbeing (see Chapter 1: 8.1; Sin & Lyubomirsky, 2009). However, less attention has been devoted to the application of positive paradigms to physical health (Prendergast et al., 2016; Walsh, 2011).

At the same time, a growing body of evidence suggests physical conditions are caused and exacerbated by psychological factors, indicating the inextricability of mental and physical health (Weiss, Haber, Horowitz, Stuart, & Wolfe, 2009). For example, cardiovascular disease is a known consequence of psychological stress (Gu, Tang, & Yang, 2012), negative affect is related to the development of coronary heart disease (Nabi et al., 2008) and mental disorder is associated with increased risk of stroke (Surtees et al., 2008). Patients suffering from noncommunicable disease are also more likely to display diminished psychological wellbeing (see Chapter 1: 1.4).

However, much of the work integrating physical and mental health has been conducted from a pathology-based perspective (Kubzansky, Boehm, & Segerstrom, 2015) and primarily considers physical health outcomes to result from psychological factors (Mata et al., 2012; Reed & Ones, 2006).

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As a result, few studies have explored the role of mental wellbeing in promoting healthy lifestyle behaviour. Indeed, little is known about the potential pathways through which mental and physical health interact (Ohrnberger, Fichera, & Sutton, 2017), and even less insight regards specific associations across psychological wellbeing and physical health behaviour. If psychological wellbeing is not simply a consequence but also an antecedent of healthy action, it may provide a novel target for interventions aiming to reduce modifiable risk behaviour and ultimately alleviate noncommunicable disease. Moreover, understanding relationships across mental and physical health from a positive perspective can offer insight beyond that gleaned from studying drivers of risky action alone. More work is needed to fully explore this concept, however accumulating cross-sectional evidence supports the idea that relationships between psychological and physical health are partially explained by a behavioural pathway (Boehm, Vie, & Kubzansky, 2012). A review of this work is presented below.

### 5.4 Relationships between Psychological Wellbeing and Physical Health

Optimism and life-satisfaction are the facets of wellbeing most commonly explored in investigations of mental and physical health. This is a consequence of the predominant perspective that wellbeing promotes longevity because it provides protection from the physiological effects of stress (e.g. Gu, Tang, & Yang, 2012; Jackson, Knight, & Rafferty, 2010; Thoits, 2011). However, more recent evidence indicates higher levels of wellbeing may actively foster engagement in healthy lifestyle behaviours.

*Optimism*; in a cross-sectional study of over 8000 Finish adults, those with greater optimism ate fewer sweets but more fruit and vegetables than their less optimistic counterparts (Kelloniemi, Ek, & Laitinen, 2005). Optimism was also related to healthy food choice as well as lower alcohol consumption and greater physical activity across adolescents of multiple socioeconomic strata over 18 months (Carvajal, 2012). Observed relationships between optimism and reduced hypertension were partially explained by favourable health behaviours in over 10,000 British civil servants (Trudel-Fitzgerald, Boehm, Kivimaki, & Kubzansky, 2014), and optimism was associated with more physical activity, not smoking and higher fruit, vegetable and wholegrain bread intake in a large sample of Dutch elderly men (Giltay, Geleijnse, Zitman, Buijsse, & Kromhout, 2007). Furthermore, in a multi-ethnic cohort of American middle school students, those who reported higher levels of optimism demonstrated a lower likelihood of smoking escalation (Carvajal, Wiatrek, Evans, Knee, & Nash,



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2000). Baseline levels of optimism also predicted a decreased likelihood of developing cardiovascular disease in multi-ethnic middle-aged women (Tindle et al., 2009), and protected against the typically observed decline in healthy eating habits across adolescence amongst a diverse population-based teenage cohort (Carvajal, 2012).

*Life Satisfaction*; in a large sample of Swedish participants aged 18-64 years, individuals with higher life satisfaction were more likely to be physically active (Melin, Fugl-Meyer, & Fugl-Meyer, 2003). Life satisfaction was also positively associated with not smoking, physical exercise, using sun protection and healthy dietary behaviour in adults aged 17-30, sampled from 21 counties across Europe, the USA and Asia (Grant, Wardle, & Steptoe, 2009). A national cohort study of New Zealand adults revealed life satisfaction to be positively associated with greater physical activity, greater fruit and vegetable intake and reduced sugary drink consumption (Prendergast et al., 2016). This work also indicated the existence of healthy behaviour clusters, whereby those who reported optimal wellbeing were 4.7 times more likely engage in over four health behaviours than those reporting lower levels of happiness (Prendergast et al., 2016).

### 6.1 Literature Gap

Growing cross-sectional evidence indicates a bi-directional relationship between psychological wellbeing and healthy lifestyle behaviour (Boehm et al., 2012). Most studies situated at this nexus consider how healthy behavioural practices support psychological wellbeing, for example the emotional benefits of exercise (Salmon, 2001). Much less investigation has explored how psychological wellbeing might promote physical health. In a recent review of relationships between positive psychology and biology, Kubzansky et al. (2015) state an important direction for future research is to establish whether changes in positive psychological functioning are linked to improvements in health behaviour. This evidence gap is yet to be addressed, with little work describing mechanistic factors, or conducting experimental studies to establish causality. Moreover, relationships between wellbeing and longevity are typically explained in terms of the mediating effects of stress (Gu et al., 2012; Jackson et al., 2010), leading to the exclusion of wellbeing facets other than life-satisfaction and optimism. Importantly, distinctions between hedonic and eudaimonic forms of happiness have not been made, which is critical given hedonic behaviour is associated with impulsive tendencies, whereas eudaimonia better represents restrained and distal choice (Peterson et al., 2005).



### Summary Four: The Value of Eudaimonia

Greater empirical attention should be devoted toward the role of mental wellbeing in actively promoting health behaviour. Specifically, understanding how positive psychological functioning can be modified and enhanced may provide a novel target for interventions aiming to reduce noncommunicable disease. Within this effort, it is important to acknowledge factors which have compromised the success of previous health promotion strategies, and to integrate the distinction between hedonic and eudaimonic wellbeing. Issues of controlled motivation, psychological reactance and futureless impede action toward physical health. In parallel, dual-process theory suggests high-quality motivation and prominent future objectives are necessary for the successful self-regulation of behaviour. Consequently, facets of psychological wellbeing which enhance the salience of long-term goals and promote a desire for longevity are most likely to promote physical health behaviour. As such, this thesis will focus upon the role of eudaimonic wellbeing in facilitating physical health, according to three possible mechanisms; enhanced appeal of health behaviour, enhanced salience of cues, and the displacement of maladaptive health behaviours.

#### 7.1 Proposed Mechanism; Health Behaviour Appeal

The desire to prolong one's life seems an obvious component of engagement in behaviour to promote longevity. However, it is also one which has been overlooked in previous health promotion (Resnicow et al., 2012). The proposition that feeling psychologically well is an essential aspect of physical health was initially present by Ryff and Singer (1998), aligned with the argument that healthy behaviour "*presupposes a life that is worth taking care of*" (pg. 22). According to this perspective, psychological health comprises *meaningful opportunity*; the autonomy to choose personally valuable projects, and *meaningful activity*; the active pursuit of such projects (Ryff & Singer, 1998). This is comparable to Deci & Ryan's (2000) description of eudaimonic wellbeing as basic psychological need satisfaction, and collectively suggests eudaimonia provides the necessary conditions for a life that is valued, and thus desirable to maintain.

Kasser and Ryan (1996) posit all humans are intrinsically motivated to develop or maintain physical fitness, however this desire can be crowded out by extrinsic pressures. For example, alternative demands on one's attention or time can degrade physical health investment (Walker, Valentiner, & Langberg, 2018). Support for this perspective is observed in the deleterious effects of

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psychological reactance and controlled motivation upon self-regulatory effort (Miller et al., 2007; Rains & Turner, 2007). Further complication arises from the context in which people act, given environmental stressors can give rise to feelings of futility and the devaluation of long-term health (Pepper & Nettle, 2017). As such, individuals who feel their freedom is restricted by authoritative instruction or by situational context are most likely to respond negatively to health promotion initiatives (Baum & Fisher, 2014). On the other hand, feelings of autonomy enable superior self-regulation as a function of internalisation (Vansteenkiste et al., 2008) and are more likely to enable intrinsic goal pursuit (Sheldon, Elliot, Kim, & Kasser, 2001). Accordingly, health promotion strategies which generate a volitional desire for physical health are most likely to be successful. The value of this approach is observed in the successful application of autonomy-supportive techniques to health promotion campaigns (Edmunds, Ntoumanis, & Duda, 2006; Katz & Assor, 2007; Reeve et al., 2002; Williams et al., 1999). Facilitating healthy behaviour by promoting current happiness develops these methods, because it gives people a reason to desire longevity, and offers immediate benefit to wellbeing (Brassai, Bettina, & Steger, 2015). As such, recipients are less likely to demonstrate reactance or controlled motivation, suggesting the applicability of this approach at the population level.

Moreover, initiatives which enhance eudaimonic wellbeing may promote health related behaviour, even in the absence of desire to prolong one's life. This is because eudaimonia affords greater salience to distal goals which are indirectly related to physical health (Ryff & Singer, 1998). For example, keeping physically fit and well helps individuals reach higher order, more abstract objectives, such as spending quality time with family (Hooker & Masters, 2016). This is particularly pertinent in the case of futurelessness, given the desire to achieve and experience important life goals may drive healthy behaviour, regardless of mortality risk perception. Indeed, Machell, Disabato, & Kashdan, (2016) demonstrate the presence of important life goals mitigates against antisocial behaviours associated with futureless in adolescent poverty, which are also linked to the devaluation of long-term outcomes. Accordingly, it is possible that methods which enhance eudaimonic wellbeing can directly or indirectly facilitate an inherent drive for longevity, and stimulate associated healthy behaviour.

### 7.2 Proposed Mechanism; Displacement of Maladaptive Behaviour

Psychological wellbeing may also promote healthy behaviour because it displaces

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engagement with substances and activities otherwise pursued as a means of bringing about happiness. Evidence suggests adverse mood states promote the desire to *self-medicate* via subconsciously seeking stimuli which are pleasurable, but often also unhealthy (Hooker, Masters, & Park, 2017; Hooker & Masters, 2016). For example, the experience of negative emotion is related to cravings for tryptophan-rich foods (Christensen, 1993; Krueger & Chang, 2008) which are thought to help alleviate dysphoric mood (Christensen & Brooks, 2006; Lieberman, Wurtman, & Chew, 1986). Similar patterns of behaviour have been observed for alcohol consumption to reduce tension, depression and fatigue (Wurtman & Wurtman, 1988) and tobacco use to relax and relieve stress (Cooper, Russell, & George, 1988; Grunberg, Moore, Anderson-Connolly, & Greenberg, 1999). High levels of stress are associated with smoking initiation and less successful smoking cessation attempts (Cohen & Lichtenstein, 1990; Steptoe, Wardle, Pollard, Canaan, & Davies, 1996) as well as increased problem drinking (Byrne & Mazanov, 2003; Chassin, Presson, Sherman, & Kim, 2002). Finally, although some individuals exercise more frequently in response to stress (Cooper et al., 1988), most people demonstrate a decrease in frequency and intensity of physical activity, in favour of immediately rewarding sedentary behaviour (Aldana, Sutton, Jacobson, & Quirk, 1996).

The self-medication of unpleasant and stressful emotion via tobacco, alcohol, food and inactivity is problematic. The nature of instant gratification provides only transitory relief to emotional difficulty (Boutelle, Murray, Jeffery, Hennrikus, & Lando, 2000; Kouvonen et al., 2005), and repeated engagement presents maladaptive consequences for long-term physical health (Diener, 2000; Huta, Ryan, Huta, & Ryan, 2010; Steger, Kashdan, & Oishi, 2008). Furthermore, evidence has shown pleasurable but unhealthy behaviours can actually increase the experience of stress (Cherukupalli, 2010; Daugherty & Brase, 2010; Dittmar & Bond, 2010).

However, whilst the strategy of alleviating negative affect via acute and sensory pleasure represents a form of hedonism, eudaimonic activity is associated with living in accordance with long-term values (Parrott, 1999; Salmon, 2001), and thus more closely approximates action toward physical health. Most modern models of happiness propose that hedonic and eudaimonic routes to wellbeing can be pursued simultaneously, and that those who experience both are happier than those who live a life dedicated to pleasure or purpose alone (Peterson et al., 2005). However, it is possible that greater eudaimonic wellbeing serves to decrease the desire to seek hedonic pleasure, because it provides a more sustainable and enduring experiences of happiness (Anić & Tončić, 2013; Huta et al., 2010; Peterson et al., 2005). For example, those who display a strong orientation toward

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eudaimonic activities report greater life satisfaction than those who demonstrate a strong orientation toward pleasure (Mekler & Hornbaek, 2016; Schueller & Seligman, 2010) and participants asked to add at least one eudaimonic activity (e.g. cheering up a friend, exercising) to their routine for ten days demonstrated significantly higher wellbeing at three-month follow-up than those asked to engage in hedonic activities (e.g. sleeping, eating more or watching television; Peterson et al., 2005). Further work indicates hedonistic behaviour is associated with increased daily negative affect (Steger et al., 2008), which suggests pleasure-seeking as a consequence of or ineffectual solution to dysphoric emotion. On the other hand, eudaimonia is associated with an enhanced ability to tolerate current emotional difficulty (Chua, Touyz, & Hill, 2004) and proactive approaches to adversity such as problem-focussed coping (Kashdan & Kane, 2011).

Taken together, this evidence suggests eudaimonic wellbeing provides a sustainable and enduring form of happiness which builds psychological strength. As a consequence, living with greater eudaimonia may dampen hedonistic pleasure-seeking desires which arise from generally attenuated wellbeing, or specific experiences of stress. Interventions which amplify eudaimonia may therefore reduce the salience of hedonistic environmental cues, helping to reduce health risk behaviours associated with noncommunicable disease.

### 7.3 Proposed Mechanism; Physical Health Salience

Lastly, psychological wellbeing may support healthy behaviour because it directs attention toward cues which evoke implicit behavioural responses. Attentional and approach biases have been implicated in the consumption of a range of rewarding substances related to NCD risk (see Chapter 1: 3.3). The role of motivation in directing attention has previously been explored in attentional modification paradigms, whereby participants are systematically reinforced for directing their attention toward or away from specific stimuli (Field & Eastwood, 2005). For example, the *alcohol attention-control training program*, developed by Fadardi & Cox (2009), reduces attentional and approach biases for alcoholic cues. A computer is used to present images of alcoholic and non-alcoholic stimuli against a coloured background, and participants are required to name the colour of the background as quickly as possible. This requires the inhibition of attention toward drinking-related objects, which is incentivised via the provision of performance feedback. Similarly, modified versions of materials typically used to measure attention (e.g. dot-probe and Stroop tasks) have been evidenced to reduce bias, consumption and cravings for alcohol cues (Fadardi & Cox, 2009;

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Field & Eastwood, 2005; Schoenmakers et al., 2010; Schoenmakers, Wiers, Jones, Bruce, & Jansen, 2007), smoking-related stimuli (Attwood, O'Sullivan, Leonards, Mackintosh, & Munafò, 2008; Field, Duka, Tyler, & Schoenmakers, 2009) and unhealthy food (Boutelle, Kuckertz, Carlson, & Amir, 2014; Kemps, Tiggemann, Orr, & Grear, 2014). Attentional retraining can also reduce symptoms of anxiety (Amir, Beard, Burns, & Bomyea, 2009; Hazen, Vasey, & Schmidt, 2009; Schmidt, Richey, Buckner, & Timpano, 2009), attenuate emotional responses to stressful cues (See, MacLeod, & Bridle, 2009) and provide protection against the reoccurrence of depression (Browning, Holmes, Charles, Cowen, & Harmer, 2012).

Whilst these paradigms have focussed on directing attention away from maladaptive stimuli, an equivalent methodology may be applied to direct attention toward salutogenic cues which displace unhealthy behaviours (see 7.3). Aligned with incentive sensitisation theory (Robinson & Berridge, 1993), an enhanced desire for longevity and long-term goals should afford greater salience to stimuli which support distal goal pursuit, and thus are in some way relevant to good physical health. This represents a positive health approach to attentional modification, whereby emphasis is placed upon health promoting stimuli rather than those that present health risk. Interestingly, attentional bias to recovery-related words are a stronger predictor of treatment outcome in alcoholics undergoing detoxification than alcohol-related or negative change-related words (Rettie, Hogan, & Cox, 2018), suggesting the power of aspirational objectives in modifying behaviour. The meaning salience paradigm (Hooker et al., 2017), provides a conceptual model regarding the role of eudaimonia in promoting attention toward healthy stimuli, and is further explored in Chapter 2.

Summary Five: Eudaimonic Framing as a Conceptual Approach to Physical Health

Psychological wellbeing may support healthy behaviour because it facilitates the necessary ingredients for effective self-regulation; a volitional desire for physical health, energy for engagement in goal-directed action and an adaptive implicit response to environmental cues. However, more research is necessary to explore causal mechanisms across psychological wellbeing and physical action. In particular, the use of eudaimonic framing in motivating healthy lifestyle behaviour deserves greater empirical attention.

### 8.1 Psychological Wellbeing is Modifiable

Aligning physical health promotion strategies with efforts to enhance psychological wellbeing are futile if happiness cannot be influenced by modifiable factors. However, a convincing body of

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evidence indicates simple cognitive and behavioural strategies can reliably improve wellbeing (Layous & Lyubomirsky, 2012). The sustainable happiness model (Lyubomirsky, Sheldon, & Schkade, 2005) posits a person's characteristic level of happiness is determined by three major factors: a genetically determined set point; circumstantial factors such as income and relationship status; and happiness-relevant activities and practices. A large proportion of individual differences in happiness are explained by environmental influences (Røysamb, Harris, Magnus, Vittersø, & Tambs, 2002; Stubbe, Posthuma, Boomsma, & De Geus,

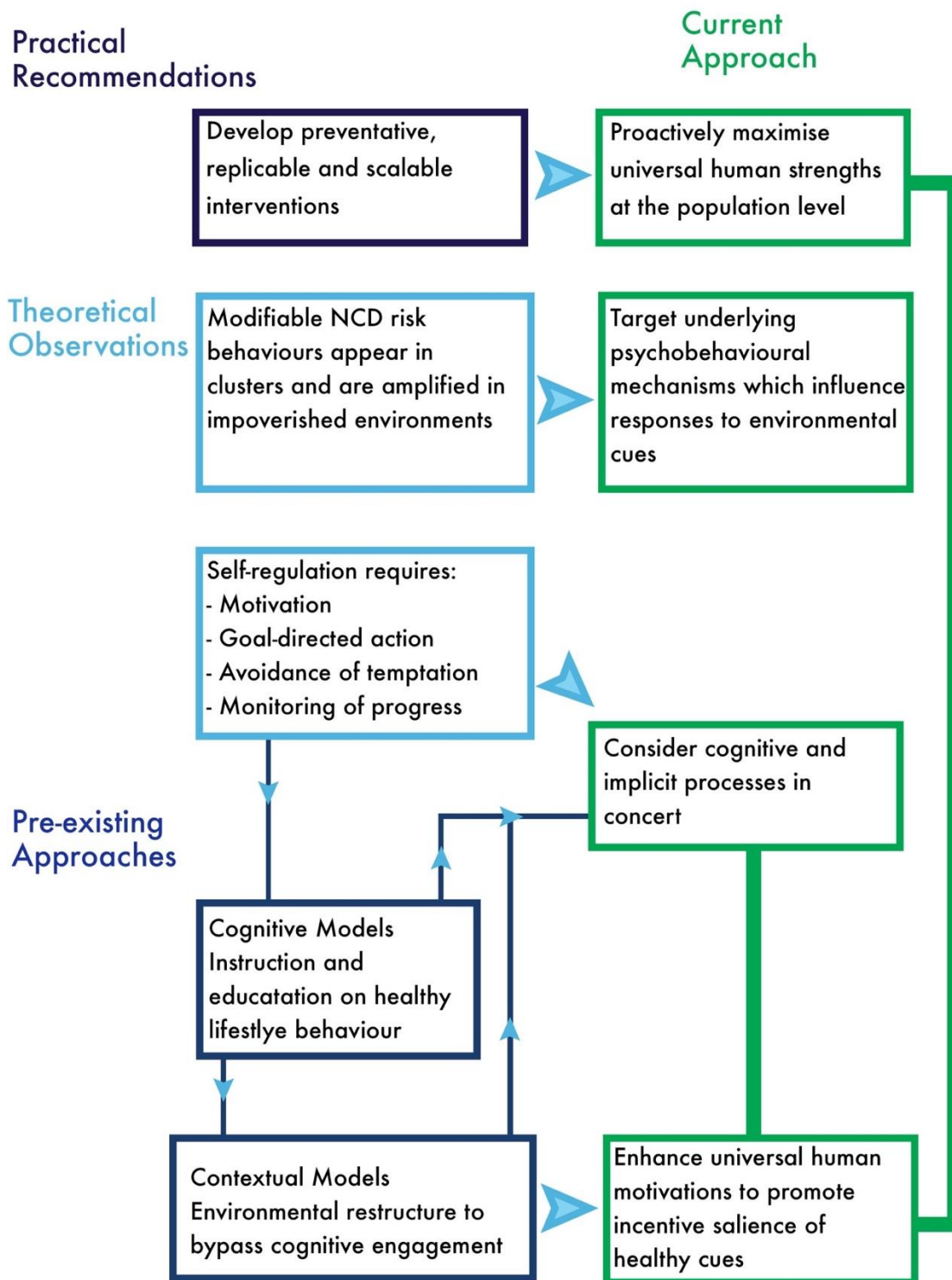


Figure 2. Schematic to depict relationships between public health recommendations, theoretical observations, pre-existing approaches and the approached proposed in the current research

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2005), and in particular the deliberate ways in which people choose to think and behave in their daily lives (Lyubomirsky & Layous, 2013). These findings have catalysed the creation of numerous positive psychology interventions, which facilitate the adoption of cognitive and behavioural practices related to eudaimonia. Typical exercises include expressing gratitude, counting blessings, performing acts of kindness, using one's signature strengths, and affirming one's important values (e.g. Carter et al., 2016; Delle Fave & Soosai-Nathan, 2014; Drozd, Mork, Nielsen, Raeder, & Bjørkli, 2014; Emmons & McCullough, 1996; Kaczmarek et al., 2015; Mongrain & Anselmo-Matthews, 2012; Seligman, Steen, Park, & Peterson, 2005). Multiple meta-analyses indicate these interventions successfully stimulate substantial and lasting increases in wellbeing (Bolier et al., 2013; Sin & Lyubomirsky, 2009) and can buffer against the development of mental disorder (Layous, Chancellor, & Lyubomirsky, 2014). However, no positive psychology interventions have been developed according to the specific goal of promoting physical health outcomes, or physical health behaviour.

### 8.2 Synergy Across Positive Psychology and Public Health Perspectives

Positive psychology methods also represent value to the promotion of physical health in terms of practical applicability. For example, strength-based approaches concur with the WHO's longstanding definition of health as '*a state of complete physical, social and mental wellbeing, and not merely the absence of disease or infirmity*' (WHO, 1946) and adopt a preventative, population-level approach to intervention. This aligns with public policy which emphasises the value of early intervention in physical health. For example, the chronic care model argues that in order to provide cost-effective and sustainable healthcare systems, prominence must be placed upon preventative strategies instead of reactively treating illness once it has arisen (O'Donnell et al., 2014). In parallel, positive psychology theorists argue supporting wellbeing across the majority of the population, instead of focusing on acute cases of mental disorder, is more effective in both absolute and financial terms (Huppert, 2009). This is because the majority of psychopathology typically develops in the general population rather than high-risk groups, purely because members of the general population are so many (Hung et al., 2007). Consequently, dampening the prevalence of disease-related risk factors in the wider population reduces the total percentage of people who meet criteria for diagnostic disorder (Rose, Khaw, & Marmot, 2008). This perspective is not only relevant to psychological health, but is supported by epidemiological evidence across gambling addiction (Huppert, 2009), heart disease (Grun & McKeigue, 2000), and alcohol abuse (Puska, Vartiainen, Tuomilehto, Salomaa, & Nissinen, 1998).



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As a consequence of these philosophical origins, many positive psychology interventions are designed to hold universal relevance. For example, strategies to improve wellbeing typically focus on innate needs which are present in all humans and can be successfully applied across multiple populations (Marmot, 2004). Identifying universal factors which promote desire or capacity to protect one's physical health may therefore represent a valuable strategy of reducing modifiable risk-behaviour across the majority of the population, and ultimately reverse the development of noncommunicable disease. This is particularly pertinent given modifiable risk behaviours tend to co-occur within individuals and communities, suggesting an underlying role of cross-cutting psychological and environmental features. Indeed, evidence suggests whole population approaches are most effective in improving societal health, as well as reducing socioeconomic health inequalities (Capewell & Graham, 2010; Rose et al., 2008). Positive psychology interventions are also frequently administered by non-clinicians and are implemented over short time periods, representing a scalable, accessible and low-cost resource (Sommer et al., 2015).

### **The Present Research**

Despite prolonged and targeted intervention, NCD and its causal behaviours remain prevalent. This suggests the need for novel methods of physical health promotion. Whilst cognitive models assume individuals perceive and act according to rational reality, evidence demonstrates fallible cognitive control and delayed reward devaluation as universal in human psychology. Furthermore, authoritarian discourse which invokes controlled motivation and reactance, as well as the environmental constraints of futurelessness, can degrade innate inclination toward physical health. These features have elicited the growing popularity of contextual models, which attempt to influence behaviour via architectural modification. However, the long-term efficacy of this approach is not established, and is restricted by logistical implementation. Theories of self-regulation suggest the drives of cognitive and emotional decision-making systems must be effectively managed to ensure adaptive health behaviour, central to which are motivation and attention. Motivational quality partially determines the susceptibility of conscious intention to ego-depletion, and dictates the salience of environmental cues which implicitly alter action. Consequently, approaches which target both motivation and bias may hold particular value in promoting positive health behaviours. The present research suggests enhanced eudaimonic framing facilitates the desirability and salience of health-related cues, and potentially explains the observed behavioural pathway between mental and physical health. Positive psychology initiatives have demonstrated psychological wellbeing can

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be influenced by modifiable factors, and even brief, light-touch interventions. These methods are also harmonious with practical public health recommendations in that they aim to prevent disorder, and are implemented at the population-level. However, no positive psychology interventions have been developed with the specific aim of promoting eudaimonia in order to facilitate a healthy lifestyle. Therefore, this thesis aimed to investigate eudaimonic constructs and positive psychology philosophy in evoking adaptive physical health behaviour.

### **Positive Psychology Constructs**

The current work considers multiple eudaimonic constructs. Accordingly, the nuance of relationships between each concept and specific health behaviours are discussed in the relevant introductory sections of each chapter. However, each construct selected represents synergy with the overarching aims of the proposed approach; to promote the appeal of longevity and physical health, to provide energising rather than depletive effects upon self-regulatory resources, and to hold universal relevance across human psychology. Specifically, in Chapter 2 the role of life meaning in supporting perceptions of a desirable, stable and coherent future is assessed. In Chapter 3, the use of construal priming to promote the salience of long-term goals is investigated, and in Chapter 4, principles of basic psychological need satisfaction and meaning in life are explored.

### **Measurement of Health Behaviour**

Vickers, Conway, and Hervig (1990) suggest health behaviours can be broadly categorised into those that present health risk, such as exposure to hazardous substances, and those that prevent ill health, such the wellness behaviour of taking vitamins. Given the current work involves the manipulation positive constructs which may differentially influence distinct types of health related behaviour, measures of both health risk and wellness activity are included.

### **Measurement of Impulsivity**

Several methods to index impulsivity are employed across experimental chapters in this thesis. In order to provide the most ecologically valid assessment of health related outcomes, measures are implemented at the behavioural level (e.g. food intake, physical activity adherence) where practicable. These are supported with experimental and self-report assessments, which are further described in the relevant methodological sections.

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### Thesis Overview

This thesis comprises three experimental chapters, with a synopsis of each section and associated hypotheses presented below. The precise evidence gap addressed in each study, and outcomes of interest, are discussed within the relevant introductory sections.

## Chapter 2: The Meaning of Life: Effects of a Brief Daily Journaling Intervention on Health

### Motivation and Behaviour.

Evidence suggests individuals with high perceived meaning in life present greater sensitivity to the future consequences of immediate action. Consequently, they are more likely to forgo instant reward in pursuit of distal goals. This chapter builds upon seminal findings regarding the wellbeing benefits of reflective practice, and presents the evaluation of a brief journaling intervention designed to promote meaning in life and physical health outcomes (motivation, behaviour) in a sample of higher education students immediately post-intervention and at one-month follow-up (study 1A). Impulsive behaviours associated with the development of noncommunicable disease are also socioeconomically patterned. Thus, study 1B involves a replication of study 1A amongst a community-based sample in a geographic area of socioeconomic deprivation. This included an objective assessment of health behaviour as indexed via attendance on a 10-week physical activity course.

### *Study 1A: Higher Education Sample*

#### H<sub>1</sub> – Meaning in Life

- a) Participants who complete a meaning in life journal will report significantly greater meaning in life at post-test and follow-up, relative to participants who complete a control diary.

#### H<sub>2</sub> – Health Motivation

- a) Participants who complete a meaning in life journal will report significantly greater autonomous motivation for health behaviour at post-test and follow-up, relative to participants who complete a control diary.

#### H<sub>3</sub> – Health Behaviour

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a) Participants who complete a meaning in life journal will report significantly decreased health risk behaviour at post-test and follow-up, relative to participants who complete a control diary.

b) Participants who complete a meaning in life journal will report significantly increased wellness behaviour at post-test and follow-up, relative to participants who complete a control diary.

### **H<sub>4</sub> – Mediatory Variables**

a) Relationships between meaning in life and health outcomes (motivation, behaviour) will be mediated by enhanced self-regulation, as indexed by delay discount rate.

### ***Study 1B: Community Sample***

#### **H<sub>1</sub> – Meaning in Life**

a) Participants who complete a meaning in life journal will report significantly greater meaning in life at post-test, relative to participants who complete a control diary.

#### **H<sub>2</sub> – Health Motivation**

a) Participants who complete a meaning in life journal will report significantly greater autonomous motivation for health behaviour at post-test, relative to participants who complete a control diary.

#### **H<sub>3</sub> – Health Behaviour**

a) Participants who complete a meaning in life journal will report significantly decreased health risk behaviour at post-test, relative to participants who complete a control diary.

b) Participants who complete a meaning in life journal will demonstrate significantly greater attendance at a 10-week physical activity programme than participants who complete a control diary.

### **H<sub>4</sub> – Mediatory Variables**

a) Relationships between meaning in life and health outcomes (motivation, behaviour) will be mediated by enhanced self-regulation, as indexed by consideration of future

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consequences.

## **Chapter 3: Reshaping the Future: The Influence of Psychological Distance on Eating Behaviour and Exercise Decisions.**

Construal level theory describes how representing objects in terms of abstract (central, invariant, high-level) or concrete (transient, specific, low-level) properties motivates either restrained choice or immediate action respectively. This chapter investigates whether pairing construal level priming with a pre-existing intervention designed to promote a future-orientation (episodic future thinking; EFT) can facilitate healthy-eating behaviour (study 2A). Subsequently, the carry-over effects of this manipulation to exercise decision-making are assessed (study 2B), based on the observation that construal priming alters the mental representation of features across all concepts.

### ***Study 2A: Eating Behaviour***

#### **H<sub>1</sub> – Food Intake**

a) Participants who engage in high-level EFT will consume significantly less high-calorie food than participants who engage in low-level EFT and episodic recent thinking (ERT).

b) Participants who engage in high-level EFT will consume significantly more low-calorie food than participants who engage in low-level EFT and ERT.

#### **H<sub>2</sub> – Abstract & Concrete Considerations**

a) Concrete considerations will be rated as significantly more salient and important by participants primed with low-level EFT than high-level EFT or ERT inductions.

b) Abstract considerations will be rated as significantly more salient and important by participants primed with high-level EFT than low-level EFT or ERT inductions.

#### **H<sub>3</sub> – Mediatory Relationships**

a) Enhanced salience of abstract considerations will decrease high-calorie food intake and increase low-calorie food intake.

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- b) Enhanced salience of concrete considerations will increase high-calorie food intake and decrease low-calorie food intake.

### ***Study 2B: Exercise Decisions***

#### **H<sub>1</sub> – Effort Mobilisation**

- a) Participants exposed to a high-level prime will be significantly more likely to select a high-effort\*reward option in relation to a low-effort\*reward option than participants exposed to a low-level prime and a no-intervention control group.

#### **H<sub>2</sub> – Abstract & Concrete Considerations**

- a) Concrete considerations (physical effort) will be rated as significantly more salient and important by participants exposed to a low-level prime than a high-level prime or a no-intervention control group.
- b) Abstract considerations (benefits of effort) will be rated as significantly more salient and important by participants exposed to a high-level prime than a low-level prime or a no-intervention control group.

#### **H<sub>3</sub> – Mediatory Relationships**

- a) Enhanced salience of abstract considerations will predict high-effort\*reward selection.
- b) Enhanced salience of concrete considerations will predict low-effort\*reward selection.

## **Chapter 4: A Runaway Success: Factors in the Popularity of a Global Physical Activity Initiative.**

Studies of the relationship between psychological wellbeing and physical health behaviour conducted in laboratory settings may not translate to typical experiences in daily life. Drawing upon concepts identified in Chapter 2, this section qualitatively explores principles underlying the success of a real-world physical activity initiative (study 3A) and assesses whether facets of psychological wellbeing (meaning in life, autonomous motivation) predict participant attendance over the course of one year (study 3B).

### ***Study 3A: Qualitative Exploration***

**H<sub>1</sub> – Antecedents, Maintenance and Consequences of *Parkrun* attendance**

a) Due to the exploratory nature of this component, it is unknown what factors will influence why individuals' initial and continued attendance at *Parkrun*, and the consequences they might experience as a result.

***Study 3B: Quantitative Longitudinal Investigation*****H<sub>1</sub> – Meaning in Life**

a) A greater sense of meaning in life at time 1 will positively predict *Parkrun* attendance over the following year.

**H<sub>2</sub> – Motivation**

a) Greater intrinsic motivation at time 1 will positively predict *Parkrun* attendance over the following year.

b) Greater identified regulation at time 1 will positively predict *Parkrun* attendance over the following year.

c) Greater controlled motivation for *Parkrun* at time 1 will negatively predict over the following year

## **Chapter Two**

### **The Meaning of Life: Effects of a Brief Daily Journaling Intervention on Health Motivation and Behaviour**

#### **Link to Thesis Objectives and Overarching Themes**

Meaning in life facilitates the salience and appeal of future goals, and is therefore one facet of eudaimonic wellbeing which may support self-regulation. Moreover, as an innate human drive, meaning represents a feasible construct to target at the population-level. This chapter explores the adaptation of a seminal positive psychology intervention to amplify participants' life meaning, and investigates multiple behavioural determinants of noncommunicable disease. As such, the present work represents a novel application of the positive health paradigm to promote healthy lifestyle behaviour, and specifically represents the first assessment of experimentally induced meaning upon physical health outcomes.



### Abstract

**Objective:** Meaning in life is a eudaimonic construct associated with basic psychological need satisfaction and prosocial action. Recent theory suggests perceptions of meaning in life may foster a greater desire for physical health behaviour, and support self-regulation. This study adapted a positive psychology intervention in developing a journaling exercise to promote meaning in life. Intervention effects upon health motivation and behaviour were assessed.

**Design & Participants:** Participants were randomly allocated to a control or intervention group. Measures of independent variables were taken at baseline and compared to scores immediately post-intervention (studies 1A and 1B) and at one-month follow-up (study 1 only). Participants in study 1A were 67 higher education students ( $M^{\text{age}} = 20.58$  years,  $SD = 2.34$ ; 50 females) and in study 1B were 22 individuals enrolled on a community-based exercise program ( $M_{\text{age}} = 41.27$  years,  $SD = 11.64$ , 100% female).

**Measures:** Assessments of meaning in life, health motivation, health behaviour and subjective-wellbeing were taken in study 1A. These were complimented with measures of time-perspective and objectively assessed physical activity in study 1B.

**Results:** In study 1A, experimental participants demonstrated significantly greater meaning in life and autonomous motivation for health behaviour at post-test and follow-up. Scores in the control group remained stable. These effects were not replicated in study 1B, however significant attrition during the intervention delivery stage resulted in statistical underpower.

**Conclusion:** A brief, scalable and low-cost intervention successfully increased meaning and health motivation amongst higher education students. Further investigation is needed to comprehensively validate this tool and generalise findings. Implications regarding intervention delivery are discussed.

## Introduction

### Meaning in Life

According to the meaning maintenance model (Martela & Steger, 2017), meaning in life (MIL) is comprised of three components: [1] purpose, the presence of core goals and aspirations; [2] significance, an importance beyond the trivial or immediate; and [3] coherence, an understanding of the self as an entity, and the perception of consistency across life events (Boyle et al., 2009; Heine, Proulx, & Vohs, 2006). As such, meaning in life represents a synergy of cognitive and behavioural factors, and involves engagement in purposeful and widely important action which can be perceptually integrated amongst one's understanding of the self (Park & George, 2013). A number of variables influence the perception of activities as purposeful and significant (Hicks, Schlegel, & King, 2010; King, Hicks, Krull, & Del Gaiso, 2006; Vess, Routledge, Landau, & Arndt, 2009). However, the most empirically robust predictors relate to whether behaviours are eudaimonic (see Chapter 1: 5.2) and beneficent (Frank Martela, Ryan, & Steger, 2017). Beneficence is a sense of prosocial impact, arises from connecting with other people and superordinate causes (Nozick, 1981), and has often featured as a fundamental component in historical definitions of meaning (Frankl, 1959; Reker, Peacock, & Wong, 1987). Beneficent activities are also described as self-transcendent, whereby they provide outcomes which support individuals other than the immediate self.

Greater meaning in life is not only associated with enhanced psychological wellbeing (Ho, Cheung, & Cheung, 2010; Zika & Chamberlain, 1992), length of lifespan (Cohen, Bavishi, & Rozanski, 2016) and a reduced risk of overall mortality (Boyle, Barnes, Buchman, & Bennett, 2009), but is also directly related to health behaviour. For example, in studies controlling for affect, depressive symptomatology, self-efficacy and sociodemographic factors, greater MIL is significantly related to self-report and objectively assessed physical activity (Holahan et al., 2011; Holahan, Holahan, & Suzuki, 2008; Hooker & Masters, 2016), healthier ageing as mediated by healthcare utilization (Zhang et al., 2018) and healthy eating (Brassai et al., 2015). Greater MIL is also associated with more frequent preventative health checks such as cholesterol tests and mammograms (Kim, Strecher, & Ryff, 2014) and predicts greater physical activity amongst previously sedentary individuals (Hooker et al., 2016). Additionally, MIL is greater in those who have never smoked than in current or ex-smokers and predicts lower smoking intensity (Thege, Bachner, Kushnir, & Kopp, 2009), whilst purpose in life is related to lower alcohol and cocaine use, and decreased likelihood of relapse in

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those recovering from addiction (Melton & Schulenberg, 2008). Inversely, feelings of futility are linked to alcohol self-regulation failure (Song, Jung & Won, 2017) and substance abuse (Newcomb & Harlow, 1986).

### **Meaning, Self-Regulation & Health Behaviour**

Despite a growing literature which examines associations between meaning and health behaviour, little experimental work has addressed causal factors in this relationship. One explanation is that meaning promotes the self-regulation of healthy behaviour because it supports the identification of and commitment to long-term goals. As discussed in Chapter 1, eudaimonic wellbeing may support healthy action via promoting the appeal (see 7.1) and salience of physical health (see 7.2), as well as displacing unhealthy cues (see 7.3). As a eudaimonic construct, meaning in life is hypothesised to afford these benefits, as well as providing energy for goal directed action, and enabling perceptions of a more stable and coherent future.

### **Energy for Action**

The self-regulation of effortful health behaviour (e.g. exercise, dietary restraint) requires a consistent stream of cognitive capital (Hooker & Masters, 2016; Maas et al., 2012). Evidence indicates meaning in life may provide a relevant source of energy because it elevates the significance of daily activities. For example, individuals living with a strong sense of meaning have greater clarity regarding their life narrative and identity (Martela & Steger, 2017) and are therefore more able to incorporate coherent goals within their sense of self (Sheldon & Elliot, 1999). This entails autonomous motivation which, as discussed in Chapter 1, is associated with persistent, engaged and resilient behaviour (Brooks, Brooks, & Goldstein, 2012; Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004; Silva et al., 2011; Stevinson, Wiltshire, & Hickson, 2015; Vansteenkiste et al., 2008; Vitali, Bortoli, Bertinato, Robazza, & Schena, 2015), and provides a vitalising effect (Kasser & Ryan, 1999). Autonomous motivation is also associated with greater wellbeing (Gunnell, Crocker, Mack, Wilson, & Zumbo, 2014), hope (May, 1975), and a drive for self-development (Moss & Wilson, 2017; Pruzan & Isaacowitz, 2006). Moreover, because meaningful objectives directly provide beneficial outcomes for sources beyond the immediate self, they are inherently perceived as socially important. This fosters greater persistence (Damon, Menon, & Bronk, 2003; Machell et al., 2016; Yeager et al., 2014), and affords the potential of reciprocal social support from others (Simpson & Willer, 2008). Collectively, healthy behaviour may be enacted because it is directly perceived as meaningful, or

because it is supported by energy which has been redeployed from other sources of meaning.

### **Future Stability**

Humans are more likely to devalue rewards if they perceive them to have a low likelihood of occurrence, known as probabilistic discounting (Myerson, Green, Scott Hanson, Holt, & Estle, 2003). For example, delayed rewards are more likely to be devalued because their attainment is influenced by factors which occur between the present instance and reward receipt. Meaning in life helps to buffer against probabilistic discounting, because it supports the perception of consistency between one's current and future activities (Bartels & Urminsky, 2011) promoting the extent to which individuals believe particular events will take place, and faith in the realisation of reward (Rachlin, 2000; Richards, Zhang, Mitchell, & de Wit, 1999). Indeed, confidence in the stability of one's goals over time predicts patient decision-making in academic and financial situations (Bartels et al., 2011), whilst perceiving one's future as vague, unrealistic, uncontrollable or unpleasant is associated with greater impulsivity and steeper discounting tendencies (Kirby & Marakovic, 1996; Myerson et al., 2003; Pepper et al., 2017).

### **Meaning Salience**

Hooker et al. (2017) propose the degree to which individuals are aware of what makes their life meaningful, or *meaning salience*, varies both intra- and individually and on a daily basis. Those who have greater meaning salience are more likely to act in ways that are consistent with their overarching life goals, because life meaning guides attention toward the longitudinal consequences of immediate action (Hooker et al., 2017). As such, highly salient sources of meaning serve as a link between the abstract conception of superordinate goals, and proximal decision-making (Hooker et al., 2017). Evidence indicates associations between attention to future consequences and reduced temporal discounting (Daugherty & Brase, 2010; Stolarski, Bitner, & Zimbardo, 2011), healthier dietary choice (Gick, 2014; Joireman, Shaffer, Balliet, & Strathman, 2012), greater exercise (Joireman et al., 2012; van Beek, Antonides, & Handgraaf, 2013), sunscreen use (Orbell & Kyriakaki, 2008) and vaccination against disease (Morison, Cozzolino, & Orbell, 2010; Nan & Kim, 2014). Conversely, those who are present-focussed are more likely to use recreational drugs (Adams & Nettle, 2009; Kirby, Petry, & Bickel, 1999) and engage in risky sexual behaviour (Appleby et al., 2005). If the regular experience of meaning does serve to link immediate action with long-term intention, interventions which promote meaning salience represent a valuable method of promoting physical health.

### **Summary: Relationships Across Life Meaning and Physical Health**

A sense of meaning is thought to present a clear and coherent future, and bolster energy for action. This can promote the degree to which individuals value their future and pursue future-supportive resources with vigour. Cultivating a sense of meaning may therefore contextualise previously laborious objectives, eliciting a source of motivation potent enough to inspire effective self-regulation. In addition, enhancing the extent to which meaning is salient in everyday life may serve to support the appeal, automaticity and monitoring of physical health behaviour. However, experimental work is needed to further explore this novel proposition (Hooker, Masters, & Park, 2017).

### **Inductions of Meaning**

Hooker et al. (2017) propose meaning salience can be conceptualised as a state variable, and one that is susceptible to environmental influence. However, whilst a large a large body of correlational evidence suggests meaning in life has a beneficial influence upon health related behaviour, no studies to date have investigated the physical health outcomes of experimentally induced meaning. Indeed, evidence regarding any independently manipulated outcome of MIL is sparse. Whilst acceptance and commitment therapy and mindfulness-based cognitive behavioural therapy explicitly target the clarification and commitment to a purpose in life, the majority of programmes are multi-component and include no direct assessment of meaning or purpose as unique constructs (Mcknight & Kashdan, 2013). Dubé, Lapierre, Bouffard, and Alain (2007) devised an intervention which indirectly addressed meaning by inviting participants to clarify life values, and plan goals in relation to a superordinate purpose, whilst Feldman and Dreher (2012) used a 90-minute interview procedure to increase participants' hope, life purpose and self-nominated goal progress, over the course of one month. However, these studies did not measure the unique role of MIL in goal pursuit, and the inherent requirement for expert guidance presents a difficulty for feasible replication at the scale necessary to tackle noncommunicable disease. Whilst some research demonstrates the long-term enhancement of MIL is possible, the majority of this work has been conducted within the context of palliative care and thus one which presents a significantly different psychological climate to that of a population-level setting (LeMay & Wilson, 2008).

Other inductions of MIL include manipulations to promote the perceived significance of activities (Reeve, Jang, Hardre, & Omura, 2002), and tasks which prompt individuals to search for

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personal coherence (Reeve et al., 2002). Sentence unscrambling tasks and letter search matrices have also been employed to subliminally prime and enhance self-reported meaning (Proulx & Heine, 2009). Such work supports the idea brief intervention can promote meaning-related cognition (Van Tongeren & Green, 2010). However, previous inductions focus exclusively on proximal assessments of meaning, and therefore cannot present evidence of longitudinal effect.

As a whole, meaning-related initiatives are cited as a promising target for the promotion of health behaviour (Hooker et al., 2017), however a greater understanding of interventions to promote MIL is needed (Boyle et al., 2009). In response, the current research considers the use of a brief daily journaling intervention to provide a framework for such development.

### **Brief Journaling Interventions**

One potential method via which to enhance the salience of life meaning, and the regular experience of meaningful events, is brief daily journaling. The expressive writing paradigm has traditionally dominated journaling focussed research, and considers the cathartic self-expression of negative events to boost wellbeing (e.g. Gortner, Rude, & Pennebaker, 2006). More recently, exercises which invite participants to reflect upon targeted positive experience have also demonstrated significant and replicable effects (e.g. Bolier et al., 2013; Giannopoulos & Vella-Brodrick, 2011; Mongrain & Anselmo-Matthews, 2012). One example, '*three good things*', invites participants to create a daily record of three positive events and the reasons underlying the event occurrence for a single week. Despite the brevity of this intervention, significant increases in happiness are not only maintained but strengthen across a six-month period (Carter et al., 2016; Mongrain & Anselmo-Matthews, 2012; Seligman, Steen, Park, & Peterson, 2005). The broaden-and-build theory of positive emotions illustrates how regularly documenting good things may generate lasting changes in cognition and behaviour, as pleasant emotions stimulate actions associated with the accumulation of personal resources, immediate affect, life satisfaction and resilience (Fredrickson, 2012). Indeed, greater positive affect is related to a number of variables which may further increase wellbeing, such as thriving personal relationships (Seligman et al., 2005) and performance at work (Zemp, Merrilees, & Bodenmann, 2014). A simple and brief documentation of daily pleasant events may promote the extent to which participants engage in other positive activities, therefore leading to significant change in emotion and behaviour. As discussed in Chapter 1, evidence demonstrates positive emotion and meaning (as hedonia and eudaimonia) represent

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complimentary routes to happiness, and are characterised by experiences of pleasure or personal growth respectively. As such, it is possible that daily journaling exercises directed at positive emotional experience can be modified to amplify the salience of eudaimonic cues, and thus stimulate behavioural engagement with meaningful activities. One previous study has explored the application of daily journaling in this way (Giannopoulos & Vella-Brodrick, 2011). However, the underlying mechanics of this effect remain unknown, and no physical health outcomes were assessed.

Given that greater life meaning may promote health behaviour via facilitating the internalisation of longitudinal goals, daily journaling interventions represent a particularly appropriate approach. This is because the explorative and independent format of personal reflection enables autonomy, which is critical to effective internalisation and sustained goal pursuit (Haerens, Aelterman, Vansteenkiste, Soenens, & Van Petegem, 2015). Such principles have previously been evidenced in motivational interviewing procedures, whereby interviewees work with practitioners to understand their ambivalence regarding a particular issue, envision a coherent and desired future, and plan the necessary steps required to achieve their goals. The efficacy of motivational interviewing in promoting health behaviour, including the treatment of alcohol addiction, weight maintenance and smoking cessation, is well-established (Hettema, Steele, & Miller, 2005; Rubak, Sandbaek, Lauritzen, & Christensen, 2005; Söderlund, Madson, Rubak, & Nilsen, 2011). Indeed, in one review motivational interviewing was found to outperform traditional healthcare advice in 80% of cases (Rubak, Sandbaek, Lauritzen, & Christensen, 2005). Further evidence suggests a greater experience of autonomy underlies the efficacy of motivational interviewing (Resnicow et al., 2012), and that this type of intervention is particularly effective for individuals who display entrenched oppositional attitudes to physical health behaviour (Hettema, Steele, & Miller, 2005). Whilst the financial and human-resource costs of motivational interviewing present difficulty for feasible replication at the population-level, daily journaling interventions may form a scalable and cost-effective method of assisting participants in uncovering their natural strivings (Black & Deci, 2000; Koestner et al., 2008), and inspiring greater engagement with meaningful activity and physical health. As such, this type of intervention could represent a population-level version of a successful individual-based treatment, identified by Bloom et al. (2011) as essential in the alleviation of noncommunicable disease.

The current study therefore adopted the daily journaling paradigm to create a meaningful

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events journal. This resource was designed to promote participants' sense of MIL by prompting the identification of eudaimonic and beneficent activities, and an awareness of how these activities form part of a coherent self. Measurements of life meaning, health motivation and health behaviour were taken immediately before and after the six-day intervention period, as well as one-month following intervention delivery. The role of self-regulation in mediating the relationship between meaning and life and health behaviour was also assessed, using measures of delay discount rate taken pre- and post-intervention. Hypotheses are as follows;

### **H<sub>1</sub> – Meaning in Life**

- a) Participants who complete a meaning in life journal will report significantly greater meaning in life at post-test and follow-up, relative to participants who complete a control diary.

### **H<sub>2</sub> – Health Motivation**

- a) Participants who complete a meaning in life journal will report significantly greater autonomous motivation for health behaviour at post-test and follow-up, relative to participants who complete a control diary.

### **H<sub>3</sub> – Health Behaviour**

- a) Participants who complete a meaning in life journal will report significantly decreased health-risk behaviour at post-test and follow-up, relative to participants who complete a control diary.
- b) Participants who complete a meaning in life journal will report significantly increased wellness behaviour at post-test and follow-up, relative to participants who complete a control diary.

### **H<sub>4</sub> – Mediatory Variables**

- a) Relationships between meaning in life and health outcomes (motivation, behaviour) will be mediated by enhanced self-regulation, as indexed by delay discount rate.



A substantial evidence-base supports the idea that daily journaling may be particularly valuable in promoting the self-awareness necessary to develop instructional and coherent life values, and to identify purposeful daily activities. It is possible that such a platform further promotes attention to meaningful stimuli, consequently supporting physical health outcomes. However, no prior studies have investigated this concept. The present investigation of brief daily journaling in promoting MIL and health behaviour aims to enhance the scientific knowledge base, and provide a novel and effective resource for healthcare practitioners.

## **Method**

### **Participants**

An a priori power analysis conducted using G\*Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007) indicated a required sample size of 65 to achieve significance at 95% power. This calculation was based on parameters of  $p = .05$  criterion, and  $d = 0.2$ , drawing on the findings of previous positive journaling interventions (Bolier et al., 2013; Burton & King, 2004; Carter et al., 2016). An estimated attrition rate of 25% was incorporated into the initial recruitment of 90 participants, following that observed in previous experiments using the same recruitment strategy (opportunity sampling; Bangor University participant pool; pre- post- and follow-up testing). Of these, 77% completed a follow-up questionnaire distributed at one-month post intervention and three were excluded for missing data. This resulted a final sample of 67 participants ( $M^{\text{age}} = 20.58$  years,  $SD = 2.34$ ; 50 females). All individuals gave fully informed consent and were compensated for their time with partial course credit (pre- and post- testing) and could select either further course credit or entry into a £50 voucher draw at follow-up. The study was approved by the Bangor University School of Psychology Research Ethics Committee (Application: #2016-15821).

### **Design**

A 2\*3 mixed measures design was employed to investigate relative differences between two conditions (control, experimental), across three time points (pre-intervention, post-intervention, one-month follow-up). Participants were randomly assigned to either condition using a digital code, and both conditions received identical instructions regarding the completion of measures and submission of diary entries.

## Materials

**The Meaning in Life Journal V1 (Appendix 4.1).** The experimental intervention was designed to promote participants' perception of meaning in life by inviting them to respond to an identical series six of questions, over six consecutive days (Table 1). This task conceptualises meaning as the sense life is filled with purposeful activities which contribute towards personal goals and provide benefit to others. The journal was constructed to support participants in generating previously unconsidered associations between daily activities and the meaningful consequences of those activities, and to enhance the frequency with which participants attended to meaningful environmental cues in a similar fashion to the hypothesised mechanics behind *'three good things'* (Carter et al., 2016; Seligman, Steen, Park, & Peterson, 2005).

A first iteration of the MIL journal was devised from these criteria, and piloted with a small sample ( $n = 16$ ) to ensure the questions were unambiguous and comprehensible. Based on participants qualitative written experience, instructional prompts were added to two of the six questions to facilitate ease of answering, for example *"Name one activity you did today that was challenging, but also interesting or enjoyable [prompt:] this could be any activity, big or small"*. Subsequent to this, a finalised electronic diary was hosted on 'SenseMaker©' (Appendix 4.1); an online platform used as a data-capture tool. All questions were displayed on the same page, and were followed by a large blank text box, in which participants typed their response.

**The Control Diary. V1 (Appendix 4.2)** Participants in the control condition accessed their diary also accessed their diary via SenseMaker. This exercise was designed to match the MIL journal in terms of the number of questions required, however participants in this condition were asked *"What was the first event/activity that happened when you woke up this morning?"* before answering five questions in relation to this event (Table 1). This design was chosen to replicate the procedural format of the experimental diary, but to encourage reflection of neutral emotional valence.

	Experimental	Control
	Meaning in Life Journal	Control Diary
1.	<p><i>"Name one activity you did today that was challenging but also interesting or enjoyable."</i></p> <p><i>This could be any activity, big or small."</i></p>	<i>"What was the first event/activity that happened when you woke up this morning?"</i>
2.	<i>"Why did you do the activity, even though it was challenging?"</i>	<i>"What kind of place did this event/activity happen in?"</i>
3.	<p><i>"How could this activity help others, or support you to help others?"</i></p> <p><i>This could be anyone from your close friends and family to future generations, wider society or total strangers."</i></p>	<i>"How long did this event/activity last for?"</i>
4.	<i>"What wider life goals does this activity help you achieve and how?"</i>	<i>"What actions did this event/activity require?"</i>
5.	<i>"What skills or values did the activity require and/or strengthen?"</i>	<i>"Who else experiences this kind of event/activity?"</i>
6.	<i>"Who initiated the activity, and how did they do it?"</i>	<i>"When is this event/activity likely to happen in future?"</i>

*Table 1. Questions and prompts of the experimental MIL journal version 1 and the control diary version 1.*

### Psychometric Measures

The categorical values for internal consistency across all scales are defined as follows: acceptable;  $\alpha < .7$ , good;  $\alpha = < .8$ ; excellent;  $\alpha = .9$  (Kline, 2000).

### **The Orientations to Happiness Scale (OTH; Peterson, Park, & Seligman, 2005; Appendix 5.1).**

The OTH assesses the extent to which individuals pursue distinct routes to wellbeing via three six-item subscales: pleasure (OTH-P), meaning (OTH-M) and engagement (OTH-E). Participants respond to eighteen statements using a five-point Likert scale from 1 (“*not very much like me*”) to 5 (“*very much like me*”) to signify the extent to which each response applies to them. The OTH-M is a particularly relevant measure of meaning in the current research as it examines the salience of activities which align with one’s superordinate goals and virtues (Kraut, 2008), and incorporates the beneficent element of meaning as identified by Machell, Disabato, and Kashdan (2016). For example, participants signify how applicable assertions such as “*In choosing what to do, I always take account of whether it will benefit other people*” are to their personal experience of life. In contrast, the OTH-P concerns activities related to the maximisation of hedonic experience, featuring claims such as “*I agree with this statement - ‘life is short, eat dessert first’*”. Given that the pursuit of hedonic and eudaimonic activities can both overlap and conflict (Baumeister, Vohs, Aaker, & Garbinsky, 2017), both the OTH-M and OTH-P were selected to determine if a gain in sense of purpose would also impact pleasure-seeking behaviour, as observed in studies of affect and consumption of high and low-calorie foods (Killgore & Yurgelun-Todd, 2006), or impact overall wellbeing. In the present study, the meaning and purpose subscales of the OTH report acceptable to good internal consistency (OTH-P  $\alpha = .82$ , OTH-M  $\alpha = .72$ )

### **The Treatment-Self-Regulation Questionnaire (TSRQ; Ryan & Connell, 1989; Appendix 5.2)**

The self-regulation questionnaires are a group of assessments which measure the degree to which behaviour is motivated by intrinsic and internalised (autonomous subscale) or extrinsic and introjected (controlled subscale) factors, whilst a third subscale assesses the absence of motivation (amotivation subscale). The original SRQ was devised for use in an academic context (Ryan & Connell, 1989), whilst the TSRQ was developed for specific application within the physical health domain and has been extensively pre-validated across a range of health behaviours (Williams, Freedman, & Deci, 1998; Williams, Cox, Kouides, & Deci, 1999; Williams, Niemiec, Patrick, Ryan, & Deci, 2009; Williams & Ryan, 1996). In the current study participants were asked to select the extent to which 15 motives apply to them, in response to the statement “*The reason I would maintain healthy behaviour, or try to become*

*healthier is...*” with ‘healthy behaviour’ defined as “*a healthy diet, taking regular physical exercise, not smoking and using alcohol responsibly*” via a 7-point Likert scale from 1 (Not true at all) to 7 (Very true). Sample items include “*because I personally believe it is the best thing for me*” (autonomous motivation), “*because I want others to approve of me*” (controlled motivation), and “*because it is easier to do what I am told than to think about it*” (amotivation).

The TSRQ is evidenced as a valid measure of health self-regulation, with each subscale demonstrating good to excellent internal consistency (TSRQ Autonomous  $\alpha = .93$ , TSRQ Controlled  $\alpha = .88$ , Amotivation  $\alpha = .79$ ). Additionally, the TSRQ shows good criterion validity, with high scores on the autonomous subscale significantly and positively associated with positive health outcomes such as frequent fruit and vegetable consumption, whilst equivalent values on the controlled and amotivation scales are more likely to be weakly or significantly unrelated to physical wellbeing (Levesque et al., 2007). Moreover, confirmatory factor analysis has established the invariance of the TSRQ across multiple health domains (diet, tobacco use and exercise; Levesque et al., 2007), supporting the use of the TSRQ as a trans-behavioural measure.

### **The Health-Risk Behaviour Inventory (HRBI; Irish, 2011; Appendix 5.3).**

The HRBI is comprised of seven subscales to provide a metric of distinct behaviours that present risk to long-term health (physical inactivity, unhealthy diet, inadequate sleep, smoking, alcohol use, illicit drug use and risky sexual behaviour). The average values for these scales can be summed to produce a total risk score. For each item, participants are provided with a brief definition of a behaviour, for example, “*aerobic exercise is any activity that significantly raises your heart rate*” and asked to select the degree to which they have engaged in that behaviour over the past week. Each response is assigned a numerical score, with lower scores signifying the lowest health risk, for example a score of 1 (“*I got lots of aerobic exercise at my job, so did not need to work out*” or “*I got more than 2.5 hours aerobic exercise over the course of the week*”) to a score of 5 (“*I hardly got any aerobic exercise*”). In the current study, the HRBI diet, physical activity, smoking and alcohol use subscales were selected due to the relevance of these behaviours to noncommunicable disease (French, Story, & Jeffery, 2001; Parry, Patra, & Rehm, 2011). These subscales demonstrated acceptable internal consistency (HRBI Activity  $\alpha = .68$ , HRBI Diet  $\alpha = .68$ , HRBI Smoking  $\alpha = .76$ , HRBI Alcohol  $\alpha = .69$ ) and show adequate convergent validity with similar pre-validated measures, such as the HRBI Activity and the

International Physical Activity Questionnaire (Craig et al., 2003;  $r = -.35$ , Irish, 2011), the HRBI diet and the Rapid Eating and Activity Assessment for Patients (Gans et al., 2006;  $r = .36$ , Irish, 2011) the HRBI smoking and the Alcohol Smoking and Substance Involvement Screening Test (ASSIST WHO, 2002;  $r = .59$ , Irish, 2011) and the HRBI alcohol and the ASSIST ( $r = .53$ , Irish, 2011). Furthermore, extensive work on the wording of each item in the HRBI has been conducted using interview data from a large student sample (Irish, 2011), in order to ensure the comprehensibility of the measure.

#### **The Wellness Behaviours Inventory (WBI; Sirois, 2001; Appendix 5.4).**

The WBI was employed to provide a global assessment of how frequently various health promoting behaviours (e.g. healthy eating, exercising) were performed. Participants rated how often they had engaged in 12 behaviours associated with the prevention of ill-health such as *"I get a good night's sleep"* and *"I eat healthy, well-balanced meals"* on a five-point Likert scale from 1 (less than once a week or never) to 5 (every day of the week). The WBI indicated acceptable internal consistency ( $\alpha = .75$ ) and shows good convergent validity via negative correlations with measures of perceived stress and negative affect, and positive correlations with health self-efficacy, health intentions (Dunne, Sheffield, & Chilcot, 2016; Sirois, 2007; Sirois & Tosti, 2012; Sirois, Kitner, & Hirsch, 2015). Further, high scores on the WBI are negatively associated with physical symptoms of ill-health such as respiratory problems ( $b = -15.66$ , Dunne et al., 2016) and positively associated the performance of other preventative health behaviours, such as annual medical check-ups ( $r = .35$ , Sirois, 2007).

#### **The Depression, Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995; Appendix 5.5)**

The DASS-21 was used to assess psychobiological symptoms of depression, anxiety and stress, whereby participants indicated the extent to which statements such as *"I felt that I had nothing to look forward to"* and *"I found myself getting agitated"* apply to their personal experience of the past seven days via a four-point Likert scale from 0 (never) to 3 (almost always). Evidence suggests the DASS-21 has good reliability in both clinical (Antony, Bieling, Cox, Enns, & Swinson, 1998; Clara, Cox, & Enns, 2001) and non-clinical (Henry & Crawford, 2005; Sinclair et al., 2012) populations, and demonstrates good convergent validity with other pre-validated measures of depression and anxiety, such as the Beck Anxiety Inventory (BAI,

Beck & Steer, 1990) and the Beck Depression Inventory (BDI, Beck, Rush, Shaw, & Emery, 1979: BAI depression  $r = 0.51$ ; anxiety  $r = 0.85$ ; stress  $r = 0.70$ . BDI depression:  $r = 0.79$ ; anxiety  $r = 0.62$ ; stress  $r = 0.69$ ; Antony et al., 1998), as well as the Hospital Anxiety Depression Stress Scale (Zigmond & Snaith, 1983: depression  $r = 0.75$ ; anxiety  $r = 0.66$ ; stress  $r = 0.58$ , Nieuwenhuijsen, de Boer, Verbeek, Blonk, & van Dijk, 2003). Further, the DASS-21 also demonstrated good to excellent internal consistency across subscales (depression:  $\alpha = .94$ ; anxiety  $\alpha = .87$ ; stress  $\alpha = .91$ ).

### **The Scale of Positive and Negative Experience (SPANE; Diener et al., 2009, Appendix 5.6).**

The SPANE was used to detect changes in the frequency with which participants had experienced 12 emotions over the past week on a five-point Likert-scale from 1 (very rarely or never) to 5 (very often or always). This assessment provides a measure of positive affect (SPANE-P) including items such as “*happy*” and “*joyful*”, and negative affect (SPANE-N), for example “*bad*” and “*angry*”. Both sub-scales demonstrated good internal consistency (SPANE-N  $\alpha = .80$ , SPANE-P  $\alpha = .84$ ) and show strong convergent validity with similar measures such as Watson, Clark, and Tellegen’s (1988) Positive and Negative Affect Schedule (SPANE-P:  $r = 0.59$ ; SPANE-N:  $r = 0.70$ , Diener et al., 2009). Both the SPANE and the PANAS are widely used in studies of affect, however recent research (Jovanović, 2015) suggests the SPANE as a statistically superior predictor of wellbeing.

### **The Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985; Appendix 5.7).**

The SWLS complements affective metrics of subjective wellbeing by providing a cognitive measurement of global life-satisfaction (Pavot & Diener, 2008). Participants respond to five statements, including “*the conditions of my life are excellent*” using a seven-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). The SWLS has consistently demonstrated good psychometric properties over several decades, and demonstrated high internal consistency in the current sample ( $\alpha = 0.86$ ). Moreover, the SWLS demonstrates a negative correlation ( $r = -0.72$ , Blais, Vallerand, Pelletier, & Brière, 1989) with clinical measures of distress such as the BDI (Beck, Rush, Shaw, & Emery, 1979). Evidence also indicates the SWLS is sensitive to incremental changes in life satisfaction over short time periods (Fujita & Diener, 2005), suggesting particular applicability to both the immediate and longitudinal

measurement-points in the current study.

## Behavioural Measures

### 5-Trial Adjusting Delay Task (Koffarnus & Bickel, 2014).

The 5-trial Adjusting Delay Task was employed to support self-report measures in assessing the overarching ability to delay gratification. In this task, participants are presented with a series of discrete choices regarding either hypothetical smaller and immediate (“£500 Now”) or larger, delayed (“£1000 in Three Weeks”) economic rewards on either side of a computer screen, and make their selections by pressing the corresponding arrow key. Throughout the task, the magnitude of both rewards is kept constant, however the temporal delay for the larger reward is systematically varied dependent on participants’ previous selection, adjusting up as a consequence of delayed choice, and down as a consequence of immediate choice. Delay discount rates are represented by the free parameter  $k$ , which functions as a parametric, operational representation of impulsivity, specified in the hyperbolic discounting model;

$$V = \frac{A}{(1 + kD)}$$

***Eq. 1 (Commons, Mazur, Nevin, & Rachlin, 2013)***

where  $A$  represents the initial magnitude of a reinforcer, and decreases as a function of the delay ( $D$ ) to receiving that reinforcer, with  $V$  representing the value of reward at each delay. Yoon and Higgins (2008) have communicated the importance of disseminating findings amongst individuals from fields relevant yet unfamiliar to delay discounting analysis, via a more accessible representation of  $k$ . This is particularly pertinent given  $k$  values often range over several orders of magnitude in a single dataset, and use the units of inverse time (Kirby et al., 1999; Yoon et al., 2007). Therefore, the Adjusting Delay Task also produces the Effective Delay 50% (ED50) value, which represents the temporal delay at which participants rate the subjective value of a future reinforcer as half that of an immediate reward, following the equation:

$$\frac{A}{2} = \frac{A}{(1 + kED50)}$$

***Eq. 1 (Yoon & Higgins, 2008)***

This calculation adapts the hyperbolic discounting model, to specifically examine the delay at which



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the reinforcer value is reduced to half its original amount. In the case of the 5-Trial Adjusting Delay Task, this results in 32 potential ED50 values, ranging from 1 hour to 25 years. Whilst most measures of delay discounting typically use a large number of trials, which can be both time-consuming and tedious (Koffarnus & Bickel, 2014), shorter alternatives such as the Monetary Choice Questionnaire (MCQ, Kirby et al., 1999) only provide participants with one of 10 discrete  $k$  values. Contrastingly, the quick and easily understandable nature of the 5-Trial Adjusting Delay Task provides an effective method of measuring behavioural impulsivity, without prompting fatigue effects, or sacrificing the statistical quality of its output. Further, this task demonstrates good convergent validity with the MCQ ( $r = .82$ , Epstein et al., 2003) and has replicated several well-known discount effects. This includes the amount effect, which states larger sums of money are typically discounted at a shallower rate than lower sums, and the consumables effect whereby primary reinforcers such as food are typically discounted at a higher rate than generalised reinforcers such as money (Koffarnus & Bickel, 2014). The 5-trial Adjusting Delay task thus provides a brief yet valid measurement, positioning it as the most appropriate measurement for operationalised impulsivity in the current research.

### Procedure

A schematic for the procedure employed in this study can be viewed in Figure 3. Prior to attending the experiment, participants were randomly allocated to the control or experimental condition using a digital allocator, and then gave fully informed consent upon arrival at the lab. All individuals independently completed paper-based self-report assessments and the computerised adjusting delay task in groups of two to five, and were separated by partition screens to ensure their privacy whilst completing potentially sensitive material. For each scale, participants were reminded to consider their emotions or behaviour with specific regard to the past week. Next, individuals were presented with an example of the diary they would later complete online, accessible via the entry of a unique and anonymous identification code. To avoid any impediment of social-desirability bias or psychological reactance on the efficacy of their reflections, participants were informed that the content of the diaries would not be analysed, but that the submission time of their

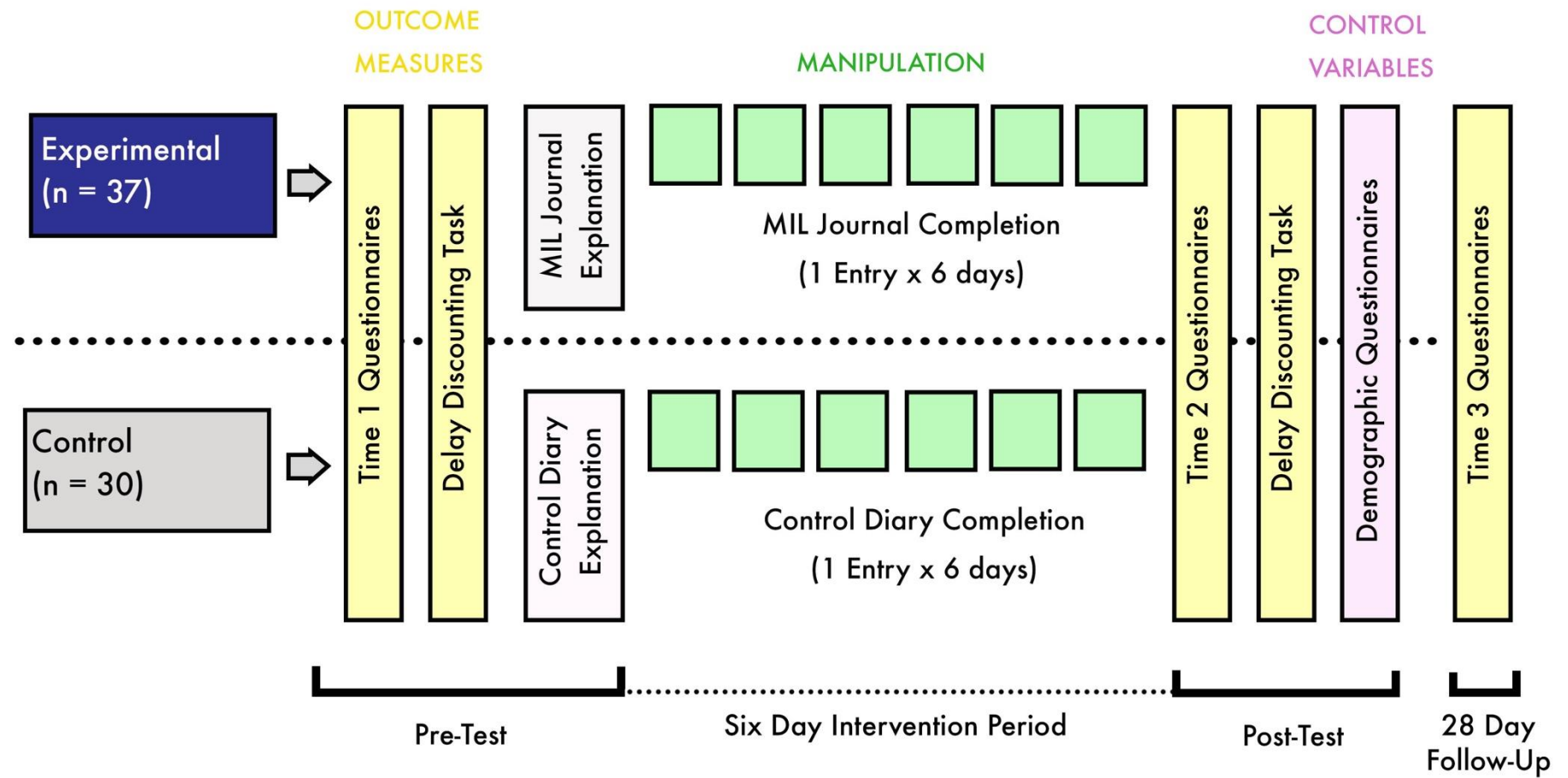


Figure 3. Schematic to depict procedure in study 1A..

entries would be recorded. This provided an ostensible rationale for the need to submit online entries, without revealing its true purpose; to monitor the overall number of entries each participant submitted. After confirming they understood these requirements, participants departed from the lab and were sent an email containing a weblink to their diary, and the unique ID with which to login to the Sensemaker platform. Seven days later, participants attended a pre-booked post-test to provide further measurements of the pre-test variables and basic demographic information. Twenty-eight days later, a third assessment of pre-test measures was collected via the use of online questionnaire, preceding the administration of a full debrief via email.

### **Data Analysis**

Initial analyses were run to ensure the data met the necessary assumptions for testing via ANOVA. Outlier checks were conducted using graphical tests via box plots, homogeneity of variance was assessed using Levene's test at baseline, sphericity was assessed using Mauchly's test across time-points and normality tests were performed via skew and kurtosis z-score at baseline. Significant strong correlations were observed between DASS-Anxiety and DASS-Stress ( $r = .75, p > .001$ ), DASS-Anxiety and DASS-Depression ( $r = .74, p > .001$ ), and DASS-Stress and DASS-Depression ( $r = .7, p > .001$ ). Hence, these subscales were treated as a composite measure of depressive symptomology. All baseline measurements excluding the smoking and alcohol subscales of the HRBI, and the delay discount ED50 values exhibited a normal distribution according to the z-scored skewness and kurtosis values of  $< 3.29$ , as proposed by Kim (2013). Thus, appropriate transformations were conducted on these values. Following this, all measurements met with the necessary requirements for subsequent statistical tests, including assumptions of homogeneity and sphericity. Independent samples t-tests were run to establish any significant between-groups differences at pre-test, followed by two-way repeated measures ANOVAs conducted to indicate the presence of any significant interactions between condition and time-point for all dependent variables. Post-hoc analyses via paired samples t-tests were subsequently performed to investigate significant condition by time-point interactions.

Measure	Homogeneity		Sphericity	
	<i>F</i>	<i>p</i>	$\chi^2(2)$	<i>p</i>
<b>The Orientations to Happiness Scale</b>				
Meaning	1.25	.27	.093	.14
Pleasure	2.47	.12	.90	.09
<b>The Self-Regulation for Health Behaviour Questionnaire</b>				
Autonomous	2.50	.12	.77	.07
Controlled	0.34	.85	.51	.09
Amotivation	3.69	.61	.71	.81
<b>The Scale of Positive and Negative Experience</b>				
Positive Affect	0.04	.84	.54	.69
Negative Affect	3.59	.06	.63	.73
<b>The Health Risk Behaviour Index</b>				
Diet	0.33	.57	.52	.67
Physical Activity	3.21	.08	.72	.78
Smoking <sup>†</sup>	0.05	.82	.99	.76
Alcohol <sup>†</sup>	0.73	.40	.97	.38
<b>The Wellness Behaviours Inventory</b>	0.30	.86	.55	.69
<b>The Depression, Anxiety and Stress Scale-10</b>	0.05	.83	.98	.53
<b>The Satisfaction with Life Scale</b>	0.07	.79	.37	.61

Table 2. Indicators of homogeneity of variance (Levene's Test) and sphericity (Mauchly's Test) for dependent variables.

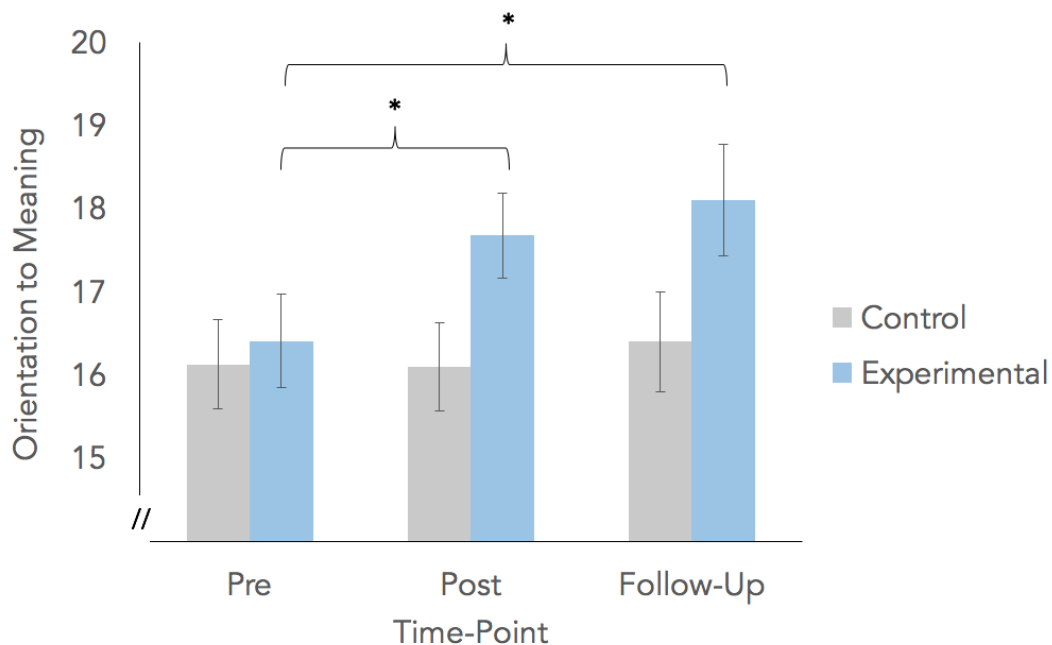
**Results: Study 1A**

No significant baseline differences were observed between experimental and control groups across average age of participants (experimental  $M = 20.33$  years,  $SD = 1.47$ ; control  $M = 20.93$  years,  $SD = 3.11$ ) or the average number of diary entries made across the course of the intervention (experimental  $M = 5.89$  entries,  $SD = 1.93$ ; control  $M = 6.03$  entries,  $SD = 1.56$ ). Equally, there were no significant between-groups differences in gender, income, religion or health goal status (Table 3).

	Experimental <sup>a</sup>	Control <sup>b</sup>		
	<i>N</i> (%)	<i>N</i> (%)	$\chi^2$	<i>p</i>
<b>Gender</b>			0.61	.43
Male	8(21.6)	9(30)		
Female	29(78.4)	70(21)		
<b>Health Goal</b>				
Improve Diet	26(70.3)	23(76.7)	0.07	.78
Increase Physical Activity	28(75.7)	21(30)	1.21	.27
Reduce Alcohol Intake	8(21.6)	3(10)	0.55	.46
Quit Smoking	4(8)	1(3.3)	3.45	.06
<b>Household Income</b>			3.07	.93
£6,000 - ≤£13,000	2(5.4)	2(6.7)		
>£13,000 - ≤£19,000	5(13.5)	3(10)		
>£19,000 - ≤£26,000	4(10.8)	3(10)		
>£26,000 - ≤£32,000	4(10.8)	2(6.7)		
>£32,000 - ≤£48,000	4(10.8)	6(20)		
>£48,000 - ≤£64,000	8(21.6)	5(16.7)		
>£64,000 - ≤£96,000	3(8.1)	5(16.7)		
£96,000+	4(10.8)	8(6.7)		
Not specified	3(8.1)	2(6.7)		
<b>Religion</b>			0.34	.31
Practicing	12(44.4)	12(46.2)		
Not Practicing	15(55.6)	14(53.8)		

Table 3. Between-groups differences and chi-square tests for categorical variables. Note <sup>a</sup> $n = 37$ , <sup>b</sup> $n = 30$ .

A significant interaction of time-point and condition was observed for participants' orientation to meaning,  $F(2,130) = 3.33$ ,  $p = .04$ ,  $\eta^2 = .005$ . This effect was driven by significant gains in the experimental group between pre- ( $M = 16.41$ ,  $SD = 3.42$ ) and post-test ( $M = 17.68$ ,  $SD = 3.09$ ;  $t = -3.39$ ,  $p = .002$ ,  $d = 0.4$ ), and pre-test to follow-up ( $M = 18.08$ ,  $SD = 4.09$ ;  $t = -3.09$ ,  $p = .004$ ,  $d = 0.39$ ). However, no significant differences were observed in the control condition between pre- ( $M = 16.13$ ,  $SD = 2.97$ ) and post-test ( $M = 16.1$ ,  $SD = 2.88$ ;  $t = 0.82$ ,  $p = .935$ ), or one-month follow-up ( $M = 16.4$ ,  $SD = 3.31$ ;  $t = -0.61$ ,  $p = .55$ ). These results are displayed in Figure 4.



*Figure 4. Mean values (and standard errors) for Orientation to Meaning by condition, across pre-, post-test and one-month follow-up. Note \* denotes statistical significance ( $\alpha = .05$ ).*

As shown in Figure 1, the mean ratings for participants' orientation to meaning significantly increase between pre- to post-test for experimental participants, but in the control condition remain stable over time. This result can be seen to increase at one-month follow-up, and demonstrate a small to moderate effect at both time-points. Additionally, participants' orientation to pleasure ratings indicated no main effect of time ( $F(2,130) = 0.77$ ,  $p = .467$ ,  $\eta^2 = .012$ ) or time by condition interaction ( $F(2,130) = 0.88$ ,  $p = .42$ ,  $\eta^2 = .013$ ).

A significant interaction between condition and time-point was observed for participants'

self-reported autonomous motivation for health behaviour,  $F(2,130) = 5.3$ ,  $p = .006$ ,  $\eta^2 = .08$ . This interaction was driven by significant gains in the experimental condition from pre- ( $M = 5.06$ ,  $SD = 1.2$ ) to post-test ( $M = 5.5$ ,  $SD = 1.14$ ;  $t = 3.0$ ,  $p = .005$ ,  $d = 0.4$ ), and pre- to follow-up ( $M = 5.7$ ,  $SD = 1.03$ ;  $t = 3.20$ ,  $p = .003$ ,  $d = 0.6$ ). No significant gains from baseline ( $M = 5.5$ ,  $SD = 0.93$ ) were observed amongst control participants, for data obtained immediately after ( $M = 5.6$ ,  $SD = 0.9$ ;  $t = -0.92$ ,  $p = .63$ ) or at one-month follow-up ( $M = 5.3$ ,  $SD = 1.01$ ;  $t = 0.91$ ,  $p = .37$ ). These results are displayed in Figure.5.

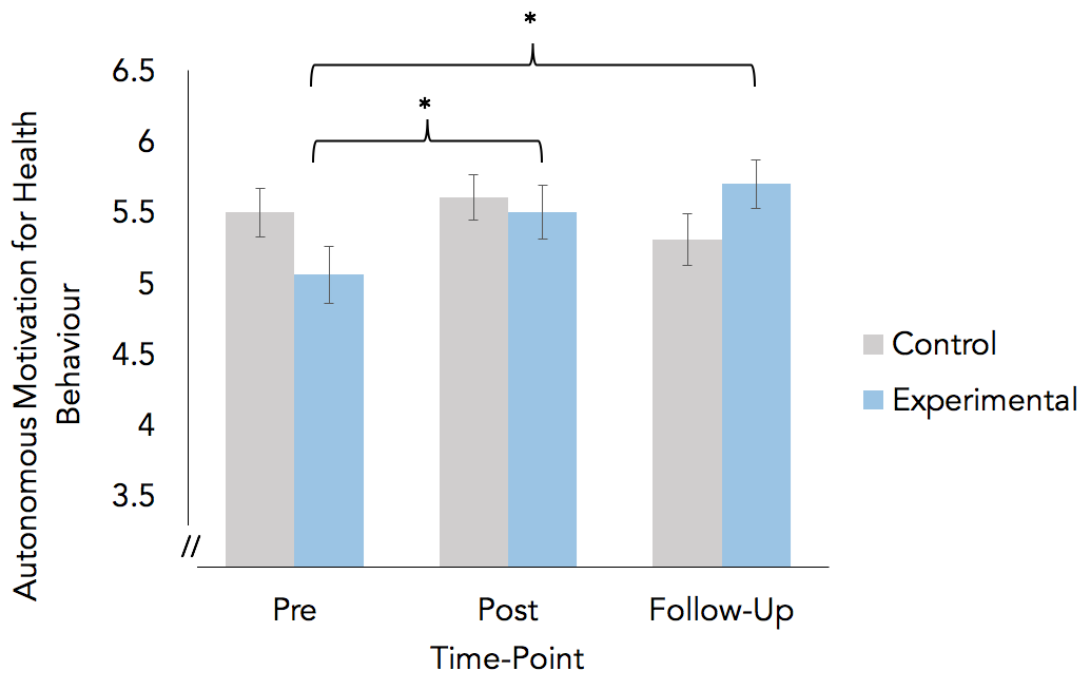


Figure.5 Mean values (and standard errors) for SRQ-Autonomous Motivation for Health Behaviour by condition across pre-, post- and one-month follow-up. Note \* denotes statistical significance ( $\alpha = .05$ ).

All other variables demonstrated no significant time by condition interaction across the three data collection points. The values for these tests can be observed in Table 4. Additionally, no statistically significant correlations between pre-post change for delay discount rate and meaning in life ( $r = .09$ ,  $p > .05$ ) or pre-post change for delay discount rate and health outcomes (autonomous motivation:  $r = .09$ ,  $p > .05$ ; WBI:  $r = -.15$ ,  $p > .05$ ; HRBI-Diet:  $r = .12$ ,  $p > .05$ ; HRBI-Activity:  $r = .16$ ,  $p > .05$ ) were observed. Pre-post change on the HRBI-smoking and -alcohol scales were significantly correlated with change in delay discount rate ( $r = .28$ ,  $p < .05$  and  $r = .36$ ,  $p < .005$  respectively), but not with change in meaning in life ( $r = .17$ ,  $p > .05$  and  $r = .02$ ,  $p > .05$  respectively). As such, no further testing regarding the mediatory influence of delay discounting was conducted.

Measure	<i>F</i>	<i>df</i>	<i>p</i>	$\eta^2$
<b>The Orientations to Happiness Scale</b>				
Meaning	3.33	2	.039*	.005
Pleasure	0.88	2	.420	.013
<b>The Self-Regulation for Health Behaviour Questionnaire</b>				
Autonomous	5.3	2	.006**	.075
Controlled	0.04	2	.701	.005
Amotivation	1.4		.249	.021
<b>The Scale of Positive and Negative Experience</b>				
Positive Affect	0.09	2	.912	.001
Negative Affect	1.63	2	.2	.024
<b>The Health Risk Behaviour Index</b>				
Diet	1.22	2	.3	.018
Physical Activity	1.27	2	.285	.019
Smoking <sup>†</sup>	0.25	2	.782	.004
Alcohol <sup>†</sup>	0.08	2	.923	.001
<b>The Wellness Behaviours Inventory</b>	0.48	2	.62	.007
<b>The Depression, Anxiety and Stress Scale-10</b>	1.16	2	.315	.018
<b>The Satisfaction with Life Scale</b>	0.92	2	.401	.014
<b>The 5-Trial Adjusting Delay Task</b>				
ED <sub>50</sub> <sup>†</sup>	0.24	1	.628	.003

Table 4. Two-Way Analysis of Variance (ANOVA) interactions between condition (control, experimental) and time-point (pre-, post-, one-month follow-up). Note \* denotes statistical significance ( $\alpha < .05$ ); \*\* denotes statistical significance ( $\alpha < .005$ ); <sup>†</sup> denotes Log<sub>10</sub> transformation.



### Discussion: Study 1A

A brief daily journaling intervention evoked reports of enhanced meaning in life, and autonomous motivation for health behaviour. These changes demonstrated small to medium effect sizes, were observed relative to a control group, and strengthened over the course of a further four weeks, supporting  $H_1$  and  $H_2$ . Augmented meaning was not accompanied by any decrement in pleasurable experience, indicating the strength of the intervention in promoting access to one form of wellbeing without degrading another. Equally, scores for autonomous motivation increased whilst those for controlled motivation remained stable, implying that the MIL journal facilitated an internalised desire to maintain strong physical health without exerting extrinsic pressure. However, participants did not demonstrate any significant change in either health-risk or wellness behaviour, and no change in delay discount rates was observed. This necessitates the rejection of  $H_{3a}$ ,  $H_{3b}$  and  $H_4$ .

Some theorists have argued the association between meaning and self-regulation is in fact moderated by positive mood (e.g. King et al., 2006). This proposition could explain the absence of behavioural change in the current research, given neither affectual nor behavioural responses were documented. Positive emotion frequently co-occurs alongside meaningful life evaluations and is implicated in a diminished desire to self-medicate in response to unpleasant sensation (Killgore & Yurgelun-Todd, 2006). However, the association between meaning and health remains robust whilst controlling for affect (Brassai et al., 2015; Holahan et al., 2011; Hooker & Masters, 2016; Zhang et al., 2015), and greater meaning is independently associated with proactive approaches to stress, such as problem focussed coping (Bartels & Urminsky, 2011; Zika & Chamberlain, 1992). Individuals who have a future time-perspective are also less likely to make impulsive choices irrespective of emotion (Hicks, Trent, Davis, & King, 2012). Collectively, these findings suggest greater life meaning may decrease myopic decision-making by promoting one's sensitivity to the future and capacity to tolerate negative affect, independently of positive emotion.

An alternative explanation, is that behavioural change occurred outside of participants' explicit awareness, and thus went undetected via self-report measurements. Indeed, a specific novelty of the current approach is to facilitate implicit health related responses to bypass the maladaptive impact of extrinsic pressure or psychological reactance on behaviour (Kirmayer, 1990; Pavey, Sparks, & Churchill, 2018; Rubak et al., 2005). The significant findings regarding autonomous

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health motivation demonstrate value in this strategy, and the use of pre-validated self-report assessments was logistically appropriate in the current research. However, as identified in Chapter 1 (see 7.3), one's underlying motivation can implicitly bias the salience of and response to environmental stimuli (Dubois et al., 2010; Kemps et al., 2014; Stockburger, Renner, Weike, Hamm, & Schupp, 2009). This suggests individuals may be conscious of their motivational status, but can remain unaware of subsequent consequences to behaviour. Broadly, some uncertainty exists regarding the degree to which self-report measures can capture a truly accurate image of health behaviour (Brener, Billy, & Grady, 2003) and when the influence of MIL upon physical activity has been assessed using both objective and subjective measurements, a notably stronger relationship exists when measured via accelerometer than via self-report questionnaire (Hooker & Masters, 2016). In alignment with these observations, a delay discounting procedure was employed in the current research to provide an implicit determinant of self-regulation. Some evidence supports the use of delay discounting paradigms in assessing one's capacity to self-regulate health behaviour (Bickel & Marsch, 2001; Critchfield & Kollins, 2001), and the brief nature of the 5-trial adjusting delay task was deemed valuable in the minimisation of fatigue effects during the present study. However, other work indicates domain-specificity in inter-temporal choice (Jimura et al., 2011; Tsukayama & Duckworth, 2010), therefore the use of an economic paradigm to assess health related impulsivity may have limited the detection of possible effects. An alternative strategy is to assess implicit variables which influence participants at an earlier stage in the decision-making process, such as attentional bias (Rettie et al., 2018).

A second explanation is that whilst experimental participants clearly obtained a greater desire to behave healthily during the intervention, further support was needed to translate this desire from intention to action. It is well established that skills, habits and environmental constraints influence behaviour in addition to pure intention (Fishbein, Hennessy, Yzer, & Douglas, 2003; Fogg, 2009; Walco & Risen, 2017). Whilst the indirect approach employed in the current study represents novel value to motivational and implicit factors, it remains necessary to acknowledge educational deficits and situational restriction as barriers to physical health. For example, poor access to facilities and skill deficiency are known impediments to exercise (Grunseit, Richards, & Merom, 2018; Scheerder, Breedveld, & Borgers, 2015) whilst lack of knowledge regarding nutrition and drink volume has been implicated in poor diet and alcohol misuse (Dickson-Spillmann & Siegrist, 2011; White et al., 2005).

**Strengths**

This study is the first to explore effects of experimentally induced meaning upon physical health outcomes, and compliments a small body of work which considers multiple noncommunicable diseases simultaneously, rather than addressing distinct behaviours in silo. Furthermore, the design and use of a brief daily journaling exercise to promote meaning in life and health behaviour represents a novel application of the positive health paradigm, and contributes to the existing body of literature on reflective practice.

Extensive pilot testing supported participants' comprehension and completion of their diaries, and the study sample size was appropriately informed by power analysis. Benefits of the experimental intervention demonstrated medium-sized effects, and were observed relative to pre-test and a neutral yet logistically similar exercise in the control group, ruling out the likelihood of placebo effects or between-groups differences at baseline. Data on participants' journal completion rate were also collected, and provide an objective index of engagement.

**Limitations**

The current sample was primarily comprised of young adult and female participants enrolled in higher education. Tools which promote the life meaning of this population are extremely valuable, given psychological distress is higher amongst university students than it is among the general population (Räsänen, Lappalainen, Muotka, Tolvanen, & Lappalainen, 2016) and can negatively impact healthy lifestyle behaviour (Stallman & Hurst, 2016). The MIL journal is designed to build psychological resources which enhance self-regulation and buffer against stress. These are also universal psychological mechanisms, and thus the present findings are encouraging in that they suggest a brief and light-touch intervention can successfully modify perceptions of life meaning and health motivation. However, it is also important to establish the practicability of this resource amongst other populations, and specifically those who demonstrate the greatest risk of NCD. The nature of life meaning is known to vary across the lifespan (Steger, Oishi, & Kashdan, 2009), and completing a daily writing task may be less accessible or appealing for individuals who are not so accustomed to this practice. Indeed, the participants in this study were incentivised to complete their diaries in return for course credit, and although the desire to seek happiness is fundamental and innate (Peterson et al., 2005) the current intervention requires self-motivated and regular albeit brief engagement with a written exercise.

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As discussed, the current work assessed health-behaviour via self-report questionnaire and a hypothetical monetary delay discounting task. Although logistically appropriate, these measures may not have effectively captured implicit behavioural change in the health-domain. As such, a second study was conducted to address these features, and is discussed forthwith.

Additionally, data on the contents of participants' journal entries were automatically collected by Sensemaker, yet not analysed. This protocol was decided upon in order to minimise the risk of demand characteristics. However, future work might wish investigate the nature of participants' reflection (e.g. activities listed) in order to glean further information regarding the mechanics of the intervention.

### Conclusions

Developing and evaluating tools which can be applied at the population-level to promote healthy lifestyle behaviour is essential in alleviating noncommunicable disease (Bloom et al., 2011). The positive health paradigm suggests eudaimonic forms of wellbeing, such as meaning in life, can enhance wellness activity. This is the first study to demonstrate induced meaning can promote autonomous motivation for health behaviour with small to medium effects, and provides a foundation for further research to explore the role of eudaimonic framing in physical wellbeing. Furthermore, the MIL journal did not evoke unintended negative consequences such as psychological reactance, controlled motivation or pleasure-seeking behaviour, which further implicates its value as an effective health promotion tool.

As discussed, the findings of study 1A are limited in terms of generalisability to other populations and the subjective measurement of physical health behaviour. In accordance with these observations, study 1B indexes health behaviour via attendance on a community-based exercise programme. Attendees also receive instructional support regarding their health literacy and environmental access to exercise, in order to investigate the translation of conscious intention to observable behaviour. Furthermore, the role of life meaning in alleviating socioeconomic health inequalities in noncommunicable disease is considered.

## Introduction: Study 1B

### Socioeconomic Deprivation and Self-Regulation

The behavioural antecedents of noncommunicable disease both precipitate and result from socioeconomic health inequalities (see Chapter 1: 1.5; 4.1.1.3; Pepper & Nettle, 2014) argue the subjective devaluation of long-term outcomes in socioeconomically deprived population-groups does not reflect an amplified failure of self-control, but instead a contextually appropriate response to impoverished environments. This is because those living in poverty often have less capacity to effect future outcomes as a product of their diminished wealth and influence, and because they face greater exposure to environmental hazards (Bolte et al., 2010; Shaw, Tunstall, & Dorling, 2005). As a result, socioeconomically deprived populations are less able to ensure returns on present investments are made, and to control their own likelihood of death or *extrinsic mortality risk*. Resultantly, affected individuals are less inclined to ensure positive long-term outcomes for a future they perceive as unpredictable, and are more motivated to capitalise upon options that can be enjoyed in the present (Pepper & Nettle, 2014).

A substantial evidence-base supports the assertion that socioeconomic deprivation can result in a decreased regard for the future. Low SES is associated with diminished perceived and actual control (Kiecolt, Hughes, & Keith, 2009; Lee, Ford, & Gramotnev, 2009; Lundberg, Bobak, Malyutina, Kristenson, & Pikhart, 2007; Whitehead et al., 2016) and greater exposure to hazards which degrade personal autonomy, such as violence and inadequate housing (Bolte et al., 2010; Shaw, Tunstall, & Dorling, 2005). Low SES communities also display decreased trust and social-cooperation (Drukker, Kaplan, Feron, & van Os, 2003; Schroeder, Pepper, & Nettle, 2014), which may further diminish confidence in the receipt of future reward, given patience is associated with social faith (Falk et al., 2015) whereas exposure to unreliable individuals is linked to impulsivity (Kidd, Palmeri, & Aslin, 2013; Michaelson, de la Vega, Chatham, & Munakata, 2013). Finally, immediate conditions of resource scarcity such as hunger are noted as a pervasive feature of deprived living, and directly drive the prioritisation of proximal rewards over the distal benefits of delayed choice (Nettle, 2017).

Evidence indicates a decreased regard for future outcomes can exert both automatic and reflective influences upon behaviour. For example, futurelessness describes how individuals consciously choose to pursue immediate rewards because they perceive future planning as

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unimportant and futile (Kidd et al., 2013; Michaelson et al., 2013). Equally, Nettle (2017) demonstrates imagining a positive future stimulates emotional experience which encourages delayed gratification, whilst prospection that features a dangerous or uncertain future exerts the opposite effect. Alternatively, cues which implicitly prime powerlessness and poverty increase impulsive behaviour (Dubois et al., 2010; Liu, Feng, Suo, Lee, & Li, 2012), whilst stimuli that imply greater control over future outcomes enhance restraint, irrespective of behavioural intention (Pepper & Nettle, 2014).

In the context of an unstable and unpredictable future, the decision to forego long-term rewards in order to capitalise upon immediate options makes rational sense. However, excessively engaging in NCD risk-behaviours nonetheless degrades quality of life (WHO, 2011). In addition, the early experience of deprivation can entrench impulsive attitudes, even when they are no longer adaptive in the current environment. For example, the ramifications of childhood events such as secondhand smoke exposure are irreversible (Pisinger, Hammer-Helmich, Andreasen, Jørgensen, & Glümer, 2012) and thus disincentivise the benefit of current healthy behaviour (Cochran & Tesser, 1996). Equally, the hardships of maternal disadvantage can manifest in poorer parenting, causing the intergenerational amplification of steep delay discounting tendencies irrespective of environmental change (Aizer & Currie, 2014). Myopic decision-making does not only impact physical health but may also degrade life satisfaction, given hedonistic pleasure is less strongly related to wellbeing than the long-term eudaimonic endeavour (Steger et al., 2008). Thus, in compliment with initiatives that tackle the environmental challenges of poverty, ameliorating the psychological response to deprivation is important for both happiness and health.

### **Meaning, Socioeconomic Deprivation and Health**

In accordance with the philosophy that poverty diminishes one's expectations rather than understanding of the future, enhancing life meaning may present a particularly effective method via which to resolve the socioeconomic patterning health inequalities. For example, greater life meaning may specifically address futurelessness by contextualising otherwise mundane behaviours within a global life goal. Indeed, the over-arching motivational framework provided by meaning in life stimulates goal identification and pursuit (Damon, 2008), and elevates the importance of everyday objectives (Kashdan & Mcknight, 2013; Steger et al., 2008). Understanding one's life meaning also helps individuals to better envisage a desired future (Machell, Disabato, & Kashdan 2016), and instils

a sense of hope and opportunity (May, 1975). Greater meaning may also buffer deprived individuals against the effects of environmental instability. Whilst socioeconomic deprivation is associated with a lack of control over future outcomes, the sense of coherence afforded by greater meaning supports the perception of consistency across life events (Damon et al., 2003), and is related to both a general and health specific internal locus of control (Ryff, 1989; Thompson, Coker, Krause, & Henry, 2003). Moreover, meaningful activity comprises behaviour which has beneficial impact beyond the immediate self (Martela et al., 2017). Engaging in prosocial behaviour can prompt reciprocal acts from others (Simpson & Willer, 2008), and promotes social trust (Putnam, 2000; Wakefield & Poland, 2005). Consequently, greater meaning may also reduce futurelessness by presenting an antidote to the decreased co-operation observed in low SES communities (Pepper & Nettle, 2014). Finally, meaning is considered to be a psychological asset which helps people endure life's hardships (Frankl, 1959). Those with a stronger orientation toward the future are more likely to employ problem-focussed coping (Holman & Zimbardo, 2009), enabling a greater tolerance of emotional difficulty (Kashdan & Kane, 2011). Inversely, primes which reduce the salience of future aspirations tend to evoke an aversion to ambivalent emotions (Hong & Lee, 2010), and reduced meaning in life is related to substance abuse (Harlow, Newcomb, & Bentler, 1986). An enhanced sense of meaning may therefore reduce the emotional impact of daily hassles faced by those living in poverty, and the desire to seek out emotionally pleasurable instant gratification as a result.

Prior research has documented an association between low income and purposelessness (Damon et al., 2003; Kaplan, Shema, Claudia, & Leite, 2008) suggesting that those most likely to benefit from a strong sense of meaning in life are paradoxically least likely to attain one. However, Machell, Disabato, and Kashdan (2016) recently indicate having greater purpose in life mitigates the effects of deprivation upon antisocial behaviour in adolescents. This suggests perceptions of meaning are not universally prevented by poverty, and that they serve as a resiliency factor when attained. Indeed, other work suggests financial capacity is not an essential prerequisite of meaning, and instead implicates psychological factors including self-awareness, gratitude and optimism as more important (Balthip, McSherry, Petchruschatachart, Piriyaakontorn, & Liamputtong, 2017). In combination with the finding that brief psychological manipulations can be used to alter impulsive tendencies (Dubois et al., 2010; Liu et al., 2012), these findings suggest promoting meaning amongst socioeconomically deprived populations is not only an important avenue for behavioural change, but also a feasible one.

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In summary, greater meaning in life may be a valuable strategy to address some maladaptive health outcomes of socioeconomic deprivation, and indirectly but powerfully influence behaviours which contribute to noncommunicable disease. However, no previous empirical work has specifically investigated this topic. Consequently, the current study aimed to enhance the life meaning of socioeconomically deprived participants using a modified version of the MIL introduced in study 1A. Hypotheses are as follows;

### **H<sub>1</sub> – Meaning in Life**

- a) Participants who complete a meaning in life journal will report significantly greater meaning in life at post-test, relative to participants who complete a control diary.

### **H<sub>2</sub> – Health Motivation**

- a) Participants who complete a meaning in life journal will report significantly greater autonomous motivation for health behaviour at post-test, relative to participants who complete a control diary.

### **H<sub>3</sub> – Health Behaviour**

- a) Participants who complete a meaning in life journal will report significantly decreased health-risk behaviour at post-test, relative to participants who complete a control diary.
- b) Participants who complete a meaning in life journal will demonstrate significantly greater attendance at a 10-week physical activity programme than participants who complete a control diary.

### **H<sub>4</sub> – Mediatory Variables**

- a) Relationships between meaning in life and health outcomes (motivation, behaviour) will be mediated by enhanced self-regulation, as indexed by consideration of future consequences.



## Method: Study 1B

### Participants

Participants were attendees of a community-based physical activity programme, recruited using an opportunity sampling procedure. Of the 100 individuals registered on the course, 61 people initially volunteered to take part in the research, and were randomly allocated to receive either a control (N = 30) or experimental (N = 31) diary, using an electronic code. Thirty-six percent of the original sample completed a post-test questionnaire distributed immediately after intervention, leaving a final sample of 22 participants ( $M^{\text{age}} = 41.27$  years;  $SD = 11.64$ ; 100% female; 13 control, 9 experimental). All participants gave fully informed consent and were offered the chance to win a £50 voucher as an incentive for completing both questionnaires. The study was approved by The Bangor University School of Psychology Research Ethics Committee (Application: #2016-15821).

### Design

A 2\*4 mixed measures design was employed, with condition (control, experimental) employed as a between-subjects variable, and time-point (pre-intervention, post-intervention) employed as a within-subjects variable.

### Materials

**The Meaning in Life Journal Version 2 (Appendix 4.3).** Participants in the experimental group were presented with an A4 paper booklet, containing an identical series of four questions repeated for a course of six days (Table 5). This second iteration of the MIL journal described in study 1A was also designed to support the identification of purposeful, significant and coherent life features. However, based on the observation that readability is a core component of effective health materials (Griffin, McKenna, & Tooth, 2003) and the format of *three good things* (Seligman et al., 2005), this version of the MIL utilised simplified language and fewer questions in order to create a more widely accessible resource.

**The Control Diary Version 2 (Appendix 4.4).** A revised control diary was designed to provide a neutral placebo tool. Over six days, participants responded to an identical series of three questions regarding the first event they had experienced on the morning of the current day (Table 5).

		Experimental	Control
		Meaning in Life Journal V2	Control Diary V2
1.	"Name one thing you did today that was hard, but made you feel good."	<i>This could be anything – big or small."</i>	"What was the first thing that happened when you woke up this morning?" <i>This could be anything – big or small."</i>
2.	"Why did you stick with it, even though it was hard?"		"What kind of place did this happen in?"
3.	"Why might this be important for other people?" <i>Your thing might be kind, inspire someone, share something good, or put you in a better place to help others.</i> <i>These people could be anyone from close friends and family, future generations, the wider community or total strangers."</i>		"What actions did this thing need?"
4.	"Why might this be important for you?" <i>It might have been a step towards bigger things you want to achieve in life, been a positive experience in some way, or taught you something new."</i>		"Who else might experience this kind of thing?"

Table 5. Questions and prompts of the experimental MIL journal version 2 and the control diary version 2.

**Physical Activity Programme.** The "Couch 2 5k" course is an established program, designed to support previously sedentary individuals in enhancing their level of fitness, over the course of 10 weeks. Participants attend weekly sessions overseen by coaches, and are advised to support their training by repeating each session a further two times before the following week (appendix 4.5). Each session involves a combination of walking and running, with the aim of completing a consistent 5km run at the end of the program. Participants are also provided with both information and social support regarding the attainment of general physical health. In the current study, this course was hosted by a running club local to the town of Llangefni, North Wales, and was advertised on community-based platforms such as social media groups and supermarkets. Llangefni is comprised of several locations that have been identified as areas of relative economic deprivation within Wales

(Welsh Government, 2014), and thus presented an appropriate location to recruit participants within a community of low socioeconomic status.

### **Psychometric Measures**

The categorical values for internal consistency across all scales are defined as follows: acceptable,  $\alpha < .7$ ; good,  $\alpha = < .8$ ; excellent,  $\alpha = .9$  (Kline, 2013). The OTH-Meaning subscale (Peterson, Park, & Seligman, 2005), the WBI (Sirois, 2001) and the TSRQ (Ryan & Connell, 1989) were employed in an identical fashion to that reported in Study 1a, in addition to two further scales described below.

#### **The Rosenberg Self-Esteem Scale (RSES, Rosenberg, 1979; Appendix 5.8)**

Participants' gave a personal assessment of their self-worth via the RSES, a 10-item measure comprised of five positively worded statements including "*On the whole I am satisfied with myself*" and five reverse scored statements, such as "*At times I think I am no good at all*". Individuals respond to statements using a four-point Likert system from 1 ("Strongly disagree") to 4 ("Strongly agree"), with higher overall scores representing greater self-esteem. The RSES has received more psychometric analysis and empirical validation than any other self-esteem measure, and demonstrates strong psychometric properties in a range of populations (Robins, Hendin, & Trzesniewski, 2001) and demonstrated excellent internal consistency ( $\alpha = .90$ ). Further, the RSES indicates convergent validity with measures of subjective well-being, including emotional affect as measured by the PANAS (PANAS-P  $r = .56$ , PANAS-N  $r = -.56$ , Robins et al., 2001), and global assessments of happiness, such as the Overall Life Satisfaction Scale (Campbell, 1976;  $r = .54$ , Robins et al., 2001). Additionally, the RSES shows sensitivity to cognitive factors which influence the development of self-esteem, including self-serving attributions as measured by Lefcourt, Von Baeyer, Ware, & Cox's (1979) Multidimensional-Multiattributational Causality Scale ( $r = .38$ , Robins et al., 2001).

#### **The Consideration of Future Consequences Scale-14 (CFC-14, Jaireman, Shaffer, Balliet, & Strathman, 2012; Appendix 5.9).**

The CFCS-14 assesses the extent to which people consider the distal consequences of their immediate actions, as well as the degree to which behaviour is influenced by this consideration. Participants use a seven-point Likert scale from 1 ("Not at all like you") to 7 ("Very much like you") in response to 14-items representative of two sub-constructs; future

(CFC-F), and immediate (CFC-I) concerns. The CFC-14 can be used as a unitary assessment of future consideration via reverse scoring the items associated with immediate concerns, or employed to calculate independent metrics for immediate and future considerations. Each subscale demonstrated excellent internal consistency (CFC-F  $\alpha = .80$ ; CFC-I  $\alpha = .84$ ), and the CFC-14 shows predictive validity regarding health promotion attitudes (CFC-F  $r = .43$ ; CFC-I  $r = -.25$ , Joireman et al., 2012). As a whole, the CFC also evidences construct validity, via associations with physical activity (Adams & Nettle, 2009), dietary control (Piko & Brassai, 2009), low body mass index (Adams & White, 2009) and vaccination use (Morison et al., 2010).

## **Behavioural Measures**

### **Physical Activity Participation**

Participants' commitment to the Couch 2 5k programme was assessed via calculating the number of sessions attended by each individual as a percentage of the total number available (10 sessions). Potential confounding variables were also recorded; at each measurement stage participants were asked to state the dates of any sessions they had been unable to attend due to injury, illness or unavoidable life commitments.

### **Demographic Information**

Participants were asked to provide basic demographic information regarding their age, gender and annual household income. In addition, participants were asked to state why they were interested in attending the Couch 2 5k program, whether they suffered from any injuries or health impairments which might impede their attendance over the duration of the course, and their current level of physical activity.

#### **Current Physical Activity**

Physical activity data were categorised according to the International Physical Activity Questionnaire scoring criteria (Craig et al., 2003), whereby "moderate" represents levels at either (a) 3 days of vigorous activity of at least 20 minutes/day; (b) 5 days of moderate-intensity activity or walking of >30 minutes/day for >10 minutes at a time; or (c) 5 days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving at least 600 minutes/week. "High" represents levels at either (a) vigorous-intensity activity on >3 days/week and accumulating at least 1500 minutes/week; or (b) >5 days of any combination

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of walking, moderate-intensity or vigorous intensity activities achieving at least 3000 minutes/week. “Low” physical activity levels are those that don’t meet either moderate nor high criteria.

### **Socioeconomic Status**

Individuals’ level of socioeconomic status was assessed using annual disposable household income. Mean disposable income levels in the UK are £34,200 (Office for National Statistics, 2015). Given the effects of SES on health primarily result from the lowest scoring categories, investigations of health disparity typically dichotomise assessments into categories of ‘low’ and ‘high’ SES groups (Werner, Malaspina, & Rabinowitz, 2007). Thus in the current study an income of less than £32,000 was classified as low SES.

### **Procedure**

A schematic for the procedure employed in this study can be viewed in Figure 6. Upon registration for the Couch 2 5k programme, all individuals gave fully-informed consent regarding their participation in the research and were directed to an online pre-test questionnaire. At the first physical Couch 2 5k session, participants were given a verbal description of the research, and were randomly allocated to the control or experimental condition using a double-blind design. All individuals were presented with a paper copy of the diary, and were informed that the content of these booklets would not be analysed unless they specifically volunteered to return them at the end of the study. Participants were instructed to make one entry per day for the next six days, and received daily reminders to do so via posts from the run coaches on a private Couch 2 5k Facebook page accessed by all participants. Seven days after the pre-test session, individuals were emailed a link to an online post-test questionnaire which included questions regarding basic demographic information. Participants were asked not to discuss their diaries with each other until the end of the Couch 2 5k course (9 weeks post intervention), at which point all individuals in the control condition also received an experimental diary and a full debrief was administered.

### **Data Analysis**

Initial analyses were run to ensure the data met the assumptions of testing via ANOVA according to the protocol described in study 1A. Scores for both the OTH-M and RSES demonstrated excessive negative skew and kurtosis and thus were log-transformed. Following this, all data met

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normality threshold values (Kim, 2013). Independent sample t-tests were conducted to establish any significant between-groups differences at baseline, and chi-square tests were employed to explore between-groups differences in categorical demographic variables. These were followed by two-way repeated measures ANOVAs to investigate effects of group upon measures of meaning, motivation, self-worth, time-perspective and course adherence.

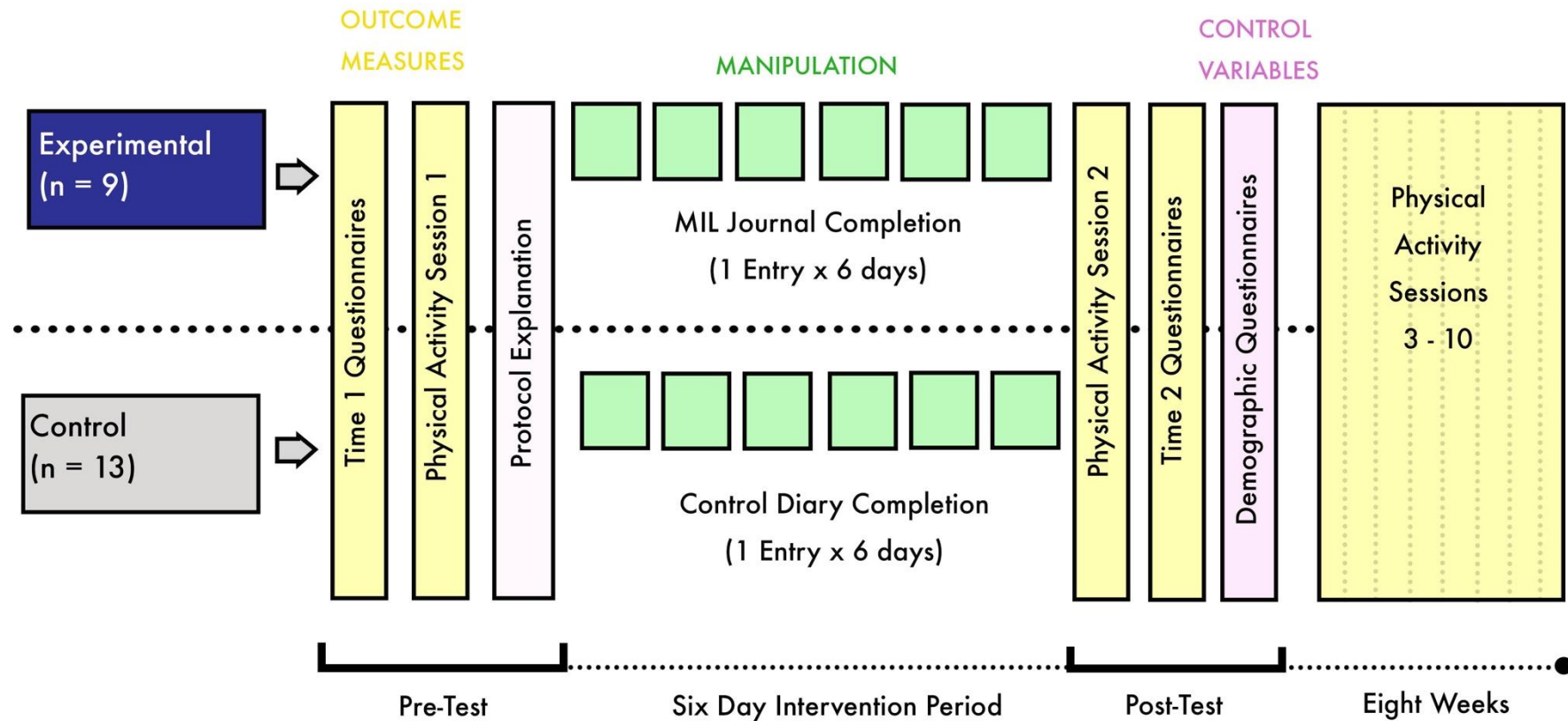


Figure 6. Schematic to depict procedure in study 1B.

**Results: Study 1B**

No significant between-groups differences in outcome measures were observed at baseline, or in participant age and number of diary entries (Table 5). Given the high levels of attrition observed in this study, comparisons of dependent variables at baseline were conducted between those who completed and did not complete the study. No significant differences were observed (Table 6). However, the number of mean diary entries across both conditions was low, with sixty-four percent of the sample completing one entry or less (experimental  $\leq 1$  entry = 44%; control  $\leq 1$  entry = 31%). Further, no significant differences in annual household income, health impairment or previous levels of physical activity between experimental and control participants were observed (Table 7). Forty-five percent of the sample reported an average gross annual household income below £32,000 (experimental = 78%; control = 77%). Testing via ANOVA indicated all variables met assumptions of homogeneity (autonomous motivation:  $F = .76$ ,  $p = .39$ ; meaning:  $F = .61$ ,  $p = .44$ ; self-worth:  $F = 2.16$ ,  $p = .16$ ; time-perspective:  $F = .38$ ,  $p = .55$ ). However no significant main effects, or group by time-point interactions were observed (Table 8), and as such no further analyses using these data were conducted.



	Control <sup>a</sup>	Experimental <sup>b</sup>	t	p
	M(SE)	M(SE)		
<b>Age</b>	43.15(2.66)	38.56(4.75)	0.91	.38
<b>Autonomous Motivation</b>	5.29(1.90)	5.99(0.99)	1.01	.32
<b>Meaning in Life<sup>†</sup></b>	1.18(0.11)	1.21(0.07)	0.28	.78
<b>Self-Worth<sup>†</sup></b>	1.47(0.84)	1.48(0.06)	0.05	.95
<b>Time Perspective</b>	25.23(2.91)	25.44(2.64)	0.43	.67
<b>Mean Diary Entries</b>	3.67(0.57)	3.13(0.77)	0.58	.57

Table 6. Mean, standard error and independent sample t-test values for continuous demographic and baseline data by condition. Note <sup>†</sup> denotes Log10 transformation; <sup>a</sup>n = 13, <sup>b</sup>n = 9.

	Completers <sup>c</sup>	Non-Completers <sup>d</sup>	t	p
	M(SE)	M(SE)		
<b>Autonomous Motivation</b>	6.11(1.90)	5.16(1.69)	0.25	.81
<b>Meaning in Life</b>	16.07(0.90)	16.53(0.61)	0.39	.69
<b>Self-Worth</b>	30.14(5.05)	29.68(0.92)	0.28	.79
<b>Time Perspective</b>	26.93(2.11)	24.63(1.21)	0.97	.34

Table 7. Mean, standard error and independent sample t-test values for continuous baseline data by completion. Note <sup>c</sup>n = 22, <sup>d</sup>n = 39.

	Control <sup>a</sup>	Experimental <sup>b</sup>	$\chi^2$	<i>p</i>
	N(%)	N(%)		
<b>Annual Household Income</b>			8.7	.27
£6,000 - ≤ £13,000	-	1(11.1)		
>£13,000 - ≤ £19,000	6(46.2)	2(22.2)		
>£19,000 - ≤ £26,000	-	1(11.1)		
>£26,000 - ≤ £32,000	-	2(22.2)		
>£32,000 - ≤ £48,000	4(30.8)	3(33.3)		
>£48,000 - ≤ £64,000	1(7.7)	-		
>£64,000 - ≤ £96,000	1(7.7)	-		
£96,000+	1(7.7)	-		
<b>Course Aims</b>			5.06	.41
Improve Fitness	6(46.2)	4(44.4)		
Improve Speed	-	1(11.1)		
Enter Events	1(7.7)	-		
Meet New People	1(7.7)	2(22.2)		
Not Specified	5(38.5)	2(22.2)		
<b>Health Impairment</b>			1.75	.42
Yes	1(7.7)	2(22.2)		
No	8(61.5)	6(66.7)		
Not Specified	4(30.8)	1(11.1)		
<b>Activity Levels</b>			4.03	.13
Moderate	3(23.1)	-		
Low	5(38.5)	7(77.8)		
Not Specified	5(38.5)	2(22.2)		

Table 8. Total count, condition percentage and chi-square values for categorical demographic data. Note <sup>a</sup>*n* = 13, <sup>b</sup>*n* = 9.

F	df	<i>p</i>	$\eta^2$	Change <i>d</i> <sup>†</sup>
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					Control	Experimental
<b>Autonomous Motivation</b>	0.04	1	.85	.002	.45	.0
<b>Meaning in Life<sup>†</sup></b>	1.26	1	.26	.07	.29	.64
<b>Self-Worth<sup>†</sup></b>	0.16	1	.7	.008	.0	.17
<b>Time Perspective</b>	0.01	1	.94	<.001	.05	.09

Table 9. Repeated measures ANOVA interactions between condition (control, experimental) and time-point (pre-, post-test). Note <sup>†</sup> denotes Log10 transformation and <sup>‡</sup> refers to effect size of change from pre- to post-test within each group.

Effects of diary condition upon participants' adherence to the course were assessed using the percentage participation metrics. No significant difference between adherence metrics for the

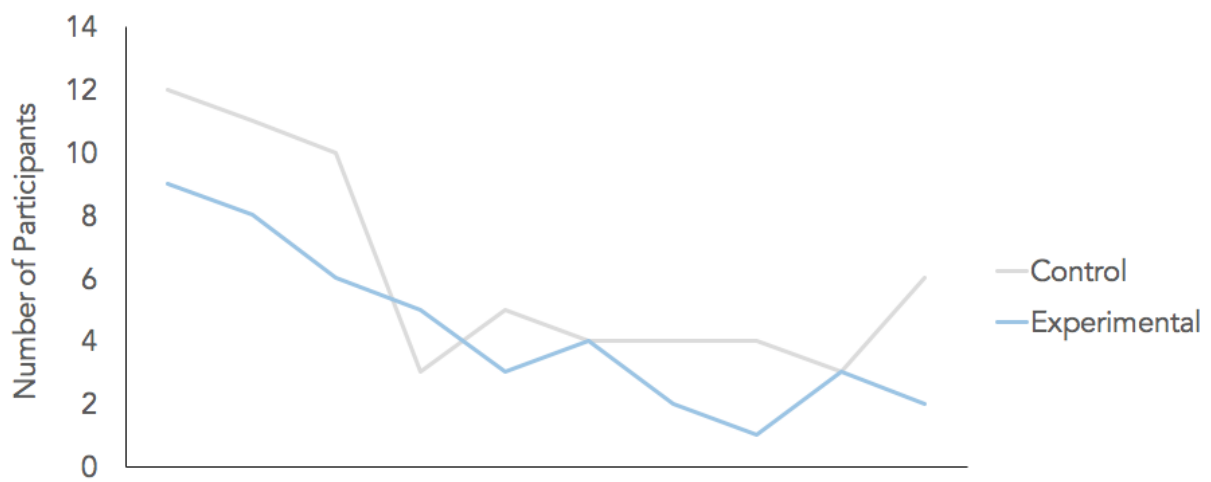


Figure 7. Weekly participant attendance metrics by condition.

control ( $M\% = 46.9$ ,  $SD = 29.2$ ) and experimental ( $M\% = 47.8$ ,  $SD = 23.9$ ) groups were revealed ( $t = 0.07$ ,  $p = .94$ ,  $d = 0.03$ ; Figure 7).

### Discussion: Study 1B

Study 1B aimed to investigate the use of a brief daily journaling intervention in enhancing the life meaning and autonomous health motivation of socioeconomically deprived participants. Secondary intentions were to examine intervention effects upon adherence to a community-based exercise programme, and the role of self-worth and time-perspective in this process. The MIL journal did not significantly enhance participants' sense of meaning and thus the relationship between meaning and health behaviour could not be assessed in greater detail. This necessitates the rejection of all hypotheses. However, the results presented here are inconclusive. Given the final sample size did not meet that determined by power analysis, one interpretation of the current findings is that a lack of statistical power impeded the detection of any significant effects. Alternatively, and given effect sizes were extremely small, it is also possible that the MIL manipulation in the present sample was ineffective due to issues of design. As such, this study should be treated as a feasibility study regarding the practical implementation of the MIL journal in an applied setting.

Principally, the current study highlights the importance of participant engagement in daily journaling. For example, sixty-four percent of the sample did not generate any diary entries, indicating issues regarding the accessibility or attractiveness of the MIL journal. Inspiring consistent engagement is an important mission for positive health practitioners, given individuals experience greater gains in wellbeing when they endorse and commit to intentional happiness activities (Lyubomirsky, Dickerhoof, Boehm, & Sheldon, 2011). It is possible participants in study 1B felt coercion to enact and record effortful events, and complimenting the MIL journal with methods of autonomy support may have alleviated this effect. For example, techniques such as presenting a rationale, offering choice, acknowledging participants' perspectives, and presenting feedback have all successfully supported the delivery of previous positive psychology interventions (Jackman & Macphee, 2017; Layous, Katherine Nelson, & Lyubomirsky, 2013; Nelson et al., 2014). Alternatively, other evidence has shown the manner in which participants access positive psychology interventions can impact their success, including one study which embedded a daily journaling exercise within an existing social medial platform (Munson, Lauterbach, Newman, & Resnick, 2010). This was observed to support adherence, by capitalising on a resource individuals were already using frequently. Disseminating multiple positive psychology exercises at once also appears to promote engagement (Schueller & Parks, 2012), possibly because it offers participants' greater variety and choice (Katz & Assor, 2007; Layous, Katherine Nelson, & Lyubomirsky, 2013). Consequently, future

work might employ such methods to enhance the practical applicability of the MIL journal, and generate further evidence regarding its effects.

### **Strengths**

The contextually appropriate response hypothesis presents a novel viewpoint on socioeconomic health inequalities. The current study aimed to integrate this insight with the positive health paradigm, and explore whether a brief daily journaling intervention could promote meaning in life and influence physical health outcomes in a community-based sample. This represents highly novel research, and utilised an objective assessment of physical health behaviour. Other measures were well validated, and effects were compared relative to baseline and a neutral yet logistically similar control. Whilst statistical underpower prevents the drawing of comprehensive conclusions, this study provides valuable insight into the realistic application of brief daily journaling interventions amongst applied settings, which few other empirical studies have addressed.

### **Limitations**

A significant and substantial limitation of this study is one of statistical underpower. A heavy attrition rate during the intervention stage resulted in an insufficient number of responses upon the completion of testing, which was dictated by time and resource constraints. Nevertheless, considerable difficulties in recruiting and retaining an appropriate sample imply the importance of features in the delivery of daily journaling interventions, which is valuable in guiding practical application and future research. Further work is necessary to determine if a revised implementation of the MIL journal amongst a similar population would produce significant effects.

### **Conclusions**

As discussed, firm conclusions regarding the efficacy of the MIL journal in the current context are difficult to draw, due to substantial statistical underpower. However, given the very small effect sizes observed, it is also possible a larger sample would fail to produce evidence of significant effect. Nevertheless, this study provides important insight regarding the implementation of brief daily journaling interventions in applied settings. Accordingly, the value of techniques to promote adherence and engagement with positive psychology interventions should be acknowledged in their practical use.

### General Discussion

This chapter explored the use of a brief daily journaling intervention to enhance the meaningfulness of life, and the effects of this induction upon health motivation and behaviour. Despite comprising a light-touch and brief exercise, daily journaling produced lasting increases in the life meaning and autonomous health motivation of young adults enrolled in higher education. These effects were not replicated in a community sample. This work represents the first examination of induced meaning in effecting health outcomes and indicates priority topics for future research.

In study 1A, effects of the MIL journal demonstrated at both post-test and one-month follow-up replicate those found in similar journaling interventions (Carter et al., 2016; Mongrain & Anselmo-Matthews, 2012; Peterson et al., 2005) and are suggestive of cognitive or behavioural habit formation. For example, given that the desire to experience meaning is noted as universal and fundamental (Frankl, 1959; George & Park, 2016) it is likely the MIL journal amplified a pre-existing need to engage in meaningful action or stimulated a reappraisal of how and why life is meaningful. Specifically, participants were required to cite challenging feats they had already achieved, which guided subsequent reflection. According to theories of self-perception and cognitive dissonance (Bem, 1972; Festinger, 1962) humans use past examples of their own behaviour to inform current attitudes. Therefore, recording previous examples of meaningful action may have enhanced participants' perceptions of themselves as a proponent of meaning, and facilitated the drawing of associations between their daily behaviour and higher-order life goals. Moreover, the autonomy with which individuals were able to select activities and construe them as meaningful may have strengthened this mechanism, given people are more likely to accept and internalise opinions which they have voiced themselves (Pelletier et al., 2001; Resnicow et al., 2012). Autonomy support is previously evidenced as an important factor in the wellbeing of participants invited to carry out prosocial behaviour (Nelson et al., 2014), suggesting feelings of autonomy may also be important for meaningful activity, which is inherently beneficent. Lastly, reflective journaling is generally considered to enhance greater self-awareness (Bolier et al., 2013; Carter et al., 2016) and thus it is possible the relatively unconstrained nature of the MIL journal prompted participants to consider the degree of congruency between core objectives and daily activities, within the context of their own life values.

Equally, the desire to populate the MIL journal each day may have biased participants'

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attention toward meaningful activities, eliciting greater behavioural engagement with long-term goals and beneficent events. As discussed in Chapter 1 (see 7.3), incentive sensitisation theory (Robinson & Berridge, 1993) describes how environmental stimuli that are associated with experiences of reward acquire conditioned incentive properties and become highly salient. In the present instance, participants' identification of events was rewarded via a tangible record of meaningful experience. This may lead to the cognitive prioritisation of stimuli which afford eudaimonic activity and prosocial behaviour. Such a mechanism parallels the approach of attentional modification programmes which reinforce individuals for directing attention toward or away from particular items (Fadardi & Cox, 2009), and have evidenced successful modification of bias and behaviour across mental and physical health (Blankers, Salemink, & Wiers, 2016; Boutelle et al., 2014; Browning et al., 2012; Hazen et al., 2009; Kemps, Tiggemann, Orr, & Grear, 2014). Given the desire for meaning is understood as a compelling drive (Steger et al., 2009), and that humans are naturally motivated to reinstate perceptions of meaning (Proulx & Heine, 2009), the MIL journal may bolster the salience, memory and behavioural engagement with environmental opportunities for meaning.

The current results suggest experiencing meaning on a regular basis may facilitate autonomous health motivation via enhancing the salience of long-term goals. This holds considerable value regarding the promotion of health behaviour, given autonomous motivation is substantially more resilient to the effects of time and cognitive depletion than controlled motivation (Deci & Ryan, 2000; Sheldon & Elliot, 1999; Vansteenkiste et al., 2008). Autonomous motivation is also associated with a number of positive health actions including frequent fruit and vegetable consumption, weight loss in the morbidly obese and adherence to medication regimens (Levesque et al., 2007; Williams et al., 1998; Williams, Grow, Freedman, Ryan, & Deci, 1996). The concept of meaning salience (Hooker et al., 2017) proposes meaning provides a critical link between abstract values and proximal behaviours, helping to support the perceived importance and consistency of self-regulation. In the present study, it is possible that meaningful reflection drove daily action toward eudaimonic and beneficent aspirations. Such action could directly encompass physical health behaviour, or physical wellbeing may be an essential factor in the realisation of an indirectly related goal. The current work indexed self-regulation via a hypothetical monetary delay discounting task in an attempt to capture impulsivity as a general tendency. However, due to the possibility of measurement error, further investigation should be conducted to establish conclusive support for the meaning salience model.

An alternative perspective is that meaning enhances one's self-esteem and promotes the inclination to 'take good care of oneself in terms of daily health practices' (Vazeou-Nieuwenhuis, 2018) and to prolong the overall life-span (Ryan & Deci, 2000; Sheldon & Elliot, 1999; Vansteenkiste et al., 2008). Reinterpreting past life events and engaging in prosocial behaviour promotes self-esteem (Meléndez Moral, Fortuna Terrero, Sales Galán, & Mayordomo Rodríguez, 2015; Van Tongeren, Green, Davis, Hook, & Hulse, 2016) and meaning-making interventions enhance the self-esteem of cancer patients (Lee, Cohen, Edgar, Laizner, & Gagnon, 2006). Self-esteem also moderates the relationship between meaning and impulsive online behaviour in university students (Zhang et al., 2015) and low self-esteem has been implicated in multiple noncommunicable disease risk behaviours (Jackman & Macphee, 2017; Wild, Flisher, Bhana, & Lombard, 2004). Conversely, high self-esteem supports regulation by exerting motivating properties and enhancing the capacity to cope with stress (Johnson, Panagioti, Bass, Ramsey, & Harrison, 2017). Further evidence suggests self-esteem promotes healthy behaviour by facilitating a more positive image of the future (Jackman & Macphee, 2017) and greater self-efficacy (Tafarodi & Swann, 1995). Experimental investigation of the relationship between meaning, self-worth and health behaviour is limited, and could not be explored more extensively in study 1B due to a lack of statistical power. Therefore, a greater consideration of this topic is a second valuable direction for future research.

The significant effects of study one were not replicated in study 1B. This finding could be explained by differences in demographic profile across the samples, however as previously stated precise conclusions cannot be drawn. The rationale for investigating the relationship between meaning and health in economically deprived populations is nonetheless sound, and the current study highlights difficulty in the practical implementation of daily journaling, with directions for future research.

### **Strengths**

Aligned with the perspective that greater MIL supports self-regulation by facilitating the salience of future goals, this study presents the first evidence of a relationship between manipulated meaning and positive physical health outcomes. Specifically, the presence of motivation to improve one's physical wellbeing is a crucial yet often overlooked component in health promotion initiatives, and autonomous motivation represents a powerful drive which is associated with committed and persistent behaviour. The current work successfully adapted a seminal positive psychology



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intervention for a sample of higher education students, however further work is required to evidence applicability at the population-level.

### Limitations

The results of the present study should be extrapolated with caution, given they are based on a primarily female, British sample of 67 university students. The predominant use of self-report measures also enhances the risk of results influenced by memory or social desirability biases. Attempts to employ a more complex sampling procedure and objective behavioural measurements in study 1B were largely unsuccessful, and therefore further research should aim to address these issues.

### Future Directions

Brief daily journaling interventions represent an effective tool in the promotion of population-level wellbeing, as evidenced by a growing body of research (Bolier et al., 2013; Carter et al., 2016; Mongrain & Anselmo-Matthews, 2012; Seligman et al., 2005; Vella-Brodrick, Park, & Peterson, 2009). As discussed, future work should investigate how regular reflection modifies psychological and behavioural processes, to establish the mechanistic factors which underly diary effects. Only one investigation has addressed this previously (Carter et al., 2016), aligned with the hypothesis that documenting the causal attributions of positive events lead to changes in one's attributional style. This work did not reveal any evidence of significant effect, and thus alternative studies could employ measures of attentional bias (e.g. dot-probe paradigms, Stroop tasks) to explore changes in the salience of environmental stimuli relevant to specific journaling interventions. Alternatively, experience-sampling methodologies could be used to monitor granular changes participants' daily activities, as an assessment of behavioural change evoked via brief daily journaling.

### Conclusions

The current investigation provides valuable knowledge regarding the creation and longitudinal manipulation of meaning. This work also adds support to theories of a causal relationship between meaning in life and health behaviour, and suggests that meaning can act as a valuable precursor to autonomous motivation. Whilst further investigation with a more diverse populous is needed to comprehensively validate the MIL journal, this intervention represents a promising brief, cost-effective and scalable resource for healthcare practitioners. Particular value

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could be derived from using the MIL journal in complement with initiatives that provide practical opportunities to engage in health behaviour. At present, brief daily journaling interventions represent an under-utilised tool in the physical health domain, and the current research demonstrates some evidence regarding the value of diary methodologies in enhancing self-awareness, motivation and well-being.

As discussed in Chapter 1, the effective self-regulation of behaviour requires high-quality motivation, engagement in goal-directed action, and avoidance of tempting distraction. The current section illustrates how one facet of eudaimonic wellbeing; meaning in life, can evoke autonomous motivation for physical health. Specifically, the meaning salience model (Hooker et al., 2017) implies those with greater life meaning have long-term goals which are more cognitively accessible. As a result, these individuals are more sensitive to the future consequences of immediate action and more willing to forego instant rewards in order to achieve distal benefits and longevity. Having greater meaning in life may also displace the seeking of pleasure via instant gratification, eliciting an implicit response to environmental cues. A brief and light-touch daily journaling exercise successfully modified participants' life meaning in one instance, however adherence to this intervention was problematic in study 1B. As such, Chapter 3 extends themes regarding future salience and self-regulation, however involves the use of priming to shape participants' consideration of distal scenarios, and immediate visceral reactions. This complements the current chapter by exploring implicit responses in healthy decision making and involves the investigation of two behaviours which protect against the development of noncommunicable disease; healthy dietary choice, and physical activity.

## Chapter Three

### **Reshaping the Future: The Influence of Psychological Distance on Eating Behaviour and Exercise Decisions.**

#### **Link to Thesis Objectives and Overarching Themes**

Eudaimonic framing directs attention to long-term objectives and away from hedonistic pursuits, helping to support self-regulation. This phenomenon is observed in both the meaning salience model, and *construal level theory*, which proposes the same event or object can be mentally represented according to two distinct categories. Concrete or ‘low-level’ construals are characterised according to transient, non-central and contextualized features (e.g. the process behind an activity; eating an apple). In contrast, abstract construals are associated with central, core and invariant features (e.g. the purpose behind an activity; nourishing the body). As such, abstract construals direct attention toward broad, high-level objectives and away from immediate visceral concerns, providing similar self-regulatory benefits to those derived from meaning in life. Implicit primes can be used to manipulate construal level, and therefore represent a method of evoking automatic responses to health-related cues. In this chapter, the role of construal priming in enhancing the efficacy of a pre-existing healthy eating intervention is assessed in study 2A. In study 2B, the carry-over effects of this manipulation upon physical effort decisions are investigated.

### Abstract

**Objective:** Behaviour aligned with abstract construals (high-level, core, invariant) typically represents eudaimonic activity (long-term goals) whereas concrete construals (low-level, transient, specific) are associated with hedonistic pursuits (short-term objectives). As such, construal level can dictate the cognitive accessibility of self-regulatory factors. This study involved a novel application of construal theory to enhance a pre-existing intervention (study 2A) and to motivate physical effort (study 2B).

**Design & Participants:** In study 2A conditions were: high-level episodic future thinking; low-level episodic future thinking; episodic recent thinking. In study 2B participants revisited high- or low-level primes generated in study 2A, or received no intervention (control). The study 2A sample comprised 86 participants ( $M^{\text{age}} = 20.8$  years,  $SD = 5.2$ ;  $M^{\text{BMI}} = 24.3$ ,  $SD = 4.07$ ; 73 female). The study 2B sample were 79 individuals ( $M^{\text{age}} = 20.63$ ,  $SD = 4.05$ , 72 female).

**Measures:** Key outcomes in study 2A were high- and low-calorie food intake and food characteristic weightings, as well as health motivation and behaviour self-reported at two-weeks post intervention. In study 2B, discrete choice of high-effort\*reward and low-effort\*reward options was assessed.

**Results:** In study 2A abstraction level was significantly lower for low- than high-level participants and was accompanied by greater high-calorie food consumption and higher sensory food characteristic ratings. In study 2B abstraction level was significantly greater for high- than low-level participants and associated with high effort\*reward choice.

**Conclusion:** Construing future food-choices in concrete terms enhances the sensory salience of high-calorie food characteristics and drives consumption. Construing physical effort in abstract terms enables greater effort mobilisation, possibly because abstract benefits subjectively reduce the perception of effort-related costs.

## Introduction

### Construal level Theory and Self-Regulation

The manner in which people think about immediate and delayed outcomes is one factor underlying NCD risk behaviour (Marteau et al., 2010). Construal level theory (CLT; Trope & Liberman, 2010) explains how the relative salience of these consequences can be differentially influenced by one's construal level mindset. According to this perspective, objects and concepts are mentally represented at multiple levels according to their psychological distance, defined as spatial, temporal, social or hypothetical remoteness from the self. Two distinct categories of construal entail the salience of different conceptual features as more or less pronounced. Abstract or 'high-level' construals are psychologically distant, and characterised by central, core and invariant features (such as the purpose behind an activity; e.g. securing one's home). In contrast, concrete or 'low-level' construals are psychologically close, and associated with transient, non-central and contextualized features (e.g. the process behind an activity; turning a key in a lock).

Research has demonstrated participants' judgments and decisions differ as a consequence of construal level, with critical relevance to eudaimonia and self-regulation. For example, abstract construals evoke a more consistent expression of core traits and values (Wakslak, Nussbaum, Liberman, & Trope, 2008), help people to appreciate the widely significant impact of their behaviour (Aknin, Van Boven, & Johnson-Graham, 2015) and provide a buffer to the emotional impact of negative feedback (Vess, Arndt, & Schlegel, 2011). Fujita and Han (2009) indicate high-level construals make it easier for people to implicitly associate temptations with negativity, and consequently promote self-control in terms of selecting apples over candy bars. Fujita, Trope, Liberman and Levin-Sagi (2006) show that high-level construals enhance physical endurance, decrease preference for immediate rewards, lead to more negative evaluations of self-regulatory disruptions, and promote the intention to exert self-control. Further research suggests high-level construals protect participants from ego-depletion (Agrawal & Wan, 2009; Schmeichel & Vohs, 2009), and elicit stronger commitment to prospective self-control strategies such as self-imposed punishment (Fujita & Roberts, 2010; Rogers & Bazerman, 2008).

Abstract construals are thought to support self-regulation by accentuating high-level and invariant outcomes, which are more closely related to long-term intentions. In this way, abstract construals represent a form of eudaimonic frame, because they direct attention to important life

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objectives and serve to facilitate proximal behaviours which align with these goals (Fujita & Roberts, 2010). In contrast, low-level construals enhance the salience of proximal results which are likely to undermine self-control. This represents a conceptual parallel to dual process descriptions of self-regulation (Metcalf & Mischel, 1999), whereby abstract construals reflect decisions aligned with rational interest, whilst concrete construals enhance visceral reactivity, and in turn impulsivity (Fujita et al., 2006).

### **Construal level Theory and Noncommunicable Disease**

Given abstract construals draw attention to high-level features and away from low-level concerns in all object representations, they represent a method of engendering healthy action across multiple behaviours (Fujita et al., 2006). As discussed in Chapter 1 (see 1.5), evidence suggests treating multiple NCD-risk behaviours simultaneously is more likely to achieve success than targeting independent factors in isolation (Arena et al., 2017; Schutz et al., 2014; Wilson et al., 2017). As such, developing interventions which address multiple health-risk behaviours is an important goal in the promotion of population health. In particular, diet and physical inactivity are most relevant to collectively address, because they are the modifiable risk-factors which most frequently co-occur (Meader et al., 2016) and directly impact the same outcome of body weight maintenance (Schutz et al., 2014). Dietary choice and activity levels also underly the development of obesity, which is implicated as a causal factor in many other forms of noncommunicable disease (Boutelle et al., 2014), and is a global epidemic (WHO, 2014).

The concept of reinforcement pathology provides further detail on the role of impulsive processes across multiple health-risk behaviours, and suggests high incentive reinforcement (the extent to which stimuli are rewarding) and steep delay discounting interact to promote unhealthy choice and noncommunicable disease (Carr, Oluyomi Daniel, Lin, & Epstein, 2011). For example, those who find appetitive food highly compelling, exercise highly aversive, and frequently discount their future health in favour of immediate gratification, are most likely document excessive energy intake, and to become obese (Carr et al., 2011.; Bonnelle et al., 2015; Carr, Lin, Fletcher, & Epstein, 2014; Manwaring et al., 2011). Consequently, interventions which shift attention away from proximal concerns regarding food or effort, and toward the long-term benefits of balanced energy consumption, can facilitate a reduction in multiple forms of NCD. Aligned with the perspective that abstract construals enhance the salience of higher-order considerations across all object

representations (Trope & Liberman, 2010), this chapter explores the application of construal level theory to enhance an existing healthy-eating intervention (study 2A) as well as the carry-over effects of this manipulation to exercise-related decisions (study 2B).

### **Introduction: Study 2A**

#### **Episodic Future Thinking: Introduction and Underlying Mechanisms**

One technique which has previously been used to alter temporal decision-making is episodic future thinking (EFT; Atance & Neill, 2001). EFT involves the pre-experience of a specific future scenario via mentally projecting oneself forward in time. Often, guided imagery is used to support this process whereby an external source such as an audio tape is used to relay sequential instructions (eg. Assagioli, 1974). Numerous experiments have documented the effectiveness of EFT in promoting eating-related self-control in obese and non-obese populations (Dassen et al., 2016), and in other forms of health-related consumption, such as alcohol use (Snider, LaConte, & Bickel, 2016). These effects are robust across age groups (Daniel, Said, Stanton, & Epstein, 2015; Daniel, Stanton, & Epstein, 2013; Schacter, Benoit, & Szpunar, 2017) and observed in both laboratory (Wu, Cheng, & Chiou, 2017) and field-settings (O'Neill et al., 2016), including a successful behavioural weight loss intervention (Sze, Daniel, Kilanowski, Collins, & Epstein, 2015). Further, EFT confers the greatest benefit for those who are typically least likely to consider the future consequences of their actions (Benoit, Gilbert, and Burgess, 2011), a factor strongly implicated in the development of numerous lifestyle related health conditions (Adams & Nettle, 2009; Visser & Hirsch, 2013), and socioeconomic health inequalities (Adams & White, 2009).

Typically, the benefits of EFT are explained in terms of the calibration model (Boyer, 2008), which proposes mental time travel provides a counter-motivation to temporal discounting tendencies. According to this perspective, future prospection disrupts impulsive goal-pursuit via activating affectual circuitry, which in turn redirects choice. For example, prospective courses of action that present short-term gain (e.g. steal from an old lady) but long-term detriment (e.g. legal prosecution) are influenced by the ability to pre-experience a remembered emotional response (eg. guilt), which exerts an immediate effect on behaviour (Boyer, 2008). A similar process is naturalistically observed by Loomes and Sugden, (1982), who indicate the anticipation of regret serves to prevent excessive risk-taking by enhancing the salience of future consequences. Whilst in some individuals this process transpires spontaneously (Peters & Büchel, 2010), providing EFT

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training for those who present impulsive behaviour is considered an effective method to attenuate discount rate (Palombo, Keane, & Verfaellie, 2016).

Further evidence indicates mental time travel influences the subjective valuation of reward. For example, EFT elicits edited value signal processing in the anterior cingulate cortex (Chudasama et al., 2013; De Martino, Kumaran, Seymour, & Dolan, 2006; Peters & Büchel, 2010), which suggests immediate emotions experienced as a result of EFT alter the relative salience of intertemporal options. This observation is consistent with reports that the representation of reward magnitude mediates the impact of episodic prospection on choice (Benoit et al., 2011), and that the effects of EFT upon temporal discounting are nullified when prospective emotion is removed (Zhang, Peng, Qin, Suo, & Feng, 2018). Alternative explanations regarding the mechanistic role of reward certainty in mental time travel have been discredited (Peters & Büchel, 2010), implying that perceptions regarding the enhanced probability of reward receipt are not responsible for the effects of EFT. Instead, mental time travel is thought to enable self-restraint via evoking immediate emotional experience that modifies the relative value of distal outcomes.

### **Episodic Future Thinking: Current Perspectives and Novel Directions**

Consistent with the perspective that mental time travel influences decision-making via an emotional simulation of the future, much prior research has emphasised the realism of this experience. Specifically, EFT with vivid mental imagery is considered highly potent as it most closely approximates reality (Tulving, 2002), and thus exerts the strongest influence upon emotional and physiological response (Cuthbert & Lang, 1989; Laor et al., 1999). Accordingly, prior EFT inductions have emphasised facilitators of vivid mental imagery, such as positive valence, temporal proximity and contextual familiarity (Arnold, McDermott, & Szpunar, 2011; D'Argembeau & Van der Linden, 2004; Szpunar & McDermott, 2008). However, a potentially important yet under-explored component regarding the efficacy of EFT is the goal-related contents of future prospection. Whilst one individual might imagine enjoying a delicious future meal in order to resist an appetitive snack in the present, a second person might employ EFT which features alternative outcomes of restrained choice, such as good cardiovascular health. Importantly, whilst both simulations bias attention toward a future reward, the appetitive qualities of the stimulus in the former example elicit immediate excitatory emotion, which prompts impulsive behaviour (Loewenstein, 1996; Metcalfe & Mischel, 1999). Indeed, reducing the influence of visceral responses that are inconsistent with



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longitudinally adaptive choice upon one's preferences and decisions is considered fundamental to effective self-control (Fujita et al., 2006). Consequently, an essential consideration of EFT is not only to encourage thought about the future, but also the precise form that such prospection takes.

This perspective is supported by the finding that unhealthy eaters tend to focus on the immediate consequences of consumption, in comparison to healthy eaters who concentrate upon future health benefits (Dassen, Houben, & Jansen, 2015), which in turn predicts body mass index (BMI; Adams & Nettle, 2009). The identification of appropriate future objectives also determines the degree to which individuals are able to engage in mental time travel (Arnold, McDermott, & Szpunar, 2011b; D'Argembeau, Ortoleva, Jumentier, & Van der Linden, 2010), and influences the realism and thus the emotional impact of prospection. For example, D'Argembeau and Van der Linden (2012) demonstrate imagining a future which holds greater relevance to one's personal goals is an important predictor of realistic EFT. This is supported by the finding that goal-congruent and self-related events are associated with stronger sense of mental time travel than other-related or experimenter provided thoughts, irrespective of vividness (de Vito, Gamboz, & Brandimonte, 2012; Lehner & D'Argembeau, 2016). Some evidence also demonstrates individuals who report high trait-impulsivity record vivid experiences of the past and future (Arnold et al., 2011), suggesting steep temporal discounting may not be driven by deficits in the ability to generate vivid mental time travel, but to identify future incentives which guide adaptive choice in the present.

### **Shaping the Contents of Episodic Future Thinking**

Importantly, the emotion-imbued choice model (Figure 8; Lerner, Li, Valdesolo, & Kassam, 2015) suggests environmental influences at the point of decision-making can shape the contents and salience of reward-related expectancies. According to this perspective, thought about the future not only impact the experience of current emotion, but incidental influences, (e.g. the weather, a good mood) impact current emotion to dictate future thought (Figure 8, lines H and I). As such, immediate factors in the environment can dictate what people picture when they engage in future prospection, as well as the perceived importance of these events.

Construal level priming represents an incidental influence which can be used to shape future expectations that promote self-regulation. As discussed, abstract construals enhance the cognitive accessibility and salience of superordinate objectives, whilst concrete construals accentuate proximal concerns. Consequently, abstract construal primes

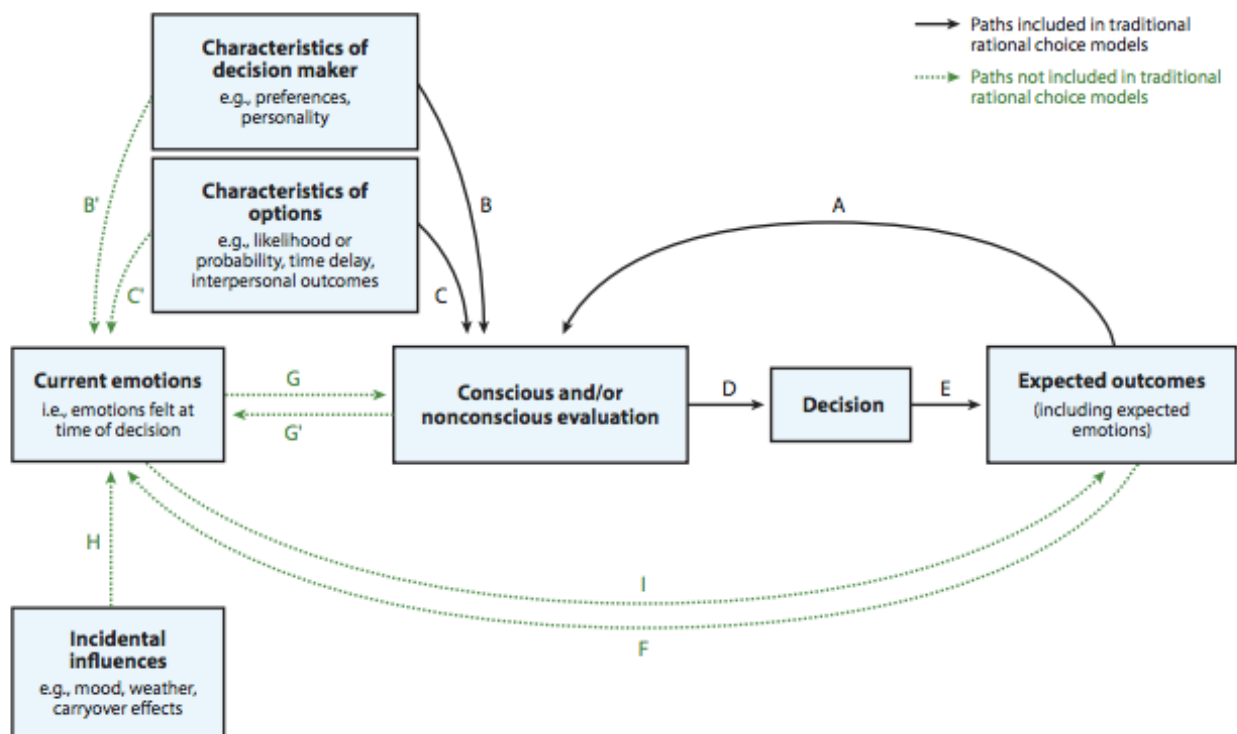


Figure 8. The Emotion Imbued Choice Model (Lerner, Li, Valdesolo & Kassam, 2015).

should support the identification and appeal of goals which are aligned with long-term intentions, and can therefore be used to optimise EFT. In contrast, concrete construals should accentuate the cognitive accessibility and reinforcing properties of low-level considerations, and drive unhealthy choice.

Complimenting EFT with construal level priming offers several core benefits. Firstly, research has shown it is possible to implicitly evoke a particular construal mindset (Smith & Branscombe, 1987), thus bypassing the need for conscious deliberation in identifying adaptive future goals. These findings implicate construal-priming as an effective method via which to support low-effort goal-identification for those whom future sensitivity is atypical or difficult, in combination with evidence that suggests abstract construals enhance the degree to which individuals wish to exert self-control (Fujita & Carnevale, 2012; Fujita et al., 2006) and promote the enjoyment of restrained choice (Borovoi, Rezlescu, & Vlaev, 2017). In addition, construal primes may represent particular value for individuals whom concrete planning creates emotional distress (Townsend & Liu, 2012). This phenomenon typically occurs in populations who perceive substantial distance between their

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current standing and an identified goal, described as poor goal standing. However, equivalent anxiety does not occur when individuals in poor goal standing are asked to make abstract plans for the future. Furthermore, abstract construals enable participants to meaningfully embed future situations within their own life context, which is considered an important aspect of effective mental time travel (Lehner & D'Argembeau, 2016). As a consequence, the introduction of construal-priming to support EFT may not only provide a mechanism via which to effectively shape the contents of mental prospection, but also evoke a more compelling and eudaimonic experience.

### Summary and Aims

Collectively, these observations suggest the selection and contextualisation of goals as an important component of enhancing healthy decision-making via future prospection. The currently unconstrained nature of EFT instructions allow participants to generate a variety of potential future scenes, however the current research proposes individual differences in goal selection may determine the efficacy of mental prospection. A lack of prior investigation in this area perhaps results from the utilisation of economic discounting paradigms to explore EFT (e.g. Daniel et al., 2013; Peters & Büchel, 2010; Sze et al., 2017). General tendencies of impulsivity are implicated in the development of multiple lifestyle driven diseases, and are frequently indexed via delay discounting (Green & Myerson, 2013). However, a critical distinction exists between healthy-eating and healthy economics. Whilst adaptive financial choice involves restraining the immediate impulse to select a smaller value of money in pursuit of an economic windfall later on, healthy food selection requires the consideration of restrained distal benefits outside of the eating domain. Indeed, theories of reinforcement pathology also implicate reward sensitivity in unhealthy decision-making, independently of temporal discounting processes (Bickel, Jarmolowicz, MacKillop, et al., 2012; Lawyer & Schoepflin, 2013). Therefore, whilst delay discounting paradigms capture one component of impulsivity, it is also important to consider how the salience of distinct rewards will differentially impact health behaviour.

### Development upon Prior Work

The current study develops the pre-existing literature base in a number of ways. Firstly, no previous investigations have employed an objective manipulation check of construal priming. This is important because most studies employ EFT as an experimental manipulation in comparison to an ostensible control exercise known as episodic recent thinking (ERT; Daniel et al., 2015; O'Neill et al.,

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2016; Daniel et al., 2013; Snider et al., 2016; Sze et al., 2017). This task instructs participants to visualise recent past events they have enjoyed and can vividly remember (Sze et al., 2017). However, ERT has been shown to influence temporal discounting (Daniel, Sawyer, Dong, Bickel, & Epstein, 2016), and therefore may not represent an effectively neutral control. Indeed, whilst EFT is naturally more likely to generate abstract construal, the psychological proximity in ERT is more closely associated with concrete thought. Fortuitously, recent technological developments provide the foundation for more rigorous assessments of construal level to be made. The linguistic category model (LCM, Semin & Fiedler, 1991) has previously been applied to assess construal level (Seih, Beier, & Pennebaker, 2017), and proposes that the extent to which individuals use different linguistic categories represents how abstractly they view the world. Specifically, adjectives and nouns are considered the most abstract linguistic forms, followed by three types of verbs. These are, in order of abstraction; state verbs (emotional or mental states without a clear timescale; *admire*), interpretative action verbs (general behaviours which share a physically invariant feature; *help*) and descriptive action verbs (observable actions with a clear timescale; *walk*). However, the use of the LCM in assessing construal level has previously relied upon human judgement, presenting significant cognitive load and the risk of subjective error (Seih et al., 2017). As an alternative, the current research capitalises upon a recent embedding of the LCM within pre-validated computerised text analysis software (LIWC, Pennebaker, Francis, & Booth, 2001) to enable a non-invasive and objective manipulation check. This methodology helps to instil confidence in the validity of the experimental findings, without amplifying, undoing or interacting with the effects of the manipulation itself (Hauser, Ellsworth, & Gonzalez, 2018).

Furthermore, many prior investigations of lab-based food consumption have employed the bogus taste test paradigm (Robinson et al., 2017), whereby participants are presented with one or more foods and accompanying rating scales, and are led to believe that the purpose of the task is to assess their food liking. In reality, the aim of this test is to assess individual differences in ad libitum food intake, by unobtrusively subtracting the post-test food weight from pre-test food values. The bogus taste test has been widely used to investigate the influence of factors that may have a causal effect on dietary consumption, and is considered particularly valuable because it provides an objective, low cost measurement of laboratory calorie consumption and reduces the impact of demand characteristics on eating behaviour (Gibbons, Finlayson, Dalton, Caudwell, & Blundell, 2014). However, the current study introduces the first investigation to determine the effects of EFT manipulations regarding the consumption of both high and low caloric foods. This is important, as

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the distinction between health-risk and wellness behaviour (Vickers et al., 1990) suggests distinct processes may contribute to the consumption of calorie-dense foods associated with poor health, and more nutritious fare that promotes functioning. Participants in the current study were presented with foods segmented into two categories; high-calorie, nutrient poor and low-calorie, nutrient rich. The high-calorie options include items that are commonly perceived as unhealthy and are highly processed, whereas the low-calorie options are generally considered to provide recommended nutrient levels without exceeding energy allowance (Drewnowski, 2005). Aligned with the perspective that current excitatory emotion can prompt impulsive behaviour (Loewenstein, 1996) and in light of evidence which suggests highly palatable food cues evoke greater arousal than less palatable options (Roefs, Herman, MacLeod, Smulders, & Jansen, 2005), EFT which is shaped by low-level priming is expected to amplify high-calorie food salience and increase intake. Conversely, the desire to consume nutrient-rich food is congruent with long-term health. Thus, EFT which is shaped by high-level priming should increase low-calorie and nutrient rich food intake.

Lastly, prior work has speculated that a single EFT experience may activate prospective thinking across the day, and that these effects may be particularly potent should users feel EFT has facilitated adaptive decision-making (Sze et al., 2017). This suggests that EFT may work as a consistent strategy for individuals to consciously employ in the self-regulation of behaviour. However, no previous studies have empirically explored the durability of EFT effects, thus rendering the long-term efficacy and most appropriate ‘dosage’ of mental prospection as unknown. Consequently the present work provides a novel contribution regarding the longitudinal influence of EFT, by assessing self-reported health motivation and behaviour at two-weeks post-intervention. Hypotheses are as follows;

### **H<sub>1</sub> – Food Intake**

- a) Participants who engage in high-level EFT will consume significantly less high calorie food than participants who engage in low-level EFT and ERT participants.
- b) Participants who engage in high-level EFT will consume significantly more low-calorie food than participants who engage in low-level EFT and ERT participants.

### **H<sub>2</sub> – Abstract & Concrete Considerations**

- a) Concrete considerations will be rated as significantly more salient and important by

participants primed with low-level EFT than high-level EFT or ERT participants.

b) Abstract considerations will be rated as significantly more salient and important by participants primed with high-level EFT than low-level EFT or ERT participants.

### **H<sub>3</sub> – Mediatory Relationships**

a) Enhanced salience of abstract considerations will decrease high-calorie food intake and increase low-calorie food intake.

b) Enhanced salience of concrete considerations will increase high-calorie food intake and decrease low-calorie food intake.

In summary, whilst EFT currently presents an effective intervention with which to ameliorate the effects of steep temporal discounting and promote healthy-eating behaviour, further evidence suggests the current paradigm may not be optimally effective for all populations. Furthermore, pre-existing evidence utilising ERT as an ostensible control may be confounded by measurement error. The current work utilises novel and robust methodology to assess the role of construal-priming in promoting more effective EFT manipulations, as well as presenting the first investigation to consider the impact this induction on both high- and low-calorie food choice, and longitudinal outcomes. This represents a further application of the positive health paradigm in motivating healthy lifestyle behaviour, and specifically utilises construal priming; a technique which involves eudaimonic framing and is universally relevant in human psychology. Such investigation enables a more nuanced understanding regarding the role of construal primes in applied future prospection and health behaviour.

## **Method: Study 2A**

### **Participants**

An a priori power analysis conducted using G\*Power 3 (Faul et al., 2007) indicated that the data from 90 participants would provide sufficient power to achieve significance at the 80% level, employing the  $p = .05$  criterion. An additional parameter was an estimated effect size of  $d = 0.7$ , as suggested by the findings of similar, relevant investigations (Borovoi et al., 2017; Daniel et al., 2015; Daniel et al., 2013). A total of 95 participants responded to an advert designed to attract those

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motivated to improve their healthy eating behaviour (Appendix 6.3), hosted on the Bangor University participant pool. In order to avoid any between-groups differences in baseline hunger, all participants were instructed to refrain from consuming any food or liquids other than water in the four hours immediately preceding the experiment. The sample gave written consent after completing a screening questionnaire (Appendix 5.10) used to exclude participants who indicated caseness for an eating disorders ( $n = 0$ ), had specific dietary requirements meaning they could not take part in the taste test ( $n = 2$ ), or who had not adhered to the fasting criteria ( $n = 7$ ). This left a final sample of 86 participants ( $M^{\text{age}} = 20.8$  years,  $SD = 5.2$ ;  $M^{\text{BMI}} = 24.3$ ,  $SD = 4.07$ ; 73 female) who were compensated for their time with partial course credit. The study was awarded full approval from the Bangor University School of Psychology Research Ethics Committee (Application: #2018-16252).

### Design

Three between-group manipulations (high-level EFT, low-level EFT, ERT) were employed at two time-points (baseline, two-week follow-up). Objective and self-reported health behaviour assessments were also taken at both time-points, and investigated within subjects.

### Materials

In both EFT groups, participants were asked to take part in a construal prime task, followed by EFT guided imagery. Those in the ERT condition completed a task which was designed to replicate the cognitive effort of the EFT groups, but to have no influence upon construal mindset. Following this, ERT participants participated in ERT guided imagery.

### The Construal Prime Materials

An adapted version of the construal prime task devised by Freitas, Gollwitzer, & Trope (2004) was used to shape the EFT inductions (Figure 9). Here, participants were required to complete a written representation of “why” (high-level condition; Appendix 4.6) or “how” (low-level condition; Appendix 4.7) they would *“have or maintain a healthy diet”*. Participants were asked to systematically list statements in a series of five boxes, whereby the content of each box explained the reasons or actions outlined in the previous statement. In the ERT condition, participants listed events they had experienced over the previous day, in response to the prompt *“woke up at:....”*. This manipulation was designed to provide a context which could feature a similar number of diet-related

events to those considered in the experimental prime conditions, but with no behavioural-change direction, for example, “*I had lunch*” (ERT condition) compared with “*I will avoid the snack aisle*” (low-level condition). Next, participants were asked to summarise their written content in order to generate a construal (high- and low-level conditions) or reconstruction (ERT condition) statement.

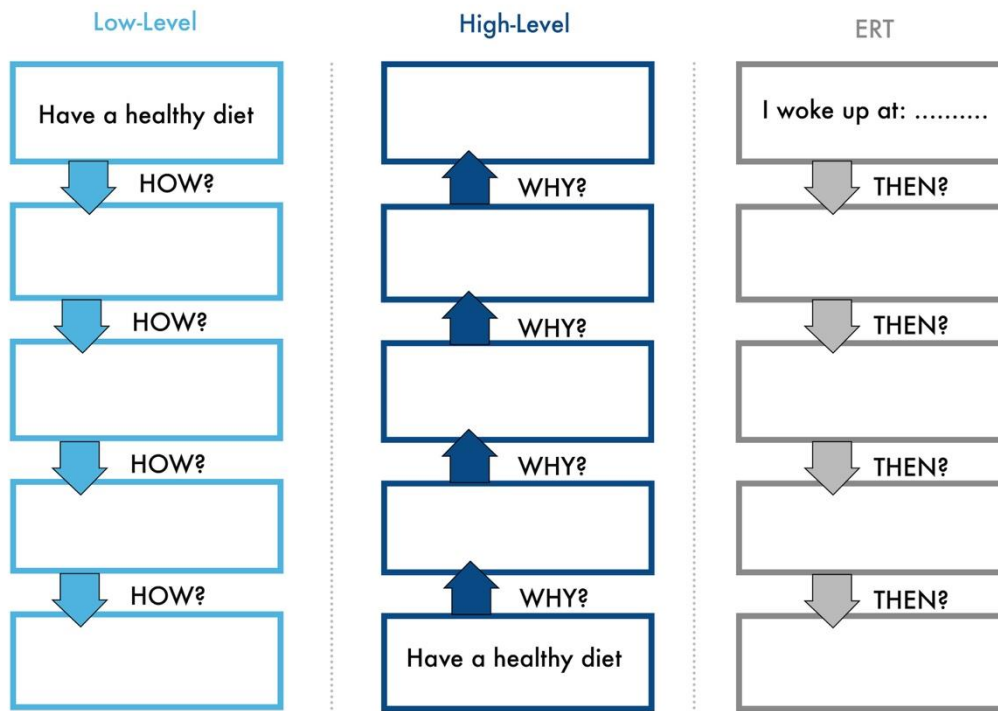


Figure 9. Schematic to depict construal prime (low-level: light blue; high-level: dark blue) or control (grey) manipulations.

### The EFT & ERT Tasks

A similar format to that used in previous investigations of episodic future thinking (Daniel et al., 2015; Dassen et al., 2016; Daniel et al., 2013; Wu et al., 2017) was employed, and comprised three distinct stages in the EFT conditions. First, the researcher invited participants to imagine their life four years from now, a time period that was chosen to most easily facilitate future thinking, based on the observation that participants spontaneously generate future events approximately +3.6 years from their present state (Addis, Wong, & Schacter, 2007). Next, participants were asked to generate as many positive, food-related future events in the following three-minutes as possible,



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such as “*cooking an elaborate meal, or having dinner with a friend*”. Subsequent to this, they ranked these events according to their perceptual detail (low-level condition) or their personal importance (high-level condition). Participants in the ERT condition were instructed to list as many positive events from the previous day as possible, and to rank these events based on the number of people present, providing a default construal reflection and arbitrary ranking system. Next, all participants were instructed to focus on the event that was the most detailed (low-level condition), most important (high-level condition) or had the most number of people present (ERT condition), whilst listening to an audio-tape of  $\approx 4.5$  minutes. In the EFT conditions, these recordings were designed to enhance the degree to which participants attended to either the sensory properties, such as taste and smell, (low-level condition; Appendix 4.10), or personal values, such as desires and morals, (high-level condition; Appendix 4.9) of their future events. In the ERT condition, the audio-tape allowed participants to mentally construe their memory of the previous day according to their default position, asking individuals to consider neutrally described properties, such as “events” and “interactions” (Appendix 4.11). Participants gave ratings regarding the valence and cognitive demand of their EFT and ERT visualisations using 5-point Likert scales.

### **The Tetris Distractor Task**

Given the frequent references to variable types of eating behaviour in an initial set of questionnaires, participants completed a brief distractor task inbetween responding to these items and undertaking food intake measures, as a means of minimising the impact of self-presentation concerns. Participants were invited to play the computer game ‘*Tetris*’, which has been evidenced as highly cognitively engaging due to its distinct visuospatial demands (Lyadurai et al., 2017) and indicated as logistically appropriate for an experimental setting, via use as a control task in the investigation of a self-regulation intervention (Yeager et al., 2014). In the current study, participants used an Ipad Air to rotate coloured blocks of variable shape, aiming to generate an inter-connected block community. Participants played for an exact duration of three-minutes, under the ostensible rationale of pre-validating this measure as an assessment of “lateral thinking”.

### **Metacognitive Strategy Cue Cards**

Individuals in the EFT conditions were provided with a customisable strip of five 8.5 x 5.5cm paper cards (Appendix 4.12) and an information sheet on the definition and applications of metacognitive strategies. These were intended to support participants’ healthy eating attempts over

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a two-week duration, with the first card in the strip completed using a written replication of participants' construal prime summary. The remainder of the cards were left blank, allowing participants to reiterate this summary as they wished. The aesthetic design of the cards was near identical across conditions, excluding the description of the card as either "My Process" (low-level condition) or "My Purpose" (high-level condition). Participants in the ERT condition were not provided with any additional support to help maintain or improve healthy eating behaviour.

## Measures

### The Bogus Taste Test

The Bogus Taste Test paradigm has been evidenced as a valid assessment of eating behaviour (Robinson et al., 2017). For example, results from this test are consistent with established associations between participant level variables and food consumption, such as gender (Robinson et al., 2017; Rolls, Fedoroff, & Guthrie, 1991) and food liking (Brunstrom & Shakeshaft, 2009; Robinson et al., 2017). The taste test also evidences validity via sensitivity to experimental manipulations that are reliably associated with fluctuations in food intake, such as self-presentation (Roth, Herman, Polivy, & Pliner, 2001) and distraction during eating (Oldham-Cooper, Hardman, Nicoll, Rogers, & Brunstrom, 2011). Further, the taste test demonstrates construct validity via significant positive correlations with self-reported hunger ( $B = 0.25$ , Robinson et al., 2017) and trait-over eating ( $B = 0.07$ , Robinson et al., 2017). The current study aimed to achieve greater ecological validity than previous investigations (Kemps, Tiggemann, Orr, & Grear, 2014.; Kuo, Lee, & Chiou, 2016; Schumacher, Kemps, & Tiggemann, 2016), by presenting a 'menu' of three healthy (low calorie, nutrient rich; red grapes; raspberries; carrots) and unhealthy (high calorie, nutrient poor; cheddar cheese; caramel shortbread; chocolate brownie) food products. These items were selected according to an extensive criteria, which was more heavily weighted by variables that could differentially influence perception and thus eating behaviour, such as colour or flavour variation (Clydesdale, 1993; Davidson, Giesbrecht, Thomas, & Kirkham, 2018). Additionally, this selection was comprised of two sweet and one savoury item per health-category, in order to cater for a range of taste preferences. Images of the items were presented in a random order, and participants were required to rank the items in terms of preference as a whole, from one to six (Appendix 5.10). This format was employed to avoid making the distinction between healthy and unhealthy items explicit, thereby limiting the influence of demand characteristics. Participants

were presented with their most preferred option from each health category in two identical white 15cm diameter bowls, which were filled to a perceptually identical quantity, whilst the size of individual pieces for each food item was also standardized to ensure common presentation across participants and conditions (Figure 10). The food sizes and bowl-weights for each item were as follows; red grapes 240g, 69 kcal per 100g; raspberries 210g, 53 kcal per 100g; carrot 1cm<sup>2</sup> pieces, 190g, 41 kcal per 100g; cheddar cheese 1cm<sup>2</sup> pieces, 200g, 399 kcal per 100g; chocolate brownie 1cm<sup>2</sup> pieces, 190g, 500 kcal per 100g; caramel shortbread 1cm<sup>2</sup> pieces, 240g, 514 kcal per 100g.



*Figure 10. High-calorie (chocolate brownie) and low-calorie (raspberries) food items as presented to participants.*

### **The Linguistic Inquiry and Word Count (LIWC) Analysis System and Linguistic Category Model (LCM; Pennebaker, Francis, & Booth, 2001)**

A computerised text analysis system, LIWC is used to detect words that correspond to pre-defined language categories. LIWC enables users to import additional dictionaries into the programme, and in this instance the linguistic category model dictionary (LCM; Seih et al., 2017) was used to examine the levels of abstraction in participants' construal level statements. The LCM has previously been applied to assess psychological distance (Freitas et al., 2004; Fujita & Sasota, 2011) and is used to calculate a general abstraction score according to weighted coefficients of different word types (Semin, Grts, Nandram, & Semin-Goossens, 2002). The use of the LCM via LIWC to assess construal level has previously been validated as

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an objective and time-efficient alternative to human coding schemes, and shows criterion validity in predicting construal level according to statements written in the first- and third-person (Seih et al., 2017).

### Psychometric measures

Participants completed online self-report assessments to control for between-groups factors which may differentially influence taste test behaviour, or to capture pre- to post-test variation in self-reported eating and exercise behaviour. It was important to limit the influence of demand characteristics inspired by these questionnaires upon food intake behaviour, and so participants were informed they were assisting in the pre-validation of all questionnaires delivered prior to the taste test, thereby implying the two activities were unrelated. Furthermore, the total selection of psychometric measures were categorised into three sets, to be delivered at separate time-points; set 1; questionnaires that were necessary to capture state variables prior to the taste test such as current hunger, or those that may produced bias responses as a consequence of behaviour during the taste test (the T-SRQ, the CFC-Food, the G-FCQ-S and the TFEQ); set 2; questionnaires that were necessary to deliver after the taste test to minimise the influence of demand characteristics or self-concordance bias on food intake (perceived goal standing, the HRBI-Diet, the HRBI-Activity, the WBI) and set 3; questionnaires designed to capture changes in variables of interest between pre-test, and the post-test session held 14 days later (the T-SRQ, the HRBI-Diet, the HRBI-Activity, the WBI).

#### **The Treatment-Self-Regulation Questionnaire (TSRQ; Ryan & Connell, 1989)**

The TSRQ was employed to measure participants' overall motivation to improve their healthy eating habits, and to provide a metric of autonomous, controlled and amotivation via distinct subscales. A full description of the TSRQ can be found in study 1A, however in the current instance participants responded to the phrase "*improve or maintain my diet*" with a 'healthy diet' previously defined as "*high in vitamins and minerals, low in sugar and fat*". The internal consistence value for the current sample is  $\alpha = .77$ .

#### **The Food Specific Consideration of Future Consequences Scale (CFC-Food, van Beek, Antonides, & Handgraaf, 2013; Appendix 5.11)**

Participants' default time perspective, that is to say their relative weighting of the

importance of future events in comparison to current events, was assessed via the Consideration of Future Consequences Scale (CFC). This questionnaire is comprised of two distinct sub-scales, the seven-item CFC-Future, which includes statements such as *“I consider how my health will be in the future, and try to influence my health with my day to day eating behaviour”*, and the five-item CFC-Immediate, which uses claims including *“I only choose my food to satisfy my immediate needs, figuring the future will take care of itself”*. Participants signify the degree to which each statement applies to them via a seven-point Likert scale from 1 (“totally disagree”) to 7 (“totally agree”). A composite score representing one’s orientation toward the future can be generated by reverse scoring the responses for the CFC-Immediate, and subsequently calculating the mean of all items, with higher overall scores indicating a higher regard for future outcomes. Importantly, prior research has indicated that the consideration of future consequences is best assessed at the behaviour specific level (Dassen, Houben, & Jansen, 2015; Hall, Fong, & Cheng, 2012; van Beek et al., 2013), and so the food specific version of the CFC was employed in the current study. In the present sample, the CFC-Food demonstrated good internal consistency ( $\alpha = .86$ ).

**The General Food Cravings Questionnaire-State (G-FCQ-S; Nijs, Franken, & Muris, 2007; Appendix 5.12).**

Participants reported their current levels of hunger via the state version of the General Food Cravings Questionnaire. This measure was selected due to its unique capacity to provide a measurement of the desire to consume food in general, rather than cravings for a specific substance (e.g. chocolate). This both captures a more holistic image of food craving (Nijs et al., 2007), and is particularly appropriate given the variety of foods on offer in the current study. Participants use a five-point Likert scale from 1 (“strongly disagree”) to 5 (“strongly agree”) to signify the extent to which 15 items apply to them, *“right now, at this very moment”*. These statements are divisible into five, three-item subcategories; (1) the intense desire to eat, (2) anticipation of relief from negative states as a result of eating, (3) craving as a physiological state, (4) obsessive preoccupation with food or a lack of control over eating and (5) anticipation of positive reinforcement that may result from eating. The C-FCQ-S demonstrated excellent internal consistency ( $\alpha = .92$ ), and indicates sensitivity to temporal and situational variables via a significant decline in reported food craving based on assessments delivered before and after satiety (Nijs et al., 2007). Further evidence supports the construct validity of

the G-FCQ-S via an association with decreased striatal D2/3R availability ( $r = .77$ , Van Der Zwaal et al., 2016), a feature which is strongly associated with increased BMI (de Weijer et al., 2014).

**The Revised Three-Factor Eating Questionnaire (R-TFE-Q, Karlsson, Persson, Sjöström, & Sullivan, 2000; Appendix 5.13)**

As a means of controlling for between-groups differences in trait eating behaviour, the R-TFE-Q was used to assess three distinct facets of food intake; (1) cognitive restraint of eating, (2) uncontrolled eating and (3) emotional eating. Here, participants respond to 18 phrases using a four-point Likert scale. The responses for 13 of these statements are “Definitely true (4)/mostly true (3)/mostly false (2)/definitely false (1)”, for three statements represent variable temporal degrees such as “never (1), at least once a week (4)” and for the final statement, participants use a quantitative rating scale from 1 to 8 to signify the degree to which they actively attempt to limit food intake, with higher values demonstrating greater dietary restriction. The separate subscales of the R-TFE-Q represented acceptable to good internal consistency (cognitive restraint  $\alpha = .77$ , uncontrolled eating  $\alpha = .83$ , emotional eating  $\alpha = .85$ ), and the three-factor structure is consistently replicated across samples of varying age, gender and BMI (Karlsson et al., 2000). Further, the emotional eating scale evidences good convergent validity with measures of low mood ( $r = -.35$ , Karlsson et al., 2000) and the symptoms of anxiety and depression ( $r = .35$  and  $.29$  respectively, Karlsson et al., 2000), as measured by the Mood Adjective Checklist (Sjöberg, Svensson, & Persson, 1979) and the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983).

**The Positive and Negative Affect Schedule-State (PANAS-S; Watson, Clark, & Tellegen, 1988; Appendix 5.14).**

The PANAS-S was used to determine the presence of any between-groups differences in state-affect, given known relationships between emotional variability and eating behaviour (Macht, 2008). This measure is devised of two 10-item subscales; positive (PA, eg. “*determined, inspired*”) and negative (NA, “*upset, hostile*”), to which participants signify the extent to which they are experiencing a given emotion “right now” from 1 (“Very slightly or not at all”) to 5 (“Extremely”). Each subscale demonstrated good internal consistency (positive  $\alpha = .89$ , negative  $\alpha = .84$ ) and in general shows convergent validity with measures of depression and anxiety as measured by the Depression, Anxiety and Stress Scale (Lovibond & Lovibond, 1995),

via significant negative correlations between the PA subscale and depression, anxiety and stress ( $r = -.48$ ,  $r = -.30$ ,  $r = -.31$  respectively, Crawford & Henry, 2004) and significant positive associations between the NA subscale and depression, anxiety and stress ( $r = -.60$ ,  $r = -.60$ ,  $r = -.67$  respectively, Crawford & Henry, 2004). Further, the PANAS-S possesses measurement invariance across demographic groups (Thompson, 2007) and is evidenced as particularly sensitive to temporal and situational variation in affect, due to the inclusion of items that are intrinsically transient (e.g. “*excited*”), or a reaction to a given cause (e.g. “*scared*” Thompson, 2007).

### **Food liking Questionnaire (Appendix 5.15)**

To measure the extent to which participants enjoyed the foods presented in their taste test, a food liking questionnaire was devised, based on the work of Borovoi et al. (2017). This survey was comprised of 10 items, which assessed participants’ enjoyment of both the sensory (“*How pleasant is the taste of this food?*”) and cognitive (“*How good for your body is this food?*”) characteristics of their taste-test selections from 1 (“Not very much at all”) to 5 (“Very much so”). Participants also indicated the degree to which each of these characteristics were important to their overall liking of the specific foods using the same measurement system, thereby generating a metric of the weighting with which sensory and cognitive factors influenced food enjoyment. The internal consistency of these subscales across healthy and unhealthy foods demonstrated acceptable internal consistency ( $\alpha \geq .62$ ).

### **Perceived goal standing**

Participants gave a global judgement of their current goal standing in relation to a self-defined goal of eating healthily, by responding to six-items. Participants indicated via a seven-point Likert scale from 1 (“Very strongly disagree”) to 7 (“Very strongly agree”) the extent to which phrases such as “*my daily behaviours match up with this goal*” and “*I feel distant from this goal*” (reverse scored) applied to them. In the current sample, this assessment demonstrated excellent internal consistency ( $\alpha = .92$ ).

### **The Health-Risk Behaviour Inventory (HRBI; Irish, 2011).**

The diet and physical activity sub-scales of the HRBI were selected to capture any differences in self-reported eating and exercise behaviour from pre- to post-test. Details regarding the experimental validation of these instruments can be accessed in study 1A.



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Individuals were also required to indicate the degree to which their responses were indicative of their general behaviour, and to list any factors which had contributed to largely unrepresentative responses, such as illness.

### **The Wellness Behaviours Inventory (WBI, Sirois, 2001).**

The WBI was considered a particularly appropriate tool with which to assess changes in participants' general orientation to health, as a consequence of attending to their process (concrete future condition), purpose (abstract future condition) or reconstruction (ERT condition) statements. A full description of the structure and psychometric properties of the WBI can be found in study 1A. As above, participants also recorded the typicality of their answers in terms of general behaviour.

### **Anthropometric Measures**

The researcher recorded participants weight and height using the Seca 899 electronic personal scale (0.1kg accuracy; class III precision calibration) and the Leicester Height Measurer (1mm accuracy). These items were concealed behind a screen, so as to negate the likelihood of them acting as a visual prime for restrained eating in the taste test task. A BMI value was subsequently generated for each participant, by calculating  $\text{kg/m}^2$ .

### **Demographic Information**

Participants were also asked to provide basic demographic information regarding their age, gender, annual household income, ethnicity and health related goals. Additionally, individuals were asked to report their personal conceptualisation of a 'healthy diet' to investigate whether this perception was congruent with that proposed in the experiment (low intake of high-calorie, nutrient-poor food; high intake of low-calorie, nutrient rich food).



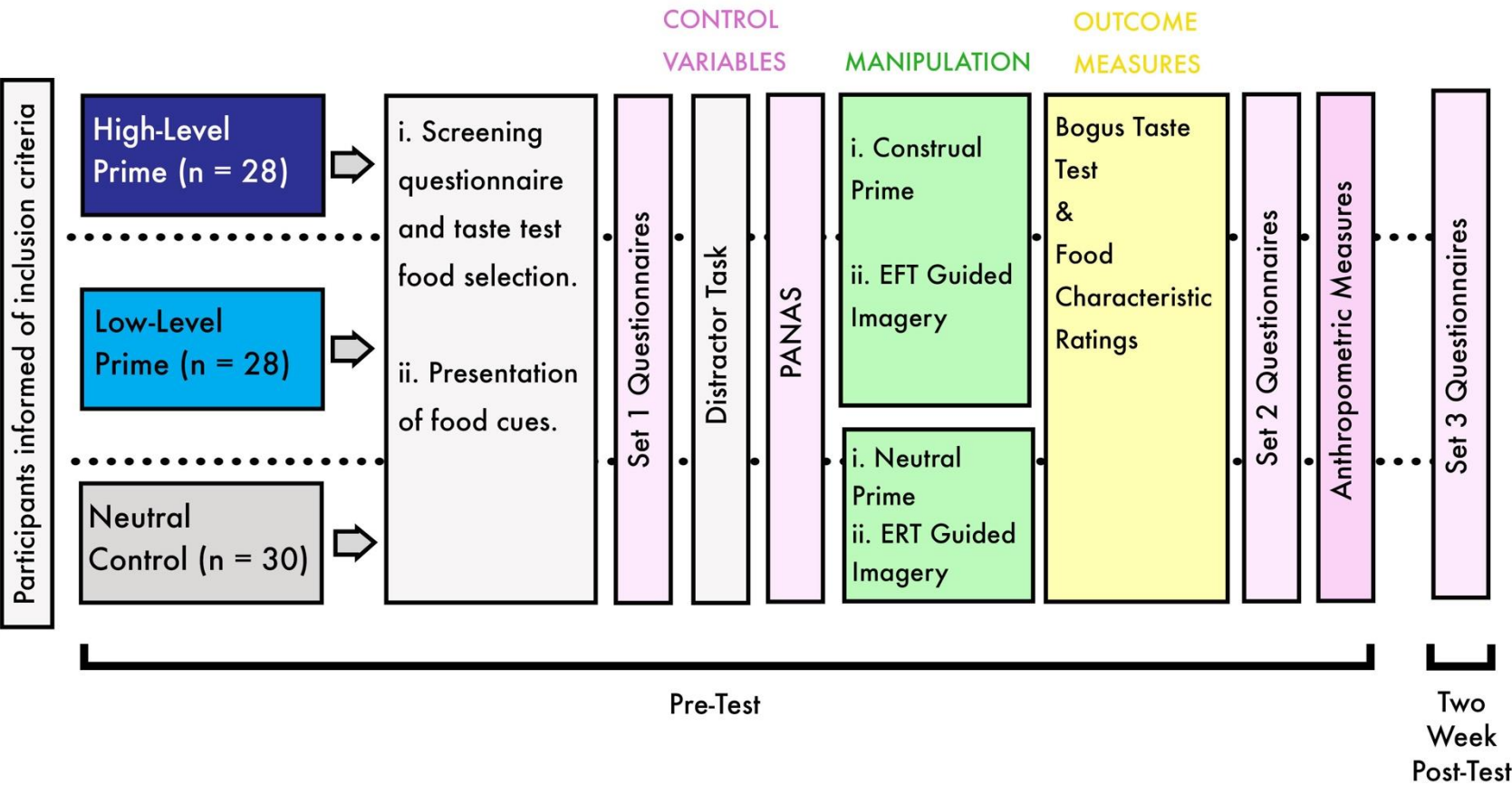


Figure 11. Schematic to depict procedure in study 2A

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### Procedure

A schematic to depict the procedure in this study can be viewed in Figure 11. All individuals were reminded of the fasting criteria on the evening immediately preceding the experiment via e-mail, and all timeslots were held between the hours of 11am and 6pm to minimise the likelihood of between-groups differences in baseline hunger. Participants were lab-tested individually and randomly allocated to a condition using an electronic code. Upon entry to the lab, participants first completed the screening questionnaire, before making their taste-test food-item selections and receiving written and verbal descriptions of the study. Participants then completed the set 1 questionnaires whilst their food selections were placed on an adjacent desk to act as a visual and olfactory hunger cue. Next, individuals completed the distractor task, before responding to the PANAS in order to provide a measure of affect immediately preceding the experimental manipulation and following taste test. Subsequently, all participants completed the construal manipulation or control exercise and episodic task specific to their condition, before rating the cognitive demand and valence of their visualisations. The researcher then directly presented individuals with their test foods, as well as paper rating scales and a glass of water. Participants were informed they had 10 minutes in which to complete the food-liking forms, during which time they were free to eat as much or as little as they liked. At this point, the experimenter left the room in accordance with the observation that self-presentation concerns disproportionately influence eating behaviour under experimental observation (Roth et al., 2001). Following this, participants completed the set 2 questionnaires, before the researcher recorded their height and weight. Lastly, participants in the construal manipulation conditions were provided with their metacognitive strategy cue cards and an accompanying advice sheet, and invited to use these materials in support of their healthy eating intentions over the course of the next two weeks. Finally, participants were thanked for their time, and debriefed. Immediately afterwards, the researcher recorded the post-test weight of participants' food items. At a second lab session held 14 days later participants completed the set three questionnaires. At this point, a funnel debrief procedure was used to probe all participants for suspicion, and to fully explain the detail and purpose of the experiment.

### Manipulation Check

Participants' written responses to the construal prime exercise were analysed using the LCM dictionary, via the LIWC program. These data were used to calculate a mean abstraction score for

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each condition, which was subsequently investigated to detect between-groups differences in the construal level and temporal orientation of statements via one-way ANOVA. Planned comparisons via independent samples t-test were conducted on observed significant interactions. Participants ratings of valence and difficulty for their guided imagery experience were also investigated via one-way ANOVA to detect effects of condition, which were subsequently investigated via independent samples t-test.

### Data Analysis

Initial data analysis checks to examine outliers, normality and homogeneity of variance were conducted according to the protocol described in study 1A. Independent sample t-tests were run to establish any significant between-groups differences in control variables at baseline, and Kruskal-Wallis tests were performed to investigate between-groups differences across relevant categorical demographic variables. These were followed by one-way ANOVA tests performed on high- and low-calorie food consumption, indexed via calorie consumption and absolute consumption in grams. Planned contrasts via independent sample t-test were run on any significant interactions across group and food consumption.

Between-groups differences in salience and importance ratings of abstract and concrete characteristics (e.g. *“How pleasant is the taste of this food?”*, concrete, salience; *“How important is nutritional value in your overall liking of this food?”*, abstract; importance) for high-calorie and low-calorie food categories were assessed via one-way repeated-measures ANOVA, which employed condition (high-level, low-level, control) as a between-subjects factor and food characteristic-type (abstract, concrete) as a within-subjects factor. Significant interactions were investigated using planned comparisons as paired-sample t-tests.

Additionally, self-report data on health-motivation and behaviour (the TSRQ, HRBI-Diet and WBI) were checked for normality, preceding independent sample t-tests to determine any between groups differences at baseline. Repeated measures ANOVA tests were used to investigate the presence of any interaction between group (between subjects factor; high-level, low-level, ERT) and time-point (within subjects factor; baseline, two-week follow-up). Significant interactions explored via the use of paired-sample t-test.

## Results: Study 2A

### Manipulation Check

An effect of condition upon abstraction level was observed ( $F(2,83) = 55.63, p < .001, \eta^2 = .57$ ), which was driven by significant differences across all three groups. As predicted, participants in the high-level condition produced significantly more abstract statements than those in the low-level condition ( $t(53) = 3.66, p < .001, d = 0.99$ ). Furthermore, statements in the ERT condition were significantly less abstract than those in both the high- and low-level conditions ( $t(58) = 10.93, p < .001, d = 2.84$  and  $t(53) = 6.64, p < .001, d = 1.72$  respectively; Table 9).

	Construal Prime Exercise		Guided Imagery	
	<i>Abstraction Level M(SD)</i>	<i>Past-Focus M(SD)</i>	<i>Valence M(SD)</i>	<i>Difficulty M<math>\pm</math>SD</i>
<b>High-Level<sup>a</sup></b>	2.62(0.25)	0.12(0.46)	6.61(0.69)	6.18(1.12)
<b>Low-Level<sup>a</sup></b>	2.34(0.31)	0.64(1.47)	6.55(0.88)	6.25(0.75)
<b>ERT<sup>b</sup></b>	1.79(0.33)	13.86(4.39)	5.83(0.83)	5.8(1.01)

*Table 10. Mean (standard deviation) values for the abstraction level of construal statements, and self-reported values for the difficulty and valence of the guided imagery task. Higher scores represent more positive valence and greater difficulty. Note  $a^n = 28$ ,  $b^n = 30$ .*

A significant effect of condition upon the frequency of past-related words in participants' construal prime statements was also documented ( $F(2,84) = 234.4, p < .001, \eta^2 = .91$ ). This effect resulted from a greater prevalence of past-related words in the ERT condition than either the high- or low-level conditions ( $t(38.9) = 17.58, p < .001, d = 4.4$ ;  $t(38.9) = 16.01, p < .001, d = 4.04$  respectively), whilst no significant difference between the high- and low-level conditions was observed ( $t(30.88) = 1.73, p = .09, d = 0.48$ ; Table 9).

Participants' ratings regarding the difficulty and valence of their guided imagery visualisation (Table 9) served to provide further insight regarding the experimental manipulation. No significant between-groups differences in the ease with which participants generated their visualisation were

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found ( $F(2,83) = 1.73, p = .18, \eta^2 = .04$ ). However, participants reported significantly different ratings of visualisation valence across conditions ( $F(2,83) = 8.26, p = .001, \eta^2 = .17$ ). Specifically, significantly lower positivity scores were given in the ERT condition compared to the high- and low-level conditions ( $t(56) = .43, p < .001, d = 0.99$ ;  $t(56) = 3.12, p = .003, d = 0.82$  respectively), whilst no significant difference between the high- and low-level conditions was observed ( $t(54) = .33, p = .74, d = 0.08$ ).

### Control Variables

No significant between-groups differences were documented regarding any of the continuous control variables as assessed (Table 10) or categorical demographics (Table 11). Therefore, these data were not included in any subsequent analyses. Furthermore, no significant between-groups differences were found with regard to participants' food selections for either the high-calorie or low-calorie categories, or the combination of food choices (Table 12).

	High-Level <sup>a</sup>	Low-Level <sup>a</sup>	ERT <sup>b</sup>		
	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>	<i>F</i>	<i>p</i>
<b>Age</b>	19.93(4.22)	20.93(4.12)	21.57(6.75)	1.31	.28
<b>PANAS</b>	14.18(8.22)	14.07(6.93)	17.73(8.55)	2.4	.1
<b>Eating Goal Standing</b>	4.76(1.09)	4.29(1.16)	4.36(0.9)	1.81	.17
<b>Income Perception</b>	4.18(1.34)	3.87(1.78)	4.22(1.33)	0.47	.63
<b>BMI</b>	22.85(3.73)	24.75(4.0)	25.21(4.21)	2.81	.07
<b>G-FCQ-S</b>	3.38(0.66)	3.5(0.71)	3.39(0.5)	0.42	.66
<b>R-TFE-Q</b>					
<i>Cognitive Restraint</i>	9.07(2.91)	9.11(2.27)	10.13(2.22)	1.55	.22
<i>Emotional Eating</i>	6.64(2.95)	7.5(2.17)	7.86(2.26)	2.16	.12
<i>Uncontrolled Eating</i>	19.7(4.91)	21.32(5.28)	22.31(4.93)	2.33	.1
<b>TSRQ-RAI</b>	2.63(.91)	2.39(.91)	2.49(0.88)	0.74	.63
<b>CFC-Food</b>					
<i>Future</i>	4.93(0.75)	4.69(0.77)	4.7(0.5)	1.31	.28
<i>Immediate</i>	3.53(0.95)	4.05(0.97)	4.02(0.87)	2.99	.06
<b>Food Liking</b>					
<i>High-Calorie</i>	12.96(2.07)	13.86(2.16)	13.19(1.74)	1.53	.22
<i>Low-Calorie</i>	19.05(3.5)	17.81(2.74)	18.28(3.01)	1.15	.32
<b>Food Characteristic Weighting (General)</b>					
<i>Abstract</i>	3.61(0.77)	3.44(0.74)	3.75(0.53)	0.1	.37
<i>Concrete</i>	4.05(0.52)	4.29(0.49)	4.06(0.49)	2.04	.14
<b>Baseline Food Weight (g)</b>					
<i>High-Calorie</i>	216.3(21.9)	221.6(24.3)	212.3(21.6)	1.23	.3
<i>Low-Calorie</i>	227(15.6)	234.1(15.1)	228(14.7)	1.84	.17

Table 11. Mean (standard deviation) values of continuous variables and one-way ANOVA interactions to investigate between-groups differences in confounding variables. Note <sup>a</sup>*n* = 28, <sup>b</sup>*n* = 30.

	High-Level <sup>a</sup>	Low-Level <sup>a</sup>	ERT <sup>b</sup>		
	<i>N</i> (%)	<i>N</i> (%)	<i>N</i> (%)	$\chi^2$	<i>p</i>
<b>Gender</b>				0.23	.89
Male	2(7.1)	6(21.4)	5(16.7)		
Female	26(92.9)	22(78.6)	25(83.3)		
<b>Ethnicity</b>				3.73	.16
White	23(82.1)	22(78.6)	25(83.3)		
Chinese	0(0)	1(3.6)	2(6.7)		
Other	5(17.9)	5(17.8)	3(9.9)		
<b>Household Income</b>				0.50	.78
£6,000 - ≤£13,000	4(14.3)	5(17.9)	7(23.3)		
>£13,000 - ≤£19,000	1(3.6)	3(10.7)	1(3.3)		
>£19,000 - ≤£26,000	5(17.9)	6(21.4)	3(10.0)		
>£26,000 - ≤£32,000	1(3.6)	5(17.9)	4(13.3)		
>£32,000 - ≤£48,000	6(21.4)	4(14.3)	5(16.7)		
>£48,000 - ≤£64,000	3(10.7)	1(3.6)	5(16.7)		
>£64,000 - ≤£96,000	3(10.7)	2(7.1)	3(10.0)		
>£96,000	2(7.1)	1(3.6)	1(3.3)		
Not specified	3(10.7)	1(3.6)	1(3.3)		
<b>No Goal</b>	2(7.1)	2(7.1)	4(13.3)	0.40	.82
<b>Reduce weight and dietary sugar/fat</b>	9(32.1)	11(39.3)	16(53.3)	0.28	.87
<b>Increase dietary vitamins</b>	12(42.9)	9(32.1)	10(33.3)	4.23	.12
<b>Gain weight</b>	2(7.1)	4(14.3)	1(3.3)	0.17	.92
<b>Goal Congruency</b>				0.43	.81
“More fruit, less fat”	21(75.0)	19(67.9)	23(76.7)		
“Balance”	7(25.0)	9(32.1)	7(23.3)		
<b>Total</b>	<b>28(100)</b>	<b>28(100)</b>	<b>30(100)</b>		

Table 12. Count (condition percentage) of categorical responses and Kruskal-Wallis tests to investigate between-groups differences in demographics and health-related goals. Note <sup>a</sup>*n* = 28, <sup>b</sup>*n* = 30.

	High-Level <sup>a</sup>	Low-Level <sup>a</sup>	ERT <sup>b</sup>		
	N(%)	N(%)	N(%)	$\chi^2$	<i>p</i>
<b>High-Calorie</b>				3.14	.21
Brownie	10(35.7)	11(39.3)	16(53.3)		
Caramel Shortbread	9(32.1)	13(46.4)	8(26.7)		
Cheese	9(32.1)	4(14.3)	6(20)		
<b>Low-Calorie</b>				3.77	.15
Carrots	1(3.6)	-	-		
Grapes	10(35.7)	16(57.1)	11(36.7)		
Raspberries	17(60.7)	12(42.9)	19(63.3)		
<b>Combination</b>				1.89	.39
Brownie-Grapes	4(14.3)	7(25)	3(10)		
Brownie-Raspberries	6(21.4)	4(14.3)	13(43.3)		
Caramel-Carrots	1(3.6)	0(0)	0(0)		
Caramel-Grapes	1(3.6)	7(25.0)	5(16.7)		
Caramel-Raspberries	7(25.0)	6(21.4)	3(10)		
Cheese-Grapes	5(17.9)	2(7.1)	3(10)		
Cheese-Raspberries	4(14.3)	2(7.1)	3(10)		
<b>Total</b>	<b>28(100)</b>	<b>28(100)</b>	<b>30(100)</b>		

Table 13. Count (condition percentage) of food selection type and combined food selection type by condition, and Kruskal-Wallis tests to investigate between-groups differences in food choice. Note <sup>a</sup>*n* = 28, <sup>b</sup>*n* = 30.

### Food Consumption: Gram Intake

In tests of between-group differences in the consumption of high-calorie and low-calorie foods (Table 13) a marginally significant effect of condition upon high-calorie food consumption was observed ( $F(2,83) = 3.03$ ,  $p = .05$ ,  $\eta^2 = .07$ ). This effect was driven by significantly greater consumption of high-calorie food in the low-level condition than the ERT condition ( $t(45.74) = 2.58$ ,  $p = .01$ ,  $d = 0.67$ ; Figure 12). No significant differences between either the high-level and the ERT condition ( $t(56) = 1.58$ ,  $p = .15$ ,  $d = 0.38$ ), or the high-level and the low-level condition ( $t(54) = 0.96$ ,  $p = .33$ ,  $d = 0.26$ ) were documented. No other significant differences regarding low-calorie or total consumption were detected (Figure 13).



	High-Level <sup>a</sup>	Low-Level <sup>a</sup>	ERT <sup>b</sup>		
Consumption (grams)	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>	<i>F</i>	<i>p</i>
High-Calorie Food	52.61(32.6)	61.36(34.05)	42.07(22.04)	3.03	.05 <sup>†</sup>
Low-Calorie Food	94.86(54.36)	119.32(62.11)	104.7(44.5)	1.46	.24
Total Food Intake	147.46(73.3)	180.68(87.5)	146.77(54.77)	2.01	.14

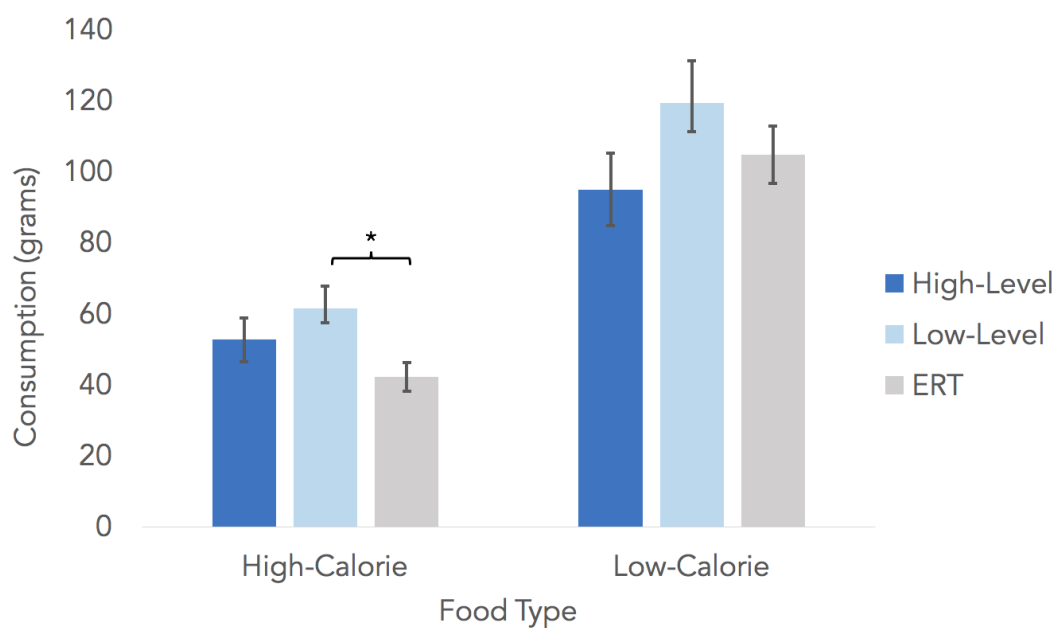
Table 14. Mean, standard deviation, and one-way ANOVA values for consumption of high-calorie, low-calorie and combined food consumption in grams, by condition. <sup>†</sup> denotes marginal statistical significance ( $\alpha < .05$ ).

	High-Level <sup>a</sup>	Low-Level <sup>a</sup>	ERT <sup>b</sup>		
Consumption (Calories)	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>	<i>F</i>	<i>p</i>
High-Calorie Food	403.56(280.89)	515.37(259.7)	506.67(314.05)	1.33	.27
Low-Calorie Food	39.05 (21.88)	53.57(27.35)	44.48(22.35)	2.62	.08
Total Food Intake	442.60 (286.16)	568.95(260.7)	551.15(314.45)	1.58	.21

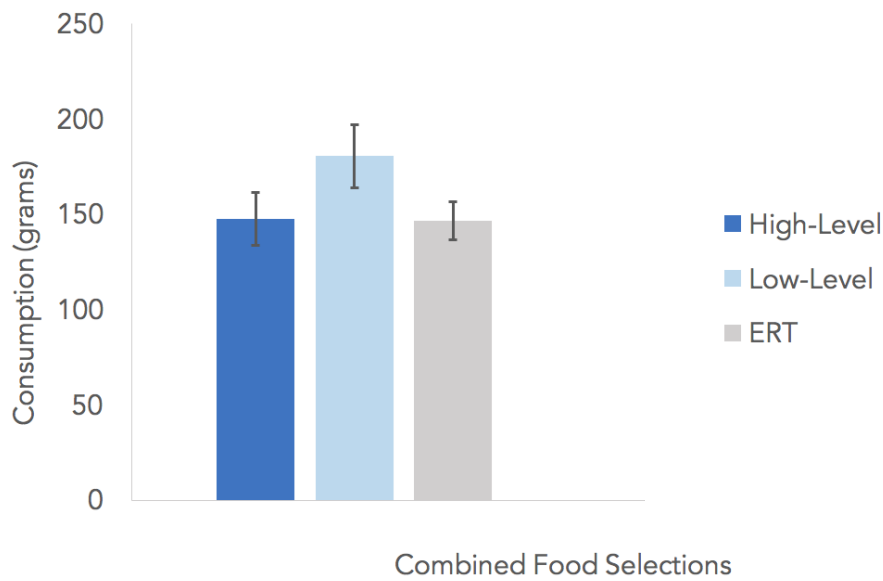
Table 15. Mean, standard deviation, and one-way ANOVA values for consumption of high-calorie, low-calorie and combined food consumption in calories, by condition.

**Food Consumption: Caloric Intake**

The caloric value of food selections was also calculated and analysed (Table 14). Regarding high-calorie food consumption, individuals in the low-level condition consumed the greatest number of calories, followed by those in the ERT condition, and then the high-level condition. This pattern was replicated for the consumption of calories in low-calorie foods. However, these differences were statistically insignificant, and thus no further tests were conducted.



*Figure 12. Mean values for consumption (in grams) by condition and food type. Error bars demonstrate  $\pm$  standard error; \* denotes statistical significance,  $\alpha < .05$ )*



*Figure 13. Mean values for consumption (in grams) for combined food consumption. Error bars demonstrate  $\pm$  standard error.*

### Food Liking

Regarding high-calorie food ratings, significant interactions were found between condition and concrete characteristic salience ( $F(2,83) = 5.35$ ,  $p = .01$ ,  $\eta^2 = .11$ ) and condition and concrete characteristic importance ( $F(2,83) = 4.2$ ,  $p = .02$ ,  $\eta^2 = .09$ ; Table 15). Specifically, participants in the low-level condition rated the concrete characteristics of high-calorie food as significantly more salient than participants in the ERT ( $t(56) = 2.66$ ,  $p = .01$ ,  $d = 0.71$ ) and high-level ( $t(54) = 3.02$ ,  $p = .004$ ,  $d = 0.8$ ) conditions. No significant difference between salience ratings in the ERT condition and high-level condition was observed ( $t(56) = 0.82$ ,  $p = .42$ ,  $d = 0.23$ ). Further, participants in the low-level condition rated the concrete characteristics of high-calorie food as significantly more important than participants in the high-level ( $t(54) = 2.95$ ,  $p = .005$ ,  $d = 0.8$ ) condition, however no significant differences in importance ratings between the low-level and ERT groups ( $t(56) = 0.94$ ,  $p = .35$ ,  $d = 0.24$ ) or high-level and ERT groups ( $t(56) = 1.84$ ,  $p = .07$ ,  $d = 0.49$ ) were documented. Finally, no significant between-groups differences regarding the salience and importance of abstract characteristics in high-calorie foods, or abstract and concrete characteristics in low-calorie foods were detected (Table 15).

	High-Level <sup>a</sup>	Low-Level <sup>a</sup>	ERT <sup>b</sup>		
	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>	<i>F</i>	<i>p</i>
<b>High Calorie Food</b>					
<b>Salience</b>					
<i>Abstract</i>	2.44(.85)	2.16(.61)	2.2(.72)	1.24	.3
<i>Concrete</i>	4.17(.55)	4.56(.38)	4.28(.41)	5.35	.01*
<b>Importance</b>					
<i>Abstract</i>	3.13(.96)	3.11(.82)	3.11(1.01)	0.01	.9
<i>Concrete</i>	4.08(.56)	4.47(.43)	4.35(.55)	4.2	.02*
<b>Low Calorie Food</b>					
<b>Salience</b>					
<i>Abstract</i>	4.74(.32)	4.59(.39)	4.66(.32)	1.46	.24
<i>Concrete</i>	4.36(.59)	4.24(.55)	4.34(.53)	0.36	.7
<b>Importance</b>					
<i>Abstract</i>	4.06(.76)	3.74(.74)	3.85(.74)	1.33	.27
<i>Concrete</i>	4.1(.65)	4.29(.48)	4.18(.59)	0.82	.44

Table 16. Mean (standard deviation) and ANOVA interactions for salience and importance ratings of high- and low-calorie foods by characteristic type (abstract, concrete) and condition (high-level, low-level, ERT). Note  $n = 28$ ,  $n = 30$ ; \* denotes statistical significance.

### Follow-Up Effects

Eighty-seven-point-two percent of the sample provided follow-up data. No significant between-groups differences in self-report measures of health motivation and behaviour were observed at baseline (Table 16). A significant group by time-point interaction for wellness behaviours was detected ( $F(2,72) = 3.28$ ,  $p = .04$ ,  $\eta^2 = .08$ ). This effect was driven by a marginally significant decrease in wellness behaviour from baseline to two-week follow-up (Table 16) in the low-level condition ( $t(25) = -2.05$ ,  $p = .05$ ,  $d = 0.3$ ), but not the high-level ( $t(20) = 1.54$ ,  $p = .14$ ,  $d = 0.2$ ) or ERT ( $t(27) = -1.11$ ,  $p = .28$ ,  $d = 0.1$ ) groups (Figure 14). No other significant interactions were found regarding additional measures of health motivation and behaviour (Table 16).

	High-Level <sup>c</sup>	Low-Level <sup>d</sup>	ERT <sup>e</sup>		
	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>	<i>F</i>	<i>p</i>
<b>TSRQ</b>				0.75	.93
Baseline	2.63(0.91)	2.39(0.91)	2.49(0.88)		
Follow-Up	2.58(1.03)	2.53(0.99)	2.57(1.34)		
<b>HRBI-Diet</b>				1.01	.37
Baseline	3.04(0.73)	3.12(0.76)	3.1(0.66)		
Follow-Up	2.6(0.54)	2.93(0.74)	2.55(0.59)		
<b>WBI</b>				3.28	.05 <sup>†</sup>
Baseline	3.09(0.53)	3.12(0.49)	3.25(0.38)		
Follow-Up	3.21(0.39)	2.98(0.47)	3.18(0.4)		

Table 17. Mean (standard deviation) and one-way repeated measures ANOVA interactions for self-reported health motivation and behaviour by time-point (pre-test, post-test) and condition (high-level, low-level, ERT). Note *cn* = 21, *dn* = 26, *en* = 28; <sup>†</sup> denotes marginal statistical significance ( $\alpha < .05$ ).

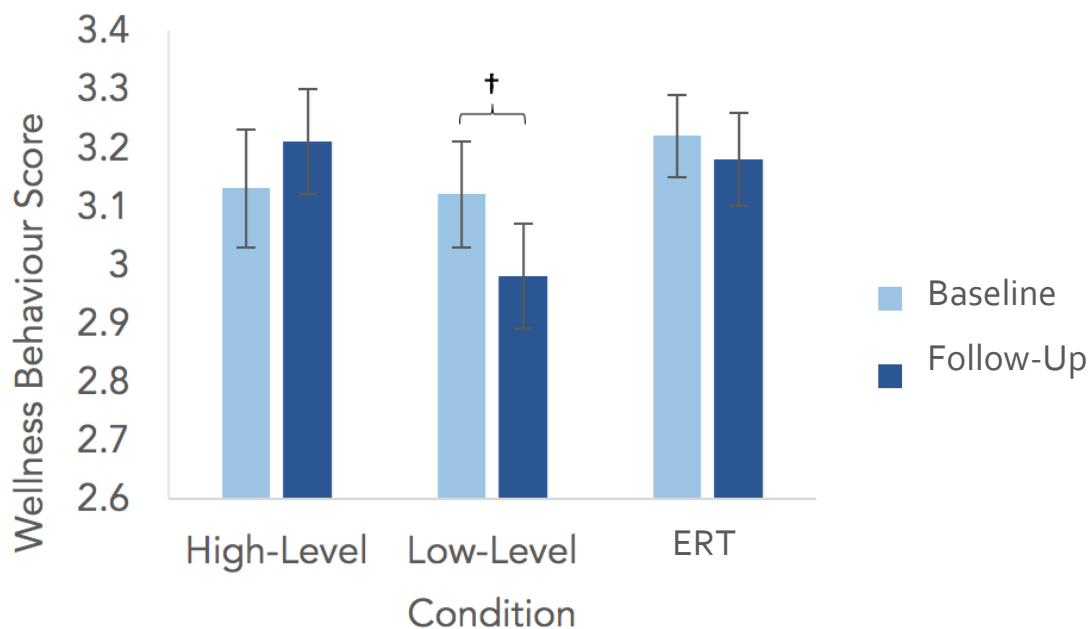


Figure 14. Mean values for wellness behaviour by condition and time-point. Error bars demonstrate  $\pm$  standard error. Note <sup>†</sup> denotes marginal significance ( $\alpha < .05$ ).

## Discussion

### Summary of Findings: Food Intake

The present study explored the influence of two episodic future thinking exercises upon eating behaviour, and in relation to a ERT task. The primary objective was to investigate the goal-related contents of prospection; a theoretically critical aspect of EFT which has been neglected by previous research. Additional aims were to establish the lasting effects of EFT on self-reported health motivation and behaviour, and to objectively assess participants' construal level using novel analytic methods.

As expected, analyses of participants' construal prime statements revealed individuals in the high-level condition presented a more abstract mindset than those in the low-level condition. Interestingly, individuals in the ERT condition created statements which were significantly more concrete than those from both high- and low-level groups. In itself, this result is unsurprising given participants in both EFT conditions were required to visualise a more hypothetical and temporally distant event than those in the ERT group and therefore one of greater abstraction. However, the relationship between food-consumption and construal level did not present a linear pattern. Participants in the ERT group documented the lowest levels of abstraction and consumed the least high-calorie food, whereas participants in the low-level group displayed median levels of abstraction, yet consumed the most high-calorie food, with small to medium effect. Further, the construal manipulation reduced high-calorie food consumption in the high-level group as compared to the low-level condition with a small to medium effect, though this did not reach significance. These results allow a partial acceptance of  $H_{1a}$  and rejection of  $H_{1b}$ .

One explanation for these finding is that the use of food-specific stimuli in the EFT groups and non-food-specific stimuli in the ERT condition differentially influenced consumption behaviour, and thus confounded the construal manipulation. Some prior evidence suggests food-related EFT is more effective in shaping healthy eating behaviour than unrestricted prospection, aligned with the observation that individuals present domain specific future-orientations (Dassen, Jansen, Nederkoorn, & Houben, 2016), and that enhancing memories of recent eating decreases food intake (Higgs, 2008). However, given the current sample were highly motivated to improve their eating

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habits, participants may actually have attempted to suppress thoughts of unhealthy food as a means of restricting consumption (Soetens, Braet, Dejonckheere, & Roets, 2006). As outlined in the theory of ironic processes, attempting to dampen unwanted thoughts can paradoxically increase preoccupation with tempting stimuli, which exerts a maladaptive influence upon behaviour (Wegner, 1994). For example, suppressing food-cravings subsequently increases the salience of food (Rodríguez-Martín, Gil-Pérez, & Pérez-Morales, 2015; Soetens et al., 2006), a feature which is particularly pronounced amongst obese, restrained eaters (Soetens & Braet, 2006) and one that directly contributes to excessive consumption and weight gain (Barnes, Ivezaj, & Grilo, 2016). Consequently, exercises which aim to manipulate temporal-orientation may not be maximally effective when highly constrained. Indeed, food-specific EFT which amplifies the salience of food-stimuli and increases ineffective thought-suppression in response mimics the natural cognitive processes of unhealthy eaters (Dassen, Houben, & Jansen, 2015). Equally, given healthy eaters consider long-term consequences of dietary choice which are often unrelated to food and serve to disrupt thoughts of consumption, it is possible food-related EFT impedes the identification of longitudinal goals which direct attention away from craved stimuli. In fact, given the paradoxical effects of thought-suppression are thought to be particularly acute in those who display high reinforcement pathology (Weller, Cook, Avsar, & Cox, 2008), engaging in non-food related EFT may provide a particularly effective strategy to diminish the salience and appeal of tempting options. However, only one other study to date has investigated the relative efficacy of food-related and unrestricted EFT (Dassen et al., 2016), suggesting this topic as a valuable avenue for future research.

### Summary of Findings: Food Characteristics

In comparisons of both EFT groups to the ERT condition, a concrete prime increased the consumption of high-calorie food, the salience of low-level features likely to drive consumption (taste, aroma) and the importance of these features to overall food liking, relative to ERT. These changes demonstrated statistically medium to large effects. In contrast, an abstract prime did not. These results allow for a partial acceptance of  $H_{2a}$ , acceptance of  $H_{3b}$ , the rejection of  $H_{2b}$  and  $H_{3a}$  and suggest that thinking about the future in concrete terms is more likely to drive unhealthy food consumption than thinking about the future according to abstract principles. This aligns with the proposals of CLT (Fujita et al., 2006), but contradicting the assumptions of many prior EFT manipulations which have emphasised perceptually vivid prospection (Arnold et al., 2011a; D'Argembeau & Van der Linden, 2004; Szpunar & McDermott, 2008).

### **Construal Priming and Autonomy**

Further findings indicate construal level manipulations may be an effective method of evoking volitional engagement with desired behaviour. Firstly, the concrete characteristics of high-calorie foods were significantly more salient to those engaged in concrete rather than abstract prospection. This suggests concrete EFT drove greater food intake via directing attention toward the sensory attributes of high-calorie food, and is supported by the absence of any between-groups differences in food characteristic weightings observed at pre-prime. Importantly, this result indicates construal priming not only dictates choice, but also alters subjective experience. Indeed, evidence demonstrates construal level influences perceptions of taste and the passing of time (Borovoi et al., 2017; Hansen & Trope, 2013). As such, construal priming may represent a technique to alter the way in which people feel about health-related events, both at the point of decision-making and after repeated instances of construal primed experience.

Secondly, construal primes may evoke volitional engagement with target behaviour via attitudinal change. Participants in the low-level group rated concrete characteristics as more important in their overall food liking than participants in the high-level condition, implying construal level contributes the conscious evaluation of stimuli. This compliments other work which documents abstract construal primes elicit negative evaluations of self-regulatory disruption and stronger commitment to self-control strategies (Fujita & Roberts, 2010; Fujita et al., 2006; Rogers & Bazerman, 2008). Relatedly, Sweeney and Freitas (2017) find autonomous motivation partially mediates the relationship between abstract thinking and fruit and vegetable intake. This occurrence is attributed to an enhanced perception of consistency between one's immediate action and wider values, afforded by the broader perspective of abstract thought. Whilst Sweeney and Freitas (2017) conclude abstract thinking may therefore represent a valuable method via which to generate an active desire for physical health, the current work adds a complimentary perspective in suggesting concrete thinking enhances the experience and perceived importance of low-level activities. Whilst in the present instance this related to unhealthy food consumption, activating a concrete construal level may be useful in situations where low-level thought prompts healthy behaviour, for example proximal and specific action such as hand-washing and vitamin intake (Curtis, Danquah, & Aunger, 2009).

### **High- and Low-Calorie Food**



The differential influence of high- and low-level EFT upon food intake and characteristic weightings was isolated to high-calorie foods. Whilst the current study proposed high-level EFT would amplify the value of nutrient-rich, low-calorie food in alignment with objectives made salient via abstract construal, several factors explain the absence of observed effect. Firstly, restrained high-calorie food consumption represents a conflict between immediate reward (i.e. pleasurable taste) and distal benefit (i.e. good physical health) whereas low-calorie food consumption does not. Consequently, low-calorie food intake may have been proportionately less affected by EFT priming in relation to additional factors influencing consumption, such as taste and satiation. Furthermore, Fujita et al., (2006) find abstract construals strengthen behavioural intentions when rewards are valued, but weaken them when they are not. Given abstract construals afford a broader focus regarding life goals, it is possible participants' attention was captivated by alternative objectives for which the consumption of nutritious food does not make a direct and immediate contribution, thus reducing its incentive salience. The present findings do however indicate further support for the argument that low-level EFT exerts an excitatory influence upon immediate emotion, which prompts impulsive behaviour. Evidence suggests cues of palatable stimuli such as high-calorie food elicit greater arousal than less palatable options (Roefs et al., 2005), which indicates the differential influence of high- and low-level EFT should be more pronounced for high- than low-calorie food, as observed in the current study. Considering obese individuals are particularly likely to show heightened arousal in response to palatable cues (Salbe, DelParigi, Pratley, Drewnowski, & Tataranni, 2004), this relationship is an important component to acknowledge in future EFT interventions.

### **Follow-Up Effects**

Empirical investigation has not yet established the durability of episodic future thinking, however the current work provides further insight on the lasting effects of EFT shaped via construal prime. Specifically, thinking about the future in concrete terms was associated with reduced behavioural engagement in health-promoting activity up to two weeks post-intervention, but was not related to variation in risk behaviour or health motivation. Collectively, this suggests the generation and use of concrete health strategies impair participants' capacity but not desire for wellness activity. In parallel, abstract future thought did not appear to enhance long-term health motivation or behaviour. This finding is unexpected in light of evidence which indicates abstractness promotes the salience of desired attitudes, decreases preference for immediate gratification, amplifies intentions to exert control, strengthens pre-commitment strategies, and increases

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disregard for distracting temptations (Carrera, Caballero, Fernández, & Muñoz, 2016; Fujita & Roberts, 2010; Fujita et al., 2006). Prior work explains the relationship between abstract thought and physical health in terms of asymmetric temptation-goal associations, which direct attention toward the future (Fujita & Carnevale, 2012). According to this perspective, those under abstract construal are more likely to think about long-term goals when faced with immediate temptation, but do not think about temptation when independently considering their long-term goals (Fishbach, Friedman, & Kruglanski, 2003). However, when under concrete construal this effect does not occur (Fujita & Sasota, 2011) suggesting only high-level thought enhances the cognitive accessibility of goals that aid self-regulation. The current work extends this proposal in suggesting abstract construals not only promote attention to distal objectives, but that concrete EFT can actively impede long-term health-behaviour. This effect is potentially a consequence of a greater attentional focus upon proximal environmental cues to the exclusion of long-term objectives. Such a mechanism is most likely implicit, given no significant change in health-related motivation was observed. Further work might therefore establish whether concrete future thought evokes prolonged attentional biases toward stimuli which disrupt self-regulatory behaviour.

### Strengths

The current study provides further insight regarding the role of eudaimonic frames in directing healthy behaviour. Specifically, this involved a novel application of the construal level framework in directing episodic prospection. This is the first study to objectively assess the relevance of abstraction level to EFT, and to explore longitudinal outcomes of this manipulation upon health motivation and behaviour. Additional novelty is presented in the investigation of both high- and low-calorie food items.

Findings account for a range of trait and state factors which could influence eating behaviour, including the use of distractor task to minimise demand characteristics, and the well-validated bogus taste test. The researcher also left the room during the taste test to minimise the likelihood of self-presentation concerns (Roth et al., 2001). Testing sessions were specifically scheduled to minimise individual differences in hunger, and appropriate fasting criteria were implemented. Moreover, although natural eating patterns vary as a function of circadian rhythms (Asher & Sassone-Corsi, 2015), evidence indicates snacking behaviour occurs throughout the day (Halkjær, Tjønneland, Overvad, & Sørensen, 2009; Howarth, Huang, Roberts, Lin, & McCrory, 2007; J. Wardle, 2007),

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suggesting this phenomenon would not influence the consumption of snack foods presented in the current work. BMI was objectively assessed, and measured at the end of the experiment so as not to influence subsequent eating behaviour. Lastly, no participants indicated suspicion regarding the relationship between the experimental inductions and the bogus taste test.

### Limitations

The conclusions of the current study are limited by the potentially confounding effects of paradoxical thought suppression. In order to address this factor, future research should employ a food-specific ERT condition to eliminate the differential influence of food-related and unconstrained thought conditions. Alternatively, investigating this relationship across variants of non-food-specific EFT would also enable controlled comparisons and provide further insight regarding the influence of construal priming on unconstrained prospection. Additionally, the sample average for BMI was within normal range at 24.3 kg/m<sup>2</sup> (normal; 18.5-24.9 kg/m<sup>2</sup>; WHO, 2011), and although restricting one's consumption of highly processed and high-fat foods represents benefit beyond weight maintenance, strong caloric intake restriction is arguably unnecessary in the current sample. Thus, future work may also conduct further testing with participants of higher BMI.

Furthermore, high- and low-calorie food items were presented simultaneously, which may have influenced intake. Whilst the current work controlled for between-groups differences in food type, food combination and the liking of independent food selections, it is possible some participants found the combination of their high- and low-calorie options more or less appetitive than others. Moreover, research has shown the successive presentation of food items increases consumption as a product of decreased sensory-specific satiety (Brondel et al., 2009). As such, future work should include the independent assessment of high- and low-calorie foods, and employ either counterbalancing or separate testing sessions to account for order and satiety effects.

### Conclusions

This study aimed to establish whether healthy eating behaviour is most likely to result from EFT which is shaped by a high- or low-level construal prime. Results indicate low-level EFT makes the concrete and sensory properties of high-calorie food more salient, driving greater consumption and experiential enjoyment. Thus, in situations when healthy choice requires behavioural inhibition, concrete future prospection results in maladaptive behaviour. Accordingly, whilst EFT manipulations

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have previously emphasised the general importance of vivid prospection, dampening the salience of low-level properties in unhealthy foods via construal priming also represents an effective strategy. Moreover, ERT manipulations appear to increase the salience and importance of concrete characteristics, which may drive food consumption. Further work involving consistently food or non-food specific episodic thinking conditions is warranted to fully investigate this notion. To explore the carry-over effects of high- and low-level construal upon other variants of health behaviour, additional work regarding exercise decision-making is conducted in study 2B.

### Introduction: Study 2B

Building upon conceptual themes introduced in study 2A, the current experiment investigates the role of construal-priming in motivating physical activity; an additional requirement of healthy weight maintenance (Carr, Friedman, & Jaffe, 2007), and one of the most important factors in preventing non-communicable disease (Reiner, Niermann, Jekauc, & Woll, 2013). This extends previous investigation by determining the robustness of construal prime effects in promoting multiple forms of healthy behaviour, and utilises a novel method to assess physical effort.

As discussed, treating multiple causes of NCD in concert may be a more efficient way of promoting population-level health (King et al., 2015), because multiple behavioural antecedents of non-communicable disease frequently co-occur (Poortinga, 2007), and precipitate the same chronic conditions (Schutz et al., 2014). Given the contention that abstract construals enhance the salience of central, core and invariant features in all object-representations (Trope & Liberman, 2010), it is possible that abstract primes entail effects which extend beyond single domain inductions. For example, Fujita et al. (2006) manipulated construal level by asking participants to consider why (high-level) or how (low-level) they maintain social relationships, and observed significant differences in the extent to which participants exerted self-control to obtain feedback about their sensory-motor system. One explanation for this finding is that abstract construals provide a eudaimonic frame to promote the identification and salience of superordinate goals, which in turn drive self-regulation across all situations. As such, construal level priming may represent a comprehensive method of evoking global health behaviour, for example to influence both healthy-eating and exercise decisions. However, recent evidence suggests the discounting of costs related to consumption behaviour and physical effort may correspond to distinct psychological processes

(Klein-Flügge, Kennerley, Saraiva, Penny, & Bestmann, 2015). Consequently, further research is required to establish the effects of construal level upon physical apathy.

### **Psychological Factors in Physical Inactivity**

The tendency to heavily discount delayed rewards has been implicated in physical inactivity (Tate, Tsai, Landes, Rettiganti, & Lefler, 2015), whereby the longitudinal health benefits of exercise are devalued in comparison to the immediate comfort of a sedentary lifestyle. However, in contrast to consumption behaviours (e.g. smoking, alcohol misuse, dietary choice), recent evidence suggests delay discounting shows inconsistent associations with exercise behaviour (Chapman et al., 2001). For example, whilst Axon, Bradford and Egan, (2009) and Bradford (2010) indicate high discount rate is linked to physical inactivity, Chapman (1998) documents a relationship of inverse nature, and Fuchs (1980) observes no significant association. Most recently, Garza et al. (2013) find discount rate does not explain variation in physical activity level when controlling for health beliefs, socioeconomic status and exercise self-efficacy. Collectively, these findings indicate more research is needed to understand the relationship between discounting and physically active behaviour.

A relevant concept which has been under-explored within the context of energetic activity and may explain these inconsistent findings, is effort discounting. This term describes the extent to which individuals decide to mobilise physical, emotional or cognitive effort in response to the net-balance of associated costs and rewards. A well-established evidence base indicates humans tend to avoid effortful action, and when faced with incentives of equivalent worth, are motivated to choose options that require less effort to obtain (Friman & Poling, 1995; Kool, McGuire, Rosen, & Botvinick, 2010; Walton, Kennerley, Bannerman, Phillips, & Rushworth, 2006). Further research indicates effort discounting rates differ across individuals (Sugiwaka & Okouchi, 2004; Treadway et al., 2012) including those specifically related to physical demand (Schmidt, Lebreton, Cléry-Melin, Daunizeau, & Pessiglione, 2012). Whilst previous research has often confounded temporal and effort-based discounting (Kurniawan et al., 2010), recent evidence indicates separation between the processing of delay- and effort-based rewards. For example, Klein-Flügge, Kennerley, Saraiva, Penny, and Bestmann, (2015) describe oppositional temporal and effort devaluation patterns, and Prévost, Pessiglione, Météreau, Cléry-Melin, and Dreher (2010) note distinct neural subsystems process these different types of cost. Further evidence demonstrates within-participant measures of temporal and effort discounting are not significantly related (Sugiwaka & Okouchi, 2004).

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Additionally, environmental factors such as sleep deprivation differentially influence temporal and effort discounting (Libedinsky et al., 2013), and Floresco, Tse, and Ghods-Sharifi (2008) illustrate effort influences decision-making independently of temporal delay in rats. Collectively, this research indicates a disassociation between temporal and effort discounting, and that effort discounting independently captures psychological processes categorised amongst the broader domain of impulsivity. This perspective is further supported by an observed distinction between cognitive and physical effort systems (Hosking, Floresco, & Winstanley, 2015; Białaszek, Marcowski, & Ostaszewski, 2017) implying that the cognitive effort of restrained choice and physical demand of exercise are also reliant upon different mental mechanisms. Given effort-averse tendencies are associated with behavioural apathy (Bonnelle et al., 2015), effort discounting measures may provide a valuable index of the psychological processes which underly physical inactivity. However few prior studies have investigated the subjective valuation of effort-related costs in dictating exercise behaviour, or integrated these considerations amongst the design of interventions to promote physical activity.

### **Recent Developments in Effort Discounting**

Some recent work has aimed to characterise the underlying mechanisms of physical effort discounting. Bonnelle et al. (2015) indicate compelling rewards or easy tasks inspire similar levels of effort mobilisation across individuals, whilst participants with steep discounting rates show a relatively sharp decrease in effort as a response to challenging exercises or sub-threshold incentives. Bonnelle et al. (2015) further implicate a role of effort sensitivity in those who heavily discount demand-based rewards, and suggest incentives subjectively influence the perception of effort costs. This observation is supported by evidence that participants report the same objective effort as easier if they are more motivated or emotionally aroused, leading to a greater production of physical force (Schmidt et al., 2009). Furthermore, patients with major depressive disorder, for which physical apathy is a known consequence, display faulty incentive motivation processing and do not experience the alleviative effects of potential rewards on effort sensation (Cléry-Melin et al., 2011). This manifests in diminished objective exertion, but a magnified subjective experience of physical effort.

### **Construal level Theory and Effort Discounting**

Collectively, these findings suggest that the relative salience of costs and rewards can influence effort-based discount rate. Further evidence indicates this process determines the

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willingness and ease with which individuals engage in demanding physical tasks, positioning it as an important component of exercise promotion. Whilst the role of effort discounting in physical activity is yet to receive substantial investigation, a small number of relevant studies suggest the relative weighting of reward and effort can be influenced by external factors, such as construal level (see study 2A). The effects of construal level have most frequently been investigated within the context of temporal frame (eg. Cheng, Shein, & Chiou, 2012), however the underlying premise of construal level theory suggests high-level construals not only promote attention toward longitudinal benefits, but to all global and invariant aspects of a situation. Accordingly, just as abstract primes enhance the salience of distal outcomes in healthy food-choice, CLT proposes the same mechanism can promote attention to high-level rewards associated with physical exertion. In fact, given recent evidence indicates reward salience subjectively diminishes effort-related costs (Bonnelle et al., 2015), high-level primes may be particularly effective in motivating physical activity, because they accentuate the salience of associated future outcomes. This theory is supported by the finding that, compared with those who experience a concrete prime, participants in receipt of an abstract construal induction are more likely to tolerate physical discomfort in attaining information about their health and personality, and to endure arduous medical procedures (Fujita et al., 2006). Sweeney and Freitas, (2017) also indicate the predisposition toward abstract thought is associated with greater self-reported physical activity, whilst planning physical activity according to abstract goals increases self-reported exercise across the following week (Sweeney & Freitas, 2014). Consequently, it follows abstract construals bolster the ability to withstand uncomfortable energetic effort in order to attain strong physical health.

### Literature Gap

Evidence suggests inducing an abstract construal level can not only promote healthy decision-making when individuals are faced with the challenge of resisting temptation, but also when required to exert physical effort. However, the pre-existing literature base is limited in size, and could be enhanced by introducing more direct and objective assessments of physical activity. This is particularly important given the theoretical relationship between construal level and effort mobilisation demands greater clarification. Whilst prior speculation suggests abstract construals dampen current emotion to facilitate the prioritisation of rational self-interest over visceral response in impulsive considerations (Fujita et al., 2006; Loewenstein & Lerner, 2003; Metcalfe & Mischel, 1999), Schmidt et al., (2009) suggest emotional arousal facilitates physical effort via promoting

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activity in the ventrolateral prefrontal cortex, which in turn drives the motor cortex. Cléry-Melin et al. (2011) also note emotional states energise effortful behaviour. Thus, it is not yet clear whether inducing an abstract mindset might stimulate effort mobilisation via enhancing the salience of high-level goals, or amplify steep effort-discounting as a consequence of decreased emotional arousal.

In order to further investigate the effects of construal priming upon effort-discounting, the current work advances prior investigation in a number of ways. Firstly, previous research has indexed effort using a physically taxing handgrip (Bonnelle et al., 2015; Fujita et al., 2006; Kurniawan et al., 2010), or finger-tapping (Bijleveld, Custers, & Aarts, 2012) and button-press (Gold et al., 2013) tasks. These methods are valuable in both abstracting the principles of effort discounting, and measuring the continued exertion of force. However, they do not assess how likely participants are to select energetic over sedentary options, as is a common dilemma of ecological exercise choice. Further, these methods do not demand whole body or cardiovascular efforts which are important for maintaining good physical health (Hallal et al., 2012). Consequently, the current study utilises a novel discrete-choice paradigm described as the fictional effort experiment task. In this scenario, the subjective valuation of concrete effort (e.g. physiological exertion) and abstract reward (e.g. decreased NCD risk) is assessed. Participants are presented with a fictional opportunity to take part in a research study, and must choose between two experiments that either represent high abstract reward, for high concrete effort (high-effort\*reward), compared with an activity that offers low abstract reward, and low concrete effort (low-effort\*reward). These activities are otherwise identically matched and ostensibly real.

### Summary and Aims

In summary, the current study investigates the role of an eating-related construal prime in promoting the mobilisation of physical effort. Building upon the contention that high-level construals promote attention to superordinate objectives and reduce the salience of visceral responses (K. Fujita et al., 2006), it is hypothesised;

### H<sub>1</sub> – Effort Mobilisation

- a) Participants exposed to a high-level prime will be significantly more likely to select a high-effort\*reward option in relation to a low-effort\*reward option than participants exposed to a



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low-level prime and a no-intervention control group.

### **H<sub>2</sub> – Abstract & Concrete Considerations**

a) Concrete considerations (physical effort) will be rated as significantly more salient and important by participants exposed to a low-level prime than a high-level prime or a no-intervention control group.

b) Abstract considerations (benefits of effort) will be rated as significantly more salient and important by participants exposed to a high-level prime than a low-level prime or a no-intervention control group.

### **H<sub>3</sub> – Mediatory Relationships**

a) Enhanced salience of abstract considerations will predict high-effort\*reward selection.

b) Enhanced salience of concrete considerations will predict low-effort\*reward selection.

## **Method: Study 2B**

### **Participants**

Ninety-two percent of the original study 2A sample returned to complete the effort experiment selection task, comprising a total of 79 participants ( $M^{\text{age}} = 20.63$ ,  $SD = 4.05$ , 72 female) returned. All participants gave written consent (Appendix 1.3) and were compensated for their time with partial course credit. The study was awarded full approval from the Bangor University School of Psychology Research Ethics Committee (Application: #2018-16252).

### **Design**

Individuals were randomly allocated to one of three construal prime groups (high level, low level, control) and were presented with a discrete choice of experiment (high effort\*reward; low effort\*reward). The presentation of these options was counterbalanced across participants and within conditions.

### **Materials**

### The Fictional Effort Experiments

Participants were informed about a fictional opportunity to take part in a research study, for which they would be economically rewarded or receive additional course credit. Individuals were presented with an information sheet listing five effortful and five rewarding features of two otherwise identically described experiments (Appendix 4.13), and asked to read the sheet carefully, before selecting their preferred choice. These experiments were described as “Resting Metrics”; in which participants were required to expend minor physical effort, for example *“have your heart rate recorded by painless finger-clip”* in return for low-value rewards, such as *“statistics on heart disease in Wales”*. In contrast, participants could choose to take part in “Active Metrics”; a study that required individuals to experience sensations associated with high physical effort as a consequence of running on a treadmill, such as *“aching muscles”*, but receive a reward of greater value, such as *“personalised information on how to live a long and healthy life”*. Participant perceptions of these characteristics were supported by the results of an online pilot sample ( $n = 80$ ). Additionally, all effort demands in these descriptions were characterised by concrete sensory details (*“feelings of minor dehydration eg. a dry mouth”*), whereas all benefits were defined by abstract properties (*“personalised strategies to keep your mind and body performing at their best”*). This decision therefore represented a discrete choice effort discounting measure, whereby participants were forced to choose between an activity that offered high abstract reward, for high concrete effort, compared with an activity that posed low abstract reward, and low concrete effort. Individuals rated all concrete and sensory experiment attributes on a 5 point Likert scale to produce a composite score of perceived desirability and effort for each experiment. These data demonstrated good internal consistency (high effort\*reward; effort  $\alpha = .84$ , desirability  $\alpha = .93$ ; low effort\*reward; effort  $\alpha = .84$ , desirability  $\alpha = .91$ ).

### Measures

Participants completed online self-report assessments to control for between-groups differences in health-motivation and exercise behaviour. These included the Treatment-Self-Regulation Questionnaire (TSRQ; Ryan & Connell, 1989), a complete description of which can be found in study 1A, and a measure of perceived goal standing, which is described in full in study 2A.

**The Exercise Specific Consideration of Future Consequences Scale (CFC-Exercise, van Beek, Antonides, & Handgraaf, 2013)**

The CFC-Exercise follows an identical format to the CFC-Food scale described in study 2A, differing only according to the replacement of “food” and “eating behaviour” with “exercise” and “exercise behaviour”. Here, the CFC-Exercise was employed to assess any between-groups differences in participants’ relative valuation of the immediate and distal consequences of exercise. The CFC-Exercise demonstrated good internal consistency ( $\alpha = .84$ ) and has been shown to predict exercise behaviour ( $r = .99$ , van Beek et al., 2013).

### **Experiment Motivation**

Participants indicated how motivated they were to attend their chosen session by responding to five items via a seven-point Likert scale from 1 (“Not at all”) to 7 (“Very”). This assessment used an extended version of the exercise motivation measure generated by Sweeney and Freitas, (2014) and included phrases such as *“How important is getting more physical activity/exercise to you?”* and *“How strongly committed are you to getting more physical activity/exercise?”*. These items demonstrated good internal consistency ( $\alpha = .89$ ) in the current sample. A sixth and final item recorded the presence of any confounding factors that might additionally influence participants experiment selection, such as a long-term health condition or injury.

### **Procedure**

A schematic to depict the procedure in this study can be viewed in Figure 15. All individuals had previously completed a construal prime-exercise in study 2A. Participants in the high- and low-level conditions were invited to review this statement upon entry to the lab, whilst participants in the control condition received no construal prime manipulation. Subsequently, participants chose which of the fictional effort selections they would most like to take part in, before completing the psychometric measures. Lastly, a funnel debrief procedure was used to probe all participants for suspicion, and to fully explain the detail and purpose of the experiment.

### **Data Analysis**

Initial data analysis checks to examine outliers, normality and homogeneity of variance were conducted according to the protocol described in study 1A. Independent sample t-tests were run to establish any significant between-groups differences in control variables at baseline, and Kruksal-

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Wallis tests were performed to investigate between-groups differences across relevant categorical demographic variables. Effects of group upon experiment choice were assessed via the Mann-Whitney U test. One-way ANOVA was performed to investigate effects of group upon effort and reward perceptions across high-effort\*reward and low-effort\*reward experiments, and the significance of these perceptions in predicting experiment choice was assessed via binomial logistic regression.

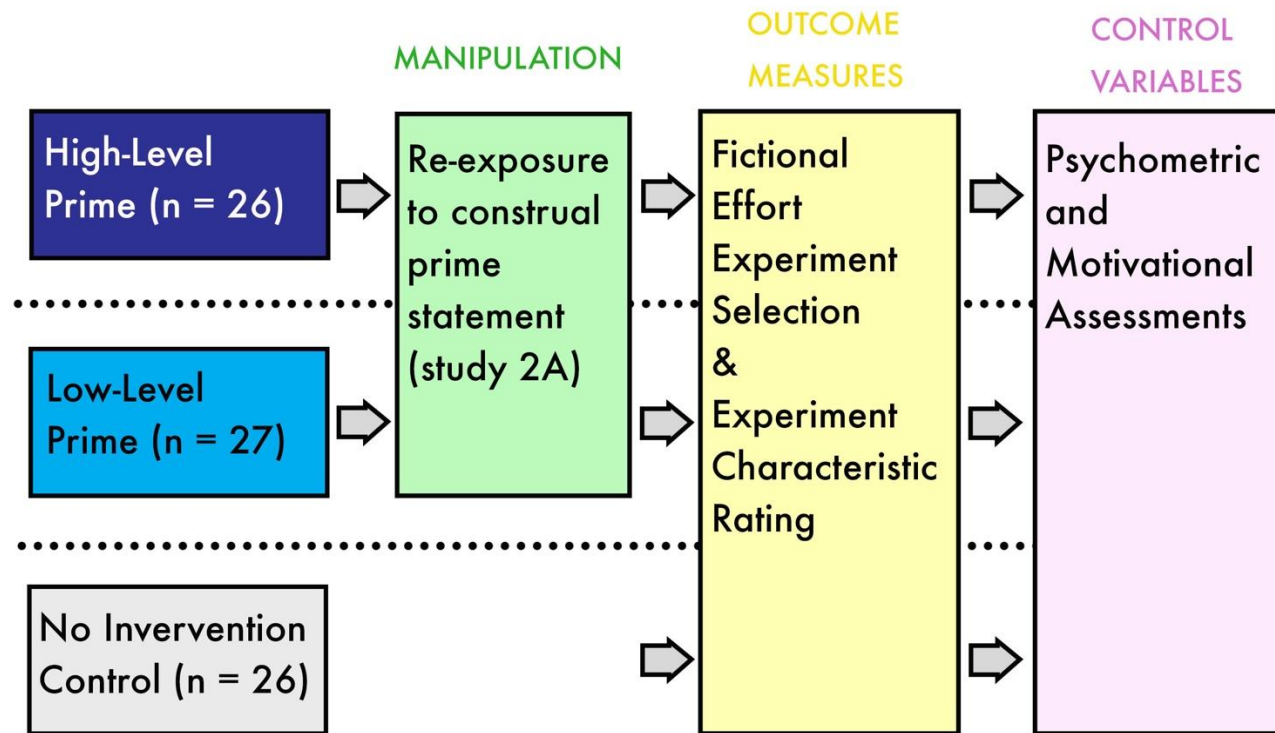


Figure 15. Schematic to depict procedure in study 2B.

## Results: Study 2B

### Manipulation Check

The original construal prime responses of those who completed the exercise selection task were reanalysed in an identical fashion to that described in study 2A, to investigate between-groups differences across the sample. Participants in the high-level condition ( $M = 2.7$ ,  $SD = 0.28$ ) produced significantly more abstract statements than those in the low-level ( $M = 2.33$ ,  $SD = 0.33$ ) condition ( $t(51) = 4.38$ ,  $p < .001$ ).

### Control Variables

No significant between-groups differences were documented regarding any of the categorical demographics (Table 18) or continuous control variables (Table 19). Therefore, these data were not included in any subsequent analyses.

	High-Level <sup>a</sup>	Low-Level <sup>b</sup>	Control <sup>a</sup>		
	<i>N</i> (%)	<i>N</i> (%)	<i>N</i> (%)	$\chi^2$	<i>p</i>
<b>Gender</b>				0.34	.84
Male	2(7.7)	2(7.4)	3(11.5)		
Female	24(92.3)	25(92.6)	23(88.5)		
<b>Ethnicity</b>				3.12	.21
White	23(88.5)	21(77.8)	18(69.2)		
Asian	1(3.8)	2(7.4)	2(7.7)		
Other	2(7.6)	4(14.8)	6(23)		
<b>Household Income</b>				1.05	.59
£6,000 - ≤£13,000	7(26.9)	4(14.8)	4(15.4)		
>£13,000 - ≤£19,000	1(3.8)	3(11.1)	3(11.5)		
>£19,000 - ≤£26,000	4(15.4)	1(3.7)	5(19.2)		
>£26,000 - ≤£32,000	3(11.5)	4(14.8)	1(3.8)		
>£32,000 - ≤£48,000	6(23.1)	6(22.2)	3(11.5)		
>£48,000 - ≤£64,000	1(3.8)	3(11.1)	4(15.4)		
>£64,000 - ≤£96,000	3(11.5)	4(14.8)	2(7.7)		
>£96,000	1(3.8)	1(3.7)	1(3.8)		
Not specified	0(0)	1(3.7)	3(11.5)		
<b>Physical Activity Goal</b>				0.34	.84
No Goal	10(38.5)	12(44.4)	12(46.2)		
Goal	16(61.5)	15(55.6)	14(53.8)		

Table 18. Count (condition percentage) of categorical responses and Kruskal-Wallis tests to investigate between-groups differences in demographics and health-related goals. Note <sup>a</sup>*n* = 26, <sup>b</sup>*n* = 27.

	High-Level <sup>a</sup>	Low-Level <sup>b</sup>	Control <sup>a</sup>		
	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>	<i>F</i>	<i>p</i>
<b>Age</b>	21.19(5.49)	20.74(3.88)	19.96(2.11)	0.61	.55
<b>BMI</b>	23.74(4.23)	25.17(3.81)	25.27(4.58)	1.08	.34
<b>Typical Weekly Exercise</b>	3.5(0.77)	3.33(0.78)	3.35(0.82)	0.36	.7
<b>Experiment Motivation</b>					
<i>Resting</i>	5.02(1.31)	4.83(1.06)	4.59(1.05)	0.53	.59
<i>Active</i>	5.32(0.9)	5.2(0.63)	5.76(1.02)	0.95	.4

Table 19. Mean (standard deviation) values of continuous variables and one-way ANOVA interactions to investigate between-groups differences in confounding variables. Note <sup>a</sup>*n* = 26, <sup>b</sup>*n* = 27.

	Active Metrics	Resting Metrics
	<i>M(%)</i>	<i>M(%)</i>
<b>High-Level<sup>a</sup></b>	13(50)	13(50)
<b>Low-Level<sup>b</sup></b>	6(22.2)	21(77.8)
<b>Control<sup>a</sup></b>	10(38.5)	16(61.5)

Table 20. Count (condition percentage) of experiment selection by condition.

Note <sup>a</sup>*n* = 26, <sup>b</sup>*n* = 27.



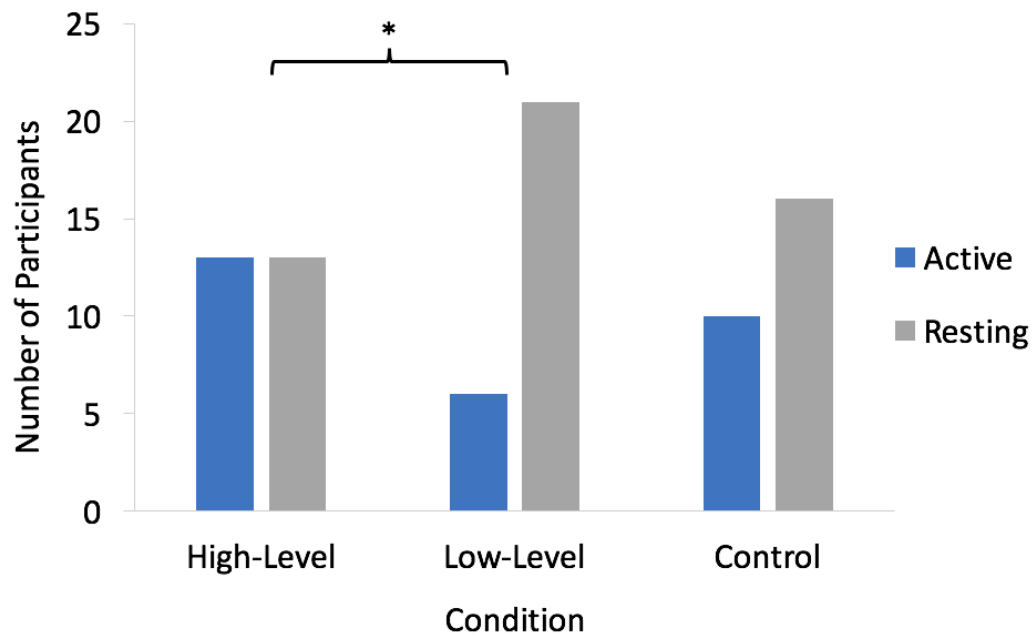


Figure 16. Number of participants who selected active or resting hypothetical experiment options by condition.

### Experiment Choice

Effects of condition upon the mean rank of experiment choice selections were assessed (Table 20). Whilst no significant difference in choice probability between the control and low-level ( $U = 294, p = .202$ ) or control and high-level ( $U = 299, p = .407$ ) conditions was observed, participants in the high-level condition were significantly more likely to select the active metrics experiment than those in the low-level condition ( $U = 253, p = .037$ , Figure 16).

	High-Level <sup>a</sup>	Low-Level <sup>b</sup>	Control		
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>F</i>	<i>p</i>
<b>Active Metrics</b>					
Perceived Effort	4.32(0.53)	4.21(0.81)	4.33(0.5)		
Perceived Rewards	4.44(0.84)	4.34(0.68)	4.59(0.83)		
Perceived Net Benefit <sup>‡</sup>	0.12(1.0)	0.13(1.07)	0.26(0.88)	0.16	.85
<b>Resting Metrics</b>					
Perceived Effort	1.3(0.4)	1.11(0.27)	1.49(0.74)		
Perceived Rewards	2.95(0.75)	3.07(0.92)	3.45(1.05)		
Perceived Net Benefit <sup>‡</sup>	1.65(0.94)	1.95(0.95)	1.96(1.29)	0.69	.51

*Table 21. Mean (standard deviation) values for the perceived effort and reward regarding active (high effort, high reward) and resting (low effort, low reward) experiments by condition (high-level, low-level, control). Note <sup>a</sup>*n* = 26, <sup>b</sup>*n* = 27; <sup>‡</sup> denotes perceptions of net benefit as calculated via the subtraction of effort perception from reward perception.*

### Experiment Perceptions

For both experiment options, participants' perception of net-benefit was calculated via subtracting their perception of associated costs from the perception of associated rewards (Table 21). No significant effects of group upon these perceptions were observed, and thus no further analyses were conducted.

Neither abstract nor concrete considerations significantly predicted experiment choice within the low-level condition (abstract:  $B = .62$  SE = .57,  $p = .18$ ; concrete:  $B = -.03$ , SE = .58,  $p = .96$ ). However, in the high-level condition, abstract considerations were a marginally significant predictor of experiment choice ( $B = 1.25$ , SE = .71,  $p = .07$ ), whilst concrete considerations were not ( $B = -.51$ , SE = .72,  $p = .48$ ), and in the control condition concrete considerations were a marginally significant predictor of experiment choice ( $B = 1.12$ , SE = .6,  $p = .06$ ), whilst abstract considerations were not ( $B = -.4$  SE = .62,  $p = .52$ ).

Furthermore, aggregated abstract considerations were significantly correlated with experiment choice ( $r = .23$ ,  $p > .04$ ), however aggregated concrete considerations were not ( $r = .09$ ,  $p = .45$ ). Equally, no significant correlation was observed between aggregated concrete and abstract

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considerations ( $r = .04$ ,  $p = .74$ ). As such, neither abstract or concrete considerations influenced decision-making under exposure to a low-level prime, experiment choice was affected only by abstract considerations when under a high-level prime, and only by concrete considerations when experiencing a no-intervention control.

### Discussion: Study 2B

The tendency to steeply discount distal rewards is considered an underlying cause of multiple maladaptive health behaviours, including substance abuse, poor diet and low physical activity (eg. Kurniawan et al., 2010; Tate, Tsai, Landes, Rettiganti, & Lefler, 2015). This has given rise to the assumption that interventions which successfully attenuate delay discounting can also motivate physical effort. However, an increasing body of evidence suggests a distinction between temporal and effort-based discounting (Klein-Flügge, Kennerley, Saraiva, Penny, & Bestmann, 2015; van Beek, Antonides, & Handgraaf, 2013), indicating a more nuanced analysis of exercise regulation is required. In response, the present study investigated the influence of construal level priming on effort-based decisions, and addressed some limitations of previous research by presenting an ostensibly real choice regarding whole-body cardiovascular exercise. Implications can inform strategies that aim to promote physical activity and protect against noncommunicable disease.

### Summary of Findings

Results confirmed the prediction that participants exposed to a high-level prime would select a high-effort\*reward over low-effort\*reward option, relative to a low-level prime, supporting  $H_1$ . This effect was also observed in comparison to a no-intervention control. As expected, only abstract considerations predicted experiment choice under high-level priming supporting  $H_{2b}$  and  $H_{3a}$ . Unexpectedly, concrete considerations did not significantly predict experiment choice for the low-level condition, but did influence the selections of control participants, necessitating the rejection of  $H_{2a}$  and  $H_{3b}$ . This result is potentially a consequence of the self-reflection and hypothetical reasoning experienced by the low-level but not control group. The aforementioned factors are both associated with more abstract thought (Trope & Liberman, 2010), therefore it is possible individuals in the low-level condition held a more abstract mindset than those in the control condition, despite their exposure to a concrete prime. This assertion cannot be objectively confirmed given participants in the control group were not instructed to produce statements for construal level analysis, however

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it is supported by similar findings presented in study 2A. In comparisons across EFT groups, results indicate participants' in the high-level condition displayed a more abstract mindset than those in the low-level condition, and were also more likely to engage in high-effort\*reward activity.

### Implications

The observation that abstract construals promote high-effort\*reward choice substantiates a limited evidence-base regarding the application of CLT to physical effort, and aligns with the perspective that abstract construals direct attention toward the reason for engaging in activity (potential rewards) whereas concrete construals make salient attributes regarding how activity is enacted (required effort; Trope & Liberman, 2010). The observation that only abstract considerations predicted experiment choice in the high-level condition further supports this notion, and is harmonious with evidence that suggests sufficiently enticing rewards diminish perceptions of effort (Bonnelle et al., 2015). Indeed, participants who received either no-intervention or a concrete prime were most likely to select a low-effort\*reward option, which is consistent with the observation that humans are typically driven to minimise effort costs (Kool et al., 2010; Bonnelle et al., 2015). Collectively, these results suggest high-level priming can recalibrate the default tendency to avoid effort, by enhancing the relative salience of associated rewards. Interestingly, no significant difference in participants' rating of effort and reward perceptions across choices and within conditions was observed, suggesting the beneficial effects of abstract construal priming operate implicitly. Consequently, this strategy represents a valuable alternative to historical methods of promoting physical activity, which demand limited reserves of conscious regulation (Teixeira et al., 2012).

More broadly, the findings presented here suggest the value of eudaimonic frames in motivating healthy behaviour. Specifically, an abstract prime statement originally developed within the context of healthy eating also promoted the extent to which individuals were prepared to tolerate physical effort. This indicates the accentuation of superordinate characteristics enhances self-regulation across multiple domains, and implies strategies which facilitate the identification and committed pursuit of high-level objectives are powerful in motivating physical health.

### Strengths

Effort discounting measures have been underutilised in previous research. This study

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capitalises upon recent work which has characterised the underlying mechanics of effort discounting (Bonnelle et al., 2015), and provides novel evidence regarding the use of construal priming in the mobilisation of physical effort. Moreover, the current study acknowledges the value of treating numerous NCD risk factors simultaneously, and indicates the applicability of construal level priming across multiple behaviours relevant to the development of noncommunicable disease. The assessment of these principles in a laboratory setting offered a highly controlled environment, and utilised a more ecologically valid methodology than prior research. Specifically, participants were presented with an ostensibly real and discrete choice between sedentary behaviour, and action representative of the whole-body cardiovascular effort required to maintain good physical health (Hallal et al., 2012).

### Limitations

The current findings are based on the results of a single discrete-choice trial and thus should be extrapolated with caution. However, whilst the nature of the fictional effort experiment task limits the presentation of multiple effort-based selections, it does represent greater ecological validity over equivalent measures. Additionally, the occurrence of pathological conditions associated with behavioural apathy in the present sample was not assessed, and therefore this is a confound which could have influenced differences between groups. Also, individuals in the control condition were not asked to generate any text, meaning their default construal level was not possible to measure. It is therefore inappropriate to draw substantive conclusions regarding abstraction level in comparisons of the control and experimental groups. Whilst the inclusion of a no-intervention control here represents a component often neglected by previous research, future experiments should facilitate the objective analysis of construal level statements.

### Conclusions

A growing body of research suggests effort discounting may explain individual differences in the extent to which people engage in physically active behaviour (Bonnelle et al., 2015; Cléry-Melin et al., 2011; Klein-Flügge et al., 2015; Prévost et al., 2010). The current study provides novel evidence that construal level primes developed in response to eating-related considerations can successfully promote effort mobilisation via enhancing the salience of high-level rewards. This provides valuable insight regarding the treatment of multiple risk factors in the development of noncommunicable disease, and further evidences the use of eudaimonic framing in promoting healthy lifestyle

behaviour.

## **General Discussion**

Discovering more about implicit influences upon healthy-decision making is important in promoting population health. Specifically, the current work assessed the influence of construal primed episodic future thinking on eating behaviour, and the carry-over effects of this manipulation to physical effort. Results showed after exposure to a high-level prime, participants were more likely to select a physically effortful exercise experiment and less likely to consume large amounts of high-calorie food when this prime was also paired with episodic future thinking. Furthermore, participants primed with a low-level induction rated the sensory attributes of high-calorie food as more salient and important, indicating an alteration in subjective experience and conscious evaluation.

### **Construal Primes and Episodic Future Thinking**

One intention of the current research was to establish how construal priming shapes episodic future thinking and directs eating-behaviour. Aligned with the emotion-imbued choice model (Lerner et al., 2015), hypotheses proposed low-level EFT would stimulate excitatory emotion and prompt consumption behaviour, whereas high-level EFT would dampen the influence of visceral responses to enhance restraint. Overall, high-level EFT did not promote the self-regulation of food-intake, however low-level EFT did evoke greater consumption of high-calorie food, as well as the salience of related sensory characteristics. Further work which employs either domain-specific or unconstrained manipulation consistently across experimental and control groups is necessary to confirm the relative efficacy of these effects to a neutral comparison. Nevertheless, these findings are important given many prior EFT interventions have emphasised the value of perceptually vivid prospection, but neglected factors which alter the goal-related contents of future thought. In the current instance, findings suggest EFT which directs attention to low-level objectives can impair health behaviour.

### **Construal Primes Across Eating and Exercise Behaviour**

Furthermore, study 2B aimed to establish whether eating related construal primes would influence decisions regarding exercise, which is important for addressing multiple NCD risk factors simultaneously. This methodology also reveals how the salience of abstract and concrete

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characteristics differentially impact distinct behaviours. The present findings indicate construal primes can successfully influence both eating and exercise behaviour, consistent with the perspective that abstract construals enhance the salience of high-level features across all object representations (Fujita et al., 2006). However, it is also important to acknowledge nuance in the mechanisms underlying healthy choice across eating and exercise decisions. Specifically, low-level considerations evoked unhealthy behaviour in the consumption of high-calorie food, but did not elicit greater aversion to physical exercise. Conversely, high-level considerations did not enhance eating-related restraint, but did promote physical activity engagement. Collectively, these results suggest generally more abstract thought promotes healthy-decision making. However, the relative importance of low-level considerations in healthy eating and high-level considerations in exercise also has important theoretical implications. Much prior CLT literature has concentrated upon the value of abstract thought in promoting health (eg. Borovoi, Rezlescu, & Vlaev, 2017; Carrera, Caballero, Fernández, & Muñoz, 2016; Fujita & Roberts, 2010; Sweeney & Freitas, 2017), whilst less work has examined the role of concrete considerations. However, the findings of study 2A suggest concrete EFT was more influential in driving unhealthy food consumption than abstract EFT in supporting dietary restraint. One explanation for this effect is that the future prospection required in both experimental conditions evoked a relatively abstract mindset, thus limiting the effects of an additional abstract prime. However, food characteristic ratings in the high-level group were not significantly different to the strongly concrete control group, implying this is not the case. Alternatively, it is possible that concrete considerations are particularly impactful when individuals are required to inhibit rather than activate behaviour. This aligns with the perspective that self-control failures occur when rational intentions are disrupted by immediate temptation (Loewenstein, 1996), suggesting that in situations which require individuals to dampen appetitive visceral sensations (e.g. food consumption) concrete considerations are most important in directing choice. In contrast, when individuals are required to endure aversive visceral sensations (e.g. physiological effort), abstract construals are of greater influence because perceptions of effort are directly influenced by associated rewards (Bonnelle et al., 2015). Thus, concrete considerations disrupt long-term intentions when individuals must inhibit behaviour, but long-term intentions are critical to the activation of effort. As such, eudaimonic frames may be particularly valuable in driving physically active behaviour.

## Implications

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The results and conclusions reported here have important implications for healthcare practitioners. Broadly, the current research suggests supporting individuals to consider health-related decisions in more abstract and less concrete terms can motivate physical activity and improve eating behaviour. Interestingly, construal priming also appears to influence subjective experience, and therefore represents an effective method of evoking volitional engagement amongst populations who demonstrate entrenched attitudes against physical health. Equally, given construal priming operates according to implicit processes, it may also help to support self-control for those who behavioural regulation is particularly difficult, such as highly-restrained eaters (Soetens et al., 2006). Specifically, the present research suggests healthcare campaigns which aim to promote a future-orientation should consider congruency across construal primes and desired behaviour. By pairing communications which direct attention away from low-level considerations, healthcare communicators can attenuate impulsivity. Alternatively, emphasising proximal rewards can evoke immediate action. Moreover, evidence indicates construal prime techniques are not only relevant to strategic intervention, but can be intentionally employed at an individual level. For example, consciously distancing oneself from negative memories facilitates adaptive self-reflection and interpersonal behaviour (Ayduk & Kross, 2010) and individual differences in knowledge regarding the utility of construals predict self-control success in academic and dietary contexts (Macgregor, Carnevale, Dusthimer, & Fujita, 2017). Consequently, healthcare interventionists may wish to develop materials that educate the wider population on the self-regulatory benefits of construals.

### **Strengths**

This chapter presents novel evidence regarding the application of construal level theory to reduce impulsivity and promote healthy behaviour. Primary health outcomes were objectively assessed at the behavioural level, supporting the ecological validity of current findings.

### **Limitations**

Across both studies, participants were primarily female, young adult higher education students. Whilst this may limit the generalisability of findings to other populations, both episodic future thinking and construal prime manipulations have previously been employed at the population-level.



### Future Directions

The current study represents the first exploration of construal level as an incidental influence upon future prospection, and provides fertile ground for future research. Further investigation should elucidate whether emotional arousal represents a mediatory influence in construal primed EFT, for example via using autonomic assessments such as galvanic skin response and pupillometry (Bradley, Miccoli, Escrig, & Lang, 2008). Evidence indicates dieters struggle to down-regulate hedonic responses to food when emotionally aroused (Hofmann, van Koningsbruggen, Stroebe, Ramanathan, & Aarts, 2010), and thus the influence of EFT on both valence and intensity of emotion in eating behaviour is valuable to assess. Additionally, given the current study presents the novel evidence regarding a lasting effect of construal primed EFT upon wellness behaviour, future studies could use attentional bias paradigms to investigate prolonged attention toward high- and low-level environmental cues. Lastly, empirical interest in CLT has recently experienced a revival, eliciting a rapidly growing-knowledge base. The current investigation considers how construal primes can complement a pre-existing EFT intervention, and given the style in which individuals represent psychological distant is relevant to a number of cognitive processes and behaviours, future investigation may explore how burgeoning insights from CLT can enhance other methods of self-regulatory support.

Furthermore, strong physical health requires individuals to both initially engage in physical activity, but also to maintain effort over an intended exercise period. Future work may expand on the current study by exploring the maintenance of effort. Individuals often disengage from the moderate-to-vigorous activity levels necessary to influence health outcomes as a result of unpleasant physiological sensations (Richards et al., 2010). However, in light of evidence that reward salience subjectively influences the perception of effort (Bonnelle et al., 2015), and the observation that abstraction level alters sensory experience (Borovoi et al., 2017; Hansen & Trope, 2013), construal priming may be used to diminish the discomfort of effortful experience. Indeed, high intensity exercises are retrospectively rated as more satisfying than low-effort alternatives (Bartlett et al., 2011), suggesting strategies which support individuals in sustaining high effort levels can result in the attainment of both physical and psychological health.

### Conclusions

In summary, this chapter demonstrates how different levels of cognitive abstraction can

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influence health behaviour in eating and exercise domains. Results suggests construal priming not only influences choice, but can alter subjective experience to support volitional engagement and potentially attitudinal change. In particular, low-level EFT drives unhealthy behaviour because it promotes the salience of sensory characteristics and high-calorie consumption. Alternatively, construing physical effort in abstract terms focuses attention on effort-related benefits, which subjectively reduce perceived costs. Healthcare practitioners should aim to incorporate these insights amongst behavioural change campaigns, and future academic research should explore the role of emotional arousal as a mediatory factor between decision-making and construal prime.

The chapters presented thus far have described the role of eudaimonic frames in supporting the self-regulation of health behaviour. Specifically, eudaimonic activity is associated with the prioritisation of distal goals over short-term objectives, and deriving enhanced wellbeing from such pursuits may displace pleasure-seeking activity. Building upon cross-sectional evidence that a behavioural pathway exists between psychological and physical wellbeing, Chapter 2 indicated enhanced life meaning can promote the appeal of healthy lifestyle action, whilst in the current section, primes which promote attention toward distal objectives and away from proximal concerns evoked healthy behavioural responses. It is important to ascertain if these principles translate to typical experiences in daily life and are ecologically valid outside of the laboratory environment. As such, Chapter 4 considers the role of eudaimonic framing in a widely successful and real-world health promoting initiative.

## Chapter Four

### **A Runaway Success: Factors in the Popularity of a Global Physical Activity Initiative.**

#### **Link to Thesis Objectives and Overarching Themes**

Meaning in life and construal primes are two forms of eudaimonic frame which promote the salience of long-term objectives and diminish the appeal hedonistic pleasures. In the following chapter, principles of eudaimonic framing are explored within the context of a real-world physical activity initiative known as parkrun. The motivations and behaviours of people who attend parkrun are particularly relevant to the current research, because these individuals report wellbeing benefits associated with freedom, achievement and reciprocity. As such, parkrun represent a successful exemplar of the positive health paradigm, in that it facilitates the basic psychological need satisfaction inherent to eudaimonia, and promotes both physical and psychological health. Parkrun is also interesting to investigate because it engages large numbers of participants, including socioeconomically deprived population groups. Lastly, initiatives which target physical activity are particularly valuable in the alleviation of noncommunicable disease, given increased exercise is often accompanied by a positive change in other health behaviours.

### Abstract

**Objective:** “parkrun” engages large numbers of participants in physical activity, including previously inactive individuals. Little is known about the antecedents, maintenance and consequences of attendance. This study aimed to identify motivational and behavioural factors regarding initial participation, and attendance sustained over one year.

**Design & Participants:** A mixed-methods design was utilised, comprising a qualitative investigation of factors underlying the precipitation and maintenance of attendance (study 3A), and a hierarchical linear regression which explored how parkrun participation relates to basic psychological need satisfaction, motivation and meaning (study 3B).

**Results:** Participants valued the accessible, novel and organic nature of parkrun, and described behavioural “spillover” behavioural effects, such as attenuated alcohol use. Basic psychological need satisfaction and intrinsic motivation were implicated in initial attendance, but did not predict long-term participation, whereas identified regulation did. Introjected regulation and meaning in life were negatively associated with parkrun attendance.

**Conclusions:** Enabling practical accessibility, and sensations of autonomy, competence and relatedness are important to initial engagement with parkrun, whilst perceptions of meaning in life and identified regulation can promote longer-term commitment. Replicating the features of parkrun which afford basic psychological need satisfaction and identified motivation in other public-health initiatives can support further population-level physical activity.

## Introduction

When undertaken regularly, physical activity (PA) can help to prevent multiple forms of noncommunicable disease. Not only is exercise independently associated with a reduced likelihood of developing various lifestyle related health conditions (Reiner et al., 2013), but higher levels of physical activity are also causally linked to improvement in other health behaviours, such as food choice (Mata et al., 2009) and smoking cessation (Janse Van Rensburg, Taylor, Hodgson, & Benattayallah, 2009). In particular, recreational running has been identified as a particularly appropriate health promotion target (Department of Health, 2004) due to noted associations with longevity (Lee et al., 2014; Schnohr, Marott, Lange, & Jensen, 2013), and mental health benefits (Paluska & Schwenk, 2000). Recreational running also offers a convenient, non-specialist and low-cost route to exercise (England Athletics, 2013; Hitchings & Latham, 2017; Scheerder, Breedveld, & Borgers, 2015), and thus reduces frequently cited physical health barriers, such as lack of time, skills and facilities (Grunseit et al., 2018; Scheerder et al., 2015). In parallel, there is some evidence that mass participation sports events (MPSEs) such as fun runs and distance races are becoming increasingly attractive to the general public (Cleland et al., 2018). MPSEs can promote recreational running whilst participants prepare for upcoming events (Bowles, Rissel, & Bauman, 2006; Murphy & Bauman, 2007). However, the extent to which these initiatives attract population groups who typically demonstrate low PA is uncertain, and additional work suggests activity can substantially decline in the months following MPSE participation (Lane, Murphy, Bauman, & Chey, 2012).

In contrast, one initiative which may provide a platform for sustained physical activity is parkrun (Stevinson, Wiltshire, & Hickson, 2015). Operating under the philosophy of promoting PA and wellbeing in an inclusive environment, parkrun provides free, weekly and timed 5km run/walk events in green spaces (parkrun, 2019). Parkrun also engages large numbers of participants and has displayed unique efficacy in attracting previously inactive individuals, with over 90.6% of registrants previously unaffiliated with any informal or formal exercise groups (M. Graney, personal communication, May 15<sup>th</sup>, 2019). Established in 2004 during an unofficial gathering of 13 amateur runners, 141,719 parkrun events have taken place across 635 international locations, with over 2 million people taking part (parkrun, 2019). Even more remarkably, the initiative depends on sponsorship to cover administration costs, has minimal marketing outputs, and each event relies on a fluctuating roster of volunteers. Despite such low economic investment, parkrun has experienced rapid growth, leading to a high prevalence of community-led events, at a global scale (Cleland et al.,

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2018). As such, parkrun appears as a regular and accessible initiative, inspiring engagement equivalent to other MPSEs, yet also presenting an opportunity for participants to cultivate regular PA practices with minimal public cost.

Parkrun may also represent a particularly appropriate environment in which to investigate positive health. This is because the initiative is thought to convey psychological wellbeing benefits, and has been recommended by the Royal College of General Practitioners as a signpost for patients wishing to alleviate anxiety and depression (RCGP, 2018). Specifically, attendees of parkrun indicate the event provides them substrates of wellbeing, including a sense of achievement and community (Stevinson & Hickson, 2013). Moreover, attendance is associated with improved mental health in women, and social relatedness in men (Grunseit et al., 2018). Further evidence indicates parkrun is a uniquely autonomous exercise context, whereby there is little pressure to take part (Stevinson et al., 2015). These observations suggest parkrun may afford eudaimonic wellbeing by enabling participants to achieve sensations of achievement and social connection in a non-pressurised environment. However, despite significant practical success and anecdotal reports of value, little empirical work has considered the success and potential of parkrun as a holistic health initiative.

Amongst existing literature, a small number of relevant studies have focussed on the physical health (Stevinson & Hickson, 2013), nutritional habits (Reeves, Grandy, Mayan, & Huber, 2017) or exclusively social motivations of ‘parkrunners’ (Hindley, 2018; Wiltshire, Fullagar, & Stevinson, 2018; Wiltshire & Stevinson, 2018). Less is known about factors which initially attract individuals, and support the maintenance of subsequent attendance. Stevinson et al. (2015) present the first and only qualitative investigation of parkrun, indicating the importance of freedom and reciprocity at the event. Additionally, Cleland et al. (2018) indicate parkrun attracts population groups hard to engage in exercise, and that participation levels are positively associated with perceived social benefits, self-efficacy, and intentions to participate. Lastly, Grunseit et al. (2018) suggest parkrun may provide a platform for athletes to express their identity, and present a non-demanding and social PA context for non-athletes. The present study integrates these findings and utilises a mixed-methods and psychological perspective in presenting a novel exploration of parkrun attendance.

Overall, parkrun presents a financially viable and highly successful route to encouraging PA. Not only does this initiative address a major public health priority in attracting typically underrepresented demographics, but parkrun may also infer a range of holistic health benefits.

Despite this, the evidence base regarding the antecedents, maintenance and consequences of parkrun attendance is sparse. Therefore, the current research aims to further prior work via a qualitative investigation of parkrun attendance in study 3A, and the first application of an established theoretical framework to understand predictors of parkrun attendance in study 3B. Resultant findings can reveal more about sustained PA, examine the role of positive health principles in a field setting, and determine essential principles in the design of future public health initiatives.

### **Method: Study 3A**

#### **Participants**

Participants were 35 adults who attended a parkrun located at Penrhyn Castle, North Wales, on one of three separate dates (for demographic data see Table 24). An opportunity sampling procedure was employed, whereby every runner who attended the event was invited to participate in the study via a scripted request from one of three researchers: *“Would you like to answer some questions about why people come to parkrun?”*. All participants were also presented the chance to win a £50 voucher as an incentive to take part. Individuals with varying degrees of previous attendance were well represented in the sample, as were participants from a broad range of socioeconomic backgrounds. The study was awarded full ethical approval by the Bangor University School of Psychology Ethics Board (application #2016-15811) and all participants gave fully informed written consent.

#### **Measures**

##### **Demographic Information**

Participants were asked to provide basic demographic information regarding their gender, annual household income, body mass index, ethnicity and religious orientation. Additionally, individuals were asked to record the level and nature of physical activity they participated in prior to attending parkrun, as well as whether they had initiated novel physical activity subsequent to attending (Table 22). These data were used to form binary categories based on frequency of participation (‘regular’  $\geq$  once per fortnight; non-regular  $<$  once per fortnight). A more nuanced analysis was not employed, as this insight was not of primary concern in the current study. Details regarding participants’ prior running experience were also

recorded. The number of parkruns individuals had attended prior to data collection was captured using the open access parkrun database, as were participants' age categories.

### **Qualitative Questionnaire**

Data were collected via the use of a paper survey (Appendix 5.18). An initial iteration of this questionnaire was first used with a pilot sample of parkrun participants ( $n = 5$ ) to establish comprehension and clarity of questions, before a revised nine-item version was employed with the full sample. The finalised items were those which prompted the most extensive consideration of ones' parkrun experience. These open-ended, free-response questions were designed to allow participants significant scope in their responses. However, all questions were neutrally framed in order to minimise bias (Patton, 1987), for example; *"Have you noticed any changes to your emotions and feelings since you started parkrun?"*. Further, the use of a paper survey allowed participants to freely comment upon their personal experience of parkrun, yet minimised the influence of social desirability concerns, which are magnified as a consequence of more direct interaction with the researcher (Heerwegh & Loosveldt, 2007).

### **Data Collection**

#### **Setting**

Although distinct parkruns operate according to a unified philosophy, it is important to consider factors which contribute to the success of individual locations, as well as cross-cutting themes that facilitate conglomerate popularity. This perspective is particularly pertinent, as whilst a common ethos emanates throughout the initiative, the volunteer-driven nature of parkrun means each location has a unique and fluctuating organisational team. Therefore, a single parkrun was identified to act as a rich data source of information about the motivations of runners at one location, whilst also providing insight about aspects of parkrun which may prompt participation more globally.

The Penrhyn parkrun presents a particularly appropriate location for analysis, as at the time of analysis, this event is the only parkrun in North West Wales, and therefore serves an extensive geographic and demographic area. Additionally, given investigation undertaken in context enables the most accurate and vivid retrieval of mental content, several conditions which facilitated data collection in situ presented additional benefit. For example, the use of enclosed spaces at the



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beginning and end of the run route meant researchers could easily explain the study to all participants preceding the run, and approach individual runners upon their exit from the finish funnel. Further, the close proximity of seated areas at parkrun enabled participants to complete their questionnaire immediately and comfortably, facilitating a larger proportion of the invited sample to be retained than might otherwise be possible.

### **Procedure**

Individuals were informed of the study at a briefing normally held before the start of each run. Participants were notified that the purpose of the study was to establish what motivates people to attend parkrun, and that they could receive an incentive for taking part. Each runner was approached by a researcher unknown to them at the end of the run, and invited to answer the questionnaire. Individuals who accepted this request were first asked to confirm whether they were over 18 years of age, before reading a more extensive description of the study (Appendix 2.4) and providing fully informed, written consent (Appendix 1.4). Subsequently, participants completed the questionnaire, were thanked for their time, and provided with a written debrief. The research team remained non-intrusively available throughout the data collection process to resolve any ambiguity regarding participants' understanding of the survey, and to capture additional nuance by making paper recordings of verbal responses participants volunteered in addition to their written text.

### **Data Analysis**

A theoretical inductive thematic analysis was undertaken by three researchers, according to the protocol specified by Braun and Clarke (2006), and in alignment with a semantic, essentialist approach (Figure 17). This entailed the identification, description and interpretation of themes to reflect participants' experience of reality, but did not include an

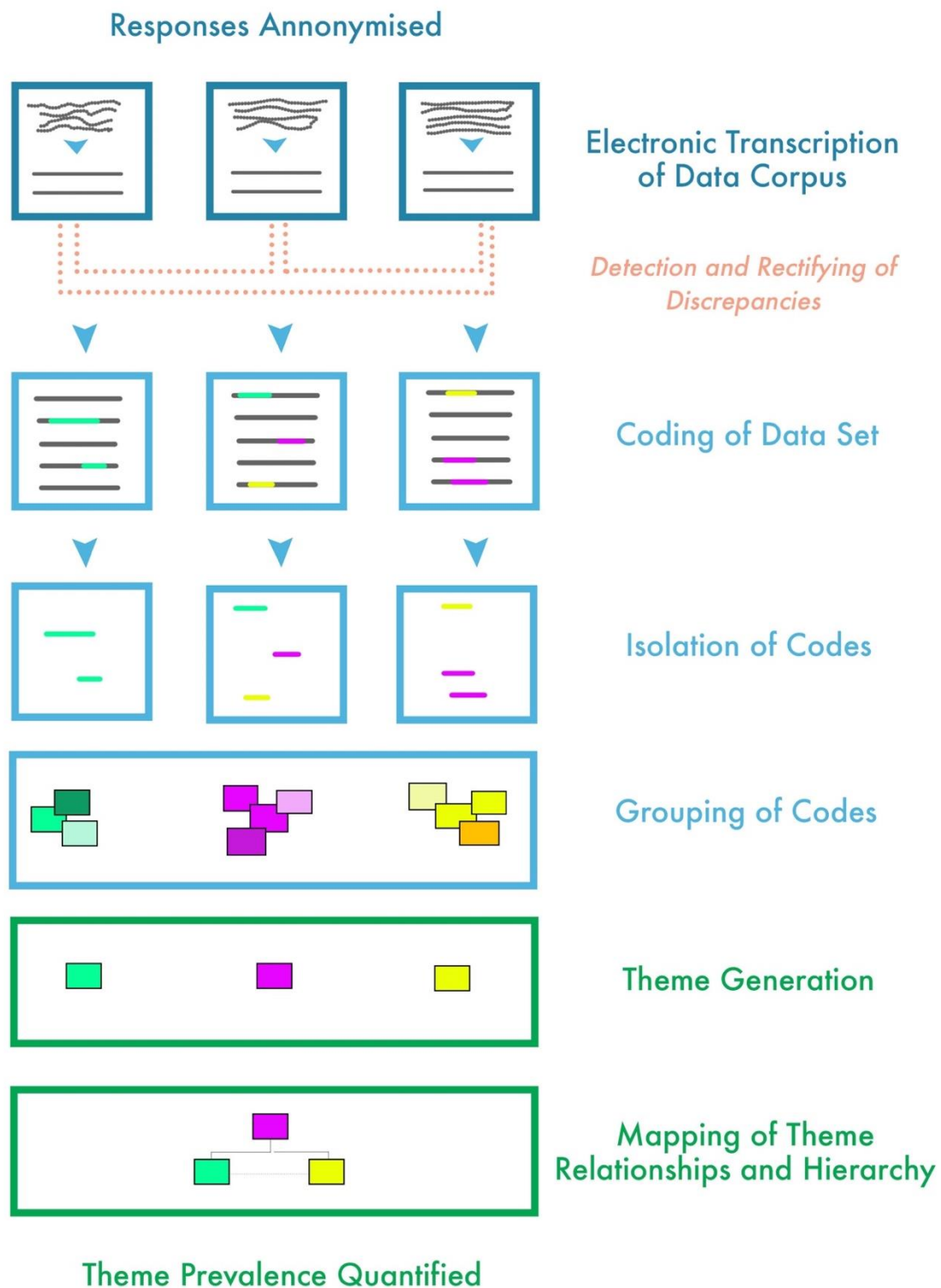


Figure 17. Schematic to depict thematic data analysis in study 3A.

analysis of how such reality is created, or the relative role of social discourse. All responses were anonymised using a unique ID, meaning researchers were blind to the demographic details of each individual. Initially, the three investigators independently transcribed the written data corpus into an electronic format to ensure familiarity with participants' narratives, and to detect and rectify discrepancies across transcriptions. This strategy also provided an opportunity for the researchers to denote their initial impression of themes. The three researchers independently coded the entire dataset in triangulation to enhance understanding and rigour (Houghton, Casey, Shaw, & Murphy, 2013). Continuing to work independently, the researchers subsequently isolated codes, retaining any contextual data relevant to their interpretation, for example to distinguish alternate forms of "free" (eg. a sense of autonomy as denoted by "pressure free", compared to economic cost). At this point, the research team collectively organised the codes into groups of duplicates or synonyms across those identified by each researcher and narrative, such as "*natural beauty*", "*beautiful scenery*" and "*surrounding outdoors*". Thereafter, groups of codes were used to generate themes, identified as repeated occurrences of comparable responses, assimilated to represent higher level constructs. Semi-quantification was employed to partially inform this development, whereby prevalence was defined as the number of times a code occurred across participant narratives and survey questions (Braun & Clarke, 2006). This approach was used to enable patterns in the data to be identified with greater clarity, and was deemed appropriate given that all participants were presented with the same questions in an identical format (Des Jarlais, Lyles & Crepaz, 2004; Tong, Sainsbury, & Craig, 2007). However, the frequency of responses was not used as an absolute proxy of importance, and therefore codes which appeared particularly noteworthy due to great elaboration or strong emotional valence were retained. Following this, the researchers collectively reviewed themes to develop a coherent final set. Next, the identified themes were named and defined within the context of the original data extracts, before being schematically mapped to identify relationships between higher and lower level constructs, as well as to devise superordinate categories for groups of related themes. Finally, the presence of each theme across all narratives was established, to supply a quantitative assessment of prevalence. According to the recommendations of Ritchie, Lewis, McNaughton Nicholls, and Ormston (2003), theme prevalence is represented by the number of participants who identified a given motif, as a proportion of the entire sample. This provides a more transparent metric of data analysis, enables further precision in the reporting of findings (Maxwell, 2010).

## Results: Study 3A

### Demographic Information

Data regarding participants' engagement in activity prior and subsequent to parkrun attendance is shown in Table 22, and demographic information data in Table 24. Seventy-six percent of the sample reported their annual household income. The modal income category was £26 – 32,000, and 65% of respondents reported annual income in this category or below. Eight-eight percent of the sample reported their body mass index, and of these 65% fell within the healthy band of 18 – 25, and 29% recorded a BMI 25. Fifty-two percent of the sample were either non- or irregular runners prior to attending *parkrun*, and 51% reported initiating novel exercise after their first event. As such, the sample documented a greater proportion of healthy-weight participants, and similar levels of prior running experience to those reported in a study by Cleland et al. (2018).

Regularly Performed Prior to Attending Parkrun		Initiated Subsequent to Attending Parkrun	
Activity	N(%)	Activity	N(%)
None	8(23.2)	None	14(40)
Circuits	2(5.8)	Circuits	1(2.9)
Cycling	5(14.5)	Climbing	1(2.9)
Football	2(5.8)	Cycling	2(5.8)
Gym	7(20.3)	Football	1(2.9)
Hill Walking	2(5.8)	Gym	1(2.9)
Running	17(49.3)	Hill Walking	1(2.9)
<i>Competitive</i>	1(2.9)	HIIT	1(2.9)
<i>Fell/Trail</i>	2(5.8)	Netball	1(2.9)
<i>Road</i>	14(40.6)	Pilates	1(2.9)
Pilates	1(2.9)	Running	13(37.7)
Sailing	1(2.9)	<i>With Club</i>	2(5.8)
Spinning	4(11.6)	<i>Competitive</i>	2(5.8)
Squash	1(2.9)	<i>Fell/Trail</i>	1(2.9)
Triathlon	2(5.8)	<i>Road</i>	8(23.2)
Swimming	7(20.3)	Swimming	7(20.3)
<i>Pool</i>	6(17.4)	<i>Pool</i>	6(17.4)
<i>Open Water</i>	1(2.9)	<i>Open Water</i>	1(2.9)
Zumba	1(2.9)	Not listed	4(11.6)

Table 22. Cohort participation in physical activity type shown in total n and % of total sample.

## Thematic Analysis

Two superordinate categories regarding parkrun participation were identified; drivers of attendance ([1.1] the organic development of parkrun, [1.2] experiencing novelty and [1.3] eudaimonic satisfaction) and consequences of attendance ([2.1] emotion, cognition and behaviour and [2.2] disposition and outlook). Participant quote codes can be viewed in Table 21, and demographic information in Table 22.

Code	Gender	Age Category	Total Parkruns
PIL	F	20-24	61
PAY	M	40-44	34
PCD	M	60-64	50

PFR	F	35-39	44
PCK	F	40-44	73
PQV	F	55-59	105
PO <sub>2</sub>	M	55-59	84
P8M	F	45-49	6
P <sub>2</sub> U	M	45-49	29
PIB	M	25-29	64
PFU	F	50-54	12
PVP	M	20-24	47
P <sub>32</sub>	M	20-24	3
PBF	M	25-29	16
P <sub>24</sub>	M	20-24	11
PUA	F	40-44	57
PLB	F	30-34	83
PCK	F	40-44	73
PZW	M	55-59	105
PM <sub>7</sub>	F	20-24	32
PP <sub>0</sub>	M	35-39	139
PMX	M	20-24	29
PSO	F	40-44	63
PX <sub>0</sub>	M	40-44	54

*Table 23. Participant information regarding qualitative quote code, gender, age category and total number of previous Parkruns at the time of data collection.*

Variable	N(%)
<b>Age Category (Years)</b>	
18-24	6(17.4)
25-34	3(8.6)
35-44	8(22.9)
45-54	1(2.9)
55-64	1(2.9)
65-74	1(2.9)
No response	2(5.7)
<b>Gender</b>	
Female	15(42.9)
Male	20(57.2)
<b>Annual Household Income (GBP)</b>	
6 - ≤ 13,000	-
>13 - ≤ 18,000	1(2.9)
>19 - ≤ 26,000	1(2.9)
>26 - ≤ 32,000	4(11.6)
>32 - ≤ 48,000	7(20.3)
>48 - ≤ 64,000	2(5.8)
>64 - ≤ 96,000	3(8.7)
>96,000	3(8.7)
No Response	12(34.3)
<b>Participated in Regular Exercise Prior to Parkrun</b>	26(74.3)
<b>Participation in Running Prior to Parkrun</b>	
None	10(28.6)
Occasional Leisure (≥ once a fortnight)	8(22.9)
Regular Leisure (< once a fortnight)	6(17.1)
Member of a Club	8(22.9)
5k Training Plan	3(8.7)
<b>Initiated Novel Exercise Post Parkrun</b>	18(51.4)
<b>BMI</b>	
> 18	2(5.7)
18 – 25	20(58)
< 25	9(26.1)
No Response	4(11.6)
<b>Ethnicity</b>	
White	33(88.5)
Other Ethnic Background	2(5.8)
No Response	2(5.7)

Table 24. Demographic information for sampled parkrun participants (n = 35).

### Drivers of Attendance [1]

Whilst 18 (51.4%) individuals reported they were initially motivated to attend parkrun in order to improve their physical fitness, only four (11.4%) participants mentioned physical health outcomes in their most significant event experiences. Alternatively, the majority of respondents reported enjoying an inclusive atmosphere, variety, and satisfying basic psychological needs, as well as appreciating practical elements such as cost, convenience and reliability.

#### Organic Development [1.1]

One of the most defining features of parkrun is its development from a small group of individuals to an expansive global network. The current research suggests social diffusion has contributed to this evolution, as the entire sample reported they had first become aware of the event via friends or relatives. Two (5.7%) respondents described how curiosity inspired by social media had prompted them to take part, including;

*“I had seen a friend post a picture on social media and decided to join in as a means of getting back into running which I hadn’t done a lot of.” (PIL).*

Another description drew an explicit association between the role of the community in parkrun, and the consequences this has for participants; *“Non-commercial, community led – more organic, more inclusive”* (PAY). Indeed, 27 (77.1%) respondents implied parkrun facilitates participation across demographics. For example, five (14.3%) participants described the ease of re-engaging with exercise at Parkrun, due to the lack of fitness prerequisites;



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**Superordinate, Subordinate and Descriptive Themes**


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**Table  
25.**
**Drivers of Attendance [1]**

## Organic Development [1.1]

*Inclusive**Non-commercialised**Existence communicated via social diffusion**Convenience and reliability help to construct routine*

## Consistent Novelty [1.2]

*Variation in weather conditions and natural environment**Seasonal themes**'Collectable' locations*

## Eudaimonic Satisfaction [1.3]

*Deriving a sense of autonomy, competence and relatedness**Fulfilling one's potential**Taking pride in the achievements of others***Consequences of Attendance [2]**

## Emotion, Cognition &amp; Behaviour [2.1]

*Greater positive affect, relief from negative affect**Enhanced focus and attention**Decreased alcohol consumption, greater physical activity and improved sleep*

## Disposition &amp; Outlook [2.2]

*Enhanced self-confidence**Greater optimism**Revised world view*


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*Superordinate, subordinate and descriptive themes regarding the experiences of parkrun participants.*

*"I had some health problems and could not participate in any physical activity for 8 months. It was my way back to fitness" (PCD).*

A further seven (20%) individuals acknowledged the value of low financial cost, and 15 (42.9%) respondents mentioned an ability to organise participation around other life commitments; *"[I] can come with the whole family, and we can all run" (PFR)*. Furthermore, the high prevalence of parkrun events enabled convenient and easy access;

*"When I am away for weekends I look to see if there is a parkrun near to where I am visiting" (PCK).*

Overall, the convenience, reliability and inclusivity of Parkrun appeared to help individuals develop habits, and maintain routine; *"It's always there - so easy to keep up, [and to] progress" (PO2)*. Finally, the organic development of parkrun also contributed to atmospheric experience. For example, one participant described how a sense of community is important;

*"It fufills all aspects of life; comrade/friendship, encouragement, looking out for others." (PCD).*

Another runner simply expressed how she finds parkrun to be a meaningful activity; *"I come to be part of something great" (P8M)*.

As a whole, 'organic development' refers to the discovery of parkrun via non-commercial sources, and concerns how the community-led nature of the initiative provides an inclusive atmosphere. Indeed, an awareness of communal involvement appears to stimulate participants' appreciation of one another, and promote the perception of parkrun as a significant and beneficial organisation. Additionally, the consistent and pervasive operation of parkrun combines with low entry barriers to facilitate routine and low effort engagement with exercise. Collectively, these features create a dependable, yet non-pressurised environment for physical activity.

### **Consistent Novelty [1.2]**

Participants appreciated how parkruns are held in diverse natural environments, host seasonally themed runs, and offer a variety of 'collectable' locations. Ten (28.6%) participants

reported enjoying running in different weather conditions; one individual simply described his favourite parkrun experience as “*Snow*” (P2U). Others mentioned battling against the elements with companions;

*“My favourite time was running in the heavy wind and rain with other parkrunners”* (PIB).

Whilst turbulent conditions present a challenge that unites runners in their efforts, more tranquil weather provided a sense of calm;

*“So far it’s just been wandering around afterwards... when the weather has been sunny, taking in the scenery and smelling the fragrance of flowers in bloom.”* (PIL).

The frequency with which this theme appeared across respondents’ most memorable experiences suggests a variable outdoor setting maintains participants’ interest across the seasons. An additional source of novelty was themed events;

*“My favourite memory is my Christmas tree outfit at the Christmas parkrun”* (PFU).

Indeed, 19 (54.3%) participants described parkrun in terms of “*fun*”, with seven (20%) respondents stating they were more likely to attend parkrun over other physical activities because of this factor. Further responses described the ‘collectable’ nature of parkrun, in terms of the number of different events interspersed throughout the UK and beyond; “*There’s so many different locations to try out if I wanted to*” (PIL). These remarks imply consistent novelty at parkrun provides an intrinsically enjoyable experience, allowing interest in the event to coexist with consistency of routine.

### **Eudaimonic Satisfaction [1.3]**

As discussed in Chapter 1 (see 5.2), eudaimonic satisfaction is associated with fulfilling universal and innate needs for competence, relatedness and autonomy (Ryan & Deci, 2000). Twenty-seven (77.1%) participants mentioned feeling social connected, 23 (65.7%) participants derived feelings of competence, and 12 (34.3%) runners mentioned experiencing autonomy.

Participants most frequently expressed feelings of autonomy in descriptions of how parkrun differed to other initiatives they had tried in the past, and in addition to reflections upon how parkrun enabled them to feel comfortable;

*“It’s less ‘judgmental’; you can do it at your own pace and just enjoy it” (PCK).*

The minimal event cost also enabled a different kind of freedom for one participant; *“Free – so can be spontaneous” (PAY)*, suggesting that practical as well as atmospheric features supported perceptions of the event as ‘pressure-free’.

The provision of accurate time and distance measurement at parkrun was a compelling method of tracking progress to satisfy competence needs; *“I wanted to run a set distance with time monitoring.” (P5V)*. Notably, feelings of achievement were exclusively expressed in terms of obtaining ‘personal bests’ or race times below a certain threshold, for example *“running sub 25 minutes in January” (PFR)*. No participants directly referenced competition against other individuals, indeed five (14.3%) runners described parkrun as more *“friendly”* than other initiatives they had tried, whilst a further two (5.7%) specifically mentioned that parkrun was *“not competitive” (PVP, P2U)*. One participant remarked that his favourite aspect of parkrun was found in *“competition/challenge” (P32)*, however the apparent dichotomy between this report and those of a more relaxed atmosphere may be explained in terms of the capacity to adapt one’s goals according to personal preference;

*“As serious or as fun as you want it to be...it can be about running against the fastest, or about getting to the line” (PBF).*

Indeed, another participant noted the non-competitive nature of the event directed his attention away from comparative outcome goals, such as defeating other runners, and toward the mastery of intrinsic, performance objectives;

*“Parkrun is different because it’s not competitive (except against myself – P.B. times)” (P2U).*

The outdoor setting at parkrun also featured in participants’ descriptions of competence. For example, two (5.7%) runners remarked upon incidences where battling against the elements had provided them with feelings of achievement. One individual

mentioned a favourite memory as;

*“The time I ran in the freezing cold about a year ago, and didn’t throw-up/die..the thing that I enjoy the most is everyone working to achieve a common goal of fitness together” (P24).*

The sense of community described here was also paralleled in responses that featured spending time socialising as a family unit and meeting friends. Seven (20%) participants reported that they enjoyed connecting with others after running;

*“I like to go to the cafe after the run, and the kids play on the park” (PFR).*

Three (8.6%) respondents implied the likelihood of social interaction was a conscious and primary factor behind their attendance, including;

*“I am motivated by friends who say “Who is going to be at parkrun?”” (PUA).*

In the case of four (11.4%) participants, the demographic variety found at Parkrun appeared to offer atypical social interaction, such as one respondent who viewed Parkrun in terms of social literacy for her family; *“Good social interactions for my children, who are home educated” (PLB)*, and another individual who reported enjoying taking part alongside *“young runners with parents” (PZW)*. A further respondent described how he derived inspiration from an elderly participant;

*“My favourite memory was Bob – an 83-year-old runner completing his 250th run to a guard of honour at Northampton Parkrun on 22/04/17)” (PCK).*

As a whole, Parkrun appears to offer a uniquely low-pressure exercise environment, and a platform for participants to socially bond, which can subsequently act as a direct participatory prompt. The inclusive atmosphere at parkrun not only provides an extensive range of interactions, but also supports feelings of autonomy. A perceived lack of pressure is supplemented by feelings of spontaneity, whereby no financial pre-commitment is required. Relevant and accurate performance statistics support sensations of competence, which are derived from personal performance objectives rather than inter-participant competition. Lastly, the outdoor setting at parkrun may also direct attention toward intrinsic feats, and

contribute to a sense of communal success.

## Consequences of Attendance [2]

### Emotion, Cognition and Behaviour [2.1]

The 27 (77.1%) participants who reported observing changes to their behaviour as a consequence of attending parkrun were most likely to mention becoming more “*active*” (15 participants; 42.9%), or reducing their alcohol consumption (14 participants; 40%). The theme of increased activity was characterised both by targeted physical activity; “*I exercise more regularly*” (PFU); and dynamism more generally; “*I am more positive and productive*” (PM7). Participants typically reported decreased alcohol use on the evening immediately preceding parkrun;

*“It’s my highlight of the week; my 3-year-old love coming... [I have] less beer on Friday night”* (PP0).

Interestingly, two (5.7%) runners explicitly commented on the relationship between their alcohol use and physical activity;

*“I sacrifice going out on Friday nights so I can get up to come to parkrun. Saturdays are more productive because I’m up early”* (PVP).

A single (2.9%) but nonetheless notable response detailed dietary change; “*I look at healthier food options*” (P2U) and four (11.4%) runners commented upon improvements to their sleep; “*Yeah I don’t drink as much, I have a better sleeping pattern*” (PMX).

Additionally, 17 (48.6%) participants reported they had experienced positive emotions both during and after the event. One participant remarked parkrun provided “*temporary relief in depression*” (PM7), whilst another reported “*[I’m] happy for the rest of Saturday*” (PP0). Attaining greater positive affect was documented by some participants in the form of enhanced motivation, a statement which was echoed by a further 15 (42.9%) runners who reflected on becoming more productive; “*[I am] More alert, brain functions better*” (PCD).

Overall, these responses suggest attending parkrun boosts positive mood both in the short and medium term, and may promote cognitive productivity. Data also indicate parkrun

inspires people to limit alcohol consumption, make more nutritious dietary choices, and maintain a healthy sleep pattern.

### **Disposition and Outlook [2.2]**

Amongst the 25 (71.4%) participants who described some form of change to their personal outlook as a result of attending parkrun, 23 (65.7%) reported improvements in their self-confidence, including a feeling of robustness when approaching challenge; *“I’m a lot more optimistic about fulfilling my goals”* (PMX). A further participant implied an increased sense of self-worth was associated with her valuation of sport; *“I am happier in myself; I enjoy running more”* (PSO). Six (17.1%) participants described how parkrun offered them an opportunity for introspection, supporting a revision of their own world view;

*“Great to hear other people’s stories – makes me question my own lifestyle/outlook.”* (PQV).

A further respondent stated he had become *“more positive, less work focussed”* (PX0), whilst another individual remarked upon an alteration in his ability to empathise;

*“I’m more compassionate, more appreciative of others commitment”* (PZW).

Globally, these responses indicate participants valued sharing life experience with individuals who offered an alternative perspective. The inclusive nature of parkrun may encourage this interaction, whereby participants are more likely to volunteer intimate information in an informal atmosphere. Additionally, the action of regularly setting and achieving challenging goals prompted a large percentage of the sample to attain improvements in self-confidence, leading to enhanced wellbeing, and a more tenacious ability to pursue challenge.

### Discussion: Study 3A

Study 3A explored factors in the popularity of a global physical activity initiative, which is considered to exemplify principles of positive health. Several themes were noted as particularly significant in relation to both drivers and consequences of attendance, and thus could be extrapolated to support the design of future public health initiatives.

#### Organic Development, Autonomy and Eudaimonia

Principally, the community-led structure of parkrun may enhance the extent to which participants experience eudaimonic wellbeing, via the satisfaction of basic psychological needs for autonomy, competence, and relatedness. For example, participants described a uniquely volitional and non-pressurised form of physical activity, whereby the absence of an authority figure such as instructor or coach promoted a sense of autonomy. The resultant perception of parkrun as low-commitment may paradoxically drive attendance, as autonomous exercise experiences are more strongly associated with long-term adherence (Fortier, Duda, Guerin, & Teixeira, 2012). Indeed, an extensive literature-base supports the value of autonomy to the self-regulation, enjoyment and maintenance of exercise (Amrose & Andersob-Butcher, 2007; Gunnell et al., 2014; Sylvester et al., 2012; Teixeira et al., 2012), and further evidence indicates heteronomous environments diminish psychological wellbeing (Sheldon & Filak, 2008). The absence of financial pre-commitment or social obligation to attend parkrun may thus position the initiative as a welcome alternative to traditional exercise platforms, which offer less flexibility to attendees.

Participants' reports of relatedness and competence satisfaction may be also driven by existence of a non-expert organisational committee. The opportunity to volunteer at parkrun without specialist knowledge or ability equalises the extent to which individuals can contribute to the initiative, and offers great potential for social connection. This unique feature provides an alternative source of competence for those who do not derive sensations of mastery from athletic pursuits, and may also offer a less daunting route to initiate parkrun attendance amongst individuals lacking physical confidence. Furthermore, the priorities of a non-expert committee may also guide attention to aspects of the event unrelated to physical performance, such as hosting themed runs, and encouraging others. A number of participants noted a focus upon community over competition as a distinctive feature of parkrun, which reduced the common exercise impediment of perceived self-efficacy (Bauman et al., 2003; Zunft et al., 1999), and was connected to the experience of



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sociability and fun. Moreover, as basic psychological needs, feelings of competence and relatedness are considered essential to motivation in any domain (Ryan & Deci, 2000), and are specifically implicated in engagement with physical exercise. For example, a large scale systematic review indicated competence satisfaction positively predicts exercise participation across a range of samples and settings (Teixeira et al., 2012). Patterns between relatedness and exercise participation were more mixed, however a general trend toward a positive association was observed (Teixeira et al., 2012). Moreover, people who experience greater psychological need satisfaction during physical activity report higher levels of associated wellbeing (Gunnell et al., 2014; Gunnell, 2013; Sylvester, Mack, Busseri, Wilson, & Beauchamp, 2012), suggesting exercise programmes which address basic psychological needs are effective in both motivating engagement, and promoting holistic health.

### **Parkrun and Meaning in Life**

The opportunity to participate in meaningful activity at parkrun also conveyed appeal. As discussed in Chapter 2, the experience of meaning in life is associated with engagement in purposeful, significant and prosocial events, which form part of a coherent life narrative (Martela & Steger, 2017). Parkrun participants experienced purpose via working to tackle important goals, and attained significance by viewing their engagement as contributing to a wider community. Greater coherence was supported by the ability to expand one's worldview, via exchanging life experience with others. Collectively, these sensations were enhanced by the opportunity to enjoy parkrun with people of all ages, genders and sociodemographic backgrounds, and to offer support and encouragement. Indeed, specific observations referenced feelings of generativity, understood as the concern for younger generations (Erikson, 1950). Both generativity and meaning in life are noted as natural humanistic desires (Erikson, 1950; Frankl, 1959) and are associated with enhanced subjective wellbeing (Ackerman, Zuroff, & Moskowitz, 2000; Ryff & Singer, 2006), suggesting that deriving meaning at parkrun may offer a valuable incentive for participants. This notion is compatible with the observation that parkrun attendees value the opportunity to reciprocate wellbeing gains, and that contributing to a widely beneficial organisation stimulates a welcome sense of belonging (Stevenson et al., 2015). Further work suggests some individuals may view parkrun as a method of improving low mood as a consequence of positive social interactions (Grunseit et al., 2018). Thus, in an increasingly secular society (Lee, 2014), perhaps parkrun offers a novel method of integrating with one's local community, and deriving wellbeing benefits associated with prosocial activity (Casiday, Kinsman, Fisher, & Bamba, 2008).

### **The Role of Organic Development in Practical Access, Attendance and Social Diffusion**

Additionally, the organic evolution of parkrun presents a number of features which hold incidental value for participants. For example, the absence of age, ability, cost, and extensive travel requirements reduced frequently cited exercise impediments of childcare commitments and time constraints (Zunft et al., 1999), which have been previously implicated in the failure of large scale exercise campaigns (Bauman et al., 2003). Moreover, parkrun utilises a franchise-like model, whereby communities are able to apply for and organise their own event. This has resulted in a high prevalence of parkrun locations, and was observed to carry an inherent sense of inclusivity. Together, these features served to promote accessibility, and may explain why parkrun has been uniquely successful in attracting typically underrepresented exercise populations (Stevinson & Hickson, 2013). Indeed, further evidence demonstrates practical access to parkrun is an important facilitator of participation, as is an inclusive set up (Stevinson, Wiltshire, & Hickson, 2015).

Respondents also identified they were able to attend parkrun more consistently than comparable initiatives, enabling the development of routine. As parkrun events are not dependent on a designated or expert host team, they remain unimpeded by organisational absenteeism, which may support a relatively more regular operation. Importantly, facilitating the capacity for participants to repeatedly enact a behaviour in an unvarying context promotes habit formation (Lally & Gardner, 2013); a mechanism which is strongly implicated in sustained physical activity (Fleig et al., 2016), due to the automatic and low effort nature of habitual behaviour (Verplanken & Melkevik, 2008). Individuals who form exercise habits are less likely to experience attrition from regular physical activity due to a lack of self-regulation, attention or memory (Danner, Aarts, & de Vries, 2007), because the continued repetition of an activity promotes responsiveness to contextual cues such as a time of day, other people or preceding actions in a sequence (Verplanken & Melkevik, 2008). Furthermore, habits decrease the requirement for awareness, control and conscious intention to initiate behaviour (Wood, Quinn, & Kashy, 2002). Accordingly, the appreciation participants' expressed regarding the consistent operation of parkrun may not only reflect gratitude for the dependable nature of the initiative, but also indicate a mechanism via which individuals are able to achieve consistent and automatic exercise behaviour.

The organic development of parkrun has largely depended on social diffusion, whereby knowledge regarding the initiative is communicated via informal channels. This aspect has been

noted as an essential component of initial parkrun participation (Wiltshire & Stevinson, 2018), and in alignment with the observation that demographic affinity between source and recipient can substantially influence the effectiveness of a message (Durantini, Albarracín, Mitchell, Earl, & Gillette, 2006), may contribute to a more volitional and trusting engagement than official marketing formats. Interestingly, the benefits of messenger-recipient similarity are most pronounced for those in lower socioeconomic groups (Durantini et al., 2006), and considering the success parkrun has experienced in attracting members of this population (Cleland et al., 2018), these findings support the value of recruiting individuals embedded within local communities to champion public health initiatives.

### **Behavioural Change and “Spillover” Effects**

Whilst continued motivation to attend parkrun as a means of physical health improvement was notably absent from responses, evidence of healthy behavioural change was nonetheless documented. This not only occurred in the form of increased exercise, but also via attenuated alcohol use, improved dietary choice, and better sleep. One explanation as to why these consequences occurred in the absence of explicit desire, is that parkrun participants are motivated to achieve goals which are indirectly related to physical health. For example, the promise of achieving a new personal best was observed to drive supportive preparatory action, such as reducing one’s alcohol consumption. Here, the existence of volitionally selected and proximal goals as primary motivators of behaviour may address commonly experienced deficits in self-regulation. As discussed in Chapter 1, impulsive tendencies are partially dictated by the propensity to devalue longitudinal rewards (Critchfield & Kollins, 2001), and self-regulation experienced as a product of external or heteronomous sources is widely understood as low quality (Ryan & Deci, 2000). Evidence supports the idea that immediate and important outcomes are more likely to be pursued with tenacity (Critchfield & Kollins, 2001), as are self-selected goals (Vansteenkiste, Niemiec, & Soenens, 2008). Thus, the proximal and compelling benefits of parkrun attendance such as enjoying oneself and achieving a new personal best time may promote healthy behaviour more effectively than the distal outcomes of avoiding disease, which are most typically communicated by healthcare initiatives.

Further, the observation that lifestyle modification occurred across health domains is contextualised via the spillover effect (Mata et al., 2009), which describes how the initiation of a single change can lead to a cascade of behavioural responses. Engaging in exercise has been noted to promote physical activity more generally (Chen et al., 1998), decrease cravings and attentional

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bias for cigarettes (Janse Van Rensburg et al., 2009; Van Rensburg, Taylor, & Hodgson, 2009) and support healthy caloric intake (Mata et al., 2009). Current explanations for the exercise spillover effect include the idea that physical activity strengthens neurocognitive resources for self-regulatory behaviour (Joseph, Alonso-Alonso, Bond, Pascual-Leone, & Blackburn, 2011) and increases individuals' health-related self-efficacy (Mata et al., 2009). Importantly, self-chosen activities are more likely to benefit from the spillover effect (Mata et al., 2009), thus in light of the observation that many government regulations regarding physical health action are too difficult to follow and maintain (Das & Horton, 2016), the non-prescriptive and gradual parkrun approach may offer a more fruitful route to holistic behavioural change.

### Strengths

This study provides rich descriptive data on the motivations and experiences of parkrun participants, which have received little prior investigation from a psychological perspective. Parkrun represents a highly successful and real-world exemplar of the positive health paradigm, and the findings presented here can be used to inform the design of other interventions which aim to promote healthy lifestyle behaviour. Specifically, this study provides highly novel information on practical elements which may motivate health behaviour via eudaimonic satisfaction and meaning in life. These observations represent high ecological validity as a product of investigation in a field setting, and are substantiated by established research.

### Limitations

These data reflect the experiences of a small number of parkrunners at a single location, making the generalisability of findings difficult to establish. Effect sizes were also small. Measures to reduce the risk of anecdotalism include the use of a structured qualitative survey, and a comprehensive and transparent procedure for data analysis. However, an audit trail could have additionally supported this approach. Furthermore, small-scale, qualitative studies are noted as useful in building theory for further investigation (Bryman & Becker, 2012), and as an original investigation of parkrun, this evidence provides a guiding foundation for future work. In addition, recent theory argues combining raw data from multiple qualitative studies is extremely valuable in presenting a picture of the common whole, yet this practice is currently underutilised in research (Wright & Patrick, 2019). As such, comparing the information gathered here with that of other investigations represents a method of recognising broad themes that are not easily captured by

independent datasets. Lastly, the findings reported here demonstrate great affinity to those presented by (Stevinson et al., 2015), providing an indication of comparability.

## Conclusions

The current research suggests parkrun may confer a number of benefits for participants, and develops current understanding regarding its pervasive appeal. Particularly noteworthy is the organic development of parkrun, which has enabled both practical and atmospheric inclusivity. As such, health promotion efforts should enable individuals to actively contribute to the design and operation of initiatives. Furthermore, positive psychological and behavioural outcomes were observed to result from parkrun attendance. These findings substantiate evidence that engagement in physical activity can stimulate further healthy consequences, and implicate the value of exercise in encouraging multiple behaviours relevant to the alleviation of noncommunicable disease.

Understanding factors which determine sustained parkrun attendance could indicate how participants can derive long-term value from the initiative, and imply important principles in the design of future health promotion efforts. Building upon observations that parkrun provides eudaimonic satisfaction and a sense of meaning in life, study 3B examined the role of these constructs in participants' longitudinal commitment.

## Introduction: Study 3B

Several themes identified in study 3A suggest parkrun promotes the ability to meet one's basic psychological needs, which is associated with eudaimonic satisfaction and superior motivational quality (Ryan & Deci, 2000). Further evidence indicated parkrun may provide a route to deriving greater meaning in life. Eudaimonic satisfaction and meaning in life are universally relevant in human psychology (Heine, Proulx, & Vohs, 2006; Ryan & Deci, 2000), which may partially explain why parkrun has evidenced widespread appeal (Stevinson & Hickson, 2013). However, potential variation in the extent to which individuals experience the aforementioned factors at the initiative is unclear, and could differentially influence attendance over time. In order to better understand sustained parkrun participation, and to examine principles of positive health in a field-setting, study 3B employed a prospective cohort design to examine the longitudinal predictive value of motivational type and meaning in life.

### **Basic Psychological Need Satisfaction and Intrinsic Motivation**

As discussed in Chapter 1, the proposal that humans ubiquitously experience the desire to feel competent, autonomous and related to others is a contention of self-determination theory (Deci & Ryan, 2000). This perspective describes how controlled and autonomous motivation comprise a superordinate category known as extrinsic motivation, whereby behaviour results from consequences separable to the target activity. In addition, intrinsic motivation is also considered to result from the satisfaction of autonomy, competence and relatedness, but refers to the maintenance of behaviour due to its inherently enjoyable properties (Deci & Ryan, 2008). Self-determination theory posits factors in the environment which address need satisfaction are instrumental in facilitating intrinsic motivation, as well as the internalisation of extrinsic motives, eliciting superior self-regulation, and greater psychological health (Chen et al., 2015; Deci & Ryan, 2000; Ferriz, Sicilia, & Sáenz-Álvarez, 2013). In contrast, neglecting or thwarting basic psychological needs will negatively impact self-determined motivation (Vallerand & Blissonnette, 1992). The value of basic psychological need satisfaction to exercise participation has been extensively validated across a variety of healthcare settings (Deci & Ryan, 2000, 2012; Ng et al., 2014; Williams et al., 2006; Williams & Ryan, 1996), and is convincingly evidenced to result in physical activity which is enacted more regularly, more intensely and is more likely to become habitual (Duncan, Hall, Wilson, & O, 2010; Edmunds, Ntoumanis, & Duda, 2006; Gardner & Lally, 2013; Standage, Sebire, & Loney, 2008).

The majority of the qualitative sample remarked attending parkrun provided a sense of autonomy, competence and relatedness, indicating the experience of basic psychological need satisfaction. Specifically, parkrun events are hosted in outdoor, communal spaces, emphasise the importance of enjoyment over performance, and place no specific requirements on the age or ability of entrants. These features support the seeking of intrinsic pursuits in a socially vibrant setting, convey sensations of environmental mastery, and promote the experience of parkrun as inclusive, low pressure and fun. Further research supports this perspective, including the finding that enjoyment, social support and self-efficacy at parkrun predict long-term attendance (Cleland et al., 2018), and that the experience of freedom is a predominant motivator of involvement (Stevinson, Wiltshire, & Hickson, 2015). Given the aforementioned relationships between basic psychological need satisfaction, intrinsic motivation and exercise persistence, the current research proposes the following hypotheses;

*H<sub>1</sub> - Greater intrinsic motivation at time 1 will predict parkrun attendance over the following year.*

### **Basic Psychological Need Satisfaction and Extrinsic Motivation**

Furthermore, whilst intrinsic forms of motivation are generally considered to evoke superior self-regulation compared with extrinsic antecedents, variation in regulatory quality exists amongst distinct types of extrinsically motivated behaviour (Vansteenkiste et al., 2008). This observation is particularly relevant to the healthcare domain, considering the maintenance of physical wellbeing often requires individuals to engage in activities that are not inherently enjoyable (e.g. expending physical effort), or to refrain from intrinsically rewarding behaviours (e.g. resisting calorie dense food; Vansteenkiste et al., 2008). Thus, when developing health-related initiatives, a consideration of extrinsic motivational type is at least of equivalent importance to the facilitation of intrinsic behaviour. As discussed (see Chapter 1: 3.2.2) the extent to which an individual personally endorses or ‘internalises’ the value of an activity via need satisfaction can determine whether they experience extrinsic motivation as controlled or autonomous (Deci & Ryan, 1985). Autonomous antecedents of self-regulation include perceived personal benefit (*identified motivation*) and self-concordance (*integrated motivation*). Thus, a critical distinction between intrinsic and autonomous motivation, is that whilst basic psychological need satisfaction may determine the perception of an intrinsic activity as enjoyable, the same process can result in the evaluation of autonomously motivated behaviours as important. As discussed in Chapter 1 (see 3.2.1; 4.1.1.1) highly controlled forms of regulation are not associated with basic psychological need satisfaction (Ryan & Deci, 2000), and represent the desire to avoid punishment and obtain reward (*external motivation*) or persist as a consequence of social pressure (*introjected motivation*; Ryan & Connell, 1989). Crucially, whilst both autonomous and controlled forms of motivation are considered extrinsic and can exert a powerful influence upon behaviour, experiencing identified regulation results in physical activity that is more likely to persist in the absence of external stimuli, to sustain across time, and to result in robust psychological health (Gunnell et al., 2014; Teixeira et al., 2012; Vansteenkiste et al., 2008; Wilson, Rodgers, Loitz, & Scime, 2007).

### **Basic Psychological Need Satisfaction and Identified Regulation**

Basic psychological need satisfaction promotes identified regulation, in that individuals are

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more likely to internalise behaviour when they are volitionally committed, when it is advocated by sources they feel connected to, and when they feel confident in their ability to change (Deci & Ryan, 2000). The experience of autonomy in particular is considered an essential prerequisite, as autonomy-supportive contexts allow individuals to willingly engage with and understand the value of activities, without eliciting psychological reactance (Miller et al., 2007; Rains, 2013). Holistically, need satisfaction enables individuals to possess a sense of ownership over their actions, and when combined with a degree of introspection, facilitates the assimilation of values associated with a given behaviour amongst their own sense of self (Koestner, Ryan, Bernieri, & Holt, 1984).

Parkrun is conducive to this process because participants receive very little pressure to take part, or to perform according to specific criteria. Investigations of non-formal running settings suggest high-demand sporting contexts can dissuade runners who seek to form an exercise habit, rather than pursue performance objectives (Hitchings & Latham, 2017), and thus parkrun may present a welcome alternative for individuals wishing to cultivate sustained PA practices without extrinsic pressure to improve. The organic development of parkrun also stimulates autonomy by positioning the initiative as a shared practice, whereby no single figure assumes authority and everyone can participate in the operational logistics. Lastly, knowledge regarding the initiative is typically communicated by pre-existing members of participants' social circle, eliciting a less authoritative entry to the event.

Once personal criteria regarding the satisfaction of autonomy have been met, participants are more able to appreciate personally relevant and important aspects of potential goals. For example, the benefits of attending parkrun are often described in terms beyond those of physical fitness. In one study, participants recognised parkrun as an important means of building social resources (Cleland et al., 2018), which parallels the motives of participants in study 3A. Additionally, marketing outputs from parkrun typically focus on valuable intrinsic goals such as self-development and tackling adversity, as opposed to extrinsic objectives such as appearance or social recognition. Such features are aligned with autonomous motivation, and have been empirically associated with greater post-event satisfaction than extrinsic objectives in other mass-participation sports environments (Coleman & Sebire, 2016). This experience was additionally related to greater self-reported moderate-to-vigorous physical activity after the event (Coleman & Sebire, 2016).

Furthermore, runners at parkrun are provided with relevant feedback regarding self-



progression, which enables the development of exercise skills. Feelings of competence promote identified regulation, as individuals will only value activities they perceive as possible to master (Niemic & Ryan, 2009). One possibility is that an emphasis upon personal development rather than performance goals at parkrun, in combination with a socially supportive atmosphere, promotes the attainment of an *incremental mindset* (Dweck & Molden, 2000) in attendees. This term describes the perception of performance as controllable, which is related to increased efficacy and outcome expectations (Strecher, McEvoy DeVellis, Becker, & Rosenstock, 1986). These factors are both important predictors of physical activity (Mcauley & Courneya, 1993; Woodgate, Brawley, & Weston, 2005), and are particularly relevant for recently sedentary individuals (McAuley & Jacobson, 1991). The motivational benefits of incremental performance perceptions have been well established in educational domains (Claro, Paunesku, Dweck, Thompson, & Wilson, 2016; Lee, Heeter, Magerko, & Medler, 2013; Yeager et al., 2016), yet have received relatively little attention from the perspective of physical activity. Thus, in the current research an additional measure regarding incremental mindset was employed to investigate the potential of a mediative role in the relationship between competence and sustained attendance at parkrun. As a whole, individual differences in the extent to which individuals experience basic psychological need satisfaction and recognise parkrun as important may determine subsequent attendance via autonomous motivation, thus accordingly, the current research makes a further prediction;

*H<sub>2</sub> - Greater identified regulation for parkrun at time 1 will positively predict attendance over the following year.*

## Meaning in Life

Finally, a particularly novel aspect of parkrun regards the stimulation of participants' sense of meaning in life (MIL). Basic psychological need satisfaction is evidenced as inherent to deriving life meaning (Hicks et al., 2012; Lambert et al., 2013; Martela et al., 2017). This is because relatedness stimulates feelings of belonging and is associated with understanding the wider significance of actions (Hicks & King, 2009; Lambert et al., 2013). In addition, autonomy affords people the capacity to identify and engage in personally meaningful activities (Weinstein, Ryan, & Deci, 2012), and feeling competent enables the perception that one is actively contributing to a cause greater than oneself (Baumeister et al., 2017; Frankl, 1959). Features of parkrun additional to need satisfaction may also support meaningful experience. For example, one of the few marketing

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techniques employed by parkrun is to disseminate participants' personal stories regarding the initiative in weekly emails that also contain performance statistics. Frequently, these anecdotes feature the role of parkrun in supporting participants to overcome adversity such as illness, disability or traumatic events. This conveys a sense of coherence by presenting membership of the parkrun community as part of an integrated life narrative. Further, as observed in study 3A, participants report pursuing personally purposeful and communally relevant accomplishments at parkrun. As discussed in Chapter 2, MIL has been implicated in general health behaviour (Heine et al., 2006; Kashdan & Mcknight, 2013; Kim et al., 2014; Song et al., 2017) and specifically in physical activity (Brassai, Bettina, & Steger, 2015; Hooker & Masters, 2016; Sweeney & Freitas, 2014). As discussed in Chapter 2, current explanations regarding this relationship include the idea that experiencing a more meaningful life promotes the desire to look after oneself and one's future (Brassai et al., 2015), enhances the salience of long-term values (Hicks et al., 2012) and aids the self-regulation of immediate behaviours (Hooker, Masters, & Park, 2017). In the context of parkrun, it is possible that MIL plays a role of dual functionality. In one instance, the initiative presents an accessible method of carrying out meaningful activity, and in turn deriving greater psychological wellbeing (Ryff & Singer, 2006). In addition to this, achieving greater MIL as a result of attending parkrun may subsequently enhance individuals' self-regulatory capacity, and thus support the ability to maintain engagement in effortful and beneficial PA over time. Accordingly, the present study also assessed participants' ability to appreciate the perspective of others, to further investigate nuanced relationships regarding MIL and parkrun attendance. Indeed, the extent to which individuals personally connect with these philosophies may differentially impact commitment, given that understanding the global relevance of a behaviour can provide strongly motivating properties (Delle Fave & Soosai-Nathan, 2014; Mcknight & Kashdan, 2009), and can bolster self-regulation within and outside of exercise contexts (Hooker, Masters, & Park, 2017; Song, Jung, Jo, & Won, 2017; Yeager et al., 2014). Thus, a further hypothesis is;

***H<sub>3</sub>** - A greater sense of meaning in life at time 1 will positively predict parkrun attendance over the following year.*

### Controlled Motivation

As a whole, these observations support the idea that parkrun presents a unique PA environment, in which individuals are highly able to fulfil their basic psychological needs, and derive

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intrinsic motivation, identified regulation and meaning in life. However, it is also important to consider individual variation in the extent to which participants experience these factors, as well as techniques with which to address potential deficits. For example, Cleland et al. (2018) have noted established social groups at parkrun may marginalise those without pre-existing ties. Furthermore, whilst parkrun may be widely noted as low pressure and inclusive, some participants may nonetheless experience controlled motivation to attend. Controlled motivation typically displays either non-existent or negative association with sustained exercise participation (Coleman & Sebire, 2016; Deci & Ryan, 1985, 2000; Hall, 2008; Teixeira et al., 2012; Vansteenkiste et al., 2008), thus a final hypothesis is;

*H<sub>4</sub> - Greater controlled motivation for parkrun at time 1 will negatively predict attendance over the following year.*

## Summary

A greater understanding regarding the relative magnitude of motivational type and MIL in predicting parkrun attendance can be used to design future health-related programmes, further promote the appeal of a successful real-world initiative and reveal more about the psychology of sustained physical activity as a whole.

## Method: Study 3B

### Participants

An a priori power analysis employing a small effect size ( $d = 0.2$ ), as suggested by related investigations (eg. Hooker & Masters, 2016; Sylvester, Mack, Busseri, Wilson, & Beauchamp, 2012), indicated a necessary sample size of 59 participants, to achieve significance ( $p = .05$ ) at 90% power using 18 predictors. The initial sample ( $n = 98$ ) were attendees of the Penrhyn parkrun, North Wales. Attendance metrics could not be calculated for 19 participants who were not registered on the parkrun database, and therefore these individuals were excluded from the analysis. A further eight

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participants could not be included due to missing data, leaving a final sample of 71 individuals, for whom the demographic information is summarised in Table 26. Individuals were recruited via opportunity sampling, and offered the chance to win a £50 voucher in return for their participation. All respondents gave fully informed consent (Appendix 1.4) after receiving verbal and written (Appendix 2.4) descriptions of the research. The study was approved by the Bangor University School of Psychology Research Ethics Committee (Application: #2016-15811).

### Design

The current study employed a prospective cohort design whereby demographic and psychographic measures were initially collected in April 2017. Participants' parkrun attendance over the following year was assessed using the open access parkrun database, until April 2018.

### Measures

#### Demographic Information

Identical demographic data to that described in study 3A were collected, and the same categorisation of physical activity conducted prior and subsequent to parkrun attendance was used. As in study 3A, the number of parkruns individuals had attended prior to data collection was captured using the open access parkrun database, as were participants age categories. In addition, individuals were asked to provide details of health conditions or injuries which might impede their parkrun attendance, as well as conflicting physical activity classes or training schedules.

#### Psychometric Measures

All self-report psychometric measures were incorporated into a pen-and-paper questionnaire packet. The categorical values for internal consistency are defined as in study 3A, and intraclass correlation coefficients regarding test-retest validity are defined as follows;  $> .70$  = acceptable,  $> .80$  = moderate,  $\geq .90$  = high stability (Vincent, 1994). Measures were selected to investigate constructs highlighted as potential predictors from study 3A (meaning in life, eudaimonic satisfaction, motivational type) in addition to variables known to influence general physical activity participation (depression, optimism, self-efficacy) as a means of examining the unique contribution of proposed predictors. Measures of positive cognition (growth, perspective taking) were included to examine further nuance in the hypothesised relationships between meaning, motivation and parkrun

participation.

**The Orientations to Happiness Scale; Meaning Subscale (OTH-M, Peterson, Park, & Seligman, 2005).**

The OTH is comprised of three subscales which independently assess the degree to which an individual derives meaning, pleasure and engagement from life. In the current investigation, the six-item OTH-Meaning subscale was employed in an identical fashion to that described in study 1A.

**The Depression, Anxiety and Stress Scale; Depression Subscale (DASS-21; Lovibond & Lovibond, 1995)**

Depressive symptomatology was assessed using the seven-item DASS-21 Depression subscale. A full description of the scale can be accessed in study 1A.

**The Exercise Self-Regulation Questionnaire (SRQ-E, Ryan & Connell, 1989; Appendix 5.19).**

The SRQ-E employs 16 statements to detect the presence of external, introjected, identified and intrinsic self-regulation in the exercise domain, each represented by four items. Typically, participants respond to the phrase *"I try to exercise on a regular basis because..."*, however in the current research this statement was adapted to *"The reason why I come to parkrun is..."* using a seven-point Likert scale from 1 ("Not true at all") to 7 ("Very true"). Sample items include *"Because I have no choice about it; others make me do it"* (external regulation), *"Because I would feel bad about myself if I did not"* (introjected regulation), *"Because I feel like it's the best way to help myself"* (identified regulation), and *"Because it's fun"* (intrinsic regulation). The SRQ was considered particularly appropriate given the sensitivity of this measure in detecting a quadripartite model of regulation, for which all categories demonstrated acceptable to good internal consistency ( $\alpha = .72$  to  $.85$ ).

**The Basic Psychological Needs in Exercise Scale (BPNES; Vlachopoulos & Michailidou, 1995; Appendix 5.20).**

The 12-item BPNES is a domain specific measurement of the extent to which individuals generally perceive their innate needs for autonomy, competence and relatedness to be satisfied. Respondents use a five-point Likert scale from 1 ("Not true at all") to 5 ("Completely true") to represent the personal applicability of statements such as *"I feel a sense of choice*

*and freedom*" (autonomy), *"I feel confident I can do things well"* (competence) and *"I feel connected with people who care for me, and for whom I care"* (relatedness). In the present study, terms regarding general exercise participation were adapted for application at parkrun. The psychometric qualities of the BPNES are supported via high test-retest reliability over four weeks (autonomy  $ICC = .97$ , competence  $ICC = .97$ , relatedness  $ICC = .97$ , Vlachopoulos & Michailidou, 1995) and convergent validity with similar measures, such as Cunningham's (2007) Physical Activity Class Satisfaction Questionnaire (autonomy  $\beta = .28$ , competence  $\beta = .25$ , relatedness  $\beta = .51$ , Ferriz, Sicilia, & Sáenz-Álvarez, 2013), and Ryan and Frederick's (1997) Subjective Vitality Scale, which provides an assessment of the vitalising effect pertaining to eudaimonic wellbeing (autonomy  $r = .47$ , competence  $r = .50$ , relatedness  $r = .40$ , Vlachopoulos, Ntoumanis, & Smith, 2010). Further, the BPNES evidences criterion validity via significant predictions with objectively assessed exercise (autonomy  $r = .33$ , competence  $r = .46$ , relatedness  $r = .31$ , Weman-Josefsson, Lindwall, & Ivarsson, 2015) and gender invariance (Vlachopoulos & Neikou, 2007) as well as resistance to socially desirable responses (Vlachopoulos & Michailidou, 2006). Analyses in the current sample demonstrated good internal consistency (autonomy  $\alpha = .84$ ; competence  $\alpha = .81$ ; relatedness  $\alpha = .92$ ).

**The Quiet Ego Scale; Growth & Perspective Subscales (QES; Wayment, Bauer, & Sylaska, 2015; Appendix 5.21).**

The QES-Growth (4-items; *"I think it is important to have new experiences that challenge how you think about yourself and the world"*) is used to detect the ability to shift one's attention away from the present moment and toward longer term processes, whilst the QES-perspective (4-items; *"I try to look at everybody's side of a disagreement before I make a decision"*) measures the capacity to empathise with others. Participants respond to statements using a five-point Likert scale from 1 ("Strongly Disagree") to 5 ("Strongly Agree"), including five reverse-coded items, with higher overall scores representing greater compassion for the self and others. The employed QES subscales demonstrated acceptable internal consistency (QES-perspective taking  $\alpha = .7$ ; QES-growth  $\alpha = .79$ ). Additionally, the QES demonstrates convergent validity with similar measures of interest including Levenson, Jennings, Aldwin, & Shiraishi's (2005) Self Transcendence Scale ( $r = .47$ , Wayment, Bauer, et al., 2015) and Robitscheck's (1998) Personal Growth Initiative ( $r = .47$ , Wayment, Bauer, et al., 2015). The QES also shows measurement invariance across gender, age or ethnic status (Wayment et al.,

2015).

**The Life Orientation Test-Revised (LOT-R; Scheier, Carver, & Bridges, 1994; Appendix 5.22)**

The 10-item LOT-R is one of the most widely used measurements of dispositional optimism (Glaesmer et al., 2012). Participants respond to three items concerning optimism, and three questions which can be reverse scored to function as a supplementary assessment, or treated independently to document pessimistic traits. In the current sample, all six items were included to generate a single measure, with higher values representing more optimistic tendencies. A further four filler items are included, and participants use a five-point Likert scale from 0 (“Strongly disagree”) to 4 (“Strongly agree”) to represent the degree to which statements such as *“In uncertain times, I usually expect the best”* (optimism) and *“I hardly ever expect things to go my way”* (reverse scored/pessimism) are personally applicable. The scale evidences sound psychometric properties, including test-retest reliability at four, 12, 24 and 28 months ( $r = .68, .60, .56, .79$  respectively, Scheier et al., 1994) and convergent validity with related assessments, such as Pearlin and Schooler’s (1978) Self-Mastery Scale ( $r = .48$ , Scheier et al., 1994), Rosenberg’s (1979) Self-Esteem scale ( $r = .50$ , Scheier et al., 1994), and Spielberger and Gorsuch’s (1983) Trait Anxiety Inventory ( $r = -.53$ , Scheier et al., 1994). The LOT-R also demonstrates criterion validity, for example in use as a predictor of resilience to depression ( $r = -.31$ , Glaesmer et al., 2012) and of life satisfaction (Glaesmer et al., 2012). In the current sample, acceptable internal consistency was observed ( $\alpha = .78$ ).

**The Spheres of Control Scale; Version 3; Personal Subscale (SOC-3; Paulhus & Van Selst, 1990; Appendix 5.23).**

The SOC employs three subscales to provide a multidimensional measure of locus of control. In the present study, the SOC-Personal subscale was used to specifically assess personal efficacy, which is empirically recognised as an independent dimension of perceived control (Spittal, Siegert, McClure, & Walkey, 2002). Participants respond to 10 items, five of which are reverse scored, using a seven-point Likert scale from 1 (“Disagree”) to 7 (“Agree”). Sample items include *“I can usually achieve what I want if I work hard for it”*, and *“Bad luck has sometimes prevented me from achieving things”* (reverse scored). The SOC-Personal demonstrated good internal consistency ( $\alpha = .80$ ) and shows convergent validity with measures of similar constructs, such as Sherer et al.’s (1982) General Self-Efficacy scale ( $r = .59$ ,

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Paulhus & Van Selst, 1990), Levenson's (1981) Multidimensional-Multiattributonal Causality Scale (Achievement internality  $r = 0.36$ ; Achievement Externality  $r = -.30$ , Paulhus & Van Selst, 1990) and Rotter's (1966) Internal-External scale ( $r = .75$ , Paulhus & Christie, 1981). The use of the SOC was particularly appropriate, as it allows the isolated investigation of personal efficacy in comparison to more general measures of attributional style. However, this assessment also provides a metric of perceived control across life-domains, rather than those purely relevant to exercise. Thus, the SOC presents a comprehensive picture of the propensity to make internal or external causal attributions, related to personal effect.

### Behavioural Measures

#### Parkrun Run Attendance

An objective measurement of parkrun engagement was captured using the open-access parkrun database, which provides information on the location and date of every parkrun each participant has attended (Appendix 5.24). All respondents gave consent regarding the use of this data in the current research. A run attendance metric was devised by summing the total number of runs attended within a 53-week period inclusive of and following initial data collection for all participants.

#### Procedure

A similar data collection procedure to that described in study 3A was used, whereby runners were made aware of the opportunity to participate in the research, study aims and associated incentives in an identical pre-run briefing, and subsequently approached by a researcher unknown to them following the run. All participants confirmed they were over 18 years of age, gave written informed consent and were debriefed upon their completion of the paper questionnaire. Following this, two researchers who were blind to the psychometric questionnaire responses independently calculated the attendance metrics, and cross-validated these measurements to resolve any discrepancies caused by human error.

#### Data Analysis

Initial data analysis checks to examine outliers and normality according to the protocol described in study 1A. A multiple linear regression using RStudio (RStudio, 2015) was performed to



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investigate predictors of sustained attendance at parkrun. Descriptive statistics were computed, including scale means and standard errors (Table 27). Continuous predictors were checked for normality. The values for relatedness, competence, extrinsic, identified and intrinsic regulation were skewed, as were the QES subscales, perspective and growth. Appropriate transformations such as natural log and square root were applied to these variables in order to meet the condition of normal distribution for further analyses. All other continuous variables were normally distributed. Scatterplots of standardised residuals and standardised predicted values were generated to check for heteroscedasticity. These plots demonstrated random scatter, indicating the assumption of homoscedasticity had been met. In addition, no variance inflation factors exceeded the value of 2.5, indicating no issue of multicollinearity.

Categorical variables were dummy coded for inclusion in linear analysis according to the following format; (a) health-condition/injury (1) and no health-condition/injury (0); b conflict from other physical activity (1) and no conflict (0); goal to increase physical activity (1) and no goal (0). Bivariate associations among study variables examined using Pearson correlations, and can be viewed in Table 28.

### Results: Study 3B

#### Demographic Information

Demographic information is shown in Table 26, and data regarding psychometric and behavioural measures in Table 27. The modal annual household income category was £64 – 96,000, and 31% of individuals reported an annual income of £32,000 or less. Eight-eight percent of the sample reported their body mass index, and of these 79% fell within the healthy band of 18 – 25, with 18% scoring beyond this range. Additionally, exactly half of the sample were either non- or irregular runners prior to attending *parkrun*, and 51% reported initiating novel exercise subsequent to their first event. As such, this sample also documented a greater proportion of healthy-weight participants, and similar levels of prior running experience to those reported by Cleland et al. (2018). Moreover, the sample means for all three basic psychological needs were high (Table 27).

### Predictors of Attendance

Separate models were run to distinguish predictor and nuisance variables in order to avoid artificial inflation of  $R^2$ , with each model yielding  $\beta$ -coefficients and standard errors, with t-statistics that could be tested against degrees of freedom ( $p < .05$ ; Table 3). Model 1 ( $R^2 = .04$ ,  $F(6,64) = 1.53$ ,  $p = .18$ ), examined an initial set of potential confounds, including three binary predictors; (i) long-term health condition or injury, (ii) conflict with other physical activity, (iii) the goal to increase one's physical activity, and three continuous variables (iv) optimism (v) sense of control and (vi) depressive symptomatology. All variables (i) through (vi) were statistically insignificant, thus were removed from subsequent analyses. Model 2 ( $R^2 = .04$ ,  $F(3,67) = 1.86$ ,  $p = .14$ ) tested the predictive value of experiencing autonomy, competence and relatedness at parkrun. Model 3 ( $R^2 = .14$ ,  $F(7,63) = 2.58$ ,  $p = .02$ ) introduced the role of external, introjected, identified and intrinsic regulation. In Model 4, a sense of meaning in life, perspective taking, and personal growth and volunteering were incorporated ( $R^2 = .3$ ,  $F(10,60) = 3.95$ ,  $p < .001$ ). Tests were performed on the residuals for all models to check for non-linearity, heteroscedasticity and multicollinearity, which demonstrated all necessary assumptions had been met. Finally, standardised beta coefficients were calculated in order to allow a relative comparison of predictors (Table 29).

In test of the primary hypotheses (Table 29), autonomy, competence and relatedness were not significantly related to Parkrun attendance. After adding scores for the four SRQ-E subscales to the model, external and introjected regulation were observed to negatively predict attendance. Identified regulation demonstrated a positive association with parkrun participation, whilst no relationship between intrinsic motivation was detected. After adjusting for meaning in life, perspective taking and growth, the relationship between attendance and extrinsic motivation became non-significant, and significant and strong associations between lower levels of meaning in life, and greater perspective taking with parkrun participation were observed. Model 4 represented a substantially better fit than models 1 to 3, as indicated by the values for adjusted  $R^2$ . This suggests the importance of both meaning in life and perspective taking regarding the prediction of variation in participants' parkrun attendance.

Variable	Frequency(%)
<b>Age (Years)</b>	
18-24	12(15.8)
25-34	12(15.8)
35-44	23(30.2)
45-54	18(23.7)
55-64	9(13.1)
65-74	1(1.3)
<b>Gender</b>	
Female	41(53.9)
Male	35(46.1)
<b>Annual Household Income (GBP)</b>	
6 -≤ 13,000	2(2.6)
>13 -≤ 19,000	2(2.6)
>19 -≤ 26,000	3(3.9)
>26 -≤ 32,000	8(10.5)
>32 -≤ 48,000	13(17.1)
>48 -≤ 64,000	10(13.2)
>64 -≤ 96,000	11(14.5)
>96	4(5.2)
No Response	23(30.3)
<b>Participated in Regular Exercise Prior to Parkrun</b>	61(80.3)
<b>Participation in Running Prior to Parkrun</b>	
None	24(31.6)
Occasional Leisure ( <i>≥ once a fortnight</i> )	14(18.4)
Regular Leisure ( <i>&lt; once a fortnight</i> )	26(34.2)
Member of a Club	12(15.8)
<b>Initiated Novel Exercise Post Parkrun</b>	39(51.3)
<b>BMI</b>	
< 18	2(2.6)
18 – 25	53(68.9)
> 25	12(15.6)
No Response	9(11.7)
<b>Ethnicity</b>	
White	72(93.6)
Chinese	1(1.3)
Other Ethnic Background	1(1.3)

Table 26. Demographic information for sampled parkrun participants (*n* = 71).

Variable	N	N(%)	M±SD	Min	Max
Long-Term Injury/Health Condition	71	15(21.1)			

<b>Participation in Conflicting Training</b>	71	31(43.7)		
<b>Physical Activity Goal</b>	71	46(64.8)		
<b>Optimism</b>	71	21.5±3.9	12.0	30.0
<b>Personal Control</b>	71	50.1±6.1	36.0	68.0
<b>Depression</b>	71	7.6±6.9	0.0	30.0
<b>Basic Psychological Need Satisfaction</b>	71	53.7±6.2	36.0	60.0
<i>Autonomy</i>	71	17.6±2.8	12.0	20.0
<i>Relatedness</i>	71	18.2±2	13.0	20.0
<i>Competence</i>	71	18±2.3	11.0	20.0
<b>Self-Regulation</b>	71	13.1±3.2	2.5	18.0
<i>External</i>	71	1.4±0.8	1.0	5.8
<i>Introjected</i>	71	2.7±1.3	1.0	6.5
<i>Identified</i>	71	6±0.8	2.5	7.0
<i>Intrinsic</i>	71	6.3±0.7	3.5	7.0
<b>Meaning in Life</b>	71	3.1±0.7	1.6	4.8.0
<b>Quiet Ego</b>	71			
<i>Growth</i>	71	16.7±2	12.0	20.0
<i>Perspective taking</i>	71	14.8±2.3	5.0	19.0
<b>Parkrun Attendance</b>	71	20.1±16.8	1	87
<i>Running</i>	71	17±13.5	1	53
<i>Volunteering</i>	71	3.1±5.8	0	34

Table 27. Mean ( $\pm$  standard errors) scores for potential predictors and confounding variables in parkrun attendance ( $n = 71$ ).

Table 28. Bivariate correlations among Parkrun attendance and potential predictors.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Parkrun attendance	-														
2. Volunteering	.41*	-													
3. Optimism	-.30**	.001	-												
4. Control	-.26*	-.16	.42**	-											
5. Depressive Symptoms	.09	-.01	-.45**	-.35**	-										
6. Relatedness	-.22	-.17	.09	.21	-.22	-									
7. Competence	-.27*	-.14	.1	.29*	-.14	.75**	-								
8. Autonomy	-.18	-.18	-.01	.30*	-.13	.60*	.72**	-							
						*									
9. External	-.14	.11	-.05	-.16	.15	-.10	-.10	-.08	-						
10. Introjected	-.31**	-.08	.23	.13	-.21	.25*	.21	.16	.45**	-					
11. Identified	.05	.26*	.07	.01	.01	.47**	.52**	.42**	-.16	.20	-				
12. Intrinsic	-.18	.06	.22	.10	-.21	.45*	.53**	.33**	-.26*	.17	.78*	-			
						*									
13. Meaning	-.28*	-.06	.20	.12	-.23	.20	.20	.27*	.15	.28*	.27*	.24*	-		
14. Growth	.04	-.02	.13	-.04	-.01	.20	.16	.11	-.30*	.01	.34**	.29*	-.001	-	
15. Perspective	.32**	.07	.04	-.08	-.13	.07	-.03	-.01	-.11	.08	.12	.04	.16	.44**	-

	Model 1		Model 2		Model 3		Model 4		
	<i>B</i> ( <i>SE</i> )	$\beta$	<i>B</i> ( <i>SE</i> )	$\beta$	<i>B</i> ( <i>SE</i> )	$\beta$	<i>B</i> ( <i>SE</i> )	$\beta$	$\eta_p^2$
Intercept	55.36(16.52)**	-	30.76(10.71)**	-	41.08(12.95)**	-	20.83(13.98)	-	-
Training Interference	1.26(3.25)	0.05	-	-	-	-	-	-	-
Injury/Health Interference	1.83(3.96)	0.06	-	-	-	-	-	-	-
Activity Goal	1.2(3.36)	0.04	-	-	-	-	-	-	-
Optimism	-0.87(0.49)	-0.25	-	-	-	-	-	-	-
Control	-0.4(0.29)	-0.18	-	-	-	-	-	-	-
Depression	-0.17(0.27)	-0.08	-	-	-	-	-	-	-
Autonomy	-	-	0.2(0.86)	0.04	0.34(0.83)	0.07	0.86(0.77)	0.17	.02
Competence	-	-	-1.09(4.32)	-0.29	-2.04(4.19)	-0.21	-2.85(3.8)	-0.21	.02
Relatedness	-	-	-5.85(4.52)	-0.05	-4.72(4.54)	-0.05	-4.5(4.14)	-0.12	.01
External Regulation	-	-	-	-	-25.86(10.48)*	-0.34	-17.78(9.9)	-0.23	.05
Introjected Regulation	-	-	-	-	-6.04(2.88)*	-0.38	-6.58(2.68)*	-0.41	.09
Identified Regulation	-	-	-	-	3.21(1.39)*	-0.31	3.04(1.28)*	0.30	.09
Intrinsic Regulation	-	-	-	-	2.12(3.84)	0.1	4.49(3.52)	0.22	.03
Meaning	-	-	-	-	-	-	-6.02(2.2)**	-0.31	.11
QES Perspective Taking	-	-	-	-	-	-	10.92(3.14)***	0.41	.17
QES Growth	-	-	-	-	-	-	-2.36(3.25)	-0.09	.01
Residual Std. Err	13.22	-	13.27	-	12.55	-	11.33	-	-
Adjusted R <sup>2</sup>	0.044	-	0.036	-	0.137	-	0.3	-	-

Table 29. Beta coefficients (and standard errors), standardised betas, residual standard errors and adjusted R<sup>2</sup> values for four linear regression models of Parkrun Attendance. \* $p < .05$ ; \*\* $p < .005$ ; \*\*\* $p < .001$ .

### **Discussion: Study 3B**

The results of study 3B indicate long-term attendance at parkrun is positively associated with identified regulation, and negatively associated with introjected regulation, allowing the acceptance of H<sub>2</sub> and H<sub>4</sub>. In contrast to expectations, no significant relationship between intrinsic motivation and parkrun participation was found, necessitating the rejection of H<sub>1</sub>. Lower levels of meaning in life predicted greater parkrun attendance, indicating a relationship of oppositional nature to that predicted in H<sub>3</sub>, and a significant and positive association between perspective taking and parkrun participation was observed. Findings regarding intrinsic, identified and introjected regulation, as well as meaning in life, are considered in the current section. Results for basic psychological need satisfaction are contextualised amongst qualitative data, and interpreted in the general discussion of the current chapter. All significant findings were observed in terms of small effect sizes.

#### **Intrinsic and Identified Regulation**

Prior work suggests intrinsically motivated exercise behaviour is more likely to be enacted consistently (Wilson, Rodgers, Fraser, & Murray, 2004), however the present findings do not provide evidence of this phenomenon at parkrun. Whilst results indicate the vast majority of the sample reported high basic psychological need satisfaction, it is possible those who attend parkrun only to achieve intrinsic enjoyment, experience alternative fulfilment via conflicting engagements. Mullan and Markland (1997) argue intrinsic motivation alone is insufficient to sustain exercise across time, given the organisation and commitment physical activity entails. Thus, the attendance of purely intrinsically motivated parkrun participants may suffer as a consequence of competing activities which offer a similar degree of enjoyment, but demand less effort.

Indeed, the present findings align with the proposition that the kind of personal endorsement associated with identified regulation is a more valuable antecedent of sustained exercise (Teixeira et al., 2012), as individuals are required to employ extrinsic forms of motivation in order to withstand the typically unenjoyable sensations related to physiological and mental endeavour (Deci & Ryan, 2000; Vansteenkiste, Niemiec, & Soenens, 2008). Whilst parkrun is generally observed as an enjoyable and low-pressure form of exercise, the event nevertheless involves substantial physical effort. Habitually sedentary individuals report relatively lower enjoyment of physical activity (Salmon, Owen, Crawford, Bauman, & Sallis, 2003), therefore identified regulation may hold particular importance in the parkrun context, considering the

initiative attracts large numbers of previously inactive participants. Further work suggests the beneficial effects of identified regulation are robust across physical activity domains (Teixeira et al., 2012), and that this is the only type of regulation to significantly predict decreased risk of exercise relapse (Thøgersen-Ntoumani & Ntoumanis, 2006). The present study corroborates these findings in a novel exercise environment, atypical in terms of its participant base and widespread appeal. Specifically, supporting individuals to identify personally relevant outcomes of physical activity may be a fruitful strategy to elicit the most frequent engagement in exercise.

### **Introjected Regulation**

Empirical observation also suggests introjected regulation motivates short-term exercise behaviour, however longitudinal adherence is unlikely to be maintained (Deci & Ryan, 1985). In fact, the results of the present study indicate introjected regulation negatively impacted parkrun attendance. This is compatible with the contention that introjection depletes motivational reserves over time, resulting in only limited persistence (Pelletier et al., 2001). Previously, parkrun participants have noted a lack of pressure regarding their attendance, effort, or performance, and that parkrun is notably less judgemental than comparable exercise options (see study 3A; Stevinson, Wiltshire, & Hickson, 2015). The results of the current work suggest individuals who do experience pressure to attend parkrun are less likely to maintain this commitment up to a year later, further supporting the perspective that buffering individuals from the tension associated with introjected regulation can engender more sustainable forms of motivation.

### **Meaning in Life**

Additionally, results demonstrated a negative association between parkrun attendance and meaning in life. Typically, low meaning in life is inversely correlated with exercise (Hooker et al., 2016; Hooker & Masters, 2016), and is associated with general apathy towards the maintenance of one's physical health (Hooker, Masters, & Park, 2017), including healthy eating (Brassai et al., 2015), healthcare services utilisation (Zhang et al., 2018), and preventative health behaviour (Kim et al., 2014). However, the present results indicate that participants who reported the lowest levels of meaning in life are most likely to engage with parkrun. In alignment with the observation that some participants deliberately attend parkrun as a means of enhancing their wellbeing (Grunseit et al., 2018), one interpretation of this finding is that parkrun offers an antidote to the disconnection and apathy associated with attenuated meaning. Evidence supports the idea that participating in



activities which are purposeful, significant and coherent can restore one's sense of meaning (Steger et al., 2008), and that meaning fluctuates intra-individually, thus influencing meaning-seeking behaviour (Choi, Catapano, & Choi, 2017). Consequently in the present sample, it is possible participants attended parkrun as a direct means of enhancing their MIL.

### **Perspective Taking**

Lastly, the present study revealed perspective taking to be one of the strongest predictors of parkrun attendance. Whilst the relationship between perspective taking and parkrun attendance should be viewed as preliminary and deserving of further investigation, one interpretation is that a stronger ability to share the perspective of others enables greater sensitivity to self-relevant consequences of behaviour. Recent work has demonstrated an overlap between the processes underlying egocentrism and delay discounting (O'Connell, Hsu, Christakou, & Chakrabarti, 2017), suggesting parity between the ability to anticipate the needs of others and of the future self. This perspective aligns with a wider literature on the benefits of longitudinal time-perspective to physical health behaviour (Adams & Nettle, 2009; Daugherty & Brase, 2010; Visser & Hirsch, 2013), and in the current context, suggests more salient perceptions of long-term exercise benefits may drive conscientious physical activity. Parkrun may present particular appeal to individuals who display advanced perspective taking, given the unique volunteer-led aspect of the event. However, the role of perspective taking in physical health behaviour is yet to be empirically explored, and thus future investigations may consider the relevance of this construct to physical health behaviour.

An alternative interpretation of the observed relationship between perspective taking and parkrun attendance, is that those who are most able to appreciate the efforts of volunteers at the event derive the greatest enjoyment and motivation from their experience. According to social exchange theory (Thibaut & Kelley, 2008), humans are inclined to reciprocate prosocial behaviour, such as altruistic efforts. The value of reciprocity at parkrun has been previously noted, and is a unique characteristic which distinguishes the initiative from comparable exercise platforms. Whilst the benefits of volunteering have been associated with mental wellbeing (Jenkinson et al., 2013), there is less consensus regarding the impact of prosocial behaviour upon physical health (Casiday et al., 2008). Further work may therefore investigate the potential of volunteer-based initiatives in not only engaging members of the community to contribute to sustainable public health programmes, but also the incidental benefits of this approach.

## **Strengths**

This work forms the first investigation to explore psychological variables in motivating longitudinal parkrun attendance. Qualitative analysis and established theory were used to inform hypotheses, presenting a rich grounding for subsequent investigation. Although relatively small, the sample size was appropriately informed by power analysis, and analyses controlled for relevant variables known to influence rates of physical activity such as optimism and personal control. Potential impediments to parkrun attendance such as injury and conflicting training schedules were also acknowledged. Moreover, this study involved a novel utilisation of information from the open-access parkrun database, and presents objective physical activity data recorded over a substantial time-period.

## **Limitations**

Although attempts were made to control for all relevant variables, several factors may influence the validity of reported data. Firstly, although based upon pre-validated assessments of motivation, the exercise self-regulation questionnaire and basic psychological needs in exercise scale were adapted to relate to the specific context of parkrun. As such, their precise psychometric properties are unknown, however both measures demonstrated good internal consistency.

In addition, individuals are required to present a personal barcode each time they attend an event in order to display as an attendee on the parkrun database. Consequently, it is possible attendance metrics were skewed by any instances in which participants attended parkrun yet forgot their barcode. Nevertheless, this is unlikely to be a frequent occurrence, given individuals are incentivised to record their attendance by way of multiple incentives (e.g. performance data, milestone t-shirts). Lastly, it is possible participants experienced injuries or health complications which impeded their attendance subsequent to those recorded in the initial data collection. However, there is no reason to suspect these confounds would disproportionately influence the attendance of participants presenting a specific motivational profile, and thus these features do not present a substantial risk to the validity of results.

## **Conclusions**

Identified regulation is a positive correlate of parkrun attendance and the relationship remains after adjusting for several relevant factors. Intrinsic motivation did not significantly support

parkrun attendance over time, suggesting sustained attendance is not driven by enjoyment of parkrun per se, but the personal valuation of its benefits. Moreover, introjected regulation was negatively associated with parkrun participation, which is harmonious with evidence that indicates introjection depletes resources necessary for the maintenance of effortful behaviour. Contextualised within the pre-existing evidence base, the relationship between meaning in life and physical activity enactment appears complex, however findings collectively suggest parkrun may offer participants a route to experience greater life meaning. As such health promotion initiatives should aim to establish conditions which afford eudaimonia, including basic psychological need satisfaction and perceptions of personal importance.

## **General Discussion**

### **Summary of Findings**

Discovering how parkrun has inspired mass physical activity has important implications for the scientific understanding of exercise motivation, and the applied design of healthcare initiatives. In particular, existing evidence suggests parkrun may represent a successful exemplar of the positive health paradigm, in that participants report wellbeing benefits comparable to eudaimonic satisfaction. Across two studies, the present work helps to substantiate a limited evidence-base regarding the potential antecedents, maintenance and consequences of parkrun participation, and has determined components of long-term attendance. This is the first investigation to specifically examine the role of psychological constructs at parkrun, and core findings suggest whilst a majority of participants experience eudaimonic satisfaction at the event, the most consistent attendees are motivated by outcomes other than intrinsic enjoyment. Individuals who perceived parkrun as personally relevant evidenced the greatest engagement, together with participants who reported low levels of meaning in life, and the ability to empathise with others. Contextualised by further qualitative evidence, these data suggest parkrun is atypically inclusive, caters for holistic wellbeing, and influences participants' general relationship with physical health.

### **Basic Psychological Need Satisfaction and Internalisation**

The results of the current research illustrate developing physical activity contexts which facilitate identified regulation can promote the successful design of healthcare initiatives. A pertinent question therefore concerns the conditions which enable identified regulation to be

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experienced. Given previous evidence indicating parkrun conveys appeal to diverse social demographics (Stevinson et al., 2015), and the globally high reports of identified regulation documented in the current work, parkrun represents a valuable environment to observe principles to this effect. Of primary interest, is the extent to which participants across both studies reported parkrun fulfilled their need for autonomy. This was expressed in terms of the capacity to attend events spontaneously, without complicated or burdensome requirements, and to share in the organisation of events. The parkrun format also contributes to the resolution of typical barriers associated with a lack of autonomy, for example Stevenson and Hickson (2013) note that highly inclusive and accessible nature of parkrun represents a uniquely valuable solution to low self-efficacy, access to facilities, and the demands of other life commitments, such as childcare (Cleland et al., 2014; Scheerder, Breedveld, & Borgers, 2015). A number of studies argue autonomy-supportive environments such as this allow participants the flexibility to establish relevant and meaningful goals, which subsequently drive the personal endorsement of behaviour (Ng et al., 2014; Ryan & Deci, 2000; Sylvester et al., 2012; Vansteenkiste et al., 2008). Thus, attempting to assimilate the autonomy-supportive conditions of parkrun is suggested as a valuable course of action for other public health initiatives.

Further evidence demonstrates individuals are more likely to internalise behaviour when it is advocated by a relatable source (Durantini et al., 2006; Ryan & Deci, 2000). A number of participants reported encountering parkrun through informal social channels, which is thought to promote the perceived value of information due to greater affinity between messenger and recipient (Aronson & Aronson, 2008; Dolan et al., 2012). A growing body of evidence suggests implicit forms of influence, such as social norms, can effect behavioural change more successfully than traditional campaigns (Bollinger & Gillingham, 2012; Kochnower, Reddy, & Flick, 2015), and the extent to which physical activity is noted as socially influenced (Hamilton & White, 2008; Litwin, 2003; Owen, Salmon, Koohsari, Turrell, & Giles-Corti, 2014), suggests the utilisation of pre-existing social channels as a powerful route for intervention. Importantly, the beneficial effects of source-messenger similarity appear to be particularly profound in socioeconomically deprived communities (Durantini et al., 2006). Indeed, Cleland et al. (2014) remark the meaningful engagement of residents in the planning, design and tailoring of initiatives is a critical determinant of success in physical activity interventions based in populations of low socioeconomic status. The communal format and ethos of parkrun, including an organisational system which is heavily volunteer dependent, enables greater input from local residents, and was reflected in participants appreciation regarding the

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organic development of the initiative. Thus, a second implication of the present findings, is that galvanising individuals embedded within target populations to engage with physical activity interventions can enhance intervention reach, experience and success.

Confidence in one's ability to achieve a behavioural goal is a final pre-requisite of internalisation (Ryan & Deci, 2000). Sensations of competence were observed across participants, both in terms of the nature of performing at parkrun, and the manner in which performance could be quantified. For example, individuals valued objective feedback as a means of tracking their personal progression, but also expressed an appreciation for the lack of requirement surrounding performance to a particular standard. The origins of this ethos can be observed in parkrun marketing material, which typically emphasises immediate benefits of physical activity, in contrast to inductions of social pressure or guilt, which degrade motivation in the long-term (Teixeira et al., 2012). Similarly, Wiltshire, Fullagar and Stevinson (2018) note many previously inactive parkrunners are motivated to improve their health in a relational and collective context, and that the inclusive parkrun atmosphere ameliorates the damaging effects of *health responsabilisation*. This construct describes the simultaneous experience of low self-efficacy and guilt regarding one's physical health (Burgess & Horii, 2012), and is associated with poor quality self-regulation, psychological ill being and adverse behavioural outcomes (Carr et al., 2007; Ferriz et al., 2013; Vansteenkiste et al., 2008). The present data suggest equipping individuals with methods to monitor their own self-progression is a globally appealing incentive for participants. However, sustaining a focus upon non-competitive and alternative benefits of physical activity, such as social relationships, can support newly active individuals to navigate novel fitness behaviours. Further, offering alternative avenues of competence, such as the chance to contribute to parkrun via volunteering, may also support the entry of less experienced individuals to physical activity programmes. Finally, perceptions of competence are influenced by the extent to which individuals hold an incremental mindset (Dweck & Molden, 2000; Strecher et al., 1986). Whilst no relationship between mindset and parkrun attendance was observed in the current research, this may indicate that attending parkrun influences participants' perceptions of ability over time. However, further investigation is needed to substantiate this notion.

### Internalisation and Meaning in Life

Whilst the intrinsically enjoyable environment of parkrun may present universal appeal, basic need satisfaction did not significantly predict longitudinal attendance. This finding suggests factors

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additional to competence, autonomy and relatedness enabled participants to derive the sense of personal importance associated with identified regulation, a possible example of which is meaning in life. A sense of meaning is thought to arise from basic psychological need satisfaction which is complemented by a further factor of beneficence (Martela et al., 2017). Thus, the focus upon reciprocal encouragement at parkrun (Stevinson et al., 2015), may adjunctly stimulate identified regulation. Observations made in study 3A suggest the global and organic nature of parkrun may elevate event participation to an enhanced level of meaning, and that parkrun offers participants the capacity to achieve purposeful and coherent goals. This perspective is supported by the work of Grunseit et al. (2018), who found the personal wellbeing of parkrunners to be significantly associated with community connection, and Stevenson et al. (2015), who describe the opportunity to reciprocate the offerings of others as “a distinctive and valued characteristic of parkrun” (pg 175). Collectively, these findings suggest parkrun may serve as both the stimulus and opportunity to engage in meaningful physical activity, and that the capacity to experience meaning at parkrun may incentivise engagement.

### Strengths

As the first investigation to explore the role of psychological constructs in the experience of parkrun, this research provides novel evidence regarding the stimulation of greater population-level physical activity. Particular value is derived from the examination of established motivational principles in a field-setting, and the investigation of factors which both precipitate and sustain attendance. Specifically, this chapter comprises detailed qualitative data and longitudinal evidence to provide a comprehensive picture of factors in the success of a real-world initiative. These findings are important in guiding future study, and can directly inform the design of health promotion initiatives.

### Limitations

The results reported in this chapter reflect the behavioural practices of a non-random sample at a single event, thus may not be representative of a wider population. In particular, both samples were predominantly comprised of white participants, with a body mass index within healthy range. However, the male/female ratio of the sampled population (46.1/53.9%) is similar to that of the registered parkrun populace (Global; 46.9/54.1%, UK; 47.9/52.1%; M. Graney, personal communication, May 15<sup>th</sup>, 2019) and includes a diverse representation of age, socioeconomic status

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and level of previous attendance. The results in this chapter also align with other investigations conducted at parkrun, indicating comparability. For example, across Tasmanian and British populations, both Cleland, Nash, Sharman, and Claflin (2018) and Wiltshire and Stevinson (2018) observe parkrun offers participants a means to expand their social networks, and benefit from the experiences of others. The importance of practical accessibility has also been previously identified (Stevinson et al., 2015), and a number of studies note attending parkrun could improve participant wellbeing (Grunseit et al., 2018; Reeves, Grandy, Mayan, & Huber, 2017; Stevinson & Hickson, 2013; Stevinson, Wiltshire, & Hickson, 2015).

A second limitation across both studies is the possibility of sampling bias. In study 3A, participants were invited to reflect on factors which diminish the appeal of parkrun, however few negative experiences were observed. This may be indicative of a self-selected sample, for whom parkrun is particularly enjoyable and motivating. Attempts to reduce bias included making the opportunity to participate available to all individuals at the event, however future work may wish to specifically investigate the views of those who are not engaged by the initiative.

### **Future Directions**

This chapter provides multiple implications for research and practice. Firstly, future study should identify how motivation for physical activity is influenced by previously unexplored concepts such as perspective taking and meaning-seeking. The current work implies these constructs are important to the maintenance of physical activity over a substantial duration and in a field-setting, but little empirical work has addressed this topic previously.

In addition, the utilisation of a larger sample would enable a more detailed analysis of the relationship between demographic variables and parkrun participation to be conducted, and subsequent investigations should aim to determine why parkrun has been particularly successful in promoting exercise participation amongst ethnic minority and socioeconomically deprived population groups. The findings reported here would also be enhanced by the use of multiple measurement periods in order to track how parkrun attendance influences motivation and wellbeing over time. In particular, it would be interesting to address whether greater meaning in life is derived from parkrun participation.

Moreover, the observation that parkrun results in behavioural spillover effects such as

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attenuated alcohol use is of distinct empirical and practical interest. Specifically, this finding implies efforts to reduce multiple NCD risk behaviours may benefit from promoting physical activity as a means of evoking additional behavioural change. Future research should aim to identify and measure the potential spillover effects of parkrun attendance in more detail, particularly as these behaviours are likely a product of implicit processes, and therefore may not be accurately captured in self-report assessments.

Several characteristics of parkrun that are central to motivating participation could be extrapolated to other settings, including different physical activity initiatives and other behavioural domains. For example, key antecedents of initial engagement were basic psychological need satisfaction, practical access, perceived importance and novelty. The importance of these features in supporting motivation has been established in laboratory and cross-sectional settings, however the current study presents further detail as to their practical development in the real world. Specifically, health promotion efforts should aim to identify and alleviate practical barriers to access amongst their target communities by integrating participants amongst the design and operation of initiatives. Furthermore, a provision and emphasis upon the proximal rewards of healthy behaviour, in the present case enjoying time with friends and achieving a personal best, should be incorporated into health promotion campaigns.

## Conclusions

Parkrun has achieved significant success in engaging a large percentage of the global population in regular physical activity, including those who are typically underrepresented in exercise. Importantly, this initiative appears as a successful exemplar of the positive health paradigm in that it facilitates eudaimonic wellbeing and attends to holistic health. The most appealing features for participants encompass the ability to experience autonomy, competence and relatedness, to share a collective experience, and perhaps to derive meaning in life. A particular finding of note was that participants' long-term attendance was driven by perceptions of the personal importance of parkrun, rather than a simple desire to have fun. The integrated volunteer-system and organic growth of parkrun may represent essential factors which have enabled universal appeal, given these features were implicated in the dissemination, design and intrigue of the event. Additionally, parkrun has managed to stimulate an effectively motivating discourse surrounding physical health, providing participants with the flexibility to pursue numerous goals, and minimising guilt or social



pressure regarding exercise. The minimisation of contextual entry barriers such as financial and time costs was also valued, implying the necessity of tailoring interventions to the needs of target communities. Engaging with physical activity at parkrun is also implicated in a wider cascade of positive behavioural responses, such as reduced alcohol intake. Collectively, the results presented here imply the importance of engaging communities in the operation of physical health initiatives to deliver feelings of autonomy and wider significance. In particular, parkrun has developed a discourse which combines the immediate benefits of physical activity with more meaningful implications, to present diverse and enduring appeal.

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### General Discussion

This thesis imparts an original contribution to scientific literature and provides a foundation for future interventions aiming to optimise population health. At the present time, noncommunicable disease is a global pandemic with damaging physical, economic and psychosocial ramifications. A substantial proportion of NCD is preventable, however previous health promotion efforts have struggled to sufficiently modify risk-related activity. In response, the current work presented a novel exploration of the positive health paradigm in promoting physical health behaviour. This section will build upon the work included in previous chapters, to summarise core outcomes and consider their collective contribution to theory and practice.

### Summary of Findings

In Chapter 1, an identified gap in the literature was the lack of investigation regarding a causal relationship between positive psychological functioning and healthy lifestyle behaviour. This was contextualised in light of dual-process theory, which suggests motivation, goal-directed activity, and resistance of temptation are required for the effective self-regulation of NCD risk behaviour. Additionally, distinctions between eudaimonia, hedonism, and their respective relationships to health behaviour were drawn. Theoretical observation suggests eudamonia may enhance the drive to prolong one's life, increase the salience of health-related cues, and displace maladaptive unhealthy behaviours. Consequently, three investigations of the relationship between eudaimonic framing and health-related outcomes were conducted.

In Chapter 2, a novel daily journaling task was developed and tested with two populations; a group of predominantly young adults in higher education, and a community-based sample enrolled on a 10-week physical activity programme. This task required participants to reflect upon a series of prompts regarding the enactment and wider implications of purposeful activities on six consecutive days. In the intervention condition of the higher education sample, ratings of life meaning and autonomous motivation for health behaviour significantly increased from pre- to post-test, and pre-test to follow-up. These changes demonstrated small to medium effects, and were not observed in a comparison control group. Unfortunately, no significant change in self-reported health behaviour or objectively measured discount rate was observed. In study 1B, no significant effects of

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intervention upon motivation, health behaviour or course adherence were documented. Collectively, these findings demonstrate that it is possible to promote life meaning and health motivation via to brief daily journaling, but that more work is needed to successfully implement the meaning in life journal in a practical setting. Furthermore, although no change in self-reported health behaviour was observed, theoretical observation suggests greater meaning in life may implicitly displace hedonistic pleasure-seeking by directing attention to eudaimonic cues. As such, it is important to utilise implicit measurements of health-related action in future assessments of the MIL journal.

Expanding upon these themes, Chapter 3 explored the use of construal level primes, which implicitly direct attention toward high-level goals and away from low-level concerns. Additionally, health-related outcomes were objectively assessed at the behavioural level. In study 2A, construal priming was specifically explored within the context of an episodic future thinking exercise. Previously, EFT tasks have demonstrated success in evoking healthy behaviour, and are thought to operate via accentuating the long-term consequences of immediate action. These tasks have typically been compared to episodic recent thinking as an ostensibly neutral manipulation. However, ERT is observed to modify delay discounting, and as such represents an inappropriate control. Furthermore, growing evidences suggests the goal-related contents of EFT visualisations are an important yet understudied component of intervention efficacy. Consequently, it was hypothesised that construal priming could present a valuable method via which to shape the contents of EFT. A manipulation check demonstrated ERT was most likely to evoke a highly concrete mindset, indicating this induction may drive attention toward proximal factors which drive food intake. In addition, participants were more likely to consume greater amounts of high-calorie food if they engaged in EFT which had been shaped by a low-level prime. These findings were somewhat compromised via the use of food-specific and non-food specific manipulations across conditions. Nevertheless, comparisons of high- and low-level EFT groups demonstrated low-level thought was associated with greater unhealthy food consumption, whereas high-level considerations were associated with reduced intake. Subsequently, and aligned with the recommendation that interventions which treat multiple NCD risk factors in parallel are more likely to achieve success, a second study tested the carry-over effects of this manipulation to a decision regarding physical effort. This study also attended to the importance of effort discounting in physical activity; an under-explored topic in previous research. Here, experimental groups were briefly re-exposed to abstract or concrete construal primes they had generated in study 2A, and were compared to a no-intervention control group. Abstract primes significantly increased the likelihood participants would select a high-

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effort\*reward option over a low-effort\*reward option, and this choice was predicted by the salience of abstract considerations. Contextualised via existing evidence, it is possible the accentuation of abstract rewards subjectively diminished effort perceptions, and drove a high-effort\*reward related choice.

Chapters 2 and 3 provided preliminary evidence that eudaimonic frames can promote wellbeing and drive attention toward high-level objectives, supporting health motivation and behaviour. In Chapter 4, these themes were extrapolated to the real-world. Specifically, the physical activity initiative parkrun was identified as successful exemplar of the positive health paradigm. This is because attendees report wellbeing benefits related to a sense of achievement and community, comparable to the basic psychological needs of competence and relatedness. Additionally, anecdotal evidence suggests parkrun have developed a discourse which deviates from a focus upon long-term outcomes of health-related behaviour (e.g. avoiding chronic disease), and emphasises more proximal benefits (e.g. enjoying physical activity with friends). This represents a contrast to approaches which attempt to draw attention to the long-term consequences of action, by motivating physical activity via compelling rewards which can be enjoyed in the present. As such, the parkrun method presents a variation on the theme of future-salience, by employing an alternative strategy by which individuals can navigate immediate and distal outcomes. A qualitative thematic analysis indicated participants of Penrhyn parkrun enjoyed feelings of eudaimonic satisfaction, and were engaged by consistent experiences of novelty. In addition, the organic development of parkrun enabled individuals to directly contribute to the initiative, carried an inherent sense of inclusivity, and minimised practical barriers to access. Attendees also reported the occurrence of behavioural spillover effects (e.g. attenuated alcohol use) as well as the experience of pleasurable emotion, and a more positive disposition and outlook. A second study (3B) was conducted to determine factors in participants' sustained attendance. Individuals from Penrhyn parkrun were tracked over the course of one year to generate attendance metrics which were regressed on measures of basic psychological need satisfaction, motivation and meaning in life. These data revealed identified regulation was a positive correlate of attendance, however in contrast to expectations, meaning in life displayed a negative relationship with parkrun participation. In light of findings which suggest a lack of life meaning drives the pursuit of purposeful and significant sources, it is possible parkrun provides participants with a sense of meaning, which subsequently promotes attendance. Lastly, introjected regulation was negatively associated with participation, which substantiates previous work on the depletive impact of extrinsic pressure.

Existing evidence indicates the degree to which individuals subjectively value current and future outcomes determines multiple health behaviours. These studies add additional nuance to this perspective, by suggesting the contents of imagined future scenes impact behaviour. As such, health promotion efforts should focus not only on promoting the salience of long-term outcomes, but also attend to what people picture when they imagine distal life scenes. Specifically, eudaimonic frames such as meaning in life and construal level may influence the cognitive accessibility of compelling future incentives, which help to drive immediate physical health behaviour. Alternatively, the parkrun approach indicates how the use of a proximal reward frame (i.e. offering immediately available incentives) can also drive adaptive action. However, these incentives should be linked to higher-order and personally important goals in order to sustain engagement.

Importantly, the incentive value of distinct future outcomes will vary across individuals. In order to derive forms of motivation that are sufficiently powerful to instigate consistent goal-related action and displace immediately tempting behaviours, people must personally identify with a salient future objective. Therefore, a second crucial implication of this approach is the importance of autonomy. Specifically, individuals should be afforded sufficient scope to select their own important goals, within the context of a frame which guides attention to future outcomes. These goals do not need to feature health-related objectives in order to drive physically healthy action. In the current research, the practical application of this perspective is observed in meaningful daily journaling and construal primes, which constrain attention, yet afford self-driven goal selection. In addition, parkrun represents a uniquely low-pressure environment, and provides participants the tools to measure progress within the context of their personal pursuits. Further detail regarding the relevance of these overarching conclusions to scientific literature are discussed herein.

## **Contribution to Theory**

### **Dual-Processes Theories of Decision Making and Positive Health**

Behaviour change techniques are typically classified according to whether they target cognitive or contextual features (Dolan et al., 2012). However, the limitations of both information-based campaigns and choice architecture suggest the need to address system I and system II processes in concert. The current research proposed eudaimonic framing can evoke healthy behaviour that is both rationalised and automatic, by generating autonomous motivation. The findings presented here fit with a growing body of research that supports this approach. For example,

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Sweeney and Freitas (2017) demonstrate health behaviours elicited via abstract construal are partially mediated by autonomous motivation, suggesting construal prime inductions can evoke automatic yet consciously supported behaviour. Indeed, in the current work abstract thinking was associated with enhanced self-regulation across multiple behaviours, as well as greater self-reported wellness behaviour over the fortnight following induction. One explanation for these findings is that construal priming not only accentuates the salience of high-level considerations which implicitly drive healthy behaviour, but also promotes the identification of goals which result in the rational perception of healthy behaviour as important. This is comparable to theory presented in the meaning salience model, which argues life meaning helps individuals to identify and internalise compelling objectives, which drive automatic responses to health-related cues (Hooker et al., 2017). Findings presented in study 1A provide partial support this perspective, given increases in life meaning were accompanied by greater autonomous motivation for physical health. More work is needed to establish whether life meaning can evoke implicit responses to health-related cues, however theories of incentive sensitisation (Kemps et al., 2014; Robinson & Berridge, 2008) indicate highly reinforcing cues are more likely to afford attention, and behavioural pursuit. Said differently, powerful forms of motivation make associated incentives salient. Given autonomous motivation is considered a resilient and pervasive resource, living in greater awareness of one's life meaning may drive automatic interaction with eudaimonic stimuli, and displace unhealthy behaviour. Somewhat relatedly, parkrun participants reported they were less likely to consume alcohol in order to prepare for the event, demonstrating how an important proximal goal, perhaps linked to higher-level objectives, can indirectly motivate health behaviour. As a whole, eudaimonic frames may represent a promising method of generating motivation powerful enough to influence automatic responses to environmental cues, and future investigation should aim to establish the validity of this proposal.

### Meaning in Life

Findings reported in Chapters 2 and 4 revealed meaning in life was not related to physical health behaviour in a straightforward way. In study 1A, reports of accentuated life meaning were accompanied by greater autonomous motivation for health behaviour. However, life meaning was a negative correlate of parkrun attendance in study 3B. A large body of evidence indicates perceptions of meaning and purpose in life are related to multiple forms of healthy behaviour, including physical exercise (Brassai et al., 2015; Burrow & Spreng, 2016b; Hooker et al., 2016; Hooker & Masters, 2016; Kim et al., 2014). In this relationship, enhanced meaning in life is thought to afford greater self-

regulation by promoting the appeal of longevity, and future sensitivity (Hooker et al., 2017). Whilst the findings of study 1A provide some evidence to support this hypothesis, study 3B presents additional nuance. As discussed, the regularity with which people experience meaning fluctuates substantially within individuals, and low levels of meaning prompt engagement in purposeful and significant behaviour (Choi et al., 2017; Steger et al., 2008). It is possible that parkrun provides an opportunity for participants engage in meaningful experience, which in turn sustains engagement over time. This suggests activities which enable the restoration of meaningful sensation may provide a powerfully motivating reward, and in the case of parkrun, stimulate greater engagement with physical activity. As such, health promotion efforts should attend to the holistic wellbeing of individuals, not only due to the biological relationships between mental and physical health (Mehta, 2011), but also because the promise of improved psychological wellbeing may offer a distinctly compelling incentive.

### **Autonomy, Internalisation and Self-Regulation**

A further contribution of the current research regards the relative importance of self-regulatory mechanisms. In study 3B, identified regulation was a positive correlate of longitudinal parkrun attendance, whereas intrinsic motivation was not. This finding supports the assertion that personal endorsement is an important component of sustained exercise (Teixeira et al., 2012), because extrinsic forms of motivation are necessary to regulate behaviour in response to the inherently unenjoyable sensation of physical effort (Deci & Ryan, 2000; Vansteenkiste, Niemiec, & Soenens, 2008). More broadly, the importance of internalisation and autonomy in supporting this process can be observed in multiple studies across this research. A sense of autonomy directly influenced participants' enjoyment of parkrun, and is evidenced as an important factor in adherence to positive psychology exercises such as those presented in Chapter 2 (Layous et al., 2013; Layous & Lyubomirsky, 2012). In addition, this thesis provides novel insight regarding the importance of autonomously selected objectives in motivating healthy behaviour. It is known that self-selected goals are more likely to be internalised, and thus more effective in sustaining self-regulatory efforts (Amorose & Anderson-Butcher, 2007; Gunnell et al., 2014; Sylvester et al., 2012; Vansteenkiste et al., 2008). Aligned with the perspective that objectives which are indirectly related to physical health can nonetheless drive healthy action (Hooker et al., 2017), this work suggests facilitating autonomous goal identification within the context of a eudaimonic frame is effective in driving outcomes of physical health. Specifically, the interventions used in Chapters 2 and 3 afforded

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participants the scope to identify their own personally meaningful objectives, within frameworks that facilitated meaning-related or high-level cognition. The importance of autonomous and indirect goal-selection was also observed at parkrun, whereby a perceived lack of pressure allowed participants the freedom to achieve personal objectives within the pre-existing constraints of the initiative. In order to develop these insights further, future work should consider the qualitative nature of goals listed in response to eudaimonic framing.

### **Contribution to Practice**

Until relatively recently, health promotion initiatives have been dominated by information-based campaigns (Dolan et al., 2012; Marteau, Hollands, & Fletcher, 2012). These efforts have struggled to tackle the growing problem of noncommunicable disease, and can even present detrimental effects as a consequence of controlled motivation (Herman & Polivy, 2011; Michie et al., 2009; Webb & Sheeran, 2006). In response, contextual approaches which attempt to bypass conscious regulation have grown in popularity (Hollands et al., 2013). However, evidence to support the long-term efficacy of these methods is lacking, and they do not address behaviour which occurs in environments that are impossible to externally manipulate (Forwood, Ahern, Hollands, Ng, & Marteau, 2015; Hollands et al., 2013; Marteau, Ogilvie, Roland, Suhrcke, & Kelly, 2011). The current work indicates positive health interventions may address some of the issues observed in these approaches, and present a viable method of encouraging healthy lifestyle behaviour. However, these methods are not mutually exclusive, and a scenario in which individuals volitionally pursue eudaimonically-framed goals within a supportively designed context may represent optimal intervention.

The current work proposes an alternative model, whereby emphasis is placed upon methods which make salient the personally relevant and proximal outcomes of physically healthy behaviour. In Chapter 2, an example of this philosophy is observed in the use of daily journaling to amplify meaningful behaviours that support one's interest in longevity, and serve as a link between longitudinal goals and proximal behaviours. In Chapter 3, findings added greater nuance to this perspective. Specifically, frames which accentuated the long-term and global benefits of exercise prompted choice to expand greater physical effort, however frames that directed attention to immediate, concrete considerations drove greater unhealthy food consumption. Collectively, this evidence suggests that health promotion efforts that either prompt individuals to consider the long-



## Chapter 5

term consequences of unhealthy action, or offer immediately available benefits for healthy behaviour, can be effective in stimulating salutogenic change. The operation of parkrun presented in Chapter 4 perhaps serves as the best example of the specified model, whereby the immediate benefits of participation are heavily emphasised and linked to highly significant and meaningful outcomes for attendees. Importantly, these benefits are not purely contextualised in terms of physical health, but allow attendees to generate their own meaning and incentives from the initiative. As a whole, positive health perspectives align with public health recommendations to prevent disease and promote wellness at the whole-population level. In alignment and based on a model of eudaimonic framing, this thesis presents four core contributions for practice;

### ***1. Changing the Discourse Around Physical Health***

Information-based health promotion efforts typically attempt to motivate health-related action by making the long-term consequences of immediate behaviour more salient (Dutta-Bergman, 2005). When communicated from a disease-based perspective, such as depicting the negative consequences of smoking-related illnesses and obesity, these efforts are largely unsuccessful in modifying behaviour (Borland et al., 2009; Puhl, Luedicke, & Lee Peterson, 2013). The current research suggests greater attention should be devoted to communicating positive aspects of behavioural change, and interestingly not necessarily those that are directly related to physical health. Hooker and Masters (2016) suggest individuals with greater meaning are more likely to engage in action which supports a long and healthy life, because longevity and vitality are necessary components of achieving one's overarching objectives. As such, meaningful goals should drive healthy behaviour even if they do not directly target physical health. In parallel, abstract construal primes drive attention toward the high-level features of all object representations. Fujita, Trope, Liberman, and Levin-Sagi (2006) argue this promotes healthy decision-making because the prioritisation of high-level considerations over proximal concerns evokes behaviour consistent with self-regulation across all domains. The work in this thesis indicates meaning in life can drive motivation for physical health outcomes, and construal priming can promote healthy dietary and exercise-related decisions. Accordingly, health promotion efforts should attend to the way in which ostensibly irrelevant goals can drive action toward physical wellbeing, and consider how health message-frames drive attention toward high- or low-level considerations.

### ***2. Designing Health Promotion Initiatives Which Account for Impulsivity***

Methods of choice architecture attempt capitalise upon predictable irrationalities of human psychology, by restructuring the environment in which people make decisions (Dolan et al., 2012). A conceptual parallel of this approach is observed at parkrun, which accounts for the human tendency to devalue delayed options (e.g. future physical health) by offering incentives which can be enjoyed in the present. For example, participants in study 3A valued immediate sources of reward including monitoring their progress and enjoying time spent with friends. Other individuals referenced the ‘collectable’ nature of parkrun, indicating the opportunity to visit multiple locations offers a source of proximal excitement and novelty. Importantly, these do not represent extrinsic benefits, but are more closely associated with internalised forms of self-regulation, which were implicated amongst sustained attendance in study 3B. As one example of a compelling immediate reward, feedback is implicated in the success of behavioural change techniques (Samdal, Eide, Barth, Williams, & Meland, 2017), and most likely to be effective when related to one’s pre-established goals (Ivers et al., 2012; Locke & Latham, 2005). This evidence indicates how one’s over-arching objectives can be supplemented with intermediary reinforcement, and as such health promotion efforts should aim to identify, offer and emphasise proximal outcomes related to personally important long-term goals.

### ***3. The Meaning in Life Journal***

In study 1A, a light-touch and low-cost method of enhancing participants’ meaning in life was developed. Although further work is needed to formally validate this tool, findings indicate it could act as a precursor or accompaniment to healthy lifestyle programmes, given observed benefits to participants’ autonomous motivation for health behaviour. Indeed, as a method of assisting individuals to internalise the benefits of a physically health-lifestyle, the MIL journal appears to represent a successful population-level version of motivational interviewing. Bloom et al. (2011) suggests such techniques are essential in the promotion of widespread physical health. More broadly, this work evidences the applicability of daily journaling paradigms to facets of wellbeing other than positive emotion, and to outcomes of physical health. As such, health practitioners may wish to explore further implementation of the meaning in life journal, and investigate the design of other journaling exercises to engender healthy lifestyle outcomes.

#### ***4. Enabling the Autonomous Pursuit of Personal Goals***

As discussed, enabling participants to select important goals within the context of a eudaimonic frame can promote outcomes of physical health. This insight is particularly relevant for populations who show entrenched and dispositional attitudes against maintaining their physical health, such as those experiencing futurelessness (Pepper & Nettle, 2014) and psychological reactance (Miller et al., 2007). The interventions developed in Chapters 2 and 3, and the approach of parkrun, offer practical examples regarding the facilitation of autonomous goals which drive future-related action. Critically, study 3B indicated how the internalisation of eudaimonic motives can act more powerfully to support health behaviour than intrinsic enjoyment, suggesting sustained exercise activity does not result from enjoyable experience per se, but an experience which is contextualised within the frame of a meaningful life. Additionally, Chapter 3 suggests eudaimonic framing can alter the subjective experience of events, according to the salience of high- and low-level characteristics. One consequence of abstract priming is the experience of greater autonomy (Sweeney & Freitas, 2017). Accordingly, health promotion efforts should aim to integrate these insights amongst future interventions and campaigns.

#### **Strengths**

A key strength of this thesis is the theoretical novelty presented in overarching themes and in independent chapters. Relationships between physical and mental health are numerous and well-established. However, a majority of prior research has investigated this association according to the impact of lifestyle behaviour upon psychological wellbeing (Weiss et al., 2009). Increasing evidence suggests psychological wellbeing may promote engagement in healthy behaviour (Boehm et al., 2012; Kubzansky et al., 2015). However, the current literature base is limited in size, largely comprises cross-sectional studies on optimism and life satisfaction, and does not distinguish between hedonic and eudaimonic forms of wellbeing. The current work presents evidence that eudaimonic frames are causally linked to health behaviour, providing fertile ground for further research. Specifically, this thesis involved the first assessment of health outcomes in relation to a longitudinal manipulation of meaning in life, a novel application of construal priming to enhance an existing intervention and reduce effort discounting, and the generation of original insight regarding factors which both motivate and sustain attendance at a real-world physical activity initiative.

In addition, multiple and diverse methods were employed across experimental studies. This

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included the development of an original brief and light-touch intervention to enhance meaning in life, and the novel integration of the LCM (Semin & Fiedler, 1991) amongst of LIWC software (Seih et al., 2017) to objectively assess construal level. Where appropriate, sample sizes were informed by statistical power analysis. Intervention effects were compared to control groups across all experimental studies, and pre-validated assessments and manipulation checks were employed when possible. Measures and materials developed for use in the current work were piloted to establish coherence and clarity. Each study accounted for the most pertinent potential confounds, and substantial attempts were made to minimise the likelihood of demand characteristics. Lastly, multiple objective assessments of behavioural health outcomes were used. These included the pre-validated bogus taste test (Robinson et al., 2017), the novel fictional effort experiment task, and an original utilisation of the open access parkrun database.

The work in this thesis was also designed according to evidence-based recommendations on the prevention of noncommunicable disease (WHO, 2014). In particular, emphasis was placed upon interventions which are appropriate at the population-level, and applicable across multiple modifiable risk behaviours. In Chapter 2, global physical health motivation and behaviour were assessed, complimented by work investigating the relevance of construal priming to both eating behaviour and effort-based decision making in Chapter 3. In Chapter 4, evidence regarding the spillover effects of physical activity to other healthy behaviour was observed. As a whole, this work presents evidence to facilitate intervention across multiple NCD risk behaviours, supporting the design of optimally effective health promotion efforts.

## Limitations

In addition to the limitations already delineated in specific chapters, several cross-cutting issues should be acknowledged in order to inform future research and intervention. Firstly, it is possible that participants in all studies altered their natural behaviour as a result of Hawthorne effects (Sedgwick & Greenwood, 2015). For example, the use of explicit measures to record physical health outcomes and psychological wellbeing is likely to have stimulated behavioural monitoring and modification over the intervention and testing periods (McCambridge, Witton, & Elbourne, 2014; McCarney et al., 2007). Numerous measures were taken in order to minimise any potential impact of these phenomena on results. Firstly, all studies in Chapters 2 and 3 compared experimental conditions to control groups who experienced a near identical procedure excluding the experimental

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manipulation. Secondly, participants in study 1A were recruited for the ostensible purpose of a study on ‘daily reflection’ rather than psychological wellbeing, in order to reduce the risk of placebo effects. In study 2A, the use of the bogus taste test as an assessment of food intake was not revealed until the end of the experiment, and participants did not indicate any awareness of links between the experimental manipulations and taste test or fictional effort experiment selection when probed for suspicion. Moreover, the qualitative survey in study 3A was designed to minimise bias via the neutral framing of questions (Patton, 1987), and to reduce social desirability concerns via a less direct interaction with researchers (Heerwegh & Loosveldt, 2007).

In study 1A a hypothetical monetary discounting task was used to provide a general measure of impulsivity and index psychological processes which underly multiple behaviours related to noncommunicable disease (Bickel, Jarmolowicz, Mueller, et al., 2012). However, as discussed in study 2B a critical distinction exists between optimal economic and healthy decision-making. Critically, impulsive tendencies related to physical health are not only determined by discount rates, but also the incentive value of competing stimuli, including primary reinforcers of food, tobacco and alcohol, and the innately aversive sensation of physical effort (Bickel, Jarmolowicz, MacKillop, et al., 2012). This explains why some evidence indicates domain-specificity in inter-temporal choice (Jimura et al., 2011; Tsukayama & Duckworth, 2010), given the reinforcement value of instantly gratifying stimuli will differ across individuals. As such, subsequent experiments were designed in order to objectively assess health-related outcomes at a behavioural level. One consequence of this approach was a relatively greater focus upon outcomes related to diet and exercise, leaving tobacco use and alcohol misuse relatively unexplored. However, the work in this thesis was designed to address the general weighting of future outcomes and immediate reward, aligned with evidence that impulsive tendencies underly multiple health-risk behaviours (French et al., 2001; McClelland et al., 2016; Parry et al., 2011). Indeed, paradigms which manipulate the incentive value of instantly gratifying stimuli are applicable across dietary choice, alcohol consumption and tobacco use (Attwood et al., 2008; Boutelle et al., 2014; Fadardi & Cox, 2009; Field, Duka, et al., 2009; Field & Eastwood, 2005; Kemps et al., 2014; Schoenmakers et al., 2007), presenting supporting evidence for the approach taken in the current work.

Moreover, it is important to acknowledge that psychobehavioural components form one aspect of noncommunicable disease development. It is also necessary to integrate social, biological and environmental issues amongst initiatives to promote human health. For example, urban sprawl

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(Ewing, Schmid, Killingsworth, Zlot, & Raudenbush, 2008), sedentary travel patterns (Frank, Andresen, & Schmid, 2004), technological development and energy-dense food environments (Chaput, Klingenberg, Astrup, & Sjödin, 2011) are all implicated in the precipitation and maintenance of noncommunicable disease. The insights presented here can be used to empower the global populace in terminating maladaptive practices to attain greater physical health, and can be integrated amongst a trans-disciplinary approach to alleviating noncommunicable disease.

Lastly a limitation of the positive health perspective taken in this thesis is that population-level interventions will not be equally effective across all individuals. The person-activity fit model (Lyubomirsky & Layous, 2013) describes how matching the characteristics of positive psychology interventions (eg. dosage, variety) and individuals (eg. personality, demographics) can promote efficacy and appeal. For example, (Layous et al., 2013) find introverts and extroverts respond optimally to different types of positive behavioural practice, and Parks (2014) reports the custom-tailoring of interventions predicts engagement. These findings are important, given adherence to the MIL journal was a significant issue in study 1B. Nonetheless, targeting interventions across a majority of the general public is observed to shift population means and elicit a substantial reduction in the prevalence of multiple mental and physical health disorders (Grun & McKeigue, 2000; Huppert, 2009; Puska et al., 1998; Rose et al., 2008), representing a cost- and resource-effective strategy. With this in mind, positive health interventions to alleviate noncommunicable disease may be best designed when accounting for factors most commonly experienced by the general population. A successful example of this approach is observed at parkrun, whereby fundamental and innate human needs, as well as widely cited barriers to exercise, are addressed.

### **Future Research**

The original work that comprises this thesis marks an important development in the application of positive health paradigms to lifestyle behaviour. Additional research should be conducted in order to further develop, understand and validate this approach. The following section details some specific future directions, based on themes presented thus far.

### **The Qualitative Contents of Eudaimonic Frames**

The current research indicates the precise content of future prospection is an important yet under-explored concept in healthy behaviour change. This is complimented by previous work which

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has attempted to characterise relationships across daily behaviours and forms of happiness (Hallam et al., 2014; Henderson, Knight, & Richardson, 2013; Steger et al., 2008). Subsequent studies should analyse the nature of activities and goals participants describe in response to eudaimonic frames. Indeed, interventions such as the meaning in life journal presented in Chapter 2 represent a method of not only manipulating meaningful experience, but also collecting information on behaviours and cognitions which are most closely associated with eudaimonia. Understanding which forms of eudaimonic activity are appealing and accessible to the general population would enable the integration of such insight amongst health promotion campaigns, and afford maximally effective health-frame messages.

### **Psychological Processes Underlying Eudamonia and Self-Regulation**

Future research could also establish the role of physical health salience and behavioural displacement as mediatory factors in the relationship between eudaimonia and healthy living. Participants in studies 1A and 2A indicated lasting effects of eudaimonic framing, indexed via autonomous motivation for health behaviour and self-reported wellness behaviour respectively. These findings are indicative of cognitive or behavioural habits, and align with previous evidence regarding the use of daily journaling to promote happiness (Carter et al., 2016; Seligman et al., 2005). Determining whether eudaimonic frames accentuate health-related cues in everyday life would add novel insight to the relationship between wellbeing and health behaviour, and provide evidence to explore effects of eudaimonic framing upon pleasure-seeking activity. Previous studies have used measures of attentional bias to investigate the salience affect-related cues (Blankers, Saleminck, & Wiers, 2016; Browning et al., 2012; Wells & Beevers, 2017), and stimuli associated with personally subjective benefits related of alcohol recovery (Rettie et al., 2018). This indicates assessments of attentional bias are feasibly applicable in examining a relative reduction in the salience of various instantly gratifying stimuli, and increased attention toward personally relevant goals.

### **Eudaimonia and Futurelessness**

This thesis identified that eudaimonic frames may be a particularly fruitful method of alleviating socioeconomic health inequalities, as meaningful goals provide more proximal reasons to engage in healthy behaviour, and thus attenuate futurelessness. An important goal for future research is to establish whether eudaimonic frames buffer individuals from the psychological impact of dangerous living environments, in order to attenuate perceived extrinsic mortality risk and

promote healthy lifestyle behaviour.

Lastly, this thesis marks only the beginning of exploration regarding eudaimonic frames and healthy lifestyle behaviour. Future work could identify additional methods and constructs which promote eudaimonic wellbeing and goal pursuit, thus promoting the appeal and salience of physical health.

## **Conclusion**

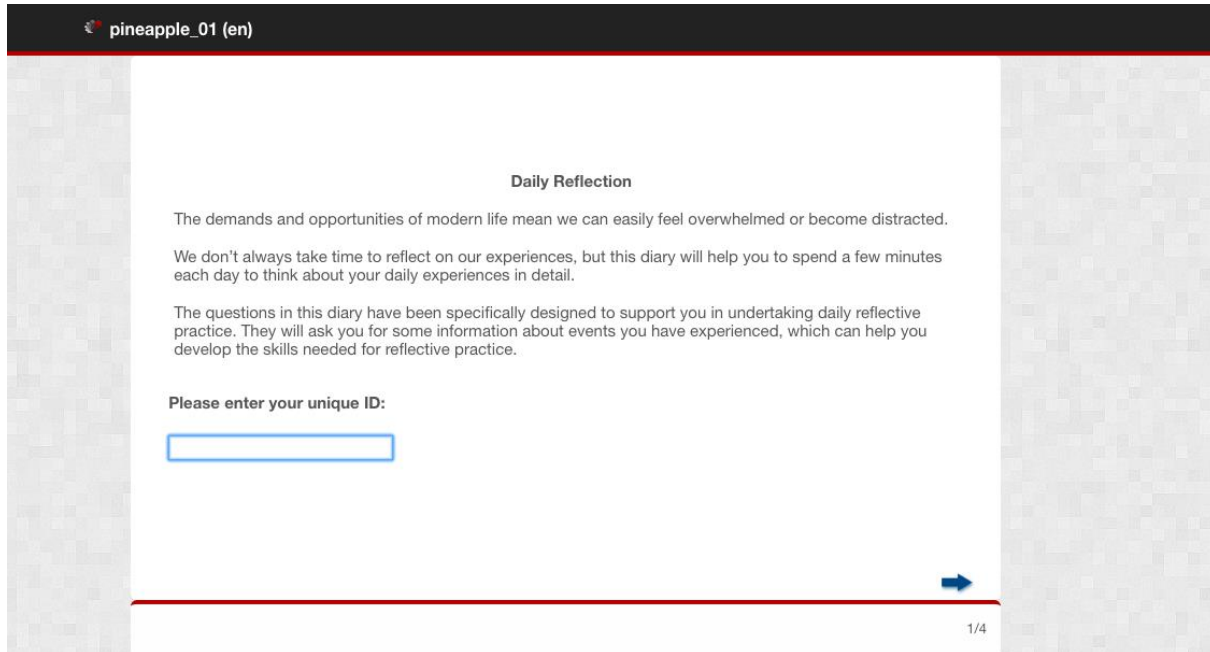
A growing body of research concerns the role of positive emotional, cognitive and behavioural practices in promoting psychological wellbeing. Aligned with the positive health paradigm, these techniques help to enhance and sustain mental wellbeing at the population level. This thesis suggests a positive health perspective may also be applied to address the global challenge of noncommunicable disease. Specifically, the research presented here presents preliminary evidence that eudaimonic frames can be used to enhance the salience of meaningful values and goals, and as a result drive immediate healthy lifestyle behaviour. This suggests a new direction for health promotion efforts, given goals which are ostensibly unrelated to physical health can nonetheless enhance the appeal of longevity and salience of distal consequences. As such, individuals should be afforded the autonomy to select their own goals, and support in identifying meaningful reasons to engage with them, inside the context of a eudaimonic frame



## Appendices

### Appendix. 4.1: The Meaning in Life Journal V1

This journal was accessed via the data capture tool Sensemaker. Screenshots of the process required to complete the diary are included below.



pineapple\_01 (en)

**Daily Reflection**

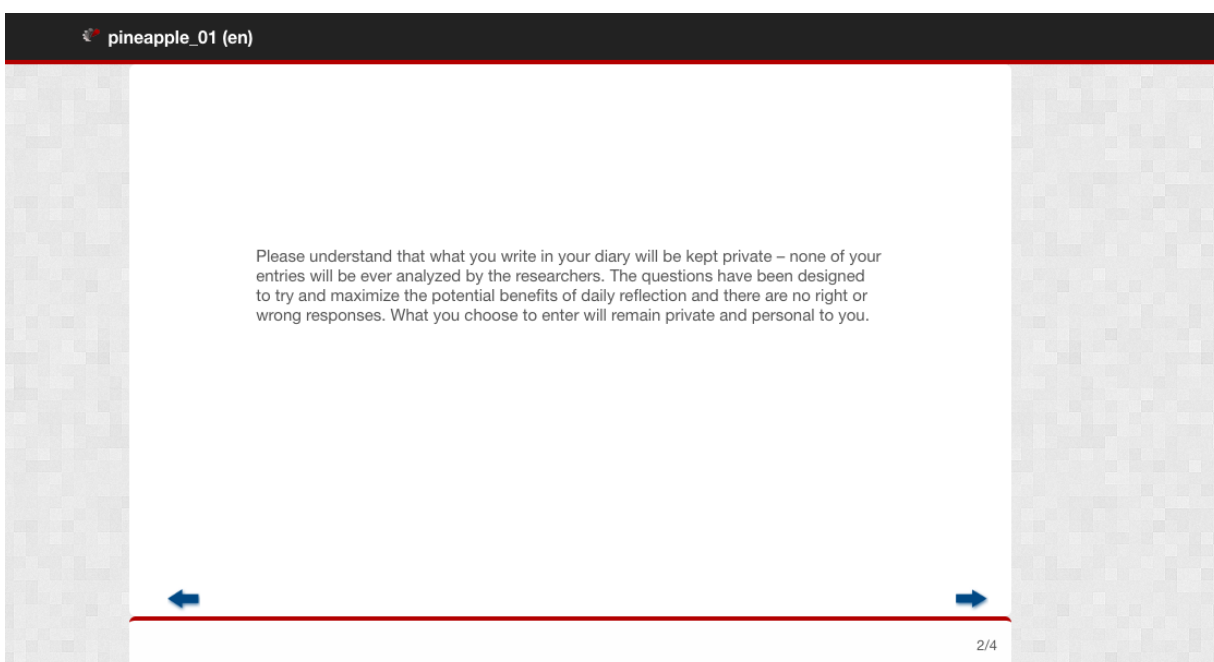
The demands and opportunities of modern life mean we can easily feel overwhelmed or become distracted.

We don't always take time to reflect on our experiences, but this diary will help you to spend a few minutes each day to think about your daily experiences in detail.

The questions in this diary have been specifically designed to support you in undertaking daily reflective practice. They will ask you for some information about events you have experienced, which can help you develop the skills needed for reflective practice.

Please enter your unique ID:

1/4



pineapple\_01 (en)

Please understand that what you write in your diary will be kept private – none of your entries will be ever analyzed by the researchers. The questions have been designed to try and maximize the potential benefits of daily reflection and there are no right or wrong responses. What you choose to enter will remain private and personal to you.

2/4

1. Name one activity you did today that was challenging, but also interesting or enjoyable. This could be any activity, big or small.

2. Why did you do the activity, even though it was challenging?

3. How could this activity help others, or support you to help others? This could be anyone from your close friends and family to future generations, wider society or total strangers.

4. What wider life goals does this activity help you achieve and how?

5. What skills or values did the activity require and/or strengthen?

6. Who initiated the activity, and how did they do it?

### Appendix 4.2: The Control Diary V1

This diary was accessed according to a process identical to that of the MIL journal (see pg. 256 only).  
Screenshot of the diary questions are included below.

1. What was the first event/activity that happened when you woke up this morning?

2. What kind of place did this event/activity happen in?

4. What actions did this event/activity require?

5. Who else experiences this kind of event/activity?

6. When is this event/activity likely to happen in future?

### Appendix 4.3: The Meaning in Life Journal V2

An example of the Control Diary V2 is included below. A full version is available on the accompanying drive.

Name one thing you did today that was hard, but made you feel good.

*This could be anything - big or small.*

Why did you **stick** with it, even though it was hard?

Why might this be important for **other** people?

*Your thing might be kind, inspire someone, share something good, or put you in a better place to help others.*

*These people could be anyone from close friends and family, future generations, the wider community or total strangers.*

Why might this be important for **you**?

*It might have been a step towards bigger things you want to achieve in life, been a positive experience in some way, or taught you something new.*



You're finished - well done!

☐

### Appendix 4.4 : The Control Diary V2


An example of the Control Diary V2 is included below. A full version is available on the accompanying drive.

What was the first thing that happened when you woke up this morning?  
*This could be anything - big or small.*

What kind of place did this happen in?

What actions did this thing need?

Who else might experience this kind of thing?



You're finished - well done!

### Appendix 4.5: Couch 2 5K Instructional Support

Participants were provided with 'handouts' at the end of every session during the 10-week course. Examples are included below.



**Couch to 5K**



**CybiStriders**  
anglesey ynys Môn

We hope that you are enjoying the sessions and managing to get your extra runs in during the week. As the time spent running increases, these runs become even more important to help your body adjust to the extra demands you are making of it.

One run can change your day, many runs can change your life.



Just remember to keep it slow and your body WILL thank you for it in the long run!!

Week 3		
Day 1 <input checked="" type="checkbox"/>	Day 2 <input type="checkbox"/>	Day 3 <input type="checkbox"/>
5 min warm up	5 min warm up	5 min warm up
90 sec jog	90 sec jog	90 sec jog
90 sec walk	90 sec walk	90 sec walk
3 min jog	3 min jog	3 min jog
3 min walk	3 min walk	3 min walk
x2	x2	x2
5 min cooldown	5 min cooldown	5 min cooldown
=18 mins	=18 mins	=18 mins

Any questions or problems, drop us an email on [training.cybistriders@gmail.com](mailto:training.cybistriders@gmail.com).

See you at 7pm next week, Josie, Rhi and Kev



Find us on Facebook @cybistriders [www.cybistriders.co.uk](http://www.cybistriders.co.uk)



**Couch to 5K**



**CybiStriders**  
anglesey ynys Môn

Congratulations on completing week 5 - you're halfway there! You've done some fantastic running already, so this is a great time to look back on what you've achieved. As we build up the distance, it becomes more and more important to look after your body by doing some homework in between the sessions.

**IT NEVER GETS EASIER YOU JUST GET STRONGER**



Try to fit in the runs below before next Thursday. Good luck and see you next week!

Week 5		
Day 1 <input checked="" type="checkbox"/>	Day 2 <input type="checkbox"/>	Day 3 <input type="checkbox"/>
5 min warm up	5 min warm up	5 min warm up
5 min jog	8 min jog	20 min jog
3 min walk	5 min walk	
5 min jog	5 min walk	
3 min walk	8 min jog	
5 min jog	8 min jog	
x1	x1	x1
5 min cooldown	5 min cooldown	5 min cooldown
=21 mins	=21 mins	=20 mins

Any questions or problems, drop us an email on [training.cybistriders@gmail.com](mailto:training.cybistriders@gmail.com).

See you at 7pm next week, Josie, Rhi and Kev



Find us on Facebook @cybistriders [www.cybistriders.co.uk](http://www.cybistriders.co.uk)



**Couch to 5K**



**CybiStriders**  
anglesey ynys Môn



**When the road gets tough don't quit just change shoes**

Congratulations on completing week 6 of your C25K. You're on the home straight now, so keep up the good work! Again, it's really important to maintain your fitness in between sessions, so try to fit in the two runs below over the course of the next week, to keep your body, muscles and mind strong and healthy!


Week 6		
Day 1 <input checked="" type="checkbox"/>	Day 2 <input type="checkbox"/>	Day 3 <input type="checkbox"/>
5 min warm up	5 min warm up	5 min warm up
5 min jog	10 min jog	
3 min walk	3 min walk	25 min jog
8 min jog		
3 min walk	10 min jog	
5 min jog		
x1	x1	x1
5 min cooldown	5 min cooldown	5 min cooldown
=24 mins	=21 mins	=25 mins

Any questions or problems, drop us an email on [training.cybistriders@gmail.com](mailto:training.cybistriders@gmail.com).


See you at 7pm next week, Josie, Rhi and Kev




Find us on Facebook @cybistriders [www.cybistriders.co.uk](http://www.cybistriders.co.uk)



**Couch to 5K**



**CybiStriders**  
anglesey ynys Môn



**Our running shoes are really erasers. Every step erases some past failure. Every mile brings us closer to a clean slate. Every foot strike rubs away a word, a look or an event which led us to believe that success was beyond our grasp.**

John Bingham

You've cracked week 7 – fantastic! The runs have really started to increase in distance and intensity now, so well done for sticking with the course and becoming a stronger runner. Try to fit in the next two runs described below over the course of the week, so you can take on week 8 at your best!

Week 7		
Day 1 <input checked="" type="checkbox"/>	Day 2 <input type="checkbox"/>	Day 3 <input type="checkbox"/>
5 min warm up	5 min warm up	5 min warm up
25 min jog	25 min jog	25 min jog
x1	x1	x1
5 min cooldown	5 min cooldown	5 min cooldown
=25 mins	=25 mins	=25 mins

Any questions or problems, drop us an email on [training.cybistriders@gmail.com](mailto:training.cybistriders@gmail.com).

See you at 7pm next week, Josie, Rhi and Kev

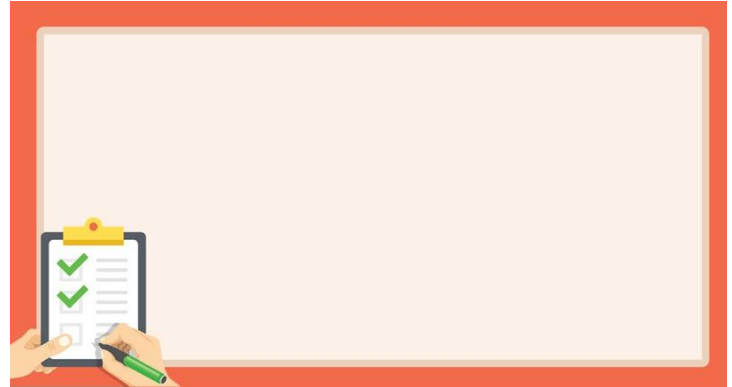


Find us on Facebook @cybistriders [www.cybistriders.co.uk](http://www.cybistriders.co.uk)

**Appendix 4.12: Metacognitive Strategy Cue Cards**

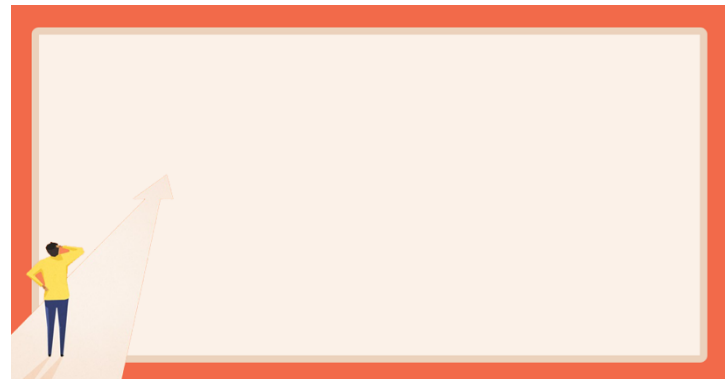
Low-Level Condition

*MY PROCESS*



High-Level Condition

*MY PURPOSE*





## Appendix 4.13: The Fictional Effort Experiment Selection

Discrete choice of high-effort\*reward vs low-effort\*reward options. Order of presentation was counterbalanced across participants and within conditions.

COLEG GWYDDORAU IECHYD AC YMDDYGIAD  
COLLEGE OF HEALTH & BEHAVIOURAL SCIENCES

YSGOL SEICOLEG  
SCHOOL OF PSYCHOLOGY



## Participant Information Form

**PhD Student Researcher:**

**Rhi Willmot**

**email:** [psp507@bangor.ac.uk](mailto:psp507@bangor.ac.uk)

**Supervisor:**

**Professor John Parkinson**

**email:** [j.parkinson@bangor.ac.uk](mailto:j.parkinson@bangor.ac.uk)

Dear Participant,

This study involves two experiments which are described below. You cannot take part in both experiments, so please read all of the information below carefully, before making your choice. Both experiments will last one hour and you will be compensated for your time with 3 SONA credits or a cash payment of £15.00.

### Experiment 1 – Active Metrics

You will be asked to run on a treadmill whilst we assess your physiological characteristics (breathing rate, heart rate etc.), which we will then use to create a database of physical exertion statistics.

*Experiment Benefits.* By participating in this experiment, you will gain:

- Personalised information on how to live a long and healthy life
- Personalised strategies to keep your mind and body performing at their best
- Specific advice based on your bodily metrics, on how best to avoid ill health conditions
- Personalised ideas on how to look after your muscles
- Information on the best physical activities for you to boost your mood

*Experiment Participation.* During this experiment, as a result of physical exertion, you will:

- Experience aching muscles
- Experience shortness of breath
- Feel physical tiredness/fatigue
- Feel sensations of physical warmth (eg. perspiration)
- Feel minor dehydration (eg. dry mouth)

### Experiment 2. – Resting Metrics

You will be asked to sit in a chair whilst we assess your physiological characteristics (breathing rate, heart rate etc.), which we will then use to create a database of physical resting statistics.

*Experiment Benefits.* By participating in this experiment, you will gain information on:

- General information on resting heart rate, breathing rate etc.
- UK Population statistics on the rates of heart disease
- UK Population statistics on the rates of type 2 diabetes
- Statistics on heart disease in Wales



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- Statistics on type 2 diabetes in Wales

*Experiment Participation.* During this experiment, you will:

- Sit in a chair
- Rest your feet on a low footstool
- Rest your arms on a chair tray
- Have your resting heart rate recorded using a painless finger-clip
- Have your back kept supported by cushions

**Please write your initials in the box for the experiment you would you like to take part in:**

☐

**Experiment 1 – Active Metrics**

☐

**Experiment 2 – Resting Metrics**

**Participant Name .....**

### Appendix 5.1: The Orientations to Happiness Scale

Orientation to meaning (highlighted in yellow) and orientation to pleasure (highlighted in blue) subscales.

Participant ID.....

Please read the following statements and for each, tick the box that best describes you. There are no right or wrong answers, so please answer as honestly as you can throughout and try not to let your response to one question influence your response to other questions.

	Not at all like me	Not very like me	Some- what like me	Mostly like me	Very much like me
My life serves a higher purpose.					
In choosing what to do, I always take into account whether it will benefit other people.					
Life is too short to postpone the pleasures it can provide.					
For me, the good life is the pleasurable life.					
What I do matters to society.					
I love to do things that excite my senses.					
In choosing what to do, I always take into account whether it will be pleasurable.					
I go out of my way to feel euphoric.					
I agree with this statement: "Life is short – eat dessert first".					
I have a responsibility to make the world a better place.					
My life has lasting meaning.					

### Appendix 5.2: The Treatment Self-Regulation Questionnaire

Autonomous motivation (highlighted in yellow), controlled motivation (highlighted in blue) and amotivation (highlighted in pink) items.

Participant ID.....

**The Treatment Self-Regulation Questionnaire (15 Items)**

The following question will ask you about your healthcare behaviours. For this questionnaire, the term 'healthcare behaviours' refers to the maintenance of a healthy diet, taking regular physical exercise, not smoking and using alcohol responsibly.

Different people have different reasons for wanting to behave in this way, or they may not want to do so at all. Please read the following statements and tick the box which best represents how you feel about each one:

**The reason I would maintain healthy behaviours, or try to become healthier is:**

	Not True At All	Not true	Some What Untrue	Neutral	Some What True	True	Very True
Because I feel that I want to take responsibility for my own health							
Because I would feel guilty or ashamed of myself if I didn't behave healthily							
Because I personally believe it is the best thing for me							
Because others would be upset with me if I didn't							
I really don't think about it							
Because I have carefully thought about it and believe it is very important for many aspects of my life							

Participant ID.....

Because I would feel bad about myself if I didn't behave healthily							
Because it is an important choice I really want to make							
Because I feel pressure from others to behave healthily							
Because it is easier to do what I am told than to think about it							
Because it is consistent with my life goals							
Because I want others to approve of me							
Because it is very important for being as healthy as possible							
Because I want others to see I can do it							
I really don't know why							

### Appendix 5.3: The Health Risk Behaviour Inventory

Participant ID.....

Please read the following statements and choose the one which best describes **your behaviour over the past week**. There are no right or wrong answers, so please answer as honestly as you can throughout and try not to let your response to one question influence your response to other questions. *Please identify your answer by circling your chosen box.*

**Over the past week...**

<i>While awake I spent...</i>	Almost all of my time sitting or lying down	More time sitting than standing or moving	Equal amounts of time sitting/lying down and standing/moving	More time moving/standing than sitting/lying down	Almost all of my time moving or standing
<i>Aerobic exercise is any activity that significantly raises your heart rate.</i>  <i>Over the past week I...</i>	Got lots of aerobic exercise at my job, so did not need to work out	Got more than 2.5 hours of aerobic exercise over the week	Got at around 2.5 hours of aerobic exercise over the week	I did get some aerobic activity, but not more than 2.5 hours over the week	I hardly got any aerobic exercise
<i>Resistance training includes activities to strengthen muscles like lifting weights.</i>  <i>Over the past week I...</i>	I did a lot of heavy lifting at my job, so did not need to do resistance training	did resistance training more than twice	did resistance training around twice	did resistance training no more than once	I did not do any resistance training
During the past week I ate...	3 or more servings of vegetables almost every day	3 or more servings of vegetables on around 5 days	I ate vegetables on most days, but only sometimes ate 3 or more servings in a day	I ate vegetables some days, but rarely ate 3 or more servings in a day	I rarely ate vegetables
During the past week I ate...	3 or more servings of fruit almost every day	3 or more servings of fruit on around 5 days	I ate fruit on most days, but only sometimes ate 3 or more servings in a day	I ate fruit some days, but rarely ate 3 or more servings in a day	I rarely ate fruit

Participant ID.....

Fried foods include French fries, fried chicken, onion rings, etc.  During the past week...	I never ate fried foods	I rarely ate fried foods	I ate fried foods a few times	I ate fried foods most days per week	I ate fried foods almost every day
Sugar-sweetened foods & beverages include non-diet soda, sweet tea, cookies, candy etc.  During the past week...	I had sugar-sweetened foods or beverages multiple times per day almost every day	I had sugar-sweetened food or beverages on most days	I had sugar-sweetened foods or beverages a few times	I rarely had sugar-sweetened foods or beverages	I almost never had sugar sweetened foods or beverages
During the past week I...	Never ate to the point of feeling too full or "stuffed"	felt too full or "stuffed" rarely	felt too full or "stuffed" once or twice	felt too full or "stuffed" on several days	felt too full or "stuffed" almost every day
During the past week I...	did not smoke any cigarettes	almost never smoked	smoked a few cigarettes but not every day	smoked at least one cigarette per day	smoked at least 10 cigarettes per day

Participant ID.....

During the past week I...	was almost never exposed to second hand smoke	was sometimes exposed to second hand smoke, but never for more than a few seconds at a time	was around people while they were smoking once or twice, but not for a very long time	was around people while they were smoking almost every day, but it wasn't for a very long time	was around people while they were smoking almost every day for long periods of time
During the past week I...	did not drink any alcohol	drank some alcohol, but never more than 1-2 drinks in a single day	drank at least 4-5 drinks a day on one or two da	drank at least 4-5 drinks a day on one or two days	drank at least 4-5 drinks in a single day 3 or more days per week
During the past week I...	did not drink any alcohol	never drove after drinking	drove after drinking 2 or more drinks once	drove after drinking 2 or more drinks more than once	
During the past week...	I did not drink any alcohol	once I started drinking I had no problem stopping at any time	once I started drinking, I sometimes did not want to stop because I was enjoying it, but could stop if I had to	once I started drinking, I often did not want to stop because I was enjoying it, but could stop if I had to	once I had started drinking, it was usually difficult for me to stop for any reason
'Activities or responsibilities' include work, school, university, family etc.  During the past week...	I did not drink any alcohol	drinking or being hungover never interfered with my usual activities or responsibilities	drinking or being hungover rarely interfered with my usual activities or responsibilities	drinking or being hungover interfered with my usual activities or responsibilities multiple times	drinking or being hungover interfered with my usual activities or responsibilities almost every day

Participant ID.....

<p>Dairy products include milk, cheese, yoghurt etc.</p> <p>During the past week...</p>	<p>I never eat any dairy products</p>	<p>I always chose low-fat or fat-free dairy products (eg. semi-skim milk)</p>	<p>When I had dairy products, I usually chose low-fat or fat-free options but I sometimes ate regular dairy products</p>	<p>I chose low-fat/fat-free options for some types of dairy (eg. skim milk) but not for others (eg. regular cheese)</p>	<p>I sometimes chose low-fat/fat-free dairy products, but about half the time I ate regular fat dairy products</p>	<p>Once in a while I chose whole grains, but usually ate regular dairy products eg. regular cheese</p>	<p>I always chose regular dairy products over low-fat or fat-free dairy products</p>
<p><i>Grains include bread, cereal, pasta etc.</i></p> <p>During the past week...</p>	<p>I very rarely or never eat any grains</p>	<p>When I ate grains, I always chose whole grain options over white or enriched options</p>	<p>When I ate grains I usually chose whole grain options but sometimes ate white or enriched grains</p>	<p>I chose whole grains for some types of food (eg. bread) but not others (eg. pasta)</p>	<p>I sometimes chose whole grains but about half the time I ate white or enriched grains</p>	<p>Once in a while I chose whole grains, but usually ate white or enriched grains</p>	<p>I always chose white or enriched grains over wholegrains</p>



### Appendix 5.4: The Wellness Behaviour Inventory

Reverse scored items are denoted via red highlight.

Please read the following statements and for each, tick the box that best describes you **over the course of the past week**.

There are no right or wrong answers, so please answer as honestly as you can throughout and try not to let your response to one question influence your response to other questions.

	Less than once a week or never	One day a week	2 – 3 days a week	4 – 5 days a week	Every day of the week
I ate breakfast					
I got a good night's sleep, eg. Uninterrupted, restful sleep					
I drank 3 or more caffeinated beverages, such as coffee, tea or colas.					
I exercised for 20 continuous minutes or more, to the point of perspiration					
I ate at least 3 meals a day					
I took time to relax					
I ate fresh fruits and/or vegetables					
I walked as much as possible, eg. I took the stairs not the lift, etc.					
I took vitamins					
I ate junk foods, such as crisps, chips, sweets, French fries, etc.					
I ate healthy, well-balanced meals					
I took natural supplements such as garlic pills, Echinacea, herbals etc.					

### Appendix 5.10: Screening Questionnaire

Participant ID.....

## Experiment Preparation Questionnaire

---

1. Do you have allergies or intolerances to any of the following: milk, soya, wheat, egg, malt, or nuts?

☐

Yes

No

☐

2. Do you have any (other) allergies? If 'Yes' please list below.

.....

3. Are you currently taking any medications that are known to effect appetite?  
(For example; antihistamines, corticosteroids, donabinhol, insulin, megestrol acetate, mirtazapine, sulfonylureas, digoxin, fluoxetine, quinidine, hydralazine etc.)

☐

Yes

No

☐

4. Have you consumed any food or caffeinated beverages in the past four hours?

☐

Yes

No

☐

5. Do you have any reason to believe, or is there a realistic probability, that you are currently pregnant?

☐

Yes

No

☐

6. Do you suffer from any of the following conditions: diabetes, hyperthyroidism, Graves' disease, hypothyroidism, Prader-Willi syndrome, Kleine-Levin syndrome?

Yes

☐

No

☐

7. Have you consumed any alcohol in the past 24 hours?

☐

Yes

No

☐

Participant ID.....

8. Do you currently feel hungover?

☐

Yes

No

☐

9. How hungry are you right now?

*Not at all  
hungry*

1 2 3 4 5 6 7 8 9 10

*Very  
Hungry*

10. How thirsty are you right now?

*Not at all  
thirsty*

1 2 3 4 5 6 7 8 9 10

*Very  
Thirsty*

11. At what time was your most recent meal?

.....am / pm (please circle as appropriate)

The time now is.....







12.

How <b>important</b> are the following factors in your <b>overall liking</b> of food:					
	1 – Not very important at all	2 – Not very important	3 - Neutral	4 – Somewhat important	5 – Very important
Taste					
Healthiness					
Nutrition					
Texture					
Good for your body					
Smell/aroma					
Naturalness					
Appearance					
Flavour					
Making you feel good					

Participant ID.....

Later on, in the session you will be asked to taste some different foods. We don't want to present you with any foods that you do not like, so please rank the following items from number 1 (would most like to taste) to number 6 (would least like to taste) by writing your number in the box next to the food image.

(All foods will be presented in equal quantities)

<div>Chocolate Brownie</div> <div></div> <div><input type="checkbox"/></div>	<div>Cheddar Cheese</div> <div></div> <div><input type="checkbox"/></div>
<div>Raspberries</div> <div></div> <div><input type="checkbox"/></div>	<div>Green Grapes</div> <div></div> <div><input type="checkbox"/></div>
<div>Carrots</div> <div></div> <div><input type="checkbox"/></div>	<div>Caramel Shortbread</div> <div></div> <div><input type="checkbox"/></div>

## Appendix 5.15: Food Liking Questionnaire

Participant ID..... Food choice.....

	<b>Not very much at all</b>	<b>Not much</b>	<b>Neutral</b>	<b>Some-what</b>	<b>Very much so</b>
How pleasant is the <b>taste</b> of this food?					
How <b>healthy</b> is this food?					
How <b>nutritious</b> is this food?					
How pleasant is the <b>texture</b> of this food?					
How <b>good for your body</b> is this food?					
How pleasant is the <b>smell/aroma</b> of this food?					
How <b>natural</b> is this food?					
How pleasant is the <b>appearance</b> of this food?					
How pleasant is the <b>flavour</b> of this food?					
To what extent does eating this food <b>make you feel good</b> ?					
How <b>important</b> are the following factors in your <b>overall liking</b> of food:					
Taste					
Healthiness					
Nutrition					
Texture					
Good for your body					
Smell/aroma					
Naturalness					
Appearance					
Flavour					
Making you feel good					

**Once you have completed the ratings, you are welcome to eat as much or as little of the food as you like.**

## Appendix 5.18: Study 3A Qualitative Survey

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### Your Experience at Parkrun

**Thank you very much for taking the time to fill in this questionnaire. We hope to use the results to create more great projects like Parkrun, and your information is very important for this. Please feel free to leave any questions you do not wish to answer blank, and to stop at any time.**

**Please write your name (this will be coded against an anonymous ID, so all of your answers will be confidential)**

.....

1. How did you first hear about Parkrun?

- a. Social media (Facebook, Twitter etc.)
- b. Friends or relatives
- c. Running club
- d. Television
- e. Newspaper
- f. Other (please state) .....

2. Why did you first come to Parkrun?

3. What do you enjoy most about Parkrun?

4. What is your favourite memory from Parkrun?



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9. How does Parkrun differ to other activities or initiatives you have tried in the past?

10. Why do you choose to come to Parkrun over other activities/initiatives?

**Once again, thank you very much for taking the time to fill in this questionnaire. We hope you enjoyed your run today!**



## Appendix 5.19: The Exercise Self-Regulation Questionnaire

Participant ID.....

There are a variety of reasons why people might come to Parkrun. Please indicate how true each of the following reasons are for you from 'Not true at all' to 'Very true'.

**The reason why I come to Parkrun is:**

	Not True At All	Not true	Some What Untrue	Neutral	Some What True	True	Very True
Because I would feel bad about myself if I did not.							
Because others would be angry at me if I did not.							
Because I enjoy Parkrun.							
Because I would feel like a failure if I did not.							
Because I feel like it's the best way to help myself.							
Because people would think I'm a weak person if I did not.							
Because I have no choice about coming to Parkrun; others make me do it.							

Participant ID.....

	Not True At All	Not true	Some What Untrue	Neutral	Some What True	True	Very True
Because it is a challenge to accomplish my goal.							
Because I believe Parkrun helps me feel better.							
Because it's fun.							
Because I worry that I would get in trouble with others if I did not.							
Because it feels important to me personally to accomplish this goal.							
Because I feel guilty if I do not come to Parkrun regularly.							
Because I want others to acknowledge that I am doing what I have been told I should do.							
Because it is interesting to see my own improvement.							
Because feeling healthier is an important value for me.							

## Appendix 5.20: The Basic Psychological Needs in Exercise Scale

Participant ID.....

There are a variety of reasons why people might come to Parkrun. Please indicate how true each of the following reasons are for you from 'Not true at all' to 'Very true'.

**The reason why I come to Parkrun is:**

	<b>Not True At All</b>	<b>Some What Untrue</b>	<b>Neutral</b>	<b>Some What True</b>	<b>Completely True</b>
I feel a sense of choice and freedom in coming to Parkrun					
I feel extremely comfortable with the other Parkrunners					
I feel I have been making huge progress with respect to the end result I am pursuing.					
I feel very strongly that coming to Parkrun reflects a decision I really want.					
I feel that I associate with the other Parkrunners in a very friendly way.					
I feel capable at Parkrun					
I feel that coming to Parkrun is an expression of myself.					

Participant ID.....

	<b>Not True At All</b>	<b>Some What Untrue</b>	<b>Neutral</b>	<b>Some What True</b>	<b>Completely True</b>
I feel there are open channels of communication with the other Parkrunners.					
At Parkrun, I feel competent to achieve my goals.					
I feel that coming to Parkrun really interests me.					
I feel very much at ease with the other Parkrunners.					
I feel that I can manage the requirements of participating at Parkrun.					

## Appendix 5.21: The Quiet Ego Scale

### Perspective Taking and Growth Subscales.

Participant ID.....

**The Quiet Ego Scale – measure of detached awareness, inclusive identity, perspective taking, and growth (14 Items)**

Subscales: **Perspective Taking**; **Growth**

Please read the following statements and tick the box which best describes how you feel about each one. There are no right or wrong answers so please answer as honestly as you can throughout, and try not to let your responses to one question influence your responses to others.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Disagree
I think it is important to have new experiences that challenge how you think about yourself and the world.					
Before criticizing somebody, I try to imagine how I would feel if I were in their place.					
For me, life has been a continuous process of learning, changing and growth.					
When I am upset at someone, I usually try to put myself in his or her shoes for a while.					
I have a sense that I have developed a lot as a person over time.					
I sometimes find it difficult to see things from another person's point of view. REVERSE					
I try to look at everybody's side of a disagreement before I make a decision.					
When I think about it, I haven't really improved much as a person over the years. REVERSE					

## Appendix 5.24: Parkrun Open Access Database


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## Rhiannon Amy WILLMOT (57 parkruns)



## Most Recent Runs

Event	Run Date	Gender Pos	Overall Position	Time	Age Grade
Penrhyn parkrun	15/06/2019	4	29	24:10	61.24%
Penrhyn parkrun	01/06/2019	3	28	22:58	64.44%
Lancaster parkrun	27/04/2019	15	97	27:32	53.75%
Newborough Forest parkrun	20/04/2019	7	66	24:09	61.28%
Penrhyn parkrun	09/03/2019	4	42	24:51	59.56%
Conwy parkrun	16/02/2019	5	45	22:49	64.86%
Penrhyn parkrun	12/01/2019	1	22	23:44	62.36%
Nant y Pandy parkrun	15/12/2018	21	45	38:24	38.54%
Nant y Pandy parkrun	08/12/2018	9	32	31:32	46.93%
Penrhyn parkrun	24/11/2018	5	30	22:50	64.82%

## Event Summaries

Event	Runs	Best Gender Position	Best Position Overall			
Penrhyn parkrun	48	1	17	00:21:57	All	
Nant y Pandy parkrun	4	1	15	00:24:29	All	
Whitstable parkrun	1	16	90	00:26:19	All	
Newborough Forest parkrun	1	7	66	00:24:09	All	
Conwy parkrun	1	5	45	00:22:49	All	
Lancaster parkrun	1	15	97	00:27:32	All	
Crissy Field parkrun	1	4	25	00:22:54	All	
	57	1	15	00:21:57	All	

## Volunteer Summary

Year	Role	Number of Times
2018	Finish Tokens	1
2018	Timekeeper	3
2017	Finish Token Support	3

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