EFFECTS OF A POSITIVE PSYCHOLOGICAL INTERVENTION ON MOOD AND PHYSICAL HEALTH IN ADULTS WITH DIABETES AND THOSE AT LOW OR HIGH RISK

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Abstract

Objectives: Positive Affect (PA) has been shown to influence a range of diabetes outcomes, including glycaemic control, mood, and self-management and preventative behaviours (Pressman, Jenkins, & Moskowitz, 2019). Positive Psychological Interventions (PPIs) are designed to facilitate PA, and several have demonstrated that they are effective when applied to a diabetes context for promoting physical and psychological outcomes. The aim of this PhD had been to build upon existing research and theory to specifically apply the 'Best Possible Self' (BPS) PPI to people with, and at risk of, diabetes.

Design: This thesis utilised a mixed-methods approach to 1) assess acceptability and feasibility of the BPS amongst people with Type 1 (T1D) and Type 2 (T2D) diabetes, and to; 2) tease out the intervention's mechanisms in a diabetes context using a non-clinical sample of participants at low and medium-high risk of T2D.

Methods: Five studes were conducted using one-to-one interviews, focus groups, self-report measures, textual analysis, and physiological methodologies.

Results: Acceptability and feasibility results demonstrated that the BPS had potential as a PPI for people with T1D and T2D. It was well-received by participants, and the quantitative findings showed that it influenced perceptions of self-care. However, the results also highlighted the need for further investigation of the intervention's mechanisms. Using a non-clinical sample of people at various risk of T2D, Studies 2 through 5 revealed the BPS' true relationship with PA in this context, while showcasing intervention benefits to diabetes-related symptomatology, feelings of autonomy, perceived stress, resilience, and blood pressure.

Conclusions: The research reported within this thesis demonstrates that PPIs may indeed be an effective way of producing a variety of positive health outcomes not only in people with T1D and T2D but also in those at various risk of T2D. This work also highlights the need to consider the unique needs of people with, at risk of,

diabetes. Future work should assess outcomes over a longer period (e.g. six months, one year, five years) while being mindful of moderating factors such as T2D risk.

Thesis' Unique Contributions (by Study)

Study 1

- Demonstrated the efficacy and acceptability of the 'Best Possible Self' as a tool for self-management of type 1 & type 2 diabetes
- This was the first study to adapt a positive psychological intervention using feedback from people with diabetes.

Study 2

- Provided first evidence that positive psychological interventions can also be administered effectively to those at *risk* of type 2 diabetes to reduce a range of negative health outcomes (including diabetes symptomatology and related-distress).

Study 3

- Added to the growing number of qualitative investigations into the 'best possible self' intervention's effects and mechanisms
- Showed how people at various levels of risk for type 2 diabetes uniquely conceptualised their health and set personalised goals using the intervention.

Study 4

- Demonstrated that the 'best possible self' intervention can promote resilience over a 4-week period in people at low and moderate-to-high risk of type 2 diabetes.
- Also highlighted that the intervention may produce unique benefits (in this case: perceived stress reduction) for people at higher risk of type 2

Study 5

- Showcased the unique benefits that engaging with the intervention could have on physiological measures of stress (specifically systolic blood pressure) in those at higher risk of type 2 diabetes.

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Chapter 1: Introduction

1.1 Overview

Diabetes mellitus is a significant public health concern for countries across the world (Diabetes UK, 2019). Type 1 (T1D) and Type 2 (T2D) diabetes alone currently affect over 3 million people in the United Kingdom (UK), and prevalence rates are increasing (Heald, Livingston, Malipatil, Becher, Craig, Stedman, & Fryer, 2018). As many as 12.3 million people in the UK are currently at risk for T2D, suggesting that, unless action is taken, prevalence will continue to increase rapidly (Diabetes UK, 2019). Altogether, this comes with significant economic costs and in 2015 it was estimated that the worldwide burden of diabetes was $1.31 trillion of global Gross Domestic Product (GDP; Bommer et al., 2017).

Effective diabetes self-management is essential to reduce the risk of complications and premature mortality in people diagnosed with T1D or T2D (American Diabetes Association, 2013) while preventive measures, including lifestyle changes, are critical for people at risk of developing T2D (Diabetes Prevention Program Research Group, 2015). Overall, responsibility is placed on the individual to educate themselves (albeit with the support of the NHS and appropriate medication) and to quickly adapt to the iterative lifestyle changes that diabetes requires (American Diabetes Association, 2013). Often, lifestyle changes not only include modifications to diet and exercise but an individual may also find themselves suddenly attending regular healthcare appointments and managing their diabetes via oral medications (such as metformin) and/or administration of insulin with injections or a pump (Atkinson et al., 2014; Chatterjee et al., 2017). To complicate things further, these lifestyle behaviours need to be achieved while managing blood sugar levels to prevent immediate negative consequences of living with diabetes (such as hypo/hyperglycaemia) or indeed the longer-term development and progression of the illness (American Diabetes Association, 2013). The burden of diabetes and its consequences has the potential to weigh heavily upon the individual, and diabetes-related distress and co-morbid anxiety and depression are common (Fisher et al., 2008; Smith et al., 2013). Even without a formal diagnosis of mental illness, frequently experiencing Negative Affect (NA; i.e. negative emotions/stress) can lead to a range of diabetes self-management and prevention issues (Powers, Richter, Ackard, & Craft, 2017). For example, healthier behaviours may become more difficult to initiate or maintain, as evidenced by the impact that NA has shown to have on a range of clinical markers (Skaff et al., 2009). Though psychological interventions that aim to eliminate NA in people with diabetes exist (and are frequently utilised; Uchendu & Blake, 2017), they have not always been effective in all scenarios and for all individuals.

Positive Psychological Interventions (PPIs) may offer an alternative for psychological support. PPIs have shown to be a novel way of addressing both mental and physical health issues by facilitating Positive Affect (PA). In cases such as diabetes, whereby NA is likely to be generated by diabetes itself (Roy, Sengupta, Sahana, Das, Talukdar, Baidya, & Goswami, 2018), facilitated PA may provide people with the emotional strength to weather through illness challenges and live a better quality of life. It has been proposed that PPIs are particularly beneficial in illness contexts (in contrast to more tradition psychological interventions) because they can be just as easily administered to individuals who are otherwise mentally “healthy” but whom may still benefit from ‘boosts’ that help them flourish under their circumstances (Bolier, Haverman, Westerhof, Riper, Smit, & Bohlmeijer, 2013). In terms of self-management and prevention efforts, the successful application of PPIs could potentially translate into a range of improved physical outcomes (some of which are detailed later in this chapter).

Fundamentally, the purpose of this thesis was to assess the effectiveness of one such intervention within the context of self-management and prevention of diabetes. The ‘Best Possible Self’ (BPS) exercise was the intervention of choice because it has shown to be well researched, flexible in its application, and to provide a range of health benefits (see Loveday, Lovell, & Jones, 2018 for a review). Before discussing the intervention in further detail, however, it was essential to first look at existing knowledge around diabetes and PA. As such, the current chapter focuses on introducing previous research around diabetes (its aetiology, prognosis, and psychological impact), PA (including definitions and its effects on a variety of health and illness outcomes) and the relationship between the two.

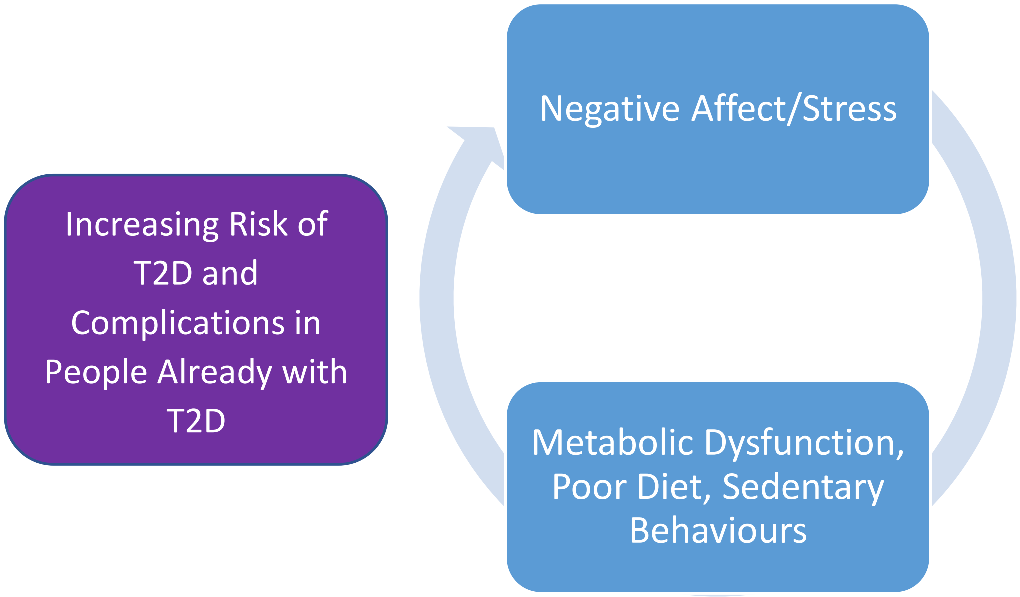
1.2 Diabetes

1.2.1 Aetiology

Diabetes mellitus may be considered an umbrella term for a range of metabolic disorders whereby glucose is improperly metabolised by the body (American Diabetes Association, 2013). Diabetes occurs because various genetic and environmental factors interact in complex ways to produce the loss of function and/or beta-cell mass that leads to hyperglycaemia (American Diabetes Association, 2013). There are two primary forms of diabetes: T1D and T2D, both of which will be discussed at various points throughout this thesis (although T2D becomes more central in later research chapters). T1D is an autoimmune disease that is typically considered a disease of childhood but in reality can occur at any age (Thomas, Jones, Weedon, Shields, Oram, & Hattersley, 2018). It is a condition in which pancreatic beta-cell destruction leads to absolute insulin deficiency (Atkinson, Eisenbarth, & Michels, 2014). It has a complex treatment regimen that involves coordination of multiple daily blood glucose tests, multiple daily insulin injections (unless the individual uses an insulin pump, though this also needs to be maintained), and monitoring diet and daily exercise levels to normalise blood glucose levels. By contrast, T2D (which accounts for almost 90% of cases; American Diabetes Association, 2017) is typically a consequence of lifestyle factors such as sedentary behaviours, diet, stress, and obesity (Chatterjee, Khunti, & Davies, 2017). In T2D, beta-cell dysfunction leads to insulin resistance in target organs and to relative insulin deficiency in later stages of the illness (Chatterjee et al., 2017).

Self-management is equally essential in T2D but, alongside issues common to both types including stigma (Schabert et al., 2013), fear (De Groot, Golden, &

Wagner, 2016), denial of the risks associated with the disease (Hendrieckx, Halliday, Beeney, & Speight, 2019), and the emotional challenges linked with a sudden increase in diabetes symptomatology (Williams et al., 2002), T2D also comes with its own unique emotional challenges including guilt (Benroubi, 2011) and self-blame (Hendrieckx et al., 2019). Unlike with T1D, these challenges need to be considered not only as a consequence of T2D but also as a precursor to it. Any of these issues may directly (and indirectly) influence metabolic dysfunction, diet, and sedentary behaviour, leading to further distress and creating a cyclical issue (Mathieson, Egerod, Jensen, Kaldan, Langberg, & Thomsen, 2019; see Figure 1.1 below). Efforts worldwide have, therefore, been slowly shifting towards the prevention of T2D over the last few decades under the assumption that prevention and early management is better both economically and for the well-being of the individual (Wanless, 2004). However, despite evidence for successful prevention programmes (including the UK National Diabetes Prevention Programme; NDPP; Penn et al., 2018), morbidity and mortality rates continue to increase across the globe.



[Fig 1.1 The influence of NA and stress on T2D risk and complications]

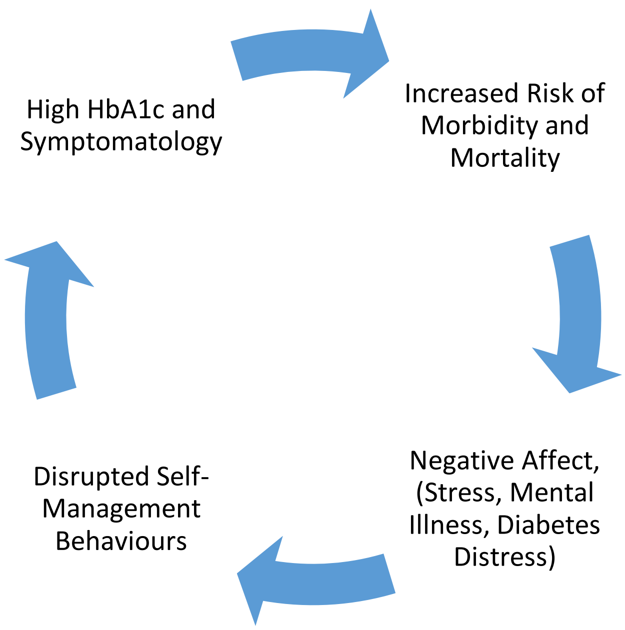
1.2.2 Hyperglycaemia, Symptoms, and Complications

The onset of T1D and T2D is associated with hyperglycaemia (Hendrieckx, Halliday, Beeney, & Speight, 2019), which increases the risk of severe consequences over time including myocardial infarction, stroke, neuropathy, kidney failure, and blindness (Atkinson et al., 2014; Chatterjee et al., 2017). Hyperglycaemia is also present in those at risk of T2D (John, Hilson, & Alberti, 2012) and so a primary goal across diabetes care (including prevention) is to maintain glucose levels within targets agreed by the healthcare team to reduce the risk of hyperglycaemia and avoid long-term complications (Driskell et al., 2014). Fear of hyperglycaemia, therefore, is quite common, and while an amount of fear can be adaptive, prolonged anxiety can be harmful (Hendrieckx et al., 2019). Paradoxically, anxiety about hyperglycaemia may even cause people to miss its symptoms, increasing the risk of a low blood glucose level (Wild et al., 2007).

Hyperglycaemia is so pertinent to T1D and T2D that measures of hyperglycaemia are used as tests of disease risk and complications across the illness timeline. During screening and diagnosis, initial detections are made using methods such as the HbA1c (glycosylated haemoglobin) assay, which provides an average measurement of blood glucose levels over the previous two to three months (World Health Organisation, 2011). Other plasma glucose readings may also be used, such as Fasting Plasma Glucose (FPG) or 2-h Plasma Glucose (2-h PG) after a 75-g Oral Glucose Tolerance Test (OGTT). Generally, all are equally appropriate for diagnostic testing but HbA1c has several, distinct advantages. First, HbA1c is more convenient (pre-test fasting is not required); it has greater preanalytical stability and is less likely to be offset by daily perturbations caused by illness and stress. HbA1c can also be used to help ascertain the risk of, or otherwise diagnose, T2D. Concentrations of 48 mmol/mol (6.5%) or higher are used in screening both T1D and T2D in most situations (John, Hilson, & Alberti, 2012). Hba1c is then routinely monitored (often annually) across the lifespan as the risk of all-cause mortality increases per 1% increase in HbA1c above 7.5% (58 mmol/mol) and decreases per 1% increase in HbA1c below 7.5% (58 mmol/mol) (Arnold & Wang, 2014).

Therefore, hyperglycaemia may be seen as a symptom of T1D and T2D. However, individuals may also present with other symptoms at various stages of the illness. The American Diabetes Association (ADA) lists seven symptoms of diabetes that apply to both T1D and T2D including a frequent need to urinate (polyuria), excessive thirst (polydipsia), extreme hunger, unusual weight loss, increased fatigue, irritability, and blurry vision (Clark, Grandy, & Fox, 2007). Symptoms can also be grouped using the Diabetes Symptoms Checklist-Revised (which is used as a measure throughout later research contained in this thesis) based on whether they are psychological (fatigue or cognitive), neurological (pain or sensory), cardiovascular, ophthalmological, hypoglycaemic, or hyperglycaemic in nature (Arbuckle, Humphrey, Vardeva, Arondekar, Danten-Viala, Scott, & Snoek, 2009).

1.2.3 The Importance of Positive Mental Health



[Fig 1.2 The Negative Diabetes Cycle]

The demands involved in self-managing and averting the consequences of the complications described above, including symptoms, can make living with (and preventing) diabetes stressful. The weight (or threat) of living with diabetes can become an encumbrance for some, triggering a vicious circle whereby depression (Egede & Ellis, 2008), anxiety (Grigsby et al., 2002), and diabetes related-distress (Berry et al., 2015) disrupt lifestyle behaviours (including decreased uptake of exercise and diet recommendations; Miles et al., 2018). In turn, self-management disruption is correlated with poorer clinical markers (including HbA1c; Ortiz & Willey, 2018) that are representative of increased symptoms and complications (Williams et al., 2002), increased health care expenditures (Egede & Ellis, 2010), and increased risk of mortality (He et al., 2017). These issues then contribute to that weight, and the cycle continues (see Figure 1.2 on the previous page for a visual aid).

Evidence shows that the cycle continues as NA (whether defined as stress or poor mental health) can increase as a reaction to poor blood glucose results (either from a health care professional or via self-checks) and the development of symptoms (Gilsanz, Karter, Beeri, Quesenberry Jr, & Whimer, 2018). Increased symptomatology, for example, is associated with anxiety and depression (Paschalides et al., 2004) as well as diabetes distress (Paddison, Alpass & Stephens, 2007) and not just the other way around. Illness symptoms such as pain, fatigue, and cognitive impairment can then hamper diabetes prevention and management behaviours such as physical activity (Murphy et al., 2008; Romero et al., 2018). In general, illness symptoms including pain and lack of energy are recognised barriers to such behaviours (Gobbi et al., 2012; Boutevillain et al., 2017) but this is particularly so for adults with T2D where pain, feeling unwell, comorbid illness, and fatigue all then become barriers to an active lifestyle (Korkiakangas et al., 2009; Brown et al., 2018). The emergence of early symptoms amongst those at risk of T2D may produce similar negative affective states (Paddison et al., 2011) lending further support to the notion that adverse mental health challenges in this population should be addressed to reduce their negative impacts on preventative behaviours (Kyrios et al., 2009).

Perhaps as a result of this cycle, as many as 67.9% of people with T1D and T2D experience some form of psychological discomfort (defined as more than just fleeting experiences of NA, psychological discomfort covers diabetes distress and comorbid mental illness; Skovlund & Peyrot, 2005). In adults with T1D, depression is two to three times more common than in those without (Barnard, Skinner, & Peveler, 2006) while depression affects as many as one in five people with T2D (Fisher, Skaff, Mullan, Arean, Glaslow, & Masharuni, 2008). There is also an increased likelihood of anxiety symptoms and disorders across types (Smith et al., 2013). Anxiety, in particular, is more likely as complications increase (Rajput, Gehlawat, Gehlan, Gupta, & Rajput, 2016), which has ramifications for future management efforts. Eating disorders are also a recognised mental health comorbidity, especially among people with T1D, and these come with consequences of their own (Pinhas-Hamiel, Hamiel, & Levy-Shraga, 2015).

Diabetes distress is similarly prevalent to anxiety and depression, though it is not classified as a mental illness. Instead, diabetes distress results from the specific emotional burden of managing diabetes and is defined as a "rational, emotional response to the threat of a life-changing illness" (Berry, Lockhart, Davies, Lindsay, & Dempster, 2015, pg. 278). Diabetes distress is important to consider as an independent construct because it is more strongly associated with poor disease-related outcomes than mental illness is (Powers, Richter, Ackard, & Craft, 2017). Indeed, diabetes distress has been significantly correlated with self-reports of poorer self-care, low diabetes self-efficacy, and lower quality of life, independent of depression (Fisher et al., 2007). Distress may include feelings of hopelessness and inevitability, of being alone, of being unsupported, and of being overwhelmed which can result in a person's sense of not doing or being "enough" (Polonsky, Fisher, Earles, Dudl, Lees, Mullan, & Jackson, 2005).

A wide range of negative psychological factors, therefore, can influence management and prevention. It is important though not to focus solely on mental illness; at any time, diabetes has the potential to discourage the individual and cause them frustration and anger regardless of their mental health status (Polonsky et al., 2005). Qualitative analyses of patient experiences of T2D have shown that a lack of support or understanding from others, difficulties communicating with health care providers, and experiencing other co-morbid illnesses were just as frustrating as the burden of lifestyle changes and insulin regimens (Tanenbaum, Kane, Kenowitz, & Gonzalez, 2016). Assessing variability in affect has shown that individuals simply experiencing higher levels of NA is associated with higher mean glucose levels and greater percentage hyperglycaemia (Wagner, Armeli, Tennen, Bermudez-Millan, Wolpert, & Perez-Escamilla, 2017). Mental illness needs to be addressed for its own sake, but there is evidence that addressing mood is also important for improving diabetes outcomes.

1.2.4 The Importance of Psychological Care

Earlier this year, the Diabetes and Emotional Health document (Hendrieckx et al., 2019) was published in the UK. It offered healthcare professionals the strategies and tools to help them recognise emotional problems in people with T1D and T2D. It also acted as a guide that they could refer to in order to structure conversations and provide appropriate support. The document was developed as part of a move to cross the "artificial divide" between the emotional and physical aspects of diabetes self-management because, as a mostly self-managed illness, when individuals do see their healthcare team it is vital that such experiences are collaborative in nature.

The Diabetes and Emotional Health document was following on from the 5 Year Forward Plan (NHS England, 2014), which began a call for increased collaboration between different health professionals. One consequence of the 5 Year Forward Plan was that psychological support was no longer the exclusive responsibility of the psychologist. As an example, receiving a diagnosis of diabetes could trigger a range of strong emotional responses and so members of the health care team, such as nurses and GPs, are now being encouraged to listen to expressions of anger and fear, to ask about patient concerns, and to relay information in a respectful way, Debono & Cachia, 2007). This way, it encourages the development of a positive support network.

To facilitate positive engagement with the healthcare team, the Language Matters document (NHS England, 2018) was also released. The Language Matters document highlighted the importance of language and argued that communication choices made by the health care professional (both verbal and non-verbal) can either be inclusive or they can be judgemental and that there are far-reaching impacts of these choices. Language can stigmatise and it can label an individual in a negative way but it can also convey meaning and shape understanding, not only for the individual with diabetes but also for the people around them (Speight, Conn, Dunning, & Skinner, 2012). There is a risk that people can feel that they are defined by their diagnosis and the connotations that come with it (Hendley, 2018) so social relationships and one's sense of identity need to be carefully negotiated, especially around contradictory advice around "control", "responsibility" and "discipline"; all phrases which can place a sense of blame on the individual (Broom & Whittaker, 2004). Similar position statements are being published worldwide to address issues around language, but implementation will take time, and more research may be necessary before the full benefits are seen (Speight, Conn, Dunning, & Skinner, 2012).

Research has shown that having a sense of support can be particularly beneficial following diagnosis, which can be a crucial time for individuals with T1D and T2D (Due-Christensen et al., 2018; van Puffelen et al., 2015). It is therefore during this time that structured education is given to individuals to aid their self-management efforts by addressing existing beliefs and supporting behaviour change to optimise glycaemic control, improve quality of life, reduce incidence of cardiovascular risk, and combat the effects of depression (Winkley, Evwierhoma, Amiel, Lempp, Ismail, & Forbes, 2014). Structured education is seen as so important that it is recognised as an essential component of NHS diabetes healthcare and is regulated by the National Institute for Health and Care Excellence (NICE; McGuire, Longson, Adler, Farmer, & Lewin, 2016). Education is crucial to get right because health literacy (an individual's capacity to access, understand, assess, and apply health-related information) has shown to have a positive impact on self-reported management behaviours (Schinkus, Dangoisse, Van den Broucke, & Mikolajczak, 2018). However, a host of factors can affect uptake, not least the fact that literacy can be impeded by distress, as depression and negative affective states can prevent people from acting on their knowledge to perform adequate self-management behaviours (Schinkus, Dangoisse, Van den Brouke, Mikolajczak, 2018).

Efforts at providing support are, therefore, not only effective but necessary. However, providing interventions to individuals experiencing NA (including distress) in a way that compliments modern-day support systems may make them more effective. The issue currently is that access to psychological therapy remains limited across the UK (and indeed, most of the western world) even for those not simultaneously managing a long-term condition (Thornicroft, 2018). Even for those who are receiving psychological treatments, however, there is no guarantee that the type of support currently available will positively influence their physical health outcomes. For example, a recent meta-analysis of Cognitive Behavioural Therapy (CBT) for people with diabetes found inconclusive evidence that this type of therapy translated into improved glycaemic control, despite reducing incidence and symptoms of depression (Uchendu & Blake, 2017).

Perhaps part of the reason why the likes of CBT are not reducing negative diabetes outcomes is that they ask individuals to control diabetes-related thoughts and feelings to “eliminate” distress. Controlling such thoughts and feelings is difficult in this context because self-management and preventative behaviours, by their nature, evoke thoughts of diabetes and reactions to its dangers (Gregg et al., 2007). Arguably, CBT may concentrate too much on trying to eliminate sources of NA to make it truly effective for people with diabetes. Novel research, however, has suggested that alternative diabetes interventions would do well to focus on more positive reinforcement and encouragement to specifically improve physical health outcomes (Robertson, Stanley, Cully, & Naik, 2012).

1.3 Positive Affect (PA)

1.3.1 A Brief Introduction to PA

It has been argued that one of psychology's limitations has been its fixation on psychological problems rather than a celebration of psychological strengths (Seligman & Csikszentmihalyi, 2014). Before the turn of the millennium, PA had received significantly less empirical attention than NA across the field of psychology and not just in diabetes research. PA had been largely absent from scientific study because it was believed to operate purely as a marker of well-being and that it had little practical value in and of itself. In 2001, however, Fredrickson argued that PA not only signalled optimal functioning but PA could produce optimal functioning in the short and long-term. Typically, it is because extreme, prolonged, or contextually inappropriate NA has shown to produce issues such as depression, anxiety, and distress that it has received considerably more focus in the literature (Fredrickson, 2004). Logically, it makes sense that if NA is causing the issue, then to solve the problem, negative emotions must be addressed or removed (as is the case with CBT). However, this ignores half of the emotional spectrum and the potential benefits that PA can produce. Indeed, it is now understood that PA may be as significant to mental and physical health as NA is (Moskowitz, Epel, & Acree, 2008). Early research in the context of T1D and T2D has shown that PA may play a particularly important role across diabetes care not only for mental health and well-being but also in terms of hard clinical outcomes (Nefs, Pouwer, Denollet, Kramer, Wijnands-van Gent, & Pop, 2012).

1.3.2 PA & Physical Health

Almost a decade and a half ago, Pressman and Cohen (2005) produced a seminal review that highlighted the specific benefits that PA could have for physical health. Since then, a plethora of research has demonstrated that both short-term state and long-term trait PA are associated with increased life expectancy, improved physical well-being, cardiovascular health, and improved outcomes in a variety of chronic illnesses (see the latest review by Pressman, Jenkins, & Moskowitz, 2019).

In that original paper, Pressman and Cohen (2005) defined PA as the feelings that reflect a level of pleasurable engagement with one’s environment (such as happiness, joy, excitement, enthusiasm, and contentment). It is not inclusive of positive non-affective constructs such as optimism or resilience, which can be considered separate, more cognitive, concepts (Pressman, Jenkins, & Moskowitz, 2019) and in some cases arise as a consequence of PA (Lyubomirsky, King, & Diener, 2005). Duration of PA is necessary to consider (especially in this context), as long-term, stable, *trai*t PA is more commonly associated with physical health outcomes than short-term, fleeting *state* PA. Increasing the frequency with which one experiences state PA can lead to an increase in trait PA in the future (Fredrickson, 2001) and so the importance of state PA should not be overlooked. Lastly, it is vital to stress that PA is distinctly (and statistically) separate from NA (Crawford & Henry, 2004) as previously there have been some assumptions that PA is merely the opposite, or even the absence, of NA (Fredrickson, 2004). However, research demonstrates that individuals may experience PA and NA at the same time (Larsen, Hershfield, Statsny, Hester, & 2017) suggesting that negative and positive affect are more than opposite ends of an affective spectrum.

Under Pressman and Cohen’s (2005) definition, PA has shown to positively influence a myriad of illnesses and health outcomes (Pressman, Jenkins & Moskowitz, 2019). As well as diabetes, PA has also shown to positively influence outcomes related to cancer (Costanzo et al., 2019), HIV (Ironson et al., 2018), chronic pain conditions (Strand et al., 2007; Zautra et al., 2005), and cardiovascular disease (Hoen et al., 2013). In a study of patients with metastatic renal cell carcinoma, for example, participant PA scores predicted longer survival, especially for those with lower depressive symptoms, highlighting the importance of looking at PA and NA together (Prinsloo et al., 2015). In people with HIV, PA (alongside other PA-relevant measures such as meaning and altruism) have shown to predict slower disease progression (Ironson & Hayward, 2008) and a higher likelihood of achieving suppressed viral load (i.e. treatment goals; Wilson et al., 2017), implicating direct biological effects (although the exact effects are unclear). Similarly, in terms of chronic pain conditions, there is clear evidence that PA reduces pain, though the researchers stated that it was unclear in this case whether this was a result of biological or perceptual changes (Pressman, Jenkins & Moskowitz, 2019). In individuals with cardiovascular diseases, PA has also been associated with lower disease severity (e.g. fewer cardiac events, rehospitalisation) and increased survival (Dubois et al., 2015). Benefits here are typically found in mid-to-high arousal PA scores as opposed to more general PA scores (Grunberg et al., 2003; Hoen et al., 2013), and high arousal PA feelings such as sociability and esteem have been found in particular to predict survival. It is possible that such emotions encourage physical activity, leading to a decreased risk of mortality (Hoogwegt, Kupper, Jordaens, Pendersen, & Theuns, 2013).

The influence of PA on illness is complex and multifaceted. Most evidence suggests that PA is more effective for reducing morbidity rather than mortality though there is clear evidence that mortality may also be influenced (Moskowitz, Epel, & Acree, 2008). Likewise, individuals in the early stage of their illnesses are better aided by PA than those in the latter stages (Pressman & Cohen, 2005), possibly because the mechanisms by which PA influences health (e.g. reducing stress, encouraging healthy behaviours) have more significant impact potential before severe organ failure (Pressman, Jenkins & Moskowitz, 2019). Going forward, the crucial thing researchers have been trying to ascertain is whether PA can be consistently manipulated to produce sustainable health benefits. It is not enough for PA to be associated with physical health benefits; PA must be utilisable to bring about consistent positive outcomes. To that end, psychological interventions designed to facilitate PA are now being developed in the hope that they may facilitate improvements to physical health.

1.3.3 Positive Psychological Interventions (PPIs)

In theory, PA can be manipulated so that anyone has the potential to benefit from its effects (Layous, Nelson, & Lyubomirksy, 2013). Lyubomirksy and colleagues (2005) argued that happiness is under the individual's control, so long as they engage in intentional activities to promote it. Aids that help people take control and facilitate

PA are known as PPIs and have shown to be effective in various contexts, including health and illness (Sin & Lyubomirsky, 2009). Such strategies include counting one's blessings (Emmons & McCullough, 2003), engaging in certain forms of meditation (Kok & Fredrickson, 2013), performing acts of kindness (Pressman, Kraft, & Cross, 2015), writing letters of gratitude (Boehm, Lyubomirsky, & Sheldon, 2011), trying to extend positive experiences by savouring them (Biskas, Cheung, Juhl, Sedikides, Wildschut, & Hepper, 2019), reflecting on and then using one's strength in novel ways (Seligman, Steen, Park, & Peterson, 2005), and writing about one's best possible self (King, 2001).

PPIs as a concept are relatively new, and only a handful have been utilised to improve physical health outcomes (see, for example, Addington et al., 2018; Moskowitz et al., 2017). Even then, a lot of that research has been constrained to laboratory studies of transient emotion induction with limited real-world application (Pressman, Jenkins & Moskowitz, 2019). However, PPIs have promise and those that have been applied to real-world settings have shown to produce enduring benefits for health (Kok & Fredrickson, 2010) including several PPI studies within the context of diabetes (Cohn et al., 2014; Jaser et al., 2014; Tran et al., 2011). Alongside the evidence for PA benefits more generally, there is enough direct evidence to suggest that PPIs should at least provide enhancements to mental health and quality of life that could help individuals cope with the adverse negative experiences of physical illness (Pressman, Jenkins & Moskowitz, 2019).

1.3.4 The Relationship between Diabetes and PA

The first review to highlight the relationship between PA and diabetes was published in 2012 (Robertson, Stanley, Cully, & Naik, 2012). Since then, interest in the effect of PA on T1D and T2D has increased significantly; a brief search of "diabetes AND positive affect" on the PsycINFO database in 2019 alone reveals over 270 peer-reviewed papers. Research into diabetes and PA is novel, but the literature base is expanding rapidly.

One of the initial studies to investigate the relationship between PA and diabetes showed that for individuals with diabetes over the age of 65, PA (especially hope and enjoyment of life) significantly predicted a lower risk of mortality. Importantly, this was shown to be independent of NA, athough PA was particularly protective amongst those who reported higher levels of stress (Moskowitz, Epel, & Acree, 2008). The authors suggested that this provided evidence of a "stress-buffering effect" whereby PA achieved its main effects (i.e. reduced mortality risk) by negating some of the harmful impacts of stress. Further support for a stress-buffering effect comes from a study demonstrating that affective processes (i.e. both NA and PA) influenced self-reported diabetes symptom frequency. Lower PA was more strongly correlated with symptom reports amongst high neuroticism individuals than high NA was, suggesting that higher rates of PA may act to combat an individual's predisposition towards stress and NA, thus reducing perceived or actual symptomatology (Williams, Colder, Lane, McCaskill, Feinglos, & Surwit, 2002).

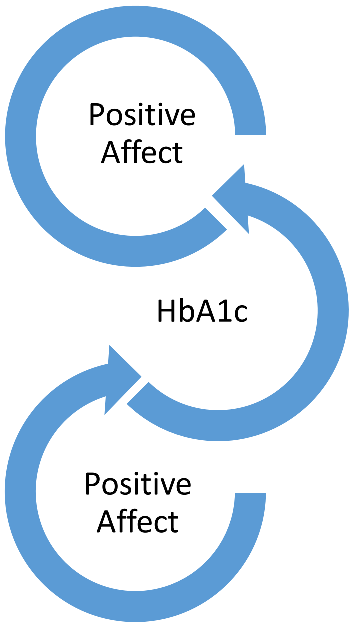
Furthermore, PA has also shown to protect individuals at risk from developing T2D by seemingly offsetting risk associated with parental history, therefore reducing related-mortality before it becomes an issue (Tsenkova, Karlamangla, & Ryff, 2016). Non-PA research has demonstrated that individuals with a family history of T2D perceive a greater threat and are more conscious of weight gain (Forsyth & Goetsch, 1997). Subsequently, PA has been proposed as a factor by Tsenkova and colleagues (2016) for motivating individuals towards engagement of health behaviours in individuals with parental history of T2D as they were already cognizant of its dangers. The authors also proposed that PA could act as a stress-buffer; protecting individuals from any harm associated with that knowledge and allowing them to act upon their awareness rather than becoming paralysed by it. However, the authors also admitted that they could not be sure because they had failed to utilise a measure of perceived threat in that study.

1.3.5 Links to Clinical Markers

Many larger-scale studies in this area have looked for correlations between affect and markers of blood glucose, such as HbA1c, in order to provide "stronger" evidence for a relationship between affective processes and diabetes outcomes. Typically, these studies may also include a mediation analysis to assess the pathways by which both NA and/or PA may exert their influence over T1D or T2D. For example, research conducted with adolescents with T1D demonstrated that daily NA mediated a relationship between low perceptions of self-control and elevated daily blood glucose (Lansing, Berg, Butner, & Wiebe, 2016). The results also showed that even participants who ranked higher in self-control may still demonstrate larger variability in blood glucose levels on days where they experienced greater fluctuations in NA. This variability highlights the importance of intraindividual fluctuations and of being mindful of the damaging effects that NA can have on anyone with diabetes (Lansing et al., 2016).

Early work initially struggled to find a connection between PA and blood glucose measures; a study conducted by Skaff et al. (2009), for example, found a relationship between NA and blood glucose levels but not PA and blood glucose levels. However, recent research has been more successful. One study focusing on adolescents with T1D found that positive mood predicted improvements in glycaemic control and externalising problems over six months (Lord, Rumburg, Jaser, 2015). The authors suggested that positive mood was not only associated with psychological symptoms and quality of life but also with glycaemic control itself. Positive mood came about in reaction to "positive" blood sugar levels, which in turn led to improved glycaemia as part of an upward spiral mechanism (see figure 1.3 on the next page). The authors suggested that PA was exerting a protective process for resilience outcomes in adolescents with T1D, making glycaemic "control" easier to achieve, although that is not to say that other more direct effects are not also taking place (see Taub et al., 2019 for an example from cancer research).

Higher levels of problem-focused coping, venting, and PA have also shown to predict lower levels of HbA1c after controlling for baseline levels (as well as sociodemographic and health factors) while PA specifically was shown to moderate the effects of problem-focused coping (i.e. active, instrumental social support, suppressing competing activities, etc.) (Tsenkova, Dienberg Love, Singer, & Ryff, 2008). Additional research has since demonstrated that PA and NA are also significantly associated with diet and exercise even after adjusting for diabetes severity, illness intrusiveness, and diabetes knowledge. Adaptive coping was shown to mediate this relationship, suggesting that PA encourages more positive coping methods and thoughts (i.e. resilience) to promote healthier behaviours in the future (Miles, Khambaty, Petersen, Naik, & Cully, 2018; see Figure 1.3 for a visual representation). Task competence (i.e. one's perceived ability to perform diabetes-related behaviours) has also been shown to act as a mediator between NA and PA fluctuations and blood glucose levels, whereby NA decreases task competence and therefore increase blood glucose levels while PA improves task competence and reduces blood glucose levels (Fortenberry et al., 2009).



[Fig 1.3 Upward Spirals Diagram. PA creates an upward spiral whereby positive changes as a result of PA lead to more PA]

1.3.6 Existing PPI Diabetes Interventions

The literature described thus far has presented enough evidence that several researchers have taken it upon themselves to begin development of PPIs for a variety of diabetes contexts. Given the focus on adolescents with T1D, Jaser and colleagues (2014) pilot tested an intervention to increase uptake of diabetes self-management behaviours. The intervention comprised of several PPIs (including gratitude and self-affirmation tasks) as well as increased support (in the form of receiving small gifts and parental encouragement) to boost PA. While there were no main effects for treatment at 6-month follow-up on HbA1c, there was a significant association between increases in adolescents' levels of PA with increases in self-reported self-management behaviours and meter downloads of glucose monitoring (Jaser, Patel, Rothman, Choi, & Whittemore, 2014).

Another intervention study examined whether benefit finding (defined as an ability to identify positive outcomes in the face of adversity; Helgeson, Reynolds, & Tomich, 2006) was associated with improved illness adjustment among adolescents with T1D (Tran, Wiebe, Fortenberry, Butler, & Berg, 2011). The notion of "benefit finding" was hypothesised to buffer negative affective reactions to diabetes stress and promote positive affective reactions. The results showed that benefit finding was indeed associated with lower depressive symptoms, higher perceived coping effectiveness and uptake of self-management behaviours, and with higher positive affective reactions to diabetes stress. Benefit finding also interacted with negative affective reactions to predict symptoms and HbA1c (Tran et al., 2011). Benefit finding appeared to be a resource that buffered the disruptive aspects of NA reactions to stress in line with previous research highlighting "stress-buffering effects" (Moskowitz et al., 2008).

Intervention research has not solely focused on T1D, however, and there is evidence that PPIs are as equally effective for people with T2D. Cohn and colleagues (2014) developed an online intervention to teach PA skills such as savouring, gratitude, and acts of kindness to people with T2D. As part of a feasibility and efficacy trial, post-intervention results revealed that PPI participants showed a greater decrease in depression than controls. Intervention recipients recruited online showed significantly increased PA, reduced NA, and reduced perceived stress. However, there were no effects on measures of diabetes-specific efficacy or sense of burden or preliminary measures of health behaviours. The research team suggested that future trials of their intervention would need to focus more specifically on health behaviours (Cohn, Pietrucha, Saslow, Hult, & Moskowitz, 2014). In doing so, they could also potentially look at the utility of the intervention as a prevention tool for T2D, where research is currently lacking.

1.4 Conclusions

Self-management of T1D and T2D (as well as the prevention of T2D diabetes), can be a stressful experience for individuals. Experiencing high levels of NA, distress or mental illness may only compound to make it harder. However, facilitating PA through PPIs could potentially relieve some of that pressure. PA is no longer thought of as a mere signal of optimal functioning; the evidence shows that it has an important role to play in the context of health. The research discussed here demonstrates that PA can encourage a host of diabetes self-management behaviours, consequently influencing HbA1c levels and symptomatology. Though more work needs to examine the exact pathways, PA has also shown to achieve some of its effects on diabetes outcomes through improved coping strategies (evidence of increased resilience) and stress-buffering effects. Existing PPIs achieved their effects with stress-buffering in particular, but more research is necessary to elucidate mechanisms and ascertain benefits over time. Currently, very few PPIs exist in the literature, and most have a limited follow-up.

Furthermore, none have been utilised to combat risk for T2D, despite evidence that PA is more effective the earlier it is used to target illness management (Pressman et al., 2019). PPIs may likely be just as effective for improving prevention outcomes as management outcomes. The research provided in this thesis aims to be the most thorough investigation of a PPI in the context of diabetes thus far and so it will explore the intervention’s utility in a variety of circumstances and against a variety of outcomes. The following chapter will discuss the specific PPI chosen at length, including its history and the reasoning for its adoption in a diabetes context.

Chapter 2: The Best Possible Self (BPS) Intervention – Literature Review & Implementation

2.1 Overview

Very little PPI research exists in the diabetes literature at the time of writing. Furthermore, the research that has been published all assess different interventions and different outcomes in different population groups: Jaser and colleagues (2014), for example, used gratitude and self-affirmation tasks combined with social support to encourage self-management behaviours in adolescents with T1D. Tran et al. (2011), meanwhile, encouraged a similar population to find the benefits of having T1D in order to improve illness adjustment. Cohn's research group (2014), on the other hand, taught adults with T2D savouring, gratitude, and acts of kindness to reduce perceived stress. There is promise in this work, though there is a lack of follow-up which would be an issue even if one of these studies was not confined to the lab (Tran et al., 2011), and the other two were not designed purely to pilot their respective interventions (Cohn et al., 2014; Jaser et al., 2014). How Cohn et al. (2014), for example, would build upon their findings and limitations for a larger-scale study remains to be seen. This thesis, therefore, represents a unique opportunity to produce a portfolio of studies on a single PPI whereby a variety of mechanisms and effects can be tested across various groups of people with and at risk of T1D and T2D. With the limited data available, it is vital that each study informs the one that proceeds it so that a picture of the intervention and its utility is built up for the discussion (Chapter 10).

This chapter provides a review of the 'Best Possible Self' (BPS) intervention, the chosen PPI for this thesis. The BPS is, in some ways, very different from the other PPIs utilised so far. What the existing diabetes PPI literature has in common is the utilisation of a gratitude intervention (even Tran et al.'s (2011) benefit finding intervention had people seeking things to be grateful for, in a way). However, trying a slightly different approach may, in fact, be beneficial, especially as there is evidence that the BPS is more effective than gratitude interventions anyway (Sheldon &

Lyubomirsky, 2006). What now follows is a history of the intervention, evidence of its efficacy, and the reasons why it may be the most suitable PPI to use in a diabetes context. There then follows a discussion on how the BPS was initially adapted for an acceptability and feasibility study (Study 1) (although the BPS did continue to grow and adapt over time; see Chapters 5 and 6 as well as Appendix 1 for a breakdown of further changes).

2.2 Literature Review

2.2.1 Introduction

The BPS is a PPI originally developed by King (2001) to help people cope with traumatic events. Fundamentally, the BPS is a brief, disclosive writing exercise designed to help individuals set goals and generate PA. It asks people to write about a future version of themselves, where everything has worked out for them. The instructions, as seen in the original paper, are as follows:

> "Think about your life in the future. Imagine that everything has gone as well as it possibly could. You have worked hard and succeeded at accomplishing all of your life goals. Think of this as the realisation of all your life dreams. Now write about what you imagined." (King, 2001, pg. 801).

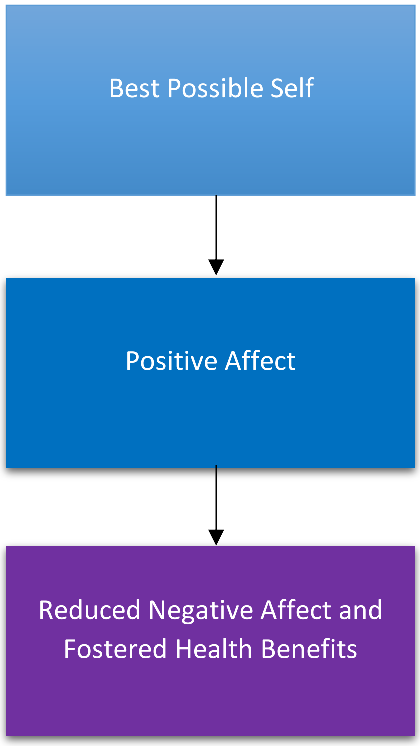
Since then, King's article has been cited over 750 times, and a whole wealth of research on the BPS has followed (most recent citations include Auyeung & Mo, 2018; Carillo et al., 2019; Heekerens et al., 2019). Indeed, searching for the phrase "best possible self" on PsycINFO alone produces 2,500 peer-reviewed papers from the years 2001 to 2019. For the purpose of this review, PsychINFO as well as MEDLINE, EBSCO host, and Google Scholar were routinely and systematically searched to identify peer-reviewed studies using the key terms "best possible self", "best possible selves", "best-self activation" (which accounts for the shift observed in the individual following engagement with the intervention; Cable, Lee, Gino, & Staats, 2015), "best self", "best selves", "positive psychological/psychology interventions", and "writing" (the last two terms of which were used in Loveday et al's 2016 review). Searches were continued right until the submission of the PhD to ensure that this review remained contemporary and well-informed. Overall, the collective findings demonstrate that that the BPS is not only effective in improving well-being but that it is also beneficial for mental and physical health (Loveday, Lovell, & Jones, 2016) and that, consequently, the BPS PPI has seen usage across a variety of contexts well beyond the realm of trauma writing (see, for example, the following citations for studies that facilitated physical health changes: Austenfeld & Stanton, 2008; Harrist et al., 2007; and Maddalena et al., 2014).

2.2.2 The Best Possible Intervention in the Context of Diabetes?

The BPS has shown to influence a variety of positive outcomes including well-being and life satisfaction (Hill et al., 2014; King & Raspin, 2004; King & Smith, 2004) as well as the likes of optimism (Peters, Meevissen, & Hanssen, 2013). Importantly, given the relationship between diabetes and PA, the BPS has also shown to directly facilitate PA (King, 2001; Peters et al., 2010; Renner et al., 2014; Sheldon & Lyubomirsky, 2006). This is important to bear in mind, as there were several PPIs that could have been utilised instead of the BPS. These including counting one's blessings (Emmons & McCullough, 2003), engaging in certain forms of meditation (Kok & Fredrickson, 2013), performing acts of kindness (Pressman, Kraft & Cross, 2015), writing letters of gratitude (Boehm et al., 2011), enaging in positive savouring exercises (Biskas, Cheung, Juhl, Sedikides, Wildschut, & Hepper (2019), and using strength reflection interventions (Seligman, Steen, Park, & Peterson, 2005). The BPS has been compared to both count your blessings interventions (as both are reflective and relatively self-focused) and the gratitude letter intervention (in that both encourage people to write and are, therefore, somewhat behavioural interventions). However, it may be more effective than both, as it also invites the generation of distinct emotions such as compassion, love, and trust (Cohn & Fredrickson, 2010). The emotions that the BPS uniquely generates are examples of mid-to-high arousal PA (Pressman, Jenkins & Moskowitz, 2019) which are hypothesised to support particularly long-term maintenance of positive behaviours (Fredrickson, 2004).

In one experiment, the BPS was shown to increase PA following a sad mood induction task, suggesting that the BPS was capable of producing benefits regardless of emotional context (Renner, Schwarz, Peters, & Huibers, 2014). In another study, PA was shown to persist even after participants were exposed to a painful stimulus (Geschwind, Meulders, Peters, Vlaeyen, & Meulders 2015). A third study demonstrated that the BPS produced PA immediately following exposure, which made it more effective to a comparable PPI (Sheldon & Lyubomirksy, 2006). Some studies had failed to find a difference when PA was not the primary outcome (Odou & Vella-Brodrick, 2013), though a review suggested that this may be explained by the population the BPS was administered to, or the way in which the intervention was delivered (more on this later in the chapter; Loveday, Lovell, & Jones, 2016).

The BPS has similarly been shown to reduce NA (Yogo & Fujihara, 2008) as well as symptoms of depression (Liau, Neihart, Teo, & Lo, 2016). This may be the result of the buffering-effect seen in other diabetes PPI research (see Chapter 1, section 1.3.6 for more information), except no BPS research has directly tested this hypothesis. Alternatively, these findings could also be explained by the fact that the BPS has frequently been associated with an increase in optimism (Meevissen et al., 2011; Peters et al., 2010), which is characteristically low in people with depression (Pietrowsky & Mikutta, 2012). One research group (Meevissen, Peters, & Alberts, 2011), meanwhile, suggested that the intervention's immediate effects could later generalise to explanatory styles in line with the predictions of the broaden-and-build model (B&B; Fredrickson, 2001), which suggests that NA is countered by built resilience. Over time, the intervention's immediate effects could lead to broader benefits still, though, again, no one else so far has used models of PA to strengthen or support the BPS theoretically. However, the BPS has shown to reduce symptoms of pain (Hanssen, Peters, Vlaeyen, Meevissen, & Vancleef, 2013; Molinari, Garcia-Palacios, Enrique, & Roca, 2017), helped to alleviate illness symptoms (Maddalena et al., 2014) and reduce the number of visits to healthcare centres (Austenfeld et al., 2006; Austenfeld & Stanton, 2008; King, 2001), all of which may be consequences of built resources in action. For more on PA theory and models, see Chapter 3. For now, it may be best to think of the BPS' relationship with PA as illustrated in figure 2.1:



[Fig 2.1 Affective processes as a result of engaging with the BPS]

2.2.3 Key and Moderating Features of the BPS

In the original experiment (King, 2001), 81 students were randomly assigned to one of four writing conditions. Participants either had to write about their most traumatic life event, their best possible future self, both of these things together, or a non-emotional control topic. Compared to the control group, writing about one's best possible self for 20 minutes a day for four days was significantly associated with increased PA at the end of the intervention, increased subjective well-being at three-weeks follow-up, and fewer health-care visits at five months follow-up. Writing about trauma led to decreased illness in a similar way as writing about one's best possible self, but the BPS condition was shown to be significantly less upsetting. King suggested this effect was not the result of catharsis but the influence of writing on self-awareness and self-regulatory processes. This activity, the author argued, might serve to integrate written experiences into a broader framework for the self, allowing the person to gain a sense of control over their emotional life and valued outcomes. Importantly, they decided, this “translation of chaotic experience into comprehensible text” (pg. 806) could be done in a way that was also positive.

Understanding the mechanisms behind PPIs is vital, as it helps to further improve their effectiveness (Lyubomirsky and Layous 2013). King (2001) justified having participants write about possible selves with theory, stating that consideration of a best possible self would lend itself to a session of focused writing in a way that was comparable to trauma writing. Specifically, Possible Self-theory (Markus & Nurius, 1986) argues that individuals hold a multitude of imagined possibilities at any one time, each representing individually significant hopes, fears, and fantasies. Not only are possible selves individualised, but they are also social. Possible selves were hypothesised to be an amalgamation of previous social comparisons to salient others; “what others are now, I could become” (Markus & Nurius, 1986, pg. 954). The BPS keeps the focus on the best possible self (King, 2001); however, as negative social comparisons may be harmful (Festinger, 1954; De Vries & Kuhne, 2015).

Although the conclusions put forward by King (2001) have never been tested empirically, later researchers would focus on the benefits associated with goal setting to understand how the BPS is achieving its effects. Self Determination Theory (SDT; Bak, 2015; Dark-Freudeman & West, 2016) in particular has been used to understand the BPS’s mechanisms better, as it explains how goals can be used to adjust beliefs and actions towards a beneficial end (Hagger, 2010). SDT proposes that human beings have three inherent psychological needs that promote optimal motivation, development, and wellness (Deci & Ryan 2000; 2008): autonomy (the sense that one’s actions are under one’s control), competence (the notion that one is capable and skilled), and relatedness (the feeling that one is close and connected to others). Feelings of need satisfaction (i.e. that one has satisfied one’s need for autonomy/competence/relatedness) have been associated with increases in PA (as well as decreases in NA; Sheldon et al., 2001) while boosting need satisfaction has shown to predict future increases in subjective well-being (Niemiec, Ryan, & Deci, 2009). Ultimately, need satisfaction can be achieved by engaging in intentional activities that help the individual in the pursuit of their goals, something that the BPS can help individuals with (Sheldon & Krieger, 2007). The expectancy-value model (Carver & Scheier, 1999) further predicts that progress towards a goal increases the confidence of a good outcome, even if progress has only been mentally simulated (Korrelboom, de Jong, Huijbrechts, & Daansen, 2009), leading to further benefits, suggesting that the BPS may be capable of providing benefits even before the individual has had chance to act on their writings.

However, in a recent study which found that the BPS increases "thriving" (which "denotes the state of positive functioning at its fullest range – mentally, physically, and socially" – Su, Tay, & Diener 2014, pg. 256) there was evidence that the BPS was acting against the SDT's key assumptions. The SDT argues that individuals must place relative importance on intrinsic goals rather than extrinsic ones (external influences such as money, fame, status or anything that acts as validation from an outside source) otherwise feelings of need satisfaction cannot be achieved (Deci & Ryan, 2001; 2008). After all, feelings of autonomy, competence, and relatedness are all examples of intrinsic, rather than extrinsic goals (Chen, Elliot, & Sheldon, 2019). However, this study demonstrated that intrinsic goals failed to mediate the intervention effects (Heekerens & Heinitz, 2018). Instead, the authors suggested that the BPS intervention serves to help individuals reorganise priorities and to decide the values that they place upon them (see also King, 2001). It is possible that context may play a role in what sort of goals are set; extrinsic goals may be just as important to the individual as personal development is under certain circumstances. Alternatively, it might be that outcomes other than thriving are mediated by more intrinsic goals and that the extrinsic/intrinsic dynamic is dependent on the outcomes being measured.

Other research has focused on the Sustainable Happiness Model (SHM), which posits that PA must be sustained over time to continually receive benefits (Lyubomirsky, Sheldon, & Schkade, 2005), and the implications this has for the intervention's ability to produce PA and related constructs. Although it is not a model of PA per se, it does offer evidence for how an intervention may facilitate PA. Five years after the original experiment, a comparison between the BPS and another PPI (specifically, a gratitude intervention) found that the BPS was more effective at producing emotional benefits following exposure and that, after two weeks, the BPS continued to be better at sustaining PA (Sheldon & Lyubomirsky, 2006). It was able to do this because the BPS prompted the most self-concordant motivation (as participants felt a high identification with, and interest in, continuing to use the exercise), implying that longer-term emotional benefits require persistent effort to achieve. As such, the authors were keen to emphasise the importance of "fit" between individual and intervention. They suggested that future researchers and practitioners may wish to consider personality, interests, and goals before recommending specific interventions. More research here is needed to understand the BPS's features fully, though utilising theory appears to be a start.

2.2.4 Fitting the BPS to Purpose

To get the most out of the BPS PPI, the idea of "fit" has been taken seriously, and researchers since have argued that investigations should focus on what small modifications can be made to make the BPS more effective for different populations (Layous et al., 2013). The investigation into "fit" has also shown to illuminate further intervention features, making this line of enquiry especially important. For example, Meevissen, Peters, and Alberts (2011) examined the role that trait optimism (i.e. an individual's endurable and stable tendency to hold positive outcome expectancies for future events; Scheier & Carver, 1985) had on intervention effects. They found that trait optimism failed to moderate state optimism (i.e. situational or context-specific hope for the future; Kluemper, Little, & DeGroot, 2009) effects, meaning that participants who were already high in optimism received as many benefits to state optimism from the BPS as participants low in trait optimism. A similar study investigated mental imagery ability as the researchers reasoned that a level of ‘imagination’ might be necessary to extract the most benefits from the intervention (Odou & Brodrick, 2013). The reasoning went that imagery ability would determine how well one could imagine their ‘best possible self’. However, they found that low versus high ability had no effect on well-being improvement over time, suggesting that the BPS can be an effective intervention regardless of one’s capacity for imagination.

Although imagery ability may not be worth bearing in mind when potentially altering the BPS, other cognitive abilities such as mindfulness attention have shown to be associated with greater boosts to PA following exposure to the intervention (Seear & Vella-Brodrick, 2013). Research has also demonstrated that aspects of personality such as neuroticism moderate the sustainability of the BPS (Ng, 2016) and that individual coping styles influence the intervention’s impact on illness and feelings of hostility (Austenfeld & Stanton, 2008). Culture may likewise play a part, as one study found that Anglo-Americans reported more significant increases in life satisfaction after completing the BPS in comparison to Asian-Americans (Boehm et al., 2011). The authors hypothesised that the focus on the individual self might be less effective for people coming from a background that ascribes greater value to family and community than the individual (Boehm et al., 2011).

Such factors would later be referred to by Loveday, Lovell, and Jones (2018) as adjustable “person-features” of the BPS. The evidence so far indicates that person-features should be considered to best maximise the effects of the BPS and that the optimal way to do this may be to modify activity instructions. One study, for example, changed the wording of the BPS before delivering it to a sample of people with depression (Shapira & Mongrain, 2010). The new instructions asked people to give themselves “some sage and compassionate advice from a better future” (pg. 381) which subsequently led to lower self-reported depression levels and an increase in “happiness” up to 6 months later. This simple change to language could be seen as providing individuals with necessary hope and reassurance that other populations would not place as much value on. Layous and colleagues (2013) argued that these effects were achieved because tailoring BPS activity instructions helped provide the most “fit” between the activity and its recipients. After all, asking a group of people with depression to think about their “best possible selves” could have been inappropriate if the language was not sensitive to their unique needs.

Other, more general and less person-focused changes have also shown to increase benefits. In a four week experimental study, participants who read a testimonial praising the virtues of the BPS experienced greater gains in well-being when compared to those who read neutral information before doing the BPS or whom only completed a control condition (Layous et al., 2013). In contrast to “person-features”, changes such as these may be better thought of as modifiable “activity-features” (Loveday, Lovell, & Jones, 2018). Other activity-features that have been trialled in the literature include dosage (i.e. how frequently people should engage with the BPS) and the use of themes (to focus people’s attention on specific aspects of their future selves). More work is needed to assess dosage properly, as few studies have used it as a manipulation. However, one study has shown that engaging with the BPS once a week was more beneficial than engaging with it every day (Maddalena, Saxey-Rees, & Barnes, 2014). This may appear contrary to current evidence given that sustained effort has shown to be crucial to long-term benefits (Lyubomirsky et al., 2005), but one could argue that using the intervention too much could lead to over-saturation, boredom, and subsequent disengagement. Further replication of these findings is necessary before conclusions are drawn, however.

One way to overcome boredom may be to use themes. A significant number of researchers have added a list of topics to help BPS recipients focus on specific aspects of their life each time they use the intervention. This may help to keep the BPS fresh and engaging as it gives users something new to think and write about each time. However, it is rare that real justification for using individual themes is provided. Furthermore, different research groups use different numbers of themes. Some have used three themes: personal, professional, and relationships (Meevissen et al., 2011;

Peters et al., 2013), one has used four: social, health, academic, and career (for a student population; Layous et al., 2013), and another has used eight: romantic, hobbies, family, friendship, community, health, career, and a free topic (Manthey, Vehreschild, & Renner, 2015). More work is therefore necessary to assess whether there are any real benefits associated with splitting the BPS up in this way. Activity features are promising but should be considered carefully given the paucity of evidence available for their necessity; person-features may currently be more pertinent to consider.

2.2.5 Delivery

Another thing to be mindful of when employing the BPS is its delivery method. In the original experiment, the BPS activity was completed in-person (although independently of the researcher's assistance) and submitted on paper (King, 2001). A successive study, however, had participants talk to the researcher about their best possible selves, and this was shown to be just as effective in increasing PA, decreasing NA, and reducing the number of health-centre visits later as writing did compare to a non-BPS control group (Harrist, Carlozzi, McGovern, & Harrist, 2007). In fact, the 'expressive talking' participants rated their mood as lower post-intervention than 'expressive writing' participants did, although participants did find it more difficult to talk about life goals than to write about them (Harrist et al., 2007). Despite this effectiveness, the spoken delivery method has not been adopted since (Loveday, Lovell, & Jones, 2016). Instead, most studies administer the intervention online (Ng, 2016; Shapira & Mongrain, 2010) as there appears to be no significant differences between receiving the expressive writing version of the intervention online versus in-person (Layous et al., 2013) although this has not stopped certain groups from trying to adapt the BPS PPI to make it more effective in a virtual context (Enrique, Bretón-López, Molinari, Baños, & Botella, 2018).

Part of the appeal of delivering the BPS online is that, even without direct benefits to PA or other outcomes, it has several advantages over face-to-face delivery. Firstly, it is cheaper, quicker, and easier for researchers to deliver online, and this may likely be the case should the BPS ever be applied outside of research. If people were worried about losing a human aspect, some groups have utilised video instructions to increase fit, improve participant motivation, and reduce dropout attrition (Manthey, Vehreschild, & Renner, 2016). Others have found that online delivery allows them to reach isolated populations; for example, one study used the BPS to provide cognitive support to individuals (including war veterans) with mild and moderate traumatic brain injuries (Rumrill et al., 2016). If the effectiveness of the BPS is the same, then it makes sense to deliver it in a way that is cheaper and more easily distributable.

Delivery mode, however, extends beyond an online/in-person dynamic. In some studies, the BPS has been just one of a few interventions delivered as part of a package. This "buffet" style approach is a common way to deliver PPIs in wider (often non-health) contexts, and two-thirds of existing diabetes PPI studies have had some success this way (Cohn et al., 2014; Jaser et al., 2014). In one non-health study, the BPS was delivered as part of an online app alongside eight other PPIs (Parks et al., 2012). The results showed that users received more benefits to mood and that gains could be predicted based on the frequency of use and number of exercises chosen. Mood scores were not provided for individual activities, but the BPS did rank as mid-range in terms of popularity. A similar study that gave participants access to up to thirteen interventions produced similar changes to mood and well-being amongst people with depression (D'raven et al., 2015). Again though, scores were not collected for each intervention. However, in a study amongst suicidal in-patients, where nine options were available, the BPS specifically was shown to improve optimism and reduce a sense of hopelessness (Huffman et al., 2014). Compared to other interventions, however, the BPS had relatively low efficacy scores, meaning that other interventions were easier to use for this population. Ideally, it would be best to consider both individual intervention outcomes as well as popularity/ease-of-use/levels of engagement to ensure that the intervention is not only working but is a viable option for that population.

In the most recent review of the literature, it was argued that the "best possible self" exercise could also be delivered as a "best possible other" exercise, whereby the focus is shifted to consider those around the individual (Loveday, Lovell, & Jones, 2018). In health, where social support can play an important role, this variation could be useful if provided to partners and family members. In a study of men with prostate cancer and their wives, the results indicated that both partners' other-focus was important in understanding perceived wellness (Wilson, Barrineau, Butner, & Berg, 2016). Alternatively, asking women to consider a physically fit other was shown to help them make "healthier" food choices when grocery shopping compared to when they were asked to think of a future physically fit self (Han & Nam, 2017). Having someone else to project onto, or look up to, maybe a useful way to motivate certain individuals.

In some cases, the BPS has also been delivered to children. In such instances, the concept of "fit" has been put front-and-centre to help shape the nature of the delivery; two studies, for example, asked participants to draw their 'best possible selves' rather than write about them. In the first study, conceptualising their best possible selves in this way allowed the children to articulate themselves more clearly which translated into greater gains in self-esteem compared to control and gratitude intervention conditions (Owens & Patterson, 2013). In the second study, the researchers argued that this way of delivering the BPS provided the children with a "voice". Indeed, the BPS was shown to give children the space to describe their learning experiences and to consider what they perceived to be important when it came to their education. The children were said to enthusiastically respond to the intervention, and they found the opportunity to express themselves in this way enjoyable. However, in this study, the BPS was not compared against another group as a reflexive inquiry analysis was undertaken to get an understanding of how children were considering their best possible selves (O'Brien, Blue, & Rowlands, 2017).

2.2.6 Conclusions

There is evidently a lot to consider when applying the BPS PPI to context. However, the BPS task has shown to be an effective exercise for facilitating PA and producing a wide range of benefits to well-being as well as to mental and physical health. This makes it an ideal intervention for people with T1D and T2D and maybe even for those at risk of T2D too. The BPS has shown to be a flexible intervention that can be used in a variety of contexts with various populations because it is adaptable; in fact, the research encourages tailoring efforts. Being mindful of person- and activity-features, as well as the method of delivery, is key to fitting the intervention to one's needs and maximising benefits. This is important not just for immediate and short-term benefits but also for long-term effects, given that continuous engagement is crucial for sustaining PA and other positive constructs such as optimism. It is essential for future work to continue considering a variety of theories when utilising the BPS (some of which will be detailed in the next chapter). As such, in order to get the most effects from the BPS in a diabetes context, it was necessary to bear some conclusions in mind and to make similar modifications before administering it as part of the research undertaken for this thesis.

2.3 Tailoring the BPS for a Diabetes Context

To ensure the BPS was "fit" for a diabetes context, it was necessary to make several small but significant changes. First, a decision was made to focus on activity-features and for this, inspiration was drawn from existing versions, most notably the iterations produced by Sheldon and Lyubomirsky (2007), Meevissen, Peters, and Alberts (2011), and Oduo and Brodrick (2013) as their versions were clear and evident in their respective reports. Each retains something of King's (2001) original while still contributing a little something of their own. Sheldon and Lyubomirsky (2007) used positive language to pad out the original, Meevissen and colleagues' (2011) version asked users to construct a "story", and Odou and Brodrick (2013) got participants to "engage their senses" to best promote visualisation of the individual's best possible selves. In subsequent versions used in later research chapter of this thesis, inspiration was also drawn from Layous, Nelson, and Lyubomirksy (2013) to promote further nurturing and understanding language. This first version would adapt each of these features in the hope that they would promote the most engagement. Additionally, a decision was made to include an introductory “text box” that would describe the benefits associated with improving HbA1c, which it was hoped the intervention may influence given enough time.

In terms of person features, the most significant change made was to rebrand the “best possible self” as one’s “best possible HbA1c”. The rationale for this decision was that it would bring diabetes to the forefront of people’s minds while giving recipients something concrete to attach to. It was reasoned that a “best possible HbA1c” would be more tangible to some people than a “best possible self” would. A decision was then subsequently made to reject using multiple themes; the assumption being that life with diabetes is multi-faceted enough and that people could use the intervention to address issues as they arose. It appeared counter-intuitive to have people focus on one particular aspect of their illness if another was playing on their minds at the time; it would make the intervention too rigid, and this could discourage engagement. Finally, it was decided that dosage would not be set until after Study 1 and in which case it could be set via communications and would not be included in the instructions themselves. This diabetes-version of the BPS was created in Microsoft Word so it could be easily distributed online or printed off and distributed in-person depending on what the research called for. See Figure 2.2 on the next page for a reproduction.

It was vital that the design was flexible and that it could be modified if necessary as time went by. Ultimately, three versions were utilised over the course of the PhD, and the changes and full rationale can be seen in Appendix 1. Where each version is first used, the new, modified BPS will also be reproduced again in the respective research chapter.

Your HbA1c gives you a picture of what your average blood sugar levels have been like over the last few weeks/months. The target for people with diabetes to aim for is about 48mmol/mol (6.5%) though you may have your own been given your own aims. Improving HbA1c by even 1% (or 11mol/mol) cuts the risk of microvascular complications (retinopathy, neuropathy, and kidney disease) by 25% and if you have type 2 it also cuts the risk of cataracts, heart failure, and amputation.

Please take a moment to think about your <u>best possible HbA1c level</u>. Imagine that your blood sugar levels have been very well controlled. It might be because you had been feeling more optimistic of late or you had been able to better deal with setbacks in relation to your diabetes management. Think of this as the realisation of the best possible HbA1c level you could hope for yourself.

Now, please use the next 10 minutes to write continuously about what you imagined about your HbA1c level. Use the instructions below to help guide you through this process:

1. Be as creative and imaginative as you want (don't worry, what you write is for your use only; no one else will ever see it). Do not worry about perfect grammar and spelling.

2. Use whatever writing style you please just remember to imagine your ideal HbA1c level in the FUTURE.

3. However, you may find it helpful to activate your senses, feelings, and perceptions to make a <u>personal story</u> of your ideal HbA1c level. Really visualising your best possible HbA1c will make it feel more personal to you and may inspire confidence.

[Fig. 2.2 The Best Possible HbA1c protocol. Modifications to language and content would be made in response to qualitative feedback from study 1. Further adaption would then take place to reflect the change in population groups for studies 2, 3, 4, and 5]

Chapter 3: Relevant Models of PA and Their Relationship with T1D and T2D

3.1 Overview

Chapter 1 discussed direct evidence for the influences of PA on diabetes self-management and risk while Chapter 2 reviewed the literature around the BPS PPI – an intervention that could take advantage of this relationship to promote positive diabetes outcomes. However, research into diabetes and PA is still a relatively new area of study, and there a lot of factors that are unclear. Similarly, the BPS literature could benefit from more rigorous work conducted using theoretical backing. There is some understanding of the BPS' mechanisms, but little work has focused on how BPS-facilitated-PA is influencing overall intervention effects. In order to understand potential mediating and moderating factors more clearly, researchers have proposed various theoretical models to help explain the nature of the relationship between PA and health. This chapter reviews existing theoretical work and outlines key PA models while discussing the evidence that supports or refutes their claims.

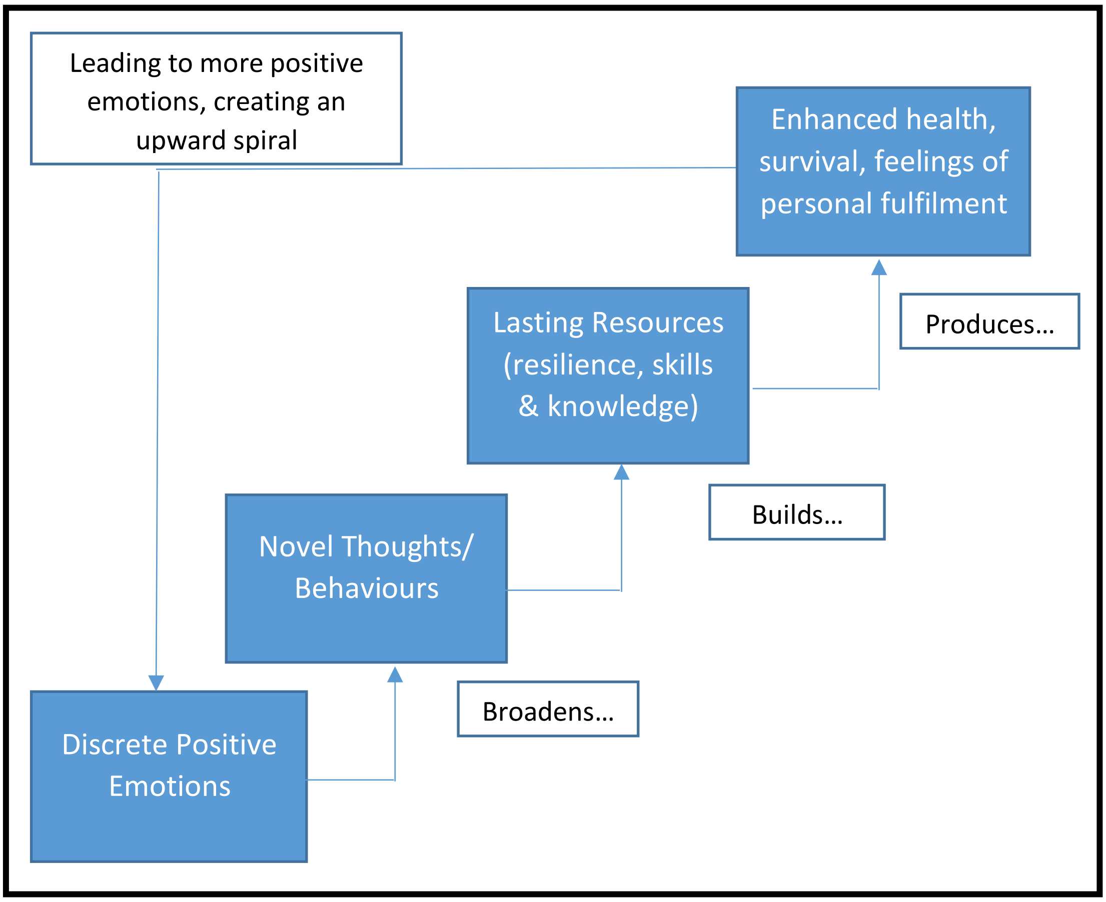
3.2 Standard Models of PA

3.2.1 Broaden-and-Build Theory

Alluded to in the previous chapters and referenced in work with the BPS (Meevissen, Peters, & Alberts, 2011), Fredrickson's Broaden-and-Build (B&B; 2001; 2004) theory of positive emotions was outlined in 2001 to describe the evolutionary benefits of PA (although Fredrickson was keen to distance herself from the phrase "affect" and preferred to think of a spectrum of positive "emotions" that are phenomenologically distinct from one another). B&B theory states that such positive emotions can broaden people's momentary thought-action repertoires and build their enduring personal resources by encouraging novel ways of being. These resources can be physical, intellectual, social or psychological in nature. For example, "love" could build relationships or it could encourage an interest in a topic that the individual seeks to learn more about, although distinct emotions are not explicitly paired with distinct behaviours by Fredrickson. However, Fredrickson was the first to frame positive emotions as equally "adaptive" as negative emotions, suggesting that:

> "those of our ancestors who succumbed to the urges sparked by positive emotions —to play, explore, and so on—would have by consequence accrued more personal resources. When these same ancestors later faced inevitable threats to life and limb, their greater personal resources would have translated into greater odds of survival, and in turn, greater odds of living long enough to reproduce. To the extent then, that the capacity to experience positive emotions is genetically encoded, this capacity, through the process of natural selection, would have become part of our universal human nature." (Fredrickson, 2004, pg. 1369)

Despite the fact that these claims about evolutionary benefits are presented without any direct evidence, Fredrickson's argument (2001;2004) was put forward in this way to compete with appraisal-based theories of emotion available at the time (in particular, see the works of Frijda, 1986; Roseman, 1984; Scherer, 1988; Smith & Ellsworth, 1985). These appraisal-based theories focused on the notion of 'specific action tendencies', which refers to how certain emotions (such as anger) promote specific and immediate reactions (such as fight or flight), position affect (but mainly NA) as necessary for survival. By contrast, any emotion that did not produce specific action tendencies (typically PA) were believed to merely indicate optimal functioning and therefore had no real benefit in and of themselves. Although Fredrickson concedes that specific action tendencies work well to describe the function of negative emotions, she argued that positive emotions must also play an important role in survival; otherwise, they would not have been passed on from ancestor to ancestor. The model, therefore, reconsidered positive emotions as serving to provide more long-term benefits by encouraging exploration and play, consequently broadening the array of thoughts and actions one engaged in, leading to a development of durable resources that outlast the transient emotional states that led to their acquisition. These resources then act as reserves that can be drawn upon at later time points, even during periods of prolonged NA (see figure 3.1 below).



[Fig 3.1 The Broaden and Build Theory of Positive Emotions (Fredrickson, 2001).]

Given enough time, the theory argues, positive emotions will act to undo lingering negative emotions, fuel psychological resiliency, and trigger upward spirals toward improved emotional well-being. Evidence for upward spirals, in particular, is quite strong (see section 3.1.2) and there is also a host of support for the model's broaden-and-build concept more generally (Kearney et al., 2014; Gloria & Steinhardt, 2016; Samios et al., 2013). The B&B's notion that PA benefits increase over time, in particular, is supported by the sustainable happiness model (Lyubomirsky, Sheldon,

& Schkade, 2005), which has been utilised to explain some of the long-term benefits associated with the BPS (see Chapter 2).

However, that does not mean that the model is free from criticism. Firstly, Fredrickson wanted to distance the model from affect and focus specifically on discrete emotions, although that has not stopped others (including Pressman, Jenkins, and Moskowitz, 2019) from treating it as a model to explain PA's influence over health and behaviours. It is also worth noting that it is hard for any model to make substantive claims about evolutionary benefits, especially when these aspects, despite being presented in a seemingly logical manner, are presented without any supporting research. The exact thoughts and behaviours that PA is meant to elicit are also left vague, which is in contrast with Fredrickson's efforts to label each discrete positive emotion that are supposedly most beneficial. It is possible that specific elicited emotions were intended to be context-specific but this is left unclear too. It is also important to note that the B&B model is not a model of health so it may be less effective than other models discussed in this chapter for understanding the relationships between PA and diabetes, and PA and the BPS.

3.2.2 Upward Spirals and the Upward Theory of Lifestyle Change

Certain aspects of the Broaden-and-Build theory (Fredrickson, 2001; 2004) work better than others. The upward spirals component, in particular, became a stand-alone model almost immediately (Fredrickson & Joiner, 2002) and empirical support for its effectiveness has shown to be replicable (Burns, Brown, Sachs-Ericsson, Plant, Curtis, Fredrickson, & Joiner, 2008). The upwards spiral effect was further investigated in 2010 by research teams lead by Garland (with insights from affective neuroscience and the treatment of emotion "dysfunctions") and Kok (with insights from autonomic flexibility as indexed by vagal tone). Both teams were able to find neurological (Garland, Fredrickson, Kring, Johnson, Meyer, & Penn, 2010) and physiological (Kok & Fredrickson, 2010) evidence for an upward spiral effect which was then supported by further studies in subsequent years (Garland, Gaylord, & Fredrickson, 2011; Kok et al., 2013).

Garland and colleague's (2010) initial study reviewed the evidence and concluded that emotions (both positive and negative) are "self-perpetuating emergent systems" which are powered by the reciprocal links they share with cognitive, behavioural, and somatic mechanisms. Garland's team argued that emotions could be considered as systems that work to maximise and maintain their organisation in line with the B&B and this argument was based on the evidence they noted around neuroplastic changes in affective brain circuitry. When stress precipitates repeated measures of dysregulated mood, negative affective states can lead to self-perpetuating, downward emotional spirals in the same way that positive emotions may produce upward spirals (Carlson, Signh, Zarate, Drevets, & Manji, 2006). Stress-induced plasticity in the amygdala (important for emotional regulation) in particular has shown to play a role in the pathogenic transition from normatively vigilant states into chronic and pervasive anxiety disorders (Rainnie et al., 2004; Shekhar et al., 2005). Repeated exposure to aversive stimuli cases cause chronic excitation of neurons connecting the prefrontal cortex (PFC; responsible for inhibition control) and the amygdala (important for emotions), which then leads to long-term potentiation of the neural circuitry that connects them (believed to be crucial in emotional regulation; Davidson, Putnam & Larson, 2000; Ochsner & Gross, 2005). In turn, this can reduce the tonic inhibition of this system such that non-threatening stimuli come to elicit feelings of anxiety and fear and produce neurohormonal cascades, autonomic activation, and further sensitisation over time (McEwen, 2003); in other words: a downward spiral.

The assumption then made by Garland et al. (2010) was that upward spirals might work similarly, especially as novel sensory experiences and learning new behaviours have shown to trigger neuronal growth in the brain (Draganski, Gaser, Busch, Schuierer, Bogdahn, & May, 2004). Evidence from lesion studies and experimental manipulation of dopamine levels suggests that the broadening effects of PA may be partly mediated by dopamine release in the nucleus accumbens, striatum, and various cortical and limbic regions (Mitchell & Phillips, 2007). It is possible that repeated experiences of PA could, therefore, increase sensitivity to natural rewards and broaden cognitive-behavioural repertoires via beneficial neuroplastic changes to the corresponding brain systems. However, Garland and colleagues (2010) were forced to acknowledge that the literature on this front was lacking and there were no direct findings of PA-induced changes in human brain structure at the time. Instead, they directed readers to meditation practices such as mindful meditation and loving-kindness meditation which may act to facilitate positive emotion and which have shown to produce durable neurobiological changes (Lutz, Greischar, Rawlings, Ricard, & Davidson, 2004; Slagter et al., 2007).

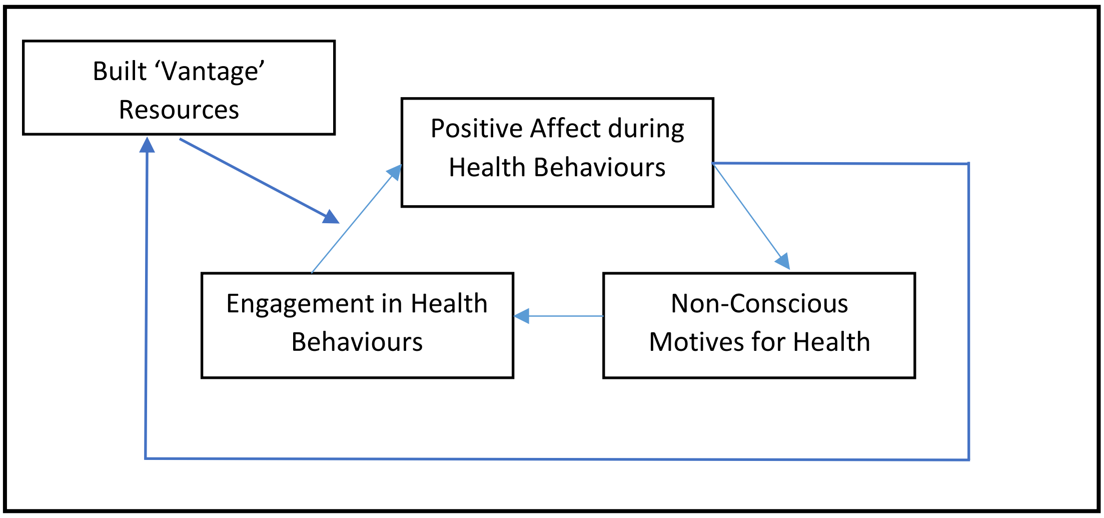
Kok and colleagues (2010), meanwhile, focused on the influence of upward spirals on cardiac Vagal Tone (VT), which is reflective of autonomic flexibility; the capacity of the parasympathetic nervous system to adapt to changes in circumstance by modifying respiration, heart rate, and arousal. A higher VT is also correlated with trait positive emotionality, prosocial behaviour, sympathy, and decreased maladaptive coping. Originally, it was put forward as a means to assess an individual's vulnerability to stress (Porges, 1995) and later research also demonstrated that it predicts superior cognitive flexibility, including working memory, directed attention, and inhibition of a dominant response. Kok and colleagues (2010) therefore hypothesised (and indeed found evidence) that VT would predict gains in PA as well as social connectedness, which in turn would produce further autonomic flexibility (i.e. an upward spiral). Evidence of increased autonomic flexibility suggests a more physiological means by which stress is countered, although it is important to note the importance of inhibition here as well. The cognitive benefits associated with VT may be because VT indexes functioning of the vagus nerve specifically, which links the heart with the brain (Porges, 2009).

Based on their initial findings, both Garland's and Kok's research would later suggest meditation as a way of purposefully stimulating upward spirals of PA. Rather than merely reducing stress via evocation of a relaxation response (Benson et al., 1974), meditation has shown to produce significantly different cardiovascular and autonomic effects than relaxation training (Ditto, Eclache, & Goldman, 2006).

Garland and colleagues (2011) posited that mindfulness practice, in particular, would facilitate positive reappraisals, i.e. the adaptive process through which stressful events are re-construed as benign, beneficial and/or meaningful. Alternatively conceptualised as 'benefit finding', this strategy is associated with reduced distress, improved mental health outcomes, and positive impacts on physiological parameters associated with stress (Bower et al., 2008; Carrico et al., 2006; Cruess et al., 2000, McGregor et al., 2004; Tugade & Fredrickson, 2004). For example, a person diagnosed with T2D might positively reappraise the diagnosis as an opportunity to change their lifestyle and health behaviours. When adolescents with T1D were asked to engage in 'benefit finding', they displayed an increase in various diabetes outcomes, including benefits to their mental health and self-reported self-management behaviours (Tran, Wiebe, Fortenberry, Butler, & Berg, 2011). Garland et al. 's (2011) findings supported their hypothesis and mindfulness was also shown to facilitate positive reappraisals. Kok and Fredrickson's study (2013), meanwhile, examined the influence of loving-kindness meditation on VT and produced similar results. They found that positive social connections, in particular, were important for the emotion-physical health connection.

These direct findings, coupled with evidence from other areas of psychology, would eventually lead to the official formation of the 'Upward Theory of Lifestyle Change' (Fredrickson, 2013; Van Cappellen, Rice, Catalino, & Fredrickson, 2017). The notion put forward by Fredrickson in 2001 that PA generates upward spirals was now being applied specifically to physical health. Based on the knowledge that actions that are rewarding or satisfying are more likely to be maintained, the theory argues that reward systems can be broken down into 'liking', 'wanting', and 'learning'. Over time, PA (and the neurochemicals they trigger in the brain) produce associations between pleasantness and cues predictive of liking to endow the cues with incentive salience, making them more likely to capture attention in the future. When those cues are later encountered, their heightened salience triggers dopaminergic wanting and seeking behaviours. Research had previously demonstrated that incentive salience thus creates automatic, non-conscious processes between liking something and subsequent and persistent behavioural urges to re-engage with it (i.e. wanting) (Ode, Winters, & Robinson, 2012).

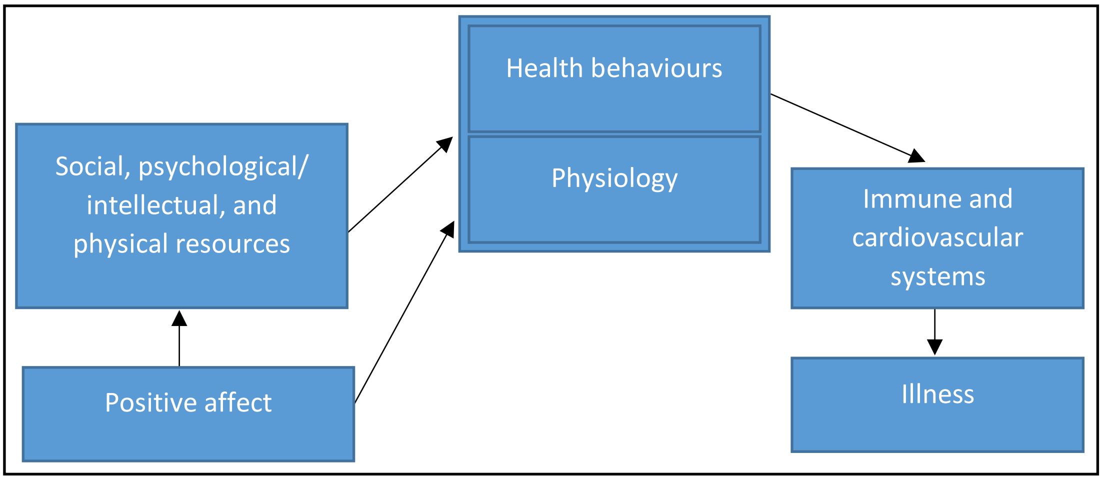
Combined with the B&B, Van Cappellen and colleagues (2017) argue that experiences of PA broaden mindsets in ways that also build biological resources (with specific references to vagal tone), as well as cognitive (with particular references to mindfulness meditation), psychological, and social (again referencing benefits associated with VT) resources. The Upward Theory of Behaviour Change argues that this can facilitate long-term adherence to positive health behaviours. It suggests that, if PA is experienced during a new health behaviour, then those feelings can increase incentive salience for the cues associated with them. In turn, heightened salience guides attention and subsequent decisions towards healthier lifestyles. See Figure 3.2 below for the full model.



[Fig 3.2 Upward spiral theory of lifestyle change (Fredrickson, 2013; Van Cappellen, Rice, Catalino, & Fredrickson, 2017). The outer loop represents PA-generated endogenous resources. Vantage resources refer to the fact that they leave people more sensitive to subsequent positive experiences.]

3.2.3 The Main Effect Model of Positive Affect and Health

Alternatively, Pressman and Cohen (2005) produced a model that incorporates built resources and considers how the resulting health behaviours and physiological changes may influence disease and illness. Rather than upward spirals, however, the model posits that PA leads to downstream impacts. There is also more of a focus on physiological functioning. Research (including studies where PA has been manipulated experimentally) has demonstrated that PA is associated with more robust vaccination responses, an increase in white blood cells, reduced inflammation, and faster healing (Marsland, Pressman, & Cohen, 2007). It has also been associated with lower levels of cortisol (the immune-altering stress hormone) (Brummett, Boyle, Kuhn, Siegler, & Williams, 2009), lower heart rate, blood pressure, and lipids (Blanchflower & Oswald, 2008), and healthier nighttime cardiovascular activity (such as nocturnal heart rate and heart rate variability) (Bhattacharyya et al., 2008). The model also references the research on VT, although they argue that more work needs to be done to understand the extent to which all physiological-PA relationships reciprocate one another, especially as systems and pathways (e.g. epigenetics, telomeres) are uncovered and implicated in the findings (see Figure 3.3 below).



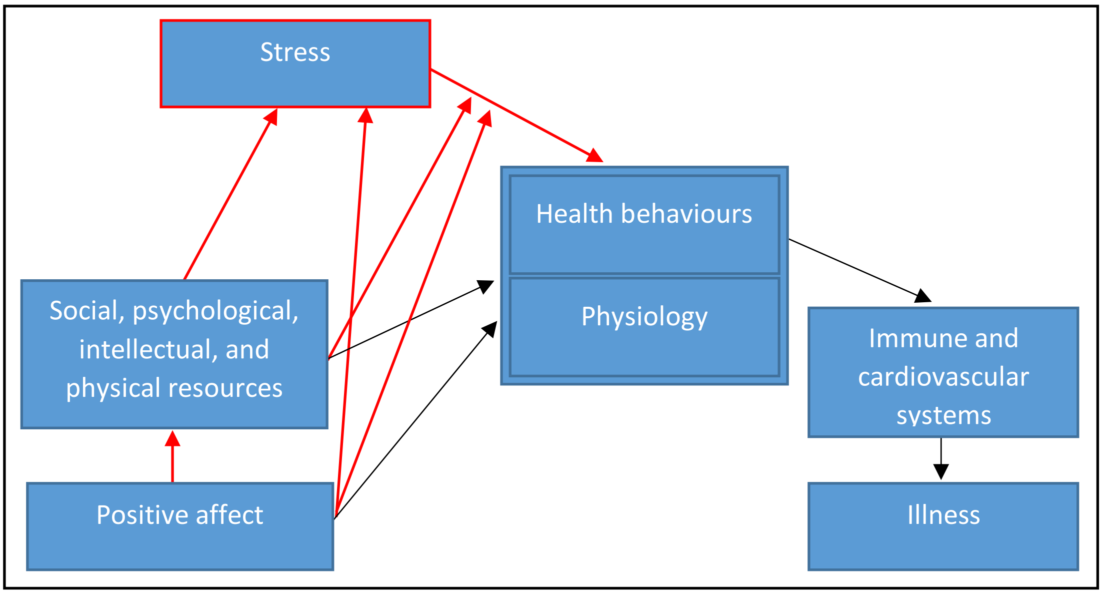
[Fig 3.3 Pressman and Cohen's (2005) Main Effect Model of positive affect (MEM). An absence of a line does not indicate an absence of an association between variables and nor do arrows indicate a single direction of causality. Instead, lines represent the focus of this mediatory model and arrows go in one direction for simplicity.]

Researchers have subsequently tested the Main Effect Model of PA and Health (MEM) and found significant support for the links between PA and physiology as well as for the associations between PA and illness. Fewer studies have tested the full mediational predictions of the model, however, where physical health acts as the dependent variable and physiology/health behaviours act as mediators. Of those that have, Doyle and colleagues (2006) demonstrated that IL-6 (a marker of inflammation) mediated the relationship between PA and infection severity when participants were experimentally exposed to a strain of rhinovirus. Similarly, Hoogwegt and colleagues (2013) showed that physical activity moderated an association between PA and mortality in patients with ischemic heart disease during a five-year follow-up period.

Pressman, Jenkins, and Moskowitz (2019) suggested that a lack of research into mediating factors may be related to timing issues, as longer periods are necessary to detect significant health effects when considering mediating factors which may need multiple measurements. Hypothalamic-Pituitary-Adrenal (HPA) activity (a measure of stress regulation) assessed over a month, for example, may be unlikely to fully account for the relationship between PA and disease because of the time necessary to detect abnormal versus regular functioning (Dockray & Steptoe, 2010).

3.2.4 Stress Buffering Model of PA and Health

Alongside the MEM, Pressman and Cohen (2005) also proposed the Stress Buffering Model of PA and Health (SBM), which states that health benefits arise out of PA’s ability to reduce stress and its impact on physical health. It makes two main predictions. Firstly, it suggests that PA moderates the link between stress, health behaviours, and physiological functioning by weakening the connection between them. Secondly, stress is proposed to mediate the association between PA and health-relevant variables either directly or indirectly via the resources accrued through PA. In other words, PA is predicted to reduce both the impact and incidence of stress. In support of these assumptions, PA has repeatedly shown to influence stress and coping appraisals, reduce physiological reactivity, and hasten stress recovery. These alterations carry significant benefits, considering the influence that stress not only has on resources and behaviours but also on physiology and long-term health complications (see the review by Pressman, Jenkins, & Moskowitz, 2019).



[Fig 3.4 Pressman and Cohen's (2005) stress-buffering model of PA. Visually, it is very similar to the MEM. The red signifies the paths by which stress moderates and is mediated by PA on the outcomes detailed in the MEM.]

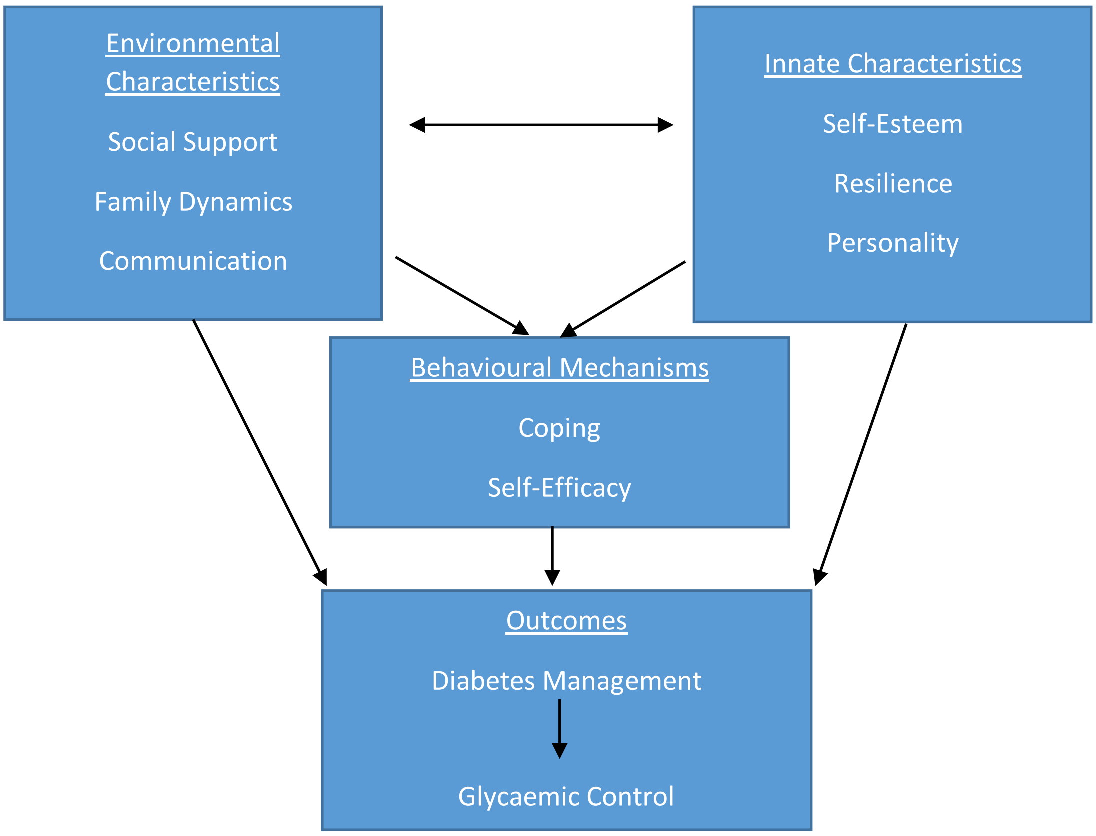
Fundamentally, the SBM is not too dissimilar from the MEM (Pressman & Cohen, 2005; see Figure 3.4 above for a visual aid). There are, however, important considerations to take into account when testing this model and putting it into practice. Firstly, it is important to determine context before attempting to utilise PA's buffering effects. Pressman, Jenkins, and Moskowitz (2019) gave the example of attempting to facilitate PA to reduce distress following a cancer diagnosis, where inappropriate hope and a complete absence of stress may prevent engagement with certain health behaviours. It is possible that there may be similar issues in a diabetes context. Facilitating PA is one thing if it encourages health behaviours/influences physiological outcomes, but utilising it specifically to combat stress could be damaging if a bit of stress is encouraging positive engagement. Secondly, it is also important to remember that the model's outcome variables may act as mediators in their own right, especially considering cardiovascular impacts on stress in particular. VT, for example, has shown to moderate stress (Kok et al., 2010), suggesting that stress may appear at any point in any health-stress model.

3.3 Models of the Relationship between Diabetes and PA

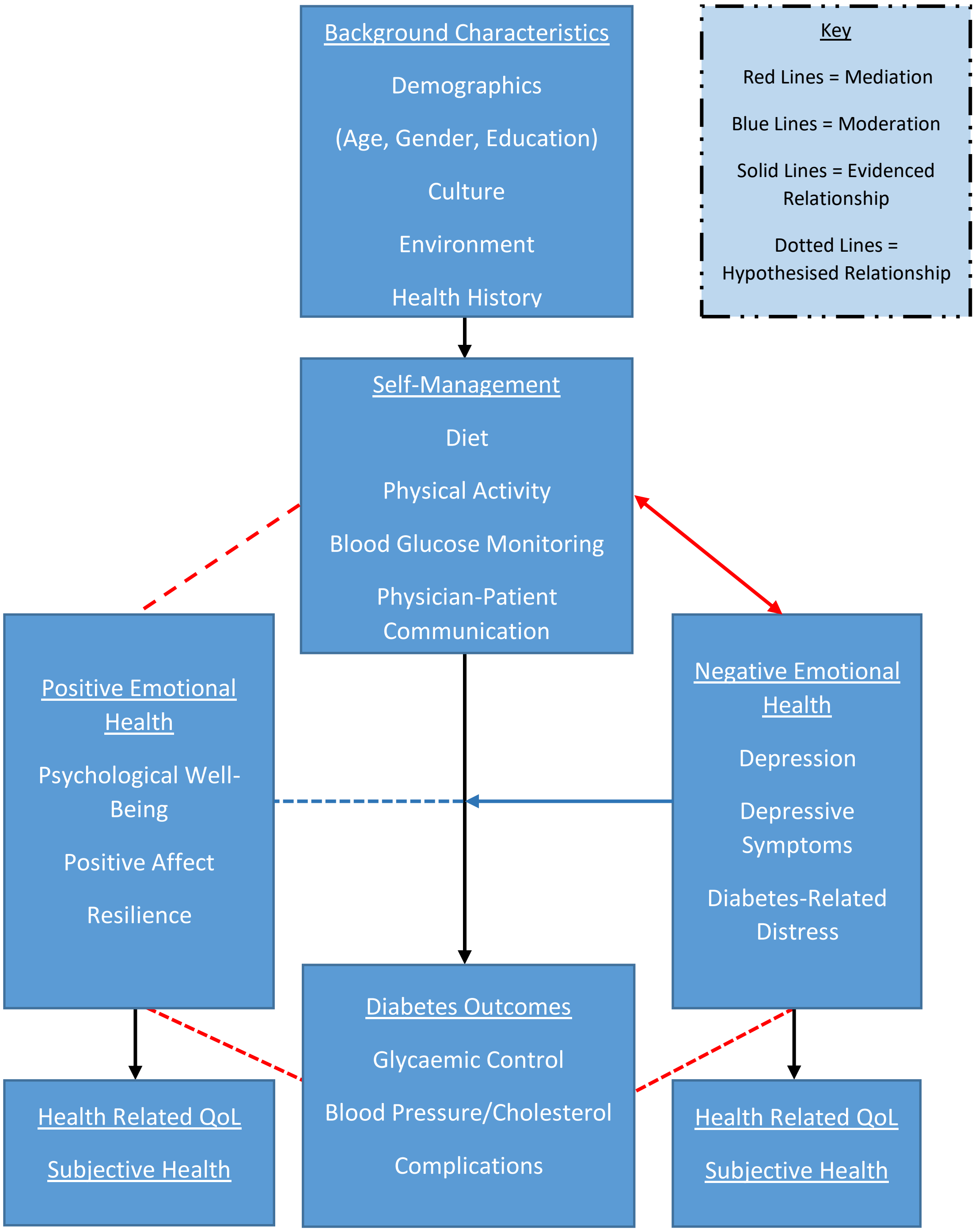
Despite the numerous models around PA, only two (basic) models have sought to even broadly consider the influence of PA on diabetes. Furthermore, neither has made any attempts to apply existing PA theory to diabetes care. Instead, the first model to explore the link between PA and diabetes was a conceptual model (Robertson, Stanley, & Naik, 2005; Figure 3.6) which highlighted positive and negative affective processes as influencing the pathway between diabetes self-management and diabetes outcomes. As a first attempt, it is to be commended for stressing the importance of affective processes on outcomes. However, PA and NA are positioned as parallel in this model, and evidence since would suggest that PA and NA influence one another (Riskind, Kleiman, & Shafer, 2013). Indeed, the PA models discussed above would suggest that PA has potential NA buffering properties, indicating an interaction effect that puts this model at odds with other theory.

The second model (Figure 3.5) is more substantial than the first, in that it was informed by a literature review of over 80 studies on positive psychosocial factors (including PA) and diabetes (Yi-Frazier, Hilliard, Cochrane, & Hood, 2012). The final model appears somewhat more in line with other theory than Robertson et al.'s (2012) model does. However, it fails to reference PA specifically. Instead, it details what the PA would consider its 'built resources' such as resilience and social support (Fredrickson, 2001; 2004). Importantly, it positions these factors before self-management, suggesting that the consequences of affective processes are something to be built upon.

In contrast to other models of PA, the effect is not a spiral but more of a tower. As such, Robertson et al.'s (2005) model may be seen as more dynamic, as it suggests that 'positive mental health' or 'negative mental health' may intervene at any time, while Yi-Frazier et al. 's (2012) model suggests that mental health acts merely as a base but without really influencing anything at later stages. Currently, is unknown which model is more accurate. In reality, it is unlikely that these two models will be relevant at all, highlighting a need for a more detailed understanding of the relationship between PA and diabetes care, especially one informed by existing theory.



[Fig 3.5 Yi-Frazier and colleagues' (2012) Model of Diabetes]



[Fig 3.6 Conceptual model adapted from Robertson et al., (2012; which in turn was adapted from Piette et al., 2004) showing positive and negative psychosocial and affective pathways associated with diabetes self-management and hard outcomes. Arrows indicate directions of the relationship.]

3.4 Conclusions

Existing theoretical literature is insufficient to fully explain the relationship between PA and diabetes. This is reflected in the lack of theoretical models exploring their relationship as well as in the conceptual inconsistencies between them. However, exploring more general theories of PA helps toward developing an understanding of this relationship. Although the multiple theories may disagree on the finer points, they all have several things in common. Firstly, the theories all state that PA leads to numerous built resources. Secondly, these resources eventually lead to improved health (as well as other outcomes).

Indeed, the advantage that the more general models (i.e. B&B, MEM, SBM, etc.) have over Robertson's (2012) and Yi-Frazier's (2012) diabetes models is that they understand there is no straightforward link between PA and health outcomes. The B&B model introduced the complexities involved, while the subsequent upward spirals, MEM, and SBM models have since put forth evidence that PA impacts brain biology, cardiovascular functioning, improved social resources, and cognition. Together, these factors slowly build health. These conceptual issues will be reflected upon when evaluating the utility of the BPS in a diabetes context and will help guide research directions.

Chapter 4: Research Outline & Strategy

4.1 Overview

With the literature reviewed, it is essential to breakdown how this thesis built upon existing ideas, models, and evidence to generate new knowledge. The plan for the research involved starting with an exploratory study (akin to the kind of investigations that have previously assessed other PPIs for use by people with T1D and T2D) and then to build on those findings using a variety of enquiry techniques informed by a mixed-methods approach. Given the dearth of previous research on the BPS as a PPI for diabetes, it was important that the PhD thoroughly explored the intervention's effectiveness. Using a mixed-methods approach meant employing qualitative and quantitative investigations to ensure a breadth and depth of understanding and partnership (Johnson, Onweugbuzie, & Turner, 2007). Creswell and Plano Clark (2017) argue that the indispensable premise of mixed methods design is that the use of quantitative and qualitative methods in rapport provide a better understanding of the research problems than use of either one method alone. It is not that one methodology takes precedence over the other but that each informs the other to "produce positive change in the world" (Bishop, 2015; pg. 7).

This chapter, therefore, serves as a primer for the research chapters that follow by detailing the research narrative and outlining the various methods and analyses contained within them. This chapter also provides some qualitative reflections from the author regarding the beginning of the research journey.

4.2 The Research Narrative

Five studies were conducted and make up the contribution to new knowledge for this PhD thesis. These empirical studies used a combination of individual mixed methods and qualitative and quantitative approaches.

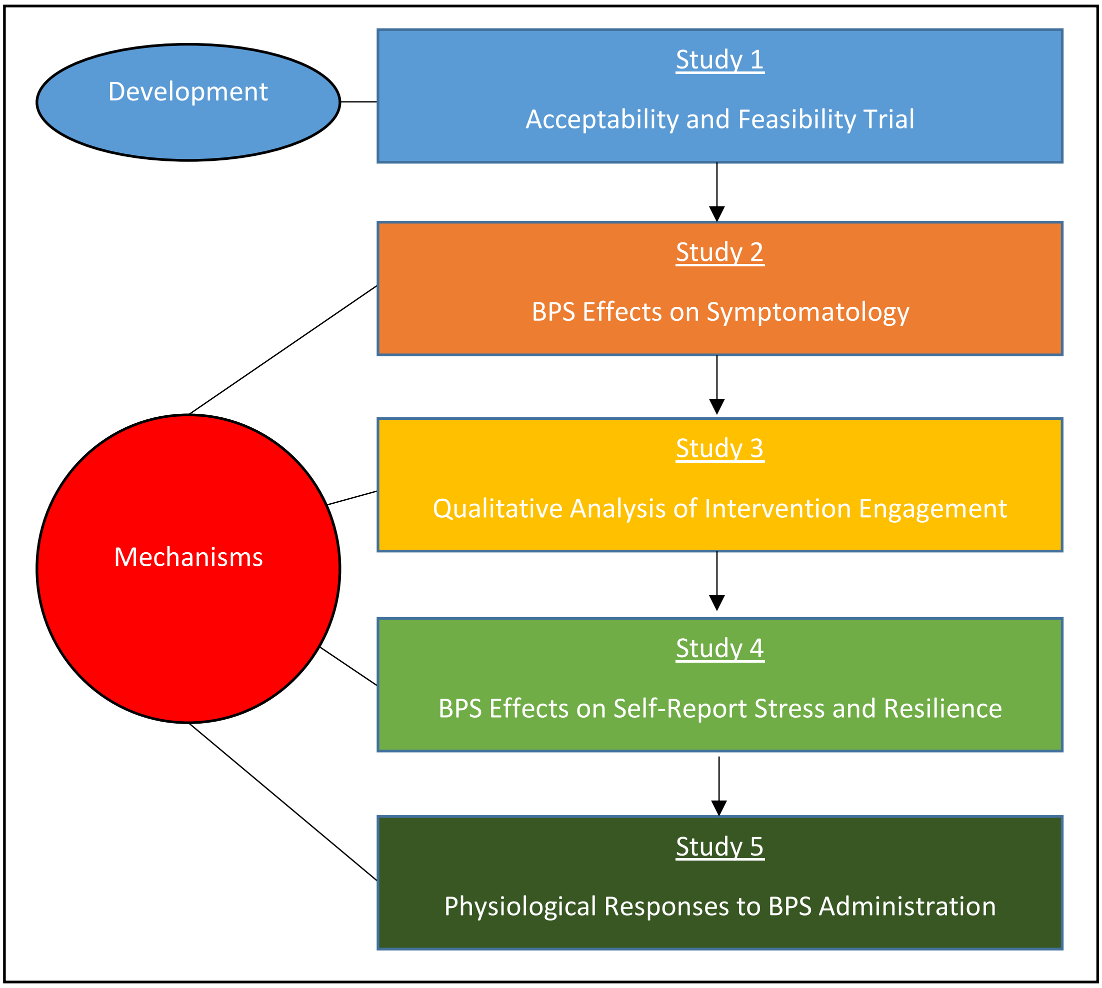
The first study (Chapter 5) assessed acceptability and feasibility of the BPS intervention in a way that mirrored previous diabetes PPI research. It was always important that the research that followed would then be influenced by the results of that preliminary investigation as follow-up is missing from the diabetes PPI literature. Consequently, Studies 2 onwards built upon Study 1's findings while also being mindful of previous literature and relevant theory. See below for a breakdown of all five studies:

Chapter 5:	Study 1, Mixed-Methods (Acceptability and feasibility trial)
	Phase 1 Qualitative
	Phase 2 Quantitative
Chapter 6:	Study 2, Quantitative (BPS effects on symptom perception)
Chapter 7:	Study 3, Qualitative (Analysis of BPS texts)
Chapter 8:	Study 4, Quantitative (BPS effects on self-report stress and resilience)
Chapter 9:	Study 5, Quantitative (Physiological responses to BPS administration)

In utilising a mixed-methods approach, one had to be mindful of philosophical differences between qualitative and quantitative methodologies. Traditionally, quantitative methods assume a positive or post-positive epistemology, while qualitative research are associated with constructionist or interpretive epistemologies (Creswell & Creswell, 20017; Bishop, 2015; Johnson & Onwuegbuzie, 2004). Post-positivist epistemologies assume that there is an ultimately knowable reality independent of human experience that can be objectively measured, free from bias. This approach takes the stance that, with the appropriate technology, one may discover universal laws that govern all behaviours. By stark contrast, constructionist or interpretive epistemologies entail the belief that the world is only knowable through experience and conceptual frameworks, which may differ from person to person and culture to culture. Reality is dependent on the individual, and it is no less real for one person than it is for another (Bishop, 2015).

A pragmatic approach was, therefore, necessary to find a balance between these parallel philosophies. In the context of mixed methods, pragmatism should not be confused with merely being "practical" (Denscombe, 2008). Instead, pragmatism sees a rejection of objective-subjective dualism and instead prefers to view scientific "truths" as provisional but achievable through diverse sources of experience (Johnson & Onwuegbuzie, 2004). Cornish and Gillespie (2009) and Yardley and Bishop (2008) argue that pragmatism leads the researcher to ask whether the knowledge produced by their research represents "reality" or whether it simply has valuable external consequences in the context of the researcher's own time and place. For health psychologists, such consequences may include more effective public health services targeting specific health behaviours (Bishop, 2015). The consequences, therefore, are not any less important than "reality" especially as reality is complex and often context-dependent. The "reality" of the BPS may be skewed in this context, for example, which is another reason a mixed-methods approach was deemed appropriate for this portfolio of work.

In total, 423 participants took part in the research contained in this thesis. Study 1's sample consisted of people with 35 people with T1D and 35 people with T2D, while Studies 2 -5 consisted of 353 people at low or high risk of T2D. The results from each study influenced the direction of the next so that each research question was affected in part by the previous findings, which is also why the sample population changed. Study 1 acted as an acceptability and feasibility trial while Studies 2-5 attempted to answer questions that Study 1 had brought to the surface. The mixed approach allowed a great deal of flexibility, which was important given the complexity of the intervention and the context in which it was being applied. The direction of this PhD was also informed by theory when certain answers were obtained. Figure 4.1 provides a visual representation of the full narrative:



[Fig 4.1 The research strategy at a glance. Results from each investigation influenced the next. Study 1 revealed general acceptability and feasibility of the BPS amongst people with T1D and T2D, but there were issues that prevented an upscaling of the research using a larger diabetes population. Subsequently, Studies 2-5 investigated the intervention mechanisms using a non-clinical sample of people at different levels of risk for T2D in order to better understand the BPS in this context.]

For more details on each study, see this brief summary below:

- Study 1 utilised a mixed-methods approach to assess the acceptability and feasibility of the 'Best Possible Self' task (BPS) amongst people with T1D and T2D. At this stage of the investigative enquiry, the BPS was expected to roughly demonstrate effects in line with the assumptions of the B&B

model (Fredrickson, 2001; 2004). The study was split into qualitative and quantitative phases. The qualitative phase consisted of one-to-one interviews and a focus group. Participants were asked to provide feedback on the intervention and themes were developed from this data. Some further modifications were then made to the BPS based on this feedback (the details of which are detailed as part of the materials section in Chapter 5, section 5.2, as well as in Appendix 1). The quantitative phase then randomly assigned participants to one of two conditions (control vs intervention) before asking them to provide self-report data on affect and self-management behaviours at two-time points over a four week period. The quantitative phase was set up online.

- Following the results of Study 1, Study 2 used the same four week quantitative design to assess the effects that the BPS had on affect and physical health (measured as reductions in symptomatology) in line with the non-PA theory of self-regulation (first discussed in Chapter 2, section 2.2.3) (Deci & Ryan, 2000; 2008). Again, this study took place online. The sample this time, however, consisted of people at various risks of T2D. Some final, very minor, modifications to the BPS were made to reflect this change in population (again, see Appendix 1 as well the materials section in Chapter 6, section 6.2, for changes to the BPS).
- Study 3 involved textual analyses of people's 'best possible selves' using a qualitative design. Participants from Study 2 were approached and asked if they would be comfortable providing an example of how they had engaged with the intervention. Participants presented their BPS texts via email or direct messages on social media. Themes were developed (see the section on qualitative methods later in this chapter), and texts were examined to assess whether recipients were using the BPS to address specific health concerns and symptoms. This study provided further insights into the outcomes the BPS was producing.

- Study 4 saw a return to the four week quantitative design to assess BPS effects on symptomatology, stress, and resilience. Again, a non-clinical sample of participants at various risks of T2D was recruited. This study was designed to investigate a potential buffering impact in line with the SBM and previous diabetes PPI research. This study was conducted online.
- Study 5 tested whether there were any physiological changes associated with the BPS in line with theory set out by the MEM (Pressman & Cohen, 2005) and SBM (Pressman & Cohen, 2005). For this study, participants at various levels of risk for T2D were invited to a laboratory and randomly assigned to one of two conditions (control vs intervention). Those assigned to the intervention condition received the BPS to do in-person in the laboratory. All participants were asked to complete self-report questions before and after condition allocation. Post-allocation, all participants completed a stress task and measures of blood pressure and ECG were taken at baseline, under stress, and during recovery.

4.3 Research Strategy

Ultimately, the aim of this PhD thesis was to assess whether the BPS was an effective intervention for promoting physical and mental health outcomes within the diabetes context. This aim was achieved by making use of the most suitable methodologies, being reflective throughout the scientific process, ensuring data quality via appropriate sampling, and through a careful consideration of ethics.

4.3.1 Quantitative Analyses

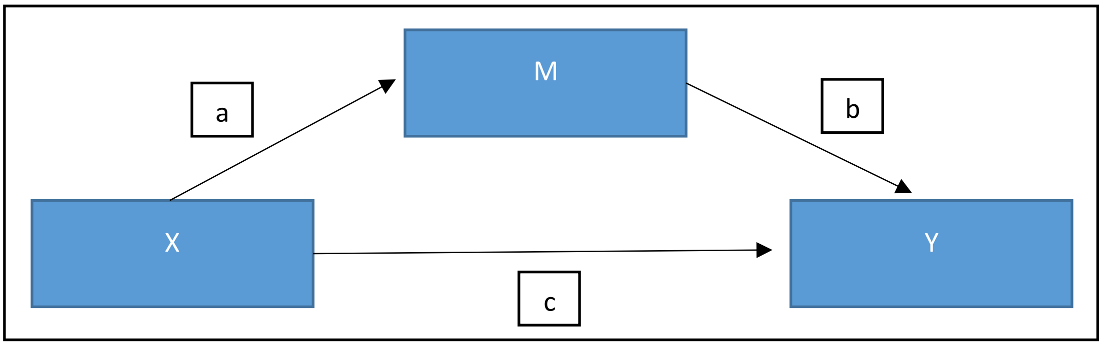
Multiple Analyses of Variance (MANOVA)

MANOVAs were often the most appropriate method for analysing the quantitative data, in which several conditions are compared against multiple outcome measures (Field, 2013). MANOVAs were employed in Studies 2, 4, and 5 to directly compare group differences (intervention vs control) at two different time points (Time 1 and Time 2), therefore providing two sets of data. Rather than assess differences across time (which can be achieved using repeated measures analyses; see below as well as Field, 2013), MANOVAs allowed for comparisons following intervention (or control) exposure and at a time point four weeks later using only two sets of measurement without the need for baseline measures (Grace-Martin, 2020). The alternative would have meant asking participants to repeat questionnaires three times (baseline/immediately following exposure/four weeks following exposure) for the same amount of data, increasing the risk of attrition and compromising validity of the findings (indeed, drop-out was an issue in studies 2 and 4, even when participants only had to provide self-report answers twice). Similar approaches have been taken by other BPS studies in the past (see, for example, Owens & Patterson, 2011), further justifying their use here.

Ultimately, MANOVAs provided assessment of the effects that the BPS (always the independent variable) had on multiple dependent variables (such as affect and behaviour) while reducing the risk of Type I errors (i.e. the risk of a “false positive”) that might occur if multiple ANOVAs (standard Analyses of Variance) were run (Field, 2013). Level of T2D risk was treated as a second independent variable in studies assessing the effects of the BPS on people not diagnosed with diabetes (i.e. Studies 2, 4, and 5). This allowed for the assessment of Condition x Risk interaction effects. MANCOVA (Multivariate Analysis of Covariance) was used to assess the contribution of covariates such as age and gender in later studies.

Mediation

Mediation is a causal model that assumes that a variable is “mediating” a relationship between two other variables (usually an independent and a dependent variable; Hayes, 2012). See Figure 4.1 for a visual example of how this model works.



[Fig 4.1 Mediation Analysis. M is the proposed mediator between X and Y. Path c represents the direct effect.]

In Study 2, for example, mediation modelling was used to explore the effect that certain symptoms (M) had on the relationship between the BPS (X) and PA (Y), after a MANOVA revealed a relationship between the BPS and the symptom of fatigue, but not between the BPS and PA. In other words, the model was used to assess the indirect impact the BPS may or may not have had on PA.

Repeated Measures

Repeated measures MANOVA was used in Study 5 to asses time-based changes to self-report measures of psychological outcomes over a brief period. As this was a within-participants procedure, participants effectively acted as their own baseline. During repeated measures analysis, BPS exposure (intervention versus control) was entered as a between-group variable, to ascertain the extent to which any significant differences in repeated measures were dependent on the intervention (Field, 2013).

4.3.2 Quantitative Measures

Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988)

The PANAS is a 20-item scale that asks participants to indicate how often they have experienced specific emotions over the past week using a 5-point Likert scale. The scale is split in two so that ten of the items measure PA and the other ten measure NA. This provides two distinct scores; a PA and a NA score. Importantly, the separation of PA and NA allows for simultaneous assessment in analyses (Pressman, Jenkins, & Moskowitz, 2019). Examples of PA items include “interested”, “strong”, and “excited”. Examples of NA items include “distressed”, “guilty”, and “scared”. Items are all considered examples of pleasure and “high arousal” PA which was important given the associations between high arousal PA and various health outcomes (Petrie et al., 2018; Shirom et al., 2010).

The PANAS is a widely used measure that has seen extended use in previous health research; consider, for example, recent investigations into PA and markers of inflammation (Stellar, John-Henderson, Anderson, Gordon, McNeil, & Keltner, 2015), PA and health behaviours in patients with coronary heart disease (Sin, Moskowitz, & Whooley, 2015) or self-compassion and health promotion (Sirois, Kitner, & Hirsch, 2015). Reliability and validity, as reported by Watson and colleagues (1988), was good, which may explain part of the questionnaire’s popularity. For the PA scale, the Cronbach alpha coefficient was between 0.86 and 0.90; for the NA scale, 0.84 and 0.87. Over an 8-week time period, the test-retest correlations were between 0.47 and 0.68 for PA, and 0.39 and 0.71 for NA. The PANAS has strong reported validity with measures of general distress, dysfunction, depression, and state anxiety in particular (Watson, Clarke, & Tellegen, 1988).

The PANAS was used across most studies (1, 2, and 5) to assess whether BPS influenced PA and/or NA. Cronbach’s alpha was calculated individually for each study.

<u>Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983)</u>

The HADS is a similar questionnaire to the PANAS in that it provides two distinct scores (a depression and an anxiety score). The HADS allows participants to indicate how strongly they agree with statements about how they have felt over the past week. Half of the statements relate to anxiety symptoms and the other half relate to depression symptoms. Higher scores equal more symptoms. Examples of anxiety statements include: “I feel tense or ‘wound up’” and “I get a sort of frightened feeling as if something awful is about to happen”. Examples of depression statements include “I feel as if I am slowed down” and “I have lost interest in my appearance”.

The HADS too is a rigorous and well-researched instrument that is often employed in studies which require a measure of anxiety and/or depression symptoms. In diabetes research alone, the HADS has seen use in research around anxiety and depression’s relationship with healthcare visits (Emre, Topal, Edirne, & Gereklioğlu, 2018), diabetes-related eye complications (Rees et al., 2016), and even with HbA1c (Camara, Balde, Enoro, Bangoura, Sobngwi, & Bonnet, 2015). In terms of reliability, a literature review of 747 papers concluded that the HADS performed well in assessing symptom severity and caseness of anxiety disorders and depression in somatic, psychiatric, and primary care patients as well as in the general population (Bjelland, Dahl, Haug, & Neckelmann, 2002). In that literature review, cronbach’s alpha for the anxiety subscale ranged from 0.68 to 0.93 and 0.67 to 0.90 for the depression subscale (Bjelland et al., 2002).

The HADS questionnaire was used exclusively in Study 1 to assess potential BPS effects on psychopathology. Cronbach’s alpha scores are provided in the methods section of that study’s chapter (see section 5.2.3).

<u>The Diabetes Self-Management Question (DSMQ; Schmitt, Gahr, Hermanns, Kulzer, Huber, & Haak, 2013)</u>

The DSMQ is a 16-item questionnaire designed to assess self-care activities associated with glycaemic control. It includes four subscales, one stand-alone question about perceptions of general self-care, and a sum scale. The subscales are: ‘glucose management’ (“I check my blood sugar levels with care and attention”);

‘dietary control’ (“The food I chose to eat makes it easy to achieve optimal blood sugar levels”); ‘physical activity’ (“I do regular physical activity to achieve optimal blood sugar levels”); and ‘health-care use’ (“I keep all doctors’ appointments recommended for my diabetes treatment”). Each questionnaire item is posed as a statement that participants had to agree/disagree with using a four-point Likert scale (a neutral response was excluded so as to force a specific leaning one way or the other). Respondents are asked to rate the extent to which each statement applies to their self-management over the previous eight weeks. This scale was developed and validated for use by people with T1D and T2D.

The DSMQ is a relatively recently developed measure, though it has shown to be more reliable than comparable scales (notably the Summary of Diabetes Self-Cares Activities Measures; Schmitt et al., 2013). Overall internal consistency had a mean Cronbach’s Alpha of 0.84 while subscales averages ranged from 0.60 (Health-Care Use) to 0.77 (Dietary Control) when it was tested by the original authors (Schmitt et al., 2013).

The DSMQ was only used in Study 1. It did not appear appropriate to use it with a non-clinical sample, given the nature of some of its questionnaires (especially on those around HbA1c). Reliability would have been at-risk, although some sub-scales (Dietary Control and Physical Activity, for example) may have shown to be more valid than others.

<u>Canadian Diabetes Risk Questionnaire (CANRISK; Robinson, Agarwal, & Nerenberg, 2011)</u>

Diabetes risk was often considered in terms of how it interacted with other outcomes. Total scores determined whether someone was low risk (<21), moderate risk (21-32) or high risk (>32). Most items asked questions about demographics to calculate risk (age, gender, Body Mass Index, waist circumference, ethnicity, etc.) while others enquired about behaviours (“how often do you eat vegetables or fruits?"), previous medical history ("have you ever been told by a doctor or nurse that you have high blood pressure?") and family history of the illness. Although this scale is targeted primarily at adults aged 40 to 74 years, it can also be used for younger age groups (Rowan et al. 2014). The questionnaire is a variation of an instrument used in Finland for its national diabetes prevention program (FINDRISC).

Reliability has not been assessed for this questionnaire using Cronbach's Alpha. Instead, Robinson and colleagues (2011) used Area under the Curve (AUC) summary statistics from Receiver Operating Character (ROC) analyses to compare CANRISK with other risk-scoring models. The AUC scores for electronic and paper-based versions of the questionnaire were 0.75 (95% CI: 0.73 – 0.78) and 0.75 (95% CI: 0.73 – 0.78) respectively, as compared with 0.66 (95% CI: 0.63 – 0.69) for the Finnish alternative. Consequently, the reliability of this measure was not assessed each time it was applied as part of this thesis.

The CANRISK questionnaire was used in Studies 2, 4, and 5 to assess participants' risk of T2D. Risk was often calculated as an interaction effect to ascertain whether risk influenced the intervention's effectiveness.

<u>Diabetes Symptoms Checklist-Revised (DSC-R; Arbuckle, Humphrey, Vardeva, Arondekar, Danten-Viala, Scott, & Snoek, 2009)</u>

The DSC-R is used to assess diabetes symptoms distress. Respondents are asked to reflect on whether they experienced symptoms in the past month and to what extent this caused them distress (on a scale of 5 items from "not at all" to "extremely"). The 34 DSC-R items are grouped into eight clusters of symptoms, each measuring different aspects of diabetes symptomatology and scored accordingly. The clusters are: 'psychological-fatigue' ("Lack of energy?"), 'psychological cognitive' ("Difficult concentrating?"), 'neuropathic-sensory' ("Numbness in feet?"), 'neuropathic-pain' ("Burning pain in the calves at night?"), 'ophthalmological' ("Persistently blurred vision even with glasses on?"), 'cardiac' ("shortness of breath during exercise?”), ‘hyperglycaemic’ (“Very thirsty?”), and ‘hypoglycaemic’ (“Moodiness?). Reliability ranged from alphas of 0.69 to 0.87. The cardiac symptom cluster rated lowest, reflecting the fact that most participants stated that cardiac symptoms did not occur (Arbuckle et al., 2009), perhaps because cardiovascular issues represent more of a co-morbidity than a symptom per se (Rawshani et al., 2017).

The DSC-R was used in Studies 2, 4, and 5.

Perceived Stress Scale (PSS; Cohen & Williamson, 1988)

The PSS is a questionnaire used for measuring perceived stress; i.e. a measure of the degree to which situations in one’s life are appraised as stressful. Three versions of the PSS exist including a 14 item, a 10 item, and a 4 item version. The 10 item version was used for this thesis because it was the most popular version. The 10 questions that make up this scale ask respondents to indicate how often they felt a certain way over the last month using a 5 point Likert scale. Examples of questions include “how often have you been upset because of something that happened unexpectedly?” and “how often have you felt confident about your ability to handle your personal problems?” A total score is used to assess overall perceived stress.

The 10 item version was also chosen because it was the most reliable. In a review of PSS versions, the PSS-10 (as it was referred to there) had a Cronbach’s Alpha of >.70 in all 12 studies in which it was utilised. In comparison, the PSS-14 only achieved an Alpha of > .70 in 11 studies, and the PSS-4 achieved a score of < .70 in half of the studies (6) that it was utilised (Lee, 2012).

The PSS was used in Studies 4 and 5, where potential stress-buffering effects were being scrutinised.

Six-Item Brief Resilience Scale (6BRS; Smith, Dalen, Wiggins, Tooley, Christopher, & Bernard, 2008)

The 6BRS is a brief questionnaire designed to assess trait resilience. Respondents are asked to what extent they agree or disagree with several statements using another 5-point Likert scale. Examples of items include “I tend to bounce back quickly after hard times” and “I usually come through difficult times with little stress”. A higher total score is equivalent to high trait resilience.

During its development, the 6BRS was administered to four samples. Cronbach’s alpha was particularly high, ranging from 0.80 to 0.91. The scale was also administered a second time to two of the samples, and test-retest reliability was 0.69 for one month in 48 participants from sample 2, and 0.62 for three months in 61 participants from sample 3 (Smith et al., 2008).

The 6BRS was used exclusively in study 4.

4.3.3 Qualitative Methods

Qualitative research is becoming increasingly recognised and valued, so it is vital that it is conducted in a rigorous and methodical way (Attride-Stirling, 2001). There is a need, therefore, for transparency and communication of methodology here that facilitates trustworthy qualitative research (Nowell, Norris, White, & Moules, 2017), beginning with a description of the types of analysis ran.

Thematic Analysis

Thematic Analysis (TA) was used to analyse all qualitative data detailed in this thesis. TA is a method for identifying, analysing, and reporting patterns or themes within a qualitative data set (Braun & Clarke, 2014). Themes are defined under this approach as a pattern of shared meaning underpinned by a central concept or idea. Unlike other methodologies, TA is not bound to any pre-existing frameworks, although it can be fitted around frameworks that are appropriate for the context. This makes it a flexible analytical approach, allowing the data to be approached with fewer assumptions. However, these assumptions (and slight differences in one's approach) still need to be clearly stated. Although the data contained within Studies 1 and 2 could have been approached with theory in mind, it was felt that, given the paucity of qualitative research on the BPS, more could be learnt by approaching the data with fewer preconceptions.

There are multiple ways of running TA, so it is important to be clear in one's approach, and Study 3 utilised a reflexive thematic analysis (Braun & Clarke, 2013) specifically which can be used to answer a variety of different research questions. Braun, Clarke, and colleagues (2019) suggested that this version of TA is suited to questions related to people's experiences, views, and perceptions; to understanding and representation; and to the construction of meaning. In some ways, this version of TA has some cross-over with Interpretative Phenomenological Analysis (IPA). IPA aims to explore how participants make sense of their personal and social world in a detailed manner such that the data generated focuses on the meanings that particular experiences, events, and states hold for participants (Smith & Osborn, 2004). Indeed, it was important that personal experiences were taken seriously, but IPA was rejected in favour of TA because the BPS (the object) was also a significant focus. This is particularly true for Study 1, where the BPS was front and centre, but also for Study 3 were personal experiences were slightly more important. If the research question had asked solely about the individual's health, then IPA would have been utilised in Study 3, but there always needed to be that focus on how the individual's experience fit in within the context of the intervention.

Different question types naturally require slightly different approaches, and reflexive TA offers a variety of orientations (i.e. options for how the researcher may code and develop themes) to consider. Studies 1 and 3, for example, required different orientations and the decisions made are adequately detailed in their respective chapters (see sections 5.2.4 and 7.2.1, specifically). However, see below for the full list of options that reflexive TA offers. In each bracket, a decision needs to be made to use one approach or the other. In other words, the approach can be conducted in:

- An inductive way – where codes and themes are directed by the content of the data
    - OR
- A deductive way – where codes and themes are directed by existing concepts or ideas,

- A semantic way – where codes and themes reflect the explicit content of the data
    - OR
- A latent way – where codes and themes report concepts and assumptions underpinning the data,

- A critical realist or essential way – focusing on reporting an assumed reality evident in the data
    - OR
- A constructionist way – focusing on examining how a certain reality is created by the data.

Typically, inductive, semantic, and critical realist approaches tend to cluster together in the same sense that deductive, latent, and constructions ones do but, realistically, any combination is possible. The important thing is to reflect on which style suits the research question best and to decide upon an orientation before analysing the data. Choices also need to be transparent so that readers can follow the author's process, allowing for criticism and replication if necessary.

The process of reflexive TA involves six phases for analysis. Phases are sequential, and each builds on the previous one. However, analysis is also recursive, and so there is often movement back and forth across phases in order to better understand the data. The phases are:

1. Familiarisation with the data – reading and re-reading the data to become immersed and intimately familiar with its content.
2. Coding – generating codes (i.e. labels) that identify important features of the data that may be relevant to the research question. Coding is done across the entire data set and needs to be collated for later stages of analysis.
3. Generating initial themes – examining codes and collated data to identify broader patterns of meaning (candidate themes).
4. Reviewing themes – checking candidate themes against the dataset to determine whether they tell a convincing story of the data while providing an answer to the research question. Themes are typically refined here, with some being split, combined, or discarded.
5. Defining and naming themes – developing a detailed analysis of each theme, working out the scope, focus, and name of each theme so as to determine its 'story'.
6. Writing up – contextualising the analysis in relation to existing literature.

A recursive process, therefore, may involve the researcher reviewing themes, for example, only to have to go back to generating candidate themes or perhaps even further to reviewing codes and generating new labels.

4.3.4 Qualitative Reflections

Regardless of the method of analysis used, Yardley (2000) argues that one must adhere to the four characteristics of good qualitative research:

- Sensitivity to context (including theory, relevant literature, empirical data, sociocultural setting, participants' perspectives, and ethical issues)
- Commitment and rigour (there needs to be in-depth engagement with the topic, methodological competence/skill, thorough data collection, and depth/breadth of analysis
- Transparency and coherence (there should be clarity and power of description and arguments, transparent methods and data protection, fit between theory and method, and evidence of reflexivity)
- Impact and importance (the produced work should enrich understanding of the subject and produce implications for the socio-cultural and practical context the research belongs to; for example, the work should be applicable for the community, health workers, or policymakers).

Although TA allows the data to be approached with fewer assumptions than if themes had been shaped using theory, researchers must still try their best to be cognizant of their own explicit and implicit biases when analysing the data. Early research used to describe themes as "emerging" from the data, but this rejects the critical role that the researcher plays (Braun & Clarke, 2014). Indeed, this language would suggest that anyone could look at the data and code it in the exact same manner, regardless of their personal experience. Although one would like to believe that the same (or at least very similar) conclusions can be drawn by multiple analysists, it would be naïve to assume that everyone interprets data in exactly the same way. In the past, there has been debate as to the validity of qualitative methods as a "scientific" approach, so hopes that themes could be simply drawn out of the data may have represented a misguided attempt to position the likes of TA alongside more "objective" methodologies (Braun & Clarke, 2014). However, this insecurity sells these approaches short; pure objective reductionism does not account for the spectrum of human experience. Instead, researchers need to be honest about their own contributions (conscious or otherwise) in order to provide transparency so that later work can reflect and act upon it if it must. Understanding that themes do not emerge, in fact, allows researchers to do better science (Braun & Clarke, 2014).

Usually, researchers have the opportunity to describe their procedure in detail when they get their work published. With TA, the recommendations are that researchers go one-step further and use this chance to also describe their orientations, as outlined above. Alternatively, though less commonly, researchers can also publish a series of reflections that provide an insight into how their own experiences shaped their analysis (see, for example, Nowell et al., 2017). There is also a unique opportunity to share insights when one conducts, for example, a qualitative or mixed methods thesis. An honest and frank discussion around some of the things that may have influenced the data collection and coding contained within this thesis are shared below:

<u>PhD student's reflections of bias:</u>

Admittedly, I had had little contact with people with T1D and T2D prior to starting the PhD. I had a rudimentary understanding of diabetes and its influence on emotion (and I do not mean to suggest that the subject was completely alien to me), but I had no first-hand experience of the way it affected peoples' lives. Therefore, when it came to conducting one-to-one interviews and a focus group, I was a little unsure as to what to expect. I wanted to be sensitive to people's needs; not least because participants would see me as a "psychologist". Fortunately, I had my supervisory team as support, and my DoS was present when I conducted the focus group. However, there was an adjustment period, and when I first started collecting the data, I was concerned with looking inexperienced. In one of my first interviews, this actually led to a misunderstanding when I struggled to communicate information in a confident manner. However, this was swiftly resolved, and I quickly learned a lot about people's experiences. My fears were shown to either be unfounded or the anxiety I was feeling meant that I put more effort into listening closely. Sharing these thoughts and feelings with the supervisory team also helped to ease my nerves as they were able to offer practical guidance and advice.

In fact, there may have been some benefits to conducting that first study with less knowledge. I had fewer preconceptions and, potentially, fewer biases when addressing participants and coding their data. It felt like I approached my themes with more of an open mind and that I could code ideas based purely on what participants had told me without worrying about preconceived notions of how someone "should" speak about their diabetes. Of course, my personal impressions of the individual may have also influenced my coding, especially in the cases of the one-to-one interviews where I had the chance to develop a rapport with the participants. It would be easy to worry about negative relationships impacting the quality and validity of the coding process, but one should also be aware that positive relationships may have introduced its own skew to the analytical process. It might have been easy to miss a critical remark of the BPS, for example, if the participant and I got along well, and I felt that they had been mostly positive about the intervention. Having members of the supervisory team double-check codes and themes helped mitigate this, however.

One thing I was particularly concerned about in the beginning was how participants would react to the intervention. Naturally, it was my first study, and I had no other results to influence my thinking or my confidence. I had very few preconceived notions of how a person with T1D or T2D would react to something like the 'best possible self', although I was secretly worried that no one would be interested. After all, a "writing exercise" may sound suspiciously like homework to some people which I felt would be off-putting. I needed people to find the BPS acceptable so that I could use it in future studies and, to be honest, my professional pride may have been somewhat injured if people disliked the intervention I had picked out for this purpose. However, going into my first interview, I reminded myself that the intervention could have been swapped out if there was a real objection to it. This was not the case, however, and these fears were immediately put to rest when the first participant did not scream and shout at me for subjecting them to the BPS. Going forward, I was a lot more relaxed even when participants were not interested in using the intervention.

Data collection and analysis for Study 3 was a very different experience compared to Study 1. Firstly, there was no opportunity to speak to participants about their 'best possible selves'; instead, participants provided me with examples of what they had written about. As such, there was no opportunity to develop rapport or otherwise get an impression of the individual. Again, there are advantages to this approach in that it removes any social influence they may have over me, and the analysis may have been more clinical. This was important because I wanted a more quantifiable idea of what recipients were getting out of the intervention. It did mean though that I had less background and therefore, less context. This may have influenced coding as the individual's story was missing a lot of background even though it gave a good idea of how people used the intervention. However, I was aware that this was a likely scenario before I even collected data, so I made sure to approach the data with a lack of context in mind. Hopefully, this is reflected in the orientation I took.

My approach to Study 3 was also different in that, by now, I had a lot more knowledge about diabetes care and how the intervention was working in this context. It was a different population group, but I doubt this would have affected my coding. I may have been more confident in my interviewing technique had that been the method I used, but as I conducted a textual analysis, the existing knowledge had no impact on the data. However, by this point in my PhD journey, I had expectations about the BPS that I did not have at the start. Consequently, I found myself feeling surprised by how people engaged with the intervention and what they said as well as some of the themes that I developed. This was in contrast to how I felt going through Study 1 data, where I felt more neutral about the results. Again, I tried not to let this influence the coding process, but I may have coded some things initially that conformed more to my expectations. Again, this was where consulting with the supervisory team and having them double-check my codes and themes really helped.

Ultimately, the researcher's job is to develop themes in order to tell a story that accurately reflects the participants' lived experiences. It is crucial then that the researcher does this in such a way that the account is clear and cohesive and therefore, open to scrutiny. Having an expert support team with a variety of backgrounds around may also help to challenge the principal investigator's anxiety, preconceptions, and interpretations. Some further reflections are provided within the discussion chapter (Chapter 10).

4.3.5 Ensuring Data Quality

Power Calculations

"Power" refers to the likelihood that a study will correctly detect an effect when there is an effect to be found. The higher a study's power the less likely it it is to commit a Type II error (i.e. conclude there is no effect when there is one) (Cohen, 1992). In order to increase a study's chance of achieving power, it can be helpful to ensure one has an appropriate sample size. Therefore, prior to to any quantitative analysis (and even quantitative data collection), *a priori* G power calculations were conducted throughout this PhD to establish approximate sample sizes necessary for statistical power (with the exception of Study 1, where BPS feasibility was the priority). Effect sizes can also be used to establish power during analysis itself by determining the magnitude of the observed difference between groups (Sullivan & Feinn, 2012). Partial eta squared (written as ηp2) is often used to calculate effect size, and different scores denoting different effect sizes (Levine & Hullett, 2002). A score of 0.02 for example, corresponds with a small effect size, 0.13 with a medium effect size, and 0.26 with a large effect size. The larger the effect size, the more easily observable the effect that has been found (making it again even less likely that a Type II error occured.

Please note that effect sizes are only calculated for MANOVA and repeated measure analyses. Effect sizes are not available for mediation due to mathematical issues with the model (Wen & Fan, 2015).

<u>Sample Saturation</u>

In qualitative research, calculations cannot be used to assess when enough data has been collected to ensure validity. Instead, qualitative researchers often aim for "saturation" whereby the depth and breadth of the information gathered is deemed sufficient to be representative of participants' views (Bowen, 2008). Data saturation cannot be estimated and is hard to define; what is saturation for one study is not necessarily enough for another (Fusch & Ness, 2015). Instead, researchers must be prepared to continue collecting data until there is enough information to replicate the study (O'Reilly & Parker, 2012), when new information is no longer being attained (Guest, Bunce, & Johnson, 2006), and when further coding is no longer possible (Guest et al., 2006). Consequently, it was important to bear these challenges mind when approaching Studies 1 and 3.

4.3.6 Ethics

Finally, a note on ethics. All research contained within this thesis was approved by the LJMU Research Ethics Committee (REC). Details of ethical approval (including reference numbers) are outlined in the methods section of each research chapter. In line with ethics, anyone interested in taking part were provided with a participant information sheet, and they all had to sign consent before their involvement in the study could begin. No participants were coerced into taking part. Studies 2-5 all went through proportionate review as they were deemed to present lower levels of risk and/or potential harm to participants. Study 1 was the only exception to this, and that went through a full review because people with T1D and T2D were considered a potentially vulnerable population. To ensure participants were properly protected, they were made aware of independent resources, including in-house counselling services and the details of the ethics team should they wish to report an issue. All Study 1 participants were likewise told to contact their health care team or their local hospital if they had any health concerns over the course of their involvement. In the case of qualitative studies, all participant data was anonymised under pseudonyms. Quotes were only ever attributed to the first letter of their pseudonym and their participant number (e.g. K7).

An application to NHS ethics was also considered for Study 2 had the results of Study 1 provided the impetus for a larger-scale follow-up. In fact, NHS ethics would have been necessary in order to obtain an appropriate sample size of people with T1D and/or T2D. However, the results of Study 1 encouraged a different direction.

4.4 Research Chapters

With the research outlined and the methods outlined, the next five chapters will go over the research undertaken as part of this thesis. Following that, Chapter 10 reflects on the findings and considered the relevance to previous literature and theory before discussing what comes next for research into PPIs for people with T1D and T2D as well as for those at risk of T2D.

Chapter 5: Study 1 - Efficacy of the Best Possible Self Protocol for Managing the Emotional Aspects of Diabetes Self-management: A Sequential Exploratory Mixed-Methods Approach

This study has been published (though rewritten for this chapter to better fit the thesis' narrative). Please see:

Gibson, B., Umeh, K. F., Newson, L., & Davies, I. (2018). Efficacy of the Best Possible Self protocol in diabetes self-management: A mixed-methods approach. Journal of Health Psychology. DOI: 1359105318814148.

<u>What Does This Study Contribute to Existing Knowledge?</u>

- This piece of research adds to the growing list of exploratory studies investigating positive psychological interventions for people with T1D/T2D.
- It was the first of these exploratory studies to use a mixed-methods approach to assess acceptability and feasibility of a PPI and was the first to get qualitative feedback from a sample of participants with T1D and T2D to help build/adapt the intervention.
- It was also the first to demonstrate the efficacy of the 'best possible self' PPI in the context of diabetes self-management.
- Specifically, this study suggests that the BPS is equally effective for people with T1D and T2D, despite being disparate populations, possibly because of its non-prescriptive nature.

- This study also highlights why further follow-up is necessary, as there is still a lot to be learnt about facilitation of PA in this context.

Abstract

Objectives: Previous research has demonstrated that PA may facilitate illness self-management. This study used a sequential exploratory mixed-methods typology to assess whether a task designed to boost PA (the BPS) could improve aspects of diabetes self-management.

Research Design and Methods: A qualitative investigation explored the views of people with T1D and T2D (n= 20) regarding the acceptance of the BPS. This was followed by a subsequent quantitative investigation that assigned people with T1D and T2D (n= 50) to a BPS or non-BPS condition and assessed changes in PA, NA, mental illness symptoms, and self-management behaviours over a four week period.

Results: Qualitative analysis produced four main themes including (1) Illness Ownership, (2) Advocating a Personal Approach, (3) Barriers & Facilitators, and (4) Real-world Context which detailed participants' experiences as well as their thoughts regarding the implementation of the intervention into their lives. The quantitative results demonstrated that the BPS significantly improved perceptions of self-management after four weeks in comparison to a control group. However, there was no significant differences in actual behaviours or PA scores between conditions.

Conclusions: Qualitative findings indicated that individuals were receptive to the BPS, while quantitative findings demonstrated that the intervention provided benefits towards perceptions of diabetes self-care. However, further investigation into the underlying affective mechanisms are warranted before widespread administration of the BPS to people with T1D and T2D.

5.1 Introduction

Diabetes self-management is an imperative set of skills for people with T1D and T2D, and a common theme between the two typologies include considerable lifestyle modification (e.g., being active, healthy eating, adhering to medication, etc.; Chen et al., 2013). Effective self-management of both T1D and T2D can be challenging, but it can be made harder when the individual experiences NA and/or co-morbid mental illness. Ensuring optimal self-management is key to decreasing the likelihood of diabetes-related morbidities such as cardiovascular problems, neuropathy, and kidney damage (American Diabetes Association, 2017) but elevated levels of psychological variables such as depression, anxiety, and NA have all shown to disrupt this process (Powers et al., 2017; Skaff et al., 2009). Such psychological variables are therefore associated with poorer clinical markers (including HbA1c; an indicator of blood glucose levels over the previous 2-3 months), indicating an increased risk of morbidity and mortality (Strandberg et al., 2014).

PPIs (interventions designed specifically to facilitate PA) have shown to be an effective form of psychological intervention for this context (Cohn et al., 2014; Jaser et al., 2014; Tran et al., 2011). PPIs are an effective alternative to traditional therapies such as CBT as they have shown to produce mental and physical health benefits to people regardless of their mental health status (Maddalena et al., 2014). Despite the novelty of the research, a small number of studies have shown that PPIs provide benefits for people with T1D and T2D including reduced NA and co-morbid mental health symptoms (Cohn et al., 2014; Tran et al., 2011) , as well as increases in self-reported self-management behaviours (Jaser et al., 2014). The BPS intervention, although never before utilised in the context of diabetes self-management, may be a particularly effective PPI for this population because it can be more easily tailored for context (Layous et al., 2013) and has shown to consistently facilitate PA across 18 years of study (King, 2001; Peters et al., 2010; Renner et al., 2014; Sheldon & Lyubomirsky, 2006). Furthermore, by encouraging people to write about a future where they have accomplished their life goals (King, 2001), the BPS has shown to reduce depression (Shapira & Mongrain, 2010), illness symptoms (Sin & Lyubomirsky, 2009), and the number of medical visits the individual makes to GPs and hospitals over time (Austenfeld et al., 2006; Austenfeld & Stanton, 2008; King, 2001).

This study, being the first in the thesis, aimed to get a broad idea of the BPS' impact on a range of diabetes-related outcomes while being mindful of potential adaption for future work. Existing diabetes PPI research is made up primarily of pilot and feasibility studies, so it was important that the portfolio of research contained in this thesis set out in the same way, especially as the BPS has not been used before in this context. It was unclear by looking at the literature whether the BPS would be more effective for people with T1D and T2D, so both (though disparate) populations were approached to begin with. A sequential mixed-methods approach, using a qualitative phase followed by a quantitative phase, was therefore adopted for this study with the qualitative and quantitative investigations addressing the following questions respectively:

1) "is the BPS acceptable to people with T1D and T2D?"
2) "is the BPS a feasible PPI for people with T1D and T2D?"

A mixed-methods approach was utilised also because it offered greater breadth and depth of understanding regarding the utility of the BPS as an aid for diabetes self-management, specifically by seeking to ascertain research triangulation in the findings (Bishop, 2015 but see also Chapter 4, section 4.1). The qualitative aspect of this study, in particular, would allow for a deeper investigation than previous diabetes PPI research by getting an idea of how well fitted the intervention was for this population. Acceptance is important for uptake of any intervention (Sheldon & Lyubomirsky, 2006), but this is especially important for PPIs because PA needs to be sustained if it is to achieve long-term benefits (Lyubomirsky, Sheldon, & Schkade, 2005). Indeed, a core tenet in most PA theory states that PA achieves its effects primarily as a result of built social, intellectual, physical, and psychological resources over time (Fredrickson, 2001; Pressman & Cohen, 2005; Van Cappellen, Rice, Catalino, & Fredrickson, 2017). Given this, it was expected that the BPS (if acceptable to people with T1D and/or T2D) would facilitate PA over time to reduce

NA and co-morbid mental illness symptoms to produce an increased uptake of self-management behaviours. Previous BPS research has frequently used four weeks as a follow-up period (Layous, Nelson, & Lyubomirsky, 2013; Sheldon & Lyubomirksy, 2006), so the same time-frame was adopted here. If there was sufficient evidence of built resources, then a long-term follow-up could take place to examine further-reaching health benefits (potentially including HbA1c).

The hypotheses for the quantitative phase, therefore, were as follows:

- The BPS will significantly facilitate diabetes self-management over a period of 4 weeks
- The BPS will achieve this by significantly increasing PA, reducing NA, and/or reducing symptoms of anxiety and/or depression

5.2 Methodology

5.2.1 Study sample and Recruitment

The study was advertised using social media (Twitter, Facebook, etc.) and through listings on the National Institute for Health Research's (NIHR) patient and public involvement website (https://www.invo.org.uk/). Recruitment was aided by the help of multiple diabetes support groups in the North West of England affiliated with Diabetes UK, a British-based charity that supports people with diabetes and health professionals across the country (Diabetes UK, 2009). The qualitative study consisted of 12 telephone interviews and one focus group session (November 2016 – March 2017) and involved 20 participants in total. The quantitative phase took the form of an exploratory study with a sample of 50 participants (March 2017 – January 2018). Ethical approval for the study was obtained from the Liverpool John Moores University Research Ethics Committee (UREC, reference: 16/NSP/062). All participants were presented with detailed participant information that described the nature of the study and listed contact information for local counselling services. Participants were required to indicate consent prior to participation. There was no monetary incentive for completing the study.

5.2.2 Qualitative data collection

Both one-to-one interviews and a focus group were utilised in this phase of the study to obtain further data source triangulation. Triangulation is a method of assuring validity through the use of complementary methods to collect data on the same topic (Carter, Bryant-Lukosius, DiCenso, Blythe, & Neville, 2014). The purpose of triangulation is not necessarily to cross-validate data but to capture different dimensions of the same phenomenon. For example, in comparison to interviews, sensitive and personal disclosures are more likely to occur in a focus group setting (Guest, Namey, Taylor, Eley, & McKenna, 2017) possibly as a result of connectedness with other participants and a sense of anonymity amongst the group.

Interviews. Interviews were conducted first. After each interviewee (n = 12) agreed to take part, the lead researcher (BG; i.e. the author) provided a copy of the one-page 'tailored-for-diabetes' version of the BPS via email ('best possible Hba1c'; first detailed in Chapter 2, section 2.3, and also available in Appendix 1), reproduced below:

> "Please take a moment to think about your best possible HbA1c level. Imagine that your blood sugar levels have been very well controlled. It might be because you had been feeling more optimistic of late or you had been able to better deal with setbacks in relation to your diabetes management. Think of this as the realisation of the best possible HbA1c level you could hope for yourself.
>
> Now, please use the next 10 minutes to write continuously about what you imagined about your HbA1c level. Use the instructions below to help guide you through this process:
>
> 1. Be as creative and imaginative as you want (don't worry, what you write is for your use only; no one else will ever see it). Do not worry about perfect grammar and spelling.

2. Use whatever writing style you please just remember to imagine your ideal HbA1c level in the FUTURE.

3. However, you may find it helpful to activate your senses, feelings, and perceptions to make a personal story of your ideal HbA1c level. Really visualising your best possible HbA1c will make it feel more personal to you and may inspire confidence."

All interviewees were then asked several open-ended questions:

- Does the intervention make sense? (Is it clear what you have to do? Are there any words you do not understand?)
- Would you be happy to use this exercise? (And if so, how often? Daily? Weekly? Monthly? For how long a period?)
- Is there anything that might get in the way of you doing this? (Time, for example? Or periods of ill-health?)
- For context, how do you feel when you receive HbA1c results?
- Would you like to make any other comments or criticisms? (Is there anything we might have missed?)

Although the interview schedule was not adapted from previous work, it was designed (with help from the research team) to assess comprehension, engagement, and context while leaving the conversation open enough for individuals to add their own comments or criticisms. Participants were encouraged to be honest and to talk freely about their experiences while the interviewer adopted the role of reflective listener. Interviews lasted 21 minutes on average. Saturation was achieved by reaching "sample adequacy" whereby the depth and breadth of the information gathered was deemed sufficient to be representative of participants' views (Bowen, 2008). Common themes were discernible by the seventh interview, whereby it became harder to develop new themes. Full saturation was considered to have had occurred by the twelfth.

Focus group. This event was conducted during a diabetes support group session in a facility community setting. Participants constituted a convenience sample (n = 8); anyone present at the meeting was eligible and invited to participate. The session began with a 10-15 minute PowerPoint presentation by two of the researchers (BG & KU, the Director of Studies) as part of an agreement with the support group (the researchers provide information to the group regarding psychological support, and in turn the researchers can use the remainder of the session to collect data). A copy of the tailored-for-diabetes BPS variant (as used for the interviews, described above) was then presented on the final slide of the presentation. The researchers gave a brief description of the nature and purpose of the study, after which group members were invited to share their thoughts about the intervention and its relevance to diabetes self-management. During these discussions, the group were asked the same open-ended questions used during the interviews. The entire session lasted approximately 1 hour and 30 minutes and was recorded on a digital recorder, same as the interviews.

5.2.3 Quantitative data collection

The quantitative study was hosted on the online platform Qualtrics once the qualitative phase was over (i.e. data was collected and analysed). Interested individuals were provided with a URL link, whereupon they viewed participant information, describing the nature of the study. They were informed that their involvement in the study would last for four weeks. Consenting individuals were then randomly assigned to either a BPS or Waiting List Control (non-BPS) condition using Qualtrics' inbuilt 'randomizer' function. The BPS group were subsequently presented with a further amended version of the tailored-for-diabetes BPS that incorporated feedback from the qualitative phase (see below and note the additional steps and changes to language; see also Appendix 1 which details changes more closely) while the control group were informed that they would receive the BPS at the end of the four week study period:

> "Take a moment to think about your best possible HbA1c level. Imagine that your blood sugar levels have been very well controlled and that you have resolved some of the issues currently concerning you. Imagine how it felt to achieve those levels and reflect on how positive it would feel to have more control. Then, tell yourself the important things you realised or the critical steps you took to get there. Think of this as the realisation of your best possible HbA1c level.
>
> Now, please use the next 10 minutes to write continuously about what you imagined. Use the tips below to help guide you through this process:
>
> 1) Be as creative and imaginative as you want. Do not worry about perfect grammar and spelling as this is for your private use. No one has to know what you wrote down, though you may find it helpful to share and develop ideas with trusted friends, family, or even your health-care team.
>
> 2) Do not feel too pressured to write everything down on your first try. As you repeat this task, more ideas will come to you naturally.
>
> 3) Remember, steps are often small, even the critical ones. There likely won't be one big fix. You may find it easier to write about more achievable things to start with, such as investing in a pedometer/walking app or making a decision to try different recipes more often. However, if you want to write about running a half-marathon, that's okay too!
>
> 4) If you find thinking about HbA1c too abstract, try focusing on another aspect of your self-management. The important thing is to focus on something long-term so that you can make more noticeable improvements to your health."

Both groups then completed questionnaires (Time 1; T1) assessing affect (frequency of PA and NA) and psychopathology (symptoms of depression and anxiety) using the Positive and Negative Affect Schedule (PANAS; Crawford & Henry, 2004) and the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983), respectively. Participants were then told they would be contacted four weeks later (Time 2; T2) to repeat the questionnaires so that intervention effects could be assessed. Those in the BPS condition were told to use the intervening time to use the writing exercise as much as they found helpful. Upon returning, they also completed the Diabetes Self-Management Questionnaire (DSMQ; Schmitt et al., 2013), which was used to gauge the frequency of participant behaviours over the intermittent period between T1 and T2. The DSMQ consists of four subscales; 'Glucose Management' (5 items), 'Dietary Control' (4 items), 'Physical Activity' (3 items), and 'Health-Care Use' (3 items). One additional item assessed the individual's perceptions of their 'Self-Care' activity. Sub-scale scores were calculated individually, and a total overall DSMQ score was also calculated. Cronbach Alpha's for the HADS were 0.87 (anxiety), and 0.81 (depression) and ranged from 0.69 (Glucose Management) to 0.91 (Health Care Use) for the DSMQ.

5.2.4 Qualitative analysis

The primary researcher (BG) transcribed audio-recordings of the interviews and focus group session verbatim. The data were analysed using Thematic Analysis (TA; Clarke and Braun, 2014). In terms of orientation to the data, an inductive, semantic, and critical realist approach was taken (see Chapter 4, section 4.3.3, for more information on orientations). Transcripts were read and re-read by the same researcher (BG), in order to familiarise themselves with the breadth and depth of data. Initial codes were then generated systematically on a line-by-line basis. Codes were collated into a large number of candidate themes. These initial themes were reworked and constantly checked against the data until only a smaller set of main themes and sub-themes remained. The final themes were then written up as a series of draft result sections that were scrutinised and reworked by the research team. After key themes had been derived, the research team met to discuss and reflect on the analytical process. Final results, as well as various drafts of this chapter, were also discussed amongst the research team.

Candidate Themes			
Controlling the uncontrollable	The HbA1c test experience	NHS structure as regimented/ineffective	Personality as barrier/facilitator
The importance of personalised care	Clarity of intervention as key to success	HCPs as unknowledgeable/distrust of HCPS	Consideration of others
Pro-active people	Gender differences?	The importance of networks	The importance of good research
Promotion of awareness	Intervention as "clinical" and/or "prescriptive."	Potential harm	Intervention as useful for newly diagnosed
Intervention to promote discussion	Other's capabilities as barriers.	Consideration of alternatives to thinking about HbA1c	Intervention as "abstract."
Intervention as novel	Questions about implementation into care	Emotions-at-the-time as barrier/facilitator	Desire not to spend more time on diabetes as necessary
Motivation as crucial	Potential benefits	Intervention as personalised/intervention as generic	Reminders

[Table 5.1. Initial candidate themes. Candidate themes would be merged or otherwise broken down and reworked into larger main themes and sub-themes.]

5.2.5 *Quantitative analysis*

Given that the BPS is intended to work by facilitating PA and has shown to reduce mental health symptoms (Austenfeld et al., 2006; Sin & Lyubomirsky, 2009), the PROCESS SPSS dialogue (version 2.15; Hayes, 2013) was employed without any prior analysis to assess direct and indirect BPS effects. This would provide an understanding of the mechanisms by which the BPS was achieving these effects in this context. Specifically, the PROCESS dialogue was used to examine whether BPS exposure (at T1) improved diabetes self-management at follow-up (T2), and/or the aforementioned association was mediated by emotional factors (i.e. affect and psychopathology) (T1, T2). Thus, the BPS condition variable was entered into the equation as variable 'X' (i.e., Predictor), while each of the five diabetes self-management factors (DSMQ) were entered as variable 'Y' (i.e., Outcome). Emotional factors (PANAS/HADS) were entered as the 'M' variables (i.e., the mediators), with T1 and T2 emotions evaluated as mediators in separate models. Overall, each mediation model assessed three regression pathways; the effect of X on M ('path a'); the effect of M on Y ('path b'), and the effect of X on Y ('path c'). Mediation was deemed to have occurred if paths 'a' and 'b' (i.e., the 'indirect effect', or 'a*b') emerged as statistically significant. The number of bootstrap samples (for bias-corrected bootstrap confidence intervals) was set at 1000 with an alpha of $p < 0.05$. All analysis was performed using SPSS (version 23).

5.3 Results

5.3.1 Descriptive data

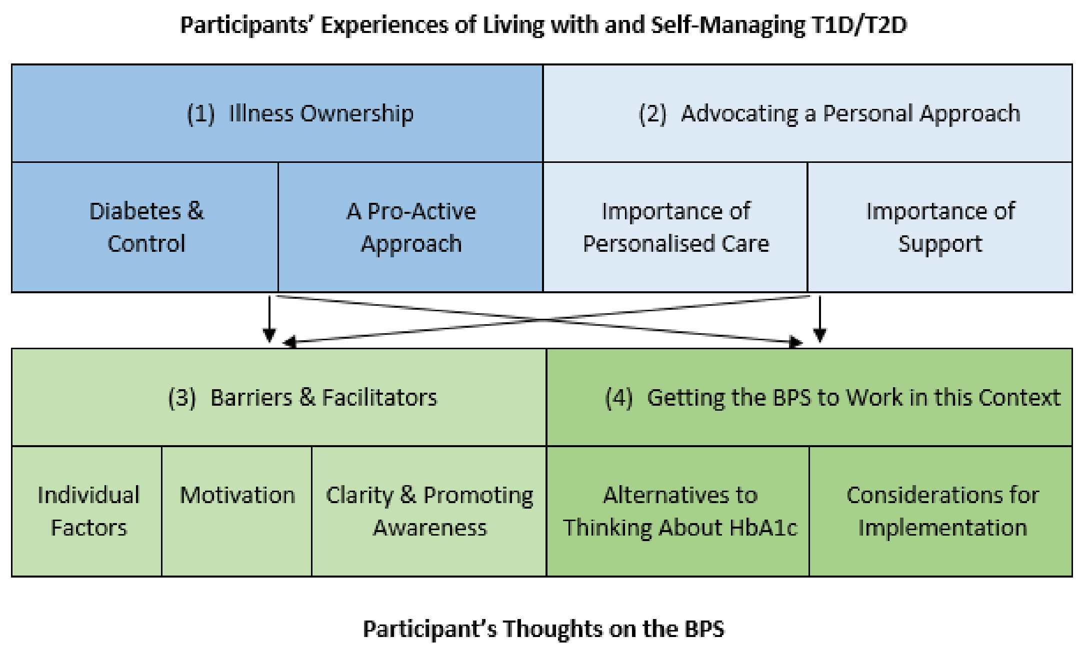
Table 5.2 shows participant characteristic data for the interviews, focus group, and exploratory study. Most of the interviewees and focus group participants had T2D. The distribution of T1D/T2D cases was more even for the exploratory participants, with just over half diagnosed with T1D. In the combined (qualitative and quantitative) sample, there was a 50-50 split between T1D and T2D cases. The average number of years since diagnosis for quantitative participants was just over 16 years, and a maximum value just exceeding 50 years. The sample was predominantly Caucasian (68%). At least 50% were UK nationals, with other nationalities stated as 'Australian', 'Caribbean', 'German/Dutch', and 'Irish'.

	Interviews	Focus Group	Quantitative Investigation	Combined
Age (mean/SD)	23-65 (based on six participants – the remainder did not state their exact age) (mean = 45.66, SD = 21.09)	40-70 (mean = 58.25, SD = 10.43)	20-76 (mean = 48.66, SD = 16.99)	20-76 (mean = 49.58, SD = 17.10)
Overall N recruited	12	8	50	70
Females/Males (N, %) Recruited	8 females (66.6%) and 4 males (33.33%)	5 females (62.5%) and 3 males (37.5%)	38 females (76%) and 12 males (24%)	51 (72.85%) females and 19 males (27.14%)
People w/ T1D recruited (N, %)	5 (41.66%)	2 (25%)	28 (56%)	35 (50%)
People w/ T2D recruited (N, %)	7 (58.33%)	6 (75%)	22 (44%)	35 (50%)

[Table 5.2. Participant characteristics by phase]

5.3.2 Qualitative findings

TA produced four main themes: (1) Illness Ownership, (2) Advocating a Personal Approach, (3) Barriers & Facilitators, and (4) Getting the BPS to Work in this Context. The main theme includes two sub-themes: 'Control and the Diabetes Experience' and 'Taking a Pro-Active Approach'. The second main theme comprised of the two sub-themes: 'The Importance of Personalised Care' and 'The Importance of Support'. The third main theme contained three sub-themes: 'Individual Factors', 'Motivation' and 'Clarity and Promoting Awareness'. The fourth, and final main theme consisted of the two sub-themes 'Alternatives to Thinking about HbA1c' and 'Considerations for Implementation'. Broadly speaking, themes either focused more specifically on the BPS or on the emotional aspects of HbA1c testing/diabetes self-management more generally. However, all themes helped aid a better understanding of the BPS in this context. See the graphic on the next page (Figure 5.1) for a visual representation of how themes iinteracted with one another.



[Fig 5.1. Thematic Map. Arrows show that the participant's experiences helped shape their thoughts on the intervention]

As well as providing the themes visualised in Figure 5.1, the data indicated that eight of the twelve participants interviewed would utilise the intervention, although one of those individuals was concerned others might not appreciate it as much as they did. Of the four individuals interviewed that would not practice the BPS, two still believed it could benefit others – they just did not see any benefits to themselves personally. Individual responses regarding uptake were not obtained from the focus group, but there appeared to be a consensus that the exercise would be helpful. When asked about the uptake of the intervention, both interview and focus group participants failed to agree on ideal dosage with some participants preferring to engage once a fortnight, once a week, or even once every couple of days. Instead, participants said they would prefer setting a flexible schedule for themselves.

Illness Ownership

"Control" and the Diabetes Experience

Having a sense of agency over T1D and T2D was seen to be very important to participants. In this first subtheme, individuals expressed a desire to be "in charge" but acknowledged the emotional and physical difficulties of maintaining power over their illness. Taking "control" manifested in a number of ways, from purchasing blood glucose monitoring equipment to refusing to see certain doctors. The motivation behind exerting control, besides improving self-management, was seemingly to promote confidence and PA.

> *'If you sort of take responsibility for it and come out with a good result, then you can feel like "oh I did that well this time"… When you've got control you feel like you're more… you know what you're in for?'* (K1)

One participant saw the intervention as a way of giving back this sense of control to the individual.

> *'What you're doing now is putting it back in control of the person by giving them a tool that's meaningful'* (G8)

This is an important insight into the workings of the BPS in this context given that this same participant felt that what was particularly "uncontrollable" was the result of their HbA1c test. Others too felt that results were often random with little they could do about it, which lead to feelings of hopelessness, fear, guilt, and anger.

> *'How do you cope with this? You've done everything right between the two measurements, and it still runs high?'* (FG1)

Taking a Pro-Active Approach

In order to create that sense of agency, participants believed that they would have to adopt a pro-active approach to their self-management. However, participants were also aware that being pro-active is a choice that not everyone will (or can) make.

> *'I remember raising this in a research environment with an endocrinologist, and he said "well someone like that, they've got to really erm start measuring out the carbohydrates" and that's quite a big thing to do'* (M3)

A number of participants provided anecdotes of others they deemed to be less "engaged" than themselves in order to support their arguments for taking the initiative with their own self-management.

> *'I think anyone who doesn't use the available resources I think is just asking for trouble because, much as we like to say "oh yeah we can do it all, we're fine, we're fine", half the time we're not'* (C7)

> *'And people still do this! Because they assume if anything important happens, somebody will tell them. But it's not always the case. Er and that can be why some people struggle'* (J10)

However, a lot can be done by reaching out to others:

> *'Slowly but surely he's now erm he's still drug-free and he's on the CORRECT diet, and he's losing weight and all those other things. So he eventually found the way to do it himself'* (R2).

Still, participants occasionally expressed frustration at being on there own, and there was a sense that some felt that being pro-active was almost their only choice.

> *'So I said "well, you know, how do I do it?" and he [the GP] just looked at me… and said, "well, I don't know!"'* (G8)

Participants understood that they needed to make that decision to take responsibility, and sometimes this means not shifting the blame to external factors, as tempting as that may be.

> *'I think the doctor's gone as far as he can go and I think it's now completely down to me'* (M3)

For some, this understanding eventually leads to a sense of empowerment and that increased participants' sense of control.

> *'At the end of the day, there is a lot that we can all do… everyone should be able to work that out, what they can do to help themselves'* (FG3)

Advocating a Personal Approach

The Importance of Personalised Care

For most participants, however, the need for personalised care was of significant importance too as it would help ensure that sense of control. Participants discussed a need to be recognised as individuals because the second they are treated otherwise, it can cause problems.

> *'Unfortunately the junior doctors like to treat everything like textbook, and I don't know about every other diabetic, but certainly, any of the ones I see in clinic, soon as you start getting treated like textbook all you wanna do is throttle them [the junior doctors]'* (C7).

Participants wanted health professionals to understand that self-management is complicated. They wanted the health team to understand that they will make mistakes, that they cannot stay motivated all of the time, and that there will be times when their efforts are not enough because, for all their efforts, ultimately diabetes is not something that one can "control". As such, a significant number of participants discussed having their own personal goals, whether that was dropping their HbA1c by a few points or coming off medication altogether which might have been different to standard guidelines and advice. In some cases, setting their own goals was vital because of the individual's biological make-up (although this did not mean that their care was modified by their health care team as a result).

‘I just can’t eat! What the books say I can’ (G11)

‘Don’t even suggest to me that 4.5[%, HbA1c] is an ideal because then I’d be in here flat on my face with a broken nose or something’ (R2)

Setting one’s own goals was also shown to be motivating for some people when standard care was perceived to be “cold” and frustrating.

‘The health professionals are very geared towards erm medication and just following through erm protocols and regimes’ (G8).

Often participants discussed wanting someone they could have a frank and open discussion with. A “textbook” approach may mean that the health professional fails to note important and idiosyncratic aspects of the person’s illness experience.

*‘…to try and achieve good HbA1cs. Which the medical profession love! *laughs* …they seem to be very, very erm dependent upon it and I think they might miss things, you know?’* (G11)

These perceptions around health care interactions were then reflected in what participants wanted from the intervention. Some argued that the BPS should be less “prescriptive” and there were contradicting views on whether the intervention, as it stands, was personalised enough. Others conversely said that it was “an individualised erm bit of thinking which you can take reflective time on” (G8) while some were worried it was too generic or too clinical in its current state. To make it more personal, it was suggested that the intervention could do more to get people to think about their own personal goals.

‘To make it feel more PERSONAL and to inspire confidence… I think there has to be a couple more strands to it. Okay? Like erm HOW, you know? Write down HOW you think you can accomplish it’ (R2)

Writing about ‘how’ would make goals concrete and aid visualisation (specifically people said that utilising concrete goals would help make “things more real”). Alternatively, a warmer, less clinical feel could be adopted by altering the language.

'Invoke the kind of the positive identification with well-being that you're looking for' (R6).

The Importance of Support

Despite some of the issues raised regarding current health care support encapsulated in the subthemes 'taking a pro-active approach' and 'the importance of personalised care', participants were keen to engage with their health team and were appreciative of the help when they received it. One suggestion that multiple participants made was to use the intervention as a way to open up a dialogue between patient and health care professional.

> *'Maybe [instruction number] 4 would be, you know, "if you… if you wish to share it with your diabetes team…" they have that option, don't they..? Because then that might open a further discussion with their team… because if they said something "I think I can achieve it by doing this…" I mean that's an opening into the team to discuss what that is'* (R2)
>
> *'You've got, like, a sort of quick reference to say "well okay diabetic nurse/you know, dietician/whatever it is… this is what's been going on"'* (C7)
>
> *'Do the exercise first and then having a discussion one-to-one so actually erm develop your ideas and thinking that you've come up with'* (G8)

If the BPS adopted this suggestion, engaging with the intervention would allow the individual to enter the consultation room better prepared, equipped with more information, more ideas, and feeling more confident. It puts the individual on an equal footing with the health professional, providing a more co-operative relationship ("that's what you want… what you need from a doctor. You want… you want to work WITH them"; G11) and some participants believe this could further facilitate self-management and help them better-set goals. Although participants acknowledged that not everyone would want to share every little thing, they also felt that one could talk to their health professional without over-disclosing.

> *'You don't necessarily always want to tell them EVERYTHING that's going on… but, you know, if it's there then they can go "oh well actually that would directly impact"'* (C7)

Support does not just have to come from the health team; however, and participants reported receiving a lot of encouragement from partners, friends, and family. Two participants found that a family history of diabetes even meant that they already had a strong support system in place. Others had to go looking for it, and a few reported internet forums as being helpful for getting advice, for putting certain things into perspective, and for making friends. There is an opportunity for the intervention to encourage discussion even within these networks.

Barriers and Facilitators

Individual Factors

Participants were interested not only in whether the intervention would work for them, but they were also quick to consider how others might feel vis-à-vis the BPS exercise.

> *'If, you know, other diabetics are like "oh well, you know, I don't like doing this, I don't like doing that" well fine they don't have to, but I personally think it would be good'* (C7)

Personality frequently came up as a barrier/facilitator. A few individuals suggesting their "laziness" or "stubbornness" frequently interfered with their self-management while others suggested the opposite; that their will-power or their natural resilience helped them get through the day

> *'My personality dictates that I'm a fighter, and I haven't given up even though I'm doing the right things and not getting the results'* (G11).

Some participants were concerned that diabetes typology would impact individual acceptance and uptake. Individuals with T1D argued that they have a much different experience of self-management and HbA1c than individuals with T2D because of the nature of their conditions. More frequently, however, participants preferred to stress that everybody's illness is different and that everyone has their own unique aims, goals, and strategies. Individual experiences, therefore, maybe more important than typology, especially given that both people with T1D and T2D were equally engaging with the interviews and focus group. Other concerns included the individual's preconceptions as well as their emotional health prior to commencement of the intervention, gender and generational differences, and cultural barriers. Two participants were even concerned that some people would find it hard to articulate their thoughts.

> *'I would also be worried that erm a lot of people, especially some of the people I've met to do with this, erm I'm not sure they could… they could actually write something down for 10 minutes'* (R2)

> *'My initial thought on looking at it was, this would not work for most people I know with diabetes because most of them would find it VERY hard to write. Most of them find it hard enough to talk'* (G8)

Motivation

A particularly salient issue for individuals was motivation.

> *'It's difficult when you're feeling quite tired and all of the rest of it to feel motivated to change'* (D4)

Participants described their illness as draining, time-consuming, and as a "challenge" meaning that staying constantly motivated is difficult. This had implications for the BPS as some individuals felt that it was "another thing to do":

'I'm not prepared to spend that amount of time on my diabetes. I don't live for my diabetes. I have… I have improved it once. Erm, for a fortnight. And at the end of that fortnight, I realised I'd done nothing for that fortnight except concentrate on everything I bloody well ate. And testing. And I would be damned if I was going to live like that' (J10)

There is a need, therefore, for the BPS to be quick and easy-to-use.

'We have a lot to do anyway; we have to take our blood every day erm we have to take our medication… so having another thing to do is a bit… it IS asking quite a lot of people… You need somebody who's happy to do that, and it's not just putting something else on their plate that will stress them out further' (D9)

However, one participant described the BPS as "not particularly time-consuming, it's not hard to do; it's not unpleasant to do really. So it's not something that would be a chore" (K1) whilst another saw it as "just a quick little reference you can jot bits and pieces down… it's almost like a quick reference, but you're not having to write every single minute of every day" (C7). In fact, C7 discussed having previously had to write a "diabetes diary" and considered the BPS a quicker and more efficient task to engage with by contrast. Still, encouraging that initial engagement may require some persuading; some participants talked of requiring a "kick in the right direction" (D12) while another spoke of not wanting to engage with the intervention if they felt they did not 'need' to do it. One participant suggested that people with diabetes need to understand "the risk of not doing something" (D4) though there was also a need for people to celebrate their successes when management does go well in order to maintain the positive feelings that the BPS is designed to facilitate.

'I'm feeling really good about it and really positive about it as well… and erm things like that, acknowledgements, getting news like that erm it does… it does effect…'

'When you get that kind of news, it does put you on a high' (FG4 & FG3)

Taking “time off” may also be of benefit for some, so long as it is done so responsibly.

> *‘But as long as I can have my bottle of red wine now and again… one of great enjoyments of life and one of the ways I relax and keep my stress levels down is I sit down and read and glass of wine and enjoy it’* (G8)

Clarity and Promoting Awareness

Clarity and awareness played a huge role in participants’ perceptions of how the BPS would work and how it might struggle. Awareness was thought to act as a barrier to change while clarity was thought to act as a barrier to the BPS.

> *‘Recognising that you need it [help] is half the problem, isn’t it?’* (J10)

J10 goes on to discuss how difficult it is to understand “why you do the things you do and why you react the way you react” but argues that the support people receive is not always enough to make people question their behaviours, similar to the ideas deliberated on in the ‘taking a pro-active approach theme’ discussed prior.

> *‘This is the danger, you see? You go to the hospital, and they go ‘oh well you’ve been diabetic for 25 years, you know all this.’ And you assume you do!’* (J10)

Other quotations suggested that the BPS may, therefore, serve as a way for some people to improve their awareness, regardless of how much experience they have had with diabetes so far.

> *‘I think I could get quite a lot out of it and a lot of, kind of, what’s the word where… self-realisation?... where you find out more about yourself’* (M3)

> *‘When I was writing stuff down, I was like “oh yeah! I didn’t think of it that way”… it’s like life itself, you go through the motions, and it’s not ‘til you stop for longer than 2 seconds and go “actually, right, just focus on this*

> *bit for a minute"… it made me think and, you know, do a mini-evaluation'* (C7)

Awareness does not always equal action for everyone, however.

> *'Has this motivated me to get myself into the gym? Erm to be honest, no not really… it's made me… I guess it's made me a bit more self-aware? Erm… I'm fully… I'm very AWARE that I need to get myself into the gym'* (R6)

Sometimes, more is necessary to translate awareness into action, even in those who were seemingly quite pro-active. There were even instances where awareness without motivation or an aid to promote action may have been detrimental.

> *'I suppose it's all… it's a reflection of my own effort, I suppose, my HbA1c… "that's my fault, like" I guess it makes you feel a bit down I suppose'* (D12)

So how does one increase awareness if the individual will not or cannot engage with the intervention? Providing clarity may help. One criticism the intervention received was that its language was "abstract" with one individual so confused that they suggested that important information was being purposefully held back. Providing further information may have helped them engage better.

> *'I usually don't budge. I… unless… I… unless I have a misplaced understanding or wrong understanding about something and then somebody says "well actually, if you look at it this way you might want to do this" and then I might think "oh okay, that's a good idea, I will do it"'* (R6)

The data suggests that participants were particularly interested in seeing evidence of how and why the BPS works. There was an acknowledgement that this kind of intervention is novel and participants made reference to this. They wanted to know the science behind the intervention including the types of evidence supporting writing and dosage.

'I think it would need some kind of way, where there is evidence, as to how this type of writing helps in creating change, I think. There needs to be some explanation or… for people to see it's worth doing' (D4)

Real-World Considerations

Alternatives to Thinking about HbA1c

A number of participants took issue with using the intervention to think about their HbA1c levels. Some found it a difficult concept to think about.

'Some people might not know what it means, but it's… it's quite difficult to imagine what your blood glucose level might be over a sustained period of time' (R6)

Others found that it was not relevant to them.

'What I need is my standard deviation, more than my HbA1c. Because you can have a great HbA1c and be swinging between high and low on your meter' (G8)

Others believed that, as a test, it could be cheated and was therefore not always reliable.

'My father's a classic example, crafty old git. He might be 90, but he'll eat chocolate and all sorts of things for 9 months and then when he knows the HbA1cs coming up, he cuts back' (G11)

'People with T1D, in particular, suggested using the intervention as a tool for self-management more generally, acknowledging that their "mood will change on a daily basis"' (FG6)

'If stuff starts building up and you think "hang on a minute, I'm getting, you know, out of control" whether it's your life and also your HbA1c or you know your blood sugars in general day-to-day…' (C7)

It may therefore be important to consider less “abstract” notions for recipients of the intervention to focus on.

Considerations for Implementation

Finally, the data also suggested a need to consider potential harm. Participants were worried that without proper support, thinking about a ‘best possible self’ and feeling that they could not achieve it would produce feelings of depression or anxiety, especially if that person “through no fault of their own, has really bad control” (C7). Others were worried that without proper guidance, users might struggle to think of what to write, therefore causing further distress.

Other considerations for implementation included incorporating the intervention into existing NHS schemes such as the DESMOND programme or getting health professionals to go over it with the patient first. Indeed, a significant number of people proposed targeting the intervention at the newly diagnosed.

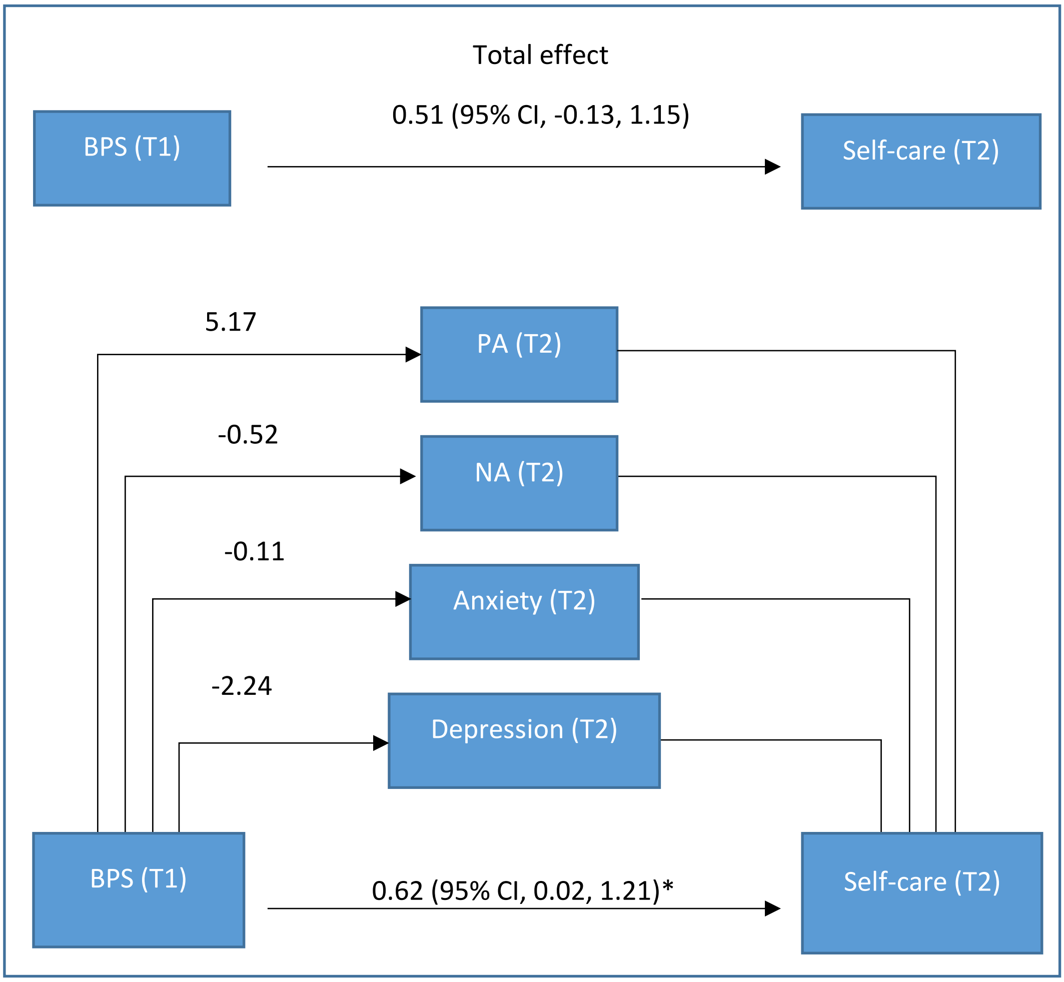
> *‘It’d set them off on the right foot. Erm but, you know, and get their brain attuned to there is help available’* (J10)

> *‘Maybe if you’d asked me to do this exercise then, maybe my erm… I would’ve… I would have found it more effective in trying to crystalise what I, you know, want to achieve’* (G8)

There was also the counter-point that anyone could benefit from the intervention, regardless of their experience, echoing statements made under the subtheme of ‘clarity and promoting awareness.’

> *‘I also think that you know, diabetics who’ve been diagnosed for longer and everything… ‘cause I mean when I read it I was ‘oh yeah!’ because it makes you stop and think’* (C7)

5.3.3 Quantitative findings



[Fig 5.3 Path model testing for direct effects of the BPS (administered at T1) on diabetes self-management (self-reported at time point 2, and the indirect effect mediated by emotional states (self-reported at time point 2). Note * $p < 0.05$]

The mediation analysis assessed the effect of the newly modified BPS' effect (T1) on self-management variables (T2) with emotional factors (PA, NA, Anxiety, and depression) (T2) as the mediating factors. This analysis revealed a significant direct effect for the writing exercise, Effect = 0.62 (95% CI 0.02 to 1.21), $p < 0.05$. Examination of the mediation results showed that the BPS group reported greater self-care activity approximately 4 weeks post-intervention when compared with the control group. Emotional factors, however, failed to mediate this relationship ($p >$ 0.05). The BPS had no other significant effects (direct or indirect) on the remaining four self-management variables (all p's > 0.05). The mediational analysis was then re-run to control for diabetes type (T1D, T2D) to see if this affected the direct effect of the BPS on self-care activity, given the differences in self-management styles. Results showed that accounting for this covariate slightly attenuated but did not completely negate the significant BPS influence, Effect = 0.62 (95% CI 0.00 to 1.24), $p = 0.05$. See Figure 5.3 for more information.

5.4 Discussion

This mixed-methods study applied the BPS PPI to a diabetes context and found the BPS to be both acceptable and feasible as a tool for aiding T1D and T2D self-management. Analysis of the qualitative data provided several key themes suggesting that people with T1D and T2D would find the BPS useful but would like it to have a more personalised format, and perhaps refined further for a diabetes context given the unique challenges associated with living with T1D and T2D. Qualitative results, therefore, support previous academic suggestions that any version of the BPS should be especially tailored for its target population (Layous et al., 2013). Whilst the BPS received some initial modifications between qualitative and quantitative phases of this study (including additional steps and the use of more positive, encouraging language), further development of a diabetes-specific BPS may still be required. Analysis of the quantitative data, meanwhile, indicated that the BPS improved perceptions of self-care after four weeks despite the absence of signicifant differences in actual behaviours between groups. Importantly, the effect on self-care was only slightly attenuated after controlling for diabetes type, suggesting that people with T1D and T2D were receiving the same benefits from the BPS.

Interview and focus group feedback suggested most participants found the BPS to be a viable tool that could be incorporated into patient treatment plans to help promote person-centred care (Coulter et al., 2013). Several participants suggested ‘sharing’ written ideas from the BPS with other individuals within their support networks. Indeed, the qualitative data suggested the BPS might help strengthen doctor-patient relationships if people with diabetes share ideas with their health care team, especially. This finding is important as previous research suggests doctor-patient rapport has a significant impact on clinical outcomes (Coulter et al., 2015; Coulter et al., 2013).

Other important observations to note include the individual’s need to understand the benefits of engaging with the BPS. There was frequent mention of a need to provide scientific evidence so that people felt the intervention was worthwhile and valid. This point relates specifically to the ‘illness ownership’ theme where participants emphasised that by ‘taking ownership’ they were constantly busy making decisions and managing their diabetes. Consequently, they did not necessarily want to spend more time and effort engaging with an intervention unless it was to be of some knowable benefit. It is essential to consider some of the salient facilitating and hindering factors involved with engagement with the exercise, especially at initial contact. Participants considered emotions and personality traits important, with feelings of “laziness” being a notable barrier for some. By contrast, resilience and will power were viewed as important characteristics to have by many individuals. Individual’s perceptions of their agency was important and could be facilitated by the intervention, but barriers may need to be overcome first. Overall, the qualitative data revealed both favourable and challenging features of the BPS.

While evaluation of the quantitative data showed that exposure to the BPS improved perceptions of self-care after approximately four weeks following initial exposure, the underlying mechanisms for this effect are unclear. In fact, the mechanisms may have had little to do with affect, meaning that models of PA (Fredrickson, 2001; Pressman & Cohen, 2005; Van Cappellen, Rice, Catalino, & Fredrickson, 2017) may have been inappropriate here. Previous research suggests the BPS is effective at improving PA (Layous et al., 2013; Huffman et al., 2014; Parks et al., 2012; Peters et al., 2010; King, 2001) which theory states should lead to novel behaviours that can be developed into resources over time. However, in this context, not only did the BPS fail to facilitate PA, the BPS failed to facilitate any appropriate self-management behaviours – blood glucose control, dietary control, physical activity, or health care use. One interpretation of the findings, therefore, would suggest that mechanisms need to be examined from the perspective of other non-PA theory.

According to the theory of self-regulation (Deci & Ryan, 2000; 2008), the BPS should provide people with an image of a future self (that is a self-standard) which they then compare to the present self (Vandellen and Hoyle, 2008) while any mismatch would motivate people to modify their behaviours in order to reduce the disparity (Cross and Markus, 1991; Markus and Nurius, 1986). Indeed, previous research has shown that the BPS increases motivation, which may be one possible mediator by which it is positively influencing perceptions of self-care (Seear & Vella-Brodrick, 2013; Sheldon & Lyubomirsky, 2006). In this scenario, positive perceptions would emerge as a result of being motivated by the task. Indeed, this finding, combined with the absence of a BPS effect on other aspects of diabetes self-management (blood glucose control, physical activity, diet, health service use), seems to validate the qualitative findings. In particular, self-care suggests autonomous, deliberate, and self-initiated activity; concepts that resonate with the 'Illness Ownership' and 'Advocating a Personal Approach' themes. In essence, the BPS may be achieving its effects in this context because it makes people with T1D and T2D feel 'in control' of their illness. Given that people with diabetes generally receive extensive education about self-management, it is plausible the BPS activates related cognitive appraisals (e.g., perceptions of 'control' or 'ownership') that then mediate its effect on self-care activities. If so, it is necessary for future research to demonstrate such mediator effects especially given that positive illness perceptions are associated with improved HbA1c (McSharry, Moss-Morris, & Kendrick, 2011) and that motivation was a subtheme in its own right in the qualitative phase of this study.

The quantitative data also revealed that the intervention failed to influence health service use, conflicting with several previous studies that reported fewer health centre visits in BPS users (King, 2001; Austenfeld et al., 2006; Austenfeld and Stanton, 2008; Maddalena et al., 2014). There is a need for further research to explain this inconsistency. However, it is worth bearing in mind that these previous studies were conducted on different samples, under different conditions, and in different health care contexts (Austenfield et al., 2006; King, 2001; Maddalena et al., 2014). It is also plausible that a longer follow-up period (i.e. greater than four weeks post-intervention) would be needed to detect whether any significant behaviour changes occurred (not just health care use), including an increase in health care centre visits, given the discrepancy between individual's perceptions of care and their scores on actual self-management. There may be a bigger lag between people's improved attitudes towards their care and a statistically significant change in behaviour than was initially anticipated.

5.5 Strengths & Limitations

This was the first study to assess the acceptability and feasibility of the BPS as an aid to diabetes self-management in people with T1D and T2D. However, the sample was arguably biased, as it consisted primarily of pro-active individuals sufficiently enthused about participating in an interview, attend group meetings and/or complete an online study. This was addressed somewhat in the 'taking a proactive approach' subtheme generated in the qualitative phase though, as participants at least provided anecdotes of those they considered to be less motivated than themselves, and this was taken into consideration when adapting the BPS further in time for the quantitative phase. Whether these changes will be enough to influence uptake in a real-life setting outside of experimental conditions, however, remains unclear.

It is also worth remembering that the sample for the quantitative phase was limited by its size but that subsequent (quantitative) studies in this thesis would attempt to use larger sample sizes. However, it is likewise worth noting that this study was designed as an acceptability and feasibility trial and that other diabetes PPI research has used similar sample sizes (Cohn et al., 2014; Jaser et el., 2014). The priority at this stage was to get an idea of whether the intervention was feasible while follow-up studies could focus more on power.

Finally, it bears highlighting that people living with diabetes in the UK receive free healthcare, which may present different emotional challenges in diabetes self-management compared to those from countries without a universal health care system. People in the UK at least do not have to factor in money to the same degree that people from other countries do, which could act as a significant and further health burden. Furthermore, this study did not specifically examine the moderating effects of various patient characteristics, such as duration of illness, medication, and diabetes complications comorbidities (e.g., Ketoacidosis), and hospital admission (Galindo et al, 2018). It is possible that the BPS may have a more potent effect on perceived self care in patients who are burdened with additional stressful diabetes complications, for example.

5.6 Conclusions

In conclusion, the BPS was found to have some utility for people with T1D and T2D. However, the intervention needs further refinement, especially given that it failed to facilitate PA in this context. The BPS improved the perception of self-care up to four weeks after exposure but did not increase uptake of self-management behaviours. It is unclear whether behaviour change may occur over a longer time frame in line with PA theory or if the intervention is more likely to influence cognitive appraisals in line with self-regulation theory (Deci & Ryan, 2000; 2008). To the best of the author’s knowledge, this was the first study to evaluate the BPS in individuals with T1D and/or T2D. The study highlighted the importance of personalising the BPS for this context. Since the running of this experiment, language used by health-care professionals and others have shown to be particularly important for this population, so future versions of the BPS should be mindful of using words that stigmatise, exclude, or evoke feelings of fear (National Health Service, 2018). One important avenue for further research is evaluating the impact of this intervention on actual physical health in line with previous research on the BPS (Layous et al., 2013). Given that this study found that the BPS intervention facilitates self-care perceptions in people with diabetes, there is a need to determine whether the protocol may also aid clinical outcomes such as symptomatology. This needs to be a priority before longer follow-ups can be considered.

Chapter 6: Study 2 – The Effects of the BPS on Illness Symptomatology in Adults at Low and Moderate-to-High Risk of T2D

What Does This Study Contribute to Existing Knowledge?

- This is the first study to administer a diabetes PPI to participants at risk of T2D. The significant findings suggest that there are others ways of successfully implementing PPIs within the diabetes context.
- This study also highlights the importance of following up on diabetes PPI research; different PPIs have different impacts, and there are a lot of outcomes to consider when it comes to diabetes care.
- In particular, this study demonstrates that the BPS reduces NA over a four week period which may be indicative of a buffering effect.
- It is also the first study to show that the BPS (or any diabetes PPI) can reduce the incidence of diabetes symptomatology.

Abstract

Objectives: Up to 45% of people at high risk of developing T2D experience diabetes-related symptoms. Illness symptoms such as pain, fatigue, and cognitive impairment can hamper diabetes prevention behaviours such as physical activity. This study investigated whether a writing intervention designed to articulate health goals for a best possible future self could help alleviate diabetes-related symptoms in participants at various levels of risk.

Research Design and Methods: Adults (N =149, aged 18 to 75 years) categorised as ‘high’, ‘moderate’, or ‘low’ risk by the CANRISK questionnaire were randomly assigned to a BPS or Waiting-List Control condition. Self-reported fatigue, cognitive function, pain, sensory problems, cardiology, ophthalmology, hypoglycaemia and

hyperglycaemia were assessed as diabetes-related symptoms using the DSC-R questionnaire.

Results: A MANOVA revealed lower levels of psychological fatigue in the intervention condition, immediately post-exposure ($p = 0.05$, ηp2 = 0.01) compared to the control condition. Further mediation analysis indicated the writing exercise indirectly reduced the symptom cognitive impairment (Effect = -0.11, CI -0.27 to -0.01) and facilitated PA (Effect = 0.58, CI 0.02 to 1.67). Additionally, the intervention group reported reduced NA after four weeks ($p = 0.03$, ηp2 = 0.06). The intervention had no immediate or delayed effect on biomedical symptoms (*p*'s > 0.05). T2D Risk had no effects on intervention outcomes.

Conclusions: Writing about a 'best possible self' reduced psychological fatigue, irrespective of categorised diabetes risk. Immediate but indirect facilitation of PA combined with a reduction in NA after four weeks may suggest a potential buffering effect.

6.1 Introduction

6.1.1 Overview

Study 1 demonstrated that the BPS was an acceptable and feasible intervention for people with T1D and T2D. However, the BPS failed to facilitate PA and the qualitative and quantitative findings, rather than aligning with the likes of the Broaden-and-Build model (Fredrickson, 2001; 2004), suggested that the BPS was instead influencing cognitive appraisals (e.g. perceptions of control and illness ownership, as well as perceived improvements in self-care). Study 1's results were, therefore, more in line with the non-PA theory of self determination (SDT; Deci & Ryan, 2000; 2008). Given that positive physical health outcomes (such as symptom complaints) are associated with changes in cognitive appraisals (Niemiec, Ryan, & Deci, 2009; Kane, Hoogendoorn, Tanenbaum, & Gonzalez, 2018), Study 1's findings warrant further investigation into BPS effects on physical health markers, an outcome that was neglected in that preliminary investigation. However, rather than continue to subject a potentially vulnerable population to an intervention with now unknown qualities, a decision was made to assess the BPS's effectiveness using a non-clinical sample at low and moderate-to-high risk of T2D while carrying over the lessons from Study 1. This would also provide the added bonus of working with an important population that has so far been neglected by diabetes PPI research.

6.1.2 Symptoms

In order to assess physical health outcomes, changes in diabetes symptomatology would be assessed over time as part of this study. A non-clinical population at various levels of risk for T2D are a good sample for assessing the effects of the BPS on diabetes symptoms because evidence suggests up to half of the people at risk of T2D experience multiple diabetes-related symptoms (Clark et al. 2007). Such symptoms may include frequent urination, fatigue, irritability, excessive thirst, blurry vision, shortness of breath, chest pressure, chest discomfort, and pain (American Diabetes Association, 2017). In fact, this is a particularly important population to target because symptoms such as pain and fatigue can hamper T2D prevention behaviours if improperly managed (Murphy et al. 2008; Romero et al. 2018). For those at higher risks of T2D in particular, it is perhaps even more important because this group are more likely to experience feeling unwell, pain, fear of hypoglycaemia or low blood sugar reactions, comorbid illnesses, and fatigue; all of which are further barriers to physical activity and dietary behaviours (Brown et al. 2018; Kanera et al., 2019; Korkiakangas et al. 2009). Various American guidelines are now highlighting a need for psychological interventions that help alleviate subjective pain, fatigue, blood sugar changes, and other perceived illness symptoms that hamper healthy behaviours (American Diabetes Association 2018). Given the recent release of the Diabetes and Emotional Health resource (Hendrieckx, Halliday, Beeney, & Speight, 2019) in the UK, similar guidance may soon be provided locally too.

Although the mechanisms underlying BPS effects on illness symptoms are unclear (Loveday et al. 2016), evidence has shown that the BPS can alleviate cold and flu symptoms, headaches, sinus issues, diarrhoea (Maddalena, Saxey-Reese, &

Barnes, 2014) and physical pain (D'raven, Moliver, & Thompson, 2015) across a variety of (non-diabetes) samples. It is possible that the BPS is leading people to make positive appraisals, therefore encouraging motivation and engagement in line with the SRT (Deci & Ryan, 2000). Such processes have shown to be important for the likes of obesity, for example, where the likes of positive goal-setting may influence physical outcomes such as weight loss through the promotion of exercise and diet (Teixeira et al., 2015). However, it may also be important for the likes of pain management if, for example, the BPS has encouraged monitoring and reflection to promote an awareness of things that can make pain more manageable. Awareness and reflection may encourage the person to be mindful of when to rest, to take anti-pain medication, or to more actively engage in physiotherapy exercises. In that way, the BPS may have similarly influenced pain perception in D'Raven and colleagues' (2015) study.

Alternatively, novel research has also shown that BPS activity strengthens the immune system, based on measured secretory immunoglobulin A (sIgA), an indicator for immune-reactivity (Cable et al. 2015), which may also explain the intervention's previous effects on illness symptoms (Maddalena et al., 2014). SIgA is an antibody that defends against infections (e.g., the common cold) by hampering bacterial and viral adherence to mucosal surfaces (Holmgren and Czerkinsky 2005; Brandtzaeg 2007). When assessing the effects of BPS on biological markers of immunity and physiological arousal, BPS activity showed a significant increase in SIgA and reduction in skin conductance compared to a control group (Cable et al. 2015). Skin conductance (activation of the sweat glands), also known as electrodermal activity, depicts physiological arousal (e.g., blood pressure), and underlying emotional and cognitive states (e.g., anxiety) (Critchley 2002). As such, it is possible that the BPS alleviates illness symptoms partly by strengthening the immune system, and/or reducing physiological arousal.

6.1.3 Present Study

The BPS is likely to be influencing physical health through one pathway or another. The aim of the current study, therefore, was to determine if writing about a future best possible selves' health goals would alleviate diabetes-related illness symptoms, particularly in individuals at high risk of developing diabetes. In contrast to the previous study, this study employed a straight quantitative design.

The hypotheses for this study were as follows:

- Compared with a waiting list control group, participants who write about their best possible selves would report significantly fewer illness symptoms associated with diabetes.
- This effect would be significantly more pronounced in people at high risk, compared to those at low risk, due to the former groups' greater symptomatology.

6.2 Methodology

6.2.1 Study Sample and Recruitment

This study utilised a between groups repeated measures design. Recruitment of participants was performed primarily online, via non-probability purposive sampling. Aiming to reach a large and varied audience (an *a priori* G power calculation [Faul, Erdfelder, Buchner, & Lang, 2009] suggested that 140 participants would be the minimum sample size to detect a medium effect for this study, given desired power levels of 95%, and a preferred alpha level of 0.05), emails were sent to diabetes support groups around the world as well as to mailing lists of staff and students from Liverpool John Moores University. Links to the study were also placed on social media websites such as Twitter and Facebook. Recruitment was conducted between October 2017 and January 2018. The final sample comprised a predominantly Caucasian (88.4%) sample of 149 adults (Mean age = 30.0 years, SD = 15.01), consisting of 30 (20.4%) males and 117 (79.6%) females. Although recruitment was conducted primarily online, such that any English speaking person in any part of the world with internet access could participate, the majority of participants (96.6%) self-identified as British born or British residents.

The study was hosted on the online platform Qualtrics. Participants were informed about the nature of the study as well as the inclusion and exclusion criteria when they accessed the study webpage. Participants were then asked to self-exclude if they were younger than 18, had a diagnosis of T1D or if they had a severe mental illness (such as bipolar depression or schizophrenia) because the intervention manipulated emotions. Eligible participants were required to read a detailed participant information sheet describing the nature of the study, including any associated risk and potential benefits, before then completing and signing a consent form. Only participants who consented were allowed to progress further on the website. The Liverpool John Moores University research ethics committee (ref 18/NSP/004) granted ethical approval for this study.

6.2.2 Data Collection

Following consent, participants were randomly assigned to either an intervention condition or control condition using the Qualtrics 'Randomizer' function. Individuals assigned to the BPS condition were provided with the intervention on-screen while those assigned to the waiting list control were informed that they would receive the intervention at the end of the study period. Given the changes in the sample population, the BPS was further modified for this study. However, it was important that changes this time were kept to a minimum in order to retain the features that made the BPS fit for this (admittedly broadening) context. Consequently, changes were primarily superficial and related to language. The biggest change was rebranding the PPI as the 'best possible self' exercise again, rather than the 'best possible HbA1c', as HbA1c would be an unfamiliar concept to some people without diabetes. The intervention remained an A4-sized Word document instructing respondents to write about a best possible future self where they had achieved all of their health goals as well as the steps they took to become that person. The sheet also incorporated a brief paragraph highlighting the importance of making small lifestyle changes in order to improve one's health (rather than stressing the importance of diabetes self-management) as a way of introducing the intervention. Appendix 1 details changes more thoroughly. See below for the main instructions:

> "Take a moment to think about your best possible self. Imagine that you are in excellent health and that you have been taking extra good care of your body. You are exercising regularly, and you are eating well. You have worked hard and succeeded at accomplishing all of your health-related goals. Imagine how it felt to achieve those goals and reflect on how positive it would feel to be this fit and healthy. Then, tell yourself the important things you realised or the critical steps you took to get there.
>
> Now, please use the next 10 minutes to write continuously about what you imagined. Use the tips below to guide you through this process:
>
> 1. Be as creative and imaginative as you want. Do not worry about perfect grammar and spelling as this is for your private use. No one has to know what you wrote down, though you may find it helpful to share and develop ideas with trusted friends, family, or your health-care team.
>
> 2. Do not feel too pressured to write everything down on your first try. As you repeat this task, more ideas will come to you naturally.
>
> 3. Remember, steps towards success are often small. You may find it easier to write about things that are more achievable, to begin with, such as investing in a pedometer/walking app or making the decision to try new recipes more often. However, if you want to aim high and write about running a half-marathon, that's okay too!
>
> 4. If you find thinking about one aspect of your health particularly difficult, try focusing on another one. The important thing is that you

write about something long-term so that you can make more noticeable improvements over time."

Following condition allocation, both groups were asked to complete self-report scales assessing diabetes risk, diabetes-related symptoms, and positive and negative affect (Time 1; T1). The CANRISK (Canadian Diabetes Risk Questionnaire) (Kaczorowski et al. 2009) was used to establish T2D risk. Answers to questions about gender, body mass index, waist circumference, physical activity, and fruit and vegetable intake (amongst others) were each assigned points ranging from 0 to 15 and categorised into one of three groups based on total score; 'Low Risk' (< 21), 'Moderate Risk' (21 to 32), and 'High Risk' (≥ 33). Diabetes symptoms (and associated distress) were assessed using the Diabetes Symptoms Checklist – revised (DSC-R) (Arbuckle et al. 2009; Grootenhuis et al. 1994; Naegeli et al. 2010) which consisted of 34 items organised into eight symptom domains: fatigue (e.g., 'Lack of energy?'); cognitive (e.g., 'Difficulty concentrating?'); pain (e.g., ''Aching calves when walking?'); sensory (e.g., 'Numbness (loss of sensation) in the feet?'); cardiac (e.g., 'Shortness of breath at night?'); ophthalmic (e.g., 'Persistently blurred vision (even with glasses on)?'); hyperglycaemic (e.g., 'Frequent need to empty your bladder?'); and hypoglycaemic (e.g., 'Moodiness?') symptoms. Responses to each item are first indicated using a 'yes'/ 'no' format ('Did the symptom occur?') and if participants responded yes, then they had to indicate how much discomfort that symptom was causing using a 5-point Likert style scale, ranging from 'not at all' (1) to 'extremely' (5)'. Cronbach alpha's ranged from .59 to .89 (though it should be noted that most subscales averaged about .8 and that the lowest score, for pain at T1, increased to .86 at T2 and so no sub-scales were excluded from the analysis). PA and NA were measured using the Positive and Negative Affect Scale (PANAS; Watson et al. 1988).

Approximately four weeks later (Time 2; T2), all participants received an email linking them to a new Qualtrics survey where they completed the DSC-R and PANAS self-report scales for a second time.

6.2.3 Data Analysis

Multivariate analysis of variance (MANOVA) assessed group differences on the immediate effects of BPS exposure (intervention versus control) and diabetes risk (low-risk versus moderate/high risk) on diabetes-related symptomatology (T1) and PA/NA (T1). Each of the eight DSC-R symptom domains (fatigue, cognitive, pain, sensory, cardiac, ophthalmic, hypoglycaemic, and hyperglycaemic) were treated as a separate outcome variable. MANOVA also assessed follow-up effects of BPS exposure and diabetes risk (T1) on diabetes-related symptomatology and positive/negative affect after approximately four weeks (T2). Finally, after assessing the immediate effects of BPS exposure and diabetes risk on illness symptoms and emotion, the PROCESS macro dialogue (version 2.16) for SPSS was used to explore various mediator effects at T2 (Hayes 2013, 2009).

6.3 Results

6.3.1 Descriptive Data

The majority of the sample (74.8%) were categorised as low-risk. The remainder were grouped as moderate-risk (10.2%), or high-risk (6.8%). A further (8.2%) provided incomplete risk information. Table 6.2 shows the means, standard deviations, and other descriptive parameters for the diabetes symptoms subscales. Psychological symptoms were the most strongly occurring malaises, led by fatigue (e.g., lack of energy) and followed by cognitive impairment (e.g., difficulty thinking clearly). Hypoglycaemic symptoms (e.g., irritability just before a meal) were the most heavily experienced physiological ills, followed by hyperglycaemia (e.g., thirst, need to urinate), and cardiovascular issues (e.g., heart palpitations). Sensory difficulties (e.g., numbness in the hands) and ophthalmic complaints (e.g., blurred vision) were the least reported physiological symptoms.

Higher levels of PA were reported more frequently than low levels of NA across the entire sample. Statistical analysis revealed no significant differences in reported diabetes-related symptoms as a function of diabetes risk groups or experimental condition (p's > 0.05). Table 6.3 shows the bivariate correlations between study variables. Note the associations between different symptom clusters in particular.

	Writing condition			Control condition		
	Total sample	Low-risk	Moderate or high-risk	Total sample	Low-risk	Moderate or high risk
Outcomes (Time 1)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Symptoms (DSC-R)						
Fatigue[b]	1.49 (1.10)	1.58 (1.13)	1.12 (0.91)	1.75 (1.17)	1.69 (1.17)	2.01 (1.13)
Cognitive	1.23 (1.06)	1.29 (1.08)	1.00 (0.98)	1.33 (1.07)	1.29 (1.05)	1.51 (1.18)
Pain	0.44 (0.57)	0.44 (0.54)	0.45 (0.71)	0.29 (0.45)	0.31 (0.48)	0.15 (0.29)
Sensory	0.30 (0.63)	0.29 (0.60)	0.33 (0.80)	0.26 (0.45)	0.23 (0.43)	0.43 (0.53)
Cardiac	0.73 (0.88)	0.73 (0.89)	0.70 (0.87)	0.60 (0.69)	0.60 (0.71)	0.61 (0.60)
Ophthalmic	0.40 (0.68)	0.38 (0.65)	0.46 (0.79)	0.30 (0.53)	0.31 (0.57)	0.24 (0.27)
Hypoglycaemic	1.15 (1.09)	1.20 (1.10)	0.97 (1.07)	1.14 (1.05)	1.18 (1.08)	0.97 (0.91)
Hyperglycaemic	0.93 (0.94)	0.94 (0.99)	0.91 (0.75)	0.98 (0.90)	0.97 (0.88)	1.03 (1.01)
Affect (PANAS)						
Positive emotion	29.43 (8.55)	29.54 (8.73)	29.00 (8.14)	29.12 (9.24)	29.20 (9.41)	28.69 (8.75)
Negative emotion	19.68 (7.81)	20.66 (8.09)	15.75 (5.11)	20.36 (7.85)	20.64 (7.91)	19.00 (7.75)

[Table 6.2 Means and SDs for diabetes symptoms and affect (at T1) based on experimental condition and diabetes risk category. Note. ap < .05, bp < .01. Statistical significance reflects the main effects, that is, differences between the total sample means for the BPS versus control condition. There was no interaction between experimental condition and diabetes risk category (risk groups are based on CANRISK scoring criteria, whereby < 21 = low risk; 21 to 32 = moderate risk; ≥ 33 = high risk).

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Mean	SD
1) Age	-												30.01	15.01
2) Diabetes risk	0.83[b]	-											11.27	13.07
3) Fatigue	-0.13	-0.08	-										1.68	1.15
4) Cognitive	-0.14	-0.05	0.78[b]	-									1.32	1.09
5) Pain	-0.15	0.01	0.37[b]	0.43[b]	-								0.35	0.51
6) Sensory	0.05	0.12	0.41[b]	0.48[b]	0.55[b]	-							0.28	0.53
7) Cardiac	-0.12	-0.05	0.42[b]	0.49[b]	0.43[b]	0.46[b]	-						0.67	0.78
8) Ophthalmic	-0.05	-0.07	0.48[b]	0.50[b]	0.36[b]	0.49[b]	0.36[b]	-					0.33	0.59
9) Hypoglycaemic	-0.18[a]	-0.11	0.56[b]	0.62[b]	0.29[b]	0.25[b]	0.38[b]	0.25[b]	-				1.14	1.05
10) Hyperglycaemic	-0.09	0.01	0.55[b]	0.58[b]	0.34[b]	0.49[b]	0.42[b]	0.41[b]	0.50[b]	-			-0.93	0.91
11) Positive affect	0.12	-0.03	-0.43[b]	-0.37[b]	-0.24[b]	-0.13	-0.29	-0.23	-0.28[b]	-0.27[b]	-		29.14	9.00
12) Negative affect	-0.19[a]	-0.12	0.49[b]	0.59[b]	0.31[b]	0.22[b]	0.33	0.27	0.58[b]	0.41[b]	-0.18[a]	-	20.08	7.82

[Table 6.3 – Bivariate correlations and descriptive statistics. Note. ap < .05, bp < .01. The sample size is 147 except for diabetes risk, based on CANRISK total scores (N = 135). Diabetes-related symptoms are based on the DSC-R subscales. Positive/negative affect are based on the PANAS subscales]

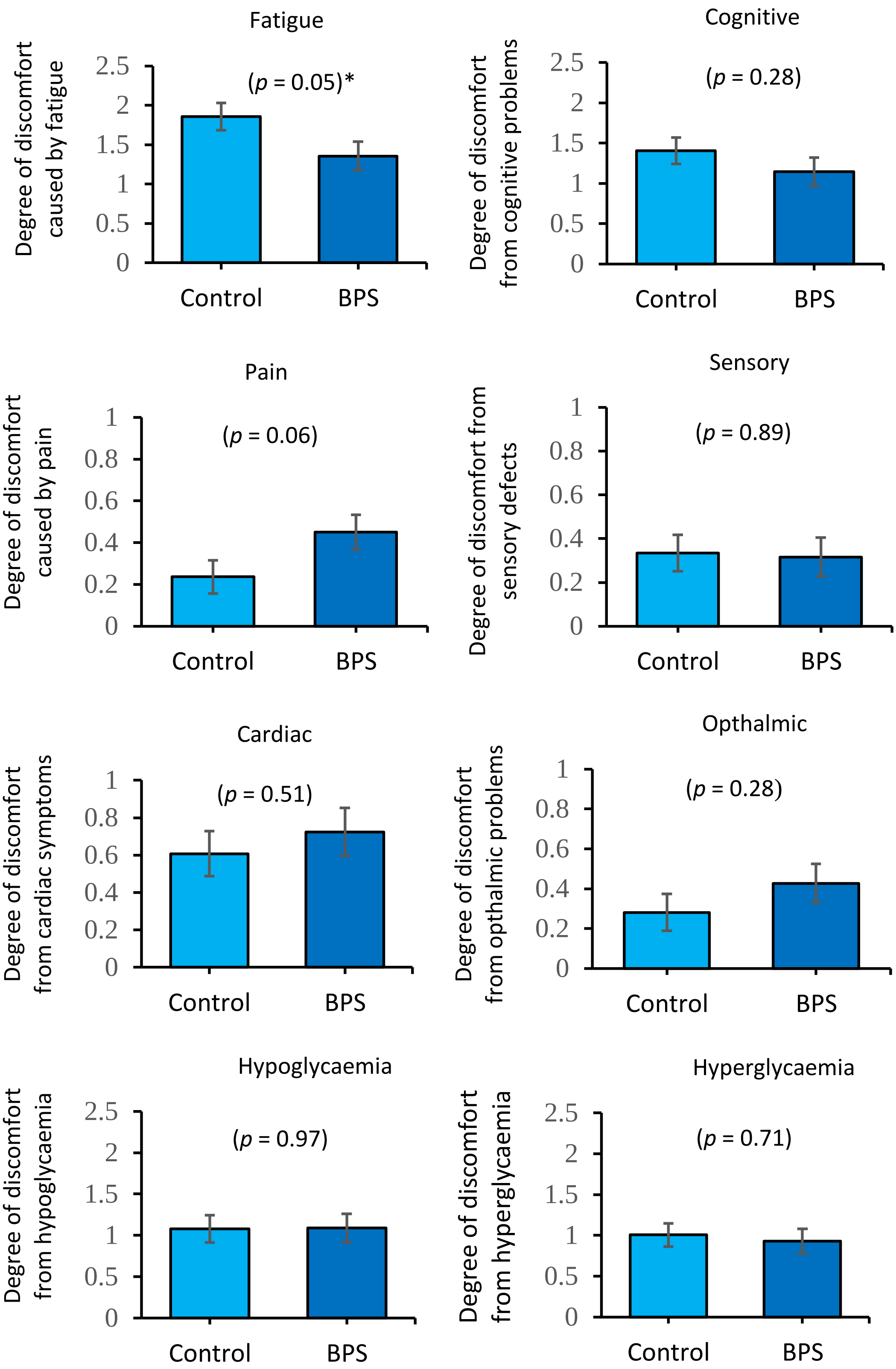
6.3.2 Intervention Effects (T1)

A 2 (BPS: intervention vs control) x 2 (Diabetes risk: Low vs moderate/high) MANOVA was performed to evaluate the effect of the BPS intervention on the eight diabetes symptomatology scales (fatigue, cognitive function, pain, sensory, cardiac, ophthalmic, hypoglycaemia, hyperglycaemia), and the two PANAS subscales (PA/NA). The omnibus MANOVA indicated a significant effect of the BPS intervention on the composite dependent variables, Wilks Λ = 0.84, $F(10, 122) = 2.17$, $p < 0.05$ ($\eta p2 = 0.15$). There was no significant effect of diabetes risk or Condition x Diabetes Risk interaction. However, Box's test suggested violation of the assumption of homogeneity of covariance matrices, Box's M = 325.577, $F(165, 4237.20) = 1.43$, $p < .001$. As an additional check of the diagonals of the covariance matrices, Levene's tests of equality of error variances across the cells was used. Results suggested that the assumption was met for all dependent variables.

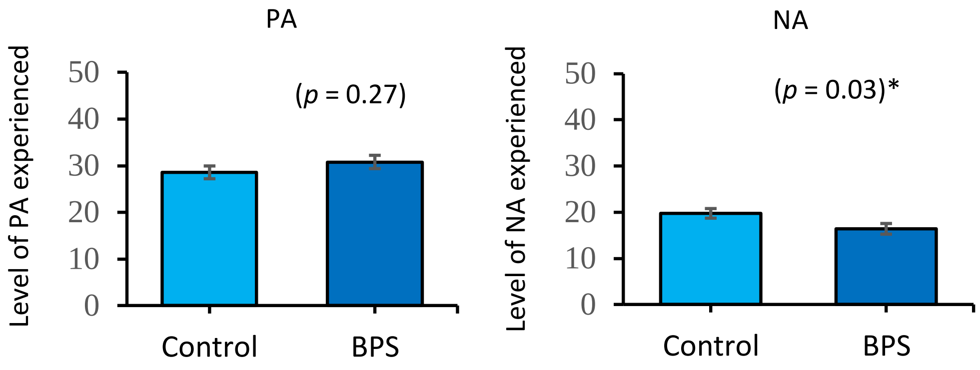
Tests of the between-group effects revealed a significant effect of the intervention on psychological fatigue, $F(1, 131) = 3.90$, $p < 0.05$ ($\eta p2 = 0.03$). Examination of the mean estimates revealed that participants exposed to the BPS experienced significantly less psychological fatigue, compared to those in the control group (see Table 6.1). This effect is also illustrated in Figure 6.1. There was no intervention effect on any of the other DSC-R symptom domains, or on either of the two PANAS subscales. Further diabetes risk had no effect on any of the dependent variables. There was also no interaction between the BPS intervention and diabetes risk (*p*'s > .05).

6.3.3 Intervention Effects (T2)

A 2 (BPS: treatment vs control) x 2 (Diabetes risk: Low vs moderate/high) MANOVA was also conducted on follow-up (T2) data for the eight diabetes symptomatology scales, and the NA/PA PANAS subscales. The omnibus MANOVA provided no significant effects for the BPS, diabetes risk or their interaction (all *p*'s > .05). However, Box's test again indicated a violation of the assumption of homogeneity of covariance matrices. Levene's tests also indicated inequality of error variances for the cognitive functioning variable. Subsequently, the MANOVA was repeated using bootstrapping as an alternative to parametric estimates, given the assumption violations (Krishnamoorthy and Lu 2010). The number of bootstrapping samples was set at 1000, with simple sampling. This analysis revealed a significant BPS effect on the negative affect PANAS subscale, $F(1, 77) = 4.88$, $p < 0.05$ ($\eta p2 = 0.06$). Mean estimates indicated that the BPS group experienced significantly less NA than the control group (see figure 6.2).



[Fig 6.1. The effect of writing about one's best possible future self versus a waiting list control condition on reported diabetes-related symptoms at T1. Symptom scores (i.e., level of discomfort) ranged from 0 (none) to 5 (extreme). The intervention group reported less psychological fatigue post-exposure. There was no interaction between the intervention and diabetes risk status or a main effect for the latter].

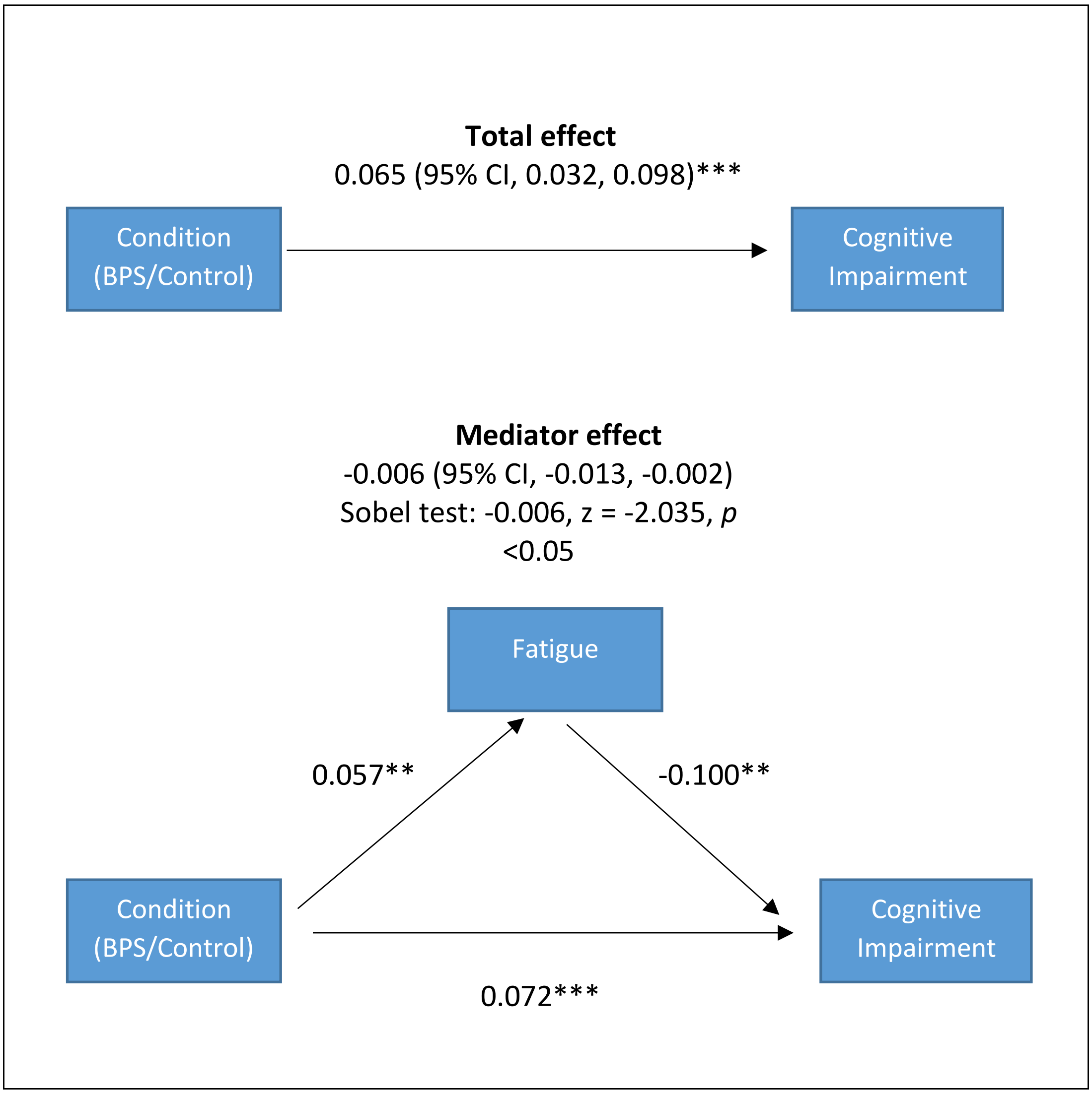


[Fig 6.2 The effect of writing about one's best possible future self versus a waiting list control condition on positive and negative emotions after four weeks (T2). The intervention group reported less NA at follow-up.]

6.3.4 Mediating Effects of Psychological Fatigue

Many illness symptoms are related to fatigue, including pain and disturbed sleep (Connolly et al. 2013). This is also evident in the table of bivariate correlations (see Table 6.2). As such, a decision was made to further explore the data and assess whether fatigue mediated the effect of BPS exposure on other DSR-C symptoms and/or on PA/NA. Assessment of the indirect effect of BPS exposure was first conducted on cognitive, pain, sensory, cardiac, ophthalmic, hypoglycaemic, and hyperglycaemic symptoms as well as PA, and NA at T1. Psychological fatigue was treated as the mediator variable (T1).

This analysis revealed two significant indirect effects. In the first effect, psychological fatigue mediated the impact of BPS exposure on cognitive functioning, ab = -0.11, BCa CI [-0.24, -0.01]. The conservative Sobel (normal theory) test for indirect effects approached significance (z = 1.88, p = 0.06). Participants exposed to the BPS reported less fatigue, which in turn was associated with less cognitive impairment (e.g., less difficulty sleeping, concentrating, or paying attention). The indirect effect accounted for 86% of the total BPS effect on cognitive functioning.



[Fig 6.3 The mediating effect of fatigue on relations between BPS exposure and cognitive functioning. BPS exposure reduced fatigue, which in turn was associated with less cognitive impairment. BPS exposure had no direct effect on cognitive functioning]

In the second indirect effect, psychological fatigue partially accounted for the impact of BPS exposure on PA, ab = 0.58, BCa CI [0.02, 1.67]. The conservative Sobel test, however, was not significant ($z = 1.37$, $p = 0.17$), suggesting a marginal effect. Examination of the pathways showed that participants in the BPS experienced less fatigue, which in turn was related to more positive emotions (e.g., 'interested', 'excited', 'enthusiastic', and 'proud') (see Figure 6.3). The indirect effect accounted for 72% of the total effect in this model. Table 6.4 provides a full breakdown of effects.

A second mediation test was conducted to assess the indirect effect of BPS exposure on follow-up measures of cognitive function, pain, sensory, cardiac, ophthalmic, hypoglycaemia, hyperglycaemia, positive affect, and negative affect at T2 (though fatigue (T1) remained the mediator variable). This analysis revealed no significant indirect effects (all *p*'s > .05).

	Cognitive				Pain				Sensory			
Mediator pathways	Effect	SE	CI (L)	CI (H)	Effect	SE	CI (L)	CI (H)	Effect	SE	CI (L)	CI (H)
Total effect of BPS	-0.12	0.12	-0.35	0.11	0.14	0.07	0.00	0.28	-0.06	0.07	-0.20	0.07
Direct effect of BPS	-0.02	0.11	-0.23	0.19	0.14	0.07	-0.01	0.29	-0.06	0.07	-0.20	0.08
Indirect effect of BPS	-0.11	0.06	**-0.24**	**-0.01***	0.00	0.02	-0.04	0.02	0.00	0.01	-0.03	0.02
Ratio of indirect to total effect of BPS	0.86	7.38	-0.58	26.74	-0.01	0.85	-2.17	0.29	0.03	0.02	-0.04	0.03
	Cardiac				Ophthalmic				Hypoglycaemic			
	Effect	SE	CI (L)	CI (H)	Effect	SE	CI (L)	CI (H)	Effect	SE	CI (L)	CI (H)
Total effect of BPS	0.10	0.12	-0.13	0.34	0.11	0.09	-0.06	0.28	0.11	0.14	-0.17	0.38
Direct effect of BPS	0.10	0.12	-0.14	0.34	0.14	0.09	-0.04	0.31	0.14	0.14	-0.14	0.42
Indirect effect of BPS	0.00	0.02	-0.03	0.08	-0.02	0.02	-0.11	0.00	-0.03	0.03	-0.12	0.01
Ratio of indirect to total effect of BPS	0.04	20.05	-0.34	9.57	-0.20	70.75	-44.54	0.10	-0.28	8.90	-161.2	0.06
	Hyperglycaemic				Positive affect				Negative affect			
	Effect	SE	CI (L)	CI (H)	Effect	SE	CI (L)	CI (H)	Effect	SE	CI (L)	CI (H)
Total effect of BPS	-0.06	0.12	-0.30	0.19	0.80	1.49	-2.16	3.75	-0.65	1.08	-2.79	1.48
Direct effect of BPS	-0.02	0.12	-0.26	0.22	0.22	1.48	-2.72	3.15	-0.64	1.09	-2.81	1.52
Indirect effect of BPS	-0.04	0.03	-0.15	0.00	0.58	0.40	**0.02**	**1.67***	-0.01	0.21	-0.58	0.33
Ratio of indirect to total effect of BPS	0.63	4.57	0.13	63.07	0.72	17.09	0.18	498.0	0.02	5.90	-2.61	1.97

[Table 6.4 Results from mediation models assessing the direct and indirect effects of writing about one's best possible self on illness symptoms and affect immediately post-intervention (Time 1). Psychological fatigue was the mediator variable. *Significant effect based on confidence intervals.]

6.4 Discussion

This was the first study to demonstrate an effect of the BPS on diabetes symptomatology. More specifically, it was the first study to demonstrate an effect of the BPS on fatigue in adults at various levels of T2D risk (even if effect sizes were only small). Fatigue as a construct may denote subjective symptoms of tiredness or objective deficits in energy and performance (Sharpe & Wilks 2002) although the intervention effect observed here likely related primarily to the former (this study did not include any objective measures of energy output or performance, e.g., metabolic equivalent data). Feeling tired or exhausted may also be symptomatic of deeper issues such as lack of motivation, sleeplessness or underlying medical or psychiatric problems (Sharpe & Wilks 2002). Given the importance of motivation for engagement in self-management behaviours identified in the qualitative phase of Study 1, these present findings may highlight a mechanism by which the BPS has been positively influencing cognitive appraisals (though one also cannot rule out the possibility that the BPS may be underpinned by physiological mechanisms too).

In fact, this argument is supported by the indirect effect that BPS exposure had on cognitive functioning via reductions in fatigue. The mediation results suggest that participants in the BPS condition experienced less difficulty concentrating because of a reduction in fatigue, implying that the writing exercise helped people to develop and clarify their thoughts (indeed, this is primarily what the BPS seems designed to do; King, 2001). Problems in cognitive performance have shown to be a common consequence of chronic fatigue (Cvejic et al. 2016) often as a consequence of changes in the autonomic nervous system (ANS; Van Cauwenbergh et al. 2014). There is, therefore, evidence from previous research that the two symptoms are connected. The indirect effect of BPS exposure on fatigue is important in this context because research suggests diminished cognitive ability and fatigue can hamper a large range of health behaviours necessary for T2D prevention (including exercise and dietary behaviours; Junger & van Kampen 2010; Nijs et al. 2011).

Although there was no evidence that the intervention influenced physiological symptoms, either directly or indirectly (fatigue and cognitive functioning are classified as psychological symptoms by the DSC-R) there was a near-significant effect on reported symptoms of neuropathic pain at T1 (p = .06), which may be worth bearing in mind for future research. Interestingly, the effects associated with BPS exposure were unaffected by T2D risk level. It was expected that high-risk individuals would experience more symptom distress (Paddison et al. 2011) (therefore highlighting potentials ways that the BPS could achieve greater effects) though this was not the case and participants at various levels of risk all received the same benefits.

These results also helped shape the understanding of how the BPS was influencing affect in this context. There was evidence of reduced NA at four weeks in comparison to the control condition, suggesting that the BPS reduced NA over time. Importantly, PA was marginally facilitated as an indirect effect of reduced fatigue, suggesting that while the intervention may not directly generate PA in this context, it may still encourage an increase in PA through reduction of other factors (such as fatigue). Consequently, it is also worth noting that this effect occurred immediately following exposure at T1 but not at T2, in contrast to the reduction of NA. It is possible that the BPS indirectly facilitates PA immediately (if only marginally) and that over time, this leads to reductions of NA in line with the stress-buffering model (Pressman & Cohen, 2005) and/or the B&B (Fredrickson, 2001; 2004), seemingly contradicting the conclusions of Study 1. More research is necessary before drawing firm conclusions, however the present findings seems to suggest that the BPS may still fit partly into certain theories of PA.

6.5 Strengths & Limitations

There was no evidence that the BPS provided more benefits for people at higher risk of T2D. However, the sample composition was biased as 78% of participants were only classified as a low risk of developing T2D. This may also partly explain why the BPS had no effect on biomedical symptoms as the overall sample would be less likely to be experiencing diabetes-related symptoms (Clarke et al., 2007). However, this was the first study to assess the efficacy of a PPI in people at risk of diabetes and it was able to demonstrate a range of positive intervention effects. Future work will just need to be more mindful of the challenges involved in recruiting from this population.

Another limitation is that the follow-up period remained unchanged from Study 1 (four weeks) and so this study was unable to offer insights into longer-term effects of the BPS (e.g., over a year). Long-term efficacy is important if the BPS is to be considered as a clinically relevant tool for managing diabetes-related symptomatology. However, in contrast to the previous study, the follow-up was long enough in this case to detect the build-up of some effects; NA, for example, was reduced after four weeks. A longer-term follow-up may be more important for observing behaviour change but since behaviour was not being measured in this study, it was not vital that a period longer was used. In fact, doing so would likely just increase attrition rates (Fewtrell et al., 2008). First and foremost, this study was designed to assess BPS effects on physical health (i.e. symptoms) and so longer-term effects (especially as the previous study had recently questionned the B&B model's utility in this context) were not considered as vital at this stage of the investigation.

6.6 Conclusions

Writing about the best possible future selves directly reduced fatigue and indirectly reduced cognitive impairment in adults irrespective of T2D risk. Adults at various risk of T2D may, therefore, benefit from this intervention in similar ways as people with T1D and T2D, since fatigue and cognitive impairment can negatively impacts exercise and dietary behaviours. There was no impact on biomedical symptoms such as hyperglycaemia or cardiovascular functioning but there was a marginal effect of the BPS on pain. If the reductions in fatigue observed here directly influence physical activity, or indirectly affect HbA1c levels through physical activity, there may be some potential for widespread implementation into diabetes prevention initiatives targeting high-risk populations for whom fatigue can be a salient comorbidity. For now though, this research would benefit from a better understanding of the intervention's influence over affect and further investigations into intervention mechanisms.

Chapter 7: Study 3 - A Thematic Analysis of 'Best Possible Self' Write-Ups Provided by People at Low and Moderate-to-High Risk of T2D

What Does This Study Contribute to Existing Knowledge?

- This study adds to the small (but growing) number of qualitative explorations into the BPS' effects and mechanisms.
- The results demonstrate that the BPS may in fact be able to reduce both physiological and psychological symptoms of diabetes in certain individuals.
- Furthermore, the results provide additional evidence that the BPS influences perceptions of control or illness ownership in line with Study 1 and the theory of self-regulation.
- Finally, the results are the first to showcase how people at low and moderate-to-high risk of T2D conceptualise their health in relation to their future 'best possible self'.

Abstract

Objectives: The BPS, a goal-setting PPI, has shown to influence perceptions of self-management in people with T1D and T2D (Study 1) and to reduce NA and symptomatology in people at low and moderate-to-high risk of T2D (Study 2). The aim of the present study was to explore how those at low and moderate-to-high risk of T2D specifically engaged with the tailored version of the BPS in order to understand the underlying mechanisms by which the exercise achieves its effects.

Research Design and Methods: Reflexive TA was used to analyse past participants' written accounts of their best possible selves. 14 participants provided data. TA identified two main themes as well as several sub-themes. The data was also scanned for allusions to diabetes symptoms (defined by the Diabetes Symptoms Checklist-Revised).

Results: The first main theme ('Addressing Health as a Whole') highlighted how participants considered their future selves in ways that sometimes went beyond their physical health. The second ('Control') emphasised ways in which participants thought about and challenged themselves to become their best possible selves. Several individuals referenced symptoms in their accounts; although most were psychological in nature (fatigue, difficulty concentrating, etc.), some were neurological (pain and paraesthesias).

Conclusions: Participants engaged with this version of the BPS exercise in ways that allowed them to set their own unique, tailored, health goals. There was evidence that this sense of agency provided boosts to mood and other positive constructs such as optimism and gratitude. Although mentions of psychological symptoms were expected, the use of the intervention to target neurological symptoms was novel.

7.1 Introduction

Study 2 demonstrated that the BPS reduced psychological symptoms associated with T2D, including fatigue and cognitive impairment. Furthermore, the results demonstrated that the BPS had some influence over affective processing. However, those results potentially contradicts the findings of Study 1, which found no evidence of intervention effects on PA or NA. Whether this is a result of the change in sample population is yet unclear, but it is essential to explore and better understand the mechanisms and motivations underlying BPS efficacy in this context.

One way to more clearly understand the intervention's effects would be to undertake a qualitative analysis of BPS content (i.e. what people wrote about when considering their best possible selves). Qualitative investigation aided the adaption of the BPS for this context, but qualitative research can also be used to assess a number of intervention outcomes after or as part of the implementation process. For example, qualitative research has been used to assess the acceptability of a PPI for depression, which the authors suggested they could use to better target individuals that would benefit from the intervention (Walsh, Szymcznska, Taylor, & Priebe, 2018). Other researchers have used qualitative analysis to increase cost-efficiency, availability, and delivery of mindfulness-based interventions (Banerjee, Cavanagh, & Strauss, 2017). Most relevant to this study, one piece of research used a qualitative analysis, guided by theory, to better understand the mechanisms of the PPI 'three good things' (a gratitude intervention). Using thematic analysis (TA), they were able to explore the content of the 'good things' reported by healthcare workers engaging with the intervention to increase knowledge around the intervention as well as the importance of personal and professional relationships amongst those in the health care profession (Rippstein-Leuenberger, Mauthner, Sexton, & Schwendimann, 2017).

A recent review of the BPS literature revealed a dearth of qualitative research in this area (Loveday, Lovell, & Jones, 2018). In considering future directions for BPS investigation, the authors suggested that studies should use qualitative methods with the aim of documenting common and important themes regarding the 'good life' (Loveday, Lovell, & Jones, 2016) in a way that parallels Rippstein-Leuenberger and colleagues' (2017) research. For example, one previous study examined sexual identity by utilising a qualitative approach to investigate how one version of the BPS influenced scores of life-satisfaction (King & Smith, 2004). A content analysis allowed the researchers to score each participants' data based on elaboration, vividness, emotionality, and detail in order to understand how people's perceptions of their gay and straight selves influenced their goals, identity, subjective well-being, and personality development (King & Smith, 2014).

The present study, therefore, aimed to utilise a qualitative approach in order to better understand previous findings as well as other mechanisms by which the BPS may have been achieving its effects (including affect). This could provide an understanding of how people conceptualise specific health-based visions for their best possible selves. The study would also examine whether participants discussed specific symptoms and whether these could be classified as diabetes-related based on the DSC-R (diabetes symptom checklist – revised; Naegeli et al. 2010). It was important that more research was conducted into symptomatology to further understand the physical health benefits of the BPS given the influence on fatigue and cognitive function in Study 2, as well as previous research on the BPS in other contexts (Loveday, Lovell, & Jones, 2018). All participants were recruited from the previous study's participant pool. Partly based on Loveday et al.'s (2016) review suggestions, a thematic analysis (TA) was employed to develop the most appropriate themes and codes from the dataset.

Research Question

- What were the mechanisms underlying BPS efficacy in people at low and moderate-to-high risk of T2D?

7.2 Methodology

7.2.1 Analysis

Reflexive thematic analysis (TA) is a method for identifying, analysing, and reporting patterns or themes within a qualitative data set (Braun, Clarke, Hayfield, & Terry, 2019). It differs from the likes of theoretically wedded methodologies such as grounded theory (GT) and discourse analysis (DA) in that it is not bound to any pre-existing frameworks. This makes it a more flexible analytical method, allowing the data to be approached with fewer assumptions, which was necessary for a study like this where it was important to be as open as possible (Braun, Clarke, & Terry, 2014). Reflexive TA is particularly suited to questions related to people's experiences, views, and perceptions; to understanding and representation; and to the construction of meaning which was important for understanding how people engaged with the BPS. Interpretative Phenomenological Analysis (IPA) can also be used to explore how participants make sense of their personal and social world in a detailed manner in order to generate data that focuses on the meanings that particular experiences, events, and states hold for participants (Smith & Osborn, 2004) but was rejected in favour of TA because the BPS (the object) was also a significant focus.

Before conducting a TA, a number of decisions had to be made regarding researcher orientation (i.e. how the themes would be coded and developed; see Chapter 4 for more details as well as Braun, Clarke, Hayfield, & Terry, 2019). This study's approach is laid out here:

- Inductive OR ~~deductive~~: When it came to approaching and interpreting the data, a decision was made to allow the codes and themes to be directed by the content of the data rather than by existing concepts or ideas. Given the lack of qualitative research into the BPS (particularly in this context), it was important that preconceptions were left behind as best as possible to get a potentially less biased view of the data.
- Semantic OR ~~latent~~: A semantic approach was utilised to reflect the explicit content of the data. However, it was important to be mindful of participant's motivations and the more subtle ways in which the intervention may have affected their ideas, goals, and behaviours, so reading between the lines was important so long as there was enough evidence to support doing so.
- Critical realist/essential OR ~~constructionist~~: Rather than examine ideas and themes through a constructionist epistemological lens that would lead to assumptions about the wider socio-cultural context, an essentialist/realist philosophy was adopted in order to assess individual psychologies.

Together, these orientations allowed the lead researcher (BG; i.e. the author) to obtain a rich description of the data set rather than a purely detailed account of one particular aspect in order to address both research questions adequately. However, the focus was occasionally shifted at appropriate times in order to ascertain certain details.

Texts were read and re-read by the same researcher (BG), in order to familiarise themselves with the breadth and depth of data. Initial codes were then generated systematically on a line-by-line basis. Codes were collated into a large number of candidate themes (see Table 7.1 below). These initial themes were worked and reworked and constantly checked against the data until only a smaller set of main themes and sub-themes remained. The final themes were then written up as a series of draft result sections that were scrutinised and reworked by the research team. After key themes had been derived, the research team met to discuss and reflect on the analytical process. Final results, as well as various drafts of this chapter, were also discussed amongst the research team.

Candidate Themes			
Appearance	Feeling Good (Quality of Life)	Support Networks/Social Aspects of Health	How a Best Possible Self Affects Others
Motivation	Mental Health	Specific/Quantifiable Goals	Existing Knowledge
Interconnectedness (How Healthy Behaviour/Mindsets are Linked/Have Beneficial Knock-on Effects)	Gaining Control over One's Health and Health Behaviours (Identifying What Works for You)	A Holistic Approach to Health	Positive Feelings Generated by Considering/Achieving Goals
BPS as Aid to Identify/Overcome Barriers	BPS as Means to Encourage Novel Behaviours	Self-Forgiveness	Technology as an Aid
Gratitude	The discrepancy between Current Self and Future Best Possible Self (negative)	Other (Non-health Related) Goals	Long-Term Goals/Future Expectancies

[Table 7.1. Initial candidate Themes. Candidate themes would be merged or otherwise broken down and reworked into larger main themes and sub-themes.]

7.2.2 Participants

A sample of participants that had previously completed the intervention as part of Study 2 were sought for this study. This way, people who already had a minimum of four weeks engagement with the intervention could share an example or a reflection of their 'best possible self' with the researcher. These individuals would not have felt a need to write "for" anyone but themselves and this reduced some of the potential bias that may have been evident in texts from people who had been recruited specifically to write with the knowledge that they were sharing it afterwards. This method allowed for a more natural "observation" of people's engagement, especially as texts could have been from various time points (some participants may have provided a first text compared with another who may have shared their last; although participants were never asked to share this information). Data was provided purely in the form of written accounts (participants were not interviewed; reflexive TA was ran as part of a textual analysis), and for most individuals, this meant providing examples of their 'best possible selves'. Some, however, preferred to provide reflections on their time using the intervention itself. One individual provided an example of both. In some cases, where people provided their thoughts rather than examples, it was because they felt uncomfortable sharing their personal hopes and ideas for a better future. Advertisements, therefore, were sent to the same recruitment pools as last time (LJMU mailing lists, Twitter, and Facebook), to specifically attract people who had taken part in Study 2 (see Appendix 4 for adverts). Anyone interested in the study was presented with detailed participant information that described the nature of the research. If they were happy to take part, then they signed consent and submitted their texts either face-to-face or via email. Ethical approval for this study was obtained from the Liverpool John Moores University Research Ethics Committee (UREC, reference: 18/NSP/045). Participants were recruited between May 2018 and June 2018.

In total, 14 participants took part, and 15 sets of data were provided. One participant's data was excluded from the analysis because they had used a different version of the BPS task. This left the team with 15 sets of usable data. Not all participants were native English speakers (though all data was provided in English). 12 sets of data were provided as electronic copies, 3 were provided as hand-written copies (that were then scanned or photographed). Of those that participated, 12 were female and 2 were male. The mean age of this sample was 30.71 (SD: 12.7) with a range between 21-71 years old, which, like the gender balance, was representative of Study 2's sample. Even after having excluding one set of data, a clear repetition of themes was evident by the 9th account. Saturation was believed to have occurred by the 15th. Saturation was based on the notion that no new knowledge was being generated by the data (Bowen, 2008).

As previous participants of Study 2, the version of the BPS that participants of this study engaged with (and were commenting on) was the same as the one detailed in Chapter 6. It has been reproduced again below as a reminder of its content:

> "Take a moment to think about your best possible self. Imagine that you are in excellent health and that you have been taking extra good care of your body. You are exercising regularly, and you are eating well. You have worked hard and succeeded at accomplishing all of your health-related goals. Imagine how it felt to achieve those goals and reflect on how positive it would feel to be this fit and healthy. Then, tell yourself the important things you realised or the critical steps you took to get there.
>
> Now, please use the next 10 minutes to write continuously about what you imagined. Use the tips below to guide you through this process:
>
> 1. Be as creative and imaginative as you want. Do not worry about perfect grammar and spelling as this is for your private use. No one has to know what you wrote down, though you may find it helpful to share and develop ideas with trusted friends, family, or your health-care team.
>
> 2. Do not feel too pressured to write everything down on your first try. As you repeat this task, more ideas will come to you naturally.

3. Remember, steps towards success are often small. You may find it easier to write about things that are more achievable, to begin with, such as investing in a pedometer/walking app or making the decision to try new recipes more often. However, if you want to aim high and write about running a half-marathon, that's okay too!

4. If you find thinking about one aspect of your health particularly difficult, try focusing on another one. The important thing is that you write about something long-term so that you can make more noticeable improvements over time."

7.3 Results

Participant	Symptoms	Do they fit the DSC-R?
8E	Concentration, disturbed sleeping pattern, back pain, headaches, feeling unfit, feeling tired.	Yes (psychological; fatigue and cognitive)
10J	Continually sneezing, sore eyes, diagnosis of "chronic allergic rhinitis", diagnosis of "basal cell carcinoma", bad back, walking is painful.	Not all, though sore eyes and painful walking could fall under neurological symptoms.
11E	Feeling tired	Yes (psychological)
12S	Feeling tired, blood circulation problems.	Yes (psychological and neurological)

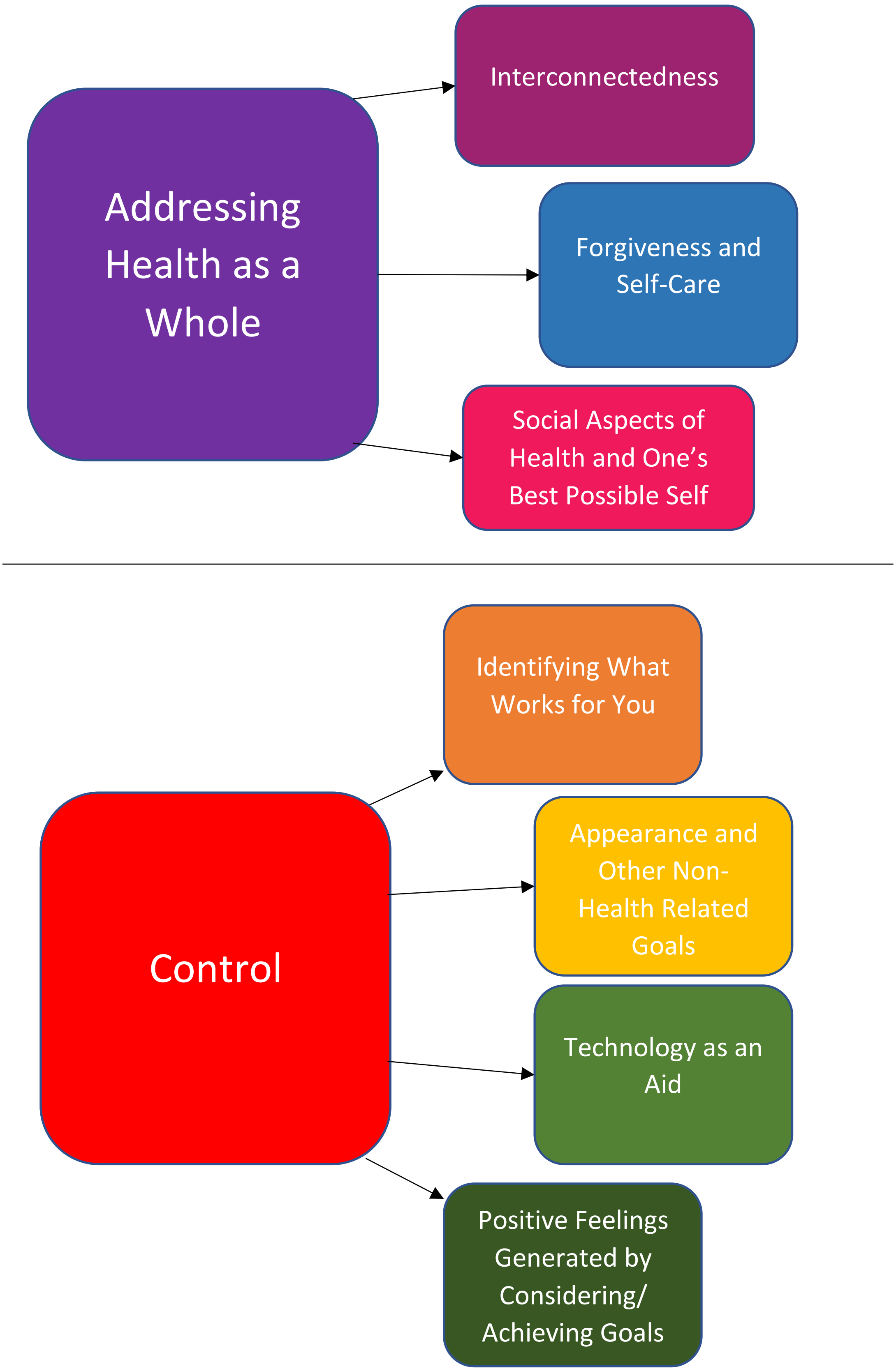
[Table 7.2 Symptoms referenced in the data set.]

Diabetes symptoms were defined using the Diabetes Symptoms Checklist-Revised (DSC-R), which was previously used to assess symptomatology in Study 2. Diabetes symptoms can be scored by the DSC-R as fatigue, cognitive impairment, pain, sensory, cardiovascular, ophthalmological, hypoglycaemic or hyperglycaemic. Combing through the accounts, it was quickly evident that only a few participants discussed actual symptoms. Of the symptoms discussed, most were psychological. Fatigue was especially an issue, although there was also evidence of some neurological issues. See Table 7.2.

Following this, the data was used to generate two main themes in order to assess people's health based visions for their best possible selves: (1) Addressing Health as a Whole and (2) Control. Addressing Health as a Whole contained four smaller sub-themes: 'interconnectedness', 'mental health', 'forgiveness and self-care', and 'social aspects of health and one's best possible self'. Control also consisted of four sub-themes: 'identifying what works for you', 'appearance and other non-health related goals', 'technology as an aid', and 'positive feelings generated by considering/achieving goals'. Addressing Health highlighted how participants thought about their future selves in a way that went well beyond their physical health while Control emphasised the myriad of ways in which they thought about and challenged themselves to become their 'best possible self'. See figure 7.1 for a simple visual representation of themes.

Addressing Health as a Whole

The first main theme demonstrated that most participants took a rather holistic approach to their health. There was a frequent acknowledgement of, and a desire to increase, their physical, mental, and social well-being. There was also an acknowledgement that physical health behaviours such as diet and exercise were important but that the health of one's best possible self was in some ways much more than that.



[Fig 7.1 Thematic Map. Themes were less interconnected than they had been in Study 1]

A Sense of Interconnectedness

Participants frequently saw different aspects of their health as complimentary or otherwise linked, and so a consideration of multiple factors was important in gaining a broader perspective. Often, recipients of the BPS were quick to realise that certain health behaviours helped promote others.

> *'I noticed that exercising makes me eat healthier too. I genuinely crave for fresh fruits and vegetables.'* (5D)

Mental health, in particular, was considered especially complementary, and a number of participants made important connections between their mental health and physical health goals. There was an understanding that, in some cases, the two were almost dependent on one another.

> *'The exercise I do in my ideal self include a variety of sports (running, cycling, yoga, climbing, swimming) that improve my fitness in different ways and relax my mind'* (13V)

> *'This highlighted how much I needed to prioritise my emotional health at the moment in order to achieve the physical goals I want to achieve'* (6C)

Forgiveness and Self-Care

Achieving health goals was described by one participant as "an ongoing journey" (4N), and for a lot of participants, this meant taking care of themselves along the way. For some, this meant being honest with themselves and celebrating small victories. For others, patience and an ability to keep moving forward was important.

> *'This isn't something that happens overnight. You can't eat whatever you want to anymore and it not be an issue; I have to look after my body, we'll be together for a while (hopefully)'* (8E)

For the individual's mental health in particular, having a "structure" (7B) and being in a position where one could "be there for [one's] self" (1A) were also ways to ensure visions of a best possible self could be realised.

Social Aspects of Health and One's Best Possible Self

Relationships were central to some participants' BPS accounts. Some people envisioned a more sociable future, either as a goal in and of itself or as a result of meeting other health goals.

> *'I want to become more confident in talking to people, especially strangers, and making myself go up to someone at an event or messaging people more often, so I am not feeling so alone'* (7B)

Others saw their existing support networks as vital for the completion of their newly created health goals; as one participant put it: "my best possible self is impacted by other people around me" (14M). Some individuals suggested that they could not become the best version of themselves without considering, and giving back to, others. One participant used the opportunity to reflect upon their existing family relationships in order to use the intervention to generate feelings of gratitude.

> *'Still, I am most fortunate in that I have a good marriage, a lovely home, enough money to live on, two super children who are doing well in their careers and one 15-year-old grandson who I adore but is a typical teenager at the moment'* (10J)

Control

Goal setting is central to the 'Best Possible Self' task. This theme highlighted how intervention recipients were able to take control of their future by being proactive in the present.

Identifying What Works for You

Participants generated a host of novel health behaviours that they managed to, or later hoped to, engage with. See Table 7.3 for a full list of behaviours.

Participant	Exercise Behaviours	Dietary Behaviours	Mental Health Care
2K	Climbing, yoga, running (including doing a 10K), walking 10,000 steps a day.	Bought more fruit and veg, prepared own lunches so as not to buy snacks/unhealthy meals.	
3J	Dancing, yoga, exercise.	Cooked more, cut down on takeouts and sugary drinks.	Meditation, doing things she enjoys.
4J	Going to the gym, lifting weights.	Aimed to hit calorie/food targets.	
5D	Working out at home with help from YouTube videos, cycling.	Improved intake of proteins (with food and powders), continue to exercise, which makes her crave fresh fruit and veg.	
7B	Go to the gym 3 times a week	Make smarter choices with food, eat well for 6 out of 7 days a week	Structure work,/life balance. Rethink existing relationships and develop new and better ones in the future.
8E	Walks/hikes exercise regularly.	Aiming to eat a balanced amount of nutrients and vitamins.	Yoga, physical exercise as a way to improve mental health/reduce anxiety.
9C	Box jumps, circuit training.		Yoga. 9C also believes improvements to physical health and a feeling of social connectedness will

			boost her mental health.
11E	Gym (including stepper/running machines), outside running.		
12S	Increase physical activity when at home (in Italy), spend less time sitting down, use stairs rather than elevators.	Snack at work to prevent hunger-fuelled binges at home, eat more fruit and veg, eat more whole-grain stuff and more legumes and lentils.	Get more (quality) sleep.
13V	Running, cycling, climbing, swimming, yoga, walk more. Bike instead of using public transport.	Eat vegetables, cook meals at home, follow a balanced diet, select only the best and most nutritious ingredients.	Continue to engage in physical activity and sports, which allow 13V to "relax (her) mind". Follow the principles of mindful, practice meditation.

[Table 7.3 Intervention-generated behaviours (in the participants' own words).]

In order to generate this list of goals, participants used the task to first consider their current levels of health. They then identified the barriers that had been preventing them from engaging with healthier behaviours before subsequently generating solutions to overcome them. Frequently, this meant coming up with ideas that made choosing healthy behaviours easier or more fun. Sometimes this required engaging in planning behaviours to make decision making easier in the moment.

> *'I took up activities that I enjoyed, and that did not feel so much like "exercise", for example, I started to go climbing once a week as well as doing yoga and running on nice days'* (2K)

There was a sense of people using this intervention to ask serious questions of themselves and their behaviour. For one individual, the BPS allowed then to gain "insight as to why I wanted to be this 'version' of myself and why I thought it was the ‘best’ version” (6C). For others, it set them on an exploratory path towards new behaviours where they would have to re-evaluate what works for them.

Appearance and Other Non-Health Related Goals

For some participants, control ocassionally meant looking more widely at their well-being and using non-health related goals as motivators to facilitate an increase in healthy behaviours. Appearance was referred to a lot, but a sense of security (either as the result of improved education or better career prospects) was also important. Often, physical health and appearance were tied together, with people believing that an improvement in physical health would lead to an improvement in physical appearance. For some, this appeared to be the reason to engage in healthier behaviours. For others, it was merely a nice bonus. One individual had already begun to notice changes in their appearance, but for them, appearance acted more as a visual indicator that their health was improving.

> *‘This would help me lose weight as well as improve my fitness making me feel healthier, more confident and attractive’* (11E)

> *‘You could feel physically that you’d made changes, it wasn’t just a superficial thing about how you looked’* (4N)

Appearance, in other words, was a goal for many participants. It was something they wanted to improve. However, one individual considered their appearance but rather than wanting to see it change, took a more accepting outlook in order to facilitate their health goals.

> *‘I decided to be more body positive and focus on health rather than weight loss’* (3J)

Technology as an Aid

Some participants mentioned that one way to help set, track, and achieve goals was with the aid of technology. People used alarms, videos, step-trackers, calorie checkers, and a range of other apps to help them monitor and encourage their behaviours. Videos, in particular, could also be used to educate the individual in order to help them develop new behaviours.

> *'I started also checking my phone app regularly to track how much I was walking and then started to do a target of 10000 steps a day'* (2K)

> *'I started using a YouTube channel that provides very detailed programmes to work out. I found it useful as you are free to choose the length and level of exercises at every workout. Being very detailed, it feels like having a coach guide a personalised session'* (5D)

The important thing, as one participant noted, was to enter data and engage with technology in a way that was honest. Skipping tutorial videos or lying about food choices on a calorie counter might look impressive but it would not benefit that participant's health.

Positive Feelings Generated by Considering /Achieving Goals

As an intervention, the BPS is designed to facilitate positive emotions by giving people the space to think about their future and generate positive goals. This sub-theme sheds some light on how exactly this was accomplished. For many participants, achieving their goals provided feelings of happiness. For others (who perhaps were not at that stage) just sitting down and thinking about their future selves made them feel motivated. Participants also reflected on feeling proud of themselves, even if they were not currently their 'best possible selves'.

> *'I feel healthy and happy that I was able to accomplish my health-related goals'* (2K)

> *'I continued to do this regularly and was able to run more long distances, and it made me feel really good to be able to achieve this'* (2K)

> *'You kept going to the gym, gradually being able to increase the weight you lifted and that felt amazing'* (4N)

> *'I found being able to talk about how I wanted to be in the future reminded me of my motivations, which are so easy to lose sight of in our busy day to day lives'* (6C)

> *'I felt proud to achieve all of my goals, I'm feeling really positive about myself and the people around me'* (8E)

There was an acknowledgement that these goals take time, but that things "became easier each time!" (2Kii). Still, some were concerned about the discrepancy between their current selves and best possible future selves.

> *'This takes a lot of hard work and effort; a lot of commitment, which sometimes I feel I do not have and so I am not my best possible self at the moment'* (8E)

7.4 Discussion

7.4.1 Overview

The primary aim of this study was to explore the mechanisms underlying BPS efficacy in people at low and moderate-to-high risk of T2D. This reflexive thematic analysis of people's 'best possible selves' highlighted a number of unique ways in which people engaged with, and benefited from, the BPS intervention. Symptoms identified in the data suggest that participants were using the task to identify and address existing health problems, especially those pertaining to mental health and psychological well-being, though certain neurological problems (including pain) were also addressed. Themes demonstrated how people conceptualised their health and how they set, managed, and achieved goals in order to take control of their health.

7.4.2 Symptoms

Only a small number of participants explicitly addressed symptoms. These findings, therefore, should not be seen to contradict the results of Study 2. Rather, they may be best thought of as highlighting potentially less common ways in which people utilised the intervention and received benefits. Indeed, the symptoms reported in the results section were still broadly reflective of previous findings. Fatigue and cognitive impairment (i.e. psychological symptoms), which were shown to be significantly impacted by the BPS (either directly or indirectly) in Study 2 were also the most frequently discussed maladies here in participants accounts. Pain was also referenced by at least one participant, and intervention effects on pain were shown to be approaching significance (p = .06) in Study 2. The BPS has been used by researchers to change the perception of pain in previous experiments (Peters et al., 2017) so this study provides further evidence that the BPS may offer similar benefits to a subset of this sample population too. The texts actually highlighted a consideration of various neurological symptoms (not just pain) including two participants who also discussed sensory issues (especially in relation to circulation). It was not clear whether participants perceived a reduction of sensory symptoms over time, but an acknowledgement and/or greater awareness of the issue might lead to benefits over time in line with the SDT (Deci & Ryan, 2000; 2008).

It was unclear why only a small sample of participants discussed symptoms. Those who discussed symptoms may have felt the need to discuss them in their accounts because they were causing particular distress at the time. On the other hand, a lack of discussion around symptoms may simply indicate that most participants were not experiencing symptomatology. Indeed, one of the limitations of Study 2 was that the population were of relatively low risk and so they may have been less likely to experience unpleasant symptoms. The results of this study suggests that there may be additional benefits of the BPS for those experiencing greater symptomatology but this needs further quantitative investigation. Given that those at higher risk should experience more symptoms (Clarke et al., 2007), future research may yet find evidence of risk interaction effects, despite Study 2’s findings.

7.4.3 Themes

The first main theme demonstrated how health was addressed and conceptualised as a holistic construct by participants. The data clearly showed that participants were not only using the intervention to think about their physical health; they were also mindful of their emotional and social well-being too. Participants often developed and reflected on existing goals specifically to meet their mental health and social well-being needs. Importantly, these aspects of health were often linked. Participants seemed not to really consider them as separate but instead saw their social, mental and physical health goals as feeding into and supporting one another (as evidenced in the 'interconnectedness' sub-theme). Given the behavioural and psychosocial aspects of T1D and T2D, diabetes has previously been defined as a 'model disease' for the biopsychosocial model (Hunter, 2016) and here, participants' views seemingly reflected this argument.

In some cases, non-health related goals were also discussed. Health is complex and multifaceted, so meeting seemingly non-health related goals may have been important for some participant's well-being. For example, appearance was discussed frequently enough to warrant its own theme as it seemed that appearance and health, in particular, were linked in people's minds. In some cases, progress towards a body "ideal" acted as motivation to engage in certain health behaviours. However, appearance goals were not just tied to being "slimmer" or "more attractive", as sometimes people used their appearance as a reflection of their progress. At least one participant also used the BPS to encourage body acceptance. Body acceptance is associated with improved self-esteem and mental health (Murakami & Latner, 2015) so future research could examine what determines why the BPS encourages this positive approach in some but not others. This would have important ramifications for obesity and weight loss, where body acceptance has shown to reduce self-stigma, emotional eating, weight-related experiential avoidance, and self-criticism (Palmeira, Cunha, & Pinto-Gouveia, 2019).

Regardless of which aspects of their health participants chose to write about, the data showed that participants used the intervention to generate tailored goals in a way that appeared concordant with the theory of self determination (SDT; Bak, 2015; Dark-Freudeman & West, 2016). This theory, which has been referenced across all three studies now, argues that goals can be used to encourage autonomy, competence, and relatedness that promote beliefs and actions towards a beneficial end (Hagger, 2010). The sense of space created by the BPS appears to be encouraging autonomy (i.e. the sense that one's actions are under one's control), which was evidenced by the data throughout the main theme of 'control'. However, the intervention may also encourage a sense of competence too (the notion that one is capable and skilled) if novel goal-related behaviours are acted on and shown to be engaging and/or effective. Furthermore, a sense of relatedness (the feeling that one is close and connected to others) may be why people were using goals to address their social well-being.

The 'technology' theme also supports the concept of autonomy as it provides some of the best examples of how participants used the intervention to take control of their health. Participants used technology not only to motivate themselves (some participants used goal monitoring apps, for example), they also used it to better inform and educate themselves (through the use of YouTube videos, for example). Alhough more work is needed to assess the effects of technology on clinical outcomes across health research (Burnham, Lu, Yaeger, Bailey, & Kollef, 2018), this sub-theme highlighted the potential of integrating the BPS with technological aids (such as educational videos, for example). It may also link somewhat with an important finding from Study 1; participants with diabetes in the qualitative phase of that study argued for a need to encourage support seeking and sharing of BPS ideas so that there were external forces helping them to attain their goals. People seeking to prevent diabetes or improve their health more generally will unlikely have the same need or support systems in place (e.g. lack of a diabetes health team, for example) but technology could provide a support system of sorts (by providing a way to receive education, to track goals, etc.). The findings in this study may, therefore, support the notion that the BPS works best not in isolation but by encouraging engagement with other various means of support. It is worth remembering at this point too that PPIs are frequently administered as part of a “buffet-style approach” (Huffman et al., 2014; Parks et al., 2012) and so this study provides more evidence that the BPS may likely make a good fit alongside other resources.

As a reflection exercise, the BPS was also shown to provide participants with the space to reflect on how goal setting and achieving goals made them feel. This might be how the BPS increases PA (indirectly or otherwise). It might also help facilitate other positive constructs such as optimism, for which there was some evidence for in the data (see the sub-theme ‘positive feelings generated by considering/achieving goals’), and which has been increased by the BPS in other studies (Peters et al., 2013). There was also evidence that these constructs (PA/optimism/etc.) were construed as motivating, and this could be a further mechanism by which change occurs over time. This would support the notion that PA encourages further PA as put forward by the theories contained within the Broaden-and-Build model (Fredrickson, 2001; 2004) and the Upward Theory of Lifestyle Change (Fredrickson, 2013; Van Cappellen, Rice, Catalino, & Fredrickson, 2017), though there was no direct evidence to support this. However, ‘motivation’ was also addressed in the qualitative phase of Study 1, suggesting more research into this area is warranted.

Interestingly, one participant also reflected on feelings of gratitude. While not related to PA, gratitude is often a component of other positive psychological interventions (Boehm et al., 2011). Little research has examined the effectiveness of the BPS as a tool for inducing the positive construct gratitude, so this may be an avenue for future research. Alternatively, the evidence from the present study may suggest that the BPS could be used alongside gratitude interventions, especially if participants are already talking about how achieving their goals makes them feel.

Finally, the present findings raise some questions around the future utility of the BPS in clinical practice. Could the intervention be administered by members of the health care team to support people at risk, helping to generate ideas or solutions that health professionals may not have the time, imagination or patience to provide, for example? If autonomy is indeed a vital mechanism (as suggested by the SDT), then pairing the BPS with education may also be effective. The 'technology as an aid' sub-theme observed in this study suggests that pairing the BPS with some other resource (whether that is a form of technology or a complimentary PPI) could be beneficial. Furthermore, continued support for the SDT provides more evidence that the BPS is achieving its effects via more cognitive pathways than hypothesised at the beginning of this thesis.

Before utilisation can be considered, however, it should be noted that some participants were concerned about the discrepancy between their current selves and best possible future selves. Participants with T1D and T2D expressed some concerns in the qualitative phase of Study 1, but this is the first actual evidence of negative impacts of the intervention. Hitherto, research on the BPS has failed to examine potential side effects of the BPS but it is worth remembering that any intervention that has the potential to do good also has the potential to do harm. It is possible that there are statistically significant psychological risks when the BPS is administered in this context. Future work should examine the potential for adverse outcomes not just in those at low and moderate-to-high risk of T2D but also for people with T1D and T2D.

7.5 Strengths & Limitations

This study uniquely used qualitative methods to further understanding of the BPS' mechanisms within this context. However, the sample, being representative of Study 2's population, was likely to be made up of more participants at low risk for T2D. It is possible that a more at-risk population may have discussed different aspects of their health, and this might have influenced the types of themes that were generated. Furthermore, there was uncertainty regarding the degree to which the goals that participants were discussing were actually met. Goal achievement could also have a significant influence on participants' accounts as well as the emotions that they experience (King, 2001). Asking for a record of which goals were and were not attained might have been useful, although it is possible this could have induced some degree of psychological distress if people suddenly had to reflect on the goals they had not yet achieved. King (2001), however, has long advocated for researchers to track people's goals and the review by Loveday and colleagues (2016) argued the same point.

7.6 Conclusions

This study aimed to identify some of the mechanisms that underpin BPS effects in people at low and moderate-to-high risk of T2D. Although there remains a number of questions unanswered, this study has shown the importance of using qualitative studies to gain insight and a deeper understanding of how the BPS works in this context. It has highlighted how people conceptualise their health when given the tools to think freely and without judgement while control (or a sense of autonomy; Deci & Ryan, 2000; 2008) seems to be particularly important in how the BPS achieves its intervention effects. The results therefore reinforces the need to be mindful of the SDT, as results have supported the theory in all three studies thus far. Future research therfore needs to continue considering BPS effects on physical health outcomes as well as affect. In order to best do this, stress was investigated more thoroughly in line with theories discussed in Chapter 3 throughout Studies 4 and 5.

Chapter 8: Study 4: The Influence of the ‘Best Possible Self’ Intervention on Stress and Resilience in People at Low and Moderate-to-High Risk of T2D

What Does This Study Contribute to Existing Knowledge?

- Results indicated that the BPS can significantly reduce physical health symptoms (namely neuropathic sensory diabetes symptoms) in participants at low and moderate-to-high risk of T2D.
- The results also demonstrated that the BPS builds resilience in this population over a four week period.
- Furthermore, the BPS immediately reduced perceived stress following exposure in those at higher risk of T2D, indicating that the level of diabetes risk is important when considering certain intervention effects.

Abstract

Objectives: Study 2 demonstrated that the BPS may reduce NA over time as part of a stress-buffering effect while Study 3 showed that a further investigation into affective processes is necessary. The aim of this study, therefore, was to assess whether exposure to the BPS directly influenced perceived stress or resilience in people at low and moderate-to-high risk of T2D over a four week period.

Research Design and Methods: Adults (N = 110) at low and moderate-to-high risk of T2D took part in an online study which utilised a 2x2 mixed factorial design to determine whether BPS exposure (intervention vs control) and level of diabetes risk (low risk vs combined moderate- and high-risk) had any influence on self-reported perceived stress or resilience. Intervention effects on symptomatology were also measured. MANOVAs were used to assess intervention main and interaction effects.

Results: After four weeks, BPS exposure had increased resilience ($F(1, 59) = 6.266$, $p < .05$, $\eta p2 = .10$). There was also a marginal effect of the BPS on stress at the same time point ($p = .06$), which interaction effects showed was a result of those at higher risk receiving greater reductions in stress. Furthermore, the BPS was also shown to significantly reduce sensory, neurological symptomatology (Wilk's Lambda = .791, $F(1, 94) = 5.34$, $p < .05$, $\eta p2 = .055$) while fatigue was also reduced in those at higher risk (Wilk's Lambda, = .791, $F(1, 94) = 6.23$, $p < .05$, $\eta p2 = .06$).

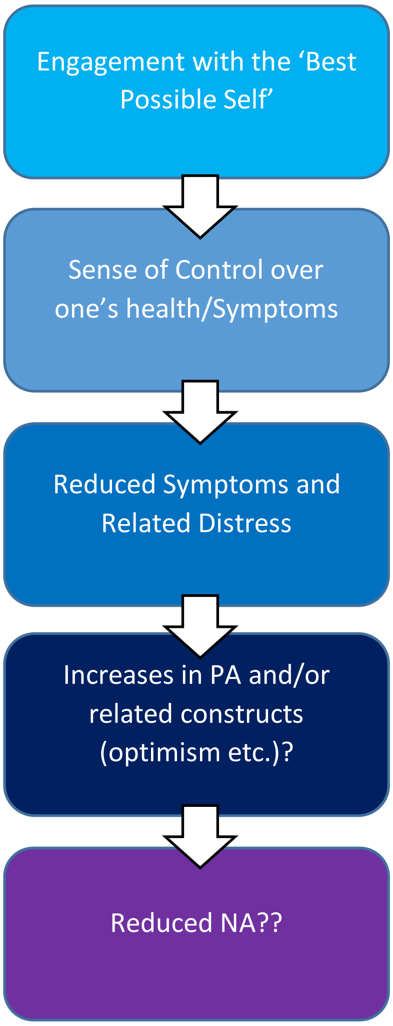
Conclusions: The BPS improved resilience and alleviated diabetes symptomatology in participants at low and moderate-to-high risk of T2D. Participants at higher risk of T2D in the BPS condition also experienced significantly reductions in perceived stress over time, which may have direct implications for diabetes prevention efforts. However, these results may suggest a development of resources or coping strategies rather than a stress-buffering effect per se.

8.1 Introduction

8.1.1 Overview

Study 2 demonstrated that the BPS marginally facilitated PA in a population of people at low and moderate-to-high risk of T2D. Furthermore, the BPS produced significant reductions in NA over a four week period, hinting at a possible stress-buffering effect (Pressman & Cohen, 2005). Study 2 also showed that the BPS has some influence on illness symptomatology in this population and that reductions in symptoms of fatigue, in particular, may have moderated the relationship between the intervention and affective benefits. Study 3 was designed to further investigate these mechanisms, and the results provided some evidence that the BPS was giving participants a sense of "control" over their own broad definitions of health (including physical and mental health, as well as the quality of their social and intellectual lives) in line with self determination theory (SDT; Deci & Ryan, 2000; 2008). The BPS was shown to help participants address symptoms, develop goals, and to potentially engage in novel behaviours. It was also shown to facilitate a range of positive constructs (not just limited to PA; there was also evidence of optimism and gratitude), indicating that participants were feeling positive after engaging with the BPS more in line with Fredrickson's (2001; 2004) and Pressman and Cohen's (2005) models of PA.

In light of these findings, further investigation into affective processes was required, especially given that PA models had been set aside in favour of the SDT following Study 1. Given that a number of previous diabetes PPIs have shown evidence of stress-buffering effects (whereby PA was facilitated, and NA was reduced over time; Tran et al., 2011) there was a need to assess whether the BPS was also acting to buffer against stress. See Figure 8.1 for a conceptual model of how the BPS may be achieving its effects amongst a population of those at risk of T2D based on the results so far.



[Fig 8.1 A conceptual model of how the BPS may be achieving its effects in this context. Structural Equational Modelling or Path Analyses will be needed to properly test this model]

8.1.2 Defining Stress

According to Selye's (1976) original definition, stress is the "nonspecific response of the body to any demand" (pg. 74) and that stressors are "that which produces stress" (pg. 78). Stressors can take many forms, from workplace demands to interpersonal losses. Stress in and of itself is not necessarily "good" or "bad" (Semmer et al., 2004) but appraisal and prolonged exposure (i.e. chronic stress) play a role in determining whether stress can lead to physical or mental health difficulties over time. For example, long-term stress exposure is associated with poor clinical outcomes across a range of health conditions (see Slavich, 2016 for examples) as well as accelerated biological ageing and premature mortality (Cohen, Janicki-Deverts, & Miller, 2007). Meanwhile, negative stress appraisals can lead to rumination and poor self-concept (Lee-Flynn, Pomaki, DeLongis, Biesanz, & Puterman, 2011; Mezo & Baker, 2012), which has consequences for the likes of depression (Willis & Burnett Jr., 2016). Appraisals are important because stress is also a matter of perception, and so stress has also been described not only as "the stimuli that produces a certain state" but also as "the subjective feelings of discomfort in this state and the responses that occur in an organism in this state" (Ursin, 1991 page 174). In this sense, stress also encapsulates NA.

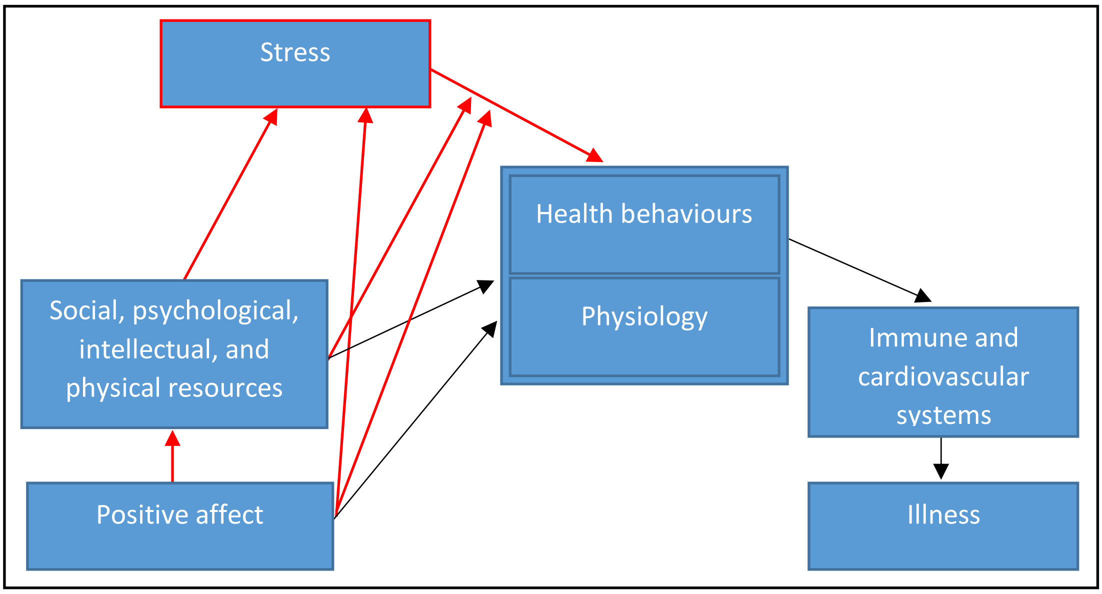
8.1.3 Stress and Diabetes

An inability to deal with stressors (subjective or otherwise) can lead to "downward spirals", whereby negative affective states become self-perpetuating (Garland, Fredrickson, Kring, Johnson, Meyer, & Penn, 2010). In T2D, a downward trajectory of self-perpetuating NA has consequences for risk, self-management, and clinical outcomes (Miles et al., 2018; Ortiz & Wiley, 2018). Education about T2D, for example, produces anticipation of life-changing complications that can paradoxically make it harder for people to act on their newly acquired health literacy, leading to further negative anticipation (Schinkus et al., 2017). Experiencing symptoms can produce similar problems, especially if they appear as a consequence of an individual's action (or inaction) (Fisher, Mullan, Arean, Glasgow, Hessler, & Masharani, 2010). The stress that this then generates influences future decision-making that can have negative consequences for diabetes prevention and long-term outcomes (Morris, Moore, & Morris, 2011). For example, people may avoid exercise if it leads to hypoglycaemia, while stress may lead to inappropriate behaviours such as eating unhealthy foods and drinking alcohol in excess (Coz & Gonder-Frederick, 1992).

Furthermore, there is also evidence for direct links between stress and blood glucose regulation. Chronic activation of the physiological stress response (PSR) which consists of the interrelated responses from the Sympathetic Adrenomedullary system (SAM) and the Hypothalamic Pituitary Adrenal Axis (HPA), can offset physiological homeostasis (Kelly & Ismail, 2015), leading to adverse effects on various organ systems and conferring risks for metabolic aspects of diabetes (McCurley et al., 2015). In normal conditions, the SAM releases catecholamines, which lead to productions of cytokines and acute-phase proteins in order to induce a systemic inflammatory response (Kyrou & Tsigos, 2009). Proinflammatory cytokines have shown to interact with insulin signalling and, under sustained activation of the SAM, can contribute to dyslipidaemia and insulin resistance (Hotamisligil, 2006). Activation of the HPA axis, meanwhile, initiates production of cortisol and other glucocorticoids which can lead to increased glucose production in liver cells, hyperglycaemia, and inhibition of insulin secretion (Kyrou, Chrousos, & Tsigos, 2006). Most current interventions designed to reduce the prevalence and incidence of T2D still largely invoke a behavioural model (Kelly & Ismail, 2015) but there may be other important underlying mechanisms that need to be addressed.

8.1.4 Stress Buffering Effects

It is, therefore, essential to understand the role of perceived stress in this context. The Stress Buffering Model of PA and Health (Pressman & Cohen, 2005) states that health benefits arise primarily out of PA's ability to reduce stress and its impact on physical health. In the model, stress is proposed to mediate the association between PA and health-relevant variables either directly or indirectly such that PA reduces both the incidence and impact of stress (see Figure 8.2 below).

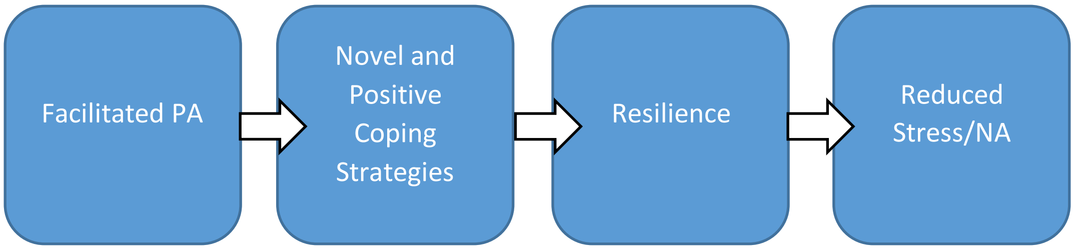


[Fig 8.2 Pressman and Cohen's (2005) stress-buffering model of PA. The red signifies the paths by which stress moderates and is mediated by PA.]

The model is supported in this context by work by Tran and colleagues (2011), who found evidence that a benefit finding intervention was associated with improved illness adjustment among adolescents with T1D. The results showed that benefit finding (i.e. attempting to identify positive outcomes in the face of adversity; Helgeson et al., 2006) was associated with lower depressive symptoms, higher perceived coping effectiveness and increased uptake of self-management behaviours. Benefit finding was also shown to interact with negative affective reactions to predict symptoms and HbA1c. PA was not objectively measured, but the authors still concluded that benefit finding acted as a resource to buffering the disruptive aspects of NA reactions to stress in line with the Stress Buffering Model (Pressman & Cohen, 2005).

8.1.5 Resilience

Alternatively, PPIs may influence stress appraisals by facilitating resilience (Gloria & Steinhardt, 2016). As a construct, resilience describes an individual's capacity to maintain psychological and/or physical well-being in the face of stress (Rosenberg et al., 2015). According to Fredrickson (2004), PA promotes resilience by expanding people's behavioural and cognitive repertoire, giving people the ability to recognise a wider range of possible coping strategies in times of need. In other words, PA allows the individual to become better equipped in dealing with stressors through the development of psychological resources. See figure 8.3 below for an illustration.



[Fig 8.3 An illustration designed to demonstrate how facilitated PA may reduce NA over time.]

In practice, resilience can moderate the impact of stress on anxiety and depression symptoms (Pinquart, 2009; Wagnild, 2003; Wingo et al., 2010), especially when programmes designed to facilitate PA are utilised. In the context of diabetes, PPIs have shown that PA predicts improvements in externalising problems as well as glycaemic control over a six-month period (Lord, Rumburg, & Jaser, 2015). This is supported by other non-intervention data which shows that resilience is negatively correlated with HbA1c such that as resilience scores increase, HbA1c levels go down, indicating improved glycaemic control (DeNisco, 2011). Work is currently ongoing to assess what types of coping strategies are most effective for promoting resilience, although strategies that encourage openness to experiences appear to be more effective than strategies that encourage withdrawal and avoidance (Jaser & White, 2011).

8.1.6 The Present Study

Research suggests that positive interventions for increasing resilience in a diabetes context are not only effective but demonstrate high acceptance amongst its users (Jaser & White. 2011; Rosenberg et al., 2015). However, there are likely to be differences between T1D populations (which those studies drew conclusions from) and populations of those at risk of T2D. Furthermore, theory also dictates that further investigation is required; for example, the Stress-Buffering model (Pressman & Cohen, 2005) and the Broaden-and-Build model (Fredrickson, 2001) offer very different explanations of PA's influence over stress, and there is little data to suggest which theory the BPS will align with, especially given previous findings in this thesis (e.g. reductions in NA over time in Study 2 and generation of PA and goals in Study 3). As such, both stress and resilience were taken into account as intervention outcomes in the present study. Similarly, potential buffering effects of both stress and resilience were also investigated as other non-diabetes interventions have demonstrated that enhancing coping strategies and protective factors decreases symptomatology (Steinhardt & Dolbier, 2008).

Thus, the aim of this study was to assess the intervention effects of the BPS on diabetes-related symptoms, stress, and resilience in people at low and moderate-to-high risk of T2D over a four week period. Given that people at low and high-risk experience different levels of diabetes-related symptoms (Clarke et al., 2007), level of diabetes risk was once again treated as a potential moderating factor.

The hypotheses were as follows:

- The BPS will significantly reduce stress
- The BPS will significantly increase resilience.

- The BPS will significantly reduce diabetes-related symptomatology
- Condition allocation will interact with diabetes risk such that participants at higher risk of T2D exposed to the BPS will see significantly more reductions in diabetes symptomatology

8.2 Methodology

8.2.1 Design

This study utilised a 2x2, between-groups factorial design whereby BPS exposure (intervention vs control) and diabetes risk grouping (low risk vs combined moderate- and high-risk individuals) acted as the study's independent between-group variables (IVs). Perceived stress, resilience, and diabetes symptomatology were the study's dependent variables (DVs). Condition x Risk interaction effects were measured to assess the impact that risk had on intervention outcomes.

8.2.2 Study Sample and Recruitment

110 non-clinical participants were recruited for this study (an *a priori* G power calculation [Faul, Erdfelder, Buchner, & Lang, 2009] suggested that 102 participants would be the minimum sample size to detect a medium effect for this study given desired power levels of 95% and a preferred alpha level of 0.05), Recruitment of participants was done primarily online via non-probability sampling. Emails were sent to mailing lists of staff and students from Liverpool John Moores University. Links to the study were also placed on social media sites such as Facebook and Twitter. Recruitment was conducted between August 2018 and March 2019.

The average age of participants was 25.7 with a range of 18 – 67 (SD: 11.307). Of those that took part, 16 (14.5%) were male and 93 (84.5%) were female while 1 participant (0.9%) did not state their gender. Of the total sample, 96 (87.3%) were White while the rest of the population was made up of Black, East Asian, South Asian, other non-White (not explicitly defined by the CANRISK questionnaire, which also acted as a means of gathering demographic information) and various mixed ethnicities (e.g. other non-White and East Asian). The majority of participants (N=

102; 92.7%) lived in the UK, but other countries of residence included Australia, Brazil, Canada, Netherlands, Philippines, Saudi Arabia, South Africa, and the USA.

8.2.3 Materials

To assess risk for T2D, participants completed the CANRISK questionnaire (Kaczorowski et al., 2009; see also Chapter 4, section 4.3.2 for more information on this measure and the others included in this study). Based on their total scores, participants were classified as "low" (<21), "moderate" (21-32), or "high" (≥33) risk. Risk was considered as an interaction effect in the main analyses in order to understand the impact that risk had on intervention effects.

The existence of symptomatology and related symptom distress was measured using the Diabetes Symptoms Checklist (DSC-R; Arbuckle et al., 2009). At Time 1, pain (α = .587) and cardiovascular (α = .691) symptoms were removed from the analysis for being unreliable (i.e. a Cronbach's alpha lower than 0.7). At Time 2, however, all eight symptom clusters (fatigue α = .893; cognitive α = .867; pain α = 863; sensory α = .848; cardiovascular α = .771; ophthalmic α = .756; hypoglycaemic α = .829; hyperglycaemic α = .790) were reliable and included in that round of analysis.

To measure stress, this study utilised the Perceived Stress Scale (PSS; Cohen & Williamson, 1988). The PSS is the most frequently used stress instrument, and it assesses aspects of the stress experience (e.g. "how often have you felt nervous and stressed"). Total scores were compared at both time points between groups. Higher scores reflected a higher degrees of stress.

Resilience was measured using the Six-Item Brief Resilience Scale (6BRS; Smith, Dalen, Wiggins, Tooley, Christopher, & Bernard, 2008). Again, total scores were compared at both time points and between groups. A higher score indicated higher levels of resilience.

8.2.4 Procedure

This study was hosted on the online platform Qualtrics. The study was advertised, and interested individuals followed a URL link to the study site, whereupon they viewed a participant information sheet. They were informed of the nature of the study, including the fact that their involvement would last for four weeks. If people were happy to take part, they declared their consent and provided their email address. Participants were then randomly assigned to either a BPS or waiting list control (non-BPS) condition using Qualtric's inbuilt 'randomizer' function. Participants in the control condition were informed that they would receive the intervention at the end of the 4-week period while participants in the BPS condition received the same version of the BPS from Study 2 (Chapter 6, section 6.2.2):

> "Take a moment to think about your best possible self. Imagine that you are in excellent health and that you have been taking extra good care of your body. You are exercising regularly, and you are eating well. You have worked hard and succeeded at accomplishing all of your health-related goals. Imagine how it felt to achieve those goals and reflect on how positive it would feel to be this fit and healthy. Then, tell yourself the important things you realised or the critical steps you took to get there.
>
> Now, please use the next 10 minutes to write continuously about what you imagined. Use the tips below to guide you through this process:
>
> 1. Be as creative and imaginative as you want. Do not worry about perfect grammar and spelling as this is for your private use. No one has to know what you wrote down, though you may find it helpful to share and develop ideas with trusted friends, family, or your health-care team.
>
> 2. Do not feel too pressured to write everything down on your first try. As you repeat this task, more ideas will come to you naturally.

3. Remember, steps towards success are often small. You may find it easier to write about things that are more achievable, to begin with, such as investing in a pedometer/walking app or making the decision to try new recipes more often. However, if you want to aim high and write about running a half-marathon, that's okay too!

4. If you find thinking about one aspect of your health particularly difficult, try focusing on another one. The important thing is that you write about something long-term so that you can make more noticeable improvements over time."

All participants, regardless of condition allocation, then completed the Time 1 questionnaires: CANRISK, DSC-R, PSS, and 6BRS. Participants were then told that they would be contacted via email in 4 weeks' time (Time 2) to repeat the questionnaires (minus the CANRISK).

8.2.5 Analysis

All analyses were conducted using SPSS (version 25). A MANOVA was utilised to assess the main and interactive effects of the BPS (intervention versus control groups) and diabetes risk (low versus combined moderate and high) on stress, resilience, and diabetes symptomatology (fatigue, cognitive impairment, sensory, ophthalmic, hypoglycaemic, and hyperglycaemic symptoms) at Time 1 (immediate exposure) and Time 2 (4-week exposure). Diabetes risk was included as an independent variable to assess its moderating influence on any significant BPS effects.

8.2.6 Ethics

This study received ethical approval from the Liverpool John Moores University Research Ethical Committee (LJMU REC; reference number 18/NSP/067). Participants were provided with an information sheet and asked to provide consent before taking part. All participants were debriefed about the full nature of the study after they had finished taking part. People were free to withdraw at any time without giving a reason.

8.3 Results

8.3.1 Descriptive Statistics

Table 8.1 shows means, standard deviations, and other descriptive parameters for the diabetes symptoms subscales and total stress and resilience scores at Time 1. Table 8.2 shows the same data for Time 2. Of the those that took part, 87 participants (79.1% of the total sample) were categorised as low risk, 12 participants (10.9% of the sample) were shown to be at moderate to high risk of developing T2D, and 11 participants (10%) failed to provide adequate risk data. At T1, fatigue and cognitive difficulties were the most common symptoms that participants struggled with, followed by symptoms of hypoglycaemia. Fatigue and cognitive issues remained common complaints at T2 (though these had seemingly decreased in the intervention condition). Pain and sensory symptoms were the least reported malaises across the study.

Given that total stress scores on the PSS can range between 0-40 (with a lower score indicative of less stress), participants' perceived stress across groups at T1 were very average. Using the same logic, participants rated themselves as slightly higher than average on scores of resilience (where total scores of the BRS range between 1-5 and higher scores denote higher levels of resilience).

	Writing condition			Control condition		
	Total sample	Low-risk	Moderate or high-risk	Total sample	Low-risk	Moderate or high risk
Outcomes (Time 1)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Symptoms (DSC-R)						
Fatigue[b]	2.09 (1.26)	2.23 (1.28)	1.17 (0.54)	1.94 (1.36)	1.84 (1.28)	2.75 (1.78)
Cognitive	1.84 (1.27)	1.91 (1.33)	1.38 (0.68)	1.46 (1.19)	1.40 (1.18)	1.88 (1.31)
Pain	0.35 (0.56)	0.36 (0.59)	0.29 (0.37)	0.37 (0.69)	0.30 (0.55)	0.83 (1.36)
Sensory[b x]	0.25 (0.47)	0.28 (0.50)	0.56 (0.14)	0.34 (0.79)	0.26 (0.48)	1.00 (1.94)
Ophthalmic	0.34 (0.50)	0.34 (0.50)	0.37 (0.54)	0.32 (0.61)	0.30 (0.60)	0.50 (0.70)
Hypoglycaemia	1.59 (1.19)	1.72 (1.19)	0.78 (0.98)	1.36 (1.16)	1.34 (1.15)	1.50 (1.36)
Hyperglycaemia	0.94 (0.90)	0.98 (0.95)	0.67 (0.46)	1.07 (0.93)	1.01 (0.91)	1.54 (1.07)
Perceived Stress (PSS) & Resilience (BRS)						
Stress	21.84 (7.47)	22.49 (6.99)	17.83 (9.77)	18.89 (6.67)	19.23 (6.53)	16.17 (7.78)
Resilience	3.29 (0.83)	3.24 (0.82)	3.58 (0.85)	3.18 (0.85)	3.20 (0.84)	3.00 (0.967)

[Table 8.1 Means and SDs for diabetes symptoms and stress and resilience (at T1) based on experimental condition and diabetes risk category. Note. ap < .05, bp < .01 reflects main effects, that is, differences between total sample means for the BPS versus control condition. Meanwhile, xp < 0.05, yp < 0.01 reflects interaction between experimental condition and diabetes risk category (risk groups are based on CANRISK scoring criteria, whereby < 21 = low risk; 21 to 32 = moderate risk; ≥ 33 = high risk).]

	Writing condition			Control condition		
	Total sample	Low-risk	Moderate or high-risk	Total sample	Low-risk	Moderate or high risk
Outcomes (Time 2)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Symptoms (DSC-R)						
Fatigue	1.51 (0.90)	1.65 (0.85)	0.75 (0.89)	1.44 (1.05)	1.39 (1.08)	1.88 (0.66)
Cognitive	1.14 (0.77)	1.23 (0.78)	0.69 (0.59)	1.22 (0.94)	1.13 (0.88)	1.88 (1.25)
Pain	0.22 (0.66)	0.19 (0.66)	0.38 (0.75)	0.35 (0.61)	0.27 (0.47)	1.00 (1.17)
Sensory	0.17 (0.61)	0.18 (0.66)	0.83 (0.17)	0.28 (0.52)	0.23 (0.47)	0.71 (0.77)
Ophthalmic	0.30 (0.76)	0.36 (0.81)	0.00 (0.00)	0.14 (0.34)	0.11 (0.27)	0.35 (0.70)
Hyperglycaemia	0.56 (0.66)	0.58 (0.69)	0.44 (0.52)	0.89 (0.77)	0.87 (0.70)	1.13 (1.30)
Perceived Stress (PSS) & Resilience (BRS)						
Stress [x]	15.84 (7.56)	17.62 (6.80)	6.50 (3.32)	16.69 (6.12)	16.69 (5.76)	16.75 (9.71)
Resilience [b x]	3.59 (0.82)	3.40 (0.74)	4.54 (0.46)	3.35 (0.78)	0.38 (0.76)	3.13 (1.03)

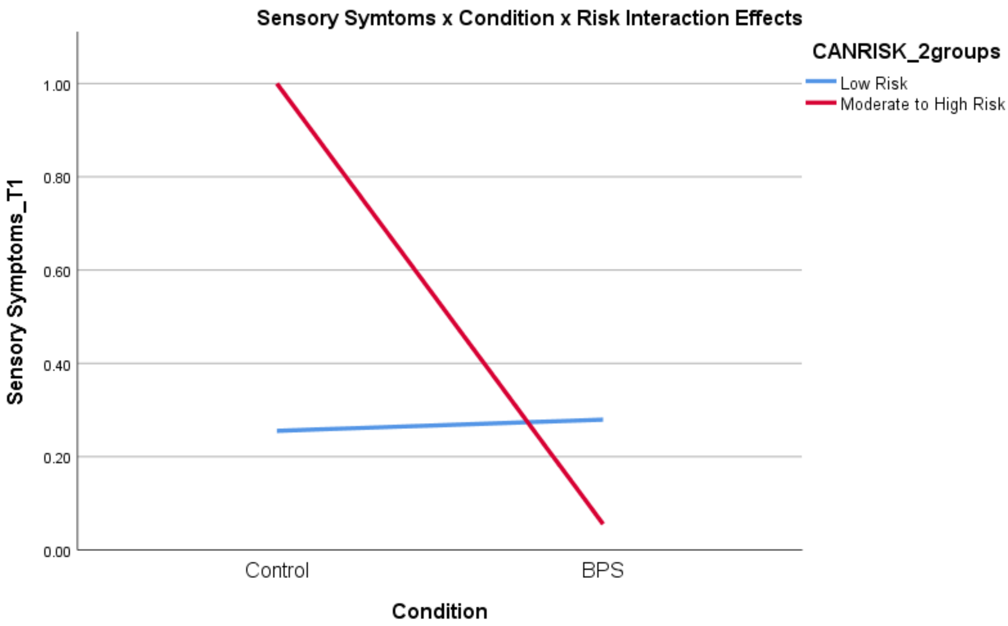
[Table 8.2 Means and SDs for diabetes symptoms and stress and resilience (at T2) based on experimental condition and diabetes risk category. Note. ^{a} = p < .05, ^{b} = p < .01 reflects main effects, that is, differences between total sample means for the BPS versus control condition. Meanwhile, ^{x} = p < 0.05, ^{y} = p < 0.01 reflects interaction between experimental condition and diabetes risk category (risk groups are based on CANRISK scoring criteria, whereby < 21 = low risk; 21 to 32 = moderate risk; ≥ 33 = high risk).]

8.3.2 Intervention Effects (T1)

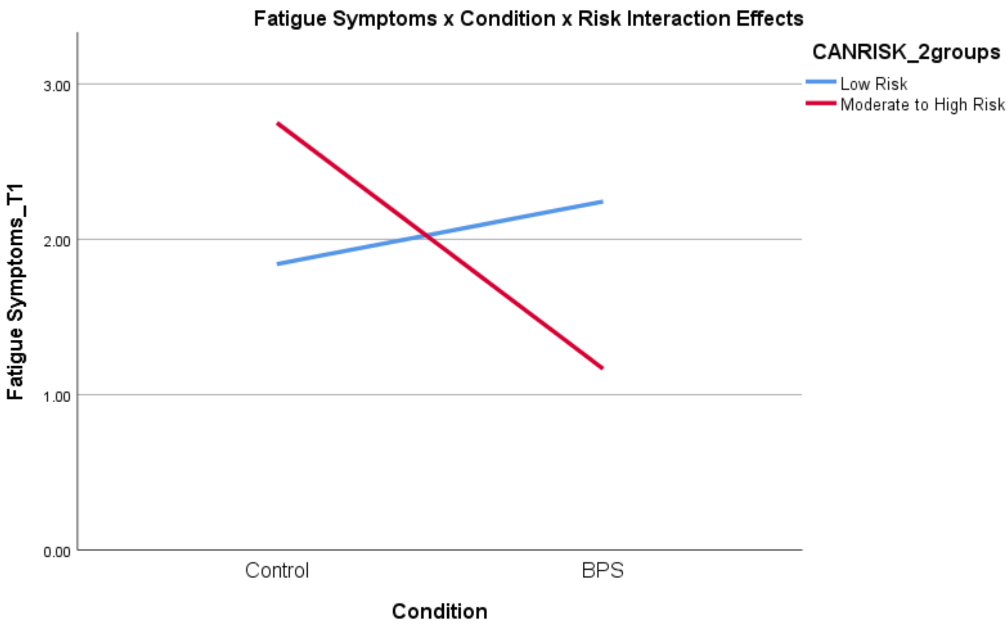
A 2 (Condition: intervention vs control) x 2 (Diabetes risk: Low vs moderate/high) MANOVA was performed to evaluate the effect of the BPS intervention on the seven diabetes symptomatology scales (fatigue, cognitive function, pain, sensory, ophthalmic, hypoglycaemia, hyperglycaemia), and on stress and resilience total scores. Box's M = 53.577, F (45, 19652.03) = 1.06, $p = .369$ showed that assumptions of homogeneity of covariance were met but Levene's tests on pain $F(3, 92) = 3.51$ and sensory symptoms $F(3, 92) = 10.67$ (p's < .05) violated assumptions of equality. As such, the MANOVA was repeated using the bootstrapping method (Krishnamoorthy and Lu 2010) to account for assumption violations. The number of bootstrapping samples was set at 1000, with simple sampling. The tests of between-group effects revealed a significant effect of the BPS on neuropathic sensory symptoms (Wilk's Lambda = .791, $F(1, 94) = 5.34$, $p < .05$, $\eta p2 = .055$).

Examination of the means revealed that participants exposed to the intervention experienced significantly less neuropathic sensory symptoms (such as numbness or tingling in the extremities), in comparison to participants in the control groups (see Table 8.1). The MANOVA demonstrated that this effect may have in part been influenced by a significant interaction effect between condition and risk group (Wilk's Lambda, = .791, $F(1, 94) = 5. 93$, $p < .05$, $\eta p2 = .06$). A significant Condition x Diabetes Risk interaction was also identified for fatigue symptoms (Wilk's Lambda, = .791, $F(1, 94) = 6.23$, $p < .05$, $\eta p2 = .06$), though there was no main effect of the BPS on this symptom cluster ($p > .05$). Examination of mean tables and graphs show that those at moderate-to-high risk of T2D in the intervention condition significantly reduced neuropathic sensory and fatigue symptoms compared to participants in the control group (see Figures 8.4 and 8.5).

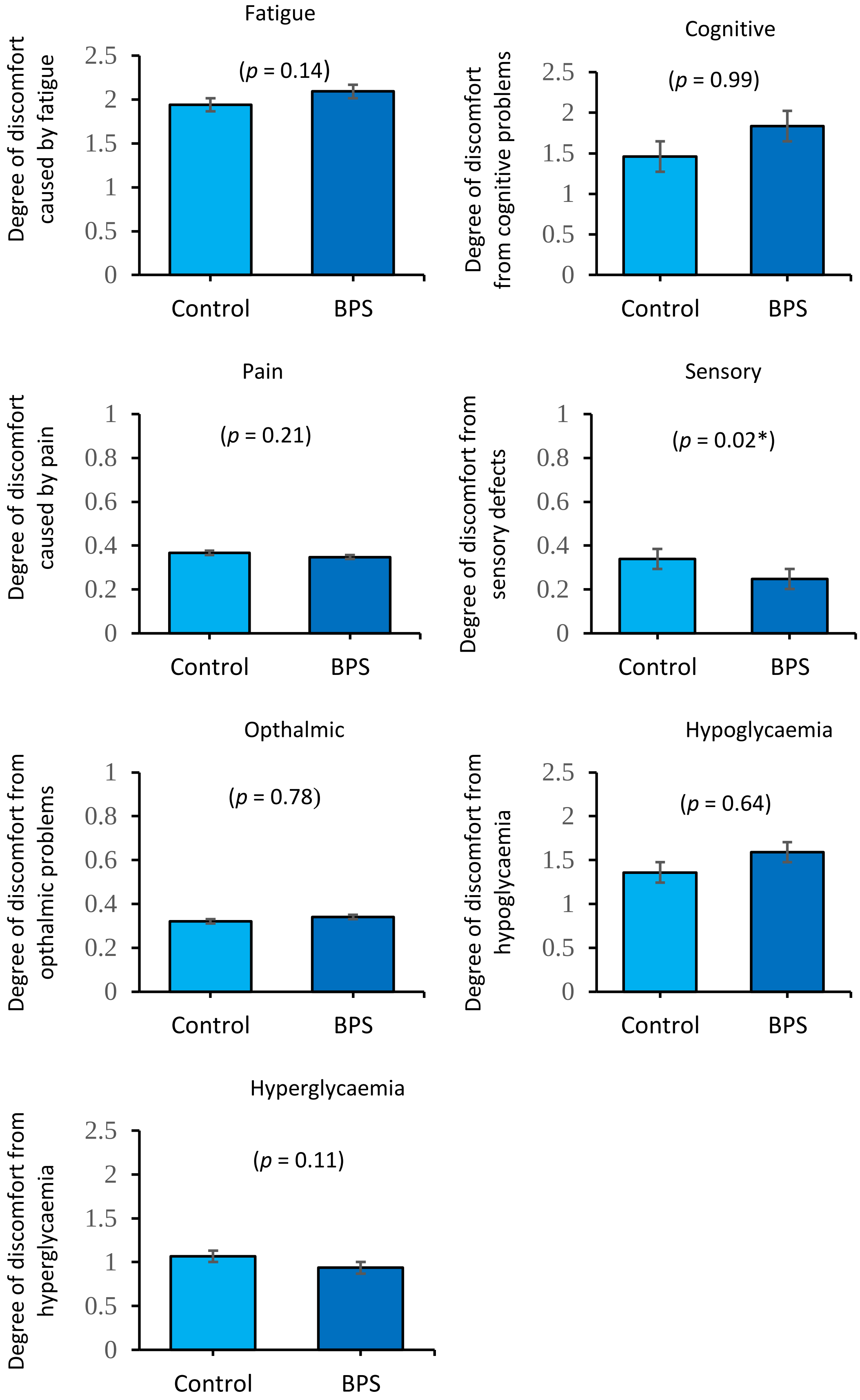
At Time 1, there were no significant main or interaction effects on stress (p > .05) or resilience ($p > .05$).



[Fig 8.4 Neuropathic Sensory Interaction Effects. Individuals at higher risk of T2D particularly showed reductions in sensory symptoms at T1.]



[Fig 8.5 Fatigue Interaction Effect. Individuals at higher risk of T2D showed the greatest reductions in fatigue symptoms]

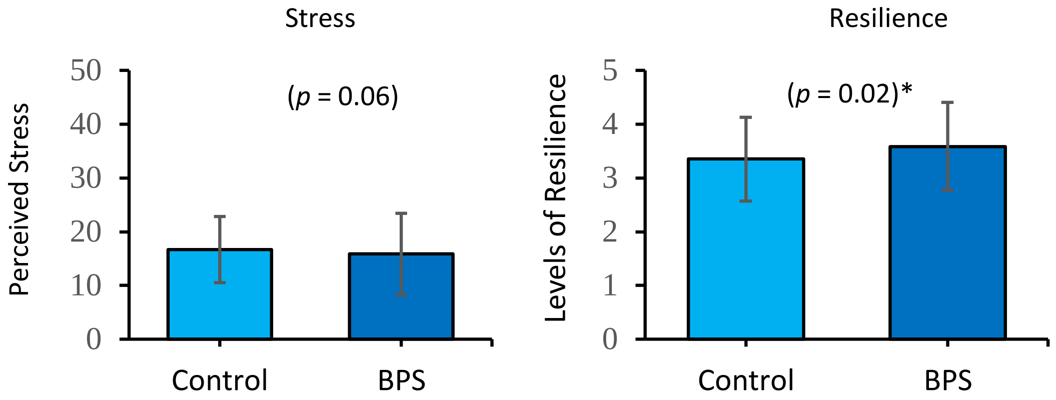

Fatigue
Degree of discomfort caused by fatigue
(p = 0.14)
2.5
2
1.5
1
0.5
0
Control
BPS
Cognitive
Degree of discomfort from cognitive problems
(p = 0.99)
2.5
2
1.5
1
0.5
0
Control
BPS
Pain
Degree of discomfort caused by pain
(p = 0.21)
1
0.8
0.6
0.4
0.2
0
Control
BPS
Sensory
Degree of discomfort from sensory defects
(p = 0.02*)
1
0.8
0.6
0.4
0.2
0
Control
BPS
Opthalmic
Degree of discomfort from opthalmic problems
(p = 0.78)
1
0.8
0.6
0.4
0.2
0
Control
BPS
Hypoglycaemia
Degree of discomfort from hypoglycaemia
(p = 0.64)
2.5
2
1.5
1
0.5
0
Control
BPS
Hyperglycaemia
Degree of discomfort from hyperglycaemia
(p = 0.11)
2.5
2
1.5
1
0.5
0
Control
BPS

[Fig 8.6 The effect of writing about one's 'best possible future self' versus a waiting list control condition on reported diabetes-related symptoms at T1. Symptom scores (i.e., level of discomfort) ranged from 0 (none) to 5 (extreme). The intervention group reported less sensory symptoms immediately post-exposure.]

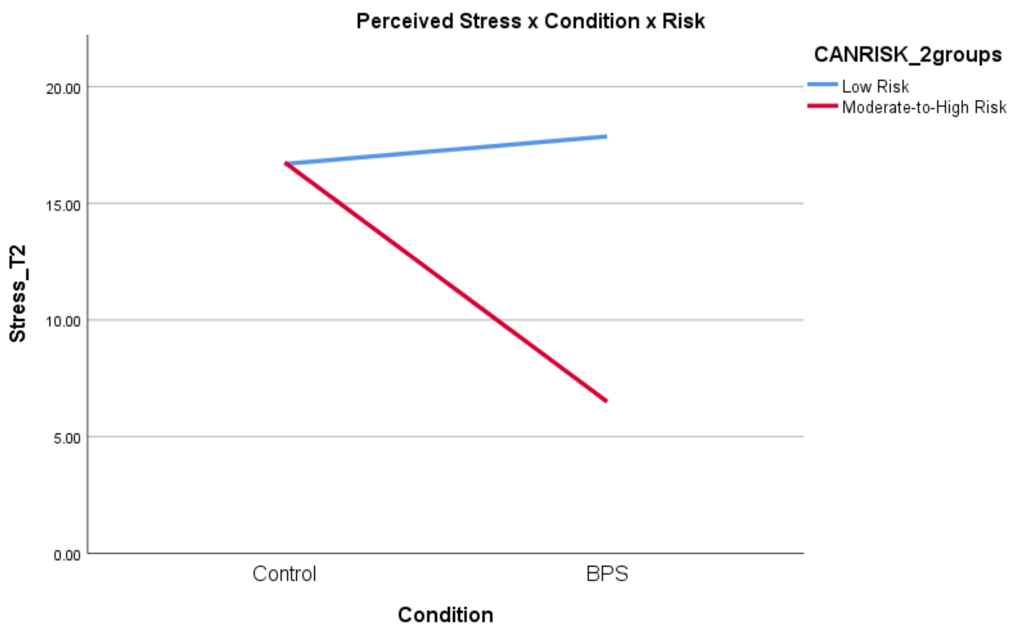
8.3.3 Intervention Effects (T2)

A 2 (Condition: treatment vs control) x 2 (Diabetes risk: Low vs moderate/high) MANOVA was also conducted on follow-up (Time 2) data for six of the diabetes symptomatology sub-scales (fatigue, cognitive function, pain, sensory, ophthalmic, hyperglycaemia), and on stress and resilience sum scores. This time, Box's test (M = 88.717, $F(36, 6198.71) = 1.02$, $p < .01$) as well as Levene's tests (half of the factors were $p < .05$) showed that assumptions of homogeneity of covariance and equality were both violated. Consequently, the MANOVA was once again rerun, using the bootstrapping method (with simple sampling and the number of bootstrapping samples set at 1000). The omnibus MANOVA revealed no significant main or interactive effects for the BPS on symptomatology at this time point (p's > .05), suggesting that the BPS no longer had any effects on symptoms at the end of the four week period. However, the MANOVA did reveal between-group difference effects on scores of resilience ($F(1, 59) = 6.266$, $p < .05$, ηp2 = .10). Consultation of the means tables showed that there was a significant, positive effect of the BPS on resilience such that participants in this group were more resilient at four weeks follow up (see Table 8.2). Perceived stress was not significantly influenced by the BPS, but it was approaching significance ($p = .06$; see figure 8.7).

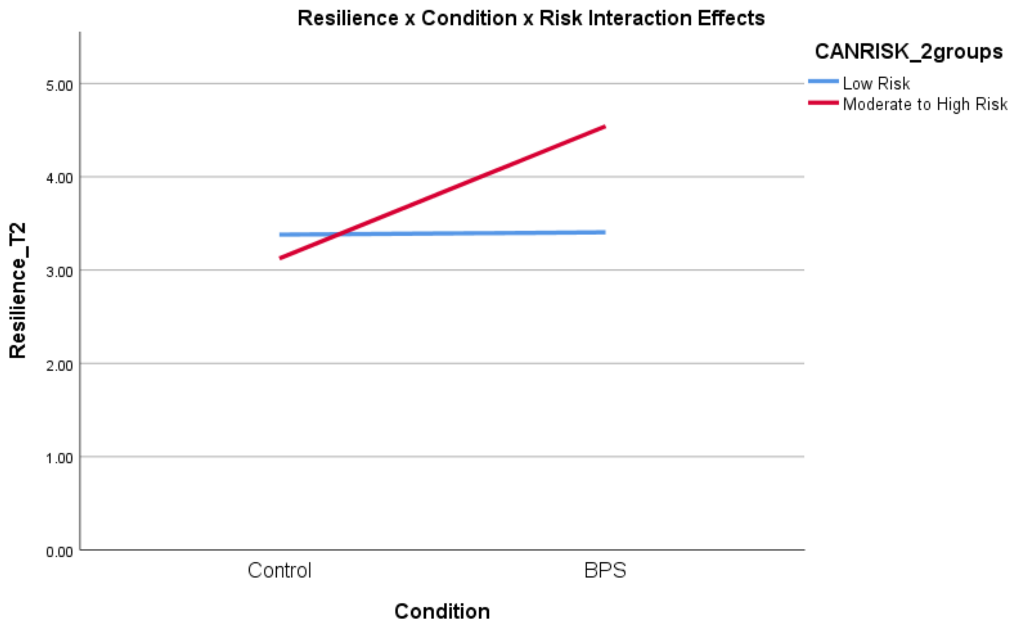
Interaction effects again provide further insights into the effects that the intervention has in relation to risk. There was a significant Condition x Diabetes Risk interaction effect on resilience ($F(1, 59) = 5.846$, $p < .05$, ηp2 = .09) as well as a significant BPS x Diabetes Risk interaction effect on perceived stress ($F(1, 59) = 5.424$, $p < .05$, ηp2 = .09). Means tables and graphs illustrated the Condition x Diabetes Risk interaction effect on both stress and resilience, such that the BPS reduced stress and improved resilience particularly in those at moderate-to-high risk of T2D. Figures 8.8 & 8.9 illustrate these interaction effects.



[Fig 8.7. The effect of writing about one's 'best possible future self' versus a waiting list control condition on perceived stress and resilience after four weeks (T2). The intervention group reported more resilience at follow-up. There was also a marginal effect of the intervention on stress (*p* = .06)]



[Fig 8.8 Perceived Stress Interaction Effects at Time 2. Those at higher risk of T2D received greater reductions in stress as a result of exposure to the BPS]



[Fig 8.9 Resilience Interaction Effects at Time 2. Those at higher risk of T2D received the greatest boosts to resilience from the BPS over time]

8.4 <u>Discussion</u>

The aim of this study had been to assess the effects of BPS exposure on diabetes-related symptoms, stress, and resilience in people at low and moderate-to-high risk of T2D over a period of four weeks. There was a need to understand whether the BPS was reducing perceived stress in line with the stress-buffering model (Pressman & Cohen, 2005) and/or increasing resilience through the development of resources in line with the Broaden-and-Build model (Fredrickson, 2001; 2004). It was hypothesised, therefore, that the BPS would reduce diabetes symptomatology (in line with Study 2's findings), reduce stress, and improve resilience, and that T2D risk would play a moderating role such that those in the intervention condition at higher risk would receive the greatest benefits from the intervention (in line with Study 3s conclusions). All hypotheses were accepted.

At Time 1, there was evidence of BPS effects on symptomatology, suggesting immediate health benefits of the intervention. This supports Study 2's results, where the BPS directly reduced fatigue and indirectly reduced cognitive impairment, both of which were psychological symptoms of diabetes. However, in this study, the BPS also reduced sensory neuropathic symptoms (or at least distress associated with such symptoms) which refers to numbness or tingling sensations in the extremities (Arbuckle et al. 2009). Reduction of neuropathic sensory symptomatology was a novel quantitative finding, though one participant addressed similar symptoms as part of their 'best possible self' account provided in Study 3 (it is also worth noting that of the symptoms the intervention has influenced thus far throughout the thesis, the BPS had the largest effect here on neuropathic sensory symptoms; $\eta p2 = 0.55$). Fatigue, meanwhile, has now shown to be consistently reduced across the last three studies, though the present findings suggest that it may be a symptom more greatly reduced in those at higher T2D risk. In Study 2, there was evidence of Condition x Risk interaction effects on fatigue, although BPS exposure also produced a main effect on fatigue too, perhaps reflecting a subtle difference in the sample composition (for example, this study had fewer people at higher risk than Study 2 did, although it is not entire clear how this difference may have impacted the general findings).

A reduction in neuropathic sensory symptoms is also important to consider because it represents the first evidence that the BPS can reduce physical health symptoms as much as psychological ones (i.e. fatigue and cognitive impairment) in people at all levels of risk of T2D. The BPS has previously shown to reduce illness symptoms and pain in other studies outside of the diabetes context (Hanssen et al., 2013; Molinari et al., 2017; Maddalena et al., 2014). Like in this study though, it has previously been unclear whether effects on physical health are the result of changes in perception or changes to physiological factors. However, results from Study 1, 2, and 3 have shown that that cognitive appraisals are likely playing an important role in BPS effects. On the other hand, this study's results demonstrate that influences of stress and resilience are also playing a part, and this is important to consider given stress' relationship with physical health (McCurley et al., 2015). The reality then, is it may be a combination of both cognitive and physiological changes, though further work is warranted to empirical test the latter as a potential mechanism.

In terms of stress and resilience, the results showed effects were evident after 4 weeks but not immediate post-exposure, in contrast to BPS effects on symptomatology. Rather, it took time for these intervention effects to manifest. Over the four weeks, the BPS may have provided participants with opportunities to develop novel coping strategies in line with the Broaden-and-Build model (Fredrickson, 2001; 2004) in order to develop resilience. This would support some of the results from Study 3, particularly the main theme of "control" in which the "identifying what works for you" sub-theme showed that the BPS gave participants the space to develop novel, tailored goals and behaviours, as well as the "positive feelings" sub-theme, which suggested that developing these goals facilitated positive emotions, optimism, and gratitude.

Likewise, it may have taken the four weeks to reduce perceived stress through a slow build-up of PA (which was uniquely not measured in this study) in the same way that reduced NA was only evident after four weeks in Study 1. According to the stress-buffering model, PA must come before NA, so the results here may seemingly support those assumptions (Pressman & Cohen, 2005). However, the perceived stress was only reduced in those at higher risk of T2D, suggesting that stress-buffering effects only manifest in populations at greater risk, whereas resilience was developed in all people regardless of their risk. It is possible, therefore, that changes to affective processing are dependent on risk. The descriptive data detailed in the results section suggests that participants were experiencing average levels of stress. In Study 2, participants were similarly experiencing average levels of PA and NA. If the participant samples were experiencing greater levels of stress (or NA or reduced PA) then they might conceivably see greater benefits from the intervention, and this has ramifications for populations with poorer mental health.

Ultimately, these findings provide some support for both models (the Broaden-and-Build and the Stress-Buffering model), though resilience was promoted more easily across the sample (i.e. perceived stress was only reduced in those at higher risk of T2D) and so the Broaden-and-Build model is slightly better supported.

NA and stress are important factors to consider not only within diabetes care but also for diabetes prevention, as they have shown to directly (and indirectly) influence metabolic dysfunction, diet, and sedentary behaviour which can lead to further distress as part of a self-perpetuating cyclical issue (Mathiesen, Egerod, Jensen, Kaldan, Langberg, & Thomsen, 2019). Reduced stress and resilience do not represent buffers against symptomatology (as symptoms were shown to be reduced prior to BPS benefits to stress and resilience) but they may highlight reductions in NA and perhaps even changes to physiology. Both models argue that resilience and reduced stress are vital for physical health changes (Fredrickson, 2001; 2004; Pressman & Cohen, 2005), so this is worth bearing in mind for future research.

8.5 Strengths & Limitations

The self-report nature of this study means that chronic stress effects (i.e. impacts on physiological functioning) were not assessed. This is important as psychological interventions can also reduce physiological stress independent of perceived stress (Oldehinkel, Ormel, Bosch, Bouma, Van Roon, Rosmalen, & Riese, 2011). A participant reporting little or no perceived stress may in fact be experiencing adverse physiological stress (e.g. increase heart rate). In order to better understand the effects of the BPS on stress, there is a need to consider the effects that the BPS may have on an individual's physiology. At this stage, it isn't clear whether the BPS effect on stress applies solely to perceived stress or may also generalise to physiological stress. While there is some correspondence between perceived and physiological stress, changes in perceived stress and/or resilience do not necessarily denote changes in physiological stress (García-León et al., 2019). Thus, there is a need to understand how the BPS effects physiological stress, especially in the context of diabetes risk. However, given the lack of research into BPS effects on stress, this study was an important first step.

8.6 Conclusions

The results of this study showed that the BPS improved resilience over a four week period in people at low and moderate-to-high risk of T2D. The BPS was also shown to significantly reduce perceived stress in those at higher risk of T2D, demonstrating for the first time additional intervention benefits for those at higher risk. These findings were therefore supportive of both the Stress-Buffering model (Pressman & Cohen, 2005) and the Broaden-and-Build model (Fredrickson, 2001; 2004), suggesting that the BPS may help with development of resources and reduction of NA over time. A return to PA models as a framework has shown that affective processes are still worth considering alongside the theory of self-regulation (Deci & Ryan, 2000; 2008). Finally, the results also provided evidence of physiological benefits of the BPS in this context, as the intervention reduced sensory, neurological symptoms immediately post-exposure. Given all of these findings, the final study of this thesis will continue to explore intervention effects on stress, and will investigate physiological changes (e.g. heart rate, blood pressure) following BPS exposure under laboratory conditions.

Chapter 9: Study 5: The Impact of the 'Best Possible Self' Task on Physiological Measures of Stress

What Does This Study Contribute to Existing Knowledge?

- Results showed that exposure to the BPS led to a significantly reduced physiological response to a laboratory stressor in those at higher risk of T2D (evidenced by lower systolic blood pressure) in comparison to a control group.
- This same group of individuals also had significantly lower systolic blood pressure during a recovery period in comparison to the waiting list control group.
- The results, therefore, demonstrate clear physiological benefits associated with the BPS.
- Furthermore, this study provides further evidence of a stress-buffering effect of the BPS in those at higher risk of T2D that agrees with theory (Pressman & Cohen, 2005).

Abstract

Objectives: To assess whether exposure to the BPS could produce immediate changes to cardiovascular physiology indicative of reduced stress in people at low and moderate-to-high risk of T2D.

Design: Study 4 showed that the BPS can reduce perceived stress in a subset of users. Further examination is required to assess whether this translates into physiological changes that benefit health and other outcomes. The present study examined whether the BPS could influence heart rate variability (HRV) and blood pressure in response to a lab-based stressor using a 2x2 within-participants experimental design.

Methods: 79 adults at low and moderate-to-high risk of T2D took part in a lab-based study. The study was based on a mixed-design multiple analysis of variance

(MANOVA). Individuals were randomly assigned to a BPS intervention or control condition, then exposed to a stress task during which baseline, test, and recovery measures of HRV (heart rate variability) and BP (blood pressure) were obtained. Participants also completed questionnaires on the experience of affect and diabetes symptomatology before and after BPS exposure.

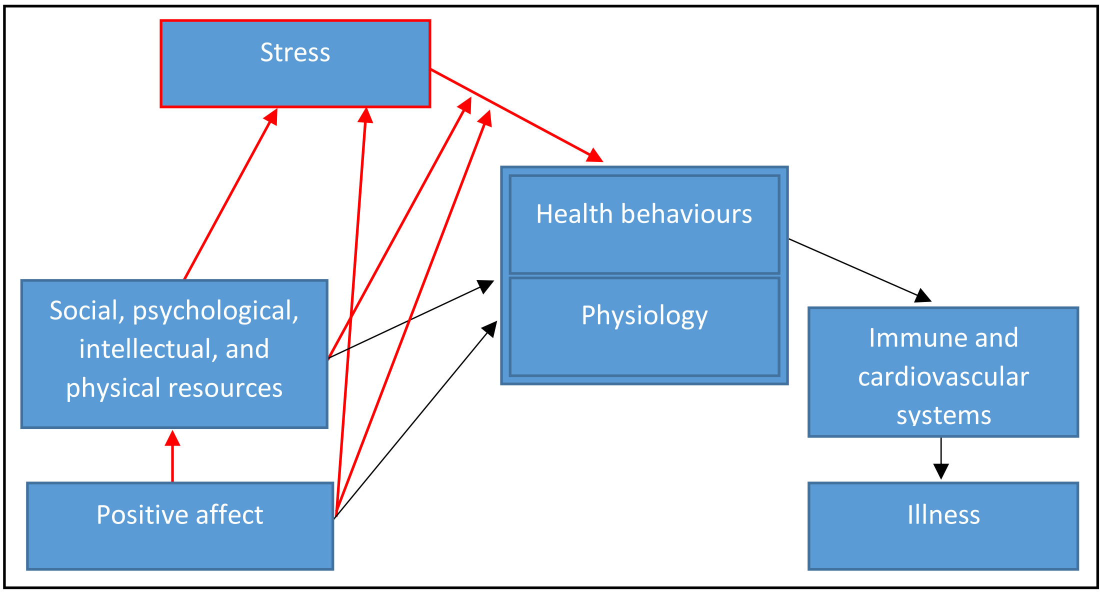
Results: Significant interaction effects showed that those at higher risk of T2D received physiological benefits from the BPS in the form of reduced systolic blood pressure under stressful conditions ($F(1, 57) = 4.611$, $p < .05$, $\eta p2 = .09$) and during recovery from stressful conditions ($F (1, 57) = 4.532$, $p < .05$, $\eta p2 = .09$). There were no significant differences between groups on HRV scores (all *p*'s > .05). There were also no differences in symptom distress, suggesting that the BPS failed to reduce diabetes symptomatology in this study.

Conclusions: The BPS has an effect on the physiological stress response, specifically BP, in people at higher risk of T2D. Implications for theory are considered.

9.1 Introduction

9.1.1 Overview

Study 4 demonstrated that the BPS significantly increased resilience in comparison to a control condition in people at low and moderate-to-high risk of T2D. Changes occurred over a four week period, suggesting a development of resources over time in line with the Broaden-and-Build model (Fredrickson, 2001; 2004). For those at higher risk of T2D, the study also showed that the BPS significantly reduced perceived stress in line with the Stress Buffering model (Pressman & Cohen, 2005). In demonstrating these effects, Study 4 provided evidence for the negation of NA as a consequence of BPS exposure, supporting the results of Study 2 (which showed a reduction of NA after four weeks). However, stress is multifaceted, and an important distinction is made in the literature between perceived stress (i.e., self-reports of distress/NA) and physiological stress (e.g., heart rate, skin conductance; consequences of NA) (García-León et al., 2019). A recent review suggested that PA (and PA facilitating interventions) may have an impact on “stress reactivity” (i.e., the degree of physiological change, such as blood pressure increases, in response to stress outcomes; Pressman, Jenkins, & Moskowitz, 2019). Stress, after all, not only has ramifications for an individual’s psychology; stress can have detrimental effects on the body. Stress can be a triggering or aggravating factor for illness (Yaribeygi, Panahi, Sahraei, Johnston, & Sahebkar, 2017) and it has long been understood that stress can directly affect physical health even independently of other psychological factors (e.g. behaviour/cognitions/etc.; McEwen, 1998). For that reason, physiology is an important component of the Stress-Buffering model (Pressman & Cohen, 2005) (see figure 9.1 below). Indeed, chronic (i.e. long-lasting) stress has shown to lead to disruption of physiological systems that are important for homeostatic regulation and metabolic control, increasing the risk for T2D (Cohen, Gianoros, & Manuck, 2016), therefore warranting a further investigation of it here in this context.



[Fig 9.1 The Stress-Buffering Model of PA (Pressman & Cohen, 2005). Note the importance of physiology to this model.]

9.1.2 Physiological Stress

Homeostatic regulation (the body’s way of maintaining a consistent internal environment, vital for health; Cannon, 1929) is reliant on the proper functioning of the autonomic nervous system (ANS), which is responsible for the unconscious regulation of heart rate, respiration, sweat response, and other vital bodily functions (Kolacz, Kovaric, & Porges, 2019). The functioning of the ANS is associated with the stress response (i.e. any compensatory reaction to an internal or external stressor; Yaribeygi et al., 2017) and is therefore considered a vital component of the emotional response in (non-PA) stress-centred theories of affect (Kreibig, 2010). The ANS can be categorised into two antagonistic subdivisions: an excitatory sympathetic nervous system (SNS) and an inhibitory parasympathetic nervous system (PNS). Together, the two subdivisions seek to ensure that the body responds to various situations in a contextually appropriate manner. For example, the SNS becomes dominant when heart rate and respiration need to be stimulated in order to prepare for a fight or flight response (Porges, 2009). By contrast, the PNS become more dominant during times of rest and play in order to conserve resources (Porges, 2009). Research has been particularly interested in the psychological and physiological effects that dysregulation of the ANS can have, especially when it leads to improper responses under "safe" conditions (Garland et al., 2010).

ANS activity (and physiological responses to stress via association) is often assessed using heart rate variability (HRV) because it acts as a useful measure of the interplay between sympathetic and parasympathetic influences over the heart (Duarte & Pinto-Gouveia, 2017). HRV can be captured using electrocardiogram, so it is also a non-invasive measure of autonomic processes involved in the regulation of cardiovascular functioning (Sztajzel, 2004). HRV is not simply a measure of heartbeats per minute but rather a measure of the fluctuation in time intervals between heartbeats. Beat-to-beat fluctuations are complex with variability of heart oscillations necessary to provide the flexibility to cope rapidly with uncertain and shifting contexts (Shaffer & Ginsberg, 2017). A healthy biological system will exhibit complexity, but chronic stress may lead to restrictions leading to a low HRV (Kim, Cheon, Bai, Lee, & Koo, 2018). Higher HRV then is typically associated with an increased capacity for self-regulation of emotions and physiological functioning (Shaffer & Ginsberg, 2017). By contrast, less flexibility (and lower HRV) is associated with an increase in self-reported stress (Salahuddin, Cho, Jeong, & Kim, 2007), poorer cardiovascular health (Tsuji, Larson, Venditti, Manders, Evans, Feldman, & Levy, 1996), and increased incidence of anxiety and depression (Agelink, Boz, Ullrich, & Andrick, 2002). In fact, HRV has recently been proposed as a diagnostic tool for detection of T2D (Albarado-Ibañez, Arroyo-Carmona, Sánchez-Hernández, Ramos-Ortiz, Frank, García-Gudiño, & Torres-Jácome, 2019). Additionally, reactivity to stress can also be measured by assessing blood pressure readings, with higher readings particularly correlated with adverse cardiac outcomes (McEvoy et al., 2016).

9.1.3 PPIs and Physiology

Research into PA (but outside of the diabetes literature) has shown that PPIs may be effective for reducing physiological stress. A loving-kindness meditation intervention, for example, showed an increase in PA in relation to a control group; the effects of which were moderated by higher baseline HRV (Kok, 2013). This increase in PA lead to further increases, in keeping with the assumptions of various upward spiral models of PA (Fredrickson, 2013; see also Chapter 3, sections 3.2.1 and 3.2.2). This is supported by further research which has shown that individuals who rate high in self-compassion (i.e. treating oneself with kindness and concern when experiencing negative life events) had higher HRV in response to acute stressors (Luo, Qiao, & Che, 2018) and reported less NA in response to daily stress (Neff, 2003). Another study, however, found an association between HRV and PA but only between low-arousal PA (e.g. feeling relaxed/calm/peaceful) and PNS activation (Duarte & Pinto-Gouveia, 2017). Other work focused on the buffering effects of PA have argued that this may be because PA is more likely to provide benefits by directly reducing stress. Fredrickson and Levenson (1998), for example, demonstrated that inducing PA helped speed cardiovascular recovery from laboratory-based stressors (in this case, NA-eliciting video content).

9.1.4 The Present Study

Given Study 4's findings, as well as the relationship between stress and the development of T2D and co-morbid mental illnesses (Hackett & Steptoe, 2017), the aim of this study was to assess immediate intervention effects across time on outcomes associated with physiological stress. This included HRV and blood pressure (BP) measures as well as measures of affect and diabetes symptomatology (as Study 4 showed evidence of physiological benefits, i.e. neurological sensory symptom reduction, that may be relevant here). Stress buffering has shown to be important not only in Studies 2 and 4 but also in the context of other diabetes PPIs (Tran et al., 2011) more generally, so further investigation was required. A laboratory study was used to assess self-report measures of risk, affect, and symptomatology as well as physiological functioning before, during, and after exposure to a stressor task.

Five key hypotheses were proposed here, focusing specifically on the effect of BPS exposure on physiological stress parameters:

- BPS exposure will significantly increase baseline, test, and recovery HRV following BPS exposure compared to the non-BPS control group
- BPS exposure will significantly lower baseline, test, and recovery blood pressure levels compared to the non-BPS control group
- The effects of BPS exposure on levels of HRV will be conditional on diabetes risk whereby BPS exposure will better affect HRV in people at high risk of developing diabetes.
- The effects of BPS exposure on BP levels will show a significantly greater beneficial HRV and blood pressure affect in people at higher risk of developing T2D.
- The effects of BPS exposure on affect and diabetes symptoms will be significantly mediated by HRV and BP variables

9.2 Methodology

9.2.1 Design

This study employed a 2 x 2 mixed-design multiple analysis of variance to test for differences between participants assigned to receive the BPS and a waiting list control group, whilst subjecting participants to repeated measures. In the first

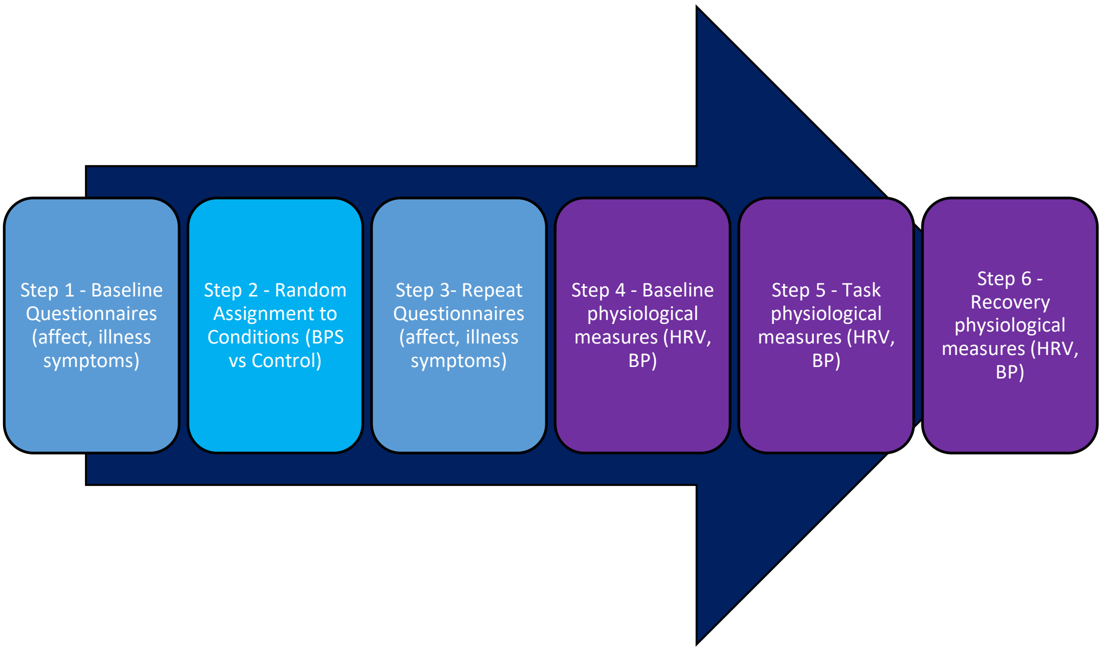
MANOVA model, condition allocation (BPS versus Control) and Diabetes Risk (Low versus combined Moderate-to-High) were the between-subjects variable, while measures of affect and diabetes-related symptoms were the within-subjects variables, measured before and after condition allocation. A repeated measures MANCOVA was then ran to test for physiological differences between groups. Three measures of physiological stress (Heart Rate Variability or HRV) – namely 'test', 'baseline', and 'recovery' data – were measured after condition allocation. Age, gender, and perceived stress scores were treated as covariates. Data was analysed using SPSS version 25.

9.2.2 Study Sample & Recruitment

Participants were recruited primarily through email mailing lists sent to students and members of staff at Liverpool John Moores University. Several posters were placed around campus and at university libraries. The study was also promoted at the beginning of several lectures with leaflets and a quick "elevator pitch" to students. Overall, 79 participants took part, aged between 18 and 63 (mean 23.38, SD: 11.62) (the *a priori* G power calculation [Faul, Erdfelder, Buchner, & Lang, 2009] suggested that 72 participants would be the minimum sample size to detect a medium effect for this study, given desired power levels of 95% and a preferred alpha level of 0.05). Of the total sample, 30 participants were male (38%), and 49 (62%) were female while 64 (81%) participants identified as White, 7 (8.9%) as East Asian, 4 (5.1%) as South Asian, 3 as Black (3.8%), and 1 as being of mixed ethnicity (1.3%).

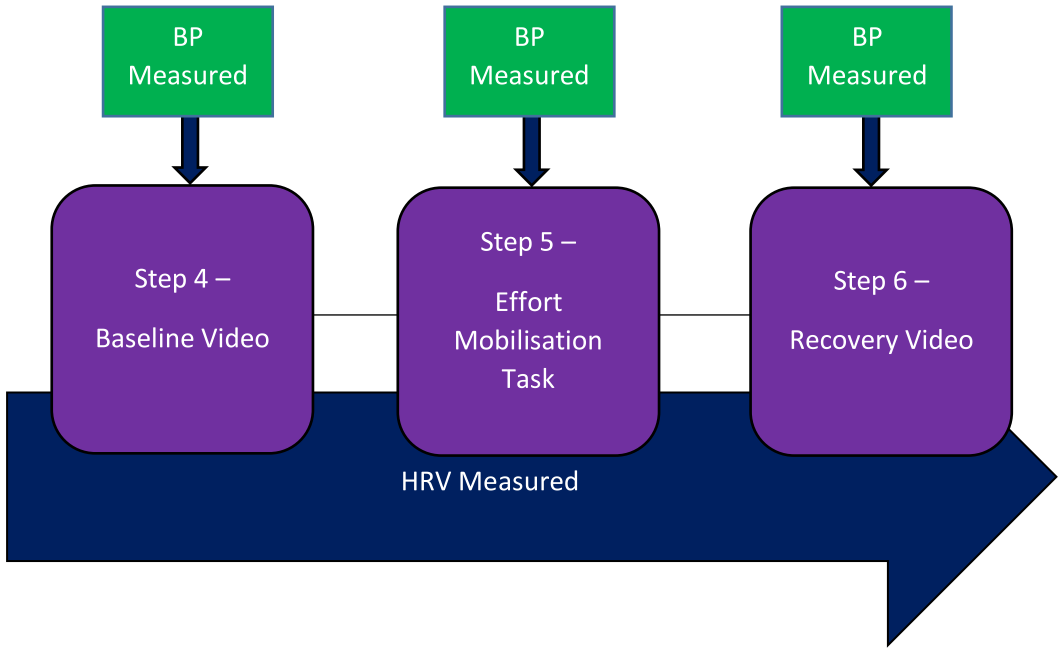
9.2.3 Procedure

Interested individuals responded to advertisements by emailing the lead researcher and organising a time to come to the laboratory (located in the Tom Reilly Building at Liverpool John Moores University). Once there, participants were provided with a copy of the participant information sheet and asked to sign a consent form. Consenting participants were then sat at a desk with a laptop on that was positioned in line of sight of the researcher. Participants were asked to complete the CANRISK, PANAS, PSS, and DSCR-R questionnaires before being randomised to one of two conditions: a BPS or waiting list control condition. Participants that received the BPS were asked to engage with the intervention for ten minutes. They were informed that what they wrote down was for their own personal use and that they would not need to present it once they were finished. Participants could ask the researcher to leave the room for some privacy if they wished, and they did not need to use the full ten minutes. They could also ask the researcher questions at any time during this period. Following the condition allocation procedure, both groups were asked to repeat the PANAS and DSC-R questionnaires.



[Fig 9.2 Full Experimental Procedure]

Next, participants were wired up to an electrocardiogram (ECG; with one electrode attached just below the left collar bone and two attached to either side of the hips) and a blood pressure monitor. Participants were asked to relax and to watch a four-minute clip from David Attenborough's 'Kingdom of Plants' (Season 1, Episode 1; see Figure 9.4). This acted as the baseline period. Following this, participants engaged with an "effort mobilisation task" (the laboratory stressor) for a further four minutes. Finally, participants were asked to relax again and to watch another four-minute clip from 'Kingdom of Plants' (Season 1, Episode 1). This acted as the recovery period. See Figure 9.3 for a visual aid of of this part of the procedure. The ECG trace was used to record heart rate across the baseline-task-recovery period so that heart-rate variability could be analysed at a later point. This was done using BIOPAC software – an ECG amplifiying device that records electrical activity generated by the heart. The blood pressure monitor provided readings of systolic and diastolic blood pressure measured halfway through each of the recovery, task, and recovery periods. Blood pressure was taken using the DINAMAP V100. Once participants had finished the recovery period, they were debriefed and given a £10 amazon voucher as compensation for their time.



[Fig 9.3. Physiology Procedure in Detail]

[Fig 9.4 Screenshot from David Attenborough's Kingdom of Plants (Season 1, Episode 1) that was used for baseline and recovery videos.]

9.2.4 Self-Report Measures

The CANRISK (Canadian Diabetes Risk Questionnaire) (Kaczorowski et al. 2009) was used to establish participants' risk for T2D. Participants were categorised into one of three groups based on their total score: 'Low Risk' (< 21), 'Moderate Risk' (21 to 32), 'High Risk' (≥ 33). Given the low number of participants at moderate and high risk, these two scores were amalgamated to produce one "at-risk" score that would be contrasted with "low risk", same as in previous studies of this thesis. Risk was calculated as part of an interaction effect to determine whether it influenced BPS effects.

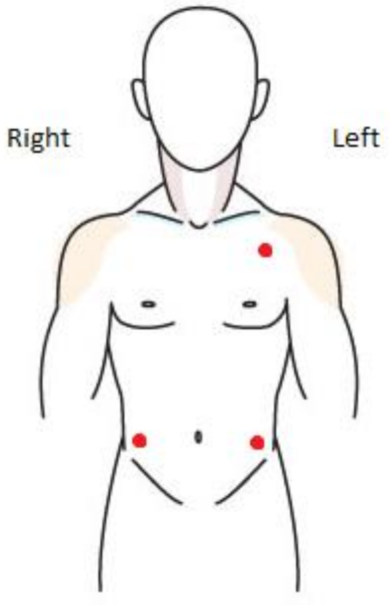
Diabetes symptomatology was then assessed using the Diabetes Symptoms Checklist – revised (DSC-R) (Arbuckle et al. 2009; Grootenhuis et al. 1994; Naegeli et al. 2010). This instrument consists of 34 items organised into eight symptom domains: fatigue (α = .84), cognitive (α = .76), neuropathic pain (α = .00), neuropathic sensory (α = .00), cardiac (α = -.09), ophthalmic(α = -.03), hyperglycaemic (α = .68), and hypoglycaemic (α = .55). Reliability was evidently low for the DSC-R (subscales with a Cronbach's alpha lower than 0.7 were dismissed as unreliable), so only fatigue and cognitive symptoms were included in the final analysis.

PA and NA were measured in the same way as previous chapters using the PANAS (Watson et al. 1988), a 20-item measure depicting a 10-item scale of negative emotions (e.g., ‘hostile’, ‘ashamed’, ‘guilty’, ‘upset’, ‘scared’, ‘afraid’) and a 10-item scale for positive emotions (e.g., ‘active’, ‘alert’, ‘determined’, ‘inspired’, ‘proud’, ‘interested’). Responses were indicated on a Likert-style scale, ranging from ‘Very slightly or not at all’ (1) to ‘Extremely’ (5). The final scoring for each scale is simply the sum total of responses. Scores can range from 10 to 50 per scale. Higher scores denote higher levels of positive (α = .90) or negative affect (α = .85).

Finally, the PSS was used to assess perceived risk. It was used purely as a co-variate measure in this study.

9.2.5 Physiological Measures

The BPS’s effects on physiological measures during baseline, task, and recovery periods were assessed by measuring high-frequency heart rate variability (HF-HRV) and systolic and diastolic blood pressure. The high-frequency band of heart rate variability (0.12-0.4 Hz) was used specifically because of its association with vagal influences over the heart (Kok et al., 2013). Data was collected continuously across baseline, task, and recovery period using three electrodes placed in a triangular configuration so that two were placed either side of the hips and one was placed on the left side of the chest, just below the collarbone (see Figure 9.5). The raw ECG data was fed into KubiosTM version 2.2, and HR-HRV was calculated on an individual basis based on average RR intervals (i.e. the distance between heart peaks) for each time point (baseline, task, and recovery so that there were three HF-HRV scores for each participant). Systolic and diastolic blood pressure were also captured to act as secondary measures to support the HF-HRV data. Systolic and diastolic blood pressure are similarly associated with sympathetic and parasympathetic activity, respectively (Silvestrini, 2017). A blood pressure reading was taken using the DINAMAP V100 halfway through each of the baseline, task, and recovery periods so that each participant also produced three systolic and diastolic blood pressure scores.



[Fig 9.5. Electrode placement. Red spots mark placement positions]

9.2.6 The Effort Mobilisation Task

The task used in this study, the Montreal Imaging Stress Task (MIST), was originally developed as a means for inducing moderate psychological stress in clinical settings (Dedovic, Renwick, Mahani, Engert, Lupien, & Pruessner, 2005). The task presents as a number of computerised mental arithmetic challenges paired with social evaluative threat components. In other words, participants taking part in MIST have to answer a number of mathematical questions under time and social pressures. The social evaluative threat component of the MIST task scores participant's mathematical abilities and feedbacks to the individual in real-time using a slider bar (participants were informed that they were being assessed based on accuracy of answers and time taken to produce them). They were scored as good, average, or poor, but the task was manipulated so that most people would find their scores slipping to "poor" when they answered a few questions incorrectly. To add to the stress, participants were also told that they were competing against one another but that, on average, everyone else performed extremely well. A reminder of others' “success” was evident at the top of the screen, next to an individual’s own performance scores (see Figure 9.6 below).

[Fig. 9.6 A screenshot of the MIST task in progress. Questions were displayed in the centre, performance was marked along the bar at the top, and time remaining for each question was displayed as the red bar which moved across the screen (left to right). Participants used the scale at the bottom right hand of the screen to indicate their answers.]

The MIST task was chosen partly for its simplicity and ease of use; it is an effective stressor and requires little set-up. The fact that it was a computerised task meant that it could be set up to immediately follow-on from, and lead into, the baseline and recovery stages of the experiment. The trier stress test that the MIST is adapted from is also one of the most utilised tasks in stress research, so the findings from this study should be generalisable across stress research (Allen, Kennedy, Dockray, Cryan, Dinnan, & Clarke, 2017). It was also chosen for its effectiveness as a social stress task because PA theories (Fredrickson, 2001; Pressman & Cohen, 2005) suggest that social resources are built as a consequence of PA and are important for the buffering effect. If the BPS is achieving its effects based on similar mechanisms (as Study 3 and 4 provided some evidence for), then the BPS should be particularly effective at reducing physiological signs of stress in response to MIST.

9.2.7 Pilot Testing

Prior to the full commencement of the study, pilot testing was performed with five individuals to ensure that the lab equipment was set up correctly and that the effort mobilisation task was effective. To increase social pressure, a decision was immediately made with the pilot participants to arrange the lab set-up so that participants completed the task in view of the researcher. Pilot participants reported that this increased their stress levels as they felt uncomfortable that the researcher was watching them “fail”. Some modifications to the task itself were also made. At first, there was evidence of disengagement when the task became too hard (e.g. slumping postures, boredom – which was confirmed when participants were asked for their opinions about the task). Changes were subsequently made to the “difficulty” so that the maths questions were simpler. The timing stayed the same, however, so that the task was still stressful. Participants actually reported this as more irritating because they would know the answers but not always react quickly enough. Importantly, this also meant that people stayed engaged because they felt like they would get the next one right. The pilot also identified the mousepad as more frustrating to use to select answers than the keyboard. The keyboard was reported as easier amongst people who were confident in their mathematical abilities but asking these same individuals to use the mousepad reduced this advantage.

9.2.8 Ethics

This study received ethical approval from the Liverpool John Moores University Research Ethical Committee (LJMU REC; reference number 18/NSP/068). Participants were provided with an information sheet and asked to provide consent before taking part. All participants were debriefed about the full nature of the study after they had finished taking part. Participants were free to withdraw at any time without giving a reason.

9.3 Results

9.3.1 Descriptive Statistics

Of those recruited, 51 participants were categorised as low risk of T2D (64.6%) and 8 (10%) were categorised and moderate-to-high risk. Uniquely for this study, as many as 20 participants failed to provide adequate risk data (25.3%), possibly because Qualtrics (used in Studies 1, 2, and 4) would now allow participants to continue without first answering all questions on a page; an advantage that paper questionnaires do not have.

At baseline, self-report data showed that symptom distress was relatively low (scores were out of 5, and fatigue and cognitive impairment averaged between 0.93 and 1.92). PA was similarly high, and NA was similarly low. Following condition allocation, scores of symptom distress were at least halved for both groups. PA seemed relatively unchanged over time and between groups, but NA was reduced over time. See table 9.1 for more information on baseline statistics. Table 9.2 shows self-report data following condition allocation (i.e. potential immediate intervention effects).

Meanwhile, the physiological data showed that BP and HF-HRV were variable over time such that blood pressure increased and heart rate variability decreased during the stressor task. Group differences for the physiological data are represented as means and standard deviations in Table 9.3 and graphically in Figures 9.7 through 9.9.

	Writing condition			Control condition		
	Total sample	Low-risk	Moderate or high-risk	Total sample	Low-risk	Moderate or high risk
Self-Report Outcomes (Baseline)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Symptoms (DSC-R)						
Fatigue	1.43 (0.61)	1.38 (0.57)	1.75 (0.90)	1.27 (0.91)	1.21 (0.88)	1.92 (1.15)
Cognitive	1.19 (0.69)	1.14 (0.65)	1.50 (1.00)	0.94 (0.69)	0.93 (0.69)	1.08 (0.80)
Affect (PANAS)						
Positive Affect	33.67 (5.81)	33.86 (6.19)	32.33 (1.53)	32.18 (6.49)	31.90 (6.55)	35.00 (6.25)
Negative Affect	19.00 (6.29)	18.81 (6.15)	20.33 (8.62)	18.88 (6.09)	19.10 (6.33)	16.67 (2.08)

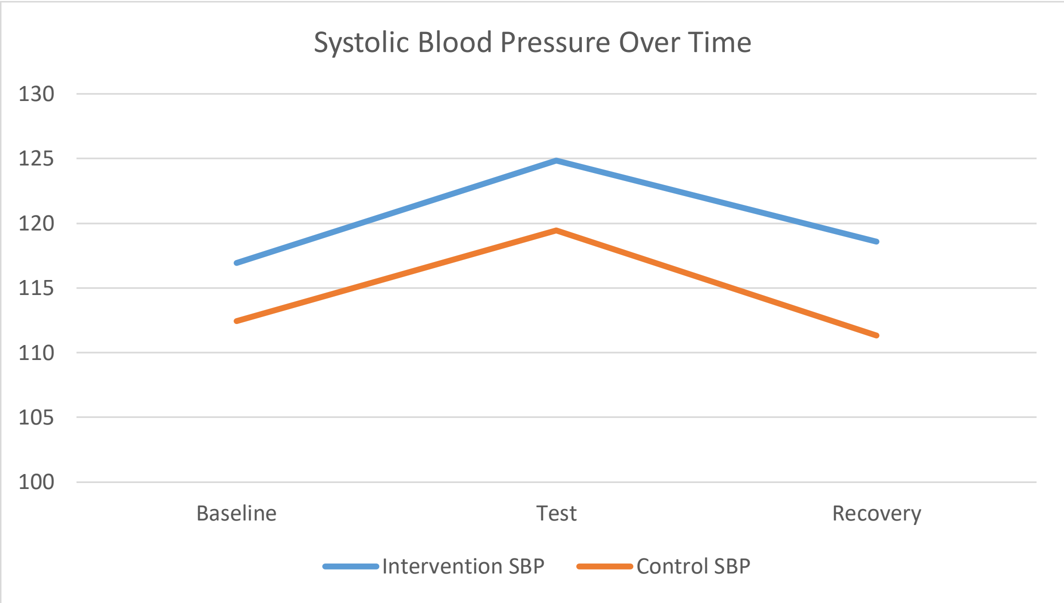
[Table 9.1 Means and SDs for symptoms and affect at Baseline]

	Writing condition			Control condition		
	Total sample	Low-risk	Moderate or high-risk	Total sample	Low-risk	Moderate or high risk
Self-Report Outcomes (Post-Condition Allocation)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Symptoms (DSC-R)						
Fatigue	0.57 (0.60)	0.55 (0.59)	0.75 (0.75)	0.65 (0.79)	0.59 (0.77)	1.25 (0.90)
Cognitive	0.33 (0.45)	0.32 (0.46)	0.42 (0.52)	0.27 (0.47)	0.26 (0.48)	0.42 (0.52)
Affect (PANAS)						
Positive Affect	32.75 (6.91)	33.33 (7.21)	28.67 (0.58)	28.03 (8.95)	27.40 (9.04)	34.33 (5.69)
Negative Affect	13.54 (5.69)	13.48 (5.69)	14.00 (6.93)	11.48 (2.22)	11.50 (2.30)	11.33 (1.53)

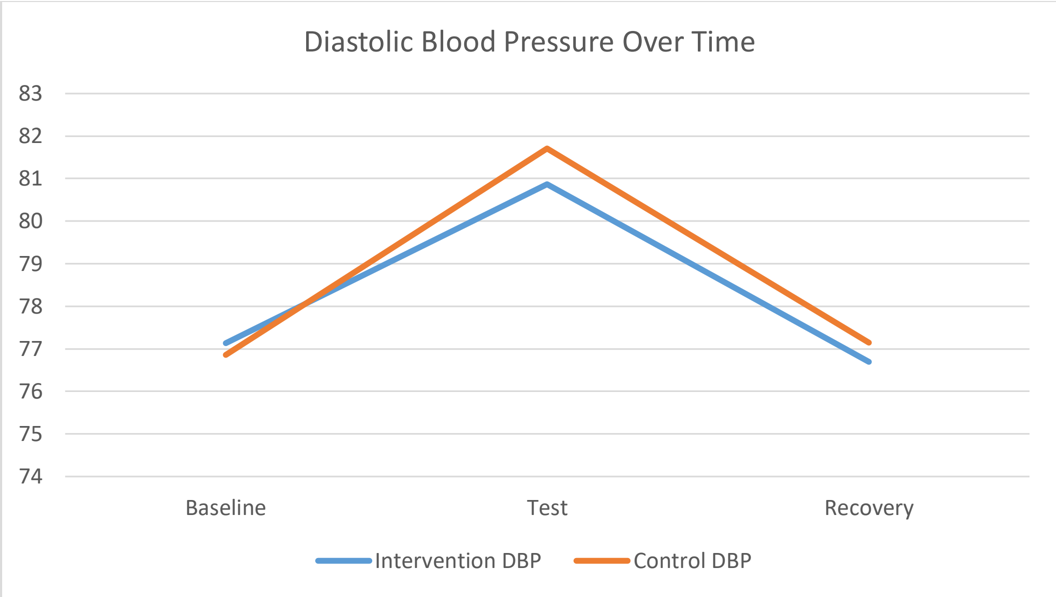
[Table 9.2 Means and SDs for symptoms and affect post-condition allocation]

	Writing condition			Control condition		
	Total sample	Low-risk	Moderate or high-risk	Total sample	Low-risk	Moderate or high risk
Outcomes Across Time	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Blood Pressure (BP)						
Systolic BP Baseline	116.91 (9.53)	117.29 (9.02)	113.00 (18.39)	112.43 (14.38)	109.57 (12.71)	129.60 (12.44)
Systolic BP Test[x]	124.83 (12.68)	125.76 (12.76)	115.00 (8.49)	119.43 (15.13)	116.33 (13.45)	138.00 (11.46)
Systolic BP Recovery[x]	118.57 (10.60)	119.10 (10.67)	113.00 (11.31)	111.34 (13.91)	108.17 (11.32)	130.40 (13.69)
Diastolic BP Baseline	77.13 (10.07)	77.00 (10.52)	78.50 (3.54)	76.86 (8.35)	75.47 (8.01)	85.20 (5.02)
Diastolic BP Test	80.87 (8.68)	81.10 (9.00)	78.50 (4.95)	81.71 (9.80)	80.63 (9.87)	88.20 (6.98)
Diastolic BP Recovery	76.70 (9.89)	76.95 (10.26)	74.00 (5.66)	77.14 (8.82)	75.73 (8.51)	85.60 (5.68)
Heart-Rate Variability						
HF-HRV Baseline	42.23 (19.16)	46.95 (19.32)	50.18 (24.33)	43.53 (21.47)	45.61 (22.02)	30.98 (13.20)
HF-HRV Test	39.49 (14.81)	38.18 (14.64)	53.22 (11.12)	38.44 (21.45)	38.75 (21.80)	36.56 (21.40)
HF-HRV Recovery	42.36 (15.33)	41.51 (15.71)	51.24 (7.64)	41.66 (20.00)	42.92 (19.60)	34.05 (23.07)

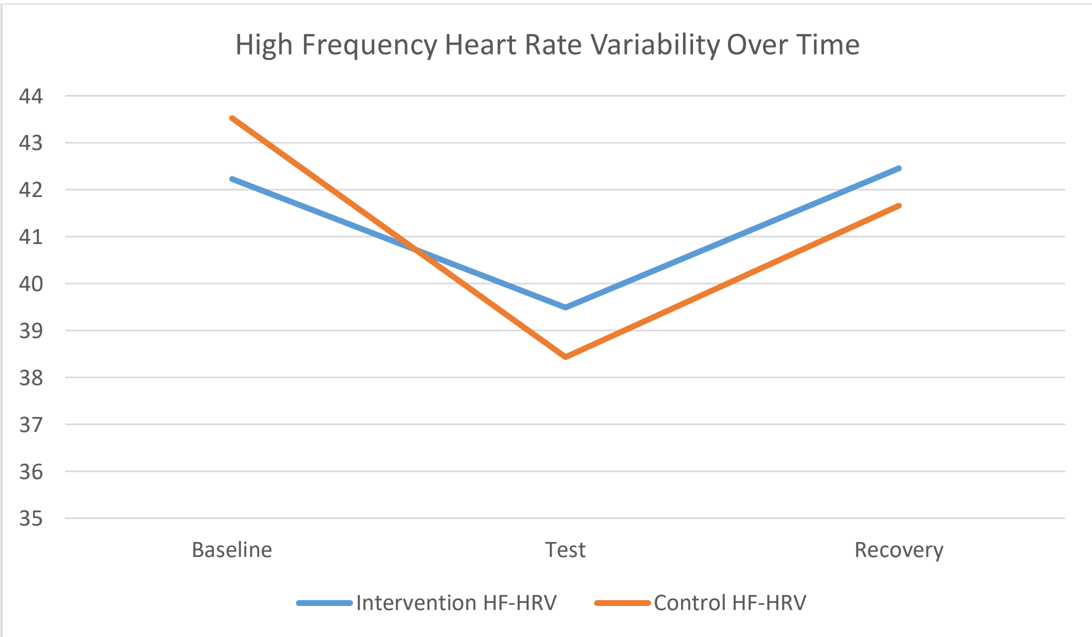
[Table 9.3 Means and SDs for various measures of blood pressure and heart-rate variability across baseline, test, and recovery periods. There were no main effects, however, note: where ^{x} = $p < 0.05$, and ^{y} = $p < 0.01$ are seen, this reflects significant interactions between experimental condition and diabetes risk category (risk groups are based on CANRISK scoring criteria, whereby < 21 = low risk; 21 to 32 = moderate risk; ≥ 33 = high risk).]



[Fig 9.7 Physiological responses to baseline video, stressor test, and recovery video on systolic blood pressure]



[Fig 9.8 Physiological responses to baseline video, stressor test, and recovery video on diastolic blood pressure]

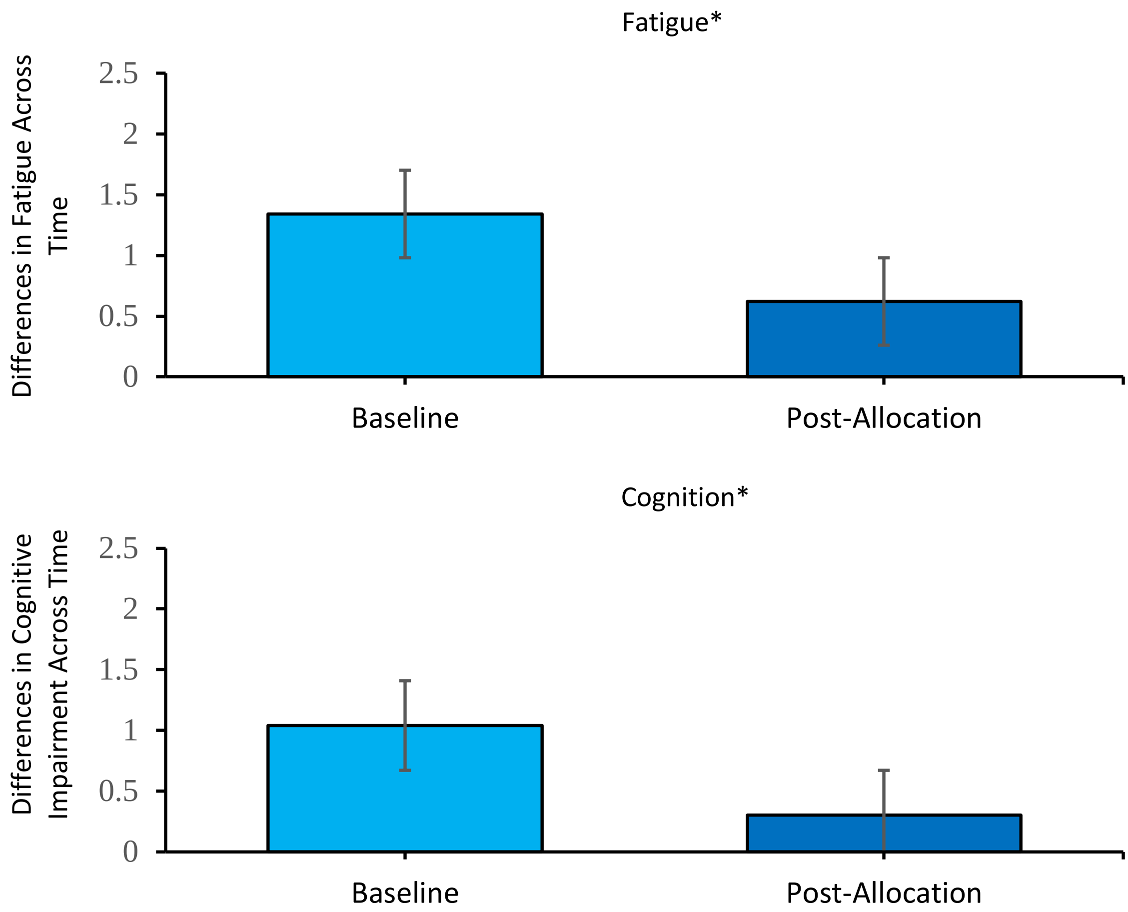


[Fig 9.9 Physiological responses to baseline video, stressor test, and recovery video on heart-rate variability]

9.3.2 Self-report Measures

A 2 (condition: intervention vs control) x 2 (diabetes risk: low vs combined moderate-to-high) repeated measures MANOVA was used to assess BPS effects on the self-report variables (fatigue, cognitive impairment, PA, and NA). Box's test (M = 84.503, F(36, 6252.56) = 1.91, $p < .01$) indicated that homogeneity of variance had been violated while Mauchly's sphericity test demonstrated that assumptions of equality of variance between within-subject conditions had also been violated (all *p*'s < .01). Furthermore, Levene's tests showed that NA data at post-condition allocation was not normally distributed (F(3, 53) = 5.82, $p < .01$). As such, the repeated measures was rerun using the bootstrapping method, multivariate tests were ignored in favour of univariate tests, and greenhouse geiser scores were taken to account for violations of sphericity, all in order to reduce risk of Type 1 errors (Chajewski, 2012).

Subsequently, univariate tests demonstrated significant changes to symptoms of fatigue (F(1,50) = 13.51, $p < .01$, $\varepsilon = .209$) and cognitive impairment (F(1,50) = 20.01, $p < .01$, $\varepsilon = .282$) over time. Examination of means showed that fatigue and cognitive impairment decreased between pre- and post-condition allocation (see Figure 9.10). However, further examination of the univariate tests revealed that the condition a participant was allocated to had no bearing on these results and that BPS and control participants equally benefitted from reductions in these symptoms. In other words, there was no group differences, and the BPS did not reduce symptoms significantly more than the control condition (all *p*'s > .05). Similarly, there were no effects on PA or NA between subjects or between groups (*p*'s > .05). Univariate tests also showed that there were no interaction effects between grouping and risk.



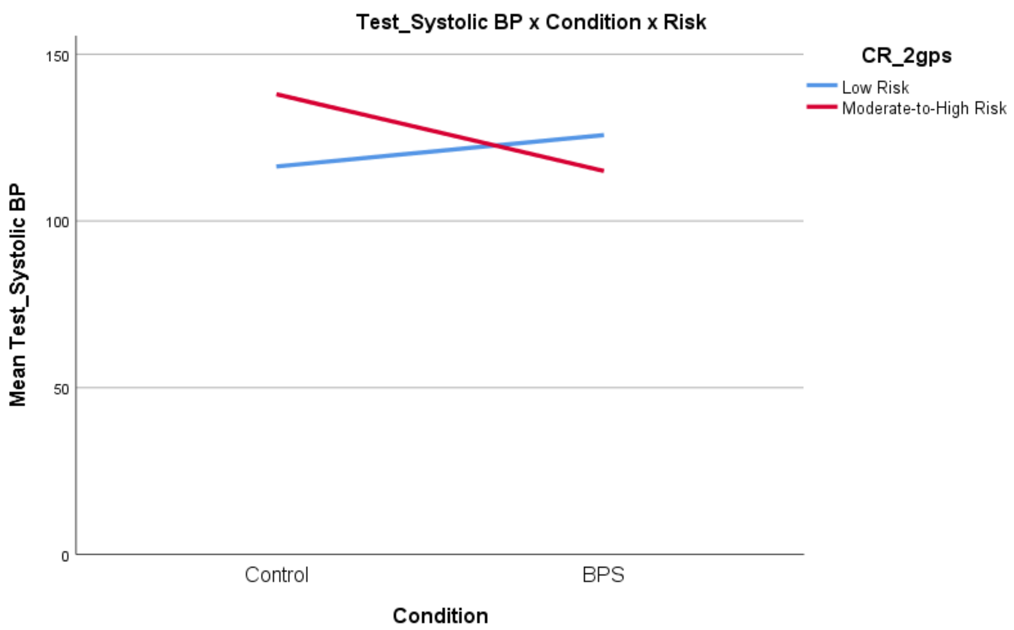
[Fig 9.10 Bar charts show changes in symptomatology across time points for all participants. Note, * indicates *p* < .05. However, these charts do not identify group differences and therefore, do not reflect intervention effects.]

9.3.3 Physiological Measures

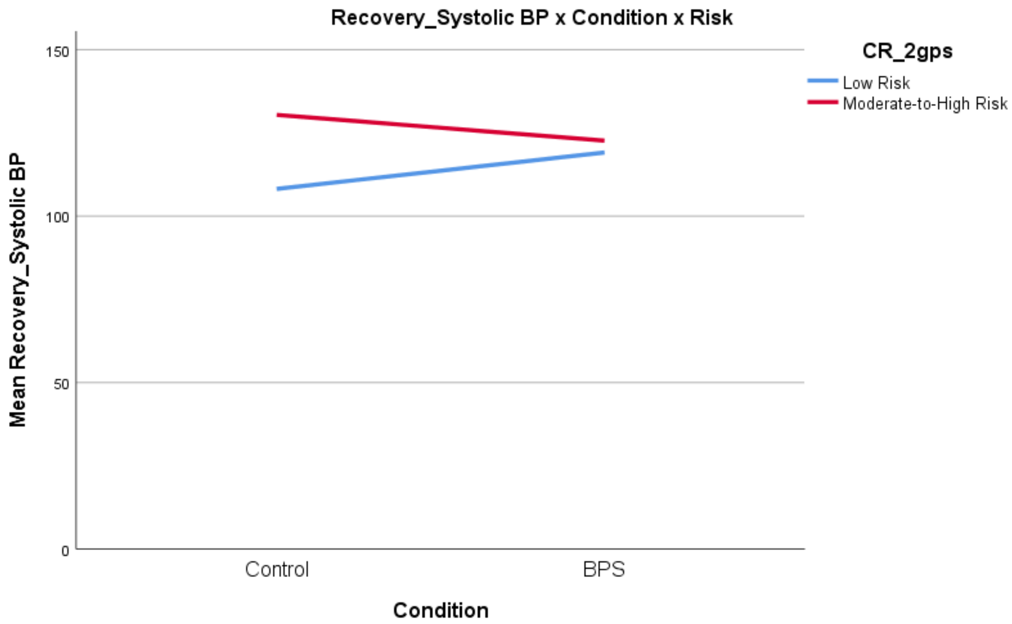
A 2 (condition: intervention vs control) x 2 (diabetes risk: low vs moderate/high) MANCOVA was performed to evaluate the effects of the BPS intervention on physiological measures (systolic blood pressure, diastolic blood pressure, and HF-HRV). Covariates included age, gender, perceived stress scores, as well as self-reported NA, PA, fatigue, and cognitive impairment scores from Time 2. Box's M = 144.037, F (28, 588.17) = 1.33, *p* = .03 showed that assumptions of homogeneity of variance were violated. Levene's test also showed that data for baseline systolic blood pressure (F (3, 54) = 2.90, *p* = .043) was not normally distributed. Subsequently, the MANCOVA was rerun using bootstrapping (Krishnamoorthy & Lu 2010) whereby samples were set at 1000 using simple sampling, and tests of between-subject effects were examined independently of multivariate test results.

The results of the between-subject effects demonstrated no main effects of the BPS on any of the physiological measures (systolic BP, diastolic BP, or HF-HRV). However, there were significant Condition x Diabetes Risk interaction effects on systolic BP during the testing ($F(1, 57) = 4.611$, $p < .05$, $\eta p2 = .09$) and recovery ($F(1, 57) = 4.532$, $p < .05$, $\eta p2 = .09$) periods. Consultation of tables and graphs show that the BPS significantly reduced systolic BP during these two periods for those at moderate-to-high risk (see Figures 9.11 and 9.12).

The results of the MANCOVA also showed that gender acted as a significant covariate on baseline, recovery, and test systolic blood pressure, as well as on baseline and recovery high-frequency heart rate variability (all ps < .05). Self-reported measures at Time 2 and perceived stress had no bearing on any of the main or interaction effects.



[Fig 9.11 Systolic Blood Pressure Interaction Effects during Stress Task. Those at moderate-to-high risk of T2D had the greatest reductions to their systolic BP when doing the stress task as a result of exposure to the BPS.]



[Fig 9.12 Systolic Blood pressure interaction effect during the recovery period. Those at moderate-to-high risk of T2D received greater reductions to their systolic BP during the recovery period following the stress task as a result of exposure to the BPS]

9.4 Discussion

The aim of this study was to assess whether the BPS was capable of reducing physiological stress in people at low and moderate-to-high risk of T2D. The results indicated that the BPS did not influence HRV as hypothesised, but it did lead to moderately reduced systolic blood pressure in those at higher risk during the task and recovery periods. In other words, those at higher risk who were administered the BPS showed less of a physiological stress response when exposed to the laboratory stressor. Furthermore, these sub-set of participants also appeared to recover more quickly from exposure to the laboratory stressor, as evidenced by lower systolic BP during the recovery period of the experiment.

An intervention effect on HRV would have demonstrated that BPS induced sympathetic dominance of the ANS and increased cardiovascular flexibility (Kolacz, Kovacic, & Porges, 2019). This would have meant that the BPS allowed participants's physiology to more quickly shift into a sympathetically dominated way of functioning, allowing users to better adapt to stress (Shaffer & Ginsberg, 2017). Instead, there was no evidence of significant HRV effects. However, systolic blood pressure is associated with sympathetic dominance nonetheless (Joyner, Charkoudian, Wallin, 2010), and lower levels of systolic blood pressure are correlated with a range of positive cardiovascular and health outcomes (Zhou et al., 2017). Reduced levels of systolic blood pressure therefore still indicate a more adaptive response to stress in those at higher risk of T2D that engaged with the BPS.

Indeed, lowering both systolic and diastolic blood pressure has shown to be important for people with T2D, where higher levels are correlated with risk of all-cause mortality, negative cardiovascular events, and stroke (Emdin, Rahimi, Neal, Callender, Perkovic, & Patel, 2015). Mean systolic blood pressure, in particular, is associated with risk of macro- and microvascular complications of T2D (Adler et al., 2000). Increasing stress-reactivity may be one way to reduce blood pressure and therefore reduce risk of T2D complications, which is important to consider even at the prevention level (Diabetes Prevention Program Research Group, 2009). The evidence presented in the current study shows that the BPS can reduce systolic blood pressure in those at risk, suggesting a reduction in physiological stress seemingly in line with the Stress-Buffering model (Pressman & Cohen, 2005).

The Stress-Buffering model (Pressman & Cohen, 2005) suggests that facilitated PA leads to reductions in NA and stress over time. Results from Study 1 somewhat demonstrated this effect, as PA was indirectly facilitated at Time 1 while NA was reduced at Time 2, four weeks later (although stress was not directly assessed in this study). Study 4 showed that perceived stress was similarly reduced after four weeks in those at higher risk of T2D. However, there is a difference between perceived stress and physiological stress; physiological stress is more strongly implicated in T2D outcomes (McCurley et al., 2015), for example. However, this study demonstrates that the BPS also directly influences physiological stress markers (as indicated by reduced systolic blood pressure), providing further support for the BPS' compatability with the model in line with previous findings contained in this thesis.

However, the Stress-Buffering model is dependent on the facilitation of PA (Pressman & Cohen, 2005) and this study further demonstrated that the BPS does not directly influence PA. It may have been assumed that the BPS had some indirect effects on PA if this study also showed evidence of reduced fatigue (as this led to indirect benefits of PA in Study 2), however, the BPS failed to reduce any diabetes symptomatology in this study, contradicting all previous findings in this thesis. Having said that, there was an issue with the reliability of the symptomatology questionnaire in this study, which may explain the lack of between-group effects. The DSMQ was not designed to be repeated in quick succession as it was developed to measure symptom perception over a month's duration. A different questionnaire (or ignoring symptomatology all together) may have been more appropriate for this study.

Alternatively, the BPS may be producing lower arousal PA than previously anticipated. High arousal PA is typically more associated with health outcomes (Grunberg et al., 2003; Hoen et al., 2013), and the PANAS questionnaire has been used consistently across studies for that reason (as it only measures high arousal PA). This is purely speculation, and future research is needed but a recent study did find an association between HRV and PA but only between low-arousal PA (e.g. feeling relaxed/calm/peaceful) and PNS activation (Duarte & Pinto-Gouveia, 2017). It is possible that there is a similar relationship between low-arousal PA and systolic blood pressure but this also needs empirically testing. However, this may help explain previous findings, given the evidence of "positive feelings" in people's accounts of their best possible selves seen in Study 3 and the lack of significant direct effects between the intervention and PA in the quantitative studies. Future research may wish to examine alternative means of assessing "positive feelings" associated with the BPS that are contributing to the intervention's effectiveness.

Given the lack of BPS effects on symptomatology results in this study, one may presume that reductions in physiological symptoms seen in Study 4 had little to do with actual physical health changes. Instead, reductions in physical health symptoms may be triggered by other means, such as changes in perception (in line with the SDT). What also remains to be seen is how changes to physiology seen in this study relates to long-term perceptions of stress and resilience. Study 4 demonstrated that perceptions of stress and resilience changed after four weeks, not immediately, which is in contrast to the changes in blood pressure demonstrated in the present study. Using this evidence, it is possible to argue that physiological changes precede psychological benefits of the BPS. Future research should therefore examine whether reductions in the physiological stress response lead to reductions in how people perceive stress. Physiological changes may be more related to perceived stress given that these factors were both only reduced in people at higher risk of T2D (García-León et al., 2019). However, it is also possible that a reduced stress response would also give people the space to build up resources and develop coping mechanisms to increase resilience to stress. Future work would be needed to test this directly.

9.5 Strengths & Limitations

The DSC-R may have been an inappropriate measure for assessing diabetes-related symptomatology in this particular study, as the reliability scores were low and only two symptom clusters (fatigue and cognitive impairment) were included in the final analysis. The DSC-R is designed such that participants reflect on their distress over a month period. When the DSC-R was administered to participants' post-condition allocation, they were asked to repeat the DSC-R and to consider how they were feeling in the present moment. These scores were compared against their pre-condition scores, but the lack of validity meant that only fatigue and cognitive symptoms could be compared across time. Perhaps another measure of diabetes symptomatology may be worth considering in future research or using a different health variable altogether.

Should this study be replicated, another thing to consider would be to allow participants to provide a rating for how stressful they found the effort mobilisation task. This could be performed with a simple rating scale measure, for example. While the physiological data supported the notion that the task was stressful, some self-report data may have provided evidence of individual differences. Participant's perception of the stress task may have been a better covariate than the PSS data, for example. Similarly, it may have been beneficial to have asked for feedback on how the BPS made participants feel. This would have allowed greater understanding of their individual experience of the intervention, though this does run the risk of demand characteristics (i.e. participants reporting that they liked the intervention in order to please the researcher; Sharpe & Whelton, 2016).

With respect to the physiological set-up, there are some additional aspects worth mentioning here. As there is minimal research available on the physiological impacts of PA, this study did not need to be overly complex; in fact, simplicity may have been beneficial. As such, a breathing belt was not utilised (which could have helped get more accurate HRV results) and nor were measures of galvanic skin response (GSR) taken (which would have provided a slightly different indicator of physiological stress). Some participants became excitable during the effort mobilisation task, which may have created some "noise" in the ECG data, so these extra measures may have been useful in providing confirmatory (or indeed conflicting) data. Likewise, the MIST task was originally designed in conjunction with neuroimaging techniques; therefore, ECG data collection (alone) may not have been the best measure of its effects.

Alternatively, future research could also utilise different tasks to facilitate physiological stress changes. The cold pressor task specifically measures autonomic reactivity and responses are designed to be assessed using HRV and blood pressure measures (von Baeyer, Piira, Chambers, Trapanotto, & Zeltzer, 2005). The cold pressor task involves placing a hand or forearm into freezing water, a stimulus designed to produce a slowly mounting pain of mild to moderate pain. Improved reactivity in response to cold pressor tasks has shown to reflect intervention benefits to cardiovascular health (Lachowska, Bellwon, Morys, Gruchala, & Hering, 2019) and given the BPS' history for alleviating pain; this task would make for a reliable alternative to the MIST task. Again, however, it is worth noting that this is the first study of its type, and that it demonstrated clear intervention effects which were previously unknown and that may have ramifications for health and diabetes prevention.

9.6 Conclusions

The aim of this study was to assess the effect of BPS exposure on physiological stress parameters in people at low and moderate-to-high risk of T2D. This study demonstrated clear BPS effects on systolic blood pressure in participants at higher risk of T2D. The results showed that engaging with the BPS allowed this subset of individuals to respond in a more adaptive manner to a laboratory stressor. How this influences longer-term stress reductions, resilience development, and even diabetes risk remains to be empirically tested, but evidence from this study suggests that physiological changes occur before psychological adjustments do. The ramifications for this are considered in the next chapter as part of a larger discussion around the collective findings from all five studies.

Chapter 10: General Discussion

10.1 Main Contribution of the Thesis

The aim of this thesis had been to assess whether the BPS was an effective PPI for promoting physical and mental health outcomes in people with, and at risk of, diabetes. It has achieved that aim through a series of investigative studies, and it currently stands as the most thorough investigation of a PPI within the diabetes context. Despite a growing body of evidence suggesting that the BPS is associated with favourable health outcomes in a variety of populations (Austenfeld et al., 2006; Hanssen et al., 2013; Loveday et al., 2018; Maddalena et al., 2014), this is also the first body of work to evaluate the utility of the BPS within the diabetes context.

This thesis extended existing knowledge in two key ways. The research contained within demonstrates that the BPS:

i. Is considered an acceptable tool for self-management by people with T1D and T2D and that it enhances perceived self-care within this population
ii. Improves both psychological and physiological outcomes in people at various risk of T2D but especially so in those at higher risk

Interpretation of results and shaping research direction was aided by the use of theory. It was important that the research contained within this thesis had a theoretical underpinning to assist in the elucidation of findings and, given that the research was iterative, theory was also used to help guide future research. For example, Study 1's results were best understood using the SDT (Deci & Ryan, 2000; 2008) and this led to a consideration of more cognitive intervention mechanisms in later research, while Study 2 provided early evidence for the Stress-Buffering theory (Pressman & Cohen, 2005) that would later be investigated more thoroughly as part of Studies 4 and 5. Other PPI research has made passing references to theory (B&B in particular; e.g. Kearney et al., 2014) but, to the author's knowledge, the research presented within this thesis has adhered to theory in a particularly rigorous way. In doing so, this thesis has additionally demonstrated the benefits that utilising theory has for assessing interventions in this context.

10.2 Research Narrative

10.2.1 Overview

This body of research began with a feasibility and acceptability study similar to the way that other PPI studies have been conducted in this context (with the exception that Study 1 also included a qualitative aspect which meant that the BPS intervention was uniquely developed with the aid of people with T1D and T2D). It was then followed by a series of investigations into the mechanisms and effects in a way that has so far been missing from the literature. These studies allowed for a comprehensive understanding of the BPS's effectiveness as an aid for self-management and prevention efforts. Importantly, and distinctly from previous research, this work remained person-based throughout (Yardley, Ainsworth, Arden-Close, & Muller, 2015) in order to make the intervention relevant, accessible, and engaging for people with, as well as for those at risk of, diabetes. A use of mixed-methods was a real strength of this work, as it allowed for a more comprehensive understanding of outcomes and mechanisms than the use of quantitative or qualitative methods alone would have achieved (Bishop, 2015).

The BPS was initially adapted following evaluation of previous relevant literature (Loveday et al., 2016), while analysis from Study 1 was used to further refine the BPS for use within the diabetes context. Despite acceptance and evidence of its positive effects on perceived self-care, the quantitative results showed that the BPS was not operating in line with PA theory, which was underpinning research direction at the time. Previous work had shown the BPS to facilitate PA (Sheldon & Lyubomirksy, 2006; Renner et al., 2014) but this was not supported by Study 1. This result may in part be explained by the novel context – people with diabetes have complex and unique needs (Hendrieckx et al., 2019) and the BPS may work differently dependent on the population it is administered to (Loveday, Lovell, & Jones, 2018) – but the work contained within this thesis may have also highlighted weaknesses in the literature's understanding of the intervention more generally. A transition to a non-clinical population led to a better understanding of the BPS' mechanisms as well as its potential benefits for a health context. Symptomatology and consideration of risk has meant that the lessons learnt in the at-risk population (e.g. which theoretical frameworks are more appropriate for this context, etc.) could potentially be applied to populations with T1D and T2D should future work want to adapt these findings into creating an even better version of the BPS. For now, a breakdown of individual benefits as evidenced by each study can be found below.

10.2.2 People with T1D and T2D

Study 1 used a mixed methods approach to assess acceptability and feasibility of the intervention amongst people with T1D and T2D. The study was designed as a foundation for the rest of the thesis, such that the results would form the basis for subsequent investigations. Ultimately, it was the only study that utilised the BPS as a self-management tool for people with T1D and T2D. It consisted of two phases; a qualitative phase and a quantitative phase.

Qualitative Phase

In the qualitative phase of Study 1, the BPS was shown to be well-received by participants. A small minority of participants struggled to see benefits for themselves (some individuals suggested that their personality or their current relationship with their illness would act as a barrier to engagement), but these participants could still often see ways it could benefit others. The majority of participants considered the BPS a positive intervention they could use to motivate engagement with their self-management regimes regardless of how long they had been living with diabetes. Participants with T1D and T2D equally saw benefits, due in part to the intervention's perceived non-prescriptive nature. Participants were particularly happy that they could use the intervention to generate their own ideas without being told what to do, and they saw writing about a 'best possible future self' as a unique opportunity to reflect on their illness. Some individuals reported wanting to think less about their illness and they in particular were grateful that they could use the BPS to set aside a small period of the day (10 minutes) to think about their self-management rather than ruminating about it all day otherwise.

Despite acceptance, participants also had their concerns regarding the intervention, so the qualitative phase was particularly useful in that it allowed further refinement of the intervention to increase fit between BPS and this population (Layous et al. 2013). Some people were worried about the language used; it was too fearful or not positive enough. Others wanted more evidence of its efficaciousness as this was not only a novel psychological intervention but most of the people were unfamiliar with why they would even need to engage with a psychological intervention in the first place. Their mental health was fine, so what role would psychology have to play in their diabetes care? Participants expressed fewer concerns once they engaged with the intervention, but this was important to bear in mind to ensure that initial engagement. Other participants were also worried about "dosage" (i.e. doing the intervention too much or too little). Ultimately, people wanted their own say on how they engaged with the BPS, which seems to be a common issue for people with diabetes who too often felt that their lives were already overprescribed by professionals (as evidenced in the 'personal approach' theme generated in Study 1). Asserting their own autonomy was important, and this was a qualitative theme also evidenced in Study 3.

Three key points to note about the qualitative phase are as follows:

- Participants felt that the intervention enhanced one's sense of control in managing their illness.
- There was evidence this could encourage a pro-active approach in self-management.
- The BPS needed further refinement to accommodate the unique needs of people with T1D and T2D.

Quantitative Phase

The BPS was further modified in time for the quantitative phase to better reflect the needs of people with T1D and T2D. Changes were made systematically and were reflective of the qualitative phase's generated themes. The results of this phase showed that the BPS was also a feasible intervention, as it positively influenced perceptions of self-care after four week of engagement. Importantly, perceptions of self-care were equally improved in people with T1D and T2D. Despite a lack of evidence for actual behaviour change at this stage, it was argued that these perceptual changes might translate into behavioural change to produce positive clinical outcomes given enough time. However, those changes would be dependent on the findings conforming to theory set out by the broaden-and-build model (Fredrickson, 2001; 2004) and the results demonstrated that the BPS failed to facilitate PA as part of this study. As such, it was unclear at this stage of the thesis whether the BPS would provide any further effects at all. Instead, interpretation of Study 1's quantitative results suggested a more cognitive aspect to the BPS than had been hypothesised at the beginning of this thesis. While it had been expected that the BPS would achieve its effects based on PA-based mechanisms (Renner et al., 2014; Sheldon & Lyubomirsky, 2006), the quantitative phase of Study 1 showed more support for self determination theory (SDT; Deci & Ryan, 2000; 2008) than it did for existing models of PA.

Four key things to note about the quantitative phase are as follows.

- The BPS enhanced perceived self-care in people with T1D and T2D.
- This outcome manifested after four weeks, suggesting a robust intervention effect.
- However, the BPS failed to facilitate PA, leading to a temporary rejection of the models underlying this thesis' assumptions.
- Subsequently, a longer-term, larger-scale follow-up with people with T1D and T2D was rejected given that underlying mechanisms were uncertain.

Most BPS research has previously focused on healthy populations (Auyeung & Mo, 2018; Carillo et al., 2019; King, 2001; King & Smith, 2004) but Study 1 demonstrated that BPS exposure could offer specific psychological benefits to a clinical population, relating specifically to issues like control and pro-active behaviour (both of which are important in disease management). A decision to conduct follow-up research using a sample of at-risk individuals meant that the thesis could examine a variety of different mechanisms and outcomes that would be important for the diabetes context. It also provided an opportunity to test the BPS out as a preventative measure too, which was important given the paucity of diabetes PPIs for prevention. The SDT (Deci & Ryan, 2000; 2008) would see more use from this point on.

10.2.3 People at Low and Moderate-to-High Risk of T2D

To assess intervention mechanisms in a way that was still relevant to diabetes, risk for T2D was considered across Studies 2-5. The BPS would continue to have people focus on their health, particularly in relation to preventative behaviours (diet, exercise, etc.) so it was important not to make any serious changes to the intervention (such as significantly increasing the word count, adding steps, or adding complementary resources/materials) as that would risk the integrity of what had been achieved so far. Instead, the core changes from the qualitative to quantitative phases of Study 1 remained the same and only minor modifications to the language were made to better reflect the population change (most people without T1D or T2D would likely struggle with the concept and relevance of HbA1c, for example). Diabetes symptomatology was also measured to get a proximate assessment of how the BPS influenced diabetes-related health outcomes.

<u>Study 2</u>

Study 2 immediately demonstrated positive BPS effects on diabetes symptomatology. The results showed a reduction in the psychological symptom of fatigue following intervention exposure. Furthermore, using mediational analysis, it was evidenced that reducing fatigue had further accumulative effects that led to reductions of cognitive impairment (another psychological diabetes symptom) and facilitation of PA. All of these effects had disappeared at follow-up, four weeks later, but by this time NA was being reduced by the intervention instead. A facilitation of

PA at Time 1, followed by a reduction of NA at follow-up four weeks later provided the first evidence of a potential buffering effect in concordance with other diabetes PPI research (Tran et al., 2011). These results showed that affect was important to the efficaciousness of the BPS (at least in this at-risk population), though results also continued to support the SDT (Deci & Ryan, 2000; 2008) too. Diabetes risk did not influence how effective the intervention was for the individual.

Things to note about Study 2:

- The intervention reduced psychological symptoms associated with diabetes (namely fatigue and, through an indirect pathway, cognitive impairment).
- PA and NA were both influenced by the BPS in this context, though at different time points, indicating a potential stress-buffering effect.
- Risk did not influence intervention effectiveness at this stage and all participants received equal benefits.

<u>Study 3</u>

Study 3 employed qualitative methods to explore the motivational themes underlying the intervention effects observed in Study 2 by assessing written examples of participant's 'best possible selves'. The results showed that participants were conceptualising their health in a broad, holistic manner and that they wanted to use the intervention to develop a sense of control over it. This supported Study 1's qualitative findings and provided more support for the SDT, especially around concepts of need satisfaction (Niemiec, Ryan, & Deci, 2009). The results also showed that the BPS was facilitating positive feelings in the form of PA, optimism, and gratitude either as a result of thinking about goals, working towards their goals, or achieving their goals. However, there was also evidence that the intervention could highlight a discrepancy between current selves and best possible future selves, which could be distressing for some individuals.

Furthermore, the results also revealed that participants specifically discussed illness symptoms (and in some cases were using the intervention to address them). Psychological symptoms including fatigue and cognitive impairment were discussed most commonly, but there was also evidence that participants were using the BPS to consider physical health complaints too, such as pain and neurological sensory symptoms (i.e. tingling and/or numbness in the extremities). These findings highlighted some of the unique ways in which the BPS may be used by people to directly target health issues in relation to diabetes.

Study 3 notes:

- The BPS gave users space to conceptualise their future selves and future goals.
- The BPS helped participants develop a sense of autonomy, competence, and relatedness to others in line with the SDT. This might be an important intervention mechanism.
- Study 3 provided the first evidence that the BPS may also influence physical health illness symptoms such as pain.
- There was also evidence that the intervention was producing "positive feelings" that may include PA but also the likes of optimism and gratitude.

Study 4

Study 4 further examined the affective mechanisms of the BPS, especially in relation to reduction of NA, and this meant a reconsideration of PA models. Impacts of the intervention on perceived stress and resilience were assessed alongside symptomatology. The results showed that resilience was reduced over a four week period (indicating a build-up of novel resources and coping strategies) in line with the broaden-and-build model (Fredrickson 2001; 2004). The results also showed that perceived stress was reduced over a four week period, but only when interacting effects of T2D risk were considered. This was the first study to demonstrate that the

BPS may provide additional benefits for those at higher risk of T2D. Increases in resilience and reductions in stress also highlighted mechanisms by which the BPS may have reduced NA in Study 2.

The BPS also reduced fatigue and neurological sensory symptoms in this study. Effects on fatigue had previously been evidenced in Study 2, but neurological sensory symptoms (i.e. tingling or numbness in the extremities) had only been previously alluded to in Study 3. The latter symptom provided the first quantitative evidence that the BPS could have benefits for physical health. Both symptom clusters, in this case, were only reduced in those at higher risk of T2D, however.

Study 4 notes:

- The BPS increased resilience after a four week period in line with the broaden-and-build model (Fredrickson, 2001; 2004).
- The BPS also reduced perceived stress after a period of four weeks in those at higher risk of T2D in line with the stress buffering model (Pressman & Cohen, 2005).
- The study provided quantitative evidence that the BPS could reduce physical health symptoms as well as psychological symptoms of diabetes.

Study 5

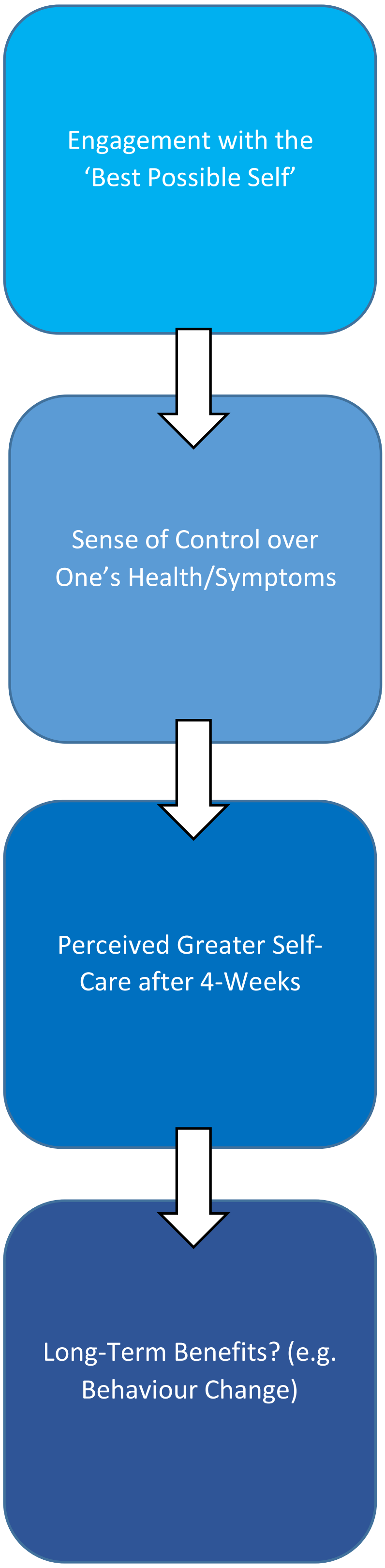
Study 5 continued to investigate the intervention's capacity for reducing stress by examining markers of physiological stress (i.e. blood pressure and heart rate variability). Using a laboratory-based study, the results showed that the BPS led to reduced systolic blood pressure in those at higher risk of T2D in response to a stress task and during a recovery (relaxing) period. These findings highlighted immediate physiological changes in response to the BPS, which has significant implications for the BPS as a T2D preventative tool (García-León et al., 2019).

Study 5 notes:

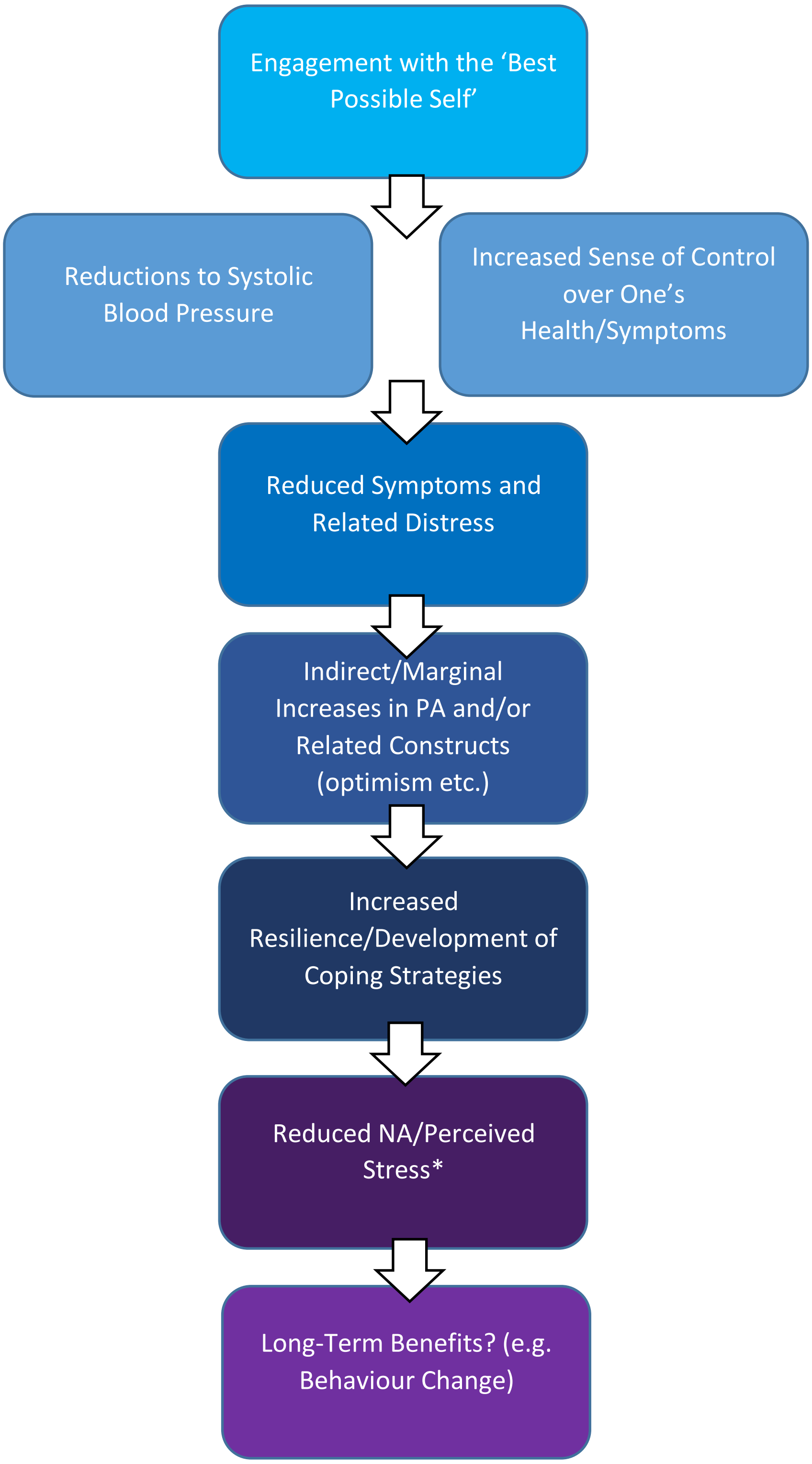
- Findings demonstrated that the BPS reduced physiological signs of stress (specifically systolic blood pressure) in comparison to a control group that was suggestive of improved adaption to stress.

10.3 Key Summations of the Thesis

It had been hypothesised that the BPS would facilitate PA in line with PA theory, but results showed that, at the acceptability and feasibility stage, the BPS was not influencing affective processes to achieve its main effects. Consequently, this PhD has produced two interventions, one for people with diabetes, and one for those at risk of diabetes. These were two disparate groups, and there are significant physiological and psychological differences between them (American Diabetes Association, 2017). However, there are also significant differences between people with T1D and T2D, and the BPS showed to produce the same benefits for these populations. Furthermore, the qualitative results from Study 1 and Study 3 showed that the BPS consistently increased a sense of control or autonomy in line with the SDT in both self-management and prevention groups. Arguably, PA was not influenced directly in either group either, but NA was only reduced across studies using the at-risk sample. Currently, the findings suggest that the BPS offers psychological benefits for people with and without diabetes, but the precise nature of these psychological benefits are different in these two populations. See figures 10.1 and 10.2 for mechanisms and effects for the two BPS variants. In both cases, more work is needed to assess longer-term benefits (e.g. changes to HbA1c, reductions in risk, etc.).



[Fig 10.1 A conceptual model for exploring the various psychological and hypothesised behavioural effects of BPS exposure on people with T1D and T2D.]



[Fig 10.2 The various psychological and/or physical effects of BPS exposure on people at low and moderate-to-high risk of T2D, based on findings from Studies 2-5. The * highlights risk interaction effects only. Arrows are there to suggest the *potential* direction of effects, and whether this is a causal chain of mechanisms would need empirically testing.]

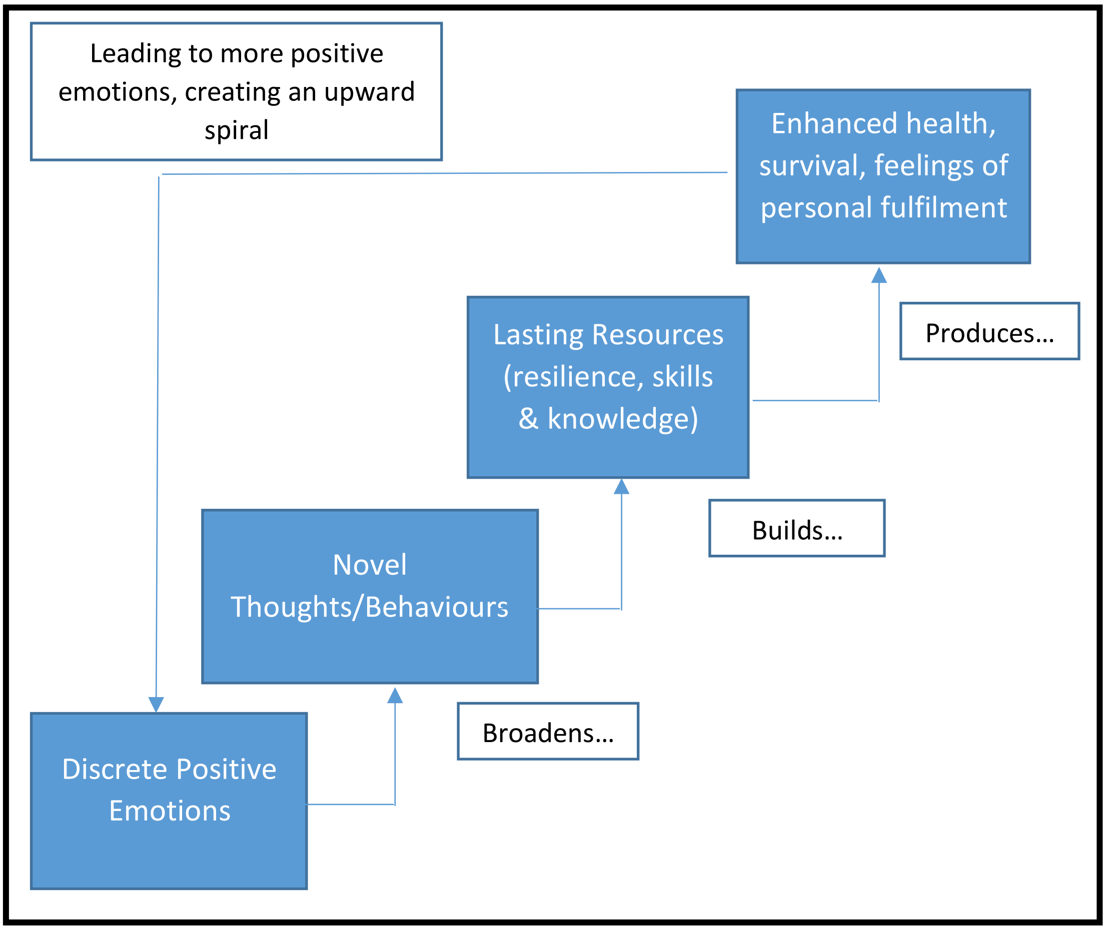
10.4 Implications for PA Theory

10.4.1 Overview

In contrast to expectations at the beginning of this thesis, examination of the conceptual models detailed in Figures 10.1 and 10.2 shows how finding support for PA models was, at times, very difficult. There is more support for the likes of the broaden-and-build (Fredrickson, 2001; 2004) and stress-buffering (Presmman & Cohen, 2005) models in at risk-populations (Figure 10.2), but even then, this evidence did not emerge until Study 4. PA was never shown to be facilitated directly, and instead, effects were either marginal or indirect at best. Study 3 suggested other positive constructs such as gratitude and optimism may have been generated as a result of engaging with the BPS, but these findings were never quantitatively assessed. Given that the broaden-and-build model was originally developed as a model of positive emotions rather than PA (Fredrickson, 2001), it is possible that these other positive constructs could be just as, if not more, responsible for the effects of the intervention seen at later time points (such as resilience and reduced NA). Certainly, previous research has shown that the BPS is equally as effective at improving optimism, for example (Peters et al., 2013) so future research may wish to check for similar outcomes within the diabetes context. Alternatively, the BPS may have been facilitating lower arousal PA, which is not measured as accurately by the PANAS tool (Pressman, Jenkins, & Moskowitz, 2019) that was used across this thesis. “Positive emotions” discussed in the sub-theme “positive feelings generated by considering/achieving goals” in Study 3 may be considered examples of calmer emotions, which physiological research (Duarte & Pinto-Gouveia, 2017) suggests are more likely to produce physiological changes (such as those observed in Study 5). Regardless of what positive constructs the BPS is facilitating in this context, evidence shows some support for each of the following PA models:

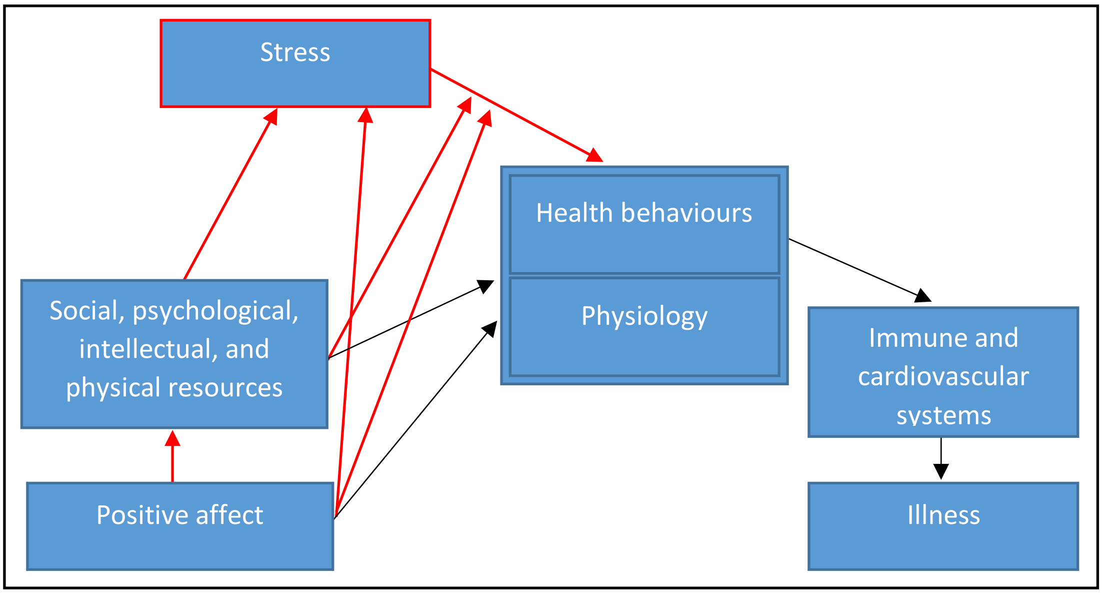
10.4.2 The Broaden & Build Model (Fredrickson, 2001)

The broaden and build theory of positive emotions provides an evolutionary explanation of PA as to why it is crucial for human beings’ survival (Fredrickson, 2001; 2004). It states that PA produces optimal functioning by giving the individual a safe space to play – to experiment with novel thoughts and behaviours – which leads to the accumulation of resources given enough time. Crucially, these resources can be drawn upon in times of distress to promote positive adaption, leading to improved health outcomes. The utility of broaden-and-build theory in this context was originally questioned in Study 1 because the BPS failed to facilitate PA in the quantitative phase of the acceptability and feasibility trial. However, there was evidence to support the Broaden-and-Build theory in Study 2 when an indirect effect of PA was found and again in Study 4, where BPS effects on resilience suggested that coping mechanisms were being developed. Evidence of novel thoughts and behaviours were also available in the people's accounts of their best possible future selves in Study 3. Whether the BPS produces long-term behaviour or health changes in line with the model is an important avenue for future research.



[Fig 10.3. The Broaden and Build Theory of Positive Emotions (Fredrickson, 2001).]

10.4.3 The Main Effect Model of Positive Affect and Health & Stress Buffering Model of PA and Health (Pressman & Cohen, 2005)



[Fig 10.4 Pressman and Cohen's (2005) stress-buffering model of PA. Visually, it is essentially an extension of the MEM (signified in black). The red signifies the paths by which stress moderates and is mediated by PA on the outcomes detailed in the MEM.]

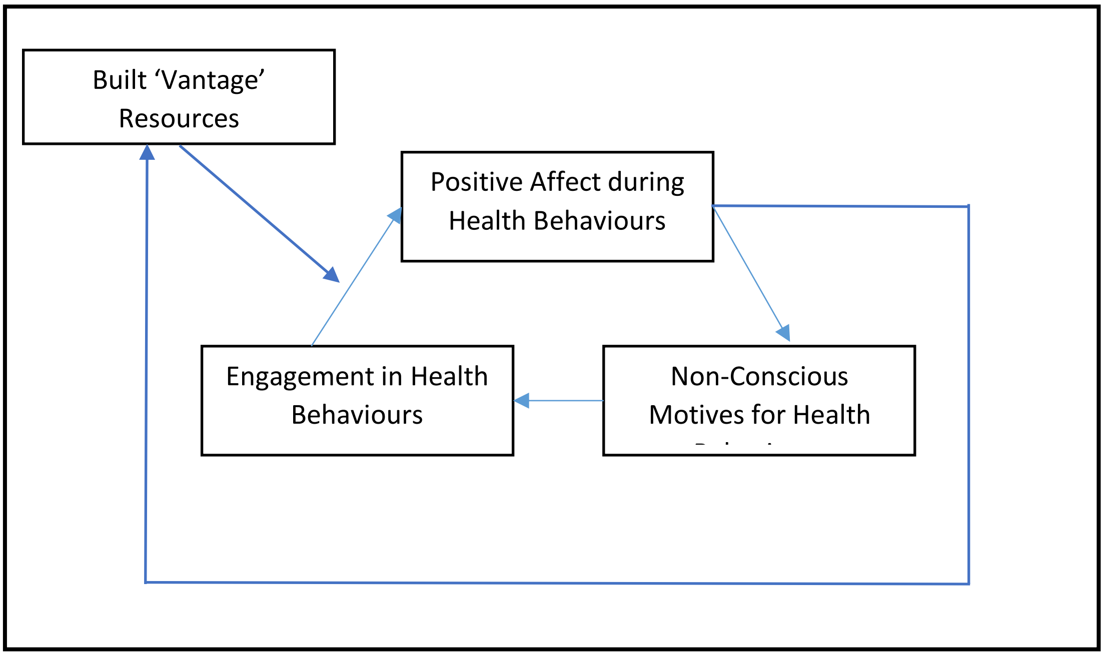
The Main Effect Model of PA (MEM) and the Stress Buffering model of PA (SBM) were both developed by Pressman and Cohen (2005) and share some common concepts. Both models were originally based on the Broaden-and-Build (B&B) model (Fredrickson, 2001; 2004) so shared a lot in common with that theory too (for example, all three models share the ethos that PA builds resources that lead to benefits over time; Pressman, Jenkins, & Moskowitz, 2019). In contrast to the B&B, however, the MEM and SBM were developed specifically as illness models. They both posit that a development of social, psychological/intellectual, and physical resources influence illness through changes in health behaviours and physiology. According to the SBM, PA also buffers against stress to minimise its impact on health behaviours and physiology. The SBM has been frequently referenced in the diabetes PPI literature (e.g. Tran et al., 2011), and there was further supportive evidence in

Studies 4 and 5 (at least for those at higher risk of T2D) for its utility in this context. Study 4 showed direct reductions of stress as well as the development of resources (evidenced by increases in resilience), while Study 5 showed direct BPS effects on physiology (in line with both SBM and MEM). Furthermore, Study 2 showed an indirect facilitation of PA at Time 1 which may have led to the reductions in NA seen at Time 2, four weeks later. The evidence in this thesis does not conclusively fit both or either of these models, but it does provide evidence that the BPS may work along similar pathways (i.e. development of resources and a reduction in stress/NA over time). Long-term follow-up would also be necessary to assess BPS effects on immune and cardiovascular systems.

On the other hand, the research presented in this thesis was unable to conclusively test the following theories that were introducted in Chapter 3:

10.4.4 Upwards Spirals and the Upward Theory of Lifestyle Change (Fredrickson, 2003; Van Cappellen, Rice, Catalino, & Fredrickson, 2017)

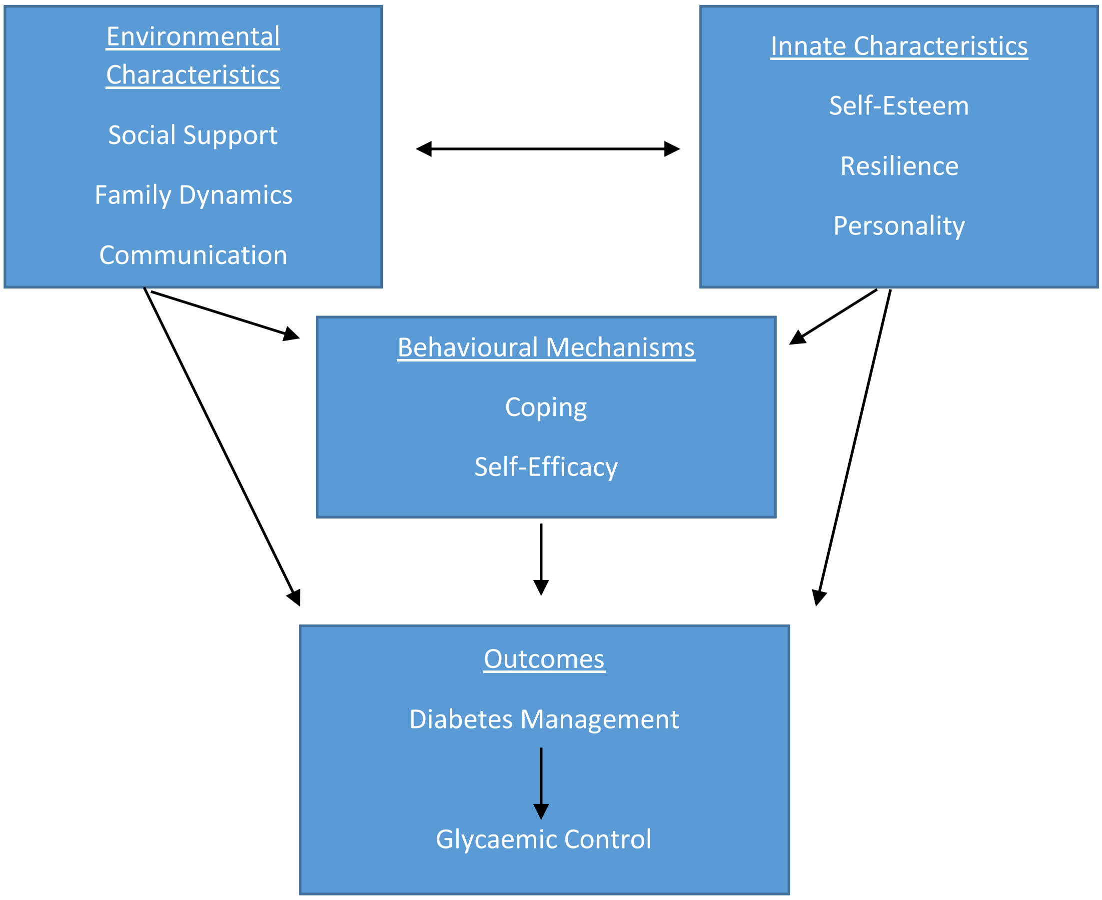
Upward spirals were originally a component of the B&B model before empirical evidence demonstrated that they could form the basis for their own behaviour change model (Fredrickson & Joiner, 2002). The notion behind the model is that PA generates PA such that PA becomes self-sustaining over time. Health behaviours generated as a result of PA provide non-conscious motives to continue engaging in those behaviours, which in turn lead to more facilitated PA all while resources are developed. However, there was no direct evidence that the BPS facilitated this process, as the intervention had limited effects on PA throughout the thesis. Furthermore, behaviour change is also central to the model, and without evidence of behaviour change, support for upward spirals was not going to be evident. There was some potential support seen in Study 3 but realitistically, future research will need to conduct longer-term observations of BPS effects to properly support this model.



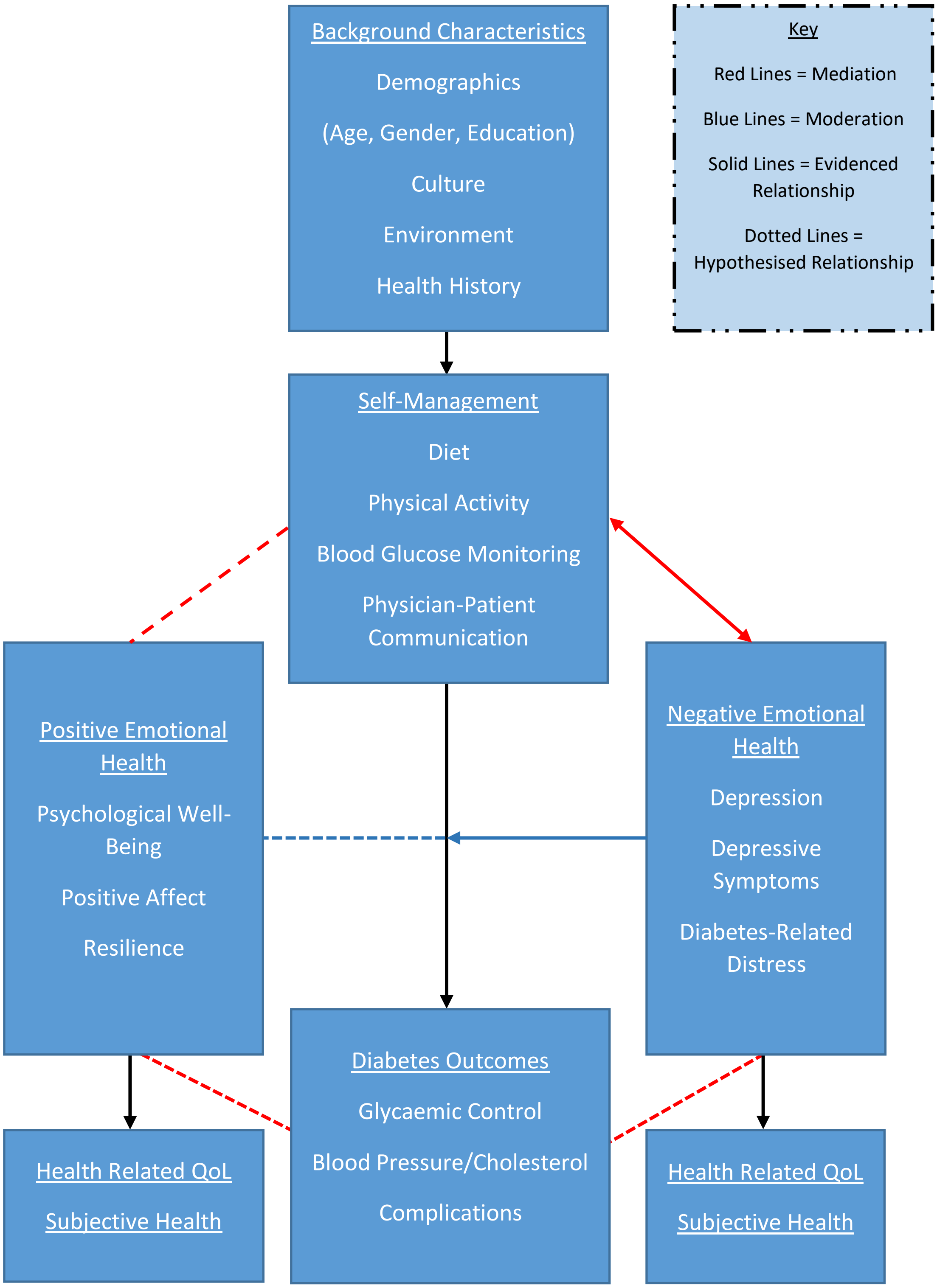
[Fig 10.5 Upward spiral theory of lifestyle change (Fredrickson, 2003; Van Cappellen, Rice, Catalino, & Fredrickson, 2017). The outer loop represents PA-generated endogenous resources. Vantage resources refer to the fact that they leave people more sensitive to subsequent positive experiences.]

10.4.5 Robertson's (2012) Conceptual Model of Diabetes/Yi Frazier et al. 's (2012) Model of Diabetes

To the author's knowledge, there are two main models that attempt to explain the relationship between PA and diabetes and even these two do not put PA central to their theories. Robertson's (2012) conceptual model positions PA and NA as two opposing mediators on the relationship between self-management and diabetes outcomes. Yi-Frazier's (2012) model, on the other hand, positions PA-built resources (resilience, self-esteem) as interacting with environmental characteristics (such as social support and family dynamics) to influence behavioural mechanisms and diabetes outcomes. Again, given a lack of evidence on behaviours and long-term outcomes, there was little opportunity to empirically test these models. However, evidence for affective processes were available in the research conducted as part of this thesis, suggesting they are important before self-management, contradicting Robertson's (2012) model. Furthermore, Study 4 showed that coping mechanisms probably occurred before a development of resilience, contradicting Yi-Frazier's model, too, suggesting that these models were not appropriate in this context.



[Fig 10.6 Yi-Frazier and colleagues' (2012) Model of Diabetes]



[Fig 10.7 Conceptual model adapted from Robertson et al., (2012; which in turn was adapted from Piette et al., 2004) showing positive and negative psychosocial and affective pathways associated with diabetes self-management and hard outcomes. Arrows indicate directions of the relationship.]

10.5 Implications for Non-PA Theory

Instead of (though sometimes alongside) support for PA theories, the evidence most consistently showed support for the theory of self determination (SDT; Deci & Ryan, 2000; 2008) across T1D and T2D and at-risk population groups. According to the original model, human behaviour is extensively motivated and regulation by ongoing exercises of self-influence. These exercises include self-monitoring of one's behaviours, its determinants, and its effects; judgement of one's behaviour in relation to personal standard and environmental circumstances; and affective self-reaction (Bandura, 1991). When SDT is applied to goal setting, previous BPS research had used the theory to explain how people could adjust their beliefs and actions towards a beneficial end (Hagger, 2010). This is because the theory proposes that human beings have three inherent psychological needs that promote optimal motivation, development, and wellness (Deci & Ryan, 2000; 2008): autonomy (the sense that one's actions are under one's control), competence (the notion that one is capable and skilled), and relatedness (the feeling that one is close and connected to others). When all of these needs are met, an individual experiences feelings of need satisfaction, which is important for future increases in subjective well-being. However, for goals to achieve these needs, they must be intrinsically motivated rather than extrinsically motivated (such as by promises of wealth, etc.). In this context, health appeared to act as an intrinsic motivator.

Qualitative data from Study 1 demonstrated that participants with T1D and T2D sensed that they could use the intervention to increase a sense of autonomy. Study 3's themes supported this, and there was evidence of participants at various levels of risk for T2D using the intervention to boost feelings of control. There was also some evidence of using the intervention to increase relatedness (in themes around using the BPS to promote social well-being). The positive feelings experienced in Study 3 may, therefore, have represented feelings of need satisfaction, rather than PA directly. The quantitative findings from Study 1 (as well as quantitative findings from Studies 2 and 4 on symptomatology) showed that perceptions and cognition was important in terms of BPS effects. Changes in perceptions may have been triggered by intervention effects on self-monitoring; for example, triggering changes in motivation that were reflected in Study 1's findings on self-care.

SDT proposed that self-regulatory processes are important for behaviour change and health promotion (Deci & Ryan, 2000; 2008). Interventions that have applied the SDT have previously reduced obesity, for example, via re-evaluation, re-judgement, and re-monitoring of behaviours and emotions in a way that was healthier and more forgiving. In this sense, the models endpoints are the same as PA models such as the B&B (Fredrickson, 2001; 2004). The research detailed in this thesis therefore shows that the SDT is just as important to consider (if not slightly more) as theories of PA when using the BPS in this specific context.

10.6 Future Research

Examining the theoretical implications of the present findings has revealed a number of ideas for future research, including using extended follow-up periods to assess long-term behaviour change and illness outcomes. Such research could assess mediating and moderating factors to obtain a more conclusive notion of BPS mechanisms. This could be done for people with T1D and T2D to assess self-management outcomes (potentially including clinical markers such as HbA1c) as well as for those at low and moderate-to-high risk of T2D to assess whether risk is reduced as a result of using the intervention. This would provide evidence of the long-term utility of the BPS for self-management and/or prevention. After all, changes to cognition, affect, and symptomatology may have limited clinical importance if they do not translate into long-term, significant intervention benefits.

Theory (specifically the MEM and SBM) also highlighted that more could be done to assess physiological and immunological benefits associated with the intervention. The evidence discussed in the introduction to Chapter 8 (Study 4) suggested that stress is linked directly to diabetes clinical outcomes via the HPA axis (Kyrou, Chrousos, & Tsigos, 2006), so future work may wish to focus more on this interaction. Research could look into cortisol, for example; obtaining saliva samples and testing them in the laboratory turned out to be beyond the limits of this PhD, but there is evidence linking cortisol with fatigue in particular (Milrad et al., 2018). Given the BPS' impact on fatigue as a symptom of diabetes, there may be some evidence of a direct physiological link between stress and fatigue. In that case, BPS effects may not be purely perceptual but may also involve physiological changes. The BPS has influenced pain in other (non-diabetes) research (Hanssenet al., 2013; Molinari, et al., 2017), so this would help identify some of the underlying mechanisms across BPS research. Pain was also discussed by some participants in Study 3, and neurological sensory symptoms were significantly reduced in comparison to a control condition in Study 4, suggesting that the relationship between the BPS and physiology requires further exploration.

In terms of physical impacts of the BPS, future work could also investigate the neural correlates of the BPS. Although not covered by any theory, research here could examine not only changes going on while the recipient is engaging with the BPS but could also assess immediate-to-short term benefits as well as potential long-term changes to the brain. Research conducted by Garland and colleagues (2010) has highlighted some of the impacts that PA has on the brain, and this may act as a good foundation for future BPS work. Research in this area is expanding and requires further investigation across affective research and not just in relation to the BPS, although there has been no research specifically looking at brain activity associated with the BPS in any context.

A return to the BPS literature also provides some interesting ideas for future work. For example, many PPIs can be delivered alongside other PPIs as part of a "buffet-style" approach (Huffman et al., 2014; Parks et al., 2012). Previous research has shown that a number of diabetes PPIs have been delivered in this format (Cohn et al., 2014; Jaser et al., 2014). It would be first important to identify what sort of interventions would complement the BPS in this context. The BPS increased gratitude in Study 3, suggesting it could be coupled with other gratitude interventions (Boehm et al., 2011) to achieve greater gains. Alternatively, the BPS could be matched with interventions that promote strength finding, for example, to encourage goal motivation. The BPS also integrates well with mindfulness exercises, as increases in mindfulness attention are associated with greater boosts to PA following exposure to the BPS compared to mindfulness alone (Seear & Vella-Brodrick, 2013).

To further increase the effectiveness of the BPS, recent research has shown that building compassion can aid goal setting and goal achievement (Biber & Ellis, 2017). Individuals may be able to set goals using the BPS with an aim to change health behaviours, but their efforts may be derailed by distractions, temptations, and negative reactions to set-backs and failures (Sirois & Giguere, 2013). Self-compassion (defined as taking a kind, compassionate, and accepting stance towards one's self during difficult times; Neff 2003) can buffer against these difficulties by providing people the tools to further promote resilience (Allen & Leary, 2014; Brion, Leary, & Drabkin, 2014; Sirois, 2014). Furthermore, self-compassion can also indirectly boost PA which leads to benefits of its own (Sirois, Kitner, & Hirsch, 2015). Future research may, therefore, wish to explore adapting self-compassion components into the BPS to further promote resilience and PA in a diabetes context.

10.7 Recommendations for Diabetes Care and Prevention

The goal of future research should be to make progress towards the application of the BPS either as a tool for self-management or for prevention. This PhD produced two versions of the BPS, one for people with T1D and T2D, and one for people at various risks of T2D. The aim of the first version was to promote self-management behaviours and reduce symptoms of co-morbid mental illness. The aim of the second version was to reduce symptomatology, facilitate physical health change, and counter-act stress. Future research will need to examine behaviour and clinical outcomes in relation to the first version in particular, and stress management and physiology in the latter. If future work can also demonstrate that findings from the Studies 2-5 can be applied to the self-management BPS (and/or vice versa), then that would also be beneficial.

10.7.1 Diabetes Care

Currently, standard psychological care for people diagnosed with T1D or T2D in the UK uses a pyramid model, which emphasises the use of Cognitive Behavioural Therapy (CBT), to support patients with emotional problems not requiring biological treatment (NHS, 2010). There is little or no mention, however, of the use of PPIs but the present findings suggest that the BPS represents an additional tool that can be used to alleviate psychological distress in people with diabetes. Still, before applying the BPS to a T1D and/or T2D population, the intervention may benefit from being presented to a comprehensive panel for a slight rework. Findings from Study 1 suggested that more changes would be necessary (including modifications to language) and having a team of doctors, nurses, dietitians, clinical/health psychologists, and patients provide expert input would be an effective way encouraging further intervention acceptance (Yardley et al., 2015). Study 1 showed how important it was to consider the unique needs of people with diabetes and doing so will allow the best "fit" for the intervention (Layous et al., 2013). In particular, there is a need for the intervention to be seen as sensitive and well-informed in order for users to trust it and engage with it. Since Study 1 was conducted, the Language Matters document (NHS, 2018) has been published, and it will be worth bearing in mind some of their suggestions for language use, which has shown to be very important for people with, and at risk of, diabetes (Speight, Conn, Dunning, & Skinner, 2012).

Once applied, the research into this version of the BPS will need to explore possible behavioural and clinical outcomes, so as to continue the work started in Study 1. Previous BPS work has actually demonstrated very little behavioural effects, (often as a result of methodological choices – not tracking goals, not using long enough follow-up, etc.) (Loveday, Lovell, & Jones, 2018) so there is scope here to significantly advance understanding of the intervention's effects and mechanisms. Other diabetes PPIs have increased engagement in self-management behaviours and led to an increase in blood glucose monitoring (Jaser et al., 2014) so behaviour change is likely given enough time and large enough sample sizes. Previous research into the BPS has at least shown that the intervention encourages visits to clinics and GPs as a result of being mindful of one's health (Austenfeld et al., 2006; Austenfeld & Stanton, 2008; King, 2001). Qualitative evidence from Study 3 suggests that diet and physical activity are most likely to be influenced by the BPS, but quantitative evidence will be necessary to verify this observation.

Clinical markers (such as HbA1c) will also be important parameters to study because of the direct health implications they have for care (Arnold & Wang, 2014). If the BPS can influence HbA1c, then it very clearly shows that the BPS offers certain benefits beyond which other PPIs have failed to influence (see the systematic review by Massey, Feig, Duque-Serrano, Wexler, Moskowitz, & Huffman, 2019). However, changes to HbA1c may mean very little if it is unclear how the BPS is producing these effects. Bear in mind that initial follow-up with a T1D/T2D population was rejected because it was not clear how the BPS' was achieving its effects and so a balance is necessary.

Finally, point of administration is also important to consider for both versions of the BPS. Qualitative data from Study 1 suggested that people with T1D and T2D felt that earlier administration would be preferable. Doing so would mean that the BPS could provide people newly diagnosed with a way to immediately "take control" of their illness. Future researchers may wish to assess whether the BPS could be provided as part of education programmes, such as the ongoing NHS DPP (Penn et al., 2018). With the latter, goal setting via the BPS intervention would provide a way to apply their new knowledge and tailor it to their own self-management regimes. However, some participants in Study 1 also stated that, despite having had diabetes for a long time, they could still see benefits of using the BPS even with all their experience. One participant saw the intervention as a way of "re-energising" themselves. Another said that self-management had a habit of becoming automatic and so the BPS represented a way for that individual to challenge their established ways of thinking and behaving. Taken together, this evidence suggests a need to administer the BPS at various time points, perhaps depending on the individuals needs. Future research may therefore wish to consider assessing the effects of having a GP or nurse provide the BPS to patients at critical junctures (e.g. following an HbA1c test, following a conversation around the individual's well-being or even following initial diagnosis) in a primary care setting.

10.7.2 Diabetes Prevention

Administering the BPS to participants at higher risk in a similar way may also be effective. If, for example, a person is diagnosed with pre-diabetes (characterised by the presence of higher than normal blood glucose levels and presenting as a high risk of T2D), then a GP or nurse could administer the BPS to help the individual alleviate stress and NA, and to develop a sense of autonomy, competence, and relatedness in line with the SDT (Deci & Ryan, 2000; 2008). The BPS could also be used as a way to encourage information seeking about T2D as well as their own risk, as seen in the 'control' theme of Study 3. The BPS could be worked into programmes such as the NHS DPP where the individual could speak to specialised professionals and people in a similar position to themselves. Education programmes for people newly diagnosed with pre-diabetes may in fact be an effective way for people to share ideas generated from using the intervention. Study 3 showed that people wanted to engage more with others, and Study 1 led to the implementation of a feature encouraging people to share their ideas and goals (see Appendix 1 for more details). People could use the intervention privately or in groups to develop novel solutions and ideas for diabetes prevention that they might not have had if they had been on their own (e.g. new physical activity classes to sign up to). Research could examine the utility of the BPS for use in individual versus group settings, especially in this context where some individuals seem to benefit from sharing.

10.7.3 Considerations of Harm

One final point to consider: the potential harm of the BPS. Qualitative feedback from Study 1 showed that some participants were worried that thinking and writing about a 'best possible future self' would exacerbate issues if the individual was struggling (emotionally/physically) at that time. Qualitative data in

Study 3 demonstrated that this was an issue for those at risk of T2D too, as some participants reported feeling a discrepancy between their current and future possible selves which led to feelings of anxiety. Changing the language of the intervention may help reduce some of these feelings. For example, one study administered a version of the BPS that was tailored for people with depression by asking recipients to “give themselves some sage and compassionate advice from a better future” (Shapira & Mongrain, 2010, pg. 381) and this showed to help reduce mental illness symptoms. Future research will need to make it a priority to assess harm as a main focus.

Issues around harm are important to consider for everyone, but they also have serious ramifications for people with co-morbid mental illness (Smith et al., 2013). People with T1D and T2D are up to 2-3 times more likely to have anxiety or depression than the general population, and more frequently experience stress and NA (Barnard, Skinner, & Peveler, 2006; Fisher et al., 2008). Those at risk may also be experiencing higher levels of distress than others. It is important, therefore, to be sensitive to this population’s unique mental health needs too. Furthermore, eating disorders are also common in these populations, and applying a “best possible self” may promote particularly harmful ideas and concepts, especially as the notion of “control” is already such a major part of the illness (NHS, 2018). Screening for mental illness might be crucial before administering the BPS, so more research needs to investigate this area. Alternatively, if appropriately used, the BPS may even help reduce symptoms of these issues (i.e. psychological distress). The BPS has already shown to reduce NA and stress as in Studies 2, 4, and 5, for example.

10.8 Strengths & Limitations

A lack of behavioural and clinical effects of the intervention was a significant limitation of this research. However, assessing long-term (e.g. over a year) follow-up would have been difficult given the constraints of the PhD. Furthermore, efforts needed to be concentrated on assessing other outcomes. Following Study 1, for example, work needed to concentrate on alternative mechanisms and effects as there was little theoretical foundation to suggest that longer-term benefits would have been found at that stage. Given more funding and a longer time frame for the PhD, a long-term follow-up study could have been implemented. Instead, future research will have to be ran to assess intervention effects on behaviour and clinical outcomes.

Another issue with the research contained within this PhD relates to attrition. Following Study 1, efforts were made to ensure that sample sizes provided modest power at least. In each case, G power was used to calculate the number of participants needed. In Studies 2 and 4, more participants were recruited than were needed to achieve power. However, drop-out between Time 1 and Time 2 four-weeks later in both studies meant that Time 2 results would occasionally lose some of this power, increasing the risk of Type II errors (i.e. false negatives). Consequently, some effects may have been missed at Time 2 in both of these studies. However, evidence of effects consistent across studies (symptomatology, reduced stress, etc.) lend a significant degree of validity and reliability to the research findings. Still, future work should continue to examine attrition more thoroughly, as retention is important for long-term intervention benefits.

At this stage of the thesis, it is also worth celebrating that a strength of this research was that it not only significantly extended existing diabetes PPI research but it did so using a variety of methodologies. Over the course of five studies, this research has demonstrated a number of intervention effects and mechanisms using interviews, focus groups, self-report measures, textual analyses, and HRV and blood pressure readings. Ultimately, this all lends further validity to the intervention and its effects. Furthermore, effect sizes (as calculated by partial eta squared; $\eta p2$) demonstrated that a significant number of the oberserved intervention effects were at least small-medium in size (which would make them noticeable even to the untrained observer, according to Cohen, 1992). In the case of neuropathic symptoms, the effect observed in Study 4 was especially large, further demonstrating that the BPS's effects were constistently anything but negligible.

10.9 Qualitative Reflections

In Chapter 4 (section 4.3.4), there was a section offering reflections of qualitative bias. Some final reflections on qualitative data collection and analysis can be found below:

Studies 1 and 3 provided insights into an intervention that we (the research team) knew less about than we originally expected. Adopting the BPS into this context came with its challenges and its surprises. Study 1 demonstrated that the intervention was broadly acceptable but that it required some modifications to better fit it for purpose. Looking back, changes to language were to be expected, but ideas such as those to use the intervention to promote discussions with health care teams/support networks were ones that I personally did not anticipate. The qualitative phase of Study 1 was actually proposed later than the quantitative phase was and did not originally feature in plans for the PhD. In retrospect, we would have seriously struggled without it, and researchers wishing to fit the BPS to novel contexts must absolutely get some feedback from their intended population. Study 3 was just as important in a lot of ways as it helped us better understand the intervention's effects in a way that another quantitative study would not have. It provided real depth and gave us an insight into people's engagement with the intervention. Although there were common themes, participants addressed themselves and their goals in a variety of ways. The length, the format, and the tone with which users addressed themselves and their goals were all unique. What was particularly surprising was the number of unique goals and solutions that individuals generated. Given that all participants were writing about their

health and the limited number of ways that people tend to talk about it (eat better, go to the gym more), there was an endless number of ways in which people addressed the unique problem of "health". Participants often took a holistic approach to their health, and they would discuss their mental health alongside their physical health. Social aspects of their health were also explicitly deliberated upon. This level of consideration had not been seen in BPS health research before, but it did fit in well with predictions of the SDT.

The results of Study 3 also highlighted a unique way in which the BPS may be applied, especially to people with T1D and T2D. Study 3 demonstrated the types of goals and solutions that people were coming up with, a lot of which may be more beneficial than say, generic advice given by a GP, for example. Not only is it more varied, but these individual goals may be more motivating, even exciting, for individuals. A few participants mentioned how they had elected to do one thing because the mainstream thing did not work for them. Although this is purely speculative, being instructed to do the same, unimaginative things by a string of health-care professional may be frustrating not only for people with diabetes but for people more generally. Utilising the BPS in GP clinics may give people the opportunity and the space to come up with their own goals. These goals can then either be agreed upon with the professional or just followed up on one's own. It may even save the GP some time in that they could hand over the BPS and not spend as much time worrying about giving novel, tailored advice. Should the patient have queries about their health, the health care professional could direct the individual to the BPS to focus their line of questioning.

10.10 Conclusions

The BPS was shown to improve a range of psychological and physical health outcomes for people with T1D and T2D as well as for those at both low and moderate-to-high risk of T2D. The precise nature of these benefits differed depending on the population, but future research can determine whether findings can be applied across contexts. Evidence from the qualitative data suggests that the BPS applied to self-management populations and to those at risk both saw the intervention as a way to promote autonomy in line with the SDT, suggesting some shared mechanisms of effect pathways. For those with T1D and T2D, the BPS also improved perceptions of self-care, which may lead to benefits in the long-term. For those at low and moderate-to-high risk of T2D, the BPS also indirectly facilitated PA while reducing NA over time, immediately reduced psychological and biomedical symptoms of diabetes, increased resilience, and reduced perceptions and physiological markers of stress in those at higher risk.

While there is a small potential for adverse effects, overall, the BPS has shown to be an effective intervention that requires further investigation in this context. It has shown to fit well with PA theories such as the broaden-and-build (Fredrickson, 2001; 2004) and the stress buffering Model (Pressman & Cohen, 2005), but future work will need to further examine relevance of SDT (Deci & Ryan, 2000; 2008) for understanding BPS efficacy. Overall, the findings may have implications for the use of psychological interventions to address emotional distress in both diabetes care and prevention.

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Appendices

Appendix 1: The 'Best Possible Self' – Adaptions over Time

The BPS went through three iterations over time:

V1. 'Best Possible HbA1c' (pre-feedback)

Your HbA1c gives you a picture of what your average blood sugar levels have been like over the last few weeks/months. The target for people with diabetes to aim for is about 48mmol/mol (6.5%) though you may have your own been given your own aims. Improving HbA1c by even 1% (or 11mol/mol) cuts the risk of microvascular complications (retinopathy, neuropathy, and kidney disease) by 25% and if you have type 2 it also cuts the risk of cataracts, heart failure, and amputation.

Please take a moment to think about your best possible HbA1c level. Imagine that your blood sugar levels have been very well controlled. It might be because you had been feeling more optimistic of late or you had been able to better deal with setbacks in relation to your diabetes management. Think of this as the realisation of the best possible HbA1c level you could hope for yourself.

Now, please use the next 10 minutes to write continuously about what you imagined about your HbA1c level. Use the instructions below to help guide you through this process:

1. Be as creative and imaginative as you want (don't worry, what you write is for your use only; no one else will ever see it). Do not worry about perfect grammar and spelling.

2. Use whatever writing style you please just remember to imagine your ideal HbA1c level in the FUTURE.

3. However, you may find it helpful to activate your senses, feelings, and perceptions to make a personal story of your ideal HbA1c level. Really visualising your best possible HbA1c will make it feel more personal to you and may inspire confidence

Version 1 was based off previous versions of the BPS utilised by Sheldon and Lyubomirsky (2007), Meevissen and colleagues (2011), and Odou and Brodrick (2013). It asked people to think about their 'best possible HbA1c' to make it more relevant to context and to give people with T1D and T2D a concrete goal to focus on. This 'best possible HbA1c' version of the BPS also used an introductory text box (in blue-grey above) to describe the benefits of looking after one's health.

V2. 'Best Possible HbA1c' (post-feedback)

Feedback from people with T1D and T2D meant that a number of significant changes were made to the 'best possible HbA1c' before the quantitative phase of Study 1 took place. The introduction box was edited so that it used more sympathetic (and less fearful) language. It says more about how the intervention can help one with making changes to self-management now, and provides evidence to support of how the BPS has worked in other scenarios. Furthermore, the introduction box let people know that they were free to use the intervention as much as they found helpful, in the hope that this gave the recipient a sense of control and the intervention a less prescriptive feel.

The positive, supportive language was continued in the instructions, and this was guided by the version Layous, Nelson, and Lyubomirksy (2013) used in their work. Step 1 was extended to let people know they could share their BPS-generated ideas with a support network if they found this helpful following a number of suggestions from people with T1D and T2D. Step 2 was removed and replaced with more empathic advice about how to approach the intervention more generally. This was included to minimise any frustration or anxiety that people with T1D and T2D had been concerned about. Step 3 still instructed people to develop a narrative but was otherwise completely reworded. Again, this step was designed to be supportive and to let people know that they could write about whatever goals they chose. This was added to help provide further structure so that people could think about their long-term future without putting pressure on people. Finally, Step 4 acknowledged that HbA1c can occasionally be an abstract (or at times inappropriate) thing to focus on, so people were encouraged here to focus on other aspects of their self-management if they found that helpful.

Receiving your HbA1c results can be stressful and it can sometimes feel like the test was something you couldn't revise for. However, making little changes to your lifestyle and staying optimistic in the face of diabetes can go a long way. This activity is designed to help you with that. Research has shown that writing about yourself in the future can help you set goals, manage and restructure your priorities, and express and come to terms with your emotions. This has shown to boost mood and give you a sense of control over your illness. Please read the following instructions and make sure to repeat this task as much as you find helpful.

Take a moment to think about your best possible HbA1c level. Imagine that your blood sugar levels have been very well controlled and that you have resolved some of the issues currently concerning you. Imagine how it felt to achieve those levels and reflect on how positive it would feel to have more control. Then, tell yourself the important things you realised or the critical steps you took to get there. Think of this as the realisation of your best possible HbA1c level.

Now, please use the next 10 minutes to write continuously about what you imagined. Use the tips below to help guide you through this process:

1. Be as creative and imaginative as you want. Do not worry about perfect grammar and spelling as this is for your private use. No one has to know what you wrote down, though you may find it helpful to share and develop ideas with trusted friends, family, or even your health-care team.

2. Do not feel too pressured to write everything down on your first try. As you repeat this task, more ideas will come to you naturally.

3. Remember, steps are often small, even the critical ones. There likely won't be one big fix. You may find it easier to write about more achievable things to start with such as investing in a pedometer/walking app or making a decision to try different recipes more often. However, if you want to write about running a half-marathon, that's okay too!

4. If you find thinking about HbA1c too abstract, try focusing on another aspect of your self-management. The important thing is to focus on something long-term so that you can make more noticeable improvements to your health.

V3. 'Best Possible Self' (for people at various levels of risk for T2D)

Maintaining our health is not always easy. However, making even small lifestyle changes and staying optimistic in the face of slumps and adversity can go a long way. This activity is designed to help you do that. Research has shown that writing about yourself in the future can help you set goals, manage and restructure your priorities, and express and come to terms with your emotions. This has shown to boost mood and give you more control over your health. Please read the following instructions and make sure to repeat this task as much as you find helpful.

Take a moment to think about your best possible self. Imagine that you are in excellent health and that you have been taking extra good care of your body. You are exercising regularly and you are eating well. You have worked hard and succeeded at accomplishing all of your health-related goals. Imagine how it felt to achieve those goals and reflect on how positive it would feel to be this fit and healthy. Then, tell yourself the important things you realised or the critical steps you took to get there.

Now, please use the next 10 minutes to write continuously about what you imagined. Use the tips below to help guide you through this process:

1. Be as creative and imaginative as you want. Do not worry about perfect grammar and spelling as this is for your private use. No one has to know what you wrote down, though you may find it helpful to share and develop ideas with trusted friends, family, or your health-care team.

2. Do not feel too pressured to write everything down on your first try. As you repeat this task, more ideas will come to you naturally.

3. Remember, steps towards success are often small. You may find it easier to write about things that are more achievable to begin with such as investing in a pedometer/walking app or making the decision to try new recipes more often. However, if you want to aim high and write about running a half-marathon, that's okay too!

4. If you find thinking about one aspect of your health particularly difficult, try focusing on another one. The important thing is that you write about something long-term so that can make more noticeable improvements over time.

Version 3 kept most of the changes but modified the language for the new target population. The introductory box needed a rewrite to reflect the different goals that people at various levels of risk might have in regards to their health. Consequently, his population were just asked to think about their ‘best possible selves’; a best possible HbA1c would have no meaning for them. In this section, the language was still designed to be supportive, there was still evidence of how the intervention has previously worked in other studies, and a sentence was left to encourage people to use the intervention however much they found helpful just as in the previous version.

The instructions, meanwhile, were practically kept word for word. The only change to the instructions was in Step 4, though the concept (having people shift focus to another area of their health if they were struggling with abstract or complex ideas) was the same.

Appendix 2: Study 1 Themes, Codes, & Quotes

Main Theme	Sub-Themes	Reference (participant, Line #)	Quote	Notes
Taking Control	Control and the Diabetes Experience	K1,p2,l26	If you sort of take responsibility for it and come out with a good result then you can feel like “oh I did that well this time”	Taking responsibility can provide feelings of control and positivity
		K1,p2,l29	When you’ve got control you feel like you’re more… you know what you’re in for? As opposed to when you feel like you haven’t got any control over it you can go in and thinking “um God what are you going to say to me this time”	Control promotes confidence and reduces negative emotions.
		J5,p3,l1	Some days I have quite good days and then other days are awful and I have no reason for it to be. Erm so at the minute I’m going on to a pump, rather than injections. Erm so hopefully it gets a bit better. When I go on to that.	Lack of control countered by hopefulness which has led her to try other routes of action which should in turn bring back some control.
		C7,p2,l37	We’re all about control, diabetics, don’t forget!	Great quote. C consistently advocates a personal approach and believes others will too.
		C7,p5,l10	I’ve actually, you know, struck myself off and said “do not make any appointments with that junior doctor or	Taken control of her care and her support network options. Link to themes “pro-active” and “intervention to promote discussion”

			that junior doctor" because I won't be spoken to like I'm a textbook because I'm not.	
		G8,p7,l28	What you're doing now is putting it back in control of the person by giving them a tool that's meaningful but doesn't take up an awful lot of time.	Doing an intervention that's meaningful (and doesn't eat into their already hectic schedule) provides control?
		J10,p20,l12	I expect them to know things. And they don't *laughs* So you get "oh oh I'd like an appointment with anybody er you know, out of your 8 doctors EXCEPT Doctor X. They were utterly unknowledgeable."	Taken control of her care and her support network in a way that mirrors C7s.
		G11,p4,l21	I've always been in a position where I've got a good idea of what it's gonna be erm and it's even better now 'cause I got a thing called a Freestyle Libre? Erm constant glucose monitoring… but it's given me a lot of insight into why my last HbA1c wasn't as good as the previous 3 *laughs*	Evidence that G has taken control of his blood sugar readings too, despite what the guidelines may say.
		G11,p7,l25	In fact, it's only this January I've got a number associated with insulin resistance. I didn't even think there was a number to go with but erm… and these are things that	Taken control and got extra tests, which seem to have helped.

			I've had to find out on my own. My GP hasn't sent me for any of these blood tests.	
		G11,p14,l3	Yeah I think this might be a problem, you see *laughs* I've got to be in charge *laughs*	GOT to be in control.
		K1,p2,l8	When you get a good result it's like you can feel proud of yourself… and you can feel accomplished that you've managed to be like "oh well I've done that okay this time, I've got the reading that I want as opposed to feeling, eurgh, guilty? Angry? Upset.	HbA1c test as emotional
		K1,p2,l12	If it's a good reading you can come away feeling "yay, I've actually got on top of this this time, I'm actually doing okay" but if you get a bad reading you think to yourself "oh well you know what's the point"… you feel a bit hopeless	HbA1c test as emotional
		D4,p3,l27	Yeah, no it's not, it's not an easy thing. Erm I think when I was really struggling with them erm it's difficult to know what to do.	HbA1c as random
		J5,p3,l13	I think erm so when you're in that kind of mind-set that you… you're recording everything	HbA1c influenced by mind-set and attitude.

			and you… you know trying to get the best you can, it really has an impact on your HbA1c	
		C7,p3,l23	It's like a test you can't revise for. You go in and you think "I hope this is alright? If it's not, oops, but I can't do much about it"	Hba1c as an exam. As random. As out of your control, to an extent?
		C7,p7,l23	As I said, it's like an exam. You know you're gonna get the result but you CANNOT possibly revise for it.	HbA1c test as exam
		C7,p7,l26	You can only sort of do your best and go "well they haven't been too bad the past few months"… there's only so much you can do… you can do as many blood tests per day as you want but…you can eat one biscuit and your blood sugars are still averaging like 14.	HbA1c as random. Attitude towards it, acceptance that it's random may be the best way to counter negative feelings and stress surrounding it.
		G8,p2,l27	The vast majority of people that I know within touch of my social network that have got diabetes spend an awful amount of time just avoiding anything to do with HbA1c.	HbA1c as frightening? Link to theme "pro-active"
		G8,p3,l26	Most diabetics would be told that score and most of them… they just know they've either passed or failed their exam when	HbA1c test as exam

			they went to the doctors.	
		FG,p2,l7	How do you cope with this? You've done everything right between the 2 measurements and it still runs high?	1. HbA1c results as random.
	Taking a Pro-active Approach	R2,p6,l33	And if they simply follow rote, you know, from the diabetes team? "You will do this, you will take this metformin, you will do this, and if it gets worse we'll give you like… whatever it is" Lipiodol or whatever and then you'll… "we'll put you on insulin" which is the worst thing they can ever do… and erm people just follow this routine.	Acknowledgement that "newbies" may simply do as the doctor tells them too which R believes to be detrimental to their health.
		R2,p7,l10	So there's…some of us that are bolshie and say "I'm gonna do this myself" "I'm not going to take any drugs" *laughs*	Personality type as beneficial to better self-management
		R2,p7,l22	We stopped taking the metformin and slowly but surely he's now erm he's still drug free and he's on the CORRECT diet and he's losing weight and all those other things. So he eventually found the way to do it himself.	Breaking away from blindly following the doctor's orders to becoming pro-active and improving self-management techniques and subsequently his health.
		M3,p6,l1	I remember raising this in a research environment with an endocrinologist and he said "well	Being pro-active is a choice. Link this to theme "desire not to spend more time on

			someone like that, they've got to really erm start measuring out the carbohydrates" and that's… quite a big thing to do. And I knew she wasn't… she was never going to do that. But sometimes that is the choice erm that a patient makes.	diabetes than is necessary"
		C7,p5,l20	I think anyone who doesn't use the available resources I think is just asking for trouble because, much as we like to say "oh yeah we can do it all, we're fine, we're fine" half the time we're not and we don't know because if we don't use the support network we don't get our insulins… it's to help yourself but it's one of those.	Again, highlighting the importance of being pro-active. Also link to themes of "awareness" and "discussion/networks" as using the intervention to promote discussions with others may help raise awareness as well as challenge existing knowledge and limits of existing awareness.
		C7,p8,l22	If it's because of a, b, c then that's different. But if it's just 'cause you're being lazy or you haven't been bothered so much well… that's down to you and you need to stop doing it so much.	There is a need to take responsibility for your own care and management.
		G8,p2,l31	They really don't want to know, they just want to be told to go away and take the pills and come back tomorrow without putting any more weight on.	There are some individuals (or a lot of individuals, according to G) that want to bury their heads in the sand and want the medication to take

				care of everything for them.
		J10,p11,l30	And people still do this! Because they assume if anything important happens, somebody will tell them. But it's not always the case. Er and that can be why some people struggle.	In order to increase awareness you must be pro-active! You can't assume your HP team will tell you everything.
		J10,p13,l11	"I'll take this pill, go away, and I'll see you in 6 months"… some pills gonna… gonna sort it for them? I used to blame it on their lack of education and that was true. Now they have much more education but they still haven't got the time.	Time as barrier to stopping people from being pro-active?
		J10,p20,l34	But if you didn't know and you were told that by your GP? Well you… "they obviously have more medical knowledge than I do!"	Those who are not pro-active are at risk of getting wrong and potentially dangerous information. Link to theme "research".
		G11,p3,l15	You can't go to your GP and say "oh I'm trying really hard" and then say "well I'm drinking 2 pints a day" *laughs* You… you… you've gotta… gotta do the right thing.	Awareness of responsibility. This could potentially influence his relationship with the doctor. Could they then trust HIM? About doing the right thing. Link to "tool to promote discussion" perhaps.
		G11,p12,l11	Again, if you look at some of these forums you'll… you'll get the very	Link to themes "personalised care" and "network". This points highlights some

			definite impression that erm it… it's a postcode lottery as to whether you've got a good GP, a good diabetic nurse, or somebody who's just got a set of rules that they apply.	of the issues you may be in if you DON'T take a pro-active role. May also link to awareness? Because if you don't have a supportive team, would you even know about it? And if you did, would you know enough to do much about it? Or would you be stuck?
		G11,p15,l3	Erm as I say, a lot of them just take the tablets without realising, I mean, one of my friends er… one of my friends was quite proud about the fact that he just eats what he wants.	Lack of awareness seems to be behind his attitude. Increased awareness may motivate him to take action.
		FG,p2,l12	At the end of the day, there is a lot that we can all do… everybody should be able to work that out, what they can do to help themselves.	3. A need to take control. Be pro-active.
		R2,p3,l5	I did all my own research because my erm… my doctor's practice really couldn't tell me how to go about this problem. Really had no idea and they sent me to a dietician who erm after 5 minutes said "well just follow the NHS guide by… divisional plate guidelines" or whatever it was and erm if I'd have done that I'd be on insulin by now.	Lack of knowledge as harmful.

		R2,p11,l32	They've said "these are your targets okay?" and er "you should change your diet, you should do this…" you know? But they won't actually give them a proper diet	Doctor says to make changes but can't say HOW to make changes
		M3,p6,l14	I think erm it's now down to me. I think the doctor's gone as far as he can go and I think it's now completely down to me.	Awareness of doctor's role and limitations in this relationship. There is an acceptance of facts here though and it's a kind of neutral statement.
		R2,p5,l28	And you can only do that by low carb, high fat diet really. The NHS up until about a year ago completely denied was the case. Okay, they're only just starting to believe it… They didn't understand. Okay? I mean they were sort of just stuck in this erm you know? Organisational rut.	What the NHS says clashes with his researched and demonstrated management techniques.
		G8,p5,l23	They have very little understanding of the sort of things that we talk about on the forum which is all around, you know, diet… dietary control and erm lifestyle things.	Doctors as having no understanding of anything outside of medication.
		G8,p9,l31	So I said "well, you know, how do I it?" and he just looked at me… and said "well I don't know!"	No knowledge of effective lifestyle options.
		R2,p18,l12	I suppose my erm concern over all of this is that the NHS itself is not really	Frustrated he has had to do so much of his own research, without prompting, and that

			giving us the kind of information that we need to do this job properly.	what he discovers (and sees to work) goes against what the HPs are saying and telling him to do.
		G8,p14,l21	I mean your other thing that they don't tell you when you're diagnosed with diabetes is that you… you don't have hypos unless you're on medication. So if like me you enjoy a few glasses of wine now and again erm once you're on medication then you are at danger of hypos.	This lack of knowledge as potentially dangerous
		G11,p1,l19	I was a bit surprised when my doctor at the time said "oh no no no, don't cut out carbohydrates" and I'm thinking "well, why not?" *laughs* You know? It's a third of my diet. It would be a good cut… way of cutting of calories… but er I know that because of NICE guidelines, a lot of diabetic nurses and GPs are not very happy about people on low-carb diets.	Guidelines and protocols as restrictive and against his own personal experience/knowledge.
		J10,p10,l24	Oh he's clueless. But he's the one with the special interest in diabetes. God help… God helps them that don't get to see him and see the ones that don't	Even the specialists as unknowledgeable.

			have a special interest, eh?	
		J10,p13,l25	There's still… still many, many GPs, not so much the nurses because they're getting younger, erm who say "don't google it!"	J gets a lot of her research online. So is their advice old fashioned?
		J10,p20,l27	"Well okay so what else are you telling me that's bollocks?"	Lack of knowledge erodes trust.
		G11,p3,l30	See, again we're back to NICE guidelines and quite a lot of type 2s are told NOT to bother monitoring their blood glucose. Now… now PERSONALLY I think that's silly… if you're only looking at that 8-12 week period, what about the other 9 months?	Again, clash between his experience and what's printed in the guidelines.
		G8,p10,l6	I went through every textbook he'd got [the GP] and there was absolutely nothing about effective diet, management or even exercise regimes. The whole thing was medication… so I'd use things like the erm… the forum that I picked you up from, the diabetes support forum, and I've used… I've gathered this huge amount of written material just either through the internet or on erm, you	So when the HPs were shown to have no knowledge, G sought out her own research to improve her management routine.

			know, from various textbooks.	
		G8,p16,l6	All their guidelines are no way near as up to date on the research in the way I'm working at it.	Discrepancy between her knowledge and the guidelines.
		G11,p8,l29	I took statins for 17 years and when I stopped the er carbs, or lowered them dramatically, my cholesterol dropped dramatically so much so that it gave me the confidence to throw the statins away because I'd been in so much pain and I… I… I really did get fed up with my previous GP coming up with a different reason every year. It was my weight, I did too much exercise, it was my age…	Frustration with doctor's advice as motivator to take action and do own research?
		R2,p12,l22	They're becoming insulin resistant… because they're not tackling the source of the problems… but by the same token they're also kind of individuals that will not go on the internet. And look for valid sites…. Okay so saying to them… "how do you expect to achieve this… this erm ideal HbA1c"… might potentially open the door for them.	R believes looking for good research to be a solution and we can encourage people to do that
		G8,p11,l1	One particular book called erm 'Blood	Useful to find out the evidence base. Link to

			Sugar 101' is it..? Brilliant book around self-management with diabetes and erm that was really helpful at giving me an indicator of the evidence base behind how you can actually manage diabetes sensibly without taking medication.	some of the stuff discussed in theme "clarity"
		G11,p6,l6	It's such a complicated thing and I'm getting all sorts of advice like "oh well, eat peanuts before you go to bed" and you start thinking "hang on a minute has any of this got any research behind it?"	Acknowledges that diabetes is complicated so getting the right knowledge is hard. May need a critical approach.

Main Theme	Sub-Themes	Reference (participant, Line #)	Quote	Notes
Advocating a Personal Approach	The Importance of Personalised Care	G8,p5,l4	The last thing they do is allow you time to say what YOU think you should do, you know, you just, from what I gather, are told erm you know what you ought to be achieving. And told to go away and do it without REALLY giving you any	No time for you. HPs as uncaring and potentially unknowledgeable too. Counter-argument to using this intervention to better network?

			realistic help on how to do it.	
		R2,p11,l1	They don't have…they just sort of serve part of this kind of er generic treatment organisation, you know? They don't… there's a lot of doctors that erm, whilst they might know, they are not going to say.	Doctors confined by guidelines and protocol
		G8,p12,l28	Very little positive support… other than people are very pleased to see you managing to do it without medication, if you manage to do so.	How much of what the HP says is negative then? Are they surprised when you manage without relying on medication?
		G8,p12,l24	Actually finding mechanisms to support you and keep you on track… very, very difficult within the current health system.	Would appreciate some more support.
		G8,p15,l30	And there are exceptions to that and there are some brilliant diabetic specialist nurses who are around that I have met, who are very positive about trying to find ways to actually keep people motivated and help. But as I say, they are very trapped into having to just really keep to the erm professional guidelines and what advice they are	The system stops the staff from offering more support. This is evident in the way she talks about doctors, she talks about how they're TRAINED.

			allowed to give and not give.	
		J10,p10,l18	My GP said “oh well you only need to try a little bit harder” and I sat there and burst into tears. And he didn’t even hand me a tissue.	GP as cold, uncaring. Insensitive.
		J10,p21,l10	I would expect somebody to… to like have a look at where I’ve got the pains not just shrug their shoulders and say “ah well, you will have…” I mean it’s ATTITUDE as much as anything else.	Attitude as also negatively affecting the relationship/trust
		K1,p4,l12	You could do it for however long you wanted to. I think if you did it for a longer period of time, more so toward the month time frame, you’d probably see better results.	K advocates a personalised approach to dosage time
		J5,p2,l4	Probably a couple of weeks to begin with and then see if that was helping	J also advocates a personalised approach to dosage time
		R6,p7,l3	“Okay another couple of weeks have gone by and I still haven’t managed to go to the gym” I’ll probably go through… I’ll probably go through it in my head	A personalised approach to dosage. Use the intervention as something to come back to.
		C7,p2,l10	I think to start off with if you do it monthly and obviously then if	Personalised approach to dosage

			you keep, almost a bit like you do in work sometimes, you keep a template	
		G8,p7,l5	What you'd need is to… to actually set an individual programme with people. So, when would it be helpful to come back and use this and have a think about it again.	Individual approach to dosage
		FG,p1,l18	It's whether that good level is something which you… realistic level… have any chance of achieving it or something which you believe at that time could BE realistic… I would put what you can achieve	2. The importance of being realistic with goals. Make it clear what these are.
		FG,p2,l18	You know where you wanna be, where you would feel comfortable	3. Individual knows best?
		FG,p2,l19	My ambition is to get down to where there's no medication, it's just under control and that… that for me is achievable!	4. Are personal goals motivating?
		R2,p7,l28	And he said erm "I'm never going to be 'normal', I'm never going to be able to reach the norms because I have got this problem however erm if I'm between this and that, you know, reading I'm going to be okay…	Personalised goals as encouraging

			and then that was an encouragement	
		M3,p4,l11	I thought 8.5, to me, that didn't sound terrible, you know? Erm it sounded "yes, I need to get it down 2 points" erm but he was quite strong about it.	HP as forcing medication without considering individual's abilities and goals.
		R2,p14,l18	It's knowing what works for you. I mean I told the… the er diabetics staff there, I said "look, you know, don't… don't even suggest to me that 4.5 is an ideal because then I'd be in here flat on my face with a broken nose or something"	So "ideal" is not necessarily realistic for THAT person
		R6,p11,l1	The word 'optimum' comes to mind when we think about ourselves… as 'optimising' our well-being or… when we think of ourselves as 'realising our full potential' whatever physiological constraints we might have because of our age or health issues.	Alternative to phrasing "best possible"
		C7,p4,l33	Unfortunately the junior doctors like to treat everything like text book and don't know about every other diabetic but certainly any of the ones I see in clinic, soon as you	Link to theme "HPs as unknowledgeable" but acknowledge that C only gets frustrated by the less experienced ones, the ones who

			start getting treated like textbook all you wanna do is throttle them.	won't treat her as a human being.
		C7,p6,l8	People are people at the end of the day. It's like "oh you shouldn't drink too much alcohol, you shouldn't smoke or you shouldn't do whatever" but we all do, we do one or the other or all of them don't we?	There needs to be a REALISTIC understanding of what people can do/achieve.
		G8,p5,l9	The health professionals are very geared towards erm medication and just following through erm protocols and regimes.	HPs as people who solely medicate with no consideration for other aspects of improving health.
		G8,p9,l23	When I started off I was absolutely concerned if I could have, I'd avoid medication. Erm there's a number of reasons behind that but it's partly a, you know, a personal mind-set.	Need for personal goals.
		G8,p14,l11	It's very hard to find a health professional who can actually erm sit down and discuss those sort of things with you. They don't have the knowledge… they're trained to medicate.	She's not asking for a heart-to-heart, just a "discussion" but this isn't possible because they don't have the knowledge. Link to themes "intervention to promote discussion" and "HPs as unknowledgeable"
		G11,p2,l19	I just can't eat! What the books say I can eat.	Importance of personalised goals. Even every BODY is different.

		G11,p10,l24	…to try and achieve good HbA1cs. Which the medical professional love! *laughs* …they seem to be very, very erm dependent upon it and I think they might miss things, you know?	Reliance on clinical markers as negative. Might miss other aspects of the illness.
		G11,p11,l5	It isn't so black and white and I… I dunno how many of the forums that you get a chance to observe over a length of time erm but you will certainly erm see from what people say, they all have different issues, they all have different ideas.	Diabetes as a unique experience and people think about it and deal with it differently.
		G11,p15,l13	And I said "you do realise that 1 in 3 diabetics is impotent?" and that… that made him buck up a bit *laughs*	Link to "networks" here actually. But this illustrates the importance of a personalised, tailored message to get best results.
		M3,p1,l28	I would have thought it was better NOT to be TOO prescriptive and let the patients decide on what medium they wanted to use. Not everybody's good with words and some might want to draw a picture.	Diabetes patients don't like being told what to do. At least people are doing other pro-active things if they decide they don't like writing though.
		M3,p6,l31	I think it's the sort of intervention that will be no ONE thing fits all	Advocates a flexible approach to the intervention? She wants options!

		R6,p11,l14	But there's something quite kinda CLINICAL about asking somebody to think about their best possible HbA1c… it sounds like something you'd read on a doctor's note or something	Best possible HbA1c as clinical. Not personal. Unfriendly.
		D9,p5,l8	Yeah, try and see if it will help	Suggestion for wording. Reduces pressure and makes it a little less prescriptive.
		K1,p5,l27	You could integrate like "what would your…if you were to continue… if you were to have these good blood glucose results all the time then what do you think the positive implications for the long run would be? What would be your like…what would be possibly like in ten years' time where would you like to yourself with your blood glucose? What position would you like to be in?	Concrete goals as a way to make things less generic
		K1,p6,l15	It can give you a real life implication of like "oh well if I can take control of it NOW it just makes my life easier in ten years' time	Use of concrete goals as a way to make intervention less abstract, more "real"
		R2,p6,l13	To make it feel more PERSONAL and to inspire confidence… I think there has to be a	Concrete goals as way to make it personal and inspire confidence

			couple more strands to it. Okay? Like erm HOW, you know? Write down HOW you think you can accomplish it.	
		R2,p8,l6	I hate to use the word ‘generic’… it’s not quite that but it needs to be, I think, expanded to ask the question of “how they think they will achieve it”	Asking people “how” makes it less generic, more personal.
		R6,p11,l25	Maybe think of some different words which invoke… invoke the kind of the positive identification with well-being that you’re looking for, if that makes any sense?	Change language to improve chances of positive emotions being brought about as a result of intervention engagement
		G8,p5,l33	I LIKE the very, you know, it’s… that it’s an individualised erm bit of thinking which you take reflective time on	Intervention as individual, opposite of generic
		D9,p2,l8	As I said I think it is very GENERAL. So some people will look at that and go “oh my goodness, I don’t know” You know? It… it all comes to you all at once or it’s like, well what am I actually going to be thinking about with this. So I would think that quite a few people might kind of freeze up and need more guidance towards it	Need more guidance to stop people from freezing. To help them do the intervention better.

			rather it being such a general thing.	
		D9,p2,l21	You could ask people about their best HbA1c as in how they felt at that point in their lives then, you know, bring all those things out first of all.	Use past feelings/successes as guidance in thinking about a best possible future. Makes it more real. Link to theme “intervention as abstract”?
		G11,p2,l23	Having said that I… I have, nutritionally, I have an excellent diet… I’m quite happy with eating my… well I think I’ve been eating the 10-day vegetables for donkey’s ages *laughs* You know, I have a good varied diet of vegetables mainly and erm chicken, fish, and red meat sometimes and I… I… I don’t go without.	Celebrating his success. Not strictly speaking about the intervention here but this compliments some of the points in this theme.
		FG,p1,l31	In a way you… you’re better setting a slight improvement and improving it and achieving it rather than setting a really HIGH improvement… and not achieve it That’s what… that’s what it should be! It should be a realistic target that you think you… you FEEL you can reach.	2 and 3 agree that realistic targets are better. Potentially less harmful. More effective/motivating.
		FG,p2,l26	That’s it! It would be a personal plan for each different person… because	3. Intervention needs to be personal

			everybody’s different.	
	The Importance of Support	R2,p8,32	Maybe 4 would be, you know, “if you… if you wish to share it with your diabetes team”… they have that option don’t they?... because then that might open a further discussion with their team.	Intervention as a way of getting people to think about their management and then using that information to promote discussion with their team to improve their management even further.
		R2,p10,8	Because if they said something, “I think I can achieve it by doing this…” I mean that’s an opening into the team to discuss what that is.	This gives the individual an element of control during consultations and puts the patient and the professional on the same level. It’s another way of making the intervention’s recipient PRO-ACTIVE.
		M3,p2,l12	They may want to share. Once they’ve put it down on paper like I did last night.	Give people the option to share. People may find it beneficial, may be a way to promote further positive well-being.
		M3,p10,l10	But I do think, you know, for some, they won’t WANT to reveal their story but I think some might like to share it… share that story.	Nice that people have the option to share their story if they WANT.
		D4,p5,l15	If they were seeing a health professional then maybe that health professional could be encouraging them.	Doesn’t suggest using the intervention as a springboard to conversation per se but still suggests they could see the importance of the

				HP being involved somehow.
		C7,p1,l27	And if they know about it then they can give you things to help getting them back down again so…	Awareness can give you the ideas which you can then talk to your HP about
		C7,p2,l23	You've got, like, a sort of quick reference to say "well okay diabetic nurse/you know, dietician/whatever it is… this is what's been going on"	Intervention as reference. You can discuss ideas generated by it with the diabetes team
		C7,p3,l11	You don't necessarily always want to tell them EVERYTHING that's going on. It's not like you can phone them and go "oh well my blood sugar's all over the shop because of x, y, z" But, you know, if it's there then they can go "oh well yeah actually that would directly impact"	Acknowledges boundaries of the doctor-patient relationship. It's about getting that balance.
		C7,p4,l5	Most of the time I know I certainly don't open up to the doctors a lot 'cause you never know which specialist doctor you're gonna see	Acknowledges that you can't talk to everyone. Certainly can't "open up" to every HP there is.
		C7,p3,l33	If then, you know, there are some people who do start worrying about it and going "ohhh well you know my blood sugars are always really bad and you're asking	Actually, encouraging people to talk either way may help people understand the point of the exercise and overcome certain barriers.

			me to look at it ‘best possible’ and everything well that would then come out in the next session they have with maybe the dietician or something like that.	
		G8,p6,l5	Do the exercise first and then having a discussion one-to-one so actually erm develop your ideas and thinking that you’ve come up with.	Discussion as way to develop ideas
		D12,p4,l28	Helpful me talking about it, actively. It’s something other than testing my blood sugars and taking insulin.	Even discussing things as part of the interview was helpful so don’t downplay the importance of talking about something. Link also to “novelty” which in his case he finds refreshing.
		C7,p4,l17	Yeah it’s vital [the relationship you have with the support team]… the one’s at Arrowe Park, I don’t know about the rest of the country, but they’ve got a really, really, really strong, very, very good diabetic team as a whole… the diabetic nurses… they’ll give their personal numbers out and say “right phone this this this or if you just go see the doctor… they’re quite flexible and,	Grateful that the team are open, supportive, and willing to just have a chat. She’s treated like a human being. It’s personal. Contrasts to being looked at like a case study from a text book.

			you know, they're… they're always ready even if it's just for a general "hi, how are you?"	
		G8,p11,l17	And teaming up with the… one group on the forum who meet up annually for a big annual binge in the midlands and all go out for a day out in the park and erm we all bring diabetic-friendly food and say hello to each other… and that was really helpful because I've, you know, I was hearing stories from other people who were much more badly affected than I was at the time.	Meeting up with others that are going through the same thing as beneficial. A way of putting things in perspective too?
		J10,p5,l19	There's a guy who… he's got a blog and er, he's also on a couple of forums, on the internet er called 'Everyday Ups and Downs'… Mike! Er and his SD's absolutely brilliant. And I've asked him. You know? How he's got there. And er… oh he's… his brain is so analytical! And mine isn't.	Comparing yourself to others as potentially harmful? Leads to feelings of defeat and saps motivation?
		J10,p14,l1	I always laugh… jokingly say they saved my life but in a lot of ways they did. When I was really struggling.	Online networks as life-saving.

			Erm, you know? Mentally and physically.	
		G11,p1,l5	Now, when I was first diagnosed, because there was quite a lot of diabetes in my family, number 1 I wasn't surprised; it didn't come as a great shock, I almost expected it. The second thing was, because most of those family members were type 1 they were all counting carbs. So even without me knowing too much, I knew that carbs were, you know, quite important.	Family experience and network as important.
		G11,p12,l27	That's what you want… what you need from a doctor. You want… you want to work WITH them.	A need for a co-operative relationship with the team.
		G11,p15,l16	I think that's the other thing, I'm very, very aware of the implications of not controlling my blood glucose. Erm I mean my own father's lost a toe. Er but he was lucky. It could have easily been a foot or a leg.	Other's experience as a way of increasing awareness. Link to awareness.
		FG,p2,l9	That is something you need to discuss with your care team and find out what they can do to help you and what you can do to help yourself.	3 responds to previous point. Argues for a collaborative effort between the individual and the HPs.

		FG,p2,l16	I'm very lucky on the support work that I get, I know what… what MY aim is.	4. Proper support as way to help set goals?

Main Theme	Sub-Themes	Reference (participant, Line #)	Quote	Notes
Getting the Intervention to Work	Individual Factors	K1,p4,l23	I can't think of any PHYSICAL things that would stop you… It'd be more so like a mood or personality or depending on sort of what had gone on with you that day.	General personality as barrier.
		R6,p8,l25	Erm but work is also another erm major factor, you know? Work never ends. I could end up… I could work 24 hours a day and I'll still never finish. It's just constant, you know?	How much of this is a serious barrier and how much of this is him not wanting to face his diabetes? Supported by next point, below…
		R6,p9,l11	If I don't want to do something then it's usually very difficult to… it's almost like it's very… it's almost as if it's set in stone. If I don't want to do something then it becomes very… er I usually don't budge.	Stubbornness as barrier.
		C7,p3,l29	If, you know, other diabetics are like "oh well, you know, I don't like doing this, I don't like doing that" well fine they don't have to but I	Attitude as barrier.

			personally think it would be good.	
		C7,p6,l36	Other than my own laziness? No.	Laziness as barrier
		C7,p7,l1	If I've got something to do, I will always do it. It's just always at like, half 4 in the morning when I'm like ughhhh, reminded myself, reminded myself and then still forgot.	Personality as facilitator. Counters last point. Is also in contrast to R6's attitude. Link to theme "reminders"
		G8,p12,l31	I would say I have a considerable amount of willpower compared with most people I know with diabetes and even so, it is exceedingly hard work.	Will power as barrier/facilitator to general management.
		G11,p11,l14	I would never suggest that it's been easy going it's just that I think my personality dictates that I'm a fighter and I haven't given up even though I'm doing the right things and not getting the results.	Personality/resilience as facilitator of management.
		D12,p2,l7	Me, personally, I know I'm lazy so I'd say once a month… I'm terrible at committing to things… I struggled to go to my own bloody appointments, you know what I mean?	Laziness as barrier.
		D12,p2,25	Me. Just me. Just me. I… I'm the problem really *laughs*	Self as barrier. Own approach/attitude/personality rather than anything physical. The intervention

				needs to address this and provide motivation/empowerment.
		R2,p1,l20	I'm not sure that it would apply equally across type 1, type 2, and pre-diabetes because they're all coming at this from a different angle.	Consideration of differences between diabetes types.
		G8,p1,l14	My initial thought on looking at it was, this would not work for most people I know with diabetes because most of them would find it VERY hard to write. Most of them find it hard enough to talk.	Writing and discussion as barrier.
		G8,p1,l18	For most of them this is the very abject, the very academically orientated piece of work rather than something that sure isn't going to get at the vast majority of people.	"Writing" makes it academic by the sounds of things and this makes it abstract.
		D9,p7,l6	And I guess, kind of people from different cultures, you know, won't necessarily have come across those ideas.	Cultural barrier. Public understanding/ acceptance of psychological interventions as potential barrier? Note she doesn't say WHAT cultures.
		J10,p12,l15	I would hope that, you know, when people get diagnosed these days they are told that treating it is down to YOU mate. Not us… Actually DOING IT and getting	Type 2s expect more from their team? Do they not want to do as much for themselves?

			there is not our job. We can't do it because we're not you and we don't live in your body. And… and that… that's what, a lot of type 2s especially…	
		J10,p19,l23	You still have to ask for it erm and that's an alien thing to a lot of people who were brought up with, you know, "the doctor's God" *laughs* but attitudes have changing more on that. Erm but not amongst older people as quickly as they have with younger people.	Consider differences between generations.
		FG,p2,l31	People can be in different starting positions too and at the point you receive your… your readings some people might be more… I would say depressive more than others.	2. Acknowledges individual starting points. Be aware of individual's mental state too.
		FG,p3,l4	Everybody's illness is very different because we're all on different medication and everything and erm so… so we all have different erm aims or goals or regimes… compared with somebody that's maybe more tablets or trying to avoid going on tablets.	5. Acknowledges individual differences because of medication. She's type 1 and compared how her decisions and lifestyle may be different to type 2s because of medication.
		R2,p2,l12	I noticed that many of the attendees didn't really grasp	Because it's too abstract

			most of what she was saying… some didn't even know how to read a blood glucose meter and had no idea between the relationship of diet and blood glucose levels and erm… so the HbA1c erm question as to erm "ideal HbA1c"… I'm not sure would… they could really answer	
		R2,p4,l2	I look at it based on erm understanding, you know? Knowledge is power.	Knowledge as key.
		R2,p4,l4	I would also be worried that erm a lot of people, especially some of the people I've met to do with this, erm I'm not sure they could put something…they could actually write something down for 10 minutes… you might be talking to about a guy in his 50s, 60s, 70s even okay? That has never actually written.	Consider the generational gap and people's education and approach to writing tasks.
		M3,p2,l23	Women MIGHT be a bit more receptive to it than men. That's just a GOOD feeling I've got. Men might think it's an 'airy fairy' thing to do… Just the fact that it's writing about FEELINGS, you know?	Men uncomfortable with emotions?
		G11,p17,l11	Men reckon there's nothing wrong with them, they're	Men don't recognise problems. Keep

			perfect, no need to worry about them… men don't recognise problems in themselves, I don't think.	in mind I asked G directly about this. He may not have said anything otherwise.
	Motivation	K1,p3,l28	If you're picturing yourself getting these good blood results then it can motivate you to be like "oh well I want this to be a reality" instead of me just thinking about "well this would be nice" it can actually go from being an ideal thought to sort of being something that's put into place?	Doing the exercise as motivator to take action.
		D4,p4,l4	And then it's difficult when you're feeling quite tired and all the rest of it to feel motivated to change.	Diabetes takes its toll and that itself can crush motivation.
		D4,p4,l16	The other thing that is a motivator is the risk of not… is understanding the risk of not doing something.	Links to awareness.
		J5,p1,l4	I think your mood really has a big impact on whether you *laughs* whether you can be bothered really to keep your blood sugar levels in check? Erm so say I'm having a bad day then I wouldn't really, you know, keep check and having um like being in a better mood gets you a bit more… focused? And you're more likely to	Mood as motivator

			have better blood sugar levels as well.	
		R6,p3,l9	I just need something to give me a good kick up the backside	In need of motivation to improve self-management. Does he not think our intervention will do this though?
		R6,p4,l26	It gave me a bit of a kind of a wake-up call, you know? Erm I need to take more care of myself because erm you know, I don't want to end up in er that kind of situation on a… on a regular or long-term basis.	Fear of repeated experiences as motivator
		G8,p11,l12	I was quite fascinated by the whole thing so it helped motivation as well because you… testing out all sorts of things.	Research and ENGAGING with the issues as motivating?
		D9,p3,l16	Because what if it's always the same thing, over and over again? They're not gonna wanna repeat that. It becomes kind of uncreative then, doesn't it?	A need to make sure the intervention stays interesting or motivation will fade. D just thinks we shouldn't have people do it for too long. Link to "importance of personalised care"
		J10,p6,l22	It's just whether I want to apply it and… and this is… this is a similar thing. If I needed to… then I would. If I don't need to then I won't. It's	NEED as motivator. Link to awareness?

			like I say er if you don't… if it ain't broke you don't fix it do you?	
		G11,p3,l9	I'm quite pleased to say that I actually gave up alcohol about ten years ago. Or eight years ago. Because I was serious about losing weight.	Personal goals/seriousness of condition as motivator.
		D12,p3,l30	I dunno, to go from that to then have to monitor everything and live your life like in units and carb-finding and… it's a bit *sighs* dry isn't it?	The tedium of the illness itself saps motivation.
		D12,p4,l33	If it will give that kick… kick in the right direction.	Intervention as motivation tool. He hopes.
		FG,p6,l10	I was on… on 3 months… and I don't mind saying this but I'm up to 51! So erm yeah I'm feeling really good about it and really positive about it as well… and erm things like that, acknowledgements, getting news like that erm it does… it does affect… When you get that kind of news, it does put you on a high.	4 and 3. Success is motivating. They induce positive emotions.
		FG,p7,l9	You must reward yourself, you know, you're doing well, you're on track and you're going for it.	4. Need to reward yourself. Acknowledge your successes. Induces more positive emotions!
		K1,p4,ll4	It's not particularly time consuming, it's not hard to do, it's not unpleasant to do	Appreciates that it's quick and easy to do

			really. So it's not something that would be a chore.	
		M3,p2,l8	I think that stress of keeping all those balls in the air at the same time, you know? The exercise, obviously the medication, the healthy cooking, you know? And I'm busy and I'm travelling on late trains and keeping all that going for me is a massive challenge.	Diabetes as challenge.
		C7,p2,l19	But this sort of thing it's just… it's just a quick little reference you can jot bits and pieces down… it's almost like a quick reference but you're not having to write every single minute of every single day	Appreciates that it's quick and easy to do and that it's something you can come back to. Alternative to diabetes diary she's been told to do which is considerably more time-consuming (which is presumably why she doesn't like it)
		G8,p12,l34	But as long as I can have my bottle of red wine, now and again… one of great enjoyments of life and one of the ways I relax and keep my stress levels down is I sit down and read and glass of wine and enjoy it.	She still needs breaks, even if they're unhealthy. She doesn't want her diabetes ruling her life.
		D9,p419	We have a lot to do anyway, we have to take our blood every	Already have enough to do. And this can

			day erm we have to take our medication… so having another thing to do is a bit… it IS asking quite a lot of people…. You need somebody who's happy to do that and it's not just putting something else on their plate that will stress them out further.	link to themes of "motivation" and even "potential harm"
		J10,p3,l7	I'm not prepared to spend that amount of time on my diabetes. I don't live for my diabetes. I have… I have improved it once. Erm, for a fortnight. And at the end of that fortnight I realised I'd done nothing for that fortnight, except concentrate on everything I bloody well ate. And testing. And I would be damned if I was going to live like that.	Not going to spend more time on her diabetes than she needs to. Doesn't want to give up her life just to be marginally healthier.
	Clarity and Promoting Awareness	M3,p5,l14	When I came up with that story er, you know, juggling all those balls, keeping all those things going in my life, I could see how hard it is. But it's… it is essential to keep all those things going on.	Intervention produced awareness
		M3,p10,l4	I think I could get quite a lot out of it and a lot of, kind of, what's the word where… self-realisation? …where	Intervention as tool to produce awareness

			you find out much more about yourself.	
		J5,p3,l17	Because I've had it for 9 years now, certain years where I haven't been, you know, really that bothered or ignored it a little bit… whereas now where I'm like recording everything and erm in a better frame of mind knowing that I have to do it erm it definitely makes you HbA1c better.	Awareness through experience and consideration of the seriousness of her condition. Bear in mind J is type 1. Link to theme "intervention useful for newly diagnosed"
		R6,p5,l15	Has this motivated me to get myself into the gym? Erm to be honest, no not really. Doing this exercise hasn't er… I don't think it has. It's made me… I guess it's made me a bit more self-aware? Erm… I'm fully… I'm very AWARE that I need to get myself into the gym.	Awareness is not necessarily enough to promote action.
		R6,p7,l19	I guess I start asking myself questions… am I genuinely not in the right physical frame to go to the gym tonight because my back hurts or er I'm too tired? Or am I just rationalising again?	Awareness is here but he's stuck. He understands the issues but cannot see the difference between real & perceived barriers.
		C7,p1,l22	It makes you have a little think about what makes things better in your control, what makes things worse if you're going through a really bad time or…	Awareness promotes control. Link to theme of control.

			life's not working out or your work life's really stressful… so it makes you think about it a bit more and that usually then helps you to start sorting things out	
		C7,p6,l24	When I was writing stuff down I was like "oh yeah! I didn't think of it that way!"… it's like life itself, you go through the motions and it's not til you stop for longer than 2 seconds and go "actually, right, jusy focus on this bit for a minute"… it made me think and, you know, do a mini-re-evaluation.	Intervention as tool to make the person stop and think. To bring about NEW awareness. The act of writing stuff down, because it's deliberate, has also allowed her to be a bit more mindful.
		J10,p7,l12	But the recognising that you need it is half the problem isn't it?	Key quote. Acknowledges limits of awareness.
		J10,p11,l4	That's how much I know after 30 years. And this is the danger, you see? You go to the hospital and they go "oh well you've been diabetic for 25 years, you know all this" And you assume you do!	Even with experience there is more to be learnt. It's whether you realise that there is more to be learnt.
		J10,p18,l1	You do not understand yourself, why you do the things you do and why you react the way you react… that's why we get people like you, researching!	Can lack of awareness be problematic for behaviour too?
		G11,p8,l19	What I need to do is get some more	Awareness here but,

			exercise in but, I mean, that's not always easy when you've got fence panels to put up.	unusually for G, no action. At least as of yet.
		D12,p4,l19	I suppose it's all… it's a reflection of my own effort, I suppose, my HbA1c… "that's my fault, like" I guess it makes you feel a bit down, I suppose.	Awareness without a tool or a way to promote action has led to him feeling a bit down. He is quoted as feeling a bit "defeated" just a few lines above in the transcript.
		FG,p5,l30	I went back 12 months later and they'd gone up to 82. So I was out of control. I knew I was.	3. Awareness was there but it wasn't promoting action. Why?
		FG,p7,l14	You've gotta be extra careful because… You can go the opposite way SO easy without realising you've done it.	3 and 4 again. Diabetes as balancing act. A need to be mindful?
		K1,p1,l22	Yeah 'cos you split it up into the sections and you've split it up into what the intervention is and how you are supposed to go about doing it… It's helpful because instead of just saying "oh here's the intervention like get on with it" it gives you like helpful hints about how to actually get on with it	Appreciates that the intervention is split into sections. Provides clarity.
		M3,p2,l6	But your particular research erm… that story may be at the heart of it and you	A need for transparency, show the research

			may NEED text, you know? I just didn't known really erm what was behind it.	behind the intervention.
		D4,p1,l8	Yeah, it does makes sense. I can understand what it's trying to do. It might need a bit more explanation I think… I could understand that writing about how you would feel about how you would feel about good blood results… but it needs a bit of explanation about the benefits of doing the writing.	Explain the benefits to increase motivation and the individual's willingness to engage with the intervention
		D4,p3,l12	I think it would need some kind of way, where there is evidence, as to how this type of writing helps in creating change, I think. There probably needs to be some explanation or… for people to see it's worth doing.	Evidence as way to show people intervention is worth doing.
		D4,p2,l23	But I don't, I mean I… I don't know what the evidence there is to how long it takes. To create a change.	Keen on seeing the evidence. Transparency may be important.
		R2,p1,l18	I find it erm slightly… a little too abstract	In response to "does the intervention make sense to you?"
		R6,p1,l5	This is one of the strangest erm exercises I've ever been asked to do… it just seems like a very, very STRANGE exercise erm thinking	Exercise as novel but strange. He later refers to it as abstract.

			about your best possible HbA1c	
		R6,p1,l27	I know that erm when er you're recruiting for subjects that erm you don't want to tell them everything and because that can, kind of, sometimes give away the erm… the rationale of er what is being intended… what is being sought out	Never our intention to keep participants in the dark but it appears he feels we haven't been as clear as we could have been
		R6,p2,l2	Maybe provide a bit more context, a bit more information about erm WHY erm you know, what's the… what's the erm… the reason for the perceived link between imagining and your best possible HbA1c?	Keen on understanding how the intervention is supposed to work
		R6,p9,l13	I usually don't budge. I… UNLESS I… unless I have a misplaced understanding or wrong understanding about something and then somebody says "well actually, if you look at it this way you might want to do this" and then I might think "oh okay, that's a good idea, I will do it"	Maybe R finds the intervention unclear or he can't see the point of it or he needs more guidance and THAT will help him better engage.
		R6,p9,l32	The reason I say it wasn't helpful is because I didn't come up with anything or write anything down or have any idea which was erm novel? Or original. Or erm	Struggling to come up with new ideas so awareness can't be expanded.

			hadn't occurred to me before… I've been diagnosed with diabetes now for over a decade so it's something I've been aware of in terms of diet, exercise, and so forth for quite a long time now.	
		J10,p3,l24	I don't understand the problem because I haven't got that problem… so it's a very… a very difficult concept for me to understand and that… I can't imagine doing it in order to be able to write for 10 minutes.	Doesn't believe she has a problem so won't engage with the intervention. She acknowledged she could do more but won't go beyond that. Could clarity help? Or would it be harmful?
		J10,p26,l11	Some of the problems are different aren't they? Er and er you know? Won't all be addressed by psychological interventions. Some of them have to be practical... I think that's er something that older people have… have a problem grasping as well. Er they expect things to be solved by simple things. Take this tablet. Stop eating this. Whatever it is.	So people need to know there's a balance. Just thinking about it won't do any good but neither will relying on medication and easy fixes. This may actually reflect her own confusion as prior she said that is she could "get there by imagining it… boy oh boy would I be doing it" (first line, page 22)
		D12,p2,l1	I mean if it works, it's for the best isn't it..? I could try it out, if	Belief that it works is enough for him

			it's there to help, yeah.	to engage. I wonder how many others would have the same attitude. What does this say about providing evidence and transparency?
		FG,p1,l25	How you've done is pretty much proof of concept of how you feel about this process. If it's a positive result then your HbA1c will improve, you know it's like the evidence for me. If, however, your HbA1c's gone higher, you're gonna think "this is a load of rubbish"	Would 2 dismiss the intervention if he did not get the clinical results he wanted? May need clarity?

Main Theme	Sub-Themes	Reference (participant, Line #)	Quote	Notes
Feasibility	Alternatives to thinking about HbA1c	R2,p3,l19	I'm not sure they could answer that really to their own benefit… because they really don't know what's their best HbA1c might be erm… because they haven't really, kind of, got into the process of managing themselves	Counter-point to "intervention useful for newly diagnosed". HbA1c not worth thinking about for newly diagnosed.
		C7,p2,l11	If stuff starts building up and you think "hang on a minute, I'm getting, you	Intervention as tool for controlling blood

			know, out of control" whether it's your life and also your HbA1c or you know your blood sugars in general day-to-day…	sugars? (bear in mind C is type 1)
		G8,p6,l22	You wouldn't make much impact on it in 3 months. You might just make an impact in 6 months.	Impact on HbA1c may take time to emerge.
		J10,p2,l13	What I need is my standard deviation, more than my HbA1c. Because you can have a great HbA1c and be swinging between high and low on your meter. And still get about a 6.5, a 7, a 7 point… you know, whatever it is… so your HbA1c is NOT, by any means, the right thing for type 1s to rely on.	Variability is more representative of her struggles than HbA1c is.
		G11,p3,l22	Well when I think about my HbA1cs, I don't think I've ever been in a situation where I've thought to myself "I hope it's going to be good" Although I do know some people who DO think like that.	Not everyone thinks about their HbA1cs. Is it too random? (though note that G monitors his own blood sugars using a FreeStyle Libre so he's probably less in the dark about what they're going to be)
		G11,p4,l8	My father's a classic example, crafty old git. He might be 90 but he'll eat chocolate and all sorts of things for 9 months and then when he knows the HbA1cs coming up, he cuts back.	HbA1c test as unreliable. Can be cheated.

		R6,p11,l17	Some people might not know what it means but it's… it's quite difficult to imagine what your blood glucose level might be over a sustained period of time…. Yeah it's a bit abstract that's… that's kind of the word I was looking for.	Imagining your HbA1c is abstract. Difficult. Link to theme 'HbA1c as random' perhaps? Link to theme 'consideration of alternatives to thinking about HbA1c, certainly.
		FG,p4,l1	My HbA1c is GOOD, over time, but that doesn't necessarily mean that my diabetic control has been particularly good. So you've got to read between the lines sometimes… I'm not trying to throw a spanner in the works here, it's just a personal experience that I've had erm with that… it probably looks more impressive than it has been but the reality is it's been a bit more…	6. HbA1c result as unreliable
		FG,p5,l5	In fact, my mood will change on a daily basis	6. Acknowledges that he'd probably want to use this to think about other aspects of his condition
	Considerations for Implementation	M3,p7,l2	I mean, is it going to be based at a clinic? Is that where it's going to happen? Or... is it that erm you know what you're saying, you give this sheet to a patient and he takes it away?	How are people going to receive the intervention?

		G8,p3,l5	And you're a health professional that specialises in diabetes and wanting to help them goal-set, you could actually use something like this; quite usefully, I think, as an introductory exercise…. I actually think , you know, if you're approaching something like this you'd need… you'd need some sort of conversation… to set the scene, make it okay to think about and read through it and… and actually just to test out what they understand about HbA1c.	Intervention as way of goal-setting with new diagnosed (link to theme below). Interested in how it's going to be administered as she's worried people won't have the knowledge to do it?
		G8,p8,l21	Have you come across the DESMOND programme, the NHS programme that's supposed to teach you how to manage your diabetes..? Well I mean building a tool like this into that would make sense. Because the people who attend that sort of course tend to be the people who really do want to do something pro-active about it but at the moment it's very limited in giving people tools to do their own individual planning.	Target the pro-active people? Work with major NHS groups?
		J10,p8,l1	I suppose if it's something that you can put into some sort of format where	She's thinking quick, easy to access, something that

			we… somebody who isn't a fully-fledged psychologist can roll out at a diabetes clinic erm or better still in doctor's surgeries because many, many diabetics of course never get as far as the hospital… Yeah but if it's something like… I mean 'cause I've seen some of the tick box things *laughs* the risk… for the risks that the GPs use, you know?	can be "rolled out"
		FG,p1,l8	Will we be doing this from home?	1 is curious about administration
		M3,p10,l19	You've always got the problem of the person whose mind just goes completely blank as well. And if the mind goes blank they can get quite stressed and then it's even harder to think of a story.	Mind going blank as potential stressor.
		C7,p8,l34	It's not really a dislike, it's just me thinking about new diabetics IF they're not using the support network as much, it could make some people, and even old… you know old timers like me, get a bit… not depressed *per se* but a bit overly anxious about the fact that "well I don't see how mine's ever going to be the best possible" because some people do, through no fault of	Intervention may make people feel hopeless? Despair?

			their own, have really bad control.	
		C7,p9,l12	I mean obviously if they've got the support network then that can be dealt with quite quickly…	Support network as buffer to potential harm. Link to theme "support network"
		G8,p16,l25	I'd say what you do need around it is intelligent discussion by somebody knowledgeable and supports it. Otherwise you finish up with people with major depression.	Concern that without the right support, intervention could depress some people.
		J10,p14,l11	No way could I have done it then. Erm because it was so far away from my grasp it would have just made me collapse in tears, reading that.	Be careful of giving this intervention to people in a sensitive emotional position.
		M3,p9,l2	Unless you're involved erm in that you've got the disease yourself and, you know, you hear stories from friends who've got the illness and er you don't realise just how complex it is.	No experience produces ignorance to the disease's complexity.
		R6,p10,12	Maybe if you'd asked me to do this exercise then maybe my erm… I would've… I would have found it more effective in trying to crystalise what I, you know, want to achieve.	Exposure to the intervention not long after diagnosis means that awareness can be built and people can develop their goals early on.
		C7,p3,l15	It'd also be useful for, you know, people who are newly turned diabetic or quite recently. They haven't got a clue… I	Intervention as tool to promote discussion especially useful for newly diagnosed. Link

			think it would only help them 'cause you got all the doctors saying "oh you know it should be 6.5 and everything"	to theme "promotion of awareness" and "difficulties with HbA1c"
		C7,p6,l18	But I also think that, you know, diabetics who've been diagnosed for longer and everything… 'cause I man when I read it I was like "oh yeah!" because it makes you stop and think.	Counter-point. Intervention just as useful for those who've had diabetes for longer because they can always learn new things, they can always improve their management.
		G8,p8,l1	I can imagine doing that, if somebody had given me this when I was first diagnosed.	Helpful when first diagnosed.
		J10,p14,l25	It'd set them off on the right foot. Erm but, you know, and get their brain attuned to there is help available. "I've only got to ask for it" You know? I… I'm not saying they'll get it but *laughs* that is without er… out of control, isn't it?	Intervention let's people know help is available. Possible link to "tool to promote discussion"
		J10,p15,7	And especially the type 2s I think it would help because they really are struggling on their own.	Type 2s as needing more support? This could help them get it sooner rather than later.

Appendix 3: Study 2 Advertisement

RE: Participants needed for health and lifestyle study

Dear potential participant,

My name is Ben Gibson and I am a PhD student within the School of Psychology. I am inviting you to take part in a research study entitled "Reducing Diabetes Risk and Managing Diabetes Symptomatology by Becoming Your 'Best Possible Self': A Randomised Controlled Trial".

I am looking to recruit adults over the age of 18 interested in receiving a lifestyle intervention. The aim of the study is to investigate how effective our purpose-designed psychological intervention is in improving behaviours associated with reducing diabetes risk and symptomatology such as diet and physical activity. You do not have to have (or be at risk of developing) type 2 diabetes to take part.

If you decide to participate, you will be sent a link to the study, which is being hosted online. Your involvement will then last for 4 weeks. You will be randomly allocated to one of two groups and asked to complete questionnaires at the beginning and at the end of this time-period. Your allocation will determine whether you receive the intervention straight away or whether you will be put on a waiting list to receive it. The questionnaires will assess whether the intervention has had an effect. For more information, please see the participation information sheet attached.

If you would like to take part, please complete the consent form that is also attached and send it to me via email at B.Gibson@2016.ljmu.ac.uk. Please also contact me at this address if you have any questions regarding the study.

This study has been approved by the University Research Ethics Committee (REC) with reference (insert ref).

Thank you for your time,

Ben Gibson.

Appendix 4: Study 2 Email Correspondence (Study Reminders)

Dear participant,

Thank you for taking part in this research project. Please find the 'Best Possible Self' task attached. Remember to read the instructions carefully. You can use the task as much or as little as you like though we recommend doing it at least once a week over the next 4 weeks for the best results. We will send you an email prompt in 2 weeks time when you are half way through this study and again in 4 weeks time (xx/xx/18) when we will link you to the final round of questionnaires. In the meantime, take care and let us know if you have any questions.

Best wishes,

The Research Team.

Dear participant,

Thank you for taking part in this research project. You are currently on a waiting list to receive a copy of the 'Best Possible Self' task. Over the next 4 weeks, please continue with your self-management as normal. We will send you an email prompt in 2 weeks time when you are half way through this study and again in 4 weeks time (xx/xx/18) when we will link you to the final round of questionnaires. In the meantime, take care and let us know if you have any questions.

Best wishes,

The Research Team.

Dear participant,

You are now half through the study period. In 2 weeks' time (xx/xx/18) we will email you again to link you to the final part of the study. We really value your participation in this study and regardless of the group you are in, you are helping us develop what could be a very important lifestyle intervention. In the meantime, please continue to look after yourself (and keep using the BPS as much as you can).

Best wishes,

The Research Team.

Dear participant,

You are now at the end of the 4 week study period. Thank you for your participation so far. Please click the following link to complete some final questionnaires: https://ljmupsych.qualtrics.com/jfe/form/SV_cHpDLGU7rjbKXLT. This should take roughly 10 minutes. Once you are done, we will send you a copy of the 'Best Possible Self' task to use as much or as little as you like/Your answers to these follow-up questions are crucial as they will allow us to see how effective the BPS has been.

Best wishes,

The Research Team.

Appendix 5: Study 3 Advertisement

RE: Participants needed for follow-up to health and lifestyle study

Dear potential participant,

My name is Ben Gibson and I am a PhD student within the School of Psychology. If you took part in my previous study ("Reducing Diabetes Risk and Managing Diabetes Symptomatology by Becoming Your 'Best Possible Self': A Randomised Controlled Trial") I am inviting you back to provide some follow-up information.

I am looking to recruit individuals who received the 'best possible self' intervention to provide an example of what they wrote about. It does not matter whether you received it at the beginning or at the end of the study, you just need to have used it. The aim of the study is to gain more insight into how our intervention works and how people are engaging with it. Your participation will allow us to further refine our work.

If you would like to take part, please see the participation information sheet attached for more information. Please then complete the consent form that is also attached and send it to me via email at B.Gibson@2016.ljmu.ac.uk. You may also contact me at this address if you have any questions regarding the study.

This study has been approved by the University Research Ethics Committee (REC) with reference (18/NSP/045).

Thank you for your time,

Ben Gibson.

Appendix 6: Study 3 Final Themes; Supported by Quotes

Main Theme	Sub-Themes	Reference (participant, Line #)	Quote	Notes
Addressing Health as a Whole	Interconnectedness	2K, L6	Because I was trying to be more active, it was easier to eat healthy because I wanted to be able to feel good enough to exercise.	2K makes a links diet and exercise. Doing one new behaviour has helped her achieve others.
		3J, L1	I focused on overall health to get my best possible self… I meditated more regularly. And focused on mental health as well as physical health.	Health as a holistic construct?
		5D, L10	I noticed that exercising makes me eat healthier too. I genuinely crave for fresh fruits and vegetables.	Exercising led to improved dietary behaviours.
		6C, L1	I found this to be a very useful tool not only for creating goals for myself (such as to be physically, emotionally, and psychologically healthy)…	Consideration of mental and physical health together
		6C, L8	This highlighted how much I needed to prioritise my emotional health at the moment in order to achieve the physical goals I want to achieve.	Positive mental health informs positive physical health.
		8E, L9	I feel happy with myself, feeling that I can do anything with my day, even if my life if I carry this on; much more motivated.	Feeling better improves motivation. Positive emotions drive positive emotions.
		8E, L12	I would be immensely positive if I was this fit and healthy, I would not worry whether I am too unhealthy a lot of the time and I should do this or I shouldn't do that.	Poor perception of health generating anxiety?

		8E, L15	My mental health would be more positive too… I wouldn't feel sluggish or tired, I would feel energised and ready for the day.	Mental health goals
		8E, L33	I will see a difference in myself. Not just physically (although that would be nice) but also mentally and in everyday life.	Mental health as a health goal.
		9C, L15	This clarity and calmness of mind enables me to ignore the negative attitudes of my PhD superiors.	Positive mental health buffers against negative emotional challenges elsewhere.
		13V, L2	The exercise I do in my ideal self include a variety of sports (running, cycling, yoga, climbing, swimming) that improve my fitness in different ways and relax my mind.	Exercise leads to improved mental health.
		13V, L7	And finally, in this ideal self I follow the principles of mindfulness in my everyday life and practice meditation in order to calm the mind and be present in every situation.	Mental health as a goal. Sets out plans for how to achieve this.
	Forgiveness and Self-Care	1A, L2	I just feel pretty and confident so I can be there for myself	Self-care
		3J, L19	I also meditated daily and did not criticise myself too much if I couldn't stick to my goals.	Acknowledged that it's okay to not always reach one's goals. This may be a more realistic approach.
		4N, L2	But it was OK if you slipped every now and then or just fell off the wagon completely. It was an ongoing journey and it still is.	Same as above. (Improvement of) health as a journey?
		4N, L4	You couldn't stick it all the time. You just got	The important thing for 4N is to be lenient with

			back on the wagon and moved forward.	himself. Just keep moving forward.
		4N, L9	You stopped lying to My Fitness Pal. You weren't cheating anyone but yourself.	Honest with himself here.
		4N, L10	You tried not to obsess over it, if you went over your food goals, you went over, you dealt with it. You kept going to the gym, gradually being able to increase the weight you lifted and that felt amazing.	Acknowledgement and celebration of patience with himself.
		7B, L6	I want to have a more structured life where I work normal hours rather than overworking myself, I want to take more time for my own mental health.	"Structure" as a way to support one's mental health
		8E, L25	This isn't something that happens over night. You can't eat whatever you want to anymore and it not be an issue; I have to look after my body, we'll be together for a while (hopefully)	Acknowledgement that time is important and to therefore be a little more forgiving with herself.
		11E, L7	I would achieve this by eating healthy with occasional treats	Incentivising herself. Is this a more realistic approach to goals?
	Social Aspects of Health and One's Best Possible Self	1A, L2	I can be there for myself but also for others that need me.	A consideration for others
		1A, L5	Even if it get to much I know that I can build on people!	Support network is important even for her future best self.
		1A, L8	She love being around people and laughs a lot!	Her BPS is social and enjoys being social.
		4N, L6	You didn't need anyone else to believe in you, because you believed in yourself.	A rejection of others. An independent attitude.
		5D, L6	I decided to work out three days per week, at the same time my partner goes to the	Social aspect to exercise. She's finding ways to encourage herself.

			gym, so that to improve motivation for both.	
		7B, L8	I want to become more confident in talking to people, especially strangers, and making myself go up to someone at an event or messaging people more often so I am not feeling so alone.	Improved social life as a (non-health related) goal. Links to mental health perhaps?
		7B, L16	I will look into getting involved with more events at the university so I am able to make friends with like-minded people.	Support networks as a (non-health related) goal.
		8E, L4	I'm feeling calmer and more at peace with myself, and thus the people around me.	Consideration of how an improved sense of self positive affects others
		9C, L23	My passion about research will be contagious to others, which will pique their interests – in turn giving me the confidence to apply for jobs.	Improvements to self has a positive impact on others which in turn makes her goals easier to achieve.
		10J, L11	Still I am most fortunate in that I have a good marriage, a lovely home, enough money to live on, two super children who are doing well in their careers and one 15 year old grandson who I adore but is a typical teenager at the moment.	An appreciation of/gratitude towards existing relationships.
		14M, L3	Your best possible self doesn't finish with these three things though, I think wider than myself and feel that my family being happy and secure impacts my best possible self too.	Best possible self is reliant on others.

		14M, L8	My best possible self is impacted by other people around me	Can one be their BPS without considering others?
		14M, L8	Being my best possible self includes helping other people to achieve their best possible selves.	Consideration of others is what MAKES 14M their BPS.

Main Theme	Sub-Themes	Reference (p, Line #)	Quote	Notes
Control	Identifying What Works for You	2K, L3	I took up activities that I enjoyed and that did not feel so much like 'exercise', for example I started to go climbing once a week as well as doing yoga and running on nice days.	BPS allowed 2K to push past that initial inertia and come up with ideas that would allow her to enjoy being healthy.
		2K, 11	I started to buy more fruit and vegetables and prepare my own lunches so that I was not as tempted to buy snacks or unhealthy meals.	2K started engaging in planning behaviours in order to be healthier.
		3J, L2	I gave myself a rest when I needed it but tried to do things I liked and enjoyed doing rather than force myself to do something I did not like.	Enjoyment as a motivator. Lack of enjoyment may have been a barrier to physical activity.
		3J, 11	Also, I set myself the task of trying a new recipe every week. This can help me cook more.	Presumably, 2K felt like she wasn't cooking enough before and that this was a bad (unhealthy?) thing.
		3J, L13	I find it easier to exercise and do yoga at home	There is an understanding here of what does and doesn't

			because I can do it more regularly and at my own time. I want to find what works for me and stick with it.	work for her. Using what does work for her may provide longer-term success.
		5D, L1	I started using a Youtube channel that provides very details (*sic*) programmes to work out… Since I don't like gyms or working out in front of other people, being able to work out at home, in a private environment, helped to make me feel confidence (*sic*) and comfortable.	BPS allowed her to identify a barrier to exercise and to find an alternative way of doing things.
		6C, L3	I also gained insight as to why I wanted to be this 'version' of myself and why I thought it was the 'best' version.	The 'why' was important for 6C. Unclear whether this translates into action, however.
		7B, L2	I want to be able to eat healthier, even if it just means making smarter choices with food rather than living off salads.	Living off salads is seemingly something she is not keen on. BPS has allowed her to identify and reflect upon this barrier to dietary behaviour.
		11E, L9	I would mix up gym sessions by combining stepper/running machine and weights to improve my strength, tone and stamina so I would start running on the streets without taking too many breaks.	Well thought-out goals.
		12S, L7	I feel less confident with my body when I stay in Italy for a long time because I do not walk as much as I should. I	Acknowledgement of short-comings and sets out goals to remedy this.

			should increase my physical activity even when I am in Italy.	
		12S, L10	I feel very tired during the day because I don't get enough sleep. I should try to sleep earlier in the night and try to get at least 7 hours of sleep. I also should try to not use my mobile devices before sleeping as it has been shown that blue light interfere with the quality of the sleep.	There's a desire to do better and she generates ideas to improve her quality of sleep.
		13V, L7	I walk more to go to places or take my bike instead of taking the public transport.	Intervention has allowed her to come up with alternatives.
	Appearance and Other Non-Health Related Goals	1A, L1	I would not only look good but I also feel unstoppable	Appearance is important for 1A. Is this a consequence of improving her health?
		1A, L2	I just feel pretty and confident	Or does she want to improve her health to look better?
		1A, L7	My best possible self is not only looking good… but she is feeling good and confident about herself	Appearance is tied into her feelings about herself but there is an understanding that her BPS is more than just appearance.
		3J, L5	I decided to be more body positive and focus on health rather than weight loss	Appearance is considered here but this is perhaps a healthier approach than others take.
		4N, L5	You were able to fit into that t-shirt you bought years ago that someone told you you wouldn't. That felt really good.	Appearance considered. Appearance a reflection of meeting fitness/weight loss goals.
		4N, L7	You could look at those pictures of yourself from years	Appearance as an indication that goals were being met.

			ago next to ones of you now and really see the improvement.	Produces positive feelings.
		4N, L12	You could feel physically that you'd made changes, it wasn't just a superficial thing about how you looked.	Appearance seems to be important to 4N but it's probably more about how he FEELS about himself.
		7B, L11	I want to work towards my goal of becoming a psychology lecturer/academic and make sure that I have worked as hard as I can.	Career goals.
		8E, L33	I will see a difference in myself. Not just physically (although that would be nice) but also mentally and in everyday life.	Appearance as a bonus.
		9C, L1	Having worked hard towards my health goals, I'll be a size 12	Appearance as a specific goal. A reflection also of having hit those health goals?
		9C, L15	This clarity and calmness of mind enables me to ignore the negative attitudes of my PhD supervisors, and allows me to complete the challenges of my PhD – this I complete within the next 18 months.	Education/career goals.
		11E, L1	I imagine being confident wearing dresses and summer clothes due to being confident in my body.	Appearance/confidence as a specific goal. Feeling good is important.

		11E, L17	This would help me lose weight as well as improve my fitness making me feel healthier, more confident and attractive.	Feeling attractive as a motivator (?) to achieve fitness/health goals.
		14M, L1	When I think of my best possible self I imagine being fully happy and content in every aspect of life. The main ones being happy within my job, financially stable and happily in a relationship.	Security goals.
	Technology as an Aid	2K, L6	I started also checking my phone app regularly to track how much I was walking and then started to do a target of 10000 steps a day.	Decision to use an app then helped her set goals.
		3J, L8	I downloaded the productivity app which helps me track my sleep, exercise and other habits I choose to include.	App helps her to keep track of goals
		3J, L13	I also want to try other apps and home work out videos.	Using apps as a goal in and of itself to help produce/maintain further health benefits in the future
		4N, L9	You stopped lying to My Fitness Pal	Reference to use of app. He had been lying to it but it sounds like that behaviour has changed.
		5D, L1	I started using a Youtube channel that provides very details (*sic*) programmes to work out. I found it useful as you are free to choose the length and level of exercises at every work out. Being very detailed, it	Tech as a way to educate the individual.

			feels like having a coach guide a personalised session.	
		12S, L22	I should stand up and move more than I do, take the stairs instead of the elevator, maybe set up an alarm which reminds me of the necessity to walk and reactivate my circulation.	Alarm as a reminder to engage in healthy behaviours.
	Positive Feelings Generated by Considering/Achieving Goals	2K, L1	I feel healthy and happy that I was able to accomplish my health-related goals.	Positive emotions have been generated by achieving goals.
		2K, L5	I continued to do this regularly and was able to run more long distances and it made me feel really good to be able to achieve this.	Acknowledgement of achievements and how they made her feel.
		2K(ii), L3	It was difficult at the start but it became easier each time!	Acknowledgement of (long-term, cumulative?) benefits.
		3J, L18	I found that some movement every day made me feel happier and healthier.	Health behaviours as their own reward.
		4N, L1	You knew you could do it, because you'd done it before.	BPS as a reminder of previous successes.
		4N, L11	You kept going to the gym, gradually being able to increase the weight you lifted and that felt amazing.	Acknowledgement and reflection on how good hitting targets felt.
		6C, L4	I found being able to talk about how I wanted to be in the future reminded me of my motivations, which are so easy to lose	Consideration of goals as a way to generate motivation.

			sight of in our busy day to day lives.	
		6C, L6	This exercise tapped into not only my thoughts about what I saw as physically healthy but also emotionally, making me aware of how different I am now to what I would call my 'best possible self'.	Discrepancy between current and best possible self.
		6C, L10	In addition, this exercise elicited emotions such as pride and contentment which I had not felt in a while.	Consideration of goals produces positive emotions.
		6C, L11	Whether I would actually experience these feelings if I were to achieve the emotional, physical and psychological health I would like to in the future is unknown, however it was nice to know that I could still feel them.	Benefits of exercise came from thinking about/setting goals rather than achieving them which is in contrast to others.
		8E, L1	I felt proud to achieve all of my goals, I'm feeling really positive about myself and the people around me.	Completion of goals produced positive feelings towards self and others.
		8E, L23	This takes a lot of hard work and effort; a lot of commitment, which sometimes I feel I do not have and so I am not my best possible self at the moment.	Discrepancy between current and best possible self.
		11E, L17	This would help me loose (*sic*) weight as well as improve my fitness making me	11E is sure that completion of goals WILL produce positive feelings in the future.

			feel healthier, more confident and attractive.	

Appendix 7: Study 4 Advertisements

RE: Participants needed for study on physical health, stress, and resilience

Dear potential participant,

My name is Ben Gibson and I am a PhD student within the School of Psychology. I am inviting you to take part in a research study entitled “Can You Reduce Diabetes Symptomatology by Becoming Your ‘Best Possible Self’?: The Role of Stress and Resilience”.

I am looking to recruit adults over the age of 18 interested in receiving a lifestyle intervention. The aim of the study is to examine the role that stress and resilience may play in diabetes prevention strategies. You do not need to have or be at risk of developing diabetes to take part.

If you decide to participate, you will be sent a link to the study, which is being hosted online. Your involvement will last for 4 weeks. You will be randomly allocated to one of two groups and asked to complete questionnaires at the beginning and at the end of this time-period. Your allocation will determine whether you receive the intervention straight away or whether you will be put on a waiting list to receive it. The questionnaires will assess what effect our intervention has on diabetes symptomatology, stress, and resilience. For more information, please see the participation information sheet attached.

If you would like to take part, please complete the consent form that is also attached and send it to me via email at B.Gibson@2016.ljmu.ac.uk. Please also contact me at this address if you have any questions regarding the study.

This study has been approved by the University Research Ethics Committee (REC) with reference (insert ref).

Thank you for your time,

Ben Gibson.

Appendix 8: Study 4 Email Correspondence (Study Reminders)

Dear participant,

Thank you for taking part in this research project. Please find the 'Best Possible Self' task attached. Remember to read the instructions carefully. You can use the task as much or as little as you like though we recommend doing it at least once a week over the next 4 weeks for the best results. We will send you an email prompt in 2 weeks' time when you are half way through this study and again in 4 weeks' time (xx/xx/18) when we will link you to the final round of questionnaires. In the meantime, take care and let us know if you have any questions.

Best wishes,

The Research Team.

Dear participant,

Thank you for taking part in this research project. You are currently on a waiting list to receive a copy of the 'Best Possible Self' task. Over the next 4 weeks, please continue with your routine as normal. We will send you an email prompt in 2 weeks' time when you are half way through this study and again in 4 weeks' time (xx/xx/18) when we will link you to the final round of questionnaires. In the meantime, take care and let us know if you have any questions.

Best wishes,

The Research Team.

Dear participant,

You are now half through the study period. In 2 weeks' time (xx/xx/18) we will email you again to link you to the final part of the study. We really value your participation in this study and regardless of the group you are in, you are helping us develop what could be a very important lifestyle intervention. In the meantime, look after yourself [and keep using the BPS as much as you find useful].

Best wishes,

The Research Team.

Dear participant,

You are now at the end of the 4 week study period. Thank you for your participation so far. Please click the following link to complete some final questionnaires: https://ljmupsych.qualtrics.com/jfe/form/SV_9smOLWLbaff0AgR. This should take roughly 10 minutes. Once you are done, we will send you a copy of the 'Best Possible Self' task to use as much or as little as you like/Your answers to these follow-up questions are crucial as they will allow us to see how effective the BPS has been.

Best wishes,

The Research Team.

Appendix 9: Study 5 Advertisement

People Interested in Receiving a FREE Lifestyle Intervention Needed for Psychological Study

Can You Reduce Diabetes Symptomatology by Becoming Your 'Best Possible Self'?: The Role of Stress and Cardiovascular Recovery (rec ref: 18/NSP/068)

The purpose of this study is to assess how a 'Best Possible Self' (BPS) exercise influences diabetes symptomatology. The BPS is a brief, self-administered intervention that has shown to help people better set goals, manage and restructure their priorities, and express and come to terms with their emotions. This helps to boost mood and can give people a sense of control over their health and lifestyle choices. Our own research has provided evidence that the BPS has potential as an aid to prevent chronic illness such as type 2 diabetes where behaviours and emotions play a large role in disease development. However, there is still a lot we do not know about it achieves its effects. In this study, we want to look at the mediating factors of stress and cardiovascular recovery.

If you are interested, we will:

- Invite you to the lab in TRB room 2.17
- Randomly assign you to one of two conditions (i.e. you will have the same opportunity to be assigned to either condition)
- Ask you to complete some questionnaires on diabetes risk, diabetes symptoms, experience of emotions, and experience of stress.
- Ask you to complete some computer tasks while we measure your physiological responses (i.e. heart rate and blood pressure).
- As compensation for your time, we will provide you with £10 in Amazon vouchers.

To take part:

- You need to be over 18
- You cannot take part if you have severe mental illness (such as schizophrenia or bipolar depression)
- However, **you do not need to have or be at risk of developing diabetes to take part!**

Can You Reduce Diabetes Symptomatology by Becoming Your Best Possible Self?
Email: B.Gibson@2016.ljmu.ac.uk

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