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**A Study of Typically Developing and Chronically Ill Adolescents**

McCue, Robyn

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# **Future Thinking and Medicine Adherence: A Study of Typically Developing and Chronically Ill Adolescents**

by

Robyn Jayne McCue, BSc

Thesis submitted to the School of Psychology, Queen's University  
Belfast, for the degree of Doctor of Philosophy (PhD)

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## **Abstract**

Future thinking is thought to play a fundamental role in guiding adaptive, future-oriented behaviour across the life span (Michaelian, Klein, & Szpunar, 2016; Schacter, Benoit, & Szpunar, 2017; Seligman, Railton, Baumeister, & Sripada, 2013; Taylor, Pham, Rivkin, & Armor, 1998), and is considered to be of profound importance during adolescence (Nurmi, 1991). With its wide-ranging influence on behaviour, future thinking has attracted attention from across psychological disciplines, with each approaching the study of future-oriented cognition from differing theoretical perspectives. Across three studies, this thesis draws together several different approaches to the study of future thinking in an effort to better understand the nature of future-oriented cognition in adolescence and the role it plays in countering myopic, short-sighted decision making during this critical period of development. Ultimately, this thesis aims to investigate whether future thinking determines treatment adherence in adolescents with chronic illness and whether living with a chronic health condition might disrupt the way in which a young person thinks or feels about the future.

Chapter 1 provides an overview of our current understanding of future thinking and of the dominant perspectives that exist in the literature. Following this, Chapter 2 reviews previous research on medication adherence in the context of adolescent chronic illness and considers the potential role future thinking might play in predicting adolescents' adherence to treatment. Then, in Chapter 3, two studies conducted with typically developing adolescents are described. Both explore how different measures of future thinking overlap in adolescence and aim to provide insight into how different aspects of future-oriented cognition relate to impulsive decision making in typically developing teens. Studies 1 and 2 reveal that there is

more than one way for an adolescent to be oriented to the future and that only certain aspects of future thinking are associated with adaptive decision making in adolescence. More specifically, the capacity to imagine one's personal future with episodic detail, known as episodic future thinking (EFT), and feeling connected, or similar, to one's future self were shown to predict future-oriented decision making during an intertemporal choice task.

Chapter 4 investigates the potential link between future thinking and treatment adherence in adolescents with chronic illness and reveals that young people who are more future-oriented in their decision making are more likely to adhere to their prescribed medications. This may suggest that intentional nonadherence is determined, at least in part, by a patient's tendency to discount future rewards. Adolescents who felt more connected to their future selves were also more likely to adhere, suggesting that teens who perceive their present and future selves to be similar are more willing to make decisions or behave in ways that prioritise their health in the future. Chapter 5 compares chronically ill adolescents and typically developing matched controls on various measures of future thinking and finds little evidence to suggest that living with chronic illness impacts adversely on how an adolescent thinks or feels about their future. However, although the chronically ill adolescents thought as much about the future as their healthy peers, the results of this comparison suggest that chronically ill young people may be more vulnerable to "*living in the present*" and making short-sighted decisions that could jeopardise their interests in the future.

Finally, Chapter 6 discusses the implications the findings of this thesis have for our understanding of future thinking in adolescence, the role it plays in guiding adaptive behaviour, and how future interventions might be designed to encourage

both typically developing and chronically ill adolescents to make better decisions by increasing the priority they give to the future and their future self.

### **Declarations**

This thesis incorporates material from the following paper: McCue, R., McCormack, T., McElnay, J., Alto, A., & Feeney, A., (2019). The future and me: Imagining the future and the future self in adolescent decision making. *Cognitive Development*, 50, 142 – 156. The second study described in Chapter 3 forms the basis of this paper.

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## **Chapter 1. Future thinking**

### **1.1 Introduction**

There is considerable variation in the way that individuals perceive their past, present and future and, often without us knowing it, our memories of the past and our dreams for the future guide much of our behaviour in the present. While psychologists have spent a considerable amount of time trying to understand how past experience shapes human behaviour (Baumeister & Vohs, 2016; Seligman et al., 2013), in recent years, more attention has been directed towards understanding the role future-oriented thought plays in planning, goal-setting, decision making and emotion regulation (Schacter et al., 2017; Seligman et al., 2013; Taylor et al., 1998). Future-oriented cognition, or future thinking, is generally considered to serve a more functional and adaptive purpose than thinking about the past. Unlike the past, events in the future can still be acted on (Caruso, van Boven, Chin, & Ward, 2013), and the capacity to imagine multiple possible futures, and plan for each accordingly, is thought to offer humans a significant adaptive advantage (Suddendorf & Corballis, 2007). This may help to explain why we spend a significant portion of our time thinking about the future, both deliberately and spontaneously (D'Argembeau, Renaud, & van der Linden, 2011).

Future thinking is considered to be especially pertinent during adolescence (Nurmi, 1991). To many developmental researchers, the primary function of this developmental stage is to prepare teens for adulthood (Call et al., 2002). This is reflected in the tendency for parents, peers, and others to set and adhere to societal norms and expectations that encourage adolescents to start thinking about, and planning for, what lies ahead (Nurmi, 1991). During this developmental stage, it is important for teens to integrate their thoughts, images and expectations of the future



with the present in order to establish goals that will help them reach key developmental milestones, and to guide decisions that may enhance, or restrict, opportunities in later life (Finlay, Wray-Lake, Warren, & Maggs, 2015; Nurmi, 1991). Adolescents' expectations for the future are also thought to play an important role in identity formation (Erikson, 1968; McGuire & Padawer-Singer, 1976). The important role that future thinking plays in adolescent development is further demonstrated by research showing that failure to actively think about and plan for the future is associated with negative outcomes in adolescence, including school failure, delinquency, substance abuse and early initiation of risky sexual activity (Chen & Vazsonyi, 2013; Johnson, Blum, & Cheng, 2014; Nurmi, 1991; Robbins & Bryan, 2004; Seginer, 2009; Trommsdorff, 1986). Future-oriented cognition has thus become a topic of specific interest to researchers interested in adolescent development. With its wide-ranging influence on human behaviour, however, future thinking has also attracted attention from many other areas of psychology, even spanning scientific fields (Seligman et al., 2013). Our current understanding of future thinking has evolved out of these various domains, although each has approached the study of future-oriented cognition from different theoretical perspectives.

## **1.2 What is future thinking?**

Despite the recent surge of interest in the study of future thinking, calls for the recognition of its importance in human psychology can be traced back to the 1930s (Seginer, 2009). These early discussions of what was called the “*psychological future*” acknowledged that thinking about the future is subjective and complex, takes place in the present, and has powerful implications for human motivation and behaviour.

There is no precise or unified definition of future thinking. Early on, future thinking was conceptualised and referred to in various ways, including future orientation (Nurmi, 1991; Seginer, 2009; Trommsdorff, Lamm, & Schmidt, 1979), future time orientation (Gjesme, 1983) and future time perspective (Husman & Lens, 1999; Nuttin & Lens, 1985). Despite the efforts of some researchers to distinguish between these terms (Seijts, 1998), they are often used synonymously and interchangeably in the literature despite their different theoretical foundations (e.g. Strathman, Gleicher, Boninger, & Edwards, 1994; Trommsdorff et al., 1979). Often, they are simply employed as umbrella terms that cover various cognitive, affective, motivational and behavioural constructs all concerning the myriad ways in which an individual subjectively thinks about their future. It is in this way that the terms future thinking and future-oriented cognition will be used throughout this thesis. Thus, in this thesis, the terms future thinking and future-oriented cognition may refer to the images and simulations individuals construct of the future (Atance & O'Neill, 2001; Gilbert & Wilson, 2007) and their future selves (Hershfield, 2011, 2019; Oyserman, Bybee, Terry, & Hart-Johnson, 2004) or the predictions (Ebert, Gilbert, & Wilson, 2009) expectations (Oettingen & Mayer, 2002), aspirations (Stoddard, Zimmerman, & Bauermeister, 2011), attitudes (Worrell, Mello, & Buhl, 2013; Zimbardo & Boyd, 1999), plans and goals (Nuttin & Lens, 1985) they hold for the future.

Regardless of how it has been conceptualised, research has shown that future thinking influences goal setting (Lens, Paixão, Herrera, & Grobler, 2012), decision making (Bromberg, Lobatcheva, & Peters, 2017; Bromberg, Wiehler, & Peters, 2015; Bulley, Henry, & Suddendorf, 2016), health behaviour (Daniel, Stanton, & Epstein, 2013; Dassen, Houben, & Jansen, 2015; Rutchick, Slepian, Reyes, Pleskus, & Hershfield, 2018), emotion regulation and well-being (Jing, Madore, & Schacter,

2016; Williams et al., 2007). These findings not only serve to underscore the importance of future thinking for adaptive behaviour, but serve to perpetuate interest in future-oriented cognition across psychological domains. However, as already alluded to, these domains each approach future thinking from different theoretical perspectives, leading to the study of various future-oriented phenomena, as well as a multiplicity of measurement tools designed to tap into, seemingly conceptually similar, future-oriented constructs. The following section seeks to provide an overview of six dominant approaches to the study of future thinking, and to review and delineate their unique contributions to our current understanding of future-oriented cognition.

### **1.3 Theoretical approaches to the study of future thinking**

#### **1.3.1 Future time perspective**

Future time perspective (FTP) was one of the earliest conceptualisations of future thinking to appear in the literature (Pavelková & Havlíčková, 2013), and is defined succinctly by Lewin (1952) as the “*totality*” of an individual’s views towards their personal future; a definition that also extends to past and present time perspective. Work on future thinking in both the motivation and individual differences literatures builds on this definition of FTP. As research from both domains stems from the work of Kurt Lewin and both employ the term future time perspective (e.g. Mello, Finan, & Worrell, 2013; Nuttin & Lens, 1985; Zimbardo & Boyd, 1999), these two approaches will be considered here together.

##### ***1.3.1.1 Motivational approach to future thinking***

The future is an essential aspect of human motivation, as it is the “*primary motivational space*” in which our hopes, goals and plans are located (Nuttin & Lens,

1985). As stated above, the study of future thinking in the motivation literature has focused on a future-oriented construct known as future time perspective (FTP). To motivation researchers, FTP is conceived of as being analogous to spatial perspective, reflecting an individual's mental perception of the future, where their goals, projects and plans are situated (Nuttin, 1984; Nuttin & Lens, 1985). More simply, FTP can be thought of as the present anticipation of future goals and plans (Simons, Vansteenkiste, Lens, & Lacante, 2004).

In early models, dimensions such as density, degree of realism, coherence, directionality, optimism, and valence were used to characterize an individual's FTP (Nuttin, 1984; Nuttin & Lens, 1985; Peetsma, 2000; Trommsdorff, 1983). Extension reflects how far ahead an individual habitually projects their thoughts into the future; density concerns the number of goals and wishes an individual has for the future; realism refers to the anticipated likelihood that these goals will be achievable; directionality concerns the perception that one is moving towards these goals; optimism reflects how positive one feels toward the future; and valence refers to the importance individuals ascribe to their future goals.

Extension and valence have both been found to play particularly important roles in motivation, especially in educational contexts (Creten, Lens, & Simons, 2001; de Volder & Lens, 1982). An extended FTP not only allows individuals to anticipate more distant future goals, but also makes the distant future seem closer (Lens & Moreas, 1994). When a goal is perceived as being temporally close it is perceived as being more valuable or important (de Volder & Lens, 1982; Husman & Shell, 2008). As a result, any behaviour that might aid an individual in achieving their goals will be perceived with greater instrumental value, leading to motivation. Conversely, those with a short FTP are less able to anticipate distant future goals,

feel as if future goals are farther away, and attach less value to these goals. This leads to the perception that present action is of little instrumental value, thus undermining motivation (Creten et al., 2001; de Volder & Lens, 1982)

According to the motivational approach to future thinking, the capacity to perceive the instrumental value of a present behaviour reflects a cognitive component of FTP, while the capacity to ascribe valence to distant future goals reflects a more dynamic component (de Volder & Lens, 1982). A third component reflecting individuals' feelings toward the future was theorised after van Calster, Lens, and Nuttin (1987) found that students who perceived education to be of instrumental value for their future goals (e.g. college) were only more motivated in school if they held positive attitudes toward the future. More recent models therefore conceptualise FTP in terms of cognitive, motivational and affective components (Andre, Van Vianen, Peetsma, & Oort, 2018).

### ***1.3.1.2 Individual differences approach to future thinking***

Research on future thinking in the individual differences literature draws heavily upon Zimbardo & Boyd's (1999) theory of time perspective (TP). Although inspired by the motivational approach to FTP (Stolarski, Fieulaine, & van Beek, 2015), Zimbardo and Boyd (1999) viewed time perspective to be a relatively stable individual differences process, and emphasised the importance of our views toward the past and present, as well as the future. TP is broadly defined in this literature as *“the often nonconscious process whereby personal and social experiences are assigned to temporal categories, or time frames, that help to give order, coherence, and meaning”* (Zimbardo & Boyd, 1999). According to this theory, individuals may develop a temporal cognitive bias over time, leading them to orient themselves towards certain time periods over others (Boniwell & Zimbardo, 2004). When this

happens, future time perspective (FTP) can become a dispositional characteristic manifesting as a tendency to plan ahead and give greater consideration to future consequences of present behaviour. Similarly, an individual may develop an orientation to the past or present.

The Zimbardo Time Perspective Inventory (ZPTI) is frequently used to measure the degree to which individuals orient themselves toward the past, present, and future. The scale consists of five TP dimensions: Past-Negative, Past-Positive, Present-Hedonistic, Present-Fatalistic, and Future TP. A Past-Negative TP reflects a generally negative, aversive, or regretful view of the past, often resulting from unpleasant or traumatic events; a Past-Positive TP reflects a warm, sentimental and nostalgic attitude towards the past; a Present-Hedonistic TP reflects a present-oriented, impulsive, "*devil may care*" attitude towards life; a Present-Fatalistic TP is characterised by hopelessness towards the future, driven by a perceived lack of control due to the existence of "*fate*"; the final factor measured by the ZPTI is the Future TP. As mentioned above, this TP reflects a motivated individual who plans in advance and is capable of making short-term sacrifices for long-term gain. Although it is possible to develop a dominant TP, individuals likely exhibit a unique and flexible combination of these five factors (Boniwell & Zimbardo, 2004; Zimbardo & Boyd, 1999).

Research has shown that scores on the five subscales of the ZPTI relate meaningfully to a range of outcomes. A Past-Negative TP is associated with depression, anxiety, low self-esteem, aggression, gambling and substance use (Drake, Duncan, Sutherland, Abernethy, & Henry, 2008; Lyubomirsky & Nolen-Hoeksema, 1995; Van Beek, Berghuis, Kerkhof, & Beekman, 2011; Zimbardo & Boyd, 1999). In contrast, a Past-Positive TP is associated with high self-esteem and

happiness (Holman & Zimbardo, 2009; Zimbardo & Boyd, 1999). Unsurprisingly, Present-Hedonism is associated with the psychological constructs of novelty and sensation seeking (Zimbardo & Boyd, 1999). In general, present-oriented individuals are less likely to give consideration to the future consequences of their decisions; this is reflected in their tendency to engage in risky driving, unsafe sex, and substance abuse (Rothspan & Read, 1996; Strathman et al., 1994; Zimbardo & Boyd, 1999; Zimbardo, Keough, & Boyd, 1997). Finally, a Future TP is generally associated with greater consideration of future consequences (Strathman et al., 1994; Zimbardo & Boyd, 1999). Individuals more oriented to the future on the ZPTI spend more time studying and have better academic attainment (Zimbardo & Boyd, 1999), and are more likely to engage in preventative health behaviours, such as cancer screening (Roncancio, Ward, & Fernandez, 2014). In adolescents, Future TP predicts a number of positive outcomes, discussed in greater detail toward the end of this chapter (see section 1.5).

The ZPTI, however, has multiple psychometric shortcomings. There is evidence showing limited construct validity, low reliability, and high correlations between factors in both adult and adolescent samples (Worrell et al., 2018). One major criticism aimed at the instrument relates to its inclusion of constructs that are not considered dimensions of time perspective (Shipp, Edwards, & Lambert, 2009; Worrell et al., 2013, 2018). For example, while the two past-oriented subscales of the ZPTI mostly consist of items assessing attitudes toward the past, the subscales exploring orientation to the present and future consist of items that tap into impulsivity, risk taking and planning behaviours.

To improve the measurement of TP, efforts have since been made to identify and separate out the cognitive, affective, and behavioural dimensions of TP (Mello &

Worrell, 2015; Shipp et al., 2009). In their multi-dimensional model, Mello and Worrell (2015) propose TP to consist of five dimensions: time attitudes, time orientation, time relation, time frequency, and time meaning. Time attitudes refers to an individual's feelings toward the past, present, and future. Future time attitudes overlap somewhat with concepts such as optimism, pessimism, and hope (Johnson, Blum, & Cheng, 2014). Time orientation is defined as the emphasis one places on the past, present, and future (Holman & Silver, 1998; Shipp et al., 2009), and is often used to refer to a behavioural predisposition to be more likely influenced by thoughts, emotions, and motivations related to a particular time period (Lasane & O'Donnell, 2005). Time relation reflects the degree to which an individual perceives the past, present, and future as being related to one another; time frequency concerns the amount of time an individual reports thinking about a specific time period; and time meaning refers to how an individual defines a time period.

Measures thought to tap into aspects of this model include the Temporal Orientation Scale (Holman & Silver, 1998), and the Time Orientation Scale (Bowles, 1999). However, much like the ZTPI, these self-report measures often integrate time orientation items with items assessing various affective, cognitive, and behavioural constructs (Park et al., 2017). Given these shortcomings, the Adolescent Time Inventory (ATI) was developed, with scales intended to assess time attitudes, time orientation, and time relation separately (Mello & Worrell, 2007). Although initially created for use in adolescents, subsequent studies have shown good psychometric properties in both adolescent and adult samples (Cole, Andretta, & McKay, 2017; Mello et al., 2016).

In addition to the five dimensions of TP proposed by Mello and Worrell (2015), several other individual differences constructs may fall under the umbrella of



time perspective, such as temporal focus (Shipp et al., 2009). Temporal focus refers to the extent to which people characteristically devote their attention to the past, present, and future (Bluedorn, 2002), and is a construct similar to that of time orientation. However, as argued by Shipp et al., (2009) time orientation characterises individuals as being predominantly focused on a single time period. In contrast, temporal focus recognises that, although people may develop an identifiable pattern of attention allocation, they are capable of focusing on more than one time period at any given time.

Despite the conceptual overlap that exists between the dimensions of TP outlined above, research rarely investigates whether instruments designed to tap into these temporal constructs overlap. With respect to future thinking, one might assume that an individual who scores high on a measure of future orientation would also report greater temporal focus, greater consideration of future consequences, and more positive attitudes toward the future. However, recent research has suggested that the relationship between various measures of TP are weaker than might be expected (McKay, Perry, Cole, & Worrell, 2018). We will return to this issue in Chapter 3.

### **1.3.2 Cognitive approach to future thinking**

Key to the motivational approach to future thinking is the understanding that people would be unable to recognize the significance, relevance, or instrumentality of present behaviour for their future goals without the capacity to think ahead. This is a view shared by cognitive researchers, who believe that our ability to simulate the future, known as episodic future thinking (EFT), is crucial for many adaptive functions, including decision-making, planning, emotion regulation, and the development of self and identity (Schacter et al., 2017). The cognitive approach to

the study of future thinking focuses on how individuals construct simulations of the future, the mechanisms that underlie this ability, and the implications this capacity has for decision making and behaviour.

### ***1.3.2.1 Episodic future thinking***

The ability to disengage from the present to mentally project oneself back and forward through time is known as mental time travel (Tulving, 1985). Just as we can re-experience our past through episodic memory, humans have the ability to pre-experience the future through simulation; a capacity referred to as episodic future thinking (EFT), episodic foresight, or prospection (Atance & O’Neill, 2001; Gilbert & Wilson, 2007; Suddendorf & Corballis, 2007). With EFT, we can “*foresee, plan and shape*” any future event in our imagination (Suddendorf & Corballis, 2007). Although many non-human species are capable of behaving in future-oriented ways, it is argued that EFT is a uniquely human trait that offers a significant evolutionary advantage (Suddendorf & Corballis, 2007).

Episodic memory is thought to provide the building blocks for EFT (Schacter & Addis, 2007), enabling experiences from the past to be flexibly re-combined in order to simulate novel, hypothetical scenarios of the future; all without having to engage in actual behaviour. There are also a number of overlaps between episodic memory and EFT, but these will be discussed in greater detail when we consider the cognitive underpinnings of future thinking later in this chapter (see section 1.4.1). Although there are parallels between episodic memory and EFT, there are also important differences. Imagined future events are often rated as being more personally significant (Addis, Wong, & Schacter, 2008; D’Argembeau & Van der Linden, 2004) and more positive than remembered past events (Dorthe Berntsen & Jacobsen, 2008). Despite this, imagined future events tend to contain less perceptual

and sensorial detail than autobiographical memories (Addis et al., 2008) and are usually reported as being experienced from an observer perspective (Berntsen & Bohn, 2010; D'Argembeau & Van der Linden, 2004). The finding that future episodes tend to be less vivid or detailed than past episodes suggests that EFT is more cognitively demanding than episodic memory, supporting the argument that it is a constructive process (Schacter & Addis, 2007).

The functional significance of EFT is varied. Simulation of the future provides individuals with the opportunity to consider obstacles or barriers they may face in relation to their goals, enabling them to pro-actively problem-solve (Szpunar, 2010; Taylor & Schneider, 1989). EFT may also serve to promote emotion regulation, as imagining a positive future scenario can ameliorate worry over the future (Brown, Macleod, Tata, & Goddard, 2002) and training individuals to think more specifically about the future can have positive effects on their subjective well-being (Jing et al., 2016). Crucially, engaging in EFT has been shown to encourage future-oriented, or more patient, decision making (Benoit, Gilbert, & Burgess, 2011; Bulley et al., 2016; Peters & Büchel, 2010). This has led to great interest in EFT as a possible intervention for a range of problematic behaviours thought to hinge on impulsive decision making, such as addiction (Snider, LaConte, & Bickel, 2016) and overeating (Sze, Daniel, Kilanowski, Collins, & Epstein, 2015). However, the effect of EFT on decision making may be complex. Some studies have suggested that when the future is anticipated to be bleak or negative, EFT may instead encourage decisions that favour the present (Lempert & Phelps, 2016; Liu, Feng, Chen, & Li, 2013; Zhang, Peng, Qin, Suo, & Feng, 2018). In other words, EFT may be adaptive not because it unfailingly orients us towards the future, but because it allows for flexibility in decision making, depending on circumstance (Bulley et al., 2016). The

role that EFT plays in decision making will be explored in greater detail later on in this chapter.

Research has shown that EFT is impaired in certain clinical populations, such as in those with depression (Williams et al., 1996), schizophrenia (D'Argembeau, Raffard, & Van der Linden, 2008), post-traumatic stress disorder (Brown et al., 2013; Kleim, Graham, Fihosy, Stott, & Ehlers, 2014), and in adults diagnosed with complicated grief (Maccallum & Bryant, 2011). Compared to healthy controls, individuals from these populations tend to remember the past and imagine the future with less episodic richness, a phenomenon known as overgeneral memory and overgeneral future thinking (Williams et al., 2007). Research examining the potential mechanisms behind these impairments suggests that they may be protective, facilitating the avoidance of potentially traumatic thoughts or memories (Williams et al., 2007). However, the phenomenon of overgeneral memory and EFT is also exhibited in many neurological populations (Gamboz et al., 2010; Hassabis, Kumaran, Vann, & Maguire, 2007), suggesting that the mechanisms underpinning these impairments likely stem from a complex interaction between neurobiological, psychological and cognitive factors.

Typically, the methods employed in the assessment of EFT borrow heavily from the episodic memory literature and can be identified as one of two approaches (Szpunar, 2010): thought-sampling procedures (e.g. D'Argembeau et al., 2011), and word cueing paradigms (Addis et al., 2008; D'Argembeau & Van der Linden, 2004; Lind & Bowler, 2010; Williams et al., 1996). Thought-sampling procedures typically assess the frequency and characteristics of future thoughts as they occur in participants' daily lives or at specific times throughout the day. Other studies utilize diary methods (Berntsen & Jacobsen, 2008; D'Argembeau et al., 2011;

Finnbogadóttir & Berntsen, 2013), in which participants use a notebook to record instances where they have remembered or imagined an event. Of course, these measures have their limitations, given they are prone to memory bias and that participants often report failing to record thoughts at inconvenient times (Szpunar, 2010). However, they have provided unique insight into the pervasiveness and functionality of future-oriented thinking in daily life.

Word-cueing paradigms require participants to describe imagined future events in response to cue words, such as nouns, events, locations, and time points. Compared to thought-sampling procedures, this method offers a more in-depth analysis of the content present when participants engage in EFT. Addis, Wong & Schacter (2008) adapted the Autobiographical Interview (AI, Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002), a semi-structured interview frequently employed in the episodic memory literature, to assess EFT. The adapted AI assesses the episodic and non-episodic content of remembered past events and imagined future events in order to provide an index of both episodic memory and EFT. In the adapted AI, participants are asked to generate specific, detailed past and future events in response to randomly presented cue words across different temporal conditions (e.g. past few weeks, next few weeks). Most importantly, the scoring of the adapted AI allows for both episodic and semantic details in the participants' descriptions to be separated and compared. Participants are often asked to rate their subjective experience of the imagined event in terms of sensory details, spatial context, and emotional experience (D'Argembeau & Van der Linden, 2006).

A similar method, known as the Scene Construction Task (Hassabis, Kumaran, & Maguire, 2007), has also been used to assess EFT, as well as non-temporal events (Hurley, Maguire, & Vargha-Khadem, 2011). In this task, participants are asked to

imagine scenes based on a cue (e.g. “*Imagine you are lying on a sandy beach in a tropical bay*”). However, unlike the AI, the Scene Construction task only assesses episodic details present in the participants’ description and does not take semantic detail into account. Other measures of EFT include sentence completion tasks, such as the Sentence Completion for Events in the Future Test (SCEFT, Anderson & Dewhurst, 2009). These tasks present participants with sentence stems (e.g. “*Next year...*”) and ask participants to complete the stems. Unlike other commonly used measures of EFT, the SCEFT does not explicitly instruct participants to imagine a specific event. Consequently, responses to this task are thought to provide a more accurate reflection of an individual’s habitual EFT (Anderson & Dewhurst, 2009).

Engaging in EFT is thought to require the projection of one’s self into the future (Atance & O’Neill, 2001). Tulving (1972, 1985) believed that awareness of one’s self through time, or auto-noetic consciousness, was integral to mental time travel. Despite building on the work of Tulving, the cognitive approach to future thinking has arguably neglected the role played by the self in mental time travel. Approaches to the study of future thinking that explicitly focus on the future self will be considered next.

### **1.3.3 Approaches that consider the future self**

The self is a mental concept that acts as a working theory about who one is, was, and will become (Oyserman & James, 2011). Our self-concept does not consist only of our present self, nor does it exist in a temporal vacuum; it encompasses our autobiographical experiences of the past, as well as our goals and aspirations for the future (Manning, 2016). As alluded to above, Tulving (1985) considered awareness of one’s temporally extended self to be a core component of mental time travel, allowing for the projection of one’s self through time to pre-experience the future. It

seems then that the self is a crucial aspect of future-oriented cognition, yet the role of the “*future self*” has yet to be addressed in the literature reviewed thus far. Two notable approaches to the study of future thinking that emphasise the importance of the future self in guiding behaviour are outlined below.

### ***1.3.3.1 Possible selves theory***

When people think of the future, they often think about who they might become. Possible selves (PS) theory refers to these images of the future self as “*possible selves*” (Markus & Nurius, 1986; Oyserman & Markus, 1990). Possible selves are multifaceted, valanced, and may pertain to different life domains, including education, career and health (Oyserman & Markus, 1990; Unemori, Omoregie, & Markus, 2004). Markus and Nurius (1986) posited there to be three distinct types of possible selves: hoped-for selves, expected selves, and feared selves. The hoped-for self is an idealistic image of one’s self in the future. This image of the future self is often unrealistic and unattainable but is what an individual most desires to become. In contrast, the expected self is a more realistic possible self; this is the self an individual anticipates they are most likely to become in the future. Feared selves are images of the self in the future that an individual seeks to avoid.

Crucially, these possible selves are thought to encourage optimism, support motivation, and guide behaviour (Oyserman, Bybee, & Terry, 2006). Moreover, conceiving of our current self as malleable can instil hope, as it suggests that change is possible (Markus & Nurius, 1986). However, simply believing that one can change is not sufficient to attain a positive possible self. To move towards becoming one’s hoped-for self, and away from one’s feared self, an individual must instigate action; thus, it has been argued that possible selves motivate self-regulatory behaviour (Hoyle & Sherrill, 2006). Having balanced possible selves, meaning an individual

has both positive and negative possible selves within the same domain, is thought to be most beneficial for self-regulation (Oyserman & Markus, 1990). While positive possible selves act as “*the carrot*”, motivating action by providing templates for individuals to work toward, negative possible selves act as “*the stick*”, discouraging counterproductive behaviour that might threaten the attainment of a positive possible self (Oyserman & James, 2008; Oyserman & Markus, 1990). This theory is supported by studies showing that adolescents with balanced possible selves that incorporate detailed strategies for achievement have greater academic attainment (Oyserman et al., 2006) and are less likely to engage in delinquent behaviour (Oyserman & Markus, 1990).

Possible selves are thought to direct behaviour by acting as “*road maps*” or templates (Oyserman et al., 2004). Like a map, possible selves provide us with a glimpse of who we want to be in the future and give us an idea of what we have to do to get there. It could also be said that possible selves help us to align who we are in the present with who we want to be in the future. A second approach to the study of future thinking, which also emphasises the important role played by the future self in guiding behaviour, posits that perceived misalignment between one’s present and future self may underpin problematic and short-sighted behaviour.

### ***1.3.3.2 Future self-connectedness***

The realisation that our long-term goals and current desires frequently conflict with one another, such as when we commit to saving money only to make an expensive purchase soon after, led philosophers and psychologists to propose that individuals consist of multiple selves, each with their own competing desires that lead to lapses in self-control (Hershfield, Garton, Ballard, Samanez-Larkin, & Knutson, 2009; Hershfield, Cohen, & Thompson, 2012). For example, Thaler and Shefrin’s (1981)



dual-self model proposed short-sighted behaviour to be the result of a conflict between a future-oriented self, the “*planner*” that is concerned with long-term interests, and a myopic self, the “*doer*” that is concerned only with prioritising immediate gain.

In another theory of how “*multiple selves*” contribute to short-sighted behaviour, Parfit (1971) stressed that identity over time is not static; instead, the identity of a single person can be thought of as a succession of selves. These selves vary in terms of how psychologically connected they are with one another, with selves closer in time sharing greater psychological connections in the form of memories, desires, likes, dislikes, and so on. Parfit (1971) argued that if an individual perceives their present self to have little in common with their future self, then they might perceive that future self as a completely different person. Consequently, if the future self is seen as a stranger, then an individual has little rational reason to care about that future self, or to prioritise that future self in decision making.

As predicted by Parfit (1971), research has shown that when the future self is seen as dissimilar to the present self, it is perceived almost as if it were a different person (Hershfield, 2011; Hershfield et al., 2009). Furthermore, feeling similar to one’s future self is associated with more future-oriented decision making (Bartels & Rips, 2010; Bartels & Urminsky, 2011; Urminsky, 2017), greater financial savings (Bryan & Hershfield, 2013; Hershfield et al., 2011), more ethical decision making (Hershfield et al., 2012; van Gelder, Hershfield, & Nordgren, 2013) and greater engagement in health behaviours such as exercise (Rutchick et al., 2018).

How positively people feel about their future self and the degree of vividness with which they perceive their future self are also thought to contribute to future-self connectedness (Hershfield, 2011). In both correlational and experimental studies, it

has been demonstrated that individuals tend to make less short-sighted decisions when they perceive their future selves more vividly (Hershfield, 2011; van Gelder et al., 2013). There is less evidence to suggest that positivity toward one's future self encourages future-oriented behaviour. Hershfield (2011) failed to find a correlation between positivity towards one's future self and decision making. However, a follow up study found that attitudes toward the elderly across 26 countries, taken as a proxy of future self-positivity, predicted national saving behaviour (Hershfield, 2011).

Much of the research on future self-connectedness is concerned with the financial implications of feeling connected to one's future self. This is because the construct of future self-connectedness has been of particular interest to researchers in the areas of behavioural economics and decision making. The approach to future thinking taken by these domains will be outlined next.

### **1.3.4 Decision making and behavioural economics**

Many decisions in daily life involve trade-offs between what we want now and what is in our long-term interest. Yet, individuals tend to demonstrate a "*pervasive devaluation of the future*" (Soman et al., 2005). Much of the research on future thinking in the behavioural economics and decision making literature explores this phenomenon and seeks to identify ways in which future thinking can be harnessed to motivate individuals to be make better decisions.

#### ***1.3.4.1 Temporal discounting***

The tendency for rewards to lose their value as the delay to their receipt increases is known as temporal or delay discounting (Green, Fry, & Myerson, 1994). When given the choice between a small amount of money available immediately or a large

amount of money available after a delay, many individuals will “*settle*” for the smaller reward (Thaler, 1981).

In the economics literature, the devaluation of delayed rewards can be explained by the *discounted utility model*, which states that the value of a delayed reward is discounted by a fixed percentage for each unit of time the reward is delayed (Frederick, Loewenstein, & O’Donoghue, 2002). However, numerous studies have since challenged the notion that discount rates are constant (see Urminsky & Zauberman, 2015), demonstrating that individuals are often inconsistent in their preferences. For example, studies have shown that close future rewards are discounted more steeply than distant future rewards (Ainslie & Haslam, 1992; Urminsky & Zauberman, 2015). Additionally, if given the choice between £100 in 1 year or £110 in 1 year and 1 week, participants will often exhibit a preference for the delayed reward; yet, when they are presented with the choice between £100 *now* or £110 in a week, they often switch their preference and exhibit greater impulsivity. As Kirby (1997) explains, “*our preference to resist [...] weakens and then succumbs as the object of temptation draws temporally closer*”. This kind of inconsistency in temporal discounting is thought to be better reflected by hyperbolic or quasi-hyperbolic models (Ainslie, 2001; Urminsky & Zauberman, 2015).

Temporal discounting has been used to understand an array of maladaptive behaviours thought to be underpinned by a preference for immediate gratification. In adolescents and adults, steeper discount rates are associated with gambling (Cosenza & Nigro, 2015; Madden, Francisco, Brewer, & Stein, 2011), substance misuse (Konecky & Lawyer, 2015; MacKillop et al., 2011; Story, Vlaev, Seymour, Darzi, & Dolan, 2014), smoking (Audrain-McGovern et al., 2009; Bickel, Odum, & Madden, 1999) and obesity (Tang, Chrzanowski-Smith, Hutchinson, Kee, & Hunter, 2019).

By indicating a preference for immediate rewards over long-term interests, temporal discounting may be conceived of as a bias towards the present. As a result, measures of temporal discounting have been used to operationalise an inclination or orientation toward the future (Steinberg et al., 2009).

Discount rates are typically measured using one of two tasks: matching-based tasks and choice-based tasks. In matching tasks, participants are provided with an amount (e.g. £10 today) at a given point in time and are asked for their subjective monetary equivalent at another point in time (e.g. £X in 1 year). In choice-based tasks, participants are provided with binary comparisons between a smaller, sooner reward or a larger, delayed reward and asked to choose which they would prefer. The aim of this is to identify the point at which an individual is indifferent between a small, immediate reward and a larger, delayed reward, as this reflects the subjective value of the delayed reward. Amounts and delays are then varied in order to calculate a discount rate. Both methods offer advantages and disadvantages. Matching tasks only require a single item to determine the discount rate but can be more cognitively demanding as participants have to generate their own indifference point. Choice based tasks, on the other hand, require a series of binary choices to calculate the indifference point but are typically easier for participants to respond to (Hardisty, Thompson, Krantz, & Weber, 2013). Discounting tasks may involve hypothetical or real-world rewards (Frye, Galizio, Friedel, DeHart, & Odum, 2016).

In behavioural economics, a great deal of effort has been placed into developing interventions to counter the human tendency to discount the future, effectively “*nudging*” them toward more patient decision making (Thaler & Sunstein, 2008). In one famous example, the Save More Tomorrow program is a pension plan designed to counteract hyperbolic discounting by asking employees to “*commit now*

*to increase their savings later*” by allocating, in advance, a portion of their future salary increases to their pensions (Thaler & Benartzi, 2004). Other interventions involve the use of incentives. In one study, smokers who were incentivised with delayed monetary rewards were three times more likely to succeed in their goal of quitting, compared to a control group who received no incentive (Volpp et al., 2009). More recently, behavioural economists and researchers interested in intertemporal decision making have identified links between temporal discounting and future-oriented constructs that have already been introduced in this chapter. Specifically, the capacity to imagine one’s personal future with episodic richness through EFT and perceived connectedness with one’s future self are both associated with a reduced tendency to discount the future.

#### ***1.3.4.2 Attenuating discounting through future thinking***

Boyer (2008) proposed that the human capacity to imagine the future might serve to attenuate temporal discounting by directing preferences towards the future and away from the present. More specifically, it was argued that thinking about the future allows consumers to preview and experience the anticipated emotional impact of a future reward, countering its devaluation (Benoit et al., 2011; Boyer, 2008).

A large body of empirical evidence supports this. As previously discussed, engaging in EFT during an intertemporal choice task can attenuate discounting, effectively encouraging more future-oriented decision making (Benoit et al., 2011; Daniel et al., 2013; O’Neill, Daniel, & Epstein, 2016; Peters & Büchel, 2010; Snider, Laconte, & Bickel, 2017; J. S. Stein et al., 2016). This is achieved by pairing a delayed reward to a personal, anticipated future event (Kwan et al., 2015; Peters & Büchel, 2010) or by having participants imagine themselves consuming the delayed reward before choosing their preference (Benoit et al., 2011). EFT that is vivid

(Peters & Büchel, 2010), emotionally intense (Benoit et al., 2011) and more positively valenced (Liu et al., 2013) tends to exhibit the greatest reductions in discounting.

Only a small number of studies have investigated the relationship between EFT and temporal discounting in adolescents so far, a population often characterised by engagement in risky or short-sighted decisions (Eaton et al., 2012). In the first, Bromberg, Wiehler & Peters (2015) found that individual differences in the capacity to engage in vivid EFT were predictive of adolescents' tendency to be impulsive in a temporal discounting task. A subsequent study found that engaging in EFT can attenuate discount rates in adolescents, replicating previous research in adults (Peters, Wiehler, & Bromberg, 2017).

Together, these findings implicate EFT as a possible target for interventions designed to reduce impulsive behaviours in adults and adolescents. One study that sought to employ EFT as an intervention for overeating asked overweight adults to vividly imagine and describe positive events that would be occurring in their futures (Daniel et al., 2013). The timing of these events corresponded with time points presented during a subsequent temporal discounting task. Participants' descriptions of the events were audio recorded and labelled with a relevant cue. During the temporal discounting task, participants were cued to think about the future event that corresponded with the delayed time period. Following this, the audio recordings of participants' future events were played out loud while participants were given unlimited access to high calorie foods. Compared to a control group, who described events from a travel blog, participants in the EFT condition exhibited greater patience during the temporal discounting task and consumed fewer calories in the behavioural task. Other similar studies have found that EFT reduces discounting and

alcohol demand in alcohol-dependent individuals (Snider et al., 2016), and reduces discounting and self-administered cigarette puffs in smokers (Stein et al., 2016).

Future self-connectedness has also been implicated as a useful target for impulsive decision making (Bartels & Rips, 2010; Bartels & Urminsky, 2011; Bryan & Hershfield, 2013; Urminsky, 2017). Studies have found that future self-connectedness can be heightened by making the stability of personal identity more salient (Bartels & Rips, 2010; Bartels & Urminsky, 2011). In one study, college seniors who were about to graduate read about changes in identity stability after graduation (Bartels & Urminsky, 2011). Those who read vignettes about the stability of identity following graduation not only felt more connected to their future selves but were also more future-oriented in a subsequent temporal discounting task. Those who read about how graduation can lead to major changes in one's identity felt less connected to their future selves and subsequently discounted more steeply. These results suggest that future self-connectedness is likely to be undermined during periods of transition, as individuals may anticipate large changes in their personal identity (Bartels & Urminsky, 2011).

Research has also shown that future self-connectedness can be manipulated by heightening the vividness with which the future self is perceived (Hershfield et al., 2011; van Gelder et al., 2013). This can be achieved using age-progressed virtual reality (VR) renderings, designed to increase the vividness of one's future self (Hershfield et al., 2011; van Gelder et al., 2013). In one study, after interacting with a virtual future self, participants allocated more money to a hypothetical retirement fund (Hershfield et al., 2011). In two separate studies, van Gelder et al., (2013) found that both a letter writing task, in which the participant wrote a letter to their

future selves, and VR technology decreased the likelihood that participants would make delinquent choices.

#### ***1.3.4.3 Do EFT and future self-connectedness overlap?***

Although the evidence suggests an important role for EFT and future self-connectedness in short-sighted decision making, there are a number of gaps in the literature. For example, the nature of the relationship between discounting and EFT has only been explored twice in adolescents (Bromberg et al., 2017, 2015), and the links between discounting and future self-connectedness in adolescence have not been studied at all. Additionally, the roles of EFT and future self-connectedness in temporal discounting have never been examined together in the same study. Thus, it is unknown whether EFT and future self-connectedness play separable roles in temporal discounting or whether they overlap. It could be that EFT counters discounting by increasing future self-connectedness, or that individuals who feel connected to their future self are less likely to discount the future because they are capable of imagining the future more vividly. It is important to understand how these constructs relate to one another because it speaks to whether interventions designed to decrease temporal discounting based on EFT or future self-connectedness work via the same, or different, mechanisms. These questions will be revisited in Chapter 3.

#### **1.3.5 Summary**

Despite their differing theoretical perspectives, these six approaches to the study of future thinking have each contributed uniquely to our current understanding of future thinking and the implications it has for decision making and behaviour. Motivation researchers have primarily emphasised the motivational power of future thinking,



while work in the individual differences tradition has established how individual differences in people's attitudes toward the future, and their tendency to think often, or not at all, about the future, shape present behaviour. At the same time, cognitive psychologists have focused on the human capacity to mentally "*pre-experience*" autobiographical future events and the adaptive advantage this confers. Elsewhere, researchers interested in the future self have demonstrated that possible future selves guide behaviour by acting as "*road maps*", and that perceived disconnectedness from one's future self can undermine future-oriented decision making. Finally, decision making researchers and behavioural economists have extensively examined how people devalue future rewards in favour of more immediate gratification and have found that temporal discounting is amenable to intervention by having individuals engage in EFT or by increasing future self-connectedness.

While the literature reviewed above has undoubtedly improved our understanding of future thinking, these various approaches are rarely considered together. One of the aims of this thesis will therefore be to explore these diverse lines of research together in a developmental context. This will allow for previously neglected questions, concerning how these different aspects of future thinking overlap in adolescence, to be addressed.

#### **1.4 Cognitive underpinnings of future thinking**

Of all the approaches to future thinking, cognitive researchers have shown the most interest in the underlying processes that allow us to imagine the future during EFT. EFT is complex, multidimensional, and likely to involve a "*suite*" of cognitive abilities (Suddendorf & Corballis, 2007). Neuroimaging and lesion studies have provided a number of insights into the neural and cognitive mechanisms that

underpin future thinking (Schacter et al., 2017), and the identification of a network of brain regions active during EFT, episodic memory, imagination, navigation, and theory of mind (Hassabis, Kumaran, & Maguire, 2007; Schacter et al., 2017; Spreng, Mar, & Kim, 2009) has helped to inform theories concerning the common mechanisms underlying these processes that likely contribute to our capacity to imagine the future (Buckner & Carroll, 2007; Hassabis & Maguire, 2007; Schacter & Addis, 2007). Also thought to play a role in the construction of future simulations are executive functions and visuo-spatial processing (D'Argembeau, Ortoleva, Jumentier, & Van Der Linden, 2010). These various mechanisms and the role they are thought to play in supporting future thinking are outlined in greater detail below.

#### **1.4.1 Episodic and semantic memory**

As alluded to earlier in this chapter, studies have identified several developmental, cognitive, and neuropsychological overlaps between episodic memory and EFT (Klein, 2013; Schacter et al., 2017; Suddendorf, 2010). Episodic memory and EFT emerge around the same time in development (Martin-Ordas, Atance, & Caza, 2014), show similar declines with aging (Addis et al., 2008; Schacter, Gaesser, & Addis, 2013), and show similar deficits in clinical populations (Hallford, Austin, Takano, & Raes, 2018). Furthermore, neuroimaging studies have identified the existence of a “*core network*” of brain regions that become activated during episodic memory and EFT (Benoit & Schacter, 2015; Schacter, Addis, & Buckner, 2007), while neuropsychological studies show that patients with damage to these regions exhibit concurrent deficits in episodic memory and EFT (Schacter et al., 2017). A potential explanation for this overlap is offered by the *constructive episodic simulation hypothesis*, which proposes that episodic memory allows for the recollection and

flexible recombination of personal memories in order to construct detailed simulations of the future (Schacter & Addis, 2007).

However, research on memory and future thinking in amnesia has challenged the claim that EFT depends solely on episodic memory. Studies have shown that, despite the presence of episodic memory deficits, some patients with amnesia are capable of constructing non-temporal imaginary scenes (Hassabis, Kumaran, Vann, et al., 2007; Maguire, Vargha-Khadem, & Hassabis, 2010), as well as future episodes (Hassabis, Kumaran, Vann, et al., 2007; Hurley et al., 2011). Researchers subsequently suggested that intact semantic memory might allow patients with amnesia to imagine events without having to rely on episodic memory (Maguire et al., 2010). For example, if asked to imagine a non-temporal or future event that involves being on a sandy beach, it is entirely possible to use one's semantic knowledge of a beach to provide a detailed answer without ever needing to retrieve a personal memory of time spent at the beach. The supporting role of semantic memory in future thinking is further evidenced by research showing that patients with semantic dementia struggle to generate episodic future events, despite having intact episodic memory (Irish, Addis, Hodges, & Piguet, 2012b). The *semantic scaffolding hypothesis* (Irish, Addis, Hodges, & Piguet, 2012a) proposes that semantic memory serves as a scaffold or framework onto which elements from episodic memory are placed in order to construct future simulations. Without this scaffold, episodic details cannot be integrated, leading to deficits in EFT. It is therefore likely that our capacity to engage in future-oriented thought is supported by both episodic and semantic memory.

### **1.4.2 Autooetic consciousness and self-projection**

Episodic memory and EFT, by definition, both involve the re-experiencing and pre-experiencing of personal events (Atance & O'Neill, 2001; Tulving, 1985). As already revealed, autooetic consciousness is considered a critical component of episodic memory and EFT (Tulving, 2005). To engage in mental time travel, it is necessary to recognise one's past and possible future experiences as belonging to a temporally extended self. As put succinctly by Tulving (2005), "*there can be no travel without a traveller*".

In addition to being aware of one's self in subjective time, the capacity for self-projection is also thought to play a role in mental time travel. Self-projection involves the shifting of perspective from the present to imagine one's self in alternative situations (Buckner & Carroll, 2007). Buckner & Carroll (2007) argue that self-projection is a common feature underlying episodic memory, navigation, theory of mind, and EFT. Neuroimaging studies support the suggestion of a shared mechanism underpinning this collection of processes, demonstrating that theory of mind and navigation can be linked to the same core network that is engaged during EFT and episodic memory (Buckner & Carroll, 2007; Spreng et al., 2009). However, an alternative explanation for the overlaps between EFT, episodic memory, and navigation is offered by the *scene construction hypothesis*, which is described below.

### **1.4.3 Scene construction**

The process of constructing or imagining a fictitious, non-temporal scene does not involve mental time travel or self-projection. Yet, doing so activates the core network, much like during episodic memory and EFT (Hassabis, Kumaran, & Maguire, 2007). It has therefore been argued that scene construction, which involves the generating and

maintaining of a complex and coherent scene or event, and not self-projection, is the key underlying mechanism shared by EFT, episodic memory, and navigation (Hassabis & Maguire, 2007). While acknowledging the importance of self-projection, these authors contend that without the capacity to construct a unified, spatially coherent scene, both memory and future thinking suffer. This theory is supported by studies showing that patients with amnesia struggle to imagine both non-temporal scenes, which do not require self-projection, as well as personally-relevant future events (Hassabis et al., 2007). Children and adults with ASD, who have been shown to exhibit impairments in episodic memory and EFT, also find it difficult to imagine non-temporal scenes (Lind, Williams, Bowler, & Peel, 2014; Lind, Williams, Raber, Peel, & Bowler, 2013). Together, these studies suggest that deficits in scene construction, and not self-projection, underlie impairments in episodic memory and EFT.

#### **1.4.4 Executive functions**

Executive functions are a set of cognitive abilities that includes inhibition, interference control, working memory, and cognitive flexibility (Diamond, 2013). In Parkinson's Disease, patients who show deficiencies in executive functioning also exhibit impairments in future thinking, suggesting the two might be linked (de Vito et al., 2012).

Executive functions are believed to support episodic memory by guiding retrieval, engaging in searching, and inhibiting irrelevant information (Blankenship & Bell, 2015; Rajan, Cuevas, & Bell, 2014). Given the overlap between episodic memory and EFT, it is likely then that these executive processes are involved in the extraction and recombination of elements from episodic memory to construct a future event (Schacter & Addis, 2007). Indeed, measures of executive processes involved in

the organisation and monitoring of retrieval are associated with the amount of episodic detail provided during EFT (D'Argembeau et al., 2010).

Working memory is also thought to play a role in future thinking as it provides a space in which to maintain and manipulate information (Suddendorf & Corballis, 2007). Episodic detail provided during EFT is associated with performance on the Backward Digit Span task, a measure of working memory (Addis et al., 2008), and the ability to imagine and describe specific future events is correlated with performance on other working memory tasks (Hill & Emery, 2013). There also appear to be links between inhibitory control, age, and the production of external details during EFT tasks, suggesting that older adults may struggle to inhibit irrelevant information during EFT, leading to greater inclusion of semantic information in descriptions of possible future events. Poor inhibition is negatively correlated with the amount of episodic details in generated future events (Zavagnin, De Beni, Borella, & Carretti, 2016), suggesting that inhibition may be necessary to disengage from the present and focus attention on an imagined event.

### **1.5 Importance of future thinking in adolescence**

Many of the mechanisms thought to underpin future thinking continue to develop during adolescence, enabling teens to envision and act upon the future in a way they could not during childhood (Coughlin, Lyons, & Ghetti, 2014; Gott & Lah, 2014). As alluded to at the beginning of this chapter, future thinking is considered to be particularly important during adolescence (Nurmi, 1991). Adolescence is a period of transition in which young people must begin to consider and plan for the future to achieve key developmental milestones, as well as to guide decisions that may have long lasting consequences (Nurmi, 1991; Finlay et al., 2015). Reassuringly, it is generally agreed that adolescents become increasingly interested in and more

concerned about the future with age (Nurmi, 1989; Nurmi, Poole, & Kalakoski, 1994; Trommsdorff et al., 1979).

Yet, at the same time, adolescence is often characterised as a period of impulsivity (Steinberg & Chein, 2015). Indeed, studies have shown that, when compared to adults, adolescents are more oriented to the present than the future (Siu, Lam, Le, & Przepiorka, 2014), discount future rewards more steeply when making intertemporal decisions (Green et al., 1994; Steinberg et al., 2009), and are also more likely to engage in short-sighted, impulsive, and risky behaviour (Steinberg, 2008; Steinberg & Chein, 2015). This tendency for adolescents to behave impulsively when it is important for them to consider their future demonstrates the importance of understanding the links between future-oriented cognition, decision making and behaviour in this population. To date, most of the research that seeks to elucidate the outcomes associated with future thinking in adolescence has focused on three main areas: academic achievement, well-being, and risk taking.

### **1.5.1 Academic achievement**

The degree to which an adolescent considers the future, feels positively toward the future, and expects the best from their future is related to achievement, in both academic and occupational domains. One study of over 700 academically talented young people examined the relationship between scores on the ZPTI and academic achievement (Mello & Worrell, 2006) and found that future-oriented adolescents had higher GPA scores, while teens who scored higher on the Present-Fatalistic subscale, indicating that they perceive the future to be uncontrollable, had worse academic attainment. Similarly, in a sample of over 600 African American adolescents, Adelabu (2008) found that adolescents more oriented to the future on the ZPTI had significantly higher GPA scores.

Although these findings coincide with the conceptualisation of future-oriented individuals as being highly organised, ambitious, and willing to sacrifice short-term benefits for long-term goals (Zimbardo & Boyd, 1999), the exact mechanism underpinning the relationship between future orientation and academic achievement is unclear. Borrowing from the motivational approach, future-oriented individuals are more likely to perceive present behaviour as being instrumental for achieving a future goal (Husman & Lens, 1999); that is, a future-oriented adolescent will be more likely to perceive behaviours like studying to be necessary for attending college in the future, leading to greater academic motivation. However, while perceived instrumentality is important for motivation, attitudes toward the future likely also play a role in this complex relationship (van Calster et al., 1987). An adolescent may understand that working hard at school is instrumental for reaching their future goals, but feeling negatively about the future may serve to undermine motivation.

Research has indeed found that attitudes toward the future also play a role in adolescents' academic achievement. Positive expectations towards the future are associated with greater academic attainment and better socio-emotional adjustment (Israelashvili, 1997), and at-risk students who express hope for the future are less likely to drop out of school (Worrell & Hale, 2001). In a study of adolescents from New Zealand, negative attitudes toward the future were found to be negatively associated with academic self-ranking, attitude toward school and teachers, and academic achievement (Alansari, Worrell, Davies, & Webber, 2013). Adolescents with negative attitudes were also more likely to be truant from school. Similarly, Andretta, Worrell & Mello (2014) found that adolescents with more negative attitudes toward the future had lower GPAs, lower self-esteem, and higher perceived



stress. These adolescents also had less consideration for future consequences, offering another potential explanation for the relationship between future thinking and academic achievement.

Attitudes toward the future may impact on adolescents' motivation by influencing the expectations adolescents have for themselves. In one study, despite having GPA scores adequate for college admission, adolescents with more negative attitudes toward the future had the lowest educational expectations (Andretta, 2011), suggesting that the negative outlook of these adolescents had diminished their expectations. This is concerning, given that the educational and occupational expectations adolescents hold for their future predicts actual attainment in adulthood (Messersmith & Schulenberg, 2008), suggesting that negativity toward the future may have far-reaching consequences.

Oyserman, Bybee & Terry (2006) highlighted the importance of school-focused possible selves for academic achievement. Low income, at-risk adolescents attended a 7-week programme designed to increase the salience of possible selves and to create strategies for achieving possible selves. Subsequently, these adolescents had fewer school absences, increased GPAs, and were less likely to repeat an academic year than controls. Furthermore, after a year, those in the intervention group reported spending more time on homework, were less disruptive in class, and maintained their improved school attendance and GPA scores.

### **1.5.2 Well-being**

In addition to being important for academic achievement, research has shown that adolescents' attitudes toward the future can be protective for well-being. Adolescents with more positive attitudes toward the future have greater self-esteem, lower

perceived stress (Andretta et al., 2014; Worrell & Mello, 2009), and greater self-efficacy (McKay, Cole, Percy, Worrell, & Mello, 2015; Seijts, 1998). In contrast, negative expectations for the future are associated with depression and anxiety in teens (Iovu, Hărăguș, & Roth, 2018). In their study of at-risk, urban children and adolescents, Wyman et al., (1993) found that those with positive expectations toward the future had better socioemotional adjustment and greater perceived self-competence, despite having been exposed to high levels of stress at a young age.

Chua, Milfont and Jose (2015) sought to further investigate the links between future thinking and well-being in a longitudinal study of over 1,700 adolescents. Young people aged 10 to 15 completed a self-report survey assessing orientation to the future, positive and negative well-being, and adaptive and maladaptive coping skills once a year, for three years. To assess future orientation, participants answered four questions concerning the extent to which they planned for and worked hard for the future. Participants also completed measures of weight satisfaction, vitality, and hours of sleep, taken to indicate positive well-being, and measures of substance abuse and self-harm, taken to indicate negative well-being. Finally, participants reported the extent to which they engaged in maladaptive coping strategies, such as rumination and externalisation, and adaptive coping strategies, such as seeking social support and problem solving. Future orientation predicted positive well-being up to 3 years later, and this relationship was mediated by coping strategies. In other words, over time, adolescents who were more oriented to the future engaged in more adaptive, and less maladaptive coping skills, leading to more positive well-being (Chua et al., 2015).

### **1.5.3 Risk taking**

Being future-oriented is thought to make the consequences of present behaviour more salient (Stratham et al., 1994; Zimbardo & Boyd, 1999), and to counter the tendency for individuals to make short-sighted decisions (Boyer, 2008). It is not surprising then that researchers interested in adolescent impulsivity have examined the role played by future thinking.

In general, using a range of measures, future-oriented adolescents are less likely to try cannabis, smoke tobacco, drink alcohol or misuse prescription drugs (Apostolidis, Fieulaine, Simonin, & Rolland, 2006; Barnett et al., 2013; Fieulaine & Martinez, 2011; Henson, Carey, Carey, & Maisto, 2006; Steiger, Stoddard, & Pierce, 2017). In a study of over 1,600 adolescents in the United Kingdom, future-oriented adolescents were less likely to report alcohol use and were more likely to be classified as abstainers (McKay, Andretta, Magee, & Worrell, 2014). Similarly, in Italian adolescents, future orientation is negatively associated with binge drinking (Laghi, Liga, Baumgartner, & Baiocco, 2012). Moreover, Stoddard, Zimmerman & Baumeister (2011) found that the amount of time teens spent thinking about the future was associated with lower levels of aggressive and violent behaviour in at-risk minority adolescents.

Research in both adolescents and adults has shown that future orientation, as defined by scores on the ZPTI, are linked to delay discounting (Daugherty & Brase, 2010; Göllner, Ballhausen, Kliegel, & Forstmeier, 2018; Guo, Chen, & Feng, 2017; van den Bos, Rodriguez, Schweitzer, & McClure, 2015), indicating that future-oriented adolescents are less likely to prioritise immediate gratification over future gain. This is further supported by a study investigating decision making styles and TP in adolescents (Molinari, Speltini, Passini, & Carelli, 2016), in which future-

oriented adolescents were more likely to engage in rational decision making and less likely to use spontaneous, impulsive decision making. Future-oriented adolescents may also be more likely to consider the negative future consequences of risk taking, thus discouraging them from engaging in risky behaviours. This is demonstrated by a study showing that adolescents who score lower on the CFC scale are more likely to engage in alcohol use (Mckay, Percy, & Cole, 2013).

Attitudes toward the future also overlap with risk taking behaviour.

Adolescents with negative future expectations are more likely to engage in risky sexual behaviour and inconsistent contraception use (Sipsma, Ickovics, Lin, & Kershaw, 2013). Furthermore, negative expectations are linked to teen pregnancy (Allen et al., 2007; Guijarro et al., 1999). In a large longitudinal study of over 20,000 adolescents in the US, adolescents who anticipated early mortality, an indicator of pessimistic and fatalistic attitudes toward the future, reported greater regular substance abuse in adulthood (Nguyen et al., 2012), while in adolescents who have engaged in criminal behaviour, negative attitudes toward the future are significantly correlated with risky sexual behaviour and substance use (Robbins & Bryan, 2004).

#### **1.5.4 Summary**

To summarise, research has demonstrated that future thinking is linked to positive outcomes in adolescence. Numerous studies utilising different measures of future thinking have shown that adolescents considered to be oriented to the future seem to have better academic attainment, more positive well-being, and are less likely to engage in short-sighted, risk taking behaviour.

However, it is notable that the vast majority of research outlined above, with the exception of Oyserman et al., (2006), stems from work on future thinking from

an individual differences perspective. Thus, while there is a rich body of research demonstrating the importance of future thinking in adolescence, the focus to date has been on constructs such as future time perspective, future time attitudes, and future time orientation. Less is known about how constructs such as EFT or future self-connectedness might relate to decision making and behaviour in adolescence. This is surprising, as both EFT and future self-connectedness are thought to play a role in future-oriented decision making and may have powerful implications for interventions designed to attenuate impulsivity (see section 1.3.4.3). As touched upon previously, one of the aims of this thesis will be to draw together the diverse lines of research on future thinking in a developmental context by examining how different aspects of future thinking overlap. This will also provide the opportunity to explore how other approaches to future thinking might contribute to our understanding of future-oriented cognition in adolescence and the role it plays in countering the myopic decision making that seems to characterise this population.

## **1.6 Chapter summary**

While we may not be able to change the past, we can still take action to influence the future. Without the capacity to think ahead, however, we would be unable to consider or plan for the future and all of its infinite possibilities. Over the years, future thinking has attracted attention from across various psychological disciplines. These disciplines all share an interest in the adaptive and functional importance of future thinking. However, they each approach the study of future thinking from different theoretical perspectives, employ different terminology and focus on different, although often conceptually similar, future-oriented phenomena. As a result, the cognitive, affective and behavioural constructs evolving out of these domains, and the instruments designed to assess them, tend to be investigated in

isolation. This raises questions about the nature of their overlap, and their unique contributions to outcomes. Additionally, a number of these future-oriented constructs, such as EFT and future self-connectedness, have so far been neglected in research on adolescence.

Despite this, the research outlined in this chapter demonstrates that future thinking has powerful implications for motivation, decision making, and behaviour in adolescence. The following chapter will consider how future thinking might shed new light on a particularly myopic behaviour: failure to adhere to medication in adolescents with chronic illness.

## **Chapter 2. Adherence in adolescents with chronic illness**

### **2.1 Introduction**

In the UK, it is estimated that that 1 in 5 young people are living with chronic illness (Shah, Hagell, & Cheung, 2019), a diagnosis of which can have a detrimental impact on an adolescent's physical and psychosocial development (Suris, Michaud, & Viner, 2004). Chronic health conditions are prolonged in duration, do not resolve spontaneously and are rarely completely cured (Stanton, Revenson, & Tennen, 2007), typically requiring regular use of medication, behavioural adjustment, frequent attention from healthcare professionals and extensive use of medical care (Mokkink et al., 2008; Stanton et al., 2007). Chronic illness can interfere with every aspect of a young person's life, and can place an extraordinary burden on patients and their families (Wallander, Thompson, & Alriksson-Schmidt, 2003).

One of the greatest predictors of positive outcomes in chronic illness is adherence to treatment (DiMatteo, Giordani, Lepper, & Croghan, 2002). Whether a patient adheres to their prescribed treatment plan is predictive of disease and symptom control, risk of hospitalisation, and risk of mortality (Lehane & McCarthy, 2007; Rapoff, 2010). Despite its importance, poor adherence is worryingly prevalent (Sabaté, 2003), and previous research suggests that adherence is particularly challenging for adolescents (DiMatteo & Miller, 2013). The tendency for teens to fail to adhere to treatment, despite the consequences this may have for their health in the future, raises questions and concerns about how these young people might think about the future, and how their thoughts and attitudes might be influencing their decisions to adhere.

In the previous chapter, I reviewed various aspects of future thinking, and discussed how future-oriented cognition may be crucial for motivation, decision making, behaviour and well-being. Before considering the potential role future thinking might play in determining adherence in adolescents with chronic illness, it is necessary to first define adherence, and to outline the various methods that exist to measure it. Following this, psychological models that have previously been used to explain adherence, and their various limitations, will be considered. Because Chapters 4 and 5 focus on future thinking in adolescents with asthma, cystic fibrosis, and Type 1 diabetes, I will briefly describe these three illnesses before exploring the barriers adolescents with these conditions have cited as affecting their decisions to adhere. Finally, this chapter will explore what evidence there is to suggest that future thinking might be a crucial, but neglected, area of research for understanding treatment adherence in adolescents with chronic illness.

## **2.2 Defining adherence**

There is little disagreement in the literature over the definition of adherence. Adherence is the extent to which a patient's behaviour coincides with agreed medical or healthcare recommendations, and refers to medication, diet and other behavioural recommendations (Haynes et al., 1980). It refers to an active, intentional process that involves collaboration between a patient and their healthcare provider. In the past, the term compliance has been used synonymously and interchangeably with adherence, but was phased out of use due to its connotations with paternalism (Horne & Weinman, 2005; Kyngäs, Kroll, & Duffy, 2000; Osterberg & Blaschke, 2005).

Poor adherence is a well-documented phenomenon that results in reduced quality of life, increased healthcare utilization (DiMatteo, 2004b; McGrady & Hommel, 2013; Rapoff, 2010; Taddeo, Egedy, & Frappier, 2008), and is thought to



cost the NHS £300 to £500 million each year (Hagan, 2015; Hazell & Robson, 2015). In an extensive review of over 500 studies, DiMatteo (2004) found that the average rate of treatment nonadherence in chronic illness is around 25%, while the World Health Organisation (WHO) estimates that 1 in 2 patients fail to adhere to their treatments as prescribed (Sabaté, 2003). As already alluded to, adherence seems to pose a greater challenge to adolescents with chronic illness than to young children or adults ( DiMatteo & Miller, 2013; McQuaid, Kopel, Klein, & Fritz, 2003; Penkower et al., 2003). In one study, only 23% of adolescents with chronic illness indicated full adherence to every aspect of their treatment regimen (Kyngäs et al., 2000). Another found that only 11% reported sufficient adherence to their regimens (Michaud, Frappier, & Pless, 1991). Estimating rates of adherence is notoriously difficult, however, as rates vary depending on the disease in question, the complexity of the treatment regimen, and the method used to assess adherence. The main methods of assessing adherence will be considered below.

### **2.3 Measuring adherence**

There is no “*gold standard*” technique for assessing treatment adherence (Garfield, Clifford, Eliasson, Barber, & Willson, 2011; Quittner, Modi, Lemanek, Ievers-Landis, & Rapoff, 2008). In previous research, pill counts, electronic monitors, self-report questionnaires, structured interviews, prescription refills, health outcomes, and biological assays have been employed (Quittner et al., 2008; Rapoff, 2010), and each method has its strengths and limitations. Consequently, a multi-method approach to measuring adherence is recommended (Quittner, Espelage, Ievers-Landis, & Drotar, 2000).

### **2.3.1 Self-report measures**

Self-report measures remain the most common method of assessing adherence (Quittner et al., 2008; Stirratt et al., 2015), as they are easy to administer, relatively inexpensive, and can be administered to both patient and caregiver simultaneously (La Greca & Bearman, 2003). One obvious limitation of this method is the highly subjective nature of self-report measures. They are also vulnerable to recall and social desirability biases. Patients may not always be honest when reporting adherence to clinicians and, with regards to complex treatment regimens, patients may not fully understand what is expected of them or may be unable to recall their level of adherence over extended periods of time. As a result, these measures tend to overestimate adherence (Rapoff, 2010).

### **2.3.2 Daily diary measures**

Although diary measures are considered a form of self-report measure, they assess adherence behaviours soon after they occur and so are less vulnerable to the memory biases that plague other forms of questionnaire measures (Rapoff, 2010). Daily diary methods may involve the use of written logs, hand-held computers with time-sensitive prompts, or daily telephone check-ins with patients. However, it can be challenging to encourage patients to comply with written logs, and previous studies using these methods report that patients often complete diaries just before they are due to be returned, rather than on a daily basis as requested (Johnson, 1993). Given that nonadherent patients find it difficult to adhere to their treatments, it is unsurprising that they would also struggle to complete a daily written log of their adherence.

One method used successfully across a number of studies is the Daily Phone Diary (DPD, Freund, Johnson, Silverstein, & Thomas, 1991; McLean, 2015; Modi et al., 2006). The DPD tracks patient mood, activities, social interactions and activities over 24 hours, and shows high levels of inter-rater agreement and strong evidence of convergent and discriminative validity (Modi et al., 2006; Quittner & Opiari, 1994). Despite being less vulnerable to recall biases and social desirability, diary measures like the DPD are still, by nature, self-report methods and can still be affected by these response biases. It is also necessary for the DPD to be carried out by an interviewer capable of establishing rapport with children, adolescents, and their parents by telephone, making it more time-intensive than other self-report measures.

### **2.3.3 Drug assays, health outcomes and electronic monitoring**

As a more direct and objective method of measuring adherence, clinicians can monitor blood, urine, or saliva samples to measure drug concentrations (Rapoff, 2010). However, this method can be influenced by individual variability in drug absorption rates, and may not reflect long-term adherence if patients simply take their medication prior to testing. Additionally, if seeking to measure the effectiveness of an adherence intervention, increased visits to a clinician for drug assays may in itself modify adherence, thus acting as a confounding factor. Pill counts and health outcomes can also be of use when assessing adherence (La Greca & Bearman, 2003). However, using health outcomes, such as graft rejection and number of hospitalizations, as indicators of adherence fails to account for individual variability and responsiveness to treatment. Pill counts may be more accurate and reliable than self-report measures, but fail to provide information about time of administration or ingestion of the correct dose.

Recent advances in technology have led to the development of more automated measures of adherence. Electronic monitors can record and store information on the date and time that medication is removed from a standard vial, blister package, or metred-dose inhaler. Information can be stored for up to 3 years, is easily downloaded into data files, and can be used to detect a range of adherence issues including underdosing, overdosing, delayed dosing, drug holidays, and even “*white coat*” adherence, whereby a patient fails to adhere until a few days before a scheduled clinic visit, thus giving the illusion of adherence (Rapoff, 2010). Although electronic monitors provide valuable information about when a pill bottle has been opened, only drug assays are capable of confirming that a drug has actually been taken by a patient. Moreover, electronic monitors are costly and may underestimate adherence if patients remove several doses from a bottle at once in order to load a pill reminder box (Quittner et al., 2008).

Due to the limitations associated with assessing adherence, it is usually considered best practice to employ multiple methods (Quittner et al., 2000), although this too has its challenges, requiring the integration of different units of measurement and timeframes.

## **2.4 Models of adherence**

Despite the widespread prevalence and ramifications of low adherence, no psychological models have been developed to specifically explain adherence to treatment. Instead, general health behaviour models have been applied by researchers to gain greater insight into when and why patients adhere. Most health behaviour models are built on expectancy-value frameworks (Pligt & De Vries, 1998), according to which behaviour is determined by expectations that a behaviour will

lead to a desired outcome and how valued that outcome is. With regards to adherence, the central tenet of these models is that the beliefs and expectations patients have of their disease, their medication and the act of adhering, are core determinants of whether or not a patient will adhere. As will be discussed, however, the empirical support for these models in adolescents with chronic illness is somewhat limited, and there is scope to believe that future thinking may have an as of yet neglected role to play in predicting adherence.

#### **2.4.1 Health Belief Model**

The Health Belief Model (HBM) was developed in an effort to understand why people fail to engage in preventative health behaviour (Rosenstock, 1974). Since then, it has been used as a framework to understand why patients fail to adhere to treatment regimens in chronic illness (DiMatteo, Haskard, & Williams, 2007). The original model identifies five key determinants of health behaviour: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action (Rosenstock, 1974). According to the HBM, if a patient perceives themselves to be susceptible to adverse outcomes as a result of their condition and perceives the consequences of these outcomes to be severe, then they will be more likely to adhere. A patient who perceives there to be benefits to adhering, and who perceives such benefits to outweigh potential barriers, should also be more likely to adhere. Finally, the HBM posits that the presence of cues to action, such as the experience of a symptom or a reminder alert on a phone, encourages adherence. Later on, self-efficacy, or the belief that an individual holds concerning his or her ability to perform the health behaviour in question, was added to the model (Rosenstock, Strecher, & Becker, 1988).

The HBM predicts a range of health behaviours in adults (Carpenter, 2010). However, few studies have systematically investigated the model in paediatric populations. One recent study in adolescents with cystic fibrosis (CF) found that perceived susceptibility, severity, benefits, barriers, and cues to action accounted for a large proportion of the variance in self-reported adherence (Dempster, Wildman, Masterson, & Omlor, 2018). Similarly, Fenton (2014) found that the HBM model predicted nonadherence in adolescents with Inflammatory Bowel Disease (IBD) and Chronic Kidney Disease (CKD). Other studies have failed to find significant associations between health beliefs and adherence (Patino, Sanchez, Eidson, & Delamater, 2005).

Although there is limited evidence available for the model as a whole in predicting adherence in adolescents, the influence of perceived barriers and benefits has been demonstrated consistently across a number of studies (Bond, Aiken, & Somerville, 1992; Dempster et al., 2018; Fenton, 2014). In general, these studies show that adolescents who perceive there to be fewer barriers to taking their medication report greater adherence, as do those who perceive their medication to be beneficial. With regards to the impact of perceived susceptibility and perceived severity beliefs, the evidence is somewhat more mixed. Some studies confirm that high perceived susceptibility (Brownlee-Duffeck et al., 1987; Fenton, 2014) and high perceived severity (Fenton, 2014; Reed-Knight, Lewis, & Blount, 2011) facilitates adherence. However, others have shown that low levels of perceived susceptibility and severity are associated with better disease control (Bond et al., 1992). This discrepancy may be because the link between threat and adherence is moderated by a third variable, such as how an adolescent copes with the threat posed by their illness (Fenton, 2014).

In summary, adolescents seem to be more motivated to adhere when they perceive themselves to be at risk of experiencing adverse outcomes as a result of their illness, when these outcomes are perceived to be severe, when adherence is thought to be of benefit and when the benefits of adherence are seen to outweigh potential challenges and obstacles. It could be argued that these health beliefs are future-oriented, as they pertain to how an adolescent envisions the future consequences of their illness and its treatment. Thus, the studies described above could offer support for the notion that adherence is influenced, at least in part, by how adolescents with chronic illness think about the future. This point will be revisited (see sections 2.4.6 and 2.8).

#### **2.4.2 Theory of Planned Behaviour**

The Theory of Planned Behaviour (TPB), an extension of an earlier model known as the Theory of Reasoned Action (TRA), posits there to be four crucial, motivational factors that determine the likelihood an individual will engage in a health behaviour (Ajzen, 1991, 2011). According to the TPB, *intention* to perform a behaviour is the most important factor, which is, in turn, determined by the other three components of the model: attitudes, subjective norms and perceived behavioural control. In the context of adherence, attitudes reflect the beliefs an individual has about adherence and its outcomes, subjective norms reflect beliefs about others' perceptions of adherence, and perceived behavioural control reflects whether a patient perceives themselves as having control over their adherence (Ajzen, 1991).

Although the TPB has been found to predict health behaviours such as physical activity, contraception use, and bicycle helmet use in children and adolescents (Giles, Liddell, & Bydawell, 2005; Quine, Rutter, & Arnold, 2001; Rhodes, Macdonald, &

McKay, 2006), it has rarely been investigated in the context of adherence. In adults, however, attitudes, subjective norms and perceived behavioural control have been shown to predict both intention to adhere and actual adherence (Conner, Black, & Stratton, 1998). However, in a study of 8 – 17-year-old children and adolescents with asthma, James (2009) found that perceived behavioural control, but not attitudes, were predictive of intentions to adhere. However, intention to adhere was the only significant predictor of self-reported adherence. It may be that the lack of relationship observed between perceived behavioural control and adherence in this study is due to the shared responsibility for adherence that typically occurs during childhood and adolescence (James, 2009). If children and adolescents have little control over whether or not they adhere, it is unlikely that their perceived behavioural control will predict adherence. This suggests that the construct of perceived behavioural control may be of limited applicability to children and young adolescents. Additionally, as speculated by James (2009), children and young adolescents may be unaware or unaffected by subjective norms. With these issues in mind, the current evidence might indicate that the current form of the TPB is of limited use when explaining adolescent nonadherence.

### **2.4.3 Social Cognitive Theory**

A third health behaviour model that has been applied to adherence is Social Cognitive Theory (SCT), which posits perceived self-efficacy to be a key determinant of processes such as knowledge acquisition, goal setting, self-regulation and resilience, processes likely to be important in motivating health behaviour (Bandura, 1998). To have self-efficacy means to believe in one's capability to accomplish a task and achieve the desired outcomes (Bandura, 1986, 1998). Referring specifically to health behaviour, Bandura (1998) argued that even in the



presence of knowledge and skill, without feeling in control of one's own behaviour and environment, it is unlikely that an individual will be incentivised to action. As already mentioned, self-efficacy was also introduced in later versions of the HBM (Rosenstock et al., 1988). Outcome expectancies is the second core construct of the SCT. Outcome expectancies are the physical, social, and self-evaluative outcomes, both positive and negative, that an individual expects they will experience if they engage in a particular health behaviour.

As self-efficacy is related to whether or not an individual will engage and persist with a behaviour (Bandura, 1986), it is a construct of specific interest to researchers interested in treatment adherence. Self-efficacy does indeed predict medication adherence across a number of conditions. Research has demonstrated that self-efficacy is associated with greater adherence to diet, glucose monitoring, insulin administration and exercise in adolescents with Type 1 diabetes (Herge et al., 2012; Iannotti et al., 2006; Ott, Greening, Palardy, Holderby, & DeBell, 2000). Similarly, self-efficacy is associated with lower HbA1c levels, indicating greater glycaemic control (Herge et al., 2012). The relationship between self-efficacy and adherence has also been observed in adolescents with CF and asthma (Bartholomew, Parcel, Swank, & Czyzewski, 1993; Rhee, Wicks, Dolgoff, Love, & Harrington, 2018; Zebracki & Drotar, 2004).

However, the links between outcome expectancies and adherence are less clear. In one study, positive outcome expectancies were associated with greater adherence to treatment in adolescents with asthma, while negative outcome expectancies were associated with poor adherence (Riekert, 2000). A more recent study found only a marginal positive relationship between outcome expectancies and asthma control (Rhee et al., 2018), while Zebracki and Drotar (2004) found that

adolescents with more positive outcome expectations actually had the highest asthma morbidity, although these were not a significant predictor of adherence. The authors suggest that unrealistically positive beliefs about health outcomes, regardless of current health status or degree of adherence, may actually be maladaptive. In another study, adolescents who held positive outcome expectations in the absence of self-efficacy had the worst adherence (Ianotti et al., 2006), suggesting again that positive outcome expectancies may not always be adaptive. The lack of consistency here may be due to differing methodologies, or as Zebracki and Drotar (2004) suggest, it may be difficult to accurately capture adolescents' expectations about adherence, as the capacity to consider the future may still be developing in adolescents. Much like the TPB discussed above, it may be that the SCT, in its current form, is not generalizable to adolescent adherence behaviour. Just as elements of the HBM pertained to how adolescents think about the future, it should be noted that outcome expectancies are an inherently future-oriented construct. This point will be revisited in section 2.4.6.

#### **2.4.4 Common Sense Model**

According to the Common Sense Model of Self-Regulation (CSM; Leventhal, 2012), illness is a threat that motivates patients to develop strategies and plans aimed at alleviating emotional reactions to this threat and to minimise the nature of the threat itself. The CSM was developed in response to the observation that simply warning people about health threats, such as smoking related cancers, does not incentivise behaviour change, unless warnings are accompanied by action plans and goals (Leventhal, 1970).

The CSM involves a dynamic, three stage process. First, to help make sense of their condition, patients form cognitive representations of their illness, also referred

to as illness perceptions. The content of these illness perceptions can be categorised as belonging to one of five domains: identity, timeline, consequence, cause, and control. Identity refers to the label given to an illness and the symptoms that a patient perceives to be associated with it; Cause refers to beliefs the patient holds about the factors responsible for the illness; Timeline concerns the patient's perceptions of the duration of the illness, such as whether it is chronic or episodic; Consequences are the perceived outcomes associated with the illness, which may be physical, social or economic; Finally, control refers to beliefs the patient holds over whether the illness is treatable, or in the case of chronic illness, whether it is perceived to be manageable. Illness perceptions may also be emotional, relating to fear, distress or anger (Leventhal et al., 2003).

The second part of the process outlined by the CSM involves the strategies or action plans individuals put in place to manage their perception of the illness threat. In the context of chronic illness, this may involve engaging in pro-active coping strategies, such as help seeking behaviour or adhering to treatment. Of course, the action plans people put into place are not always so adaptive. For example, if a patient perceives themselves to have little control over their illness, perceive their illness to have serious consequences, or perceive their illness to be episodic when it is, in fact, chronic, patients may engage in maladaptive coping strategies, such as avoidance or denial, or may fail to engage in self-management behaviour altogether (M. S. Hagger & Orbell, 2003). Patients also develop coping strategies to deal with their emotional representations of the illness (Leventhal et al., 2003). The third stage of the process involves appraisal, in which the patient evaluates how effective their strategies are. Each component of the CSM is capable of interacting with the other components, and continues until a strategy is deemed to be successful by the patient.

Studies support the existence of the illness perception categories outlined by the CSM, and for their intercorrelations (Hagger & Orbell, 2003; Weinman, Petrie, Moss-morris, & Horne, 1996). In a meta-analysis, Hagger and Orbell (2003) also found evidence for the hypothesised overlaps between illness perceptions and use of coping strategies, reporting that perceived adverse consequences are associated with avoidance coping, while perceiving one's illness to be controllable is associated with problem-focused coping, such as help seeking, making plans, and adhering to regimens. Horne and Weinman (1999) later delineated between two control factors; one concerning beliefs of personal control, or self-efficacy, and one concerning beliefs in the treatment's effectiveness.

Research also supports the role played by illness perceptions in determining adherence in paediatric populations. Of all the illness perceptions outlined by the CSM, perceived personal control and treatment control, perceived consequences, identity and timeline are the most investigated in adolescence (Law, Tolgyesi, & Howard, 2014). In adolescents with Type 1 diabetes, belief in treatment control is predictive of dietary self-management (Nouwen, Urquhart Law, Hussain, McGovern, & Napier, 2009; Skinner & Hampson, 2001; Skinner et al., 2003; Skinner, John, & Hampson, 2000; Skinner, Hampson, & Fife-Schaw, 2002), and blood glucose monitoring (Gaston, Cottrell, & Fullen, 2012). Treatment control is also associated with greater antibiotic use in adolescents with CF (Bucks et al., 2009), and better self-management in minority adolescents with asthma (Crowder, Hanna, Carpenter, & Broome, 2015). As seen when reviewing the literature on SCT, feelings of personal control have also shown a consistent relationship with adherence (Bartholomew et al., 1993; Herge et al., 2012; Iannotti et al., 2006; Law et al., 2014; Ott et al., 2000).

Just as the evidence is mixed with regards to the impact of perceived susceptibility and severity on adherence in the HBM literature, there is also mixed evidence for the role of perceived consequences in studies using the CSM. Gaston et al., (2012) found that adolescents with diabetes who reported greater perceived consequences engaged more often in blood glucose monitoring. Similarly, Crowder et al., (2015) found that adolescents who perceived there to be greater consequences to their asthma reported better self-management. The findings above suggest that perceiving there to be negative outcomes associated with one's illness encourages better adherence. However, Skinner et al., (2000) found that greater perceived consequences were associated with poorer dietary self-management in teens with diabetes, while other studies have failed to find any association at all (Griva, Myers, & Newman, 2000; Law et al., 2014; Nouwen et al., 2009; Skinner & Hampson, 2001). As stated previously, perceived adverse consequences are linked with the use of maladaptive coping strategies, such as denial and avoidance (Hagger & Orbell, 2003). Therefore, much like with the susceptibility and severity constructs of the HBM, it is possible that the relationship between perceived consequences and adherence is moderated by an additional variable, such as how an adolescent copes when faced with the prospect of their illness negatively impacting them in the future.

Illness identity has also been implicated in dietary self-management in diabetes. Adolescents who report fewer symptoms, reflecting a weak illness identity, report better dietary self-care (Gaston et al., 2012; K. Griva et al., 2000). This is likely because a stronger illness identity is associated with more maladaptive coping strategies (Hagger & Orbell, 2003). Finally, a small number of studies assessing timeline beliefs have also reported conflicting findings. While recognition that an illness is chronic is weakly associated with better adherence to antibiotics in

adolescents with CF (Bucks et al., 2009), the opposite is true in adolescents with diabetes, where perceptions of chronicity are associated with poorer blood glucose monitoring (Gaston et al., 2012). Other studies have failed to find a relationship between the timeline construct and adherence (K. Griva et al., 2000; Law et al., 2014; Skinner et al., 2003).

Overall, as with research using the HBM, TPB and SCT, studies applying the CSM to understand adolescent adherence highlights how adherence is determined by the beliefs and expectations adolescents hold about their illness and its treatment. Again, it could be argued that some of the illness perceptions outlined by the CSM reflect future-oriented beliefs, such as whether a young person thinks their illness might adversely impact them in the future (perceived consequences), or how an adolescent perceives their illness will progress (timeline). Thus, studies of the CSM in adolescence seem to indicate that how a chronically ill adolescent thinks about the future could influence their decision to adhere.

#### **2.4.5 Necessity-Concerns Framework**

That patients weigh the perceived benefits of adherence against the perceived costs is central to a number of the models reviewed here. According to the HBM, patients must perceive the benefits of adherence to outweigh the perceived barriers in order for them to adhere to their treatment. In the SCT, patients' attitudes toward their medication, positive and negative, are encapsulated within the component of outcome expectancies, while patients' attitudes are also important predictors of intention to engage in behaviour according to the TPB. Similarly, the CSM posits that adherence is, in part, determined by whether patients perceive their illness to be

controllable, a belief that is likely influenced by the perceived benefits of their prescribed treatment regimen.

The Necessity-Concerns framework (NCF) evolved out of the HBM (Horne & Weinman, 1999) and emphasises the importance of perceived benefits and barriers. The NCF asserts that beliefs about the necessity of treatment, or necessity beliefs, and beliefs about potential costs of treatment, or concern beliefs, are critical determinants of whether or not a patient will adhere. Necessity and concern beliefs can be assessed using the Beliefs about Medicines Questionnaire (BMQ; Horne, Weinman, 1999), in which high scores on the necessity subscale indicates a patient perceives their medicine to be necessary and beneficial, while high scores on the concerns subscale indicates a patient perceives there to be a high cost to their treatment.

A large meta-analysis of studies utilising the NCF to investigate adherence in chronically ill adults (Foot, La Caze, Gujral, & Cottrell, 2016) showed that high necessity beliefs and low concern beliefs are significantly associated with better medication adherence across a range of chronic illnesses, from asthma to HIV. As mentioned earlier, studies using the HBM consistently demonstrate the importance of perceived benefits and barriers in predicting adherence (Bond et al., 1992; Dempster et al., 2018). However, few studies have explored the NCF in adolescence using the BMQ. In adolescents with cystic fibrosis, necessity beliefs predict adherence to chest physiotherapy and antibiotics (Bucks et al., 2009). However, poor internal consistency in the concerns subscale precluded it from being analysed. In a study of adolescents with asthma, strong necessity beliefs were associated with adherence to inhaled corticosteroids (Koster, Philbert, Winters, & Bouvy, 2015). While scores on the concerns subscale were unrelated to adherence, the adolescents in this particular

study reported generally low levels of concern towards their treatment. In a more recent qualitative study, adolescents reported treatment necessity beliefs to be facilitators of adherence, while concern over side effects and social stigma were considered barriers (De Simoni, Horne, Fleming, Bush, & Griffiths, 2017).

These preliminary findings suggest that the NCF may be of use in understanding adherence in adolescents with chronic illness, although more research is needed to determine if necessity and concern beliefs, as measured by the BMQ, are as useful in explaining adherence in adolescents as they have been in studies with adults. Although perceived benefits and barriers to adherence are clearly important in predicting adherence, as demonstrated by their presence in most health behaviour models, it could be argued that the NCF oversimplifies the complexity of treatment decision making. Some of the other barriers to adherence in adolescence will be considered later on in section 2.6.

#### **2.4.6 Summary**

It is clear from the health behaviour models reviewed above that whether or not a patient adheres to their prescribed treatment regimen is, in part, determined by the beliefs and expectations patients have of their illness and its treatment. These expectations, and patients' attitudes towards these expectations, are reflected in every model reviewed here. In the HBM, the constructs of susceptibility, severity and barriers reflect negative expectations, while perceived benefits reflect anticipated positive outcomes that a patient expects to receive by adhering. In the TPB, attitudes and subjective norms both represent outcome expectations; subjective norms involve anticipated rejection or acceptance from socially important others, while patients' attitudes towards adherence can stem from their expectations surrounding its



outcomes, such as side effects. In the CSM, the perceived consequences of illness represent negative outcome expectations, while timeline pertains to the anticipated duration of illness. Finally, in the NCF, both the necessity and concern components of the model reflect expectations. Necessity beliefs reflect whether a patient anticipates that taking the medication will improve their health. This point is illustrated by items of the BMQ such as “*My health in the future will depend on my medicine*” (Horne & Weinman, 1999). Similarly, concern beliefs reflect the anticipation of negative outcomes associated with adherence, such as side effects or long-term dependence.

Expectations are, by definition, future-oriented. The outcomes that patients anticipate might happen as a result of their condition or their adherence do not pertain to their health in the present, but rather their health in the future. That every model reviewed here incorporates expectations is perhaps a testament to their importance for adherence. Given this, and given the role that future thinking is thought to play in motivation and decision making (see Chapter 1), it seems reasonable to hypothesise that a chronically ill adolescent’s thoughts and feelings about the future might influence their decision to adhere. Exploring this possibility will be a key aim of this thesis.

## **2.5 Asthma, cystic fibrosis and Type 1 diabetes**

Having reviewed models and frameworks used previously in the literature to understand when and why adolescents with chronic illness adhere, this next section will consider the factors that adolescents themselves have cited as barriers to adherence. However, it is important to first describe the conditions that will feature later on in this thesis. This will allow for greater focus when considering why

adolescents fail to adhere, as barriers can vary depending on the condition in question and its treatment (Hanghøj & Boisen, 2014).

Asthma, cystic fibrosis (CF) and Type 1 (T1) diabetes are chronic conditions that share a number of characteristics, including a prolonged and unpredictable course, behavioural modifications, and commitment to self-management regimens that have little apparent immediate benefits (Anderson & Wolpert, 2004; Creer & Bender, 1995; Kyngäs et al., 2000). Psychological distress is also prevalent in these populations during adolescence (Hagger, Hendrieckx, Sturt, Skinner, & Speight, 2016; Pfeffer, Pfeffer, & Hodson, 2003; Vila et al., 2003). Thus, it may be especially important to consider how adolescents in these groups think and feel about the future.

### **2.5.1 Asthma**

Asthma is the most common chronic health condition in children and adolescents (Asher & Pearce, 2014). Asthma is a chronic inflammatory airway disease that affects approximately 1 in 11 children in the UK (Asthma UK, 2017). Characterised by recurrent episodes of wheezing, breathlessness, chest tightness and coughing, asthma can interfere with children's activities (Sheth, 2003; Williams, Powell, Hoskins, & Neville, 2008), and can result in poor school performance due to school absenteeism (Moonie, Sterling, Figgs, & Castro, 2006).

Asthma is typically controlled with the daily use of a “*preventative*” medication, typically an inhaled corticosteroid (ICS), as well as a short-acting bronchodilator, often referred to as an “*emergency*” or “*reliever*” medication for quick relief from symptoms. The preventative medication used in asthma offers no immediate symptomatic relief; however, failure to adhere to this element of the

treatment regimen is associated with future symptom exacerbation, as well as increased risk of asthma attacks, hospitalisation and mortality (Bender, Milgrom, & Rand, 1997; Bitsko, Everhart, & Rubin, 2014). Thus, although there are substantial long-term benefits associated with adherence, there is little immediate incentive for teens to adhere to their preventative medication. Additionally, corticosteroids can lead to local and systemic side effects, including impaired growth and osteoporosis (Hossny et al., 2016). As a result, patients tend to avoid their preventative medication in favour of their reliever medication (Hand & Bradley, 1996; Stern et al., 2006), Reliever medication, in contrast to preventative medication, offers immediate relief from symptoms such as wheezing, chest tightness and coughing, but does little for the health of the patient in the long-term; in fact, overreliance on one's reliever may actually increase risk in the future (Reddel, Ampon, Sawyer, & Peters, 2017).

Adherence to preventative medication in asthma is poor in both children and adults (McQuaid et al., 2003) and, much like with other chronic conditions (DiMatteo, 2004), adherence to treatment declines during adolescence (Tiggelman, van de Ven, van Schayck, & Engels, 2015). Adolescents with asthma are particularly at high risk of complications, due to their tendency to underestimate the severity of the disease, to fail to adhere to preventative medication, and to participate in typical adolescent risk taking or experimental behaviour that can worsen symptoms, such as smoking (Towns & van Asperen, 2009).

### **2.5.2 Cystic fibrosis**

Cystic fibrosis (CF) is an inherited condition that affects around 1 in 2,500 live Caucasian births in the UK (Taylor-Robinson et al., 2018). This chronic, progressive disease affects the mucus-secreting glands of the lungs, pancreas and exocrine

glands, resulting in long-term sinopulmonary, gastrointestinal, endocrine and reproductive issues (O’Sullivan & Freedman, 2009). Over 10,000 patients were registered with the UK CF Registry in 2016, approximately 20% of whom were between the ages of 12 and 19 years old (Cystic Fibrosis Registry, 2016).

CF is an ultimately fatal disease, with an unpredictable and variable disease course (Higham, Ahmed, & Ahmed, 2013). However, recent dramatic improvements in prognosis are largely attributed to advances in care and treatment (Elborn, 2016), and the current predicted survival for CF patients is now 47 years old (Cystic Fibrosis Registry, 2016). Treatment is palliative, since there is no known cure, and patients must commit to an intensive and burdensome regimen, typically involving chest physiotherapy, enzyme and vitamin supplementation, and antibiotics to prevent infection (Bucks et al., 2009; Sawicki, Sellers, & Robinson, 2009). Adherence to treatment is associated with a number of positive outcomes, including improved nutritional status, lung function and longevity (Elborn, 2016; Patterson, Budd, Goetz, & Warwick, 1993).

The progression of CF lung disease tends to accelerate during adolescence, and pulmonary function declines steeply (Preston, 2014). At the same time, research indicates that adherence to treatment worsens (Eakin, Bilderback, Boyle, Mogayzel, & Riekert, 2011; Quittner et al., 2014; Zindani, Streetman, Streetman, & Nasr, 2006). It is therefore crucial to identify factors that may be contributing to poor adherence in adolescents with CF.

### **2.5.3 Type 1 (T1) Diabetes**

T1 diabetes is the second most common chronic illness in childhood. Of the estimated 31,500 young people with diabetes mellitus under the age of 19 in the UK, 95% are affected by T1 diabetes (National Paediatric Diabetes Audit, 2017). Type 1 diabetes is characterised by deficient insulin production, leading to elevated levels of blood glucose, and management is complex and intrusive (Borus & Laffel, 2010). Patients with T1 diabetes must frequently monitor their blood glucose levels, count carbohydrates, administer insulin therapy, engage in physical activity, and make adjustments to their insulin as needed. Although self-management is challenging, optimal glycaemic control is crucial to prevent the onset and progression of complications (Daneman, 2006).

In the short-term, poor glycaemic control, characterised by high HbA1c levels, can lead to hypoglycaemia or diabetic ketoacidosis (DKA; Daneman, 2006). In the long-term, diabetes can cause damage to the heart, kidneys, nerves and eyes, resulting in heart attacks, strokes, loss of vision, blindness, kidney failure, and even limb amputation (Borus & Laffel, 2010; Daneman, 2006). Glycaemic control deteriorates during adolescence and HbA1c levels may be higher during this period than at any other age (Mortensen et al., 1998). Although this may partially be attributed to an increase in insulin resistance during puberty (Amiel, Sherwin, Simonson, Lauritano, & Tamborlane, 1986), adherence to the diabetes regimen is a contributing factor in glycaemic control, and, much like for adolescents with asthma and CF, adherence is known to present a challenge for adolescents with diabetes (Borus & Laffel, 2010; Burke & Dowling, 2007; Hood, Peterson, Rohan, & Drotar, 2009). Adolescents who subsequently improve their glycaemic control in adulthood

are still at increased risk of adverse outcomes (Nathan, 2014), highlighting the importance of early intervention and management in this population.

## **2.6 Reasons for intentional nonadherence**

As revealed above, adherence declines during adolescence in asthma, cystic fibrosis and Type 1 diabetes. Before considering why adolescents fail to adhere to treatment, it is important to delineate between two types of nonadherence seen in the literature. Unintentional nonadherence occurs when a patient desires to adhere but is prevented from doing so by factors outside of their control (Horne et al., 2013; Molloy et al., 2014). Poor memory, time management issues and difficulties understanding instructions are all factors that contribute to unintentional nonadherence in adolescents with chronic illness (Hanghøj & Boisen, 2014). Other barriers to adherence can arise from a patient's environment; for example, low socioeconomic status is a predictor for nonadherence, and medication or prescription costs can prevent patients from refilling prescriptions even when they want or need to (Kripalani, Henderson, Jacobson, & Vaccarino, 2008).

In contrast, intentional nonadherence is deliberate and occurs as a result of attitudes, beliefs and expectations that interfere with a patient's motivation to initiate and persist with their treatment regimen (Horne et al., 2013; Horne & Weinman, 2005). There is no doubt that unintentional nonadherence is a major factor in explaining poor adherence rates (Gadkari & McHorney, 2012), and explains why previous interventions targeting patient knowledge and organisation skills have shown some improvements in adherence (Dean, Walters, & Hall, 2010). However, this thesis explores how future-oriented cognition influences adolescents' decision to adhere. Therefore, the following section will focus specifically on reasons

adolescents with chronic illness intentionally fail to adhere to their regimens, rather than looking at barriers in general. While a number of these factors, such as side effects, illness beliefs and medication beliefs are common across patients of all ages, a number are developmentally-specific to adolescents. These challenges are important to note when considering why adolescents may be particularly prone to nonadherence.

### **2.6.1 Normality and freedom**

The desire to be perceived as similar to one's peers is important to most, if not all, adolescents (Neinstein & Zeltzer, 1996; Crosnoe, 2011). This desire is no different for those living with chronic illness, who often report feeling different to their peers at a time when being able to "*fit in*" is important (D'Auria, Christian, & Richardson, 1997; Lambert & Keogh, 2015; Spencer, Cooper, & Milton, 2014). Adolescents with chronic illness may feel different for several reasons; their disease may have observable symptoms or physical markers, may require treatment that draws attention or has physical side effects, may have frequent absences from school due to periods of hospitalisation, or may be restricted, or completely excluded, from partaking in everyday activities with their peers. Indeed, adolescents with chronic illness often report feeling stigmatized by their peers, leaving them feeling discriminated against, isolated or rejected (Earnshaw & Quinn, 2012; Lambert & Keogh, 2015; Oliver et al., 2014; Pizzignacco, Mello, & Lima, 2010).

In order to avoid rejection or stigmatisation from their peers, chronically ill young people purposefully neglect elements of their treatment regimen that they feel will make them stand out. Adolescents with asthma and diabetes report worse adherence when they feel different to their peers (Davidson, Penney, Muller, & Grey,

2004; Freeborn, Dyches, Roper, & Mandleco, 2013; Kyngäs et al., 2000), and adolescents with CF report reluctance to adhere to treatments in front of peers (Sawicki, Heller, Demars, & Robinson, 2015). In turn, this has implications for clinical outcomes. For example, perceived stigma is negatively associated with pulmonary function in adolescents with CF (Oliver et al., 2014), and is associated with poor glycaemic control in diabetes (Brazeau et al., 2016).

To further cope with the feeling of being different or stigmatised, adolescents with chronic illness may also conceal, deny or minimise the nature of their illness. Reluctance to disclose a diagnosis is common (Kaushansky et al., 2017; Velsor-Friedrich, Vlasses, Moberley, & Coover, 2004), and patients may experience periods of denial (Buston et al., 2000; Pfeffer et al., 2003). Denial and other avoidant coping strategies are linked to poor glycaemic control in adolescents with diabetes (Jaser & White, 2011), and poor adherence in adolescents with asthma and CF (Abbott, Mary Dodd, Louise Gee, Kevi, 2001; Rhee, Belyea, Ciurzynski, & Brasch, 2009). This is likely because an adolescent in denial about the nature of their illness will see no need to persist with treatment and, as stated previously, feeling the need to hide the signs of illness or its treatment creates obstacles for adherence when the teen is in public or with peers.

Adolescents may also intentionally fail to adhere to elements of their treatment in order to feel free from the constraints of their disease. It is common for adolescents with chronic illness to feel as if their conditions and its treatment dominate their lives (Hanghøj & Boisen, 2014). Adolescents with CF and diabetes, for whom treatment is especially time intensive and burdensome (Withers, 2012; Ziaian et al., 2006), feel that achieving perfect adherence means sacrificing other, more important aspects of their lives (Dziuban, Saab-Abazeed, Chaudhry, Streetman,



& Nasr, 2010; Kyngäs & Hentinen, 1995; Olsson et al., 2003). In the case of asthma, adolescents often have their freedom and activities controlled and restricted to prevent exacerbation (Rhee et al., 2009). Thus, for some chronically ill adolescents, choosing not to adhere offers freedom from a restrictive regimen (Kyngäs & Hentinen, 1995; Taddeo et al., 2008), allowing them to regain a stolen sense of autonomy. Adolescents see themselves as gaining freedom as they begin to assume responsibility for their management, indicating that freedom and autonomy are goals of importance to adolescents with chronic illness (Christian, D'Auria, & Fox, 1999). To some, freedom might be better achieved by going against the recommendations of their parents and the healthcare team. Experimentation with regimens may also reflect a process by which adolescents attempt to construct an identity that is independent from their disease (Christian et al., 1999). For an adolescent who seeks to gain freedom from their illness or a sense of normality, nonadherence offers immediate and tempting benefits that may outweigh the distant rewards to be gained by adhering.

### **2.6.2 Peers and parents**

An adolescent's relationships with their peers and parents can be both a help and a hindrance to treatment adherence. Family cohesion and perceived social support from family, friends and caregivers are important predictors for adherence in all three diseases (DiMatteo, 2004a; Hanghøj & Boisen, 2014; King, Berg, Butner, Butler, & Wiebe, 2014; Patterson et al., 1993; Rhee, Belyea, & Brasch, 2010). However, they may also contribute to adolescents' decisions concerning their treatment.

Peers are important to adolescent development (Fuligni, Eccles, Barber, & Clements, 2001). This is reflected in the tendency for teens to spend more time with

peers and less time with parents as they develop (Modi, Marciel, Slater, Drotar, & Quittner, 2008). It is therefore important to consider how peers facilitate and impede adherence efforts. Adolescents with chronic illness frequently report that the demands of maintaining peer relationships can conflict with the demands of disease management (Suris et al., 2004; Yeo & Sawyer, 2005). Teens with CF resent having to plan activities with friends around their treatment regimens (M. George et al., 2010), and are inclined to prioritise social demands over treatment demands (Bregnballe, Schiøtz, Boisen, Pressler, & Thastum, 2011). Similarly, adolescents with diabetes report deliberately skipping insulin injections during lunchtime at school to stay with their friends (Lehmkuhl et al., 2009; Spencer et al., 2014).

While it seems the development and maintenance of peer relations can at times take precedence over treatment demands, it is important to note that there is evidence to show that peer support can be beneficial for adherence. In diabetes, support from friends is associated with better self-reported adherence (Kyngäs, 2004), and conflict with peers has been shown to lead to deteriorations in physical and psychological health over time (Helgeson, Lopez, & Kamarck, 2009; Helgeson, Reynolds, Escobar, Siminerio, & Becker, 2007). This is also true for adolescents with asthma, with peer rejection and lack of peer support being linked to symptom exacerbations and poor adherence (Sandberg et al., 2000). In adolescents with CF, positive friendship qualities, such as companionship and support, and negative friendship qualities, such as conflict and criticism, are associated with adherence (Helms, Dellon, & Prinstein, 2015). When it comes to intentional nonadherence, feeling supported by friends likely eases the adolescent's anxieties surrounding peer rejection, thus removing it as an obstacle to self-management (Kyngäs et al., 2000; Spencer et al., 2014). However, it is difficult for peers to provide appropriate support

if a young person is concealing or minimising the nature of their illness. Thus, the perceived threat that chronic illness poses to social well-being during adolescence may create a further obstacle to good self-management by impeding young people from seeking and receiving support from their friends.

A primary developmental goal of adolescence is to achieve autonomy and independence from parents or caregivers (Noom, Deković, & Meeus, 2001). Adolescents with chronic illness, however, often become more dependent on their parents as a result of their condition (Olsson et al., 2003; Price, 1996; Yeo & Sawyer, 2005). Adolescents are therefore faced with the challenge of achieving autonomy from their parents, while also feeling different from and, at times, rejected by their peers. This period also presents a challenge to parents, who must inevitably relinquish control over management. If this process happens before their child is ready or responsible enough, adherence can suffer (Ingersoll, Orr, Herrold, & Golden, 1986; Miller & Drotar, 2007).

When it comes to parental support, there is an important, albeit complicated, balance that needs to be met by parents. Treatment adherence seems best facilitated when adolescents are surrounded by a cohesive, supportive and encouraging family environment. Perceived family support is associated with greater disease control and quality of life in asthma (Rhee et al., 2010), and diabetes (D. M. Cohen, Lumley, Naar-King, Partridge, & Cakan, 2004; Duke et al., 2008). In CF, pulmonary function and weight gain are both linked with family cohesion and suffer in the presence of conflict (Patterson, McCubbin, & Warwick, 1990; Patterson, Goetz, Budd, & Warwick, 1993; Quittner et al., 1996). Parental supervision is also important (Ellis et al., 2007), with adherence declining in the absence of parental monitoring (King et al., 2014). However, too much “unwarranted” input can be interpreted by the

adolescent as nagging behaviour (Altin & Yakinci, 2012). Adolescents often report that their parents' inability to let go of responsibility can be detrimental for their sense of autonomy and self-efficacy; factors that are crucial for self-management (Hanghøj & Boisen, 2014). In some cases, choosing not to adhere to treatment may be an act of rebellion against overprotective or controlling and intrusive parents (Kyngäs, Hentinen, & Barlow, 1998).

### **2.6.3 Illness and medication beliefs**

As discussed earlier when considering health behaviour models (see section 2.4), patients have pre-existing beliefs and expectations concerning their illness and its treatment that can influence whether or not they adhere. For example, an adolescent who perceives their illness to be episodic when it is, in fact, chronic may be less likely to adhere because they believe their condition will resolve on its own (Bucks et al., 2009; De Simoni et al., 2017). Perceptions that their illness is not serious (Wamboldt, Bender, & Rankin, 2011), or even embarrassing (Dziuban et al., 2010), are also cited by adolescents as reasons for nonadherence. The literature on illness perceptions is reviewed in greater detail in section 2.4.

Illness perceptions can, in turn, influence medication beliefs (Horne & Weinman, 2002). As stated earlier when considering the Necessity Concerns Framework, perceived benefits and costs to treatment are important predictors of adherence. As expected then, chronically ill adolescents often report difficulty with adherence because they perceive their medication to be ineffective or unnecessary (Naimi, 2012; Velsor-Friedrich et al., 2004). In one study, 20% of adolescents with asthma felt they received no symptomatic benefit from treatment, while 18% reported ambivalence towards the benefits of their preventer medication (Buston et al., 2000).

Similarly, adolescents with CF report skipping treatments because they fail to perceive the benefits (Bucks et al., 2009) or because there are no adverse consequences when they fail to adhere (Sawicki et al., 2015). In a study of adolescents with diabetes, 25% failed to take their insulin or monitor their blood levels because they perceived these actions to be unnecessary (Weissberg-Benchell et al., 1995).

#### **2.6.4 Depression**

The chronic nature of many life-long conditions is a risk factor for anxiety and depression (Clarke & Currie, 2009), and psychopathology is thought to be highly prevalent in adolescents with chronic illness (Eiser, 1990; Pinquart & Shen, 2011; Suris et al., 2004). This may be due to the burden of self-management and the psychosocial impact of living with, and coping with, chronic illness (Suris et al., 2004). In turn, psychological distress is linked to poor adherence and health outcomes (Bender & Zhang, 2008; DiMatteo, Lepper, & Croghan, 2000; Kongkaew, Jampachaisri, Chaturongkul, & Scholfield, 2014; Smith, Modi, Quittner, & Wood, 2010).

It is unclear why depression seems to undermine adherence. Although psychological distress may lead to unintentional nonadherence through cognitive impairment (DiMatteo et al., 2000), it is also possible that psychopathology influences the decision making processes around adherence. It has also been suggested that depression might undermine patient's beliefs in the efficacy of their treatment, leading to worse adherence and poor outcomes (DiMatteo et al., 2000), or that adolescents with depressed mood might be more likely to withdraw from the social support that typically facilitates adherence.

### 2.6.5 Side effects

It is not unusual for adolescents with chronic illness to have concerns regarding how medications may affect their appearance. In such cases, failure to adhere to medication offers an immediate and tangible benefit; the avoidance of side effects that might attract unwanted attention from peers. For example, adolescents with CF cite coughing and gastrointestinal side effects to be embarrassing, posing a challenge to chest physiotherapy and enzyme adherence (Pfeffer et al., 2003). Fear of weight gain affects adolescents with all three conditions. To achieve good nutritional status, a strong predictor of clinical outcomes in CF, adolescents with CF need a high calorie diet and daily supplementation (Matel & Milla, 2009). Yet in a survey of patients with CF, a third reported restricting their food intake, and a quarter reported failing to adhere to their enzyme supplementation for the goal of weight loss (Didsbury & Thackray, 2010). Adolescents with asthma also worry about weight gain associated with steroid use (De Simoni et al., 2017; Wamboldt et al., 2011). In diabetes, young people have been known to deliberately administer insufficient amounts of insulin to avoid weight gain (Kaufman, 2006; Davidson, 2014). Worryingly, the deliberate restriction of insulin for the purposes of weight loss is a common enough occurrence in diabetes that it has been clinically labelled *diabulimia* (Callum & Lewis, 2014).

In diabetes, fear of hypoglycaemia presents a unique and potent barrier to treatment (Driscoll, Raymond, Naranjo, & Patton, 2016; Gonder-Frederick, Nyer, Shepard, Vajda, & Clarke, 2011). Hypoglycaemia, in which blood glucose levels become abnormally low, can lead to headaches, shakiness, fatigue and in more severe cases, seizures and death (Clarke, Jones, Rewers, Dunger, & Klingensmith, 2009). The anxiety that arises from “*hypos*” has been known to cause patients to intentionally withhold their insulin treatment in order to prevent reoccurrence (Barnard, Thomas,

Royle, Noyes, & Waugh, 2010). To some adolescents, these side effects may prove too costly for adherence, and the decision to neglect the treatment regimen offers an attractive, and simple, short-term solution.

## **2.7 Living with chronic illness**

As is hopefully clear from what has been discussed thus far, chronic illness places an extraordinary burden on adolescents. Managing a chronic health condition requires prolonged dependence on health care providers, increased dependency on caregivers and life-long commitment to self-management behaviours that can be intrusive and burdensome (Wallander et al., 2003). Treatment demands permeate every area of a young person's life and frequent hospitalisation interferes with schooling, extracurricular activities and the maintenance of peer relationships (Holmbeck, 2002; Kyngäs et al., 2000; Sawyer, Drew, Yeo, & Britto, 2007; Woodgate, 1998; Yeo & Sawyer, 2005). Physical characteristics of illness, and side effects of medication, may mark teens as being different from their peers (Suris et al., 2004; Yeo & Sawyer, 2005), increasing the likelihood they will be rejected by their peers (DiNapoli & Murphy, 2002).

In addition to these challenges, chronic illness can introduce an adolescent to new frightening, stressful or even traumatic experiences, such as asthma attacks, hospitalization, periods of intense pain, and immobility (Kyngäs et al., 2000). In diabetes, adolescents are faced with the prospect of severe complications in the future, while in CF, adolescents must come to terms with the reality of possible sterility and a reduced lifespan (Drotar, 1978; Iles & Lowton, 2008). Moreover, the unpredictable and prolonged nature of these conditions can lead to uncertainty about the future (Dodgson et al., 2000; Mishel, 1988; Mullins et al., 2007; Mullins,

Chaney, Pace, & Hartman, 1997). It is not altogether surprising then that elevated levels of distress have been found in adolescents with chronic illness and their parents (Pinquart & Shen, 2011b, 2011a; Quittner et al., 2014). Some studies suggest that these teens are two to three times more likely to experience depression and anxiety than their healthy peers (Eiser, 1990; LeBlanc, Goldsmith, & Patel, 2003; Venning, Elliott, Wilson, & Kettler, 2008).

With this in mind, it is important to ask questions about how chronic illness might disrupt an adolescent's view of the future, and what impacts this might have on their tendency to adhere. One might expect that if an adolescent with chronic illness views their future to be restricted, uncertain or even threatening as a result of their condition, they might then show a tendency to turn their attention away from the future to "*live in the present*". Research, however, has yet to explore whether chronically ill adolescents think or feel differently about the future than their typically developing peers. Additionally, given that future thinking is thought to play a crucial role in motivation and decision making (see Chapter 1), it seems reasonable to suspect that a chronically ill adolescent's thoughts and feelings about the future might, in turn, influence their decision to adhere.

## **2.8 Nonadherence – Devaluing the future?**

Intentional nonadherence involves a decision-making process (Horne & Weinman, 2005). Common to the health behaviour models outlined earlier in this chapter is the notion that individuals must first weigh up the advantages and disadvantages of a health behaviour before they decide to engage in it. The decision to adhere to medication, however, and the decision to engage in many other health behaviours (Story et al., 2014), not only concerns the weighing of *immediate* benefits and risks,



but also involves the consideration of long-term consequences. Consider an adolescent with asthma who must decide whether to adhere today or face an increased risk of exacerbation in the future. Deciding whether or not to adhere might therefore be conceived of as an intertemporal choice, and one that may be vulnerable to the phenomenon of delay discounting.

For adolescents, nonadherence offers a number of attractive and immediate rewards, such as reduced side effect burden, increased flexibility in their schedule, freedom from thinking about their illness, and freedom from feeling judged or ostracised (De Simoni et al., 2017; Hanghøj & Boisen, 2014; Taddeo et al., 2008). Adherence, on the other hand, typically offers few immediate benefits (Taddeo et al., 2008). Many medications, such as in the case of preventative inhalers for asthma or nebulised antibiotics in CF, are taken prophylactically and are aimed at preventing deterioration in the future rather than providing immediate symptomatic relief. Consequently, chronically ill adolescents are faced with a choice between the short-term rewards of nonadherence and the long-term benefits of adherence. That is, adherence can be thought of as a choice between benefitting now or benefitting later.

Consequently, it could be argued that adolescents who fail to adhere to treatment are discounting the future health benefits associated with adherence in favour of the more attractive, short-term rewards gained by avoiding treatment. This would help to explain why adolescents find it easier to take their medication when they perceive there to be immediate, symptomatic relief (Abbott, Dodd, & Webb, 1996; Kyngäs et al., 2000; Rapoff, 2010; Sawicki et al., 2015), and why adolescents who experience adverse consequences from nonadherence feel more motivated to adhere (De Simoni et al., 2017; Sawicki et al., 2015). Without such incentives, it is

likely that the immediate benefits of nonadherence will outweigh the distant rewards of adherence.

Chronically ill adolescents might be especially vulnerable to discounting the rewards of adherence due to the uncertainty associated with chronic illness. There is evidence to suggest that when the future is perceived to be uncertain, then choices that favour certainty and immediacy become adaptive (Bulley et al., 2016).

Consequently, if an adolescent is uncertain about the future due to their health, or anticipates the future to be threatening, then they may make decisions about their treatment that favour immediate, concrete rewards at the expense of their health in the future.

Although temporal discounting is linked to a number of other health behaviours (Story et al., 2014), there is a surprising lack of research investigating whether nonadherence is underpinned by a preference for immediate rewards. However, studies have demonstrated that temporal discounting is a predictor of nonadherence in patients with Type 1 and Type 2 diabetes (Lebeau et al., 2016; Reach et al., 2011; Reach, Boubaya, Bami, & Lévy, 2018; Stoianova, Tampke, Lansing, & Stanger, 2018). Additional evidence for the link between discounting and adherence comes from studies showing that adherence declines steeply during adolescence (Borus & Laffel, 2010; Burke & Dowling, 2007; Eakin et al., 2011; Quittner et al., 2014; Tiggelman et al., 2015; Zindani et al., 2006), while discount rates peak (Banich et al., 2013; Christakou, Brammer, & Rubia, 2011; Khurana, Romer, Betancourt, & Hurt, 2018; Steinberg et al., 2009).

Crucially, if nonadherence is, to some degree, determined by an adolescent's tendency to discount future rewards, then understanding how chronically ill young

people think about the future may be key to encouraging better self-management behaviour. As poor adherence habits in adolescence tends to persist into adulthood, this is a critical time for intervention (Murphy, Thompson, & Morris, 1997), and as seen in Chapter 1, discount rates are amenable to intervention. Thus, in addition to exploring future thinking in typically developing adolescents, this thesis will also seek to test hypotheses about the links between future thinking and treatment adherence in adolescents with chronic illness.

## **2.9 Chapter summary**

In summary, living with and managing chronic illness can be challenging, and adolescents with chronic health conditions are thought to face a number of unique psychosocial challenges that their healthy peers do not. However, it is unknown whether young people with chronic illness think differently about the future than their healthy peers as a consequence of their condition.

One of the greatest predictors of positive outcomes in chronic illness is adherence to treatment. Failure to adhere is associated with reduced symptom control and poor quality of life. Despite this, adherence rates tend to decline during adolescence. Young people with chronic illness cite a number of reasons for intentionally avoiding their treatments. Nonadherence offers a number of immediate and attractive rewards, allowing teens to fit in with peers, avoid side effects, and gain freedom from a restrictive routine. In contrast, the health benefits gained by adhering tend to be situated in the future. Previous health behaviour models have emphasized the importance of patients' expectations in determining adherence, suggesting that how patients think and feel about the future might influence their decisions to adhere. Additionally, if the decision to adhere is thought of as a choice between benefitting now or benefitting later, then failure to adhere might be determined, at least in part,

by an adolescents' tendency to discount future rewards. There might therefore be merit in exploring the links between future thinking and treatment adherence in this population.

## **2.10 Thesis overview**

The ultimate aim of this thesis is to investigate whether future thinking and adherence to treatment are linked in adolescents with chronic illness and whether living with a chronic health condition might disrupt the way in which a young person thinks or feels about the future. However, as revealed in Chapter 1, interest in future thinking has spanned psychological disciplines, leading to the study of numerous future-oriented constructs that tend to be investigated in isolation. This raises questions about the nature of their overlap, and their unique contributions to important outcomes in adolescence.

Therefore, before investigating future thinking in the context of chronic illness, this thesis will first seek to draw together several of the diverse lines of research on future thinking by examining how different measures of future-oriented cognition relate to one another in typically developing adolescents. This will not only provide insight into how different aspects of future thinking overlap in adolescence, but how they relate to short-sighted, impulsive decision making as assessed by an intertemporal choice task. In Chapter 3, two studies are described that seek to achieve this aim. Although Chapter 4 will also explore how different measures of future thinking overlap in adolescents with chronic illness, this is not the primary aim of the study described in Chapter 4.

This thesis will then investigate the links between future thinking and adherence to treatment in adolescents with chronic illness, given that future-oriented

cognition is thought to play a role in motivation, decision making and behaviour.

Chapter 4 will examine how different measures of future thinking relate to treatment adherence in adolescents with asthma, cystic fibrosis and Type 1 diabetes. Finally, this thesis will investigate the potential impact chronic illness might have on future thinking in adolescence, given the unique psychosocial burden young people living with chronic health conditions can experience. In a continuation of the study described in Chapter 4, Chapter 5 will compare chronically ill adolescents with matched controls on several measures of future thinking to explore whether chronically ill adolescents differ from their healthy peers in terms of how they think and feel about the future. Differences between adolescents with asthma, cystic fibrosis and Type 1 diabetes will also be examined to determine whether specific conditions might impact differently on how an adolescents sees the future.

## **Chapter 3. Future thinking and Decision Making in Typically Developing Adolescents**

### **3.1 Introduction**

To recap on what was discussed in Chapter 1, we have seen that future-oriented cognition is thought to play a fundamental role in a range of adaptive functions and behaviours, including motivation, goal-setting, planning, decision making, and emotion regulation across the life span (Baumeister, Vohs, & Oettingen, 2016; Schacter et al., 2017; Seligman et al., 2013; Taylor et al., 1998). However, Chapter 1 also outlined how thinking about the future is of particular importance during adolescence, on the assumption that the primary function of this developmental stage is to prepare for adulthood (Nurmi, 1991). To achieve a successful transition to adulthood, it is necessary for adolescents to integrate their thoughts of the future with their present, in order to set goals and guide decisions. Failure to do so is associated with a number of outcomes, which were considered toward the end of Chapter 1.

Although there is a crucial need for young people in particular to consider their future, adolescence is often characterised as a time of heightened impulsivity and short-sightedness (Arnett, 1996; Steinberg & Chein, 2015), with a popular stereotype depicting teenagers as having little regard for the future consequences of their decisions. This stereotype is argued to be a somewhat reductionist view of adolescent risk taking (Romer, Reyna, & Satterthwaite, 2017). Nonetheless, as already emphasised in Chapters 1 and 2, studies show that adolescents discount future rewards more steeply than other age groups, with discount rates peaking in early adolescence before declining into adulthood (Banich et al., 2013; Christakou et al., 2011; Khurana et al., 2018; Steinberg et al., 2009). This phenomenon, known as

temporal or delay discounting, leads individuals to prefer small immediate rewards over larger delayed rewards and is thought to underpin impulsive decision making (Ainslie, 2001; Frederick et al., 2002). Individual differences in discount rates have been found to predict problematic, impulsive behaviour in adolescents and adults (Audrain-McGovern et al., 2009; Cosenza & Nigro, 2015; MacKillop et al., 2011; Nigro, Cosenza, & Ciccarelli, 2017; Story et al., 2014) and, as hypothesised in Chapter 2, there may be reason to believe that discounting is a determinant of failure to adhere to treatment in adolescents with chronic illness.

The tendency for teens to be myopic in their decision making, when it is important for them to be considering and prioritising their future interests, highlights the importance of understanding future thinking in adolescence and its implications for impulsive decision making. Therefore, before investigating the associations between future thinking and medication adherence in young people with chronic illness, as this thesis ultimately aims to do, there is merit in first gaining a greater understanding of how future thinking and decision making are linked in typically developing adolescents.

By drawing together some of the diverse lines of research that exist on future thinking, the two studies described in this chapter will address previously neglected questions concerning how different aspects of future thinking overlap in adolescence, and to what extent they predict short-sighted, impulsive decision making in typically developing young people. Additionally, investigating future thinking in this population will allow for comparisons to be drawn between typically developing adolescents and those diagnosed with chronic illness later in this thesis, in order to determine the potential impact chronic illness might have on future thinking.

### **3.1.1 Future thinking and decision making**

Future thinking has attracted much recent interest in the area of intertemporal decision making. Specifically, two future-oriented constructs that have been found to predict individuals' discount rates are episodic future thinking (Benoit et al., 2011; Bromberg et al., 2015; Peters & Büchel, 2010) and future self-connectedness (Bartels & Rips, 2010; Bartels & Urminsky, 2011; Hershfield, 2011; Urminsky, 2017). However, our knowledge of the role played by these two constructs in adolescent decision making remains limited.

#### ***3.1.1.1 Episodic Future Thinking***

As we saw in Chapter 1, the capacity to construct detailed simulations of the future, known as episodic future thinking (EFT, Atance & O'Neill, 2001), is thought to help support future-oriented decision making by yielding previews of the emotional significance of delayed rewards (Benoit et al., 2011; Boyer, 2008). By doing so, EFT is thought to impede us from discounting the value of a delayed reward, thus countering our tendency to show an impulsive preference for immediate gratification (Bar, 2009). Studies in adults have supported this, demonstrating that the extent to which individuals discount delayed rewards can be attenuated by cueing them to imagine personally-relevant future events (Benoit et al., 2011; Daniel et al., 2013; Peters & Büchel, 2010). Furthermore, cueing EFT has been found to reduce engagement in problematic behaviours thought to be underpinned by impulsivity, such as smoking (J. S. Stein et al., 2016), and overeating (Daniel et al., 2013; O'Neill et al., 2016).

While research looking at EFT in adult populations is now well established, to date there are only two studies that have investigated EFT and decision making in



adolescent samples. Bromberg et al., (2015) were the first to explore the associations between EFT and adolescent impulsivity. Utilising the Autobiographical Memory Interview (AMI) with forty-nine 12 to 16 year olds, participants were asked to remember six events that occurred 6 months ago and one year ago in the past, and to imagine six corresponding future events. The adolescents' verbal descriptions of their remembered and imagined events were then coded for episodic and non-episodic details based on a coding procedure routinely used in the literature (Levine et al., 2002). Episodic details are those which provide contextual information relevant to the narrative of a remembered or imagined event, and are taken to indicate that an individual is truly re-experiencing or pre-experiencing the event (Levine et al., 2002). Participants also completed a computer-based measure of temporal discounting, in which they were presented with a series of choices between a small immediate reward, kept constant at €10, and a series of larger delayed rewards. The value of this delayed reward was adapted depending on the adolescent's previous choices, and the delay to its receipt ranged from 1 to 180 days.

The results of this study showed that adolescents who described imagined future events with more episodic detail, indicating more vivid EFT, discounted less than those who described future events with less episodic detail. In other words, this study found that adolescents who imagined the future with greater episodic richness were more patient when making decisions that concerned the future. Furthermore, the episodic richness of participants' EFT remained a significant predictor of temporal discounting rates after controlling for a number of possible confounding factors, including intelligence and episodic memory ability.

Following this study, Bromberg et al., (2017) further found that, as in adults, cueing adolescents to engage in EFT during an intertemporal decision making task

led to attenuation in discount rates. Although the extant literature on EFT and temporal discounting in adolescents is scarce, the studies described here provide initial support for the idea that EFT and the tendency to make future-oriented decisions are linked in adolescence.

### **3.1.1.2 Future self-connectedness**

The extent to which individuals discount delayed rewards has also been shown to vary depending on their degree of perceived future self-connectedness; that is, the degree to which they feel their present self is connected, or similar to, their future self (Bartels & Rips, 2010; Bartels & Urminsky, 2011; Urminsky, 2017). Individuals who feel similar to their future self are more patient in intertemporal choice tasks and are more likely to behave in future-oriented ways (Bartels & Rips, 2010; Bartels & Urminsky, 2011; Hershfield et al., 2009; Urminsky, 2017). For example, as outlined in Chapter 1, individuals who feel more connected to their future self are more likely to save money for retirement (Hershfield et al., 2011), tend to be more ethical in their decision making (Hershfield et al., 2013; van Gelder et al., 2013), and are more likely to engage in behaviours such as exercise and healthy eating (Rutchick et al., 2018). It is still unknown how feeling connected to one's future self might encourage such future-oriented decision making. There is evidence to suggest that, in terms of neural activation, thinking about one's distant future self more closely resembles thinking about another person than it does thinking about one's present self (Hershfield et al., 2009), and people generally prefer not to reward strangers over themselves (Hershfield et al., 2011; Pronin, Olivola, & Kennedy, 2008). Therefore, as one account posits, if an individual feels disconnected from their future self, and thus views it as if were a different person, then they have less reason to choose a delayed reward that benefits this future self, as this would be analogous to making a choice to

reward a stranger over one's present self (Hershfield et al., 2009; Parfit, 1971). In contrast, feeling similar to one's future self should give people more reason to care about themselves in the future, leading to more future-oriented decision making.

Feeling connected to one's future self may be undermined before or during periods of transition, like adolescence, as such periods can lead to the anticipation of personal change (Bartels & Rips, 2010; Bartels & Urminsky, 2011). In one study, in which future self-connectedness was compared across different age groups, adolescents did indeed report feeling less similar to their future selves than adults (Frederick, 2003). In turn, this heightened sense of disconnectedness from one's future self can lead to greater devaluation of delayed rewards (Bartels & Urminsky, 2011). As a result, adolescents may be especially vulnerable to making short-sighted decisions at a time when it is important to be considering the needs and desires of their future self (Nurmi, 1991). Accordingly, future self-connectedness may be an important construct for understanding adolescent impulsivity. However, to date no studies have examined how future self-connectedness relates to temporal discounting, or to other aspects of future-oriented cognition, in adolescence.

### **3.1.2 Individual differences in future thinking**

As emphasised in Chapter 1, future thinking is a multi-faceted concept that broadly refers to various cognitive, affective, motivational and behavioural constructs, all concerning the myriad ways in which an individual subjectively represents their future. As such, there are a number of different conceptualisations of future thinking across the literature, and an even greater number of measures designed to tap into these constructs. In addition to the future-oriented constructs described above, there is also a rich tradition of research that has established the role played by individual

differences in people's attitudes toward the future, and their tendency to think often, or not at all, about the future in shaping present behaviour (Mello, et al., 2009; Mello & Worrell, 2015; Shipp, et al., 2009; Zimbardo & Boyd, 1999).

Work on future thinking in this individual differences tradition has revealed that although people are capable of shifting their attention between different time periods depending on situational context, they tend to preferentially attend to certain time periods over others (Holman & Silver, 1998; Shipp et al., 2009; Zimbardo & Boyd, 1999). The extent to which people characteristically devote their attention to thoughts of the past, present and future has been referred to as both temporal orientation (Holman & Silver, 1998; Zimbardo & Boyd, 1999) and temporal focus (Shipp et al., 2009). Future orientation, defined by Zimbardo and Boyd (1999) as a "cognitive bias" toward the future, is associated positively with educational achievement (Mello & Worrell, 2006), and negatively with risky behaviours such as substance use (Apostolidis, Fieulaine, & Soulé, 2006; Barnett et al., 2013). However, frequently used measures of temporal orientation, such as the Zimbardo Time Perspective Inventory (ZPTI, Zimbardo & Boyd, 1999), have garnered criticism for often integrating items assessing temporal focus with items assessing time attitudes and other individual differences constructs, such as conscientiousness.

Consequently, Shipp et al. (2009) argued that it may be beneficial to use measures that separate out the amount of time spent thinking about specific time periods from one's feelings about such periods, and from other relevant constructs. To this end, they developed the Temporal Focus Scale (TFS) to assess the extent to which individuals devote their attention to the past, present and future, with high levels of future temporal focus being associated with life satisfaction, optimism and risk taking in adults (Busseri, Malinowski, & Choma, 2013; Shipp et al., 2009), and

life satisfaction, career efficacy, and self-esteem in adolescents (Chishima, McKay, & Cole, 2017; Chishima, McKay, & Murakami, 2017).

While the TFS is intended to solely assess levels of cognitive engagement with the future, it is possible to examine adolescent's affective evaluations of the past, present and future using instruments such as the Adolescent Time Inventory – Time Attitude scale (ATI-TA, Mello & Worrell, 2007). Time attitude consists of an individual's emotions and evaluative feelings toward the past, present and future (Mello et al., 2009). Attitudes toward the future are a frequently measured dimension of future-oriented cognition, and overlap somewhat with concepts such as optimism, pessimism, and hope (Johnson, Blum, & Cheng, 2014). Overall, and as outlined toward the end of Chapter 1, positive attitudes toward the future are associated with psychological well-being (Andretta et al., 2014) and educational attainment in adolescents (Adelabu, 2008; Andretta et al., 2014), in addition to lower levels of substance abuse and risk taking (Robbins & Bryan, 2004).

In addition to its time attitude scale, the Adolescent Time Inventory (ATI) is also capable of assessing the emphasis adolescents place on the past, present and future with its measure of time orientation (ATI-TO), and adolescents' perceptions of how the past, present and future are related with its measure of time relation (ATI-TR). While studies using these dimensions of the ATI are limited, one study found that educational attainment was higher, and risk taking lower, in adolescents who rated the present and future to be of equal importance, relative to those who placed emphasis on the present or future alone (Mello & Worrell, 2013); the same was true for those adolescents who perceived the past, present and future to be related, compared to those who perceived the past, present and future to be unrelated (Mello & Worrell, 2013). Collectively, these findings suggest that, in addition to focus and

attitudes toward the future, it may be of interest to explore how the emphasis adolescents place on the future, and their perceptions of time relation, may be linked to future-oriented decision making.

### **3.1.3 Future Orientation: A single construct?**

Within the individual differences literature on future thinking, individuals with positive attitudes toward the future, and those who think often about the future, are typically referred to as “*future-oriented*” (Robbins & Bryan, 2004; Zimbardo & Boyd, 1999). However, willingness to wait for delayed rewards during temporal discounting tasks could also be taken as an indication of a future-oriented individual (Steinberg et al., 2009). Furthermore, feeling connected to one’s future self and being capable of vividly imagining future episodes might also be characteristic of an orientation towards the future. That is, looking across the literature on future thinking, there are a number of different ways in which one might operationalize the notion of future orientation.

Although one might assume these various measures relate to one another, there is surprisingly little work exploring how different measures of future orientation overlap, and rather mixed findings from those studies that have included more than one measure. Some studies with both adolescents and adults have found that measures of future orientation derived from Zimbardo’s Time Perspective Inventory are at least modestly correlated with delay discounting (Daugherty & Brase, 2010; Göllner, Ballhausen, Kliegel, & Forstmeier, 2018; Guo, Chen, & Feng, 2017; van den Bos et al., 2015, though see Baumann & Odum, 2012). However, one recent study with adults suggests that questionnaire-based measures of future orientation themselves are only weakly related, and are differentially related to health

outcomes (McKay et al., 2018). Despite this, there is often an implicit assumption, particularly in the individual differences literature, that a person who is future-oriented in one capacity will also be future-oriented in another.

Turning to EFT, there are mixed findings regarding links between questionnaire-based measures of future orientation and aspects of EFT. While Arnold, McDermott, & Szpunar, (2011) found that future orientation, as measured by the Zimbardo Time Perspective Inventory, predicted the degree to which participants reported a sense of “pre-experiencing” future events, D’Argembeau, Ortoleva, Jumentier, & Van Der Linden, (2010) did not find this relation, although they did find a selective correlation between future orientation and the number of sensory details individuals reported about imagined future events. Elsewhere, Kwan, Craver, Green, Myerson, & Rosenbaum, (2013) found that some amnesic individuals who have lost the ability to imagine future events nevertheless score highly on future orientation on the Zimbardo Time Perspective Inventory, suggesting that EFT skills may not be necessary for individuals to self-report as future-oriented.

As outlined above, both EFT and future self-connectedness have been linked to future-oriented decision making, as measured by intertemporal choice tasks (Bartels & Rips, 2010; Bromberg et al., 2015; Hershfield et al., 2011). However, it is not clear how these two factors may be interrelated. As Hershfield and Bartels (2018) have pointed out, as of yet we know relatively little about what determines future self-connectedness. Hershfield and Bartels (2018) suggest that future self-connectedness may be at least in part be determined by how vividly individuals imagine the future. However, they also speculate that vividly imagining one’s future might facilitate delayed gratification even if it does not affect levels of future self-connectedness. In fact, to date, the roles of EFT and future self-connectedness in

temporal discounting have never been examined in the same study, thus it is unknown whether EFT and future self-connectedness have independent or overlapping relations with temporal discounting.

Therefore, one particular aim of this chapter is to explore how the burgeoning constructs of EFT and future self-connectedness relate to one another, in order to establish whether they are independent predictors of impulsive decision making in typically developing adolescents. Additionally, by examining the relationships between the discussed measures of future thinking, it will be possible to determine whether these measures reflect, to some degree at least, the operation of a single underlying “future oriented” characteristic. Therefore, this chapter will examine how a number of future-oriented constructs, including future time attitudes and future temporal focus, relate to EFT, future self-connectedness and temporal discounting in typically developing adolescents.

#### **3.1.4 Depression, future thinking and decision making**

The final aim of this chapter relates to an additional measure that has not yet been discussed, which is a measure of depression. This measure will be included in Study 2 of this chapter for two reasons. The first reason concerns the associations between depression, future-oriented cognition and decision making that have been documented in the literature. With regards to future-oriented cognition, depression has been linked with impaired episodic memory and EFT (Roepke & Seligman, 2016; Williams et al., 1996), with depressed individuals showing a tendency to remember past events and imagine future events that are less specific in nature, a phenomenon referred to as over-general memory and over-general future thinking (Williams et al., 1996; Williams et al., 2007). With regards to decision making,



depressive symptomatology is known to be associated with a tendency to discount future rewards (Jarmolowicz et al., 2014; Pulcu et al., 2014). Because of what is known about the relationship between depression, EFT, and temporal discounting, I hope to control for depression when evaluating the role of EFT in adolescent decision making in Study 2 of this chapter. However, this also provides the opportunity to examine relations between adolescent depression and all the elements of future-oriented cognition discussed so far. Knowledge about the associations between depression, future self-connectedness, temporal focus and time attitudes in typically developing adolescents is limited. Although future self-connectedness and temporal focus relate to depressive symptoms in adults (McKay, Cole, & Percy, 2017; Sokol & Eisenheim, 2016), this association has yet to be replicated in adolescents, and while scores on the Adolescent Time Inventory – Time Attitude scale have been linked with self-esteem and self-efficacy (McKay, Percy, Cole, Worrell, & Andretta, 2016; Mello & Worrell, 2015; Mello et al., 2009), it is unknown how scores on this scale specifically overlap with depressed mood in adolescents. Elucidating how depression influences or is influenced by future-oriented cognition in adolescents is of interest given that impaired future-oriented cognition might contribute to impaired decision-making, planning and self-regulation (Roepke & Seligman, 2016; Taylor et al., 1998), which is likely to be detrimental to adolescents' development.

The second reason for including a measure of depression in this chapter relates to a study that will be described later in Chapter 5, in which typically developing and chronically ill adolescents will be compared on a number of measures of future thinking. Including a measure of depression in Study 2 of this

chapter allows for a comparison to be made between adolescents with chronic illness and their healthy peers with respect to depressive symptomatology.

### **3.1.5 Study Overview**

Overall, the studies described in this chapter aim to explore the associations between different measures of future thinking in typically developing adolescents. In Study 1, adolescents completed existing measures of temporal focus (Shipp et al., 2009), time orientation (“*importance*”), time attitudes, and time relation (Adolescent Time Inventory, ATI, Mello & Worrell, 2007), as well as a measure of future self-connectedness (Hershfield, 2011). EFT was assessed using a task in which participants had to generate a single written description of an imagined future event in response to the cue word “*Holiday*”. Adolescents’ tendency to discount future rewards was assessed using an intertemporal choice task. An overview of Study 2 can be found in section 3.5.

## **3.2 Study 1: Method**

### **3.2.1 Participants**

144 (56.3% female) adolescents aged 11 to 18 years ( $M = 13.52$ ,  $SD = 1.64$ ) were recruited from three schools in Northern Ireland. All participants aged under 16 years of age were required to provide parental or guardian consent in order to take part. The study received ethical approval from the Research Ethics Committee of the School of Psychology at Queen's University Belfast (see *Appendix 3.1*).

### **3.2.2 Measures**

#### ***3.2.2.1 Temporal discounting task***

To assess temporal discounting, participants were instructed to make repeated choices between a large constant reward (£30) available after a delay (*Tomorrow, Day after tomorrow, 1 week, or 2 weeks*), and a smaller reward (£5, £10, £20, £30) that would be available immediately. These choices were hypothetical, that is, participants did not receive any reward based on their choices. The values of the immediate reward and the delays to the later reward were based on previous developmental studies looking at temporal discounting in children (Demurie, Roeyers, Baeyens, & Sonuga-Barke, 2012). Each of the 4 delays was paired once with every immediate choice, resulting in 16 trials. For example, the adolescents were asked to choose between receiving £20 now or waiting 1 week to receive £30. Choices were presented in the same pseudo-random order to all participants, and were visually represented using corresponding pound notes (see *Figure 3.1*). The left or right position of the delayed reward was balanced over the 16 trials. Subjective values of the delayed reward were then determined in order to calculate the area

under the curve, using the procedure detailed below (AUC, Myerson, Green, & Warusawitharana, 2001).



Figure 3.1 An example of the intertemporal choice administered to participants.

**Discounting data pre-processing.** The subjective value of the delayed reward for each delay was calculated by determining the participant's switch point; that is, the point at which the participant's preference for the larger, delayed reward (typically when the value of the immediate reward is small, or the delay is short) switched to a preference for the smaller, immediate reward (typically when the value of the immediate reward is larger, or the delay increases). Operationally, this was taken as the midpoint between the smallest value of immediate reward accepted and the largest value that was rejected (Mitchell & Wilson, 2010). For example, consider an adolescent who indicates a preference for receiving £30 tomorrow over £10 today and then, when the value of the immediate reward increases, subsequently shows a preference for receiving £20 today over £30 tomorrow. In this example, the smallest value of immediate reward accepted is £20 and the largest value rejected was £10. Therefore, the subjective value of the delayed reward for the 1-day delay would be £15.

The subjective values for each delay, and the 4 delays were then normalized. First, subjective values were expressed as proportions of the amount of the maximum delayed reward (i.e., the participant's subjective value at each delay was divided by 30). Delays were expressed as proportions of the maximum delay (14 days). These normalized values are then used as x and y coordinates, with delay plotted on the x axis and subjective value on the y axis. Theoretically, if vertical lines were then drawn from each data point on the x axis, it would create four trapezoids. The area of each trapezoid is calculated using the formula  $(x_2 - x_1) * [(y_1 + y_2)/2]$ , where  $x_1$  and  $x_2$  represent successive delays and  $y_1$  and  $y_2$  are the subjective values associated with these delays. When summed, the area of these four trapezoids gives the total area under the curve (AUC). As values were normalized, the AUC ranged from 0 to 1 meaning the smaller the AUC, the steeper the discount rate.

### ***3.2.2.2 Episodic Future Thinking***

Participants' episodic future thinking (EFT) was assessed using a pen-and-paper task (see also Arnold et al., 2011). Participants were instructed to "*Try and imagine yourself on holiday 5 years in the future*" and to write down what they imagined. This method, in which a theme or cue-word such as "*holiday*" is used to facilitate the generation of an event, was drawn from a study investigating children's autobiographical memory (Piolino et al., 2007). Participants were also instructed that what they imagined had to occur over minutes or hours, had to be novel, had to be something that could realistically happen to them in the future, and had to be pictured as if they were really there and seeing it through their own eyes (instructions based on Levine et al., 2002). These descriptions were then coded for episodic detail using the procedure described below, with an independent rater also coding the descriptions for reliability.

**Event Coding Procedure.** Each written description was coded by two raters using a 4-point episodic richness scale (Piolino et al., 2007). The scale takes into account the specificity of the content (i.e., single or repeated event), spatial and temporal detail, and the presence of other internal details (i.e., perceptions, thoughts, feelings). An episodic richness score of 4 was given for a specific event with sensory details, situated in time and space (e.g. *“I am playing in the pool with my sister. We are having lots of fun, though the chlorine hurts my eyes. We just had some ice cream and the sun is shining. I can feel it on my back”*). A specific event without any other detail, but situated in time and space was scored 3 (e.g. *“I am playing in the pool with my sister. We just had some ice cream and the sun is shining”*). A repeated or extended event was scored 2 if it was situated in time and space (*“I am playing in the pool...with my sister...in the afternoon”*) or 1 if it was not (e.g. *“I am playing in the pool”*). An absence of a written description, or a description including only general information, was scored 0. Discrepancies between rater scores were resolved by taking the mean of the two raters’ scores. Intraclass correlation coefficients (ICC; two-way mixed effects model) were used to examine the covariance and agreement between raters (Portney & Watkins, 2000). The ICC for the raters’ scores of episodic richness was high (ICC = .895,  $p < .001$ ).

**Phenomenological rating scales.** After having described their imagined event, participants assessed the phenomenal characteristics of the adolescent’s imagined event using a series of rating scales (adapted from D’Argembeau & Van der Linden, 2006). Participants were asked about the extent to which visual and other sensory details (sound and smell) were clear ( $1 = \textit{not at all}$ ,  $7 = \textit{completely}$ ). The clarity of the location and time in which the imagined event took place was also assessed ( $1 = \textit{not at all}$ ,  $7 = \textit{extremely clear}$ ). Participants also rated their feeling of

pre-experiencing the event (*1 = not at all, 7 = completely*) and sense of mentally travelling to the time when the event would happen (*1 = not at all, 7 = completely*). Three items assessed the emotional content of the imagined event: participants rated their feeling of pre-experiencing the emotions associated with the event (*1 = not at all, 7 = completely*), the valence of the event (*-3 = very negative, +3 = very positive; recoded to 1 to 7*) and the emotional intensity of the event (*1 = not strong, 7 = very strong*). A final rating scale assessed the feeling of subjective distance to the event (*1 = quite far away, 10 = very far away*).

***Phenomenal characteristic composites.*** Participants' ratings of sensory (visual, sound, smell), temporal and locational clarity were summed to create a composite score labelled clarity. Participants' ratings of pre-experiencing the event and ratings of mentally travelling forward in time to when the event would happen were summed to create a composite labelled mental time travel. Participants' ratings of pre-experiencing the emotions associated with the event were analysed as a separate variable, as were ratings of emotional intensity, emotional valence and temporal distance. Table 3.1 provides an overview of the EFT phenomenal variables used in analysis and their associated items.

*Table 3.1 A summary of EFT phenomenal variables and their corresponding items*

<b>Variable name</b>	<b>Item(s)</b>
Clarity	Sum of five items assessing visual clarity, clarity of sound and smell, and temporal and locational clarity of the imagined event.
Mental time travel (MTT)	Sum of two items assessing extent to which the participant pre-experienced the event and the extent to which participant felt they travelled forward in time to when the event would happen.
Emotional pre-experiencing	One item assessing the extent to which participants felt they pre-experienced the emotions that would happen, as they imagined the event.
Emotional intensity	One item assessing the strength of the emotions the participant felt as they imagined the event.
Emotional valence	One item assessing whether the imagined event was positive or negative.
Temporal distance	One item assessing how distant the imagined event felt (subjectively) to the participant.

### ***3.2.2.3 Future self-connectedness***

Future self-connectedness was assessed using the future self-continuity scale developed by Hershfield (2011), alongside instructions adapted from Bartels and Rips (2010) (see *Appendix 3.2*). Participants were asked to think about the person they are now and the person they will be in 5 years. The reason participants were asked to think about a future self in 5 years is because a shorter timescale might induce ceiling effects with most participants reporting high levels of connectedness (Hershfield et al., 2009). Participants were provided with the following instructions, *“It might help you to think about the things that make you who you are: What is your personality like? What do you love doing? What are your likes and dislikes? What would you like to achieve this year? How much do you think these things will change*



*in 5 years?*” They were then presented with a 7-point scale marked at each point by two circles that ranged from depicting no overlap to almost complete overlap, and which was verbally anchored at either end by “*Not similar to me at all*” and “*Very similar to me*”. Participants were asked to choose which of the seven pairs of overlapping circles they thought best described how similar they felt to their future self in 5 years.

#### **3.2.2.4 Temporal Focus Scale**

The TFS (Shipp et al., 2009) is a 12-item scale consisting of three, four-item subscales assessing an individual’s degree of cognitive engagement with the past, present and future. Scores on each subscale are summed and divided by 4 to give an average score for that subscale. While the past and future subscales of the TFS had acceptable internal consistency ( $\alpha = .80$  and  $.77$  respectively), the internal consistency of the TFS present subscale was not as high ( $\alpha = .68$ ). This is similar to estimates reported in previous studies utilising the TFS in adolescents (Chishima, McKay, & Murakami, 2017; McKay, Percy, Goudie, Sumnall, & Cole, 2012). Examples of scale items include “*I replay memories of the past in my mind*”, “*I live my life in the present*” and “*I think about times to come*”.

#### **3.2.2.5 Adolescent Time Inventory**

The Adolescent Time Inventory (ATI) is an instrument designed by Mello and Worrell (2007), which seeks to assess multiple dimensions of an adolescents’ views about time.

**Time attitudes.** The ATI-TA (Mello & Worrell, 2007) is a 30-item scale consisting of six five-item subscales (past negative/ positive, present negative/positive and future negative/positive) designed to assess how adolescents

feel about the past, present and future. Examples of positive scale items include, “*I have good memories of childhood*”, “*I am happy with my current life*”, and “*My future makes me smile*”. Examples of negative scale items include, “*I would like to forget my past*”, “*I have negative feelings about my current situation*” and “*I doubt I will make something of myself*”.

Typically, scores on each subscale are summed and divided by 5 to give an average score for that subscale. For the purposes of this study, however, the negative subscale items for each time period were reverse scored. These reverse scored items were then summed alongside the positive subscale items for each corresponding time period, and a mean calculated by dividing by 10. These three scales were labelled “*past positivity*”, “*present positivity*” and “*future positivity*”. Internal consistency estimates for past, present and future positivity subscales were high ( $\alpha = .89, .92$  and  $.88$  respectively).

***Time orientation.*** The Time Orientation dimension of the ATI (ATI-TO) seeks to assess the *relative* emphasis an individual place on each time period. The measure presents participants with seven circle configurations, and asks which of these configurations best reflects how important the past, present and future are to the participant. Each configuration consists of three circles which represent the past, present and future, and the size of each circle indicates the level of importance. For example, one configuration consists of two small circles for past and present and a large circle for future. This would be taken to indicate the participant thinks the future is more important than the past and present.

However, for this study, an adapted version of this measure was used to assess how important adolescents consider the past, present and future separately,

instead of relatively (see *Appendix 3.3*). For each time period, participants were presented with a 5-point scale marked at each point by a circle and anchored at either end with “*Not important to me at all*” and “*Very important to me*”. At each point along the scale, the circle successively increased in size. Participants were asked to choose the circle they felt corresponded to how important they viewed the past, present and future, with a larger circle indicating greater importance.

To avoid confusion when discussing the term “*future orientation*” and the future directed scale of this measure, the scale was instead labelled “*future importance*”, and the past and present scales were labelled accordingly.

***Time relation.*** In this task, the relationship of the past, present and future are represented by three circles overlapping in four different configurations: interrelated, linear related, present-future related and unrelated (see *Appendix 3.4*). Participants were asked to choose which of the four configurations best represented their personal view of the relationship between the past, present and future.

### **3.2.3 Procedure**

Schools were invited to take part in the study by letter. Three schools in total agreed to take part, and were provided with parental information sheets and consent forms prior to data collection. Data was collected in classroom settings. Parental consent forms were collected from participants younger than 16 years on the day of testing, and written informed assent was obtained from these participants. For adolescents aged 16 years and above, written informed consent was obtained on the day of data collection. Two questionnaire booklets were then distributed, the first of which contained the measure of future self-connectedness, time attitudes, time importance, time relation, temporal focus and the temporal discounting task. The second booklet

contained the EFT task. Participants were instructed to complete the booklets in this order. Once all the participants had completed both booklets, they were collected and the participants were provided with a debrief sheet that the researcher read aloud (see *Appendix 3.5*).

The order of the booklets was decided based on the known effect of EFT on discount rates (Bromberg et al., 2017; Peters & Büchel, 2010). Had the EFT task preceded the discounting task, it may have mimicked the effects of EFT interventions. It was therefore decided that the EFT task should be placed in a separate booklet to be given to participants after they had already completed the discounting task. Similarly, the future self-connectedness measure was separated from the discounting task, due to their association in the adult literature. This measure was therefore placed at the beginning of the first booklet with the remaining measures intervening.

### **3.3 Study 1: Results**

#### **3.3.1 Data pre-processing**

##### *3.3.1.1 Missing data and outlier removal*

Three adolescents failed to provide a written narrative of an imagined future event, and temporal discounting data was missing for ten participants. Data was screened for outliers greater than 3 SD above or below the mean, as in a previous study investigating the associations between EFT and temporal discounting (Bromberg et al., 2015). One participant scored more than 3 SD below the mean on the past positivity subscale of the ATI-TA, and more than 4 SD below the mean on the future positivity subscale. Two additional participants scored more than 3 SD below the mean on the future positivity subscale. Of the TFS subscales, one present focus score was identified as being more than 3 SD below the mean. Of the time importance rating scales, two present importance ratings and two future importance ratings were identified as being more than 3 SD below the mean. Of the phenomenology ratings, four emotional valence ratings were identified as being more than 3 SD below the mean. Two AUC scores were identified as being more than 3 SD below the mean. These outliers were excluded from further analysis.

##### *3.3.1.2 Normality and transformations*

Although skew values between -2 and +2 have previously been recommended as general cut off points in determining non-normal distributions (Field, 2013; George & Mallery, 2010), the use of skewness z-scores has been recommended for smaller ( $n < 50$ ) to medium ( $50 < n < 300$ ) sample sizes (Kim, 2013). Skewness z-scores are calculated by dividing the skew value by its standard error. Following this method, a

skewness z-score of +/- 3.29 is taken to indicate a non-normal distribution in a medium sized sample.

AUC scores were negatively skewed ( $Z$ -skew = - 3.43), indicating that the discount rates across the sample were low. Square transformation reduced the skewness of AUC scores ( $Z$ -skew = -1.01). The emotional valence of participants' future event narratives ( $Z$ -skew = - 7.93), and their ratings of present and future importance ( $Z$ -skew = - 3.56 and - 5.22 respectively) also showed elevated skewness. However, transforming these ratings failed to reduce the skewness to within the +/-3.29 limit. Thus, Spearman's rank order correlations were used to analyse the relationship of the time importance and emotional valence ratings to the other measures.

### **3.3.2 Descriptive statistics**

Descriptive statistics for the key variables used in analysis can be found summarised in *Table 3.2*. As described above, the adolescents in this sample did not exhibit steep discounting of the delayed reward (as indicated by high AUC). With regards to their emphasis on the past, present and future, the adolescents rated all three time periods as being high in importance. This is reflected by the fact that 88% of participants chose the largest or second largest circle for future importance, and 87% chose the largest or second largest circles for present importance. The past was rated as somewhat less important, although over half (58%) of the participants still chose the largest or second largest circles. Participants also reported high positive attitudes toward the past, present and future. With regards to how the adolescents felt the past, present and future were related, 41% of participants viewed them as interrelated; 23% endorsed a linear relationship; 28% reported feeling that only the present and

future were related, with the past existing as separate; finally, 8% of participants felt the past, present and future were unrelated.

Descriptive statistics for the EFT variables are shown in Table 3.3. The future event narratives provided by adolescents tended to be both rich in episodic detail and positive in valence; 45% of the adolescents were assigned a score of 3 or above for their future event narrative, and all participants reported their event was positive, with 68% of the sample rating what they imagined to be “*very positive*”.

*Table 3.2 Means, standard deviations, medians, minimum and maximum scores for key variables.*

	<i>n</i>	M ( <i>SD</i> )	Median	Min - Max
Connectedness	144	4.59 (1.01)	5	2 – 7
Future positivity	139	4.01 (.54)	4.10	1.80 – 5
Future importance	141	4.51 (.68)	5	3 – 5
Future focus	143	4.60 (1.18)	4.75	1.75 - 7
AUC	132	.74 (.18)	.81	.23 - 1

*Table 3.3 Means, standard deviations, medians, minimum and maximum scores for EFT episodic richness ratings and phenomenological ratings.*

	<i>n</i>	M ( <i>SD</i> )	Median	Min - Max
Episodic richness (of written narrative)	144	2.56 (1.18)	2.50	0 – 4
Clarity	136	23.3 (6.64)	23	7 – 35
MTT	143	7.94 (3.34)	8	2 – 14
Emotional pre- experiencing	143	4.80 (1.91)	5	1 – 7
Emotional intensity	138	4.75 (1.76)	5	1 – 7
Emotional valence	138	6.48 (.88)	7	3 – 7
Temporal distance	139	2.80 (1.09)	3	1 – 5

### 3.3.3 Do EFT and future self-connectedness relate to one another, or to temporal discounting?

Partial correlations controlling for age were conducted first in order to explore the links between future self-connectedness, EFT and temporal discounting. However, as shown in *Table 3.4*, there was no significant association between future self-connectedness and discounting (partial  $r_{(123)} = -.093, p = .30$ ). Additionally, the extent to which participants felt connected to their future selves and the episodic content included in their written EFT narratives were also not significantly associated (partial  $r_{(135)} = .05, p = .57$ ). As neither EFT nor future self-connectedness were related to adolescents' discount rates, a regression analysis examining whether EFT and future self-connectedness independently predict temporal discounting was not conducted.

*Table 3.4 Partial correlations (controlling for age) between key future thinking variables and discounting.*

	1	2	3	4
1. Connectedness	-			
2. Future positivity	.14 (130)	-		
3. Future focus	.082 (134)	.56** (130)	-	
4. Episodic richness	.049 (135)	.035 (130)	.085 (134)	-
5. AUC <sup>Δ</sup>	-.093 (123)	-.069 (123)	.083 (123)	.078 (123)

\*  $p < .05$  level

\*\*  $p < .001$  level

<sup>Δ</sup> transformed variable



### 3.3.4 How do measures of future orientation overlap?

Attitudes toward the future and future temporal focus were moderately correlated ( $r > .5$ , Ferguson, 2009) with one another after controlling for age. Specifically, positivity towards the future was associated with greater cognitive engagement with the future (partial  $r_{(130)} = .56, p < .001$ ). With respect to the emphasis participants placed on the future, adolescents who indicated the future was of high importance felt more positive about the future ( $r_{s(137)} = .30, p = .005$ ) and indicated greater cognitive engagement with the future (partial  $r_{s(140)} = .55, p < .001$ ).

Turning to time relation, a One-Way ANOVA found no differences across the four time relation categories in terms of temporal discounting,  $F(3,128) = .35, p = .79$ , or future self-connectedness  $F(3,140) = 2.86, p = .064$ . There were also no significant differences in terms of EFT, future time attitudes, future importance or future focus across time relation categories.

### 3.3.5 Phenomenology of EFT

Although participants' attitudes toward the future, their level of cognitive engagement and perceived future importance did not relate to the episodic richness of participants' future event narratives, these variables were weakly related to participants' phenomenological ratings (see Table 3.5).

As emotional valence ratings were skewed, Spearman's rho correlations were conducted to explore the associations between this phenomenological variable and the other future-oriented constructs (these variables are not included in Table 3.5). Adolescents who rated their imagined future event to be more positive felt more similar to their future self ( $r_{s(137)} = .24, p = .005$ ) and generated written narratives that contained more episodic detail ( $r_{s(137)} = .20, p = .018$ ). With regards to future

importance ratings, which were also skewed, Spearman's rho correlations determined that adolescents who felt the future was high in importance reported greater feelings of “*mental time travel*” during the task ( $r_{s(140)} = .18, p = .039$ ) and felt the future was significantly closer in terms of temporal distance ( $r_{s(136)} = -.22, p = .009$ ).

*Table 3.5 Partial correlations (controlling for age) between key variables and the phenomenology ratings of EFT.*

	Clarity	MTT	EmP	Intensity	Temporal distance
Connectedness	.011 (127)	-.011 (134)	.007 (134)	.043 (129)	.11 (130)
Future positivity	.34** (127)	.41** (130)	.17* (130)	-.032 (129)	-.029 (130)
Future focus	.29** (127)	.35** (134)	.23* (134)	.08 (129)	-.16 (130)
AUC <sup>Δ</sup>	-.038 (121)	.008 (123)	.070 (123)	.17 (123)	-.047 (123)
Episodic richness	.26* (127)	.27* (134)	.15 (134)	.09 (129)	.042 (130)

*MTT = Mental time travel EmP = Emotional pre-experiencing*

*\*  $p < .05$  level*

*\*\*  $p < .001$  level*

*Δ transformed variable*

### **3.4 Study 1: Discussion**

The main purpose of this study was to gain greater insight into the links between EFT, future self-connectedness, and temporal discounting in adolescents. However, unexpectedly, this study failed to find any association between these three future-oriented constructs. Although it seems intuitive to consider that an adolescent who imagines the future with greater episodic richness would feel more connected to their future self, the findings of this study offer no support for this claim. Individual differences in adolescents' EFT capabilities, and the degree to which they felt connected to their future self, were also unrelated to their tendency to discount the future during an intertemporal choice task. These findings, or lack of, are in direct contrast to previous research looking at EFT and temporal discounting in adolescents (Bromberg et al., 2015), and future self-connectedness and discounting in adults (Bartels & Rips, 2010; Bartels & Urminsky, 2011; Hershfield et al., 2009).

However, there are a number of criticisms to be made concerning how EFT, future-self connectedness, and temporal discounting were measured in this study. The high levels of patience observed across the adolescents, reflected by the high negative skew observed in discount rates, suggests the presence of a ceiling effect. This could be attributable to the short delays involved in this task, which were derived from a study comparing temporal discounting between children and adolescents aged 6 – 16 years with ADHD, ASD, and healthy controls (Demurie et al., 2012). In this task, the longest adolescents had to wait to receive their hypothetical rewards was 2 weeks, and although Demurie et al., (2012) concluded that the task was sensitive enough to distinguish between those with ADHD and healthy controls, it may be that these delay magnitudes are not far enough in the future to detect steep discounting in a typically developing adolescent sample. It is

possible that increasing the delays to which adolescents must wait to receive their hypothetical rewards would diminish this ceiling effect.

The measure employed to assess the adolescents' EFT capabilities may also have been somewhat limited. Almost half of the adolescents in this sample provided descriptions of future events that were very high in episodic richness. This may have been due to the use of the cue word "*holiday*", which was included in this study to help facilitate the adolescents' generation of a future event. However, some researchers have suggested that using cue words or explicit instructions to facilitate event generation may instead reduce the sensitivity of EFT tasks by enabling individuals with poor EFT capabilities to mask their deficits (Anderson & Dewhurst, 2009; Raes, Hermans, Williams, & Eelen, 2007). As a result, it may have been easy for the adolescents in this study to generate detailed descriptions, regardless of whether or not they were truly vividly "*pre-experiencing*" the imagined event. An additional issue, arising from the use of this particular cue, involves its valence. Holidays are typically positive events, as demonstrated by the fact that none of the adolescents in this study imagined a negative event. This too may have made it easier for adolescents to generate an event with a high degree of episodic richness, as positive events tend to be imagined with more detail than negative events (D'Argembeau & van der Linden, 2004). Together, these task limitations may have made it easier for the adolescents in this study to describe vivid future events, even if they might struggle to describe a detailed future event were another measure used.

Finally, with respect to the measure of future-self connectedness employed in this study, this is the first time the future self-continuity scale (Hershfield, 2011) has been employed in adolescents. The scale utilises overlapping euler circles to represent perceived similarity between present and future selves. A number of

participants asked for clarification of the meaning of these representations, suggesting that participants of this age may struggle to understand the scale when it is presented in this way.

Moving away from EFT, future self-connectedness and temporal discounting, an additional aim of Study 1 was to explore the relationships between a wide-range of future-oriented measures that, up until now, have yet to be investigated together in the same study. In doing so, I hoped to assess the extent to which various future-oriented measures tap into a single, underlying “*future-oriented*” characteristic. Surprisingly, the only future-oriented measures to correlate significantly with one another in this study were those that assessed future time attitudes, future temporal focus and future importance (as assessed by an adapted measure of “*time orientation*”). These measures were not correlated with future self-connectedness or the episodic richness of adolescents’ EFT, nor were they associated with adolescents’ discounting behaviour. There are a number of conclusions that may be drawn from these findings. First, as consistent with previous research comparing measures of time attitudes, time focus and consideration of future consequences (McKay et al., 2018), positivity toward the future, cognitive engagement with the future, and perceived importance of the future are linked. Secondly, these characteristics do not seem to encourage connectedness to one’s future self, nor do they seem to promote future-oriented decision making. The third conclusion that can be taken from this pattern of results is that there is no one way to be future-oriented, as these three measures were only weakly to moderately correlated one with another, suggesting they tap into different aspects of what some researchers call “*future orientation*” (Steinberg et al., 2009). This is a point that will be returned to again in the General Discussion following Study 2.

### **3.5 Overview of Study 2**

On the basis of the discussion above, and in order to better address the aims of this thesis, a number of revisions were made to the previously used measures of EFT and temporal discounting for the purposes of a second study. EFT will be assessed using a task in which participants are asked to generate written descriptions of two future events, one that might occur in the near future (3 months) and one that might occur in the more distant future (1 year). In addition to these future events, adolescents will also be asked to remember two past events. This allows for the selectivity of any relations between the other future-oriented measures and EFT to be examined by controlling for episodic memory skills.

To improve on the limitations of Study 1's measure of discounting, a greater number of reward magnitudes and delay magnitudes were added, in the hopes of diminishing the ceiling effect observed in Study 1. The final revision made for the purposes of Study 2 concerns the measure of future self-connectedness. In Study 1, future self-connectedness was assessed using the future self-continuity scale (Hershfield, 2011), using instructions adapted from Bartels and Rips (2010). In Study 2, the future self-continuity scale was modified to facilitate adolescents' understanding of the overlapping circles, and participants were asked to think about different dimensions of their future self, taken from the instructions used in Study 1 (see section 3.6.2.3).

Study 2 will again include existing questionnaire measures of temporal focus (TFS, Shipp et al., 2009) and time attitudes (ATI-TA, Mello & Worrell, 2007). As the revised measures added to the duration of the study, the decision was made to remove the measures of future importance and time relation due to concerns over the

length of the study if these measures were retained. This decision was also based on the findings of Study 1, in which no association was found between the time relation dimension of the Adolescent Time Inventory (ATI, Mello & Worrell, 2007) and the other measures used, and because, with respect to the time orientation dimension of the ATI, most of the adolescents reported that they thought the future was of high importance. Finally, as outlined toward the start of this chapter, given that depressive symptomatology has been linked with impaired abilities to imagine and make decisions about the future, a measure of depression (Center for Epidemiologic Studies Depression Scale, CES-D, Radloff, 1977) will be included in Study 2 in order to explore how various measures of future thinking relate to psychopathology in adolescents.

Despite these changes, Study 2 poses the same questions as Study 1. These are reiterated below:

- 1) Do EFT and future self-connectedness correlate with one another, and with adolescents' discounting behaviour?
- 2) Do EFT and future self-connectedness independently predict temporal discounting?
- 3) Do EFT and future self-connectedness correlate with other measures of future thinking, such as future temporal focus and future time attitudes?

Additionally, Study 2 seeks to assess the links between depression, future thinking and decision making. Therefore, the final aim of Study 2 is to answer the following question: How do various measures of future thinking correlate with depressive symptomatology in typically developing adolescents?

## **3.6 Study 2: Methods**

### **3.6.1 Participants**

One hundred and seventy-five (61.7% female) adolescent participants aged 11.7 to 18.5 years ( $M = 14.75$ ,  $SD = 1.84$ ) were recruited from five schools in Northern Ireland. All participants aged under 16 years of age were required to provide parental or guardian consent in order to take part. The study received ethical approval from the Research Ethics Committee of the School of Psychology at Queen's University Belfast (see *Appendix 3.6*)

### **3.6.2 Measures**

#### ***3.6.2.1 Temporal discounting task***

As in the previous study, participants were asked to make a series of hypothetical choices between a constant large reward, and smaller rewards available immediately. However, in this study, participants were asked to choose between a large constant reward of £100, available after a delay (Tomorrow, day after tomorrow, 1 week, 2 weeks, 2 months, 6 months and 1 year) and a smaller reward (of 12 values ranging from £5 to £96) available immediately. Each of the 7 delays was paired once with every immediate reward resulting in 84 choices. For each participant, the smaller reward was presented in ascending order, while the delay to the larger reward was presented in the same pseudo-random order.

***Discounting data pre-processing.*** As before, the subjective value of the delayed reward at each delay were determined in order to calculate the area under the curve (AUC; Meyerson et al., 2001). The subjective value of the delayed reward for each delay was calculated by determining the participant's switch point.

Operationally, this was taken as the midpoint between the smallest value of immediate reward accepted and the largest value that was rejected (Mitchell &



Wilson, 2010). Subjective values and delays were then normalized following the process outlined by Myerson et al., (2001), and which was previously detailed in section 3.2.2.1. First, subjective values were expressed as proportions of the amount of the maximum delayed reward (i.e., the participant's subjective value at each delay was divided by 100), and delays were expressed as proportions of the maximum delay (365 days). These normalized values were then used as x and y coordinates, with delay on the x axis and subjective value on the y axis. Vertical lines were then drawn from each data point on the x axis to create seven trapezoids. Using the formula  $(x_2 - x_1) * [(y_1 + y_2)/2]$ , where  $x_1$  and  $x_2$  are successive delays and  $y_1$  and  $y_2$  are the subjective values associated with these delays, the areas of the seven trapezoids were calculated. When summed, this gives the total area under the curve (AUC). The smaller the AUC, the steeper the participants' discounting function.

### ***3.6.2.2 Episodic future thinking***

Participants' episodic past (EPT) and future thinking (EFT) were, as before, assessed in a task using a pen-paper format. This task and its instructions (see *Appendix 3.7*) were adapted from the Child Autobiographical Interview (Willoughby, Desrocher, Levine, & Rovet, 2012), which itself is adapted from the Autobiographical Memory Interview (Levine et al., 2002). Participants were asked to remember two past events, one which occurred *3 months ago* (near) and one which occurred *1 year ago* (distant). They were also asked to imagine two future events, one which might occur *in 3 months* and one which might occur *in 1 year*. All participants were first asked to describe a past event that occurred 3 months ago and a future event that might occur in 3 months. This is because a previous study found that adolescents struggled to generate future events without having been asked to remember a past event first

(Gott & Lah, 2014). The order of the third and fourth event (past/future or future/past) was then counterbalanced across participants.

At the beginning of the task, participants were provided with an example list of autobiographical events (see *Appendix 3.8*), but were instructed, both verbally by the researcher and written on the test booklet, that they could describe any event, even if it was not present on the list. Participants were explicitly asked to describe specific events, meaning that (a) they had to be personally involved in the event, (b) the event was specific to a time and place, and (c) the event occurred over no more than one day. They were also verbally instructed that future events were to be novel. Participants were also provided with an example of an event that would be appropriate (e.g. a day spent at Disneyland Paris) and an example of an event that would not be appropriate (e.g. a two-week holiday in France). Participants had three minutes to describe their event by writing down as much detail as possible about what they remembered/imagined. This was then followed by a general verbal probe provided by the tester (*“Is there anything else you can tell me about that event?”*).

***Scoring of the Remember/Imagine task.*** Participants’ four event narratives were assessed using the Autobiographical Memory Interview (AMI) scoring manual (Levine et al., 2002). While the previous study utilised a coding scheme by Piolino et al., (2007), the AMI scoring manual has the added benefit of being able to distinguish between episodic and non-episodic details. Participants’ written text was segmented into two main categories of details: internal (episodic) and external details (non-episodic). Details were categorized as internal if they were directly related to the event described, were specific in time and place, and conveyed a sense of episodic re/pre-experiencing. Details that did not fit these specifications were categorized as external.

Internal details were then assigned to one of five episodic detail subcategories: a) event; b) place; c) time; d) perceptual; and e) emotion or thought. External details were assigned to one of four subcategories: a) semantic fact; b) repetition; c) metacognitive statements; and d) events that occurred outside of the main event described. Compound scores for internal and external scores were calculated by averaging over these subcategories. Each described event was also assigned a qualitative experimenter rating assessing the episodic richness of the description on a scale of 0 to 6. This rating was used as a measure of the extent to which the description evoked an impression of re/pre-experiencing by taking the reader back to a specific moment in time and place in which they are able to re-create the perceptual, emotional and cognitive contextual detail of the event.

All event narratives were scored first by the researcher and then by a second, independent rater for reliability. Intraclass correlations (ICC; two-way mixed effects model) were calculated to examine the covariance and agreement between raters (Portney & Watkins, 2000). ICCs were high for past internal details (ICC = .94,  $p < .001$ ), future internal details (ICC = .86,  $p < .001$ ), past external details (ICC = .84,  $p < .001$ ), future external details (ICC = .84,  $p < .001$ ), and future episodic richness (ICC = .85,  $p < .001$ ), and only slightly lower for past episodic richness (ICC = .80,  $p < .001$ ). The internal details provided by participants and their episodic richness ratings were highly correlated ( $r_{(160)} = .91$ ,  $p < .001$  for future event narratives and  $r_{(160)} = .86$ ,  $p < .001$  for past narratives). Therefore, these two measures were combined using z-scores to give an overall episodic rating for past and future event narratives, yielding the EPT and EFT episodic measures respectively.

***Phenomenological rating scales.*** As in the previous study, after having described each event, participants assessed the phenomenal characteristics of the

remembered/imagined event using a series of rating scales (adapted from D'Argembeau & Van der Linden, 2006). Participants were asked about the extent to which visual and other sensory details (sound and smell) were clear (1 = not at all, 7 = completely). The clarity of the location and time in which the remembered/imagined event took place was also assessed (1 = not at all, 7 = extremely clear). Participants also rated their feeling of re-experiencing/pre-experiencing the event (1 = not at all, 7 = completely) and sense of mentally travelling to the time when the event happened/would happen (1 = not at all, 7 = completely). Three items assessed the emotional content of the remembered/imagined event: participants rated their feeling of re-experiencing/pre-experiencing the emotions associated with the event (1 = not at all, 7 = completely), the valence of the event (-3 = very negative, +3 = very positive) and the emotional intensity of the event (1 = not strong, 7 = very strong). A final rating scale assessed the feeling of subjective distance to the event (1 = quite far away, 10 = very far away).

***Phenomenal characteristic composites.*** For each event, participants' ratings of sensory (visual, sound, smell), temporal, and locational clarity were summed to create a composite score labelled clarity. As outlined in section 3.2.2.2 of the previously described study, and as summarised in Table 3.1, participants' ratings of re-experiencing/pre-experiencing the event and ratings of mentally travelling backward/forward in time to when the event happened/would happen were summed to create a composite labelled mental time travel. Participants' ratings of re-experiencing/pre-experiencing the emotions associated with the event were analysed as a separate variable, as were ratings of emotional intensity, emotional valence and

temporal distance. Final past and future variables were calculated by averaging across the near (3 months) and distant (1 year) conditions.

### 3.6.2.3 Future self-connectedness

A measure of future self-connectedness was adapted from Bartels and Rips (2010) and Hershfield (2011). Participants were first introduced to the overlapping circles representing the present and future self (see *Appendix 3.9*). Participants were then asked to think of the person they are now (the present self) and the person they think they will be in 5 years (the future self) and to rate, on a horizontal scale of 0 – 100, how similar they feel their present self and future self to be in terms of four dimensions: personality, hobbies, likes-dislikes, and overall. The scale was verbally and pictorially anchored at either end by two circles representing the present and future selves that overlap to different degrees (not overlapping to almost completely overlapping) and by the labels “*completely different*” to “*exactly the same*” (see *Figure 3.2*). For the purpose of analysis, an average of the four dimensions was taken. Cronbach’s alpha across the 4 dimensions indicated moderate internal consistency ( $\alpha = .64$ ).



*Figure 3.2 Scale administered to participants to assess future self-connectedness. Participants rated how similar they felt to their future selves on four dimensions: a) personality b) hobbies c) likes and dislikes and d) overall.*

#### **3.6.2.4 Temporal focus scale**

As in the previous study, the TFS (Shipp et al., 2009) was used to assess the degree of participants' cognitive engagement with the past, present and future. Past and future temporal focus subscales had internal consistency estimates greater than .78. However, present temporal focus was less internally consistent ( $\alpha = .56$ ). This is consistent with what was found in the previously reported study (see section 3.2.2.4), and reliability estimates reported by McKay et al., (2012).

#### **3.6.2.5 Adolescent Time Inventory – Time Attitudes**

Again, the ATI-TA (Mello & Worrell, 2007) was used to assess adolescents' evaluations of the past, present and future (see section 3.2.2.5). As in the previous study, the negative subscale items for each time period were reverse scored. These reverse scored items were then summed alongside the positive subscale items for each corresponding time period, and a mean calculated by dividing by 10. These three scales were labelled "*past positivity*", "*present positivity*" and "*future positivity*". Internal consistency estimates for the three ATI-TA positivity subscales ranged from .89 to .93. This is consistent with the previously reported study.

#### **3.6.2.6 Depression**

The Centre for Epidemiologic Studies Depression Scale (CES-D, Radloff, 1977) is a 20-item validated scale used to assess signs of depressed mood in the general population. Cronbach's alpha indicated good internal consistency ( $\alpha = .92$ ).

### **3.6.3 Procedure**

Schools were invited to take part in the study by letter which linked to a promotional video that outlined the purpose and nature of the study. Five schools in total agreed

to take part. Schools that agreed to take part were provided with parental information sheets and consent forms prior to data collection.

Data was collected in classroom settings by the same researcher. Parental consent forms were collected from participants younger than 16 years on the day of testing. Written informed assent was then obtained from participants under the age of 16 years. Written informed consent was obtained from participants aged 16 years and over. Two questionnaire booklets were then distributed, the first of which contained the measure of future self-connectedness, ATI-TA, TFS and the CES-D, and the second of which contained the temporal discounting task. Participants were instructed to complete the booklets in this order. Once the researcher had ascertained all participants were finished, a third booklet containing the Remember/Imagine task was distributed. This task was facilitated by the researcher, who read aloud the instructions on the front page. Participants were then timed for 3 minutes as they wrote, after which they were verbally prompted by the researcher. The researcher then waited for the participants to complete the accompanying phenomenological rating scales. Once finished, the timer was reset, and the participants were asked to move on to the next event. Following this final task, the booklets were collected, and participants were provided with a debrief sheet that the researcher read aloud (see *Appendix 3.10*).

## **3.7 Study 2: Results**

### **3.7.1 Data pre-processing**

#### ***3.7.1.1 Missing or non-systematic data and outlier removal***

Fifteen adolescents failed to complete either one or more of the written narratives and/or their associated rating scales and so were excluded from any analysis involving EPT or EFT variables.

Temporal discounting data from eleven participants was identified as non-systematic using a procedure outlined by Johnson and Bickel (2008), and so was excluded from analysis. Data was deemed non-systematic if any subjective value was larger than the subjective value associated with the previous, shorter delay by a magnitude greater than 20% of the delayed reward (£20). An additional criterion recommended by Johnson and Bickel, (2008) was applied, whereby data was deemed non-systematic and excluded if the last subjective value was not less than the first subjective value by at least 10% of the later reward (£10). Non-systematic patterns may occur due to the participant changing response strategy during the task, a lack of attention on the task, or specific time points being associated with a need for money in the participant's real context, such as a birthday party (Wilson, Mitchell, Musser, Schmitt, & Nigg, 2011). The second criterion, in which the participant exhibits close to no discounting despite large delays, may also suggest the presence of demand characteristics (Johnson & Bickel, 2008).

With regards to outliers, three participants were identified as scoring more than 3 SD above the mean on the CES-D. Of the TFS and ATAS scores, one future temporal focus score, one future positivity score and two past positivity scores were identified as being more than 3 SD below the mean. Of the phenomenological



ratings, two future valence ratings and one past intensity rating were more than 3 SD below the mean. These scores were excluded from subsequent analysis.

### 3.7.1.2 Normality and transformations

AUC and depression scores were highly positively skewed as determined by skewness z-scores (Z-skew = 4.16 and 6.63 respectively). Square root transformations reduced the skew of both (Z-skew = 1.42 and 1.89). The number of external (non-episodic) details in participants' past and future event narratives were also skewed (Z-skew = 5.67 and 4.06 respectively). Square root transformations also reduced the skewness of these variables (Z-skew = -.82 and -1.26 respectively).

### 3.7.2 Descriptive statistics

Descriptive statistics for key variables are summarised below in *Table 3.6*.

*Table 3.6 Means, standard deviations, medians and range for key variables used in analysis.*

	<i>n</i>	M ( <i>SD</i> )	Median	Min – Max
Future connectedness	175	60.3 (14.6)	60.8	21.3 – 93
Future positivity	171	3.55 (.54)	3.60	2 – 4.50
Future focus	174	4.47 (1.12)	4.50	2 – 6.75
AUC	163	.35 (.27)	.26	.026 - .96
Depression	172	13 (9.5)	10	0 – 44
Future external details	160	2.72 (1.81)	2.50	0 – 8
Future episodic richness ( <i>composite</i> )	160	0 (1.95)	-.27	-2.74 – 6.59
Future temporal distance	157	5.75 (2.18)	5.50	1 – 10
Past external details	160	2.42 (1.80)	2.25	0 – 9.25
Past episodic richness ( <i>composite</i> )	160	0 (1.93)	.22	-4.30 – 4.90

### **3.7.3 Do EFT and future self-connectedness relate to one another?**

After controlling for age, the extent to which participants felt connected to their future selves was significantly associated with the episodic detail they included in their written future event narratives, although the size of this association was small (Ferguson, 2009). During the EFT task, participants who felt more connected to their future self provided future event narratives that were more episodic (partial  $r_{(155)} = .25, p = .002$ ). These findings were unique to EFT. As can be seen from Table 3.7, future self-connectedness did not relate meaningfully to the episodic detail in participants' past event narratives.

### **3.7.4 Do EFT and future self-connectedness relate to discounting behaviour in adolescents?**

As expected, even after controlling for age, future self-connectedness correlated significantly with AUC (partial  $r_{(160)} = .35, p < .001$ ), indicating that adolescents who felt more similar to their future selves were less likely to discount the value of future rewards. EFT also related meaningfully to discounting behaviour. Participants who provided future event narratives that were more episodic were less likely to discount delayed rewards (partial  $r_{(145)} = .23, p = .005$ ). This association continued to be statistically significant when variance due to performance on the same aspect of the EPT task had been controlled for (partial  $r_{(144)} = .28, p < .001$ ).

A positive correlation was also observed between AUC and participant's self-reported clarity of EFT (partial  $r_{(145)} = .20, p = .018$ ), when controlling for age and clarity of EPT. When controlling for age and temporal distance of EPT, AUC also correlated negatively with subjective temporal distance of the future event (partial  $r_{(145)} = -.26, p < .001$ ), indicating that participants who felt their imagined future events were subjectively farther away discounted more than those who felt the events

were subjectively closer. The relations between these phenomenological ratings of EFT and AUC were selective: clarity of EPT and subjective distance of past events were not significantly correlated with AUC. As can be seen from Table 3.7, discounting behaviour was not associated with the episodic content of participant's past event narratives.

*Table 3.7 Partial correlations controlling for age showing the relationships between key variables.*

	1	2	3	4	5	6
1. Connectedness	-					
2. Future positivity	-.032 (168)	-				
3. Future focus	-.15* (171)	.49** (167)	-			
4. AUC <sup>Δ</sup>	.35** (160)	-.006 (156)	-.016 (159)	-		
5. Depression <sup>Δ</sup>	-.21* (169)	-.41** (166)	-.043 (169)	-.15 (157)	-	
6. Past episodic richness	.083 (155)	-.008 (151)	-.033 (155)	.009 (145)	-.098 (153)	-
7. Future episodic richness	.25* (155)	.040 (151)	.049 (155)	.23* (145)	-.065 (153)	.56** (155)

\*\*  $p < .001$

\*  $p < .05$

<sup>Δ</sup> transformed variable

### **3.7.5 Do EFT and future self-connectedness independently predict discounting behaviour?**

To address questions about whether future self-connectedness and EFT have independent or overlapping relations with temporal discounting, hierarchical regression was used to identify whether EFT and future self-connectedness

independently predicted variance in participants' tendency to discount the future, while controlling for potentially relevant variables.

First, a reduced linear model was set up including only the control variables as predictors of AUC. Control variables were age, external details for past and future events, EPT (episodic composite), and CES-D scores. This model explained < 1% of the variability in AUC (adjusted  $R^2 = .012$ ), thus falling below Ferguson's (2009) recommended minimum (practical) effect (RMPE) of >.2 for standardised  $\beta$ , and >.04 for adjusted  $R^2$ . Age was the only significant predictor of AUC in this reduced model (see Table 3.8). Next, a reduced model was set up with the additional variable of future self-connectedness. This model explained 14% of the variance in AUC (adjusted  $R^2 = .14$ ). Age remained a significant predictor of AUC. Future self-connectedness was also a significant predictor of AUC. The addition of future self-connectedness in this model led to a significant increase in  $R^2$  of .13,  $F(1,141) = 22.3$ ,  $p < .001$ .

A final full model was set up with the additional variable of EFT (episodic composite). This full model significantly predicted AUC,  $R^2 = .22$ ,  $F(7,140) = 5.53$ ,  $p < .001$ , and explained 18% of the variability in AUC scores (adjusted  $R^2 = .18$ ). The addition of EFT led to a significant increase in  $R^2$  of .041,  $F(1,140) = 7.31$ ,  $p = .008$ . Both future self-connectedness and EFT were significant predictors of AUC. Age remained a significant predictor of AUC in the full model. Future self-connectedness uniquely explained 9% ( $sr^2 = .091$ ) of the variance in AUC, while EFT and age explained 4% ( $sr^2 = .041$ ) and 3% ( $sr^2 = .034$ ) of the variance respectively. Unexpectedly, past episodic detail was also a significant predictor of AUC in this final model, although as it explained only 2% of the variance in AUC, both it and age fall below Ferguson's (2009) minimum RMPE of .04.

Most importantly, both future self-connectedness and EFT independently predicted significant amounts of variance in temporal discounting when controlling for future external details, and after controlling for a number of other potentially confounding variables.

*Table 3.8 Hierarchical regression predicting temporal discounting (AUC).*

Variable	Model 1		Model 2		Model 3	
	B	$\beta$	B	$\beta$	B	$\beta$
Constant	.23		-.25		-.15	
Age	.026*	.20	.026	.21*	.025	.20*
EPT (episodic composite)	-.003	-.021	-.006	-.052	-.024	-.20*
Past external details <sup>Δ</sup>	-.018	-.047	-.023	-.060	-.025	-.068
Future external details <sup>Δ</sup>	.032	.082	.044	.11	.054	.14*
Depression <sup>Δ</sup>	-.025	-.13	-.010	-.051	-.011	-.060
Future-self connectedness			.006	.37**	.005	.32**
EFT (episodic composite)					.030	.26*
Adjusted R <sup>2</sup>	.012		.14		.18	
F	1.35		5.01**		5.53**	
ΔR <sup>2</sup>	.046		.13		.041	
ΔF	1.34		22.3**		7.31*	

\*\*  $p < .001$

\*  $p < .05$

<sup>Δ</sup> transformed variable,  $\Delta R^2 = \text{change in } R^2$ ,  $\Delta F = \text{change in } F$

### 3.7.6 How do the measures of future orientation overlap?

We examined relations between the various measures of future orientation included in the study. The relations between the measures (temporal discounting, EFT and future-self-connectedness) which our analyses had shown to be related, and measures of attitudes towards and engagement with the future, were of particular interest. To

summarize, these latter measures were related to each other. Thus, more positive attitudes towards the future were associated with greater cognitive engagement with the future (partial  $r_{(167)} = .49, p < .001$ ). Although a small, but negative association was found between future temporal focus and future self-connectedness (partial  $r_{(171)} = -.15, p = .045$ ), positivity about and engagement with the future were unrelated to temporal discounting, or the episodic content of participants' EFT (see Table 3.7).

### **3.7.7 Phenomenology of EFT**

We also examined correlations between the phenomenological ratings of EFT and the other future-oriented measures; these are reported in Table 3.9 (partial correlations controlling for age only). In summary, emotional intensity, mental time travel (MTT), and the extent to which participants reported pre-experiencing future emotions were all related both to positive attitudes towards the future and the amount of cognitive engagement with the future. Adolescents who reported more frequent engagement with the future also reported great clarity during EFT (partial  $r_{(155)} = .24, p = .003$ ). Again, these relations were selective to EFT: the equivalent phenomenological ratings for EPT were not significantly related to attitudes to or cognitive engagement with the future.

### **3.7.8 Relations between future thinking and depression**

CES-D scores were largely unrelated to participant's EFT and EPT, although there was an association between the valence of the participant's past and future thinking and depressive symptoms. Participants who scored higher on the CES-D were more likely to remember negative past events (partial  $r_{(151)} = -.19, p = .02$ ) and to imagine more negative future events (partial  $r_{(152)} = -.21, p = .01$ ). Although a negative association was observed between CES-D scores and AUC, suggesting higher

depressive scores were associated with greater discounting behaviour, this correlation was not significant (partial  $r_{(157)} = -.15, p = .057$ ).

Future self-connectedness was significantly correlated with CES-D scores (partial  $r_{(169)} = -.21, p = .006$ ), indicating that adolescents who felt more connected to their future selves reported fewer depressive symptoms. Perhaps unsurprisingly, positive attitudes about the future were also associated with lower CES-D scores (partial  $r_{(166)} = -.41, p < .001$ ). As shown in Table 3.7, temporal focus was unrelated to the adolescents' depressive symptoms.

*Table 3.9 Partial correlations controlling for age showing the relationships between key variables and the phenomenology of participants' EFT.*

	Future clarity	Future MTT	Future EmP	Future valence	Future intensity	Future distance
Connectedness	.10 (155)	-.033 (154)	-.025 (154)	.00 (152)	.08 (154)	-.15 (152)
Future positivity	.16 (151)	.24* (151)	.26** (151)	.16 (150)	.17* (151)	-.09 (150)
Future focus	.24* (155)	.26** (154)	.25* (154)	.10 (152)	.24* (154)	-.16 (152)
AUC <sup>Δ</sup>	.19* (145)	-.050 (145)	-.086 (145)	-.10 (144)	-.061 (145)	-.26** (145)
Depression <sup>Δ</sup>	-.05 (153)	-.08 (153)	-.05 (153)	-.21* (152)	-.11 (153)	.01 (152)
Past episodic richness	.33** (155)	.21* (154)	.18* (154)	.20* (152)	.28** (154)	.05 (152)
Future episodic richness	.44** (155)	.25* (154)	.23* (154)	.17* (152)	.25** (154)	-.12 (152)

*MTT = Mental Time Travel, EmP = Emotional Pre-experiencing*

*\*\*  $p < .001$*

*\*  $p < .05$*

*<sup>Δ</sup> transformed variable*

### **3.8 Study 2: Discussion**

In Study 1, individual differences in EFT and perceived future self-connectedness were unrelated to adolescents' impulsivity in a temporal discounting task. These findings failed to replicate previously documented associations between EFT and temporal discounting in adolescents (Bromberg et al., 2017, 2015), and between future self-connectedness and discounting in adults (Bartels & Rips, 2010; Hershfield et al., 2011). Using revised measures of EFT, future self-connectedness and temporal discounting, Study 2 subsequently found, as expected, that adolescents who exhibited greater patience during the temporal discounting task imagined the future with greater episodic richness and felt more connected to their future selves. In contrast to Study 1, Study 2 also found an association between EFT and future self-connectedness. It therefore seems likely that the conflicting results of Study 1 are attributable to limitations in the measures that were used to tap into these constructs.

Putting the differences between Studies 1 and 2 aside, this study has a number of notable and novel findings. To our knowledge, this is the first time a study has investigated the constructs of EFT and future self-connectedness together. The results of this study suggest that EFT and future self-connectedness tap into some of the same processes, while also predicting different aspects of temporal discounting in adolescents. These findings have a number of important implications that will be discussed in greater detail in the general discussion below. This study also demonstrated, for the first time, that the association between future self-connectedness and temporal discounting previously observed in adults extends to an adolescent sample. Adolescence is conceived of as a period in which the sense of self can change dramatically (Habermas & Bluck, 2000; Kroger, Martinussen, & Marcia, 2010; Sebastian, Burnett, & Blakemore, 2008), thus it is striking that the link



between future self-connectedness and delay discounting was observed in this population. Adolescents' judgments in the revised self-connectedness task were also meaningfully related to other variables, including depression (see General Discussion below), indicating that this task may be of considerable use in this population. Future research might use this measure to explore more carefully the broader significance of self-connectedness in the adolescent period.

### **3.9 General discussion**

The two studies of future thinking described in this chapter offer a number of new insights into future thinking in typically developing adolescents. First, their findings indicate that EFT and future self-connectedness are distinct constructs. In Study 1, there was no association between adolescents' EFT and their perceived future self-connectedness and Study 2 found only weak relations between the two constructs using revised measures. Although the latter finding accords with intuitions that vividly imagining the future and feeling connected to one's future self are linked, that neither study found a strong association between the two and that they independently predicted discounting in Study 2, makes it unlikely that future self-connectedness and EFT interventions decrease impulsive decision making because they tap into identical underlying psychological processes.

A second set of notable findings pertains to the selective associations found between the various measures of future thinking used in both studies. In Studies 1 and 2, positive attitudes toward the future and cognitive engagement with the future were correlated, but neither were associated with future self-connectedness, temporal discounting, or the degree to which participants imagined the future with episodic richness. These results suggest that frequent cognitive engagement with the future and positive attitudes toward the future are not sufficient to make adolescents feel

connected to their future selves, nor do they seem to encourage the prioritisation of the future in decision making. Furthermore, these findings suggest that the different measures used in this study tap into different aspects of future thinking.

The third set of notable findings concerns the selective relationships observed between depressive symptoms and measures of future thinking. Adolescents with high depression scores felt significantly less connected to their future self and were more likely to imagine negative future events, but somewhat surprisingly in the light of the adult literature on depression and episodic thinking (Hallford et al., 2018), they did not generate less episodically rich future (or past) event narratives. Moreover, there was not a strong association observed between depression scores and temporal discounting.

### **3.9.1 EFT, future self-connectedness and temporal discounting**

One of the primary aims of this chapter was to address questions pertaining to whether the constructs of EFT and future self-connectedness overlap and whether they independently predict variance in delay discounting in a sample of adolescents. As already stated, this study is the first to report a correlation between EFT and future self-connectedness in any sample. However, it is not clear whether this reflects a causal relation between the two constructs, and if so what the direction of causation may be. It seems plausible that the ability to richly imagine the future might assist in helping one feel connected to it (Blouin-Hudon & Pychyl, 2017; Hershfield & Bartels, 2018) and that EFT provides this rich imagination. Alternatively, it could be that representing one's future self as stable and continuous provides a foundation for more richly imagining the future, especially given that EFT is thought to involve self-projection (Buckner & Carroll, 2009). That future self-connectedness was correlated with adolescents' EFT in Study 2, and that both independently predicted

discounting, suggests that EFT and future self-connectedness are related, but distinct constructs. While EFT might attenuate discount rates through making salient the significance of future rewards (Boyer, 2008), it has been argued that conceiving of and having concern for one's future need not depend on EFT (Craver, Kwan, Steindam, & Rosenbaum, 2014; Kwan et al., 2015), as evidenced by the fact that individuals with EFT deficits can use autobiographical knowledge to make future-oriented decisions. Individual differences in underlying beliefs about continuity in the self, and a tendency to feel responsible for (Bryan & Hershfield, 2012), or to empathize with (Blouin-Hudon & Pychyl, 2017), oneself in the future may account for the variance in temporal discounting that is uniquely explained by future self-connectedness.

That EFT and future self-connectedness seem to be weakly related, although distinct, constructs that independently predict temporal discounting raises hope for new, more effective interventions designed to improve adolescent decision making. The implications this finding might have for interventions will be revisited in Chapter 6 (General Discussion).

### **3.9.2 Different measures of future thinking**

A striking finding common to both studies in this chapter is that future time attitudes and future temporal focus were correlated with one another, but not to the measures of EFT, future self-connectedness, or temporal discounting. Thus, there appears to be two clusters of measures purporting to reveal how adolescents think about the future. This pattern conflicts with the tendency to group a number of future-oriented constructs together under the rubric of "*future orientation*" (Steinberg et al., 2009). When referring to a future-oriented adolescent, it is typically meant that the adolescent thinks often, and feels positively, about the future (Robbins & Bryan,

2004; Zimbardo & Boyd, 1999). It may be tempting then to assume that this adolescent would also discount the future less, feel more connected to their future self, and imagine the future more vividly in EFT. The results of these studies provide no evidence to support this assumption. Again, the theoretical implications of these results will be returned to in Chapter 6.

However, it should be noted that although EFT, as measured in terms of the amount of episodic information participants produced, was not related to attitudes towards and cognitive engagement with the future, some of the phenomenological ratings of EFT were correlated with these latter measures. Specifically, positivity towards the future and greater cognitive engagement with the future were related to the extent to which participants reported “*pre-experiencing*” future events/emotions and the intensity of the associated emotions (see also Arnold et al., 2011). The causal underpinnings of these associations are not clear: it could be that participants with a positive attitude towards and greater cognitive engagement with the future spend more time thinking about the future, leading to their future imaginings being more emotionally rich. An alternative possibility is that these associations reflect emotion regulatory style (D’Argembeau & Van der Linden, 2006), with adolescents who are more likely to suppress their emotions scoring lower on this set of measures.

### **3.9.3 Depression**

A secondary aim of Study 2 was to explore how depressive symptoms and adolescent future thinking relate to one another, given that depression has previously been linked with an impaired ability to generate episodically rich future events (Williams, 1994) and to discount the future (Jarmolowicz et al., 2014; Pulcu et al., 2014). Although previous research with adults suggests that those with symptoms of depression provide less episodic and more general descriptions of future events (e.g.

Dickson & Bates, 2006), the studies in this chapter found no evidence for a link between EFT and depression. The absence of an association between EFT and depressive symptomatology may be due, in part, to the explicit nature of the EFT task used in both studies, which might lack the sensitivity to identify overgeneral future thinking in adolescents in a non-clinical setting. It is possible that using a task that involves explicit instructions or prompts participants to produce descriptions of specific future events is not always sufficiently sensitive in a non-clinical population (Anderson, Boland, & Garner, 2016; Raes et al., 2007). Future studies exploring EFT impairments in adolescents with depressive symptoms might consider utilizing alternative methods, such as the sentence completion task (Raes et al., 2007). Moreover, given the results of Study 1, future studies may also consider the emotional content of any cues provided and whether these cues make it easier for participants to mask impairments (Anderson et al., 2016).

There was also no significant relationship between depressive symptoms and delay discounting in our sample. This is not the first study to fail to find an association between depressive symptoms and temporal discounting in an adolescent sample (see Nigro, Cosenza, & Ciccarelli, 2017). The inconsistent findings in the literature may be due to the existence of opposing effects: whereas depressive symptomatology in general may be associated with impaired EFT and thus lead to increased temporal discounting, anhedonia, which is an important component of depression, appears to be associated with decreased temporal discounting, due to decreased interest in the present (Lempert & Pizzagalli, 2010). Thus, in any particular sample, the effects of anhedonia may mask any effects of more general depressive symptoms on discounting rates.

The results did show that, consistent with the hypothesized link between depressive symptomatology and EFT, adolescents with depressive symptoms were more likely to imagine negative future events during the EFT task, supporting the work of a number of researchers interested in how depression impacts on future thinking (MacLeod, 2017; Miles, MacLeod, & Pote, 2004). It is believed that negative events are more accessible to individuals experiencing depression and thus are more easily generated (MacLeod & Byrne, 1996; MacLeod & Copley, 1995). The episodic simulation of positive future events likely serves to elevate mood and to challenge negative thoughts about what may lie in the future (Pictet, Coughtrey, Mathews, & Holmes, 2011). Consequently, it is argued that the inability to envisage such positive future events might have a reciprocal relationship with depression. In other words, depressive thinking might lead to the imagination and anticipation of a bleak future, which would further serve to entrench low mood (Roepke & Seligman, 2016).

Adolescents with greater depressive symptoms also felt less connected to their future selves. This finding replicates an association recently found in adults and extends it to an adolescent sample (Sokol & Eisenheim, 2016). Due to the correlational nature of this study, the causal direction of this relationship is unknown, although Sokol and Eisenheim (2016) propose that feeling disconnected from the future self could be both a cause and consequence of depression. The precise nature of the link between depressive symptomatology and future self-connectedness might be addressed in future research.

#### **3.9.4 Conclusion**

To summarise, although there was no association between EFT, future self-connectedness and temporal discounting in Study 1, the results of a subsequent study

using revised measures found EFT and future self-connectedness to be weakly related constructs that independently predict discounting behavior in adolescents. The results also suggest that measures of adolescent future thinking may cluster, according to whether they necessitate consideration of the self in the future. Different measures of adolescent future thinking may assess very different things and researchers should exercise care when choosing how to measure future thinking in adolescence. In particular, these studies suggest that positive attitudes toward the future and cognitive engagement with the future are not predictors of impulsive choice, as assessed by an intertemporal choice task.

Future thinking is of profound importance during adolescence (Nurmi, 1991) and in order to help adolescents make good decisions about their future, it is important that we understand how to measure how they think about the future and which interventions are likely to be most effective in helping them make the best decisions. These results suggest that increasing the vividness with which adolescents consider a future self (to whom they feel closely connected) is likely to be an effective way of helping adolescents make better decisions about the future.

Having established there to be a link between aspects of adolescents' future thinking and future-oriented decision making, the following chapter explores the potential role played by future thinking in determining treatment adherence in adolescents with chronic illness.

## **Chapter 4. Future Thinking and Medication Adherence in Adolescents with Chronic Illness**

### **4.1 Introduction**

As emphasised throughout the previous chapters, future thinking is thought to play an important role during intertemporal decision making. When faced with a choice between receiving a reward immediately or waiting for a larger delayed reward, humans typically exhibit a myopic preference for instant gratification (Ainslie, 2001). Future thinking, or future-oriented cognition, is thought to offset this preference by redirecting our interest away from the present and toward the future (Boyer, 2008). Two constructs discussed throughout the previous chapters, known as future self-connectedness and episodic future thinking (EFT), have indeed been shown to encourage more future-oriented decision making in previous research, and in Chapter 3, I found further evidence to support this, demonstrating that future self-connectedness and EFT were significant independent predictors of delay discounting rates in typically developing adolescents. Specifically, I found that when adolescents felt more dissimilar to their future selves, and when they imagined the future less vividly, they exhibited greater impatience when making decisions that concerned the future.

In Chapter 2, I argued that adolescents with chronic illness who intentionally fail to adhere to their treatments, despite the consequences, could be discounting the delayed health rewards gained through adherence in favour of the immediate rewards to be gained by not adhering. It may seem irrational or “short-sighted” for a patient to decide against taking a medication that could substantially reduce their risk of complications in the future. In reality, however, the benefits to be gained by failing to adhere, such as avoidance of side effects, freedom from a restrictive routine, or the



feeling that one is “*fitting in*” with their peers, can be instantaneous and highly attractive (Hanghøj & Boisen, 2014; Taddeo et al., 2008). This is likely to be especially true for adolescents, for whom peer relations and autonomy are goals of great importance (Neinstein, Kaufman, Durant, Smith, & English, 2002). When such salient and instantaneous rewards are pitted against the distant, abstract promise of “*better*” health, and when adolescents encounter considerable costs and barriers to taking their prescribed treatments (e.g. Hanghøj & Boisen, 2014; Kyngäs et al., 2000), then it is not entirely unsurprising that teens would prefer the more immediate, and more subjectively attractive option of nonadherence.

This link between temporal discounting and adherence seems intuitive, yet our knowledge concerning whether adherence to treatment might be predicted by a patient’s tendency to discount the future is limited. Additionally, despite the well documented tendency for adherence to decline sharply during adolescence (Borus & Laffel, 2010; Burke & Dowling, 2007; Eakin et al., 2011; Hood et al., 2009; Tiggelman et al., 2015; Zindani et al., 2006), while discount rates rise (Banich et al., 2013; Khurana et al., 2018; Steinberg et al., 2009), the role of temporal discounting in treatment adherence has yet to be investigated in adolescents with chronic illness.

As stated in Chapter 2, the tendency for young people to fail to adhere to treatment, despite the ramifications this has for their health in the future, raises serious questions over how adolescents with poor adherence might think about or feel about the future, and whether this might influence their decision to adhere. Thus, the main aim of the following chapter is to answer questions surrounding how the phenomenon of temporal discounting and other aspects of future thinking might help to shed light on intentional nonadherence, specifically in adolescents with chronic illness.

#### 4.1.1 Discounting the future and adherence

As discussed in Chapter 1, the tendency to devalue future rewards is implicated in several maladaptive behaviours thought to be underpinned by short-sighted decision making. In adolescents, these include alcohol use (Field, Christiansen, Cole, & Goudie, 2007; Rossow, 2008; Rossow & Romelsjö, 2006), engagement in risky sexual behaviours (Chesson et al., 2006; Kahn, Holmes, Farley, & Kim-Spoon, 2015), smoking (Audrain-McGovern et al., 2004; Reynolds & Fields, 2012), and gambling (Cosenza & Nigro, 2015). Together, in addition to the literature on adults (Cisneros & Silva, 2017; Story et al., 2014), these studies demonstrate that individual differences in temporal discounting can predict an adolescent's tendency to engage in problematic or impulsive behaviours. Consistent failure to adhere to one's treatments in patients with chronic illness, for whom this medication is vitally important for achieving positive health outcomes, can be considered to be another example of a maladaptive health behaviour, yet there is only a small number of studies investigating the role of temporal discounting in medication adherence.

One early study, using scenario based measures of "*time preference*" to assess individuals' preferences for immediate or delayed rewards, found a relationship between poor adherence to cholesterol medication in patients with hypertension and a preference for immediate monetary rewards (Chapman & Coups, 1999). However, this association was weak, and the authors suggested scenario-based measures of discounting may be limited, in that the content and format of the scenario might influence participants' decisions. One of the first studies to utilise a more traditional temporal discounting measure specifically sought to examine whether individual differences in discounting predicted medication adherence and glycaemic control in ninety older adults with Type 2 diabetes (Reach et al., 2011). In

this study, temporal discounting was assessed with a single multiple-choice item, which asked participants to choose between receiving €500 (euros) immediately, €800 in 6 months' time, or €1500 in 1 year. If the participant chose either of the two most immediate rewards, they were classified as "impatient". Medication adherence was assessed using five-items that enquired about certain behaviours, such as failing to take that days' medication or having ever run out of medication. Nonadherence was defined as a positive response to at least three of the five behaviours. Patients were also asked if they monitored their weight, smoked cigarettes, wore a seatbelt, exercised or visited their dentist for check-ups. If participants indicated they did not engage in at least two of these diabetes non-specific behaviours, they were said to have "*sub-optimal foresight*", although this is a questionable conclusion and will be discussed below following a summary of the study's findings. As expected, reluctance to wait 1 year for the largest reward, indicating greater delay discounting, was a predictor of nonadherence. A lack of what the authors termed "*foresight*" was also a predictor of nonadherence. Furthermore, both impatience in the monetary decision task and "sub-optimal foresight" were associated with higher HbA1c levels, reflecting poorer glycaemic control.

This study was the first to identify a link between greater discounting of future rewards and nonadherence behaviours in patients with chronic illness. However, the authors' conclusion that suboptimal foresight is predictive of adherence may be flawed. The measure of "*sub-optimal foresight*" used in this study employed items assessing whether a patient engaged in adaptive behaviours, such as exercising. While the authors concluded that the association between this measure and nonadherence suggested that patients with impaired foresight were less likely to adhere to their medications, it is perhaps more accurate to conclude that patients who

fail to adhere to their medication, and who have poor diabetes control, are also less likely to engage in other healthy behaviours. Thus, given that the authors' conclusion regarding impaired foresight and nonadherence may be weak, it is still important for research to clarify whether an impaired ability to project oneself into the future, known as episodic foresight or episodic future thinking (Atance & O'Neill, 2001), is predictive of nonadherence. This is one of the aims of the present chapter, and will be discussed in greater detail in the following section. Another limitation of this study concerns the measure of temporal discounting used, which presented participants with a single multiple-choice item. This contrasts with the tasks more commonly used in the discounting literature, which typically employ a series of choices to ascertain a participant's discount rate over time, allowing for more precise estimation. Finally, a number of possible confounding variables, such as presence of depressive symptoms, or the presence of comorbidities were not accounted for.

A subsequent study improved on some of these limitations, recruiting ninety-three adults with Type 2 diabetes (Lebeau et al., 2016). For this study, temporal discounting was assessed using a computer-based task, in which participants made a series of 60 choices between small immediate rewards, and larger delayed rewards, with rewards ranging from €1 to €100 and delays ranging from 3 days to 10 years. A number of confounding variables, such as the presence of comorbidity, depressive symptomatology, and type of treatment, were also considered. The results supported those reported previously by Reach et al., (2011). Patients who discounted future rewards more steeply were less adherent and had higher HbA1c levels. Furthermore, it was determined that the association between discounting and HbA1c was partially mediated by adherence and remained significant even after controlling for potentially confounding variables, such as gender and social deprivation. A more recent study

replicated the association between discounting, adherence and HbA1c in a larger sample of two hundred and sixty-seven young adults aged 18 to 26, this time in patients with Type 1 diabetes (Stoianova et al., 2018).

As stated at the start of this chapter, research suggests that discount rates peak during adolescence (e.g. Khurana et al., 2018), while adherence rates tend to decline (e.g. Quittner et al., 2014; Tiggelman et al., 2015). Yet the question of whether chronically ill adolescents who struggle to adhere to their medication exhibit steeper discount rates has so far been neglected. However, one recent study of note found associations between discounting and HbA1c in sixty-one adolescents with Type 1 diabetes (Lansing, Stanger, Crochiere, Carracher, & Budney, 2017). In this study, participants were asked to choose between a large constant reward of \$1000, available after four varying delays that ranged from 1 day to 6 months, and a smaller sooner reward starting at \$500, that was adjusted depending on the participant's previous choice. Consistent with earlier studies, adolescents who discounted the value of delayed rewards more steeply had higher HbA1c levels, reflecting worse glycaemic control, albeit the association was weak. This association was moderated by parental observation, suggesting that parental monitoring may act as a buffer against the effects of discounting on HbA1c. However, there was no association between discounting and blood glucose monitoring (BGM), indicating that the link between discounting and glycaemic control in adolescents might be better explained by another aspect of diabetes self-management.

Although this study supports the suggestion of a link between discounting and glycaemic control in adolescents with diabetes, it did not explicitly measure medication adherence. More evidence is therefore needed to elucidate whether chronically ill adolescents' discount rates are predictive of their treatment adherence.

Establishing such a link is important for the development of interventions designed to improve adherence. As previous research has so far focused on patients with T1 and T2 diabetes, it is also important to determine whether this relationship between discounting and nonadherence can be extended to other chronic health conditions.

Examining the role played by delay discounting in adherence to treatments is just one of the aims of this chapter. In light of the research demonstrating that future thinking promotes future-oriented decisions, the relationship between treatment nonadherence and a number of other aspects of future-oriented cognition will also be explored. These aspects of future thinking and their possible links to adherence will be considered next.

#### **4.1.2 Adherence, future self-connectedness and EFT**

People often think about and treat their future self as if it were a different person (Hershfield et al., 2009; Pronin et al., 2007), and this may be one reason for why we tend to make impulsive, present-oriented decisions (Parfit, 1971). As outlined in Chapter 1, and as discussed in Chapter 3, feeling closer to our future self is thought to give us greater motivation to make decisions that will benefit us in the future (Parfit, 1971; Bartels & Rips, 2010; Hershfield et al., 2009). Similarly, episodic future thinking (EFT), which refers to the human capacity to project oneself into the future to pre-experience a possible event (Atance & O'Neill, 2001; Gilbert & Wilson, 2007), is thought to encourage future-oriented decisions as it allows us to vicariously sample future rewards, attenuating our tendency to discount their value due to an associated delay (Boyer, 2008).

The findings of Chapter 3, in addition to the previous literature outlined in Chapter 1, suggest that individual differences in future self-connectedness and EFT

independently predict people's tendency to discount the future. If failure to adhere to medication is, at least in part, due to the discounting of delayed rewards, then adolescent's adherence might be influenced by how connected they feel to their future self, or their capacity to imagine the distant future. To date, no studies have directly investigated whether future self-connectedness and EFT promote medication adherence.

One study, which was published during the writing of this thesis, does, however, investigate conceptually similar, but arguably distinct, constructs in an effort to determine whether failure to adhere to medication is the result of an impaired capacity to consider the future, which the authors referred to as a "*disruption in time projection*" (Reach et al., 2018). This study explored the relationships between medication adherence, temporal discounting and a number of constructs designed to tap into different aspects of future thinking in one hundred and twenty older adults with Type 2 diabetes. As in a previous study (Reach et al., 2011), participants were asked whether they would prefer €500 now or €1500 in one year, with a preference for the smaller reward reflecting "impatience". Participants were also asked to rate the degree to which they felt their present self would *look* similar to their future self in 1 month, 1 year, 5 years and 10 years. A construct labelled "temporal horizon" was assessed by asking participants to list five possible future events and calculating the number of years between the patient's current age and their age at the time of the final event. Additionally, participants were asked to complete the following sentence: "*Joe, drinking his coffee, starts to think of the future. He thinks that...*". Again, the time between the participant's age during which the imagined event occurred and their age at the time of recruitment was calculated

to find the participant's "*time horizon*". Social deprivation and depression were also accounted for.

The findings of this study support those outlined previously. Univariate analysis showed that an unwillingness to wait 1 year for the larger monetary reward was predictive of patients' adherence. Higher depressive symptoms, greater social deprivation, and a longer "temporal horizon", reflecting that a participant generated more distant future events, were also significant predictors of adherence. However, the degree to which patients felt physically similar to their future selves was not. In a multivariate analysis, impatience and depression were independent predictors of adherence, while nonadherence and a long "temporal horizon" were independent predictors of glycaemic control.

However, it should be noted that this study does not directly address the role of future self-connectedness and EFT in adherence, although it does explore constructs that are conceptually similar. While the measure of physical future self-similarity included in this study seems akin to the construct of future self-connectedness described previously, the future self-connectedness referred to throughout this thesis is defined as a *psychological* connectedness between the present and future self (Partfit, 1984; Bartels & Rips, 2010), not a physical similarity. This might explain why Reach et al., (2018) failed to find a significant association between their measure of physical future self-similarity and adherence. Furthermore, although the "temporal horizon" tasks used in the study are similar to sentence completion tasks and event generation tasks employed in some studies of EFT, it is unclear whether a participant being able to list events in the future is indicative of their capacity to simulate detailed future events (Miloyan & McFarlane, 2019).



Therefore, more research is needed to clarify whether future self-connectedness and EFT are predictive of medication nonadherence, as is hypothesised in this chapter.

Crucially, if adolescents who fail to adhere to their medications do indeed feel more distant from their future selves or have difficulty projecting themselves into the future to simulate possible events, then previous research suggests that these may be amenable to intervention. For example, it has been shown that future self-connectedness can be heightened simply by writing a letter to one's future self, which reduces impulsive decision making in delinquent youth (van Gelder et al., 2013), and was shown to lead to an increase in time spent exercising in a study of 191 adults (Rutchick et al., 2018). With regards to EFT, there is now a rich body of research showing that cueing individuals to imagine the future during temporal discounting tasks attenuates their discount rates and discourages impulsive behaviour like overeating and smoking (see Bulley et al., 2016, for a review). Thus, investigating whether these constructs predict medication adherence in adolescents with chronic illness, as this chapter aims to do, may have powerful implications for interventions designed to improve medication adherence.

#### **4.1.3 Adherence, time attitudes and temporal focus**

As we have seen when discussing the individual differences approach to future thinking in Chapter 1, individuals attend to certain time periods over others, creating a predisposition to be influenced by thoughts, emotions and motivations related to that particular time period (Holman & Silver, 1998; Lasane & O'Donnell, 2005; Shipp et al., 2009; Zimbardo & Boyd, 1999).

The limitations of referring to an individual as being "*future-oriented*", when there are seemingly a multitude of ways in which an individual can be oriented to the future, were discussed in Chapters 1 and 3. However, looking beyond this, studies

generally show that greater consideration toward the future is associated with adaptive behaviour. For example, individuals who score high on the Future Time Perspective subscale of the Zimbardo Time Perspective Inventory, reflecting a tendency to plan ahead and set goals, are less likely to engage in problematic substance use (Keough et al., 1999), and more likely to exercise (Griva, Tseferidi, & Anagnostopoulos, 2015). Using the Consideration of Future Consequences scale, researchers have found that individuals who give greater consideration to the future consequences of their behaviour tend to eat healthier foods (Dassen et al., 2015), smoke less (Adams & Nettle, 2009), and those that do smoke are more likely to quit successfully (Kovač & Rise, 2007). A study employing both scales found that a greater orientation to the future predicted a host of behaviours, such as substance use, exercise, and seatbelt use (Daughterty & Brase, 2010). Given that the consequences of nonadherence are situated in the future, while the benefits of failing to adhere are situated in the present, it may be that poor adherence is indicative of a tendency to focus on the present. It is therefore important to explore whether chronically ill adolescents who fail to adhere might be focusing their attention more on the present and less on the future than those with better adherence.

People also differ with respect to their feelings toward the future, and these attitudes are important predictors of positive outcomes in adolescence. As detailed in Chapter 1, positive attitudes toward the future, and positive expectations of the future, are associated with academic achievement (Alansari et al., 2013; Israelashvili, 1997; McKay et al., 2014), self-esteem (Andretta et al., 2014; Worrell & Mello, 2009), and self-efficacy in adolescents (McKay et al., 2015; Seijts, 1998). In the adherence literature, these factors are important predictors of adherence, such that adolescents with better adherence report greater academic achievement (Lansing et

al., 2018), greater self-esteem (Johnston-Brooks, Lewis, & Garg, 2002) and greater self-efficacy (e.g. Griva et al., 2000; Rhee et al., 2018). Furthermore, future time attitudes are conceptually similar to the constructs of hope and optimism (Johnson, Blum, & Cheng, 2014), and chronically ill adolescents with high levels of hope tend to report better adherence (Berg, Rapoff, Snyder, & Belmont, 2007; Maikranz, Steele, Dreyer, Stratman, & Bovaird, 2007). Together these findings suggest there may be an association between how chronically ill adolescents feel about the future and their tendency to adhere to their medications.

In Chapter 3, typically developing adolescents' positivity toward the future and the degree to which they reported focusing on the future, did not correlate with their tendency to discount future rewards. However, as just discussed, future temporal focus and future time attitudes have both been shown to predict positive outcomes in adolescents. It is therefore possible that an adolescent's degree of cognitive engagement with the future and their attitudes toward the future play an important role in encouraging adherence. This possibility will be investigated further in the current chapter.

#### **4.1.4 Adherence and depression**

As reflected on in Chapter 2, living with and managing a chronic illness can be demanding, and is a known risk factor for the development of depression and anxiety in adulthood (Clarke & Currie, 2009). Adolescents with chronic conditions are estimated to be two to three times more likely to experience depression than their peers (Eiser, 1990; LeBlanc et al., 2003; Venning et al., 2008), which is a significant issue considering that adherence declines in the presence of depressed mood (Bender & Zhang, 2008; DiMatteo et al., 2000; Kongkaew et al., 2014).

In Chapter 3, it was noted that depression is linked with an impaired ability to engage in vivid EFT (Dickson & Bates, 2006; Roepke & Seligman, 2016; Williams et al., 1996), and in some studies is associated with a tendency to more steeply discount future rewards (Jarmolowicz et al., 2014; Pulcu et al., 2014). As a result, it was important to control for the presence of depressive symptoms in the previous chapter to ensure any associations between future thinking and discounting in typically developing adolescents were selective and not accounted for by low mood. While typically developing adolescents' discount rates, or their ability to engage in vivid EFT, were not associated with depression in the previous chapter, the high rates of depression in chronically ill adolescents, and the previously documented links between depression and adherence, mean that it is an important factor to account for when investigating the relationships between adherence and future thinking. Of course, this also provided the opportunity to explore associations between future thinking and depression in adolescents with chronic illness.

#### **4.1.5 Adherence and medication beliefs**

In addition to depression, patients' beliefs about the necessity of their medication and the concerns they have regarding their medication are important predictors of adherence (Horne et al., 2013). As with depression, it is important to take account of such beliefs when examining the role played by future thinking in adherence. Strikingly, however, a number of these necessity and concern beliefs are future-oriented. For example, beliefs such as "*My health in the future depends on this medicine*" and "*I sometimes worry about the long-term effects of this medicine*" relate to patients' thoughts about the long-term effects of their medication, both positive and negative. One might assume that a patient who endorses necessity beliefs about preventative medications might be more future oriented than a patient

who is unable to see the long-term benefits of their medication. Similarly, a patient who endorses greater concern beliefs might have more negative attitudes toward the future, given their worries. Therefore, the associations between aspects of future thinking and patient's beliefs about their medicines were also of interest in this chapter.

#### **4.1.6 Study aims**

Ultimately, the aim of this study is to explore the links between future thinking and medication adherence in chronically ill adolescents. As the decision to adhere to treatment can be thought of as a trade-off between immediate and delayed rewards, this study seeks to determine whether chronically ill adolescents who intentionally fail to adhere to their treatments show a greater tendency to discount the value of future rewards. Feeling disconnected from one's future self and an impaired ability to imagine the future with episodic richness are thought to undermine future-oriented decision making; therefore, this study will also seek to explore whether chronically ill adolescents with low adherence feel less connected to their future self or whether they struggle to imagine the future with episodic richness. An additional aim of this study is to investigate the extent to which adolescents with low adherence focus on the future and the extent to which they feel positively about the future. Finally, as depressive symptoms and medication beliefs are known to predict adherence, this study sought to control for these when examining the relationships between future thinking and adherence. However, this also provided the opportunity to examine the associations between these constructs and aspects of future-oriented cognition in chronically ill adolescents.

It may be important to determine whether adolescents with certain conditions are more prone to discounting the future, as this may have implications for the design

of future interventions. Previous studies investigating the role of temporal discounting in medication adherence have so far focused on patients with T1 and T2 diabetes (Lebeau et al., 2016; Reach et al., 2018, 2011). This study sought to replicate and extend these findings to a sample of adolescents with three different chronic conditions: asthma, cystic fibrosis (CF) and Type 1 (T1) diabetes.

#### **4.1.7 Study overview**

In this study, adolescents with a consultant confirmed diagnosis of asthma, cystic fibrosis (CF), or Type 1 (T1) diabetes completed existing questionnaire measures of adherence (Medication Adherence Report Scale, MARS, Horne & Weinman, 1999), medication beliefs (Beliefs about Medications Questionnaire, BMQ, Horne & Weinman, 1999), depression (Centre for Epidemiological Studies Depression scale, CES-D, Radloff, 1977), temporal focus (Temporal Focus Scale, TFS, Shipp et al., 2009), time attitudes (Adolescent Time Inventory Time Attitude scale, ATI-TA, Mello & Worrell, 2007), and the same measure of future self-connectedness and temporal discounting used in the second study of Chapter 3. Again, episodic memory and EFT were assessed using the Remember/Imagine task, in which participants were asked to remember and imagine and describe past and future events.

To examine the links between adherence and future thinking, adolescents with low and high adherence were compared to explore differences on the measures of future thinking described above, while associations between future thinking, depression, and medication beliefs were also examined in a separate correlation analysis. Results from an analysis including adolescents with three different chronic conditions are reported. This is followed by results from an analysis with the largest subgroup, consisting of the adolescents with T1 diabetes.

## **4.2 Method**

### **4.2.1 Participants**

Adolescents and their parents were recruited from paediatric outpatient (OP) clinics and inpatient wards (IP) at the Royal Belfast Hospital for Sick Children and Beech Hall Health Centre. Adolescents were considered eligible to take part if they were aged 12 to 17 years of age and had a consultant confirmed diagnosis of asthma, cystic fibrosis (CF), or Type 1 (T1) diabetes. Adolescents were not invited to take part if their physician did not believe them capable of providing assent, or if they were not accompanied by a parent. Details on the consent process can be found in section 4.2.3.

Although the aim of this study was to recruit fifty adolescents per condition, totalling one hundred and fifty adolescents and their parents, only seventy-six agreed to take part in the end. Two of these adolescents, despite initially agreeing to be involved, were unable to initiate the study due to time constraints. Information was not collected from those adolescents who did not accept the invitation to take part. Overall, seventy-four adolescents with a chronic illness (51% female) aged 12 to 17 years ( $M = 14.5$ ,  $SD = 1.62$ ) and their parents completed the study. Twenty adolescents had a diagnosis of asthma, sixteen had a diagnosis of CF and thirty-eight a diagnosis of T1 diabetes. Of the adolescents with T1 diabetes, seven had an insulin pump. Of the adolescents with CF, two had a co-morbid diagnosis of CF related diabetes. Of the adolescents with asthma, half (50%) were recruited from “difficult to treat” asthma clinics. More detailed information about participant characteristics based on illness group can be found in section 5.3.2.

Favourable ethical approval was granted by Leicester Central Research Ethics Committee (17/EM/0303) and final research governance permission was obtained

from the Belfast Health and Social Care Trust (17075AF-SW) (see *Appendices 4.1, 4.2 and 4.3*). Data collection took place from December 2017 to October 2018.

#### **4.2.2 Measures**

A summary of the measures used in this study can be found in Figure 4.1 Summary of administered measures and order in which they were completed by participants. A number of these measures are identical to those used in Study 2. Where applicable, relevant sections in the previous chapter will be signposted.

##### ***4.2.2.1 Adherence***

As recommended by Modi et al., (2006), this study aimed to employ a multi-method approach to assess adherence, using self-report measures of adherence alongside a more objective measure (based on Goodfellow et al., 2015). To be consistent with convention in the adherence literature, a threshold of 80% was utilised to dichotomise adherence. Although this method of dichotomising adherence has attracted criticism (Tueller, Deboech & Van Dorn, 2016), the decision to dichotomise adherence in this study is based on the argument that there is often a cut-off point at which non-adherence will directly impact on patient outcomes. A threshold of 80% adherence is generally considered to be optimal and has been shown to predict patient outcomes in previous studies (Karve et al., 2009; Lasmar et al., 2009). That is, patients who fall below this 80% threshold are likely to be taking less medication than is necessary for clinical efficacy. An additional reason for dichotomising adherence in this study was to allow for triangulation of the three adherence measures.

**Medication Adherence Report Scale (MARS).** Self-reported nonadherence was assessed separately for both the adolescents and their parents using the



Medication Adherence Report Scale (MARS, Horne & Weinman, 1999), providing an adolescent self-report measure (adolescent MARS) and a parental self-report measure (parent MARS) of adherence. Assessing the extent of patients' nonadherence, instead of their adherent behaviour has been shown to better correlate with more objective measures of adherence, such as pill counts (Haynes et al., 1980). Two versions of the MARS were used in this study; a 7-item scale, and a 10-item scale. Three 7-item subscales were used to measure the frequency of nonadherence to enzyme supplements, vitamins and chest physiotherapy in the CF group. A single 7-item MARS was used to measure the frequency of nonadherence to insulin in the diabetes group. For the asthma group, a 10-item asthma-specific MARS (MARS-A, Cohen et al., 2009) was used to measure the frequency of nonadherence to preventative inhalers (see *Appendices 4.4, 4.5 and 4.6*).

To reduce the threat of social desirability, items of the MARS are phrased in a non-threatening manner, and the questionnaire is prefaced with a statement designed to normalise nonadherence: *"Here are some ways in which people have said they use their medicines..."* Examples of scale items common to both versions of the questionnaire include *"I decide to miss out on a dose"*, *"I avoid using it"* and *"I stop taking it for a while"*. The MARS is scored on a 1-5 Likert scale (always-never), with one item on the 7-item scale (*"I use it regularly every day"*) being reverse scored. Although both the 7 and 10-item MARS include the item *"I/They forget to take it"*, this item was excluded from the final adherence total on the basis that it assesses unintentional nonadherence. The items are then summed. For the CF group, scores were summed over the three separate subscales to provide a single score for the adolescent and a single score for the parent. Due to the different numbers of items on the scales, and to facilitate group comparison, scores were

transformed to range from 0 – 100 (i.e. expressed as proportions of the highest possible score for that participant), with higher scores reflecting greater self-reported adherence.

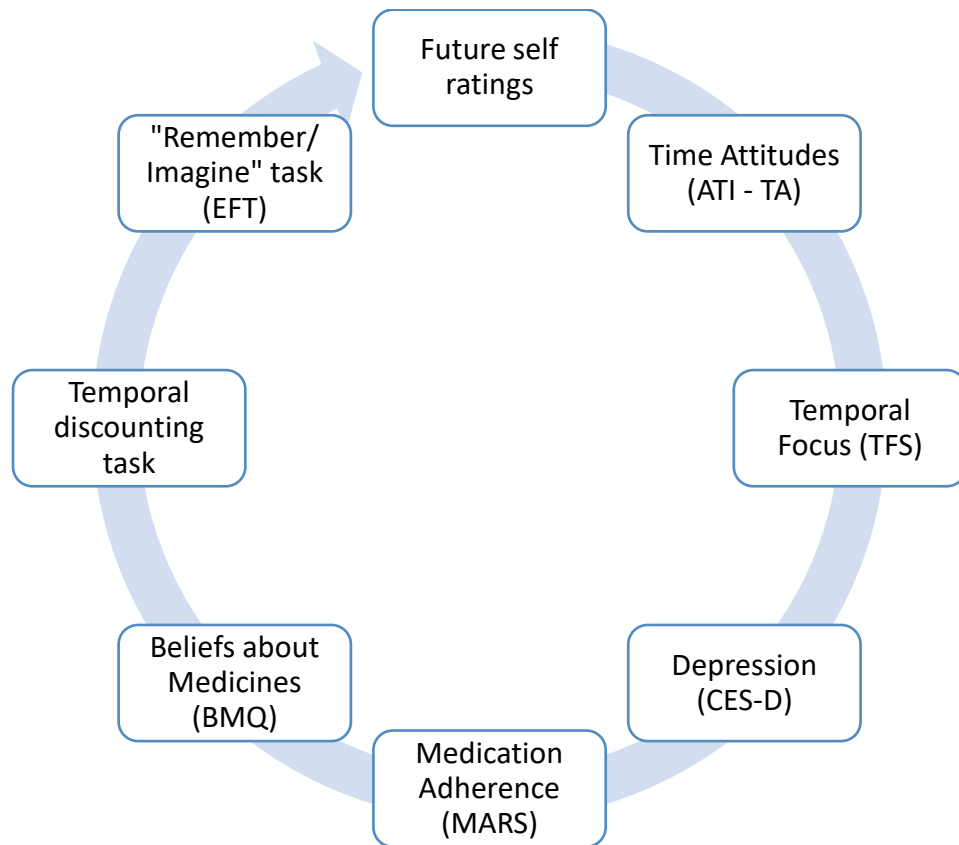


Figure 4.1 Summary of administered measures and order in which they were completed by participants.

**Reliability and item removal: Adolescent MARS.** Cronbach’s alpha showed good internal consistency for the adolescent MARS scores in the asthma group ( $\alpha = .83$ ). In the diabetes group, Cronbach’s alpha for the adolescent MARS was  $<.7$ , indicating poor internal consistency. On further investigation, it was determined that the item “*I use it regularly every day*” was poorly correlated with the other items in the scale ( $r <.12$ ), despite being appropriately reverse coded. As this item was positively worded, participants had to tick the left-most column which read “*always*”

to indicate good adherence. Up until this final item, the “*always*” column would have indicated nonadherent behaviour. Participants may have ticked the “*never*” box for this final item, not recognising this change in wording. Excluding this item increased Cronbach’s alpha from .69 to .74.

For the CF group, the internal consistency estimates of the three adolescent MARS subscales were investigated separately before looking at the overall internal consistency of the combined scale. Cronbach’s alpha for the enzyme subscale was extremely poor ( $\alpha = .18$ ). After investigation, it was determined that the item “*I/They alter the dose*” correlated negatively with the other items ( $r > -.25$ ). This is consistent with previous research using this scale (Goodfellow et al., 2015). This is likely because altering the dose of enzymes depending on meals and snacks is a necessary aspect of self-management and so endorsement of such a behaviour is not reflective of nonadherence per se. Removing this item improved internal consistency substantially ( $\alpha = .66$ ). This item also proved problematic on the vitamin subscale for the same reasons, and its removal led to an increase in Cronbach’s alpha from .69 to .80. For the chest physiotherapy subscale, the item “*I only use it when I experience symptoms*” was found to be negatively correlated with other items ( $r > -.3$ ). The removal of this item increased Cronbach’s alpha from .67 to .74. Across all three subscales, item removal led to an improvement in Cronbach’s alpha from .65 to .72.

To summarise, all analyses comparing low and high adherers were conducted following the removal of item 7 from the adolescent MARS in the diabetes group. For the CF group, item 1 was removed from both the enzyme and vitamin subscale, and item 4 was removed from the chest physiotherapy subscale (see *Appendices 4.4, 4.5 and 4.6*).

**Reliability and item removal: Parent MARS.** Cronbach's alpha for parents' vitamin and enzyme subscales in the CF group were both  $>.7$  ( $\alpha = .79$  and  $.83$  respectively). The internal consistency estimate of the chest physiotherapy subscale, however, was very poor ( $\alpha = .17$ ). As seen in the adolescent MARS for the diabetes group, the item "*They use it regularly every day*" was negatively associated with other items on the subscale ( $r > -.3$ ), despite appropriate reverse coding. Removal of this item improved the internal consistency of the scale ( $\alpha = .58$ ). Overall, the internal consistency across the three subscales increased from  $.76$  to  $.83$  after the removal of this item. The internal consistency estimates of the parent MARS in the diabetes and asthma groups were lower ( $\alpha = .60$  and  $.65$  respectively). However, no items were identified as being candidates for removal.

**General Practitioner (GP) data.** Prescription issue records covering the 12 months prior to recruitment were requested from participants' GPs in order to calculate their Medication Refill Adherence (MRA; Hess, Raebel, Conner, & Malone, 2006). Using the threshold of 80%, adolescents would be classified as low adherers if their GP records indicated that less than 80% of their medications were issued in the 12 months prior to recruitment. However, the requested data was only received for 35 participants - a response rate of 47%.

The MRA method involves calculating the total days' supply from the patients' dose and the amount of medication they are prescribed with each prescription issue. For example, a patient who is issued 28 tablets and prescribed 1 tablet daily will have a total days' supply of 28. If the patients' records then show 10 prescription issues over the course of the study/evaluation period (in this study, the evaluation period was taken to be the 12 months prior to recruitment), with the same dose and amount prescribed, then the total days' supply during the study period

would be 280. Typically, this total days' supply is then divided by the number of days in the study period (i.e. 365 days) and multiplied by 100. However, to account for adolescents who had been hospitalised in the 12 months prior to recruitment, “*days spent in hospital*” was deducted from the evaluation period. As reported by Goodfellow et al., (2015), the revised calculation was therefore:

$$\text{MRA} = \frac{\text{Total days' supply}}{\text{Days in study period} - \text{Days spent in hospital}} \times 100\%$$

For the adolescents with asthma, MRA was calculated for any medication taken daily for preventative reasons, such as ICS inhalers, combination inhalers, or other preventative treatments. For adolescents with CF, MRA was calculated for enzyme supplements and vitamins. For the adolescents with diabetes, MRA was calculated for both short acting and, where applicable, long acting insulin. For the two participants in the CF group who had cystic-fibrosis related diabetes, the MRA was calculated only for their CF medications. For the purposes of analysis, an average was taken across all relevant medications to yield one composite MRA score for each participant. MRA values were truncated at 100%.

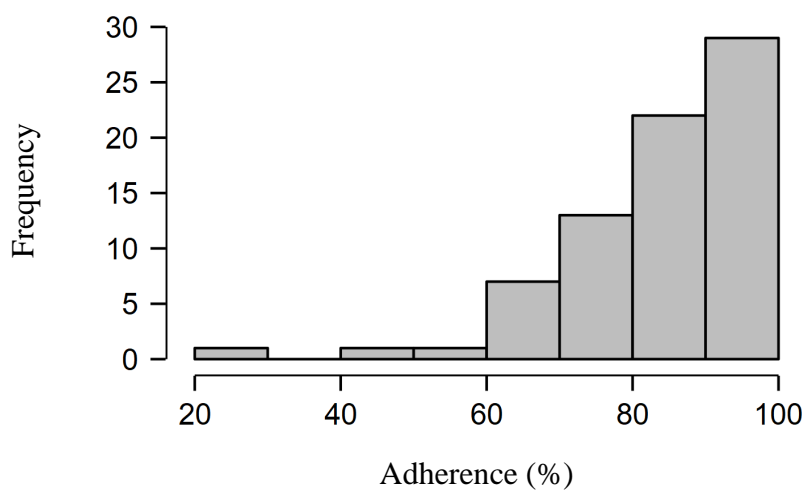
***Medication Refill Adherence (MRA) adjustment.*** As insulin and enzyme supplements are dose-adjusted daily, dosage was not stated on the prescription issue records obtained from GPs. This presented a challenge for calculating total days' supply for participants in the diabetes group and those prescribed enzymes in the CF group. Although a possible solution is to assume that GPs are prescribing 28 days' worth with each prescription issue, this is problematic when dealing with treatments that require daily dose adjustments (Buysman, Conner, Aagren, Bouchard, & Liu,

2011). Patients may seem nonadherent when they fail to request another prescription after 28 days, when in reality they may simply have more than a months' worth due to appropriate adjusting (Baser, Bouchard, DeLuzio, Henk, & Aagren, 2010).

Therefore, a method outlined by Buysman et al., (2011) was employed to correct for this. This method allows for the calculation of a more accurate estimate of total days' supply by taking into account the median length of time between prescription claims for participants taking the same medication. More simply, it provides an estimate of how long a specific medication tended to last in the group of interest. Medication Refill Adherence (MRA) was calculated with and without this adjustment, and this did not result in a change of adherence categorisation for any participant.

First, the MRA was calculated as described previously, with each prescription issue assumed to be a 28 days' supply. Then, for each participant in the CF group prescribed enzyme supplements and for whom GP data was available ( $N = 10$ ), an adjustment factor was calculated by dividing the groups' median time between prescription issues by the groups' median days' supply. The unadjusted MRA was then multiplied by this adjustment factor to yield an adjusted MRA for enzyme users. In the diabetes sample for whom prescription issue records were available ( $N = 12$ ), an adjustment factor was calculated for each "cohort" or group of participants using same-sized packages of insulin (Buysman et al., 2011). In this group, two rapid-acting insulin package sizes were identified (3ml pen and 10ml vials), and only one long-acting insulin package size was identified. Again, the median days between prescription issue claims was divided by the median days' supply to produce an adjustment factor for each cohort. Finally, the unadjusted MRA for each participant was multiplied by the adjustment factor specific to their insulin.

**Composite measure of adherence.** Initially, analysis was to be conducted on an adherence composite that would categorise a patient as a low adherer if they scored  $< 80\%$  on any of the measures of adherence described above. However, as GP data and the resulting Medication Refill Adherence (MRA) data could only be obtained for 47% of the participants in the sample, a composite was created based on only with the adolescent and parent self-report data. As such, adolescents were classified as low adherers if they scored less than 80% on either the parent *or* adolescent MARS (Medication Adherence Report Scale). This meant that if a participant was classified as a low adherer using one self-report measure then they were classified as a low adherer, even if the other self-report measure indicated that they were a high adherer, as was the case for 23 participants. 65% of adolescents in the asthma group were classified as low adherers, 13% of adolescents with CF were low adherers, and 37% of adolescents with diabetes were low adherers. The distribution of child and parent adherence rates (%) prior to dichotomisation can be seen in *Figure 4.2* and *Figure 4.3*.



*Figure 4.2* Distribution of adherence rates (%) based on child self-report.

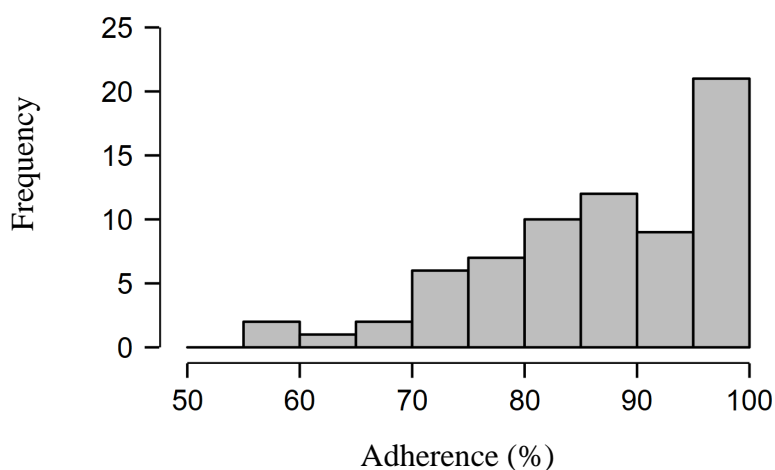


Figure 4.3 Distribution of adherence rates (%) based on parent self-report

#### 4.2.2.2 Beliefs about medicines

The Beliefs about Medicines Questionnaire - Specific (BMQ; Horne, Weinman, & Hankins, 1999) was used to assess participants' beliefs about the necessity of their prescribed medication as well as their concern beliefs regarding possible adverse consequences of adherence. Necessity beliefs are assessed using a 5-item subscale (e.g. "My health at present depends on my medicine(s)"). Concern beliefs are assessed using a 6-item subscale (e.g. "I sometimes worry about the long-term effects of my medicine(s)"). Items on both subscales are rated on a Likert Scale of 1 to 5 (Strongly Disagree – Strongly Agree). High necessity and concern scores indicate greater necessity beliefs and concern beliefs respectively.

Internal consistency estimates for the necessity subscale ranged from .75 to .85 across the three illness groups. With regards to the concerns subscale, internal consistency for the asthma and diabetes groups was moderate to good ( $\alpha = .75$  and  $\alpha = .82$  respectively). However, Cronbach's alpha was lower in the CF group ( $\alpha = .54$ ). It is possible that the low internal consistency observed in the CF group is due to



participants only completing one version of the BMQ, as opposed to separate, medication-specific subscales as seen in other studies (e.g. Goodfellow et al., 2015). Adolescents with CF are often taking numerous medications and are likely to have different views depending on the treatment in question, which perhaps explains the poor internal consistency seen here. However, this internal consistency estimate is consistent with a previous study using adapted, and separate versions of the BMQ-Specific to assess concern beliefs regarding physiotherapy and antibiotic use in adolescents with CF (Bucks et al., 2009), suggesting there may be other possible explanations for the low internal consistency seen here.

#### ***4.2.2.3 Health outcomes and baseline data***

Information regarding patients was collected using the Northern Irish Electronic Care Record (NIECR) and medical notes where necessary. This included information regarding the contact details of their GP, whether or not the adolescent had been hospitalised in the year prior to recruitment, whether or not they had comorbid diagnoses, and the number of medications they were prescribed at the time of recruitment. Relevant health outcome data specific to the day of recruitment was also collected, specifically FEV1% (assessing forced expiratory volume in one second; an indicator of lung function) for participants with asthma and CF, and HbA1c (assessing glycated hemoglobin; an indicator of glycaemic control) for participants in the diabetes group.

Collection of postcode data from parents allowed for information regarding the participants' socioeconomic status (SES) to be determined using the Northern Ireland Multiple Deprivation Measure 2017 (NIMDM, Northern Ireland Statistics and Research Agency, 2017). The NIMDM ranges from 0 – 890, with higher rankings indicating areas of less deprivation.

#### ***4.2.2.4 Temporal (TD) discounting***

As in the previous chapter, participants were asked to make repeated hypothetical choices between a large constant reward available after a delay, and a smaller reward available immediately. Subjective values of the delayed reward were determined in order to calculate the AUC (see section 3.6.2.1 for detail; Meyerson et al., 2001).

#### ***4.2.2.5 Episodic Future Thinking – the “Remember/Imagine” task***

Participants’ episodic past (EPT) and future thinking (EFT) was assessed using the same pen and paper task outlined previously (see section 3.6.2.2). Participants were asked to remember two past events, and to imagine two future events, and to write in as much detail what they had remembered or imagined.

***Scoring of the Remember/Imagine task.*** For details on how the adolescents’ narratives were scored, see section 3.6.2.2. To summarise, details were categorised as being internal (episodic) or external (non-episodic). Details were categorised as internal if they pertained directly to the event described, were specific in time and place, and conveyed a sense of episodic re/pre-experiencing. Details that did not fit these specifications, such as repetitions or details about other events, were categorized as external. Each described event was also assigned a qualitative experimenter rating assessing the episodic richness of the description on a scale of 0 to 6. This rating was used as a measure of the extent to which the description evoked an impression of re/pre-experiencing by taking the reader back to a specific moment in time and place, in which they are able to re-create the perceptual, emotional and cognitive contextual detail of the participant’s event.

All event narratives were scored first by the researcher and then by a second, independent rater for reliability. As summarised in Table 4.1, there was acceptable

agreement between raters. Interrater correlations ranged from .79 to .92, and intraclass correlation coefficients (ICCs) ranged from .88 to .98.

*Table 4.1 Interrater and intraclass correlation coefficients for past and future event narratives showing agreement between raters.*

	Internal details	External details	Episodic richness
<b>Interrater correlation coefficients</b>			
Past	.97	.82	.82
Future	.91	.79	.82
<b>Intraclass correlation coefficients</b> ( <i>two-way mixed, consistency</i> )			
Past	.98	.90	.91
Future	.96	.88	.89

*N = 58 (only including adolescents who generated all four event narratives; see section 4.3.1.1 for details on missing EPT/EFT data)*

**Phenomenological rating scales.** After having described each event, participants assessed the phenomenal characteristics of the remembered/imagined event using a series of rating scales (adapted from D'Argembeau & Van der Linden, 2006; see section 3.6.2.2 for more detail). To recap, these scales assessed the visual and sensory clarity of the remembered/imagined event, the clarity of the location and time in which the event took place, the extent to which the participant felt they mentally travelled in time to when the event happened/would happen and the degree to which the participant felt they were re-experiencing/pre-experiencing the event. Emotional aspects of the event were also assessed, including the degree of emotional re-experiencing or pre-experiencing during the task, the valence and the emotional intensity of the event. The subjective temporal distance of the event was also assessed.

***Phenomenological characteristic composites.*** Composites of participants' phenomenal ratings were calculated as outlined in the previous chapter (see Table 3.1). For each event, participants' ratings of sensory (visual, sound, smell), temporal, and locational clarity were summed to create a composite score labelled clarity. Participants' ratings of re-experiencing/pre-experiencing the event and ratings of mentally travelling backward/forward in time to when the event happened/would happen were summed to create a composite labelled mental time travel. Participants' ratings of re-experiencing/pre-experiencing the emotions associated with the event were analysed as a separate variable, as were ratings of emotional intensity, emotional valence and temporal distance. Final past and future variables were calculated by averaging across the near/distant conditions.

#### ***4.2.2.6 Future self-connectedness***

As in the previous study (see section 3.6.3.2), participants were asked to think of the person they are now (the present self) and the person they think they will be in 5 years (the future self) and to rate, on a horizontal scale of 0 – 100, how similar they feel their present self and future self to be in terms of 4 dimensions: personality, hobbies, likes-dislikes, and overall. Participants' tended to score lower on their ratings of overall future self-connectedness than on the average rating taken across all four dimensions. Therefore, both the overall and average ratings were used for the purpose of analysis.

#### ***4.2.2.7 Temporal Focus Scale***

The TFS (Shipp et al., 2009) was used to assess the adolescents' degree of cognitive engagement with the past, present and future (see section 3.6.2.4). Cronbach's alpha across the three illness group ranged from .77 to .85. For the sample as a whole, Cronbach's alpha indicated good internal consistency ( $\alpha = .80$ )

#### ***4.2.2.8 Adolescent Time Inventory – Time Attitudes***

Participants' attitudes toward the past, present and future was assessed using the ATI-TA (Mello & Worrell, 2007). As in the previous two chapters, three subscales labelled past positivity, present positivity and future positivity were calculated and used for the purpose of the study (see section 3.6.2.5). Internal consistency estimates across the three illnesses ranged from .85 to .91 for the past subscale, .74 to .91 for the present subscale and .84 to .89 for the future subscale. Overall, Cronbach's alpha indicated good internal consistency for the past, present and future subscales ( $\alpha = .89$ ,  $\alpha = .89$ , and  $\alpha = .87$  respectively).

#### ***4.2.2.9 Centre of Epidemiological Scale – Depression***

The CES-D (Radloff, 1977) was used to assess depressive symptomatology (see section 3.6.2.6). Internal consistency estimates ranged from .83 to .89 across the three illnesses and Cronbach's alpha showed good internal consistency across all participants ( $\alpha = .87$ ).

### **4.2.3 Procedure**

#### ***4.2.3.1 Invitation to take part***

A summary of the study's procedure can be found in Figure 4.4. Adolescents and their parents deemed eligible to take part by their physician were first approached by a member of their healthcare team, such as their nurse or doctor, who gave a brief summary of the study and asked if the adolescent and their parent would be interested in finding out more or were interested in taking part. If the young person and their parent agreed to either, they were introduced to the researcher who provided parental and child information sheets and explained the study in greater detail. This process was identical for both adolescents recruited from outpatient

clinics and the five CF patients recruited from inpatient wards. If the adolescents and their parents agreed to take part, then consent was obtained as outlined below.

#### ***4.2.3.2 Consent process***

Following full explanation of the study, parents of adolescents aged 12 to 15 were asked to provide written consent for themselves and their child to take part, while their child provided written assent to take part. Adolescents aged 16 and above were asked to provide written consent, while their parents gave consent for themselves to take part in the study. Consent/assent (as detailed above) was also sought to allow access to the young person's medical notes and for prescribing data to be collected from their GP. Participants and their parents were also asked to provide consent for the researcher to contact their clinician if the results of the CES-D indicated the adolescent was experiencing high levels of distress.

#### ***4.2.3.3 Completion of study***

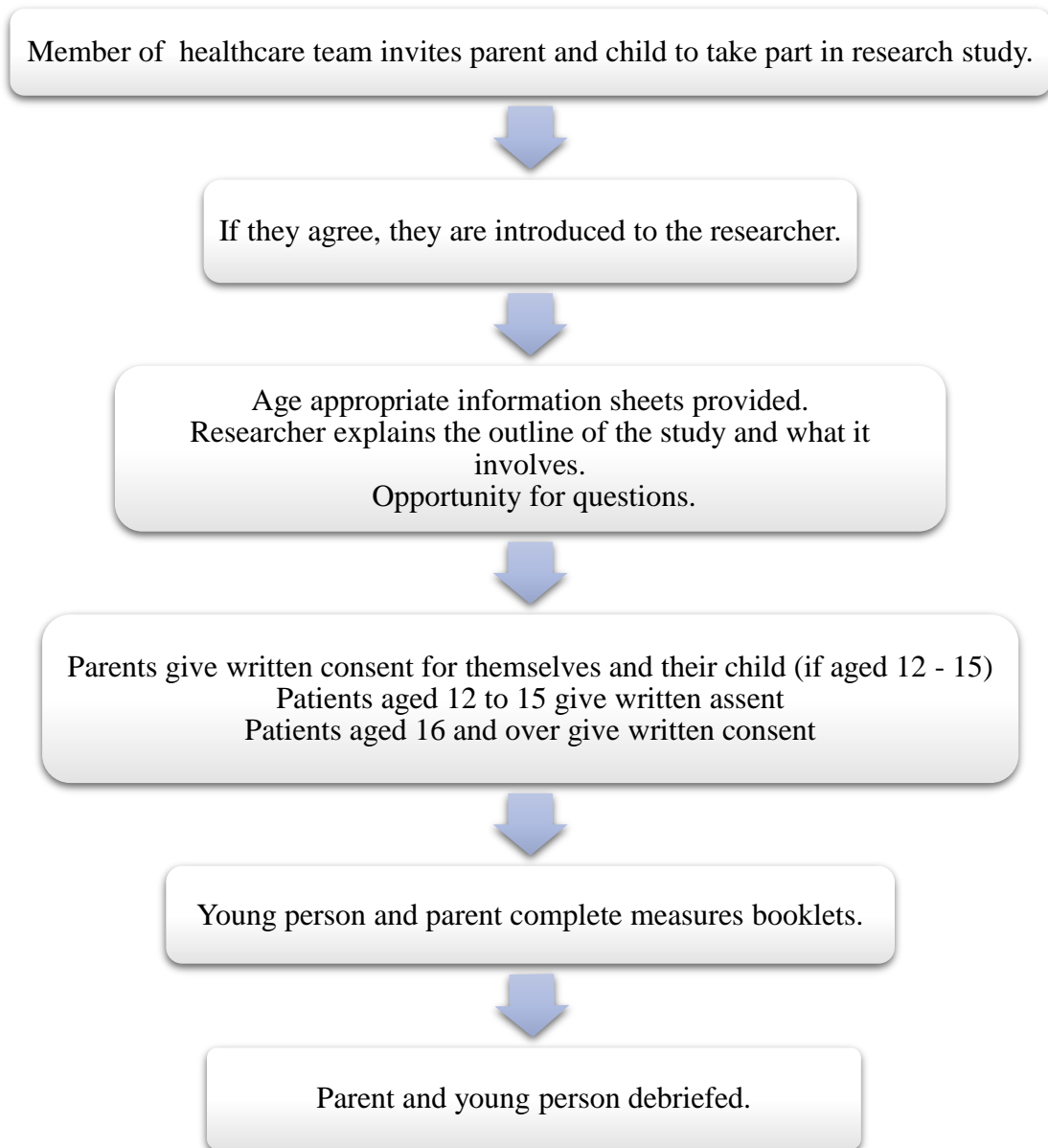
Once the consenting process was complete, parents were provided with a booklet that asked some basic demographic questions about their child. Specifically, their date of birth, gender and post code. Postcode data allowed for SES to be determined and allowed for the matching of participants on the basis of SES in Chapter 4.

Parents were then asked to rate on a 6-point scale the degree to which their child (vs. their parent) was responsible for the taking of their medication/treatment, where 1 indicated the child had no responsibility for their medication, and 3 indicated shared responsibility. Parents then completed a parental version of the Medication Adherence Report Scale (MARS; Horne & Weinman, 1999). Parents of adolescents with CF were asked to complete three versions of the MARS: one designed to assess adherence to enzymes, one for chest physiotherapy and one for

vitamins. Parents of adolescents with diabetes and asthma were only asked to complete one version of the MARS.

At the same time, the adolescent received two questionnaire booklets. As in Chapter 3, the first questionnaire booklet contained the measure of future self-connectedness, ATI-TA, TFS and the CES-D. This booklet also contained the illness-specific MARS, and the BMQ. The second booklet contained the temporal discounting task. Participants completed the booklets in this order. For participants recruited from OP clinics, participants and their parents completed their questionnaires independently at a time convenient to the running of the clinic, although for two younger participants, the researcher facilitated the completion of the first booklet by reading aloud the items when required.

When finished, the participants completed the third booklet containing the “Remember/Imagine” task. This was facilitated by the researcher who read aloud the instructions on the front page. Participants were then timed for 3 minutes as they wrote, after which they were verbally prompted by the researcher. The researcher then waited for the participants to complete the accompanying phenomenological rating scales. Once finished, the timer was reset, and the participants were asked to move on to the next event. Following this final task, participants and their parents were provided with a debrief sheet that the researcher read aloud (see *Appendix 4.7*). The study took approximately 50 minutes to complete for each participant, and was completed in a quiet area of the waiting room.



*Figure 4.4 Summary of study procedure.*

#### ***4.2.3.4 Collection of data from medical records***

Baseline data was collected using the Northern Ireland Electronic Care Record (NIECR), and participants' medical notes where necessary. This was carried out with the assistance of research nurses from patients' healthcare teams.



## 4.3 Results

### 4.3.1 Future thinking and adherence in adolescents with chronic illness

#### 4.3.1.1 Data pre-processing

**Missing or non-systematic data.** Discounting data from five adolescents were considered non-systematic and so were excluded from analysis. Data was deemed non-systematic if any subjective value of the delayed reward was larger than the subjective value associated with the previous, shorter delay by a magnitude greater than 20% of the delayed reward (£20; criterion 1 from Johnson & Bickel, 2008).

In total, sixteen adolescents failed to generate all four event narratives. Five of the adolescents with diabetes, one adolescent with asthma, and one adolescent with CF failed to complete any of the four event narratives due to time constraints. Of the remaining nine adolescents, two adolescents with diabetes, four adolescents with asthma and three adolescents with CF struggled to generate all four events, but did provide at least one past event narrative and one future event narrative. The ratings associated with these events were used for the purpose of analysis.

**Outliers.** Outliers were identified separately by group for the main analysis comparing between low and high adherers on key measures (Tabachnik & Fidell, 2012; Field, 2013). For the separate correlation analysis, outliers were assessed across the group as a whole. The main analysis comparing low and high adherers was conducted following the removal of one depression score and one past positivity score from the high adherence group, for being more than 3 SD above the mean. One low adherer had an AUC more than 3 SD above the mean, which was also removed.

The separate correlation analysis was conducted following the removal of one average connectedness rating, one present positive score, two future positive scores, and one present focus score, which were all more than 3 SD below the mean. Two depression scores more than 3 SD above the mean were also excluded from correlation analysis.

**Normality and transformations.** Key variables were examined for evidence of skew. Normality was assessed separately by group (i.e. low or high adherer) for the main analysis comparing low and high adherers (Tabachnik & Fidell, 2012; Field, 2013). For the separate correlation analysis, skew was assessed across all participants. A number of descriptive variables, such as number of medications, were skewed but unable to be transformed. Therefore, the non-parametric Mann Whitney-U was used to compare median scores on these variables.

**Low and high adherers.** Skewness z-scores  $> +/- 1.96$  were used to define non-normality, as appropriate for the sample size of each group (Kim, 2013). Discount rates (AUC) were highly positively skewed in both low and high adherers ( $Z\text{-skew} = 2.52$  and  $2.99$  respectively). This was also true for CES-D scores ( $Z\text{-skew} = 3.99$  and  $3.02$ ). A square root transformation reduced the skewness in discount rates in low and high adherers ( $Z\text{-skew} = 1.92$  and  $1.51$ ) but did not reduce the skewness of depression scores. A log transformation (with a constant of 1 to account for zero values) also failed to reduce the skewness of depression scores ( $Z\text{-Skew} = -2.77$ ). Therefore, a non-parametric method was used, in addition to independent t-tests, when comparing low and high adherers on CES-D scores.

BMQ Necessity scores were negatively skewed in both groups ( $Z\text{-skew} = -2.05$  and  $-2.06$ ), while future positivity scores were negatively skewed in the low

adherence group only ( $Z\text{-skew} = -2.50$ ). Square transformations reduced the skewness of BMQ Necessity scores in both groups ( $Z\text{-skew} = -1.54$  and  $-1.19$ ). Square transformations (applied to future positivity scores across both groups) effectively reduced the skewness of future positivity scores in low adherers ( $Z\text{-skew} = -1.35$ ), without adversely influencing the distribution of the high adherer future positivity scores.

Of the EPT and EFT variables, past valence ratings were negatively skewed in low and high adherers ( $Z\text{-skew} = -2.35$  and  $-2.78$  respectively), as were future valence ratings ( $Z\text{-skew} = -3.11$  and  $-2.22$ ). A square transformation reduced the skewness of past valence ratings in both groups ( $Z\text{-skew} = -1.24$  and  $-1.80$ ) and future valence ratings in both groups ( $Z\text{-skew} = -1.03$  and  $-1.21$ ). Internal details in low and high adherers' past event narratives were positively skewed ( $Z\text{-skew} = 3.29$  and  $2.39$ ), while past external details were positively skewed in the high adherers ( $Z\text{-skew} = 4.81$ ). Future external details were also positively skewed ( $Z\text{-skew} = 2.79$  and  $4.65$ ). Square root transformations effectively reduced the skewness of past internal detail scores ( $Z\text{-skew} = 1.64$  and  $.33$ ), past external detail scores ( $Z\text{-skew} = -.40$  and  $1.70$ ) and future external details ( $Z\text{-skew} = .95$  and  $.98$ ).

In summary, univariate analysis comparing low and high adherers was conducted on transformed AUC, CES-D, BMQ Necessity and future positivity scores. Of the EPT and EFT variables, analysis was performed using transformed past valence and future valence ratings, past internal detail scores, and past external and future external detail scores.

**Correlation analysis.** In the separate correlation analysis, conducted to explore associations between key variables across all participants ( $N = 74$ ), the cut-

off for normality was skewness z-scores  $> +/- 3.92$  (Kim, 2013). As only AUC and CES-D scores were highly skewed ( $Z\text{-skew} = 4.76$  and  $5.14$  respectively), correlations were conducted on square root transformed discount rates and depression scores, which effectively reduced the skewness of both variables ( $Z\text{-skew} = 2.78$  and  $.35$  respectively).

#### ***4.3.1.2 Descriptive statistics***

Table 4.2 shows the baseline characteristics of low and high adherers. The characteristics of the group as a whole can be found in Chapter 5 (see Table 5.10). Age did not differ significantly between low and high adherers,  $t(72) = -1.57$ ,  $p = .12$ , and there was no significant difference between the two groups with respect to parent-reported responsibility for adherence.

Across all adolescents, 58% of parents reported having full to shared responsibility for their child's adherence; the remaining 42% responded that their child had most, if not all, of the responsibility for their adherence. Only three parents indicated that their child had full responsibility for adherence. Adherence was not associated with gender, socioeconomic status, hospitalisation or comorbidity status (see Table 4.2). Across all participants, 42% provided postcodes that placed them as living in areas ranked in the bottom quartile for deprivation in Northern Ireland. 47% had a diagnosed co-morbidity and 19% had been hospitalised in the year prior to recruitment.

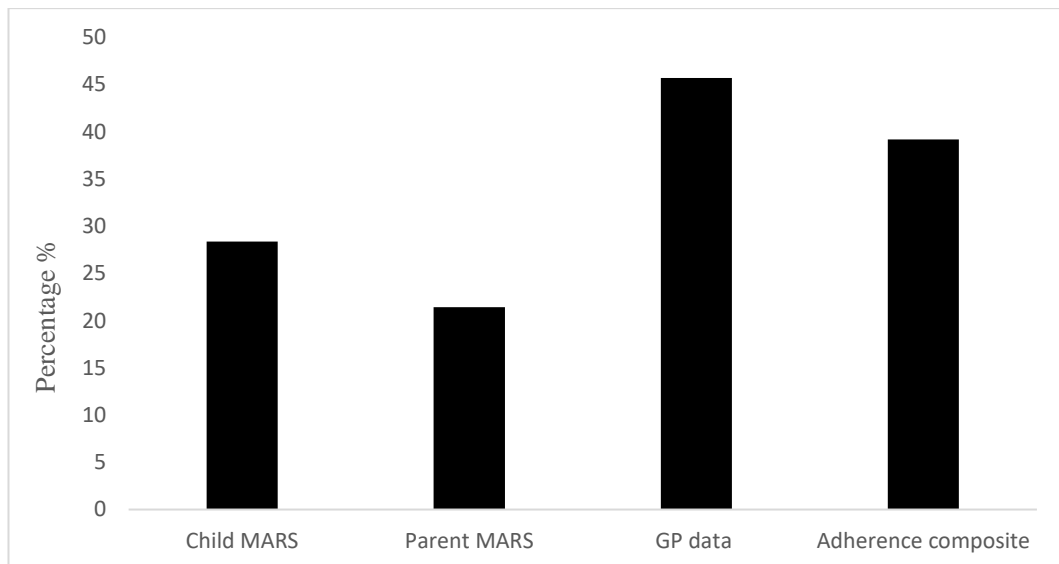
As shown in Figure 4.5, adherence estimates varied depending on the method employed and the person responding. Although parents tended to overestimate their child's adherence, there was no significant difference between the adolescents and their parents adherence scores,  $t(142) = -1.11$ ,  $p = .27$ . GP prescription issue records

showed a less optimistic picture of adherence than the self-report measures, indicating that 46% of the 35 participants for whom prescription data was available were classified as low adherers. Based on the composite, by which adolescents were classified as being low adherers if they scored < 80% on either the parent or adolescent self-report measure of adherence, 39% of the adolescents were classified as low adherers to their medication.

*Table 4.2 Baseline characteristics of low and high adherers.*

	Adherence status		<i>p</i>
	<b>Low adherers</b>	<b>High adherers</b>	
Total N (%)	29 (39)	45 (61)	-
<b>Age</b>			
Mean ( <i>SD</i> )	14.1 (1.44)	14.7 (1.70)	.12
<b>Gender</b>			
Female N (%)	14 (48)	24 (53)	.67
<b>Parental responsibility</b>			
Median ( <i>IQR</i> )	3 (3 – 4)	3 (3 – 4)	.76
<b>Multiple Deprivation Measure</b>			
N (%)			
< 25 %	14 (48)	17 (38)	
25 – 50 <sup>th</sup> %	3 (10)	11 (24)	.49
50 – 75 <sup>th</sup> %	6 (21)	8 (18)	
> 75 %	6 (21)	9 (20)	
<b>Hospitalised in year prior?</b>			
Yes N (%)	4 (14)	10 (22)	.37
<b>Num. of prescribed medications</b>			
Median ( <i>IQR</i> )	3 (2 – 6)	3 (2 - 7)	.93
<b>Other medical diagnosis</b>			
Yes N (%)	14 (48)	23 (51)	.41

*Categorical variables analysed using Chi-Square. Independent t-test used to assess differences in age. For all remaining variables, where the median is reported, Mann Whitney U tests were used to assess differences due to skew.*



*Figure 4.5 Percentage of adolescents classified as low adherers to medication across multiple methods.*

Descriptive statistics for key variables across low and high adherers can be found in Table 4.3. Descriptive statistics corresponding to the measure of EPT and EFT can be found in Table 4.4. As already stated, AUC scores were positively skewed, reflecting steep discount rates across both groups. Depression scores were also positively skewed, demonstrating that adolescents in this sample reported few depressive symptoms. With respect to the BMQ Necessity and Concern subscales, the adolescents in this sample reported low levels of concern toward their treatments and recognised their treatments to be high in necessity; 92% of adolescents scored above the scale mid-point on the necessity subscale, indicating strong necessity beliefs, and 23% reported strong concerns toward their treatments (see Koster et al., 2015).

Table 4.3 Means, standard deviations, medians and range of scores of key variables across low and high adherers, and significance of univariate analysis.

	Low adherers			High adherers			p
	M (SD)	Median	Min - Max	M (SD)	Median	Min - Max	
<b>Connectedness</b>							
<i>(0 – 100)</i>							
Overall	46.8 (28.1)	52	0 - 87	62.2 (27.6)	67	0 - 100	.022*
Average	57.9 (19.6)	59.5	4.25 – 86.8	65.6 (18.5)	67.3	20 - 100	.093
<b>Time Attitudes</b>							
<i>(1 – 5)</i>							
Past	3.86 (.87)	4	4.25 – 86.8	4.17 (.55)	4.15	2.60 - 5	.12
Present	3.75 (.75)	3.90	1.80 - 4.90	4.17 (.55)	4.30	2.90 - 5	.013*
Future	3.57 (.57)	3.70	2.10 – 4.50	3.78 (.43)	3.70	2.80 – 4.50	.097
<b>Temporal Focus</b>							
<i>(1 – 7)</i>							
Past	3.57 (.97)	3.50	1 – 5.50	3.53 (1.02)	3.50	1.50 – 5.75	.81
Present	4.64 (1.11)	4.75	1 – 6.75	4.89 (1.01)	5	3 - 7	.31
Future	4.15 (1.55)	4	1.75 - 7	4.26 (1.25)	4	1 - 7	.74
<b>Beliefs about Medicines (BMQ)</b>							
Necessity <i>(1- 25)</i>	19.8 (3.64)	22	13 - 25	21.2 (3.51)	22	12 - 25	.95
Concerns <i>(5-30)</i>	16.3 (6.01)	15.5	6 - 28	13.1 (4.09)	13	7 - 23	.017*
AUC	.18 (.12)	.14	.070 - .45	.33 (.28)	.21	.038 - .98	.014*
<b>Depression (CES-D)</b>							
	12.9 (9.67)	10	3 - 39	8.52 (5.84)	8	0 - 26	.015*

Past positivity, future positivity, BMQ Necessity, AUC and CES-D analysis carried out using transformed variables see section (4.3.1.1).

Analysis conducted on 29 low adherers, except for AUC (N = 23) and BMQ Necessity and Concerns (N = 28), and 45 high adherers, except for past positivity and CES-D scores (N = 44).

\* p < .05

Table 4.4 Means, standard deviations, medians and range of scores of EPT/EFT across low and high adherers, and significance of univariate analysis.

	Low adherers			High adherers			p
	M (SD)	Median	Min - Max	M (SD)	Median	Min - Max	
<b>Remember Task (EPT)</b>							
Clarity (5 - 35)	21.3 (5.60)	20.5	12 - 34.5	22.2 (5.68)	23	9 - 31	.51
MTT (2 - 14)	8.77 (2.96)	8.75	3 - 14	8.83 (3.05)	9	2.50 - 14	.94
EmR (1 - 7)	3.92 (1.75)	4	1 - 7	4.17 (1.58)	4.50	1 - 7	.54
Intensity (1 - 7)	5.25 (1.47)	5.25	2.5 - 7	5.44 (1.22)	5.50	2.50 - 7	.57
Valence (1 - 7)	5.44 (1.73)	6	1 - 7	5.92 (1.23)	6.50	2.50 - 7	.27
Distance (1 - 10)	6.31 (2.39)	6.50	1 - 10	5.16 (2.14)	6.50	1 - 10	.047*
Internal details	7.96 (4.06)	7	2.25 - 20.5	8.16 (4.38)	8.50	1.75 - 22.8	.96
External details	.66 (.63)	.63	0 - 2	.52 (.73)	.25	0 - 3	.22
Ep. Richness (0 - 6)	2.58 (.99)	2.50	1 - 5	2.40 (.97)	2.50	.50 - 4.25	.45
<b>Imagine Task (EFT)</b>							
Clarity (5 - 35)	20.4 (6.42)	20.5	5.5 - 31	18.9 (6.83)	19.8	5.5 - 31.5	.39
MTT (2 - 14)	8.96 (3.26)	9	2 - 14	8.64 (3.13)	9	2 - 14	.70
EmR (1 - 7)	4.54 (1.60)	4.50	1.5 - 7	4.27 (1.77)	4.50	1 - 7	.54
Intensity (1 - 7)	5.19 (1.42)	5.50	2.5 - 7	5.24 (1.42)	5.50	1 - 7	.87
Valence (1 - 7)	5.58 (1.43)	5.75	1 - 7	5.73 (1.28)	6	2.5 - 7	.70
Distance (1 - 10)	5.40 (2.29)	5.50	1 - 9.50	5.62 (2.27)	5.50	1.50 - 10	.70
Internal details	4.66 (2.58)	3.88	1 - 10.8	5.59 (3.50)	5.25	0 - 16.3	.26
External details	.88 (1.10)	.25	0 - 3.75	.70 (.85)	.50	0 - 3.50	.67
Ep. Richness (0 - 6)	1.80 (.81)	1.50	.50 - 3.75	1.94 (.98)	1.75	0 - 4.75	.55

MTT = Mental Time Travel, EmR/EmP = Emotional re-experiencing/pre-experiencing, Ep. Richness = Episodic richness. All analyses based on 24 low adherers and 43 high adherers. Past and future valence, past and future internal details, and past external details carried out using transformed variables

\*  $p < .05$



### 4.3.1.3 Univariate analysis

To explore differences between low and high adherers, a series of independent t-tests were first conducted (see Table 4.3). This was followed by multivariate analysis using binary logistic regression, in order to identify possible independent predictors of adherence status. Pearson correlations were used to explore associations between key variables of interest across all participants.

**Adherence, temporal discounting and future self-connectedness.** As expected, chronically ill adolescents classified as low adherers exhibited steeper discount rates during the intertemporal decision making task, indicating a greater tendency to discount the value of delayed rewards,  $t(65.8) = -2.53, p = .014, d = .33$ .

Compared to high adherers, low adherers also felt less connected to their future selves,  $t(72) = -2.34, p = .022, d = .55$ . However, this was only true for the overall rating of future self-connectedness; the groups did not differ significantly in terms of average future self-connectedness,  $t(72) = -1.70, p = .093$ .

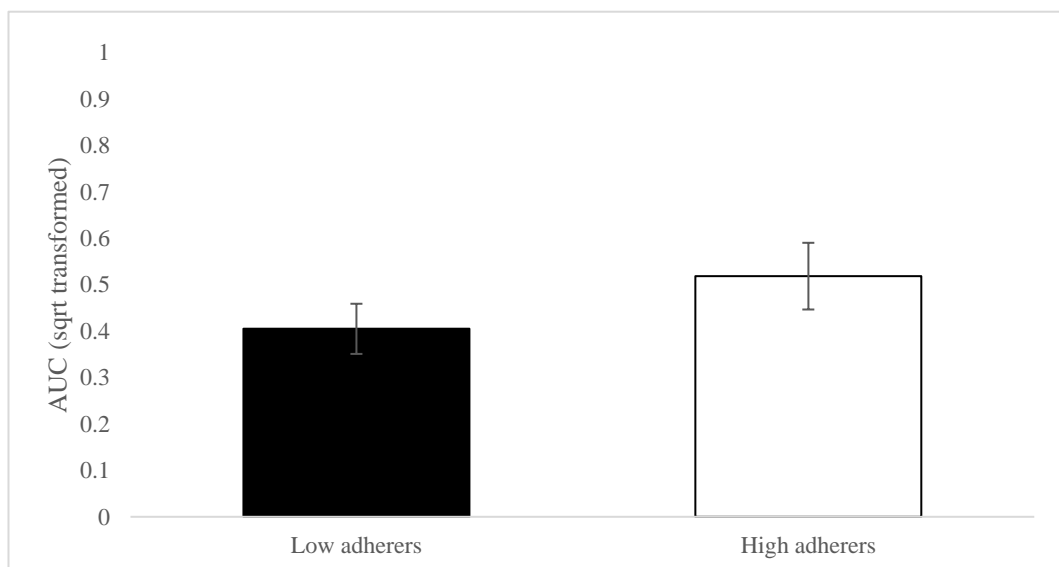
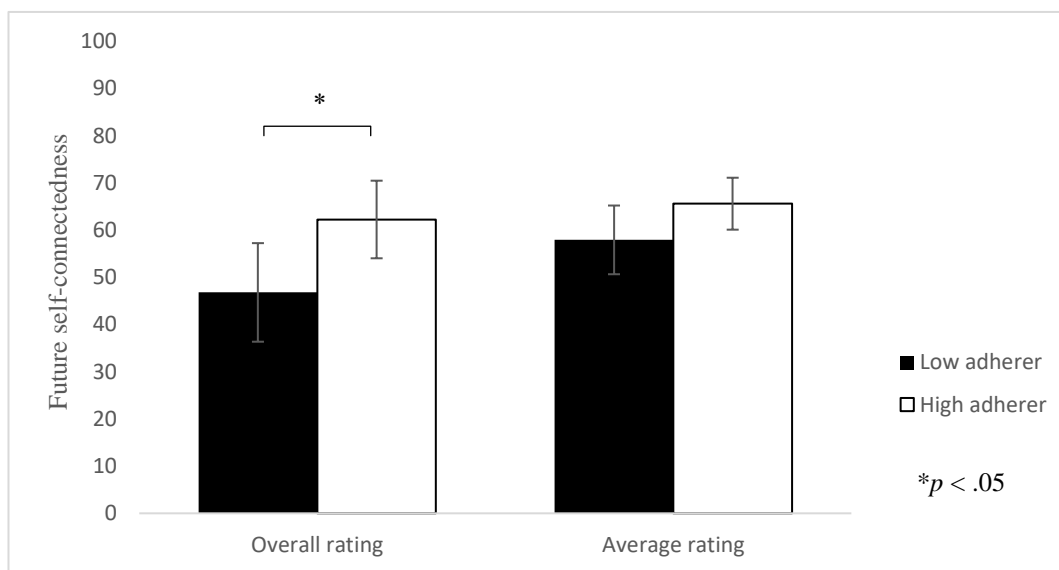


Figure 4.6 Discount rates in low and high adherers in adolescents with chronic illness (with 95% CIs).

Given the previously documented associations between temporal discounting and future self-connectedness, correlations were examined to determine whether chronically ill adolescents who felt closer to their future selves were also more patient during the temporal discounting task. However, AUC was not significantly associated with participants' ratings of overall future self-connectedness ( $r_{(69)} = .10$ ,  $p = .42$ ) or average future self-connectedness ( $r_{(68)} = .11$ ,  $p = .37$ ).



*Figure 4.7 Chronically ill adolescents' ratings of "overall" future self-connectedness and average connectedness. Average connectedness rating is based on all 4 dimensions: personality, hobbies, likes/dislikes and overall similarity in low and high adherers (with 95% CIs).*

**Adherence, discounting and episodic future thinking (EFT).** Although low adherers rated their past events as feeling farther away than high adherers,  $t(65) = 2.02, p = .047, d = .51$ , there were no other significant differences between the groups with regards to the episodic content of their past or future event narratives, or the phenomenology of their episodic past (EPT) or episodic future thinking (EFT).

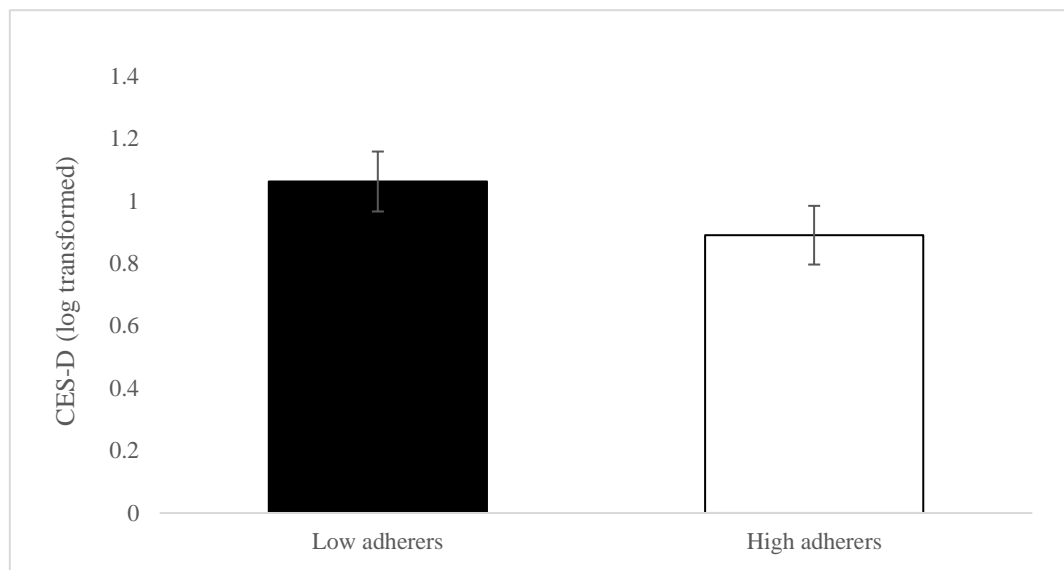
In Chapter 3, there was an association between discounting and EFT in typically developing adolescents. Therefore, the relationship between participants' discount rates and the episodic content of their imagined future events was examined. AUC was positively, but not significantly, associated with the number of internal details provided in participants' future event narratives ( $r_{(64)} = .20, p = .12$ ) and the episodic richness of participants' EFT ( $r_{(64)} = .21, p = .096$ ). Notably, the strength of these associations are similar to those observed in the second study of Chapter 3 between these variables. Participants' EFT was not associated with future self-connectedness.

**Adherence, time attitudes and temporal focus.** Contrary to expectations, low adherers did not feel less positive about the future,  $t(72) = -1.68, p = .097$ . They did, however, feel significantly less positive about the present,  $t(46.9) = -2.57, p = .013, d = .66$ . There was no difference between the groups in terms of their attitudes toward the past,  $t(46.2) = -1.48, p = .15$ . With respect to temporal focus, low and high adherers did not differ with respect to their degree of cognitive engagement with the past, present or future.

Across the group as a whole, past and present positivity were strongly correlated ( $r_{(71)} = .73, p < .001$ ). In contrast, future positivity was not associated with past positivity ( $r_{(71)} = .19, p = .11$ ) and was only weakly associated with present

positivity ( $r_{(72)} = .29, p = .014$ ). With respect to the relationship between future time attitudes and future temporal focus, adolescents who had more positive attitudes toward the future also reported greater cognitive engagement with the future, ( $r_{(72)} = .39, p = .001$ ).

**Adherence, future thinking and depression.** Consistent with previous literature, low adherers reported significantly more symptoms of depression,  $t(71) = 2.49, p = .015, d = .58$ . As the log-transformed depression scores were still somewhat skewed after transformation, a Mann Whitney U was also conducted on raw CES-D scores, which confirmed a significant difference in depressive symptoms between the low (mean rank = 43.6) and high adherence groups (mean rank = 32.7),  $U = 447, p = .030, r = .25$ .



*Figure 4.8 Depressive symptoms in low and high adherers in adolescents with chronic illness (with 95% CIs).*

Depressive symptoms were significantly associated with a number of key variables.

Unsurprisingly, adolescents who reported more symptoms of depression felt significantly less positive about the past ( $r_{(71)} = -.48, p < .001$ ), present ( $r_{(71)} = -.51, p < .001$ ) and the future ( $r_{(71)} = -.32, p = .002$ ). They also reported a greater focus on the

past ( $r_{(72)} = .24, p = .046$ ). Adolescents who had greater concerns about their medicines also reported more depressive symptoms ( $r_{(71)} = .27, p = .025$ ). Depression was not significantly correlated with future self-connectedness or AUC.

**Adherence and medication beliefs.** Low adherers reported significantly greater concerns regarding the potential adverse consequences of their medication than high adherers,  $t_{(71)} = 2.70, p = .017, d = .62$ . Additionally, across the group as a whole, adolescents who reported greater concerns about their medications exhibited steeper discount rates ( $r_{(68)} = -.33, p = .007$ ), felt less connected to their future self using the overall rating, ( $r_{(71)} = -.23, p = .048$ ), and felt less positivity toward the future ( $r_{(71)} = -.36, p = .002$ ). They also reported less positivity toward the present ( $r_{(71)} = -.33, p = .004$ ). With regards to beliefs in the necessity of their medication, low adherers did not differ significantly from high adherers,  $t_{(71)} = .065, p = .95$ , and necessity beliefs were not significantly associated with discounting ( $r_{(68)} = .11, p = .39$ ).

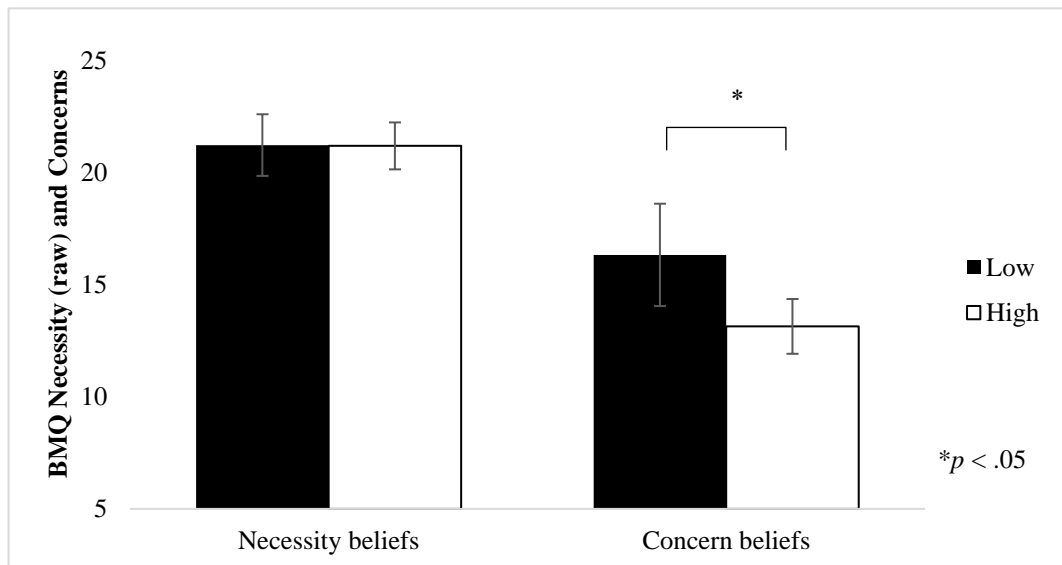


Figure 4.9 Necessity and concern beliefs in adolescents with chronic illness across low and high adherers (with 95% CIs).

#### ***4.3.1.4 Multivariate analysis***

Given the large number of variables and comparatively small sample, variables were selected for multivariate analysis if they were significant at the level of  $p < .10$  in univariate analysis (see Bursac, Gauss, Williams, & Hosmer, 2008; Kavanagh, Gooley, & Wilson, 1993; Lebeau et al., 2016; van Dellen, Stronks, Bindels, Öry, & van Aalderen, 2008). This led to the selection of the following variables for entry to the multivariate model: increasing overall future self-connectedness ratings, increasing present and future positivity, increasing AUC (reflecting less steep discounting of future rewards), increasing CES-D scores, and increasing BMQ Concerns scores.

Backwards, stepwise logistic regression using Wald's method was conducted to identify significant predictors of adherence status. The final main effects model is presented in Table 4.5. The final model was significant  $\chi^2(2) = 9.90, p = .007$  and explained between 14% (Cox & Snell  $R^2 = 13.9$ ) and 19% (Nagelkerke  $R^2 = 19.3$ ) of the variance in adherence status. The Hosmer and Lemeshow test suggested good model fit ( $p = .52$ ). Only two variables remained in the final model: present positivity and AUC. However, neither predicted an independent, statistically significant proportion of the variance in adherence status. The inflated ORs and confidence interval for AUC suggests limitations in sample size, leading to sparse data bias (Greenland, Mansournia, & Altman, 2016). It is possible that this is because all five of the adolescents for whom AUC data was excluded for being non-systematic were in the low adherence group.

Table 4.5 Final model for binary logistic regression predicting adherence status in adolescents with chronic illness.

	<i>B</i>	<i>SE</i>	Wald	<i>df</i>	<i>p</i>	Odds Ratio	95% CI for Odds Ratio	
							Lower	Upper
Present positivity	.92	.47	3.76	1	.053	2.50	.99	6.30
AUC	2.97	1.59	3.48	1	.062	19.4	.86	440
Constant	-4.32	1.97	4.79	1	.029	.013		

*N* = 66 (due to non-systematic AUC data and outlier removal)

Note: AUC scores have been square root transformed

Cox & Snell  $R^2 = 13.9$ , Nagelkerke  $R^2 = 19.3$

To determine the additional variance explained by discount rates, a model without AUC was explored using the same backwards, stepwise method as above. Again, overall future self-connectedness ratings, increasing present and future positivity, increasing CES-D scores, and increasing BMQ Concerns scores were entered into the model. The final model, which included only present positivity scores, was significant  $\chi^2(1) = 5.80, p = .016$ . Present positivity was a significant predictor of adherence status (OR = 2.83, 1.15 – 6.97;  $p = .024$ ). The model without AUC explained between 8% (Cox & Snell  $R^2 = 8.4$ ) and 12% (Nagelkerke  $R^2 = 11.7$ ) of the variance in adherence status, indicating that AUC explained an additional 6% to 7% of the variance in adherence status in the original model (see Table 4.5).

### **4.3.2 Future Thinking and Adherence in Adolescents with Type 1 (T1) Diabetes**

Due to the limited size of the CF and asthma samples, analyses were not conducted comparing low and high adherers in these groups separately. However, the relationship between adherence and future thinking was explored in the largest subgroup, which consisted of adolescents with T1 diabetes. This also allowed for an investigation into how the key variables were associated with HbA1c, an indicator of glycaemic control.

#### ***4.3.2.1 Data pre-processing***

**Normality and transformations.** AUC scores were highly positively skewed in low and high adherers (Z-skew = 2.06 and 2.43 respectively). CES-D scores were positively skewed in the low adherence group (Z-skew = 2.92), and future focus scores were positively skewed in the high adherence group (Z-skew = 2.28). A square root transformation reduced the skewness in discount rates (Z-skew = .14 and 1.00 respectively), but failed to reduce the skewness of CES-D scores. However, a log transformation on CES-D scores reduced the skewness in low and high adherers (Z-skew = .35 and -.50). Square root transformation also reduced the skewness of future focus scores (Z-skew = .50 and 1.84).

BMQ Necessity scores were negatively skewed in both low and high adherers (Z-skew = - 2.32 and - 2.30 respectively). Future positivity was negatively skewed in the low adherence group (Z-skew = -2.06). A power transformation (cube) reduced the skewness of BMQ Necessity scores (Z-skew = -1.62 and -.99). A square transformation reduced the skewness of future positivity scores (Z-skew = -1.34 and 1.30).



In summary, analysis comparing low and high adherers was performed following the transformation of AUC, CES-D, BMQ Necessity and future positivity and future focus scores. These variables were also skewed across the group as a whole and so the same transformed variables were used to explore correlations between key variables.

#### ***4.3.2.2 Descriptive statistics***

Table 4.6 shows the baseline characteristics for low and high adherers in the adolescents with T1 diabetes. The low and high adherers did not differ significantly in terms of age,  $t(36) = 1.39, p = .70$ , and adherence to insulin was not associated with gender, socioeconomic status, hospitalization, parental responsibility, duration of diagnosis, or comorbidity status.

With regards to adolescents' glycaemic control, the median HbA1c level across all the adolescents was 71.5 mmol/mol. According to NICE guidelines (2015), an HbA1c level less than 48 mmol/mol is optimal in children, adolescents and adults with T1 diabetes to reduce the risk of long-term complications. Based on this, all but one of the adolescents in this sample had higher than recommended HbA1c levels. 30% of the adolescents met the International Society for Paediatric and Adolescent Diabetes recommendations of less than 58 mmol/ml (Donaghue, Chiarelli, Trotta, Allgrove, & Dahl-Jorgensen, 2007). HbA1c did not differ by gender,  $t(36) = .48, p = .64$ , or comorbidity status,  $t(36) = -3.1, p = .76$ , and was not associated with duration of diagnosis,  $(r_{35}) = .24, p = .16$ . Adolescents who had been hospitalised in the year prior to recruitment had worse glycaemic control on average, but this was not significant,  $t(36) = 1.81, p = .08$ .

Table 4.6 Baseline characteristics of adolescents with Type 1 (T1) diabetes by low and high adherers and significance of univariate analysis.

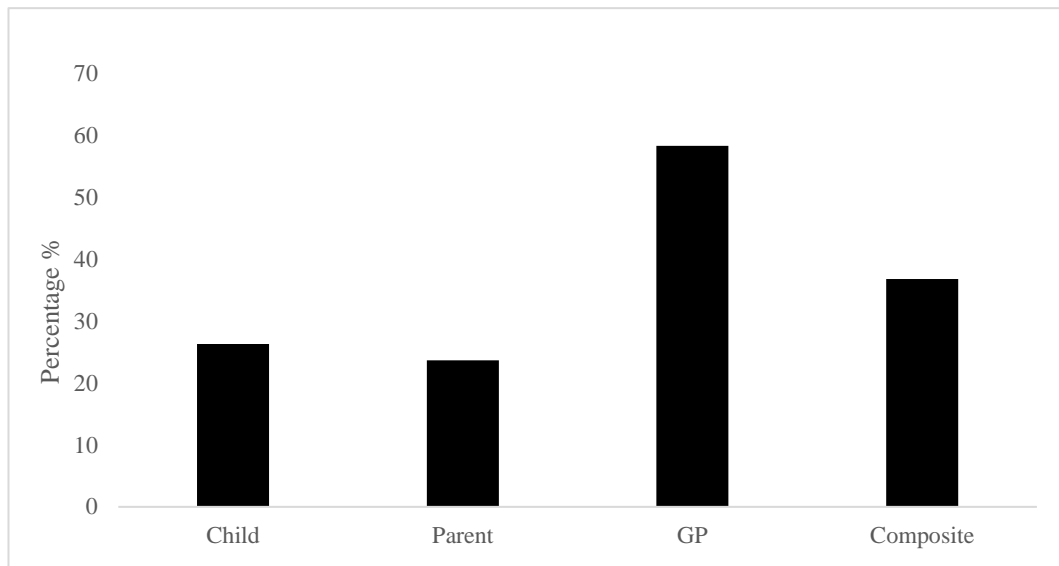
	Low adherers	High adherers	<i>p</i>
Total N (%)	14 (37)	24 (63)	
<b>Age</b>			
Mean (SD)	14.2 (1.64)	14.4 (1.67)	.70
<b>HbA1c</b>			
Mean (SD)	81.6	64	.001*
Min - Max	52 - 114	40 - 94	
<b>Gender</b>			
Female N (%)	9 (64.3)	12 (50)	.39
<b>Parental responsibility</b>			
Median (IQR)	3 (3 – 4)	4 (3 – 4)	.41
<b>Years since diagnosis</b>			
Mean (SD)	6.19 (3.96)	7.48 (3.67)	.33
<b>Multiple Deprivation Measure (SES)</b>			
N (%)			
< 25 %	8 (57)	8 (33)	.17
25 – 50 <sup>th</sup> %	0 (0)	5 (21)	
50 – 75 <sup>th</sup> %	3 (21)	3 (13)	
> 75 %	3 (21)	8 (33)	
<b>Hospitalised in year prior?</b>			
Yes N (%)	3 (21)	2 (8)	.25
<b>Num. of prescribed medications</b>			
Median (IQR)	2 (2 – 2.25)	2 (2 – 2.25)	.36
<b>Other medical diagnosis</b>			
Yes N (%)	3 (21)	9 (38)	.30

Categorical variables analysed using Chi-Square. For variables where the median is reported Mann Whitney U tests were used to assess differences between the groups due to skew.

\*  $p < .05$

HbA1c was, however, significantly associated with socioeconomic status, ( $r_{(36)} = -.36, p = .026$ ), and there was a significant main effect of socioeconomic status quartile on HbA1c,  $F(3,34) = 3.44, p = .027$ . Post-hoc comparisons with Bonferroni adjustment indicated that adolescents in the lowest quartile for deprivation had higher HbA1c levels ( $M = 79.4, SD = 17.8$ ) than those in the highest quartile, ( $M = 62.1, SD = 13.6$ ),  $p = .043$ . In other words, adolescents living in the most deprived areas of Northern Ireland had worse glycaemic control than those living in the least deprived areas. HbA1c was also negatively associated with parental responsibility, ( $r_{(35)} = -.38, p = .022$ ), indicating that adolescents with worse glycaemic control were those that had more responsibility for their adherence.

Across all participants, 54% of parents reported having full to shared responsibility for adherence, and the remaining 46% of adolescents had most, if not all, of the responsibility for taking their medications. Only one parent indicated their child had total responsibility for their adherence. 97% of adolescents with T1 diabetes reported strong necessity beliefs, and 32% reported strong concerns towards their treatments. Consistent with the findings previously reported between low and high adherers across all three illness groups, adherence status varied depending on the method employed and the responder (see Figure 4.10). Adolescents with diabetes and their parents tended to report similar levels of nonadherence; with 26% of the adolescents being classified as low adherers based on their scores on the adolescent MARS (i.e. based on adolescent self-report) and 23% based on scores on the parent MARS (i.e. parent self-report). As before, the GP prescription issue records showed high rates of nonadherence, indicating that almost 60% of the 12 participants for whom prescription data was available were low adherers.



*Figure 4.10 Percentage of adolescents classified as low adherers to insulin across multiple methods.*

According to the adherence composite, high adherers had lower HbA1c levels,  $t(36) = 3.58$ ,  $p = .001$ , providing some validation for the adherence composite used in this study. Additionally, adolescent self-reported adherence (i.e. their continuous scores on the MARS) correlated significantly with HbA1c ( $r(36) = -.49$ ,  $p = .002$ ). Descriptive statistics for key variables between the low and high adherers can be found summarised in Table 4.7 and Table 4.8.

Table 4.7 Means, standard deviations, medians and range of scores of key variables across low and high adherers, and significance of univariate analysis.

	Low adherers			High adherers			<i>p</i>
	M (SD)	Median	Min - Max	M (SD)	Median	Min - Max	
<b>Connectedness</b>							
<i>(0 – 100)</i>							
Overall	34.2 (27.9)	33.5	0 - 80	63.7 (26.9)	62	21 - 100	.003*
Average	50.8 (21)	51	4.25 - 78	64.7 (18.8)	64.4	30 - 100	.043*
<b>Time Attitudes</b>							
<i>(1 – 5)</i>							
Past	3.67 (.93)	3.85	1.90 - 5	4.17 (.53)	4.10	2.60 - 5	.085
Present	3.55 (.67)	3.40	2.70 - 4.70	4.14 (.56)	4.15	2.90 - 5	.006**
Future	3.52 (.58)	3.70	2.10 - 4.20	3.76 (.41)	3.65	3.10 - 4.50	.17
<b>Temporal Focus</b>							
<i>(1 – 7)</i>							
Past	3.57 (.88)	3.50	2 - 5.25	3.46 (.92)	3.25	2 - 5.75	.71
Present	4.71 (.73)	4.50	3.75 - 6.25	5.09 (.92)	5	3.50 - 6.50	.20
Future	4.54 (1.48)	4.13	2.50 - 6.75	4.40 (1.19)	4.13	3 - 7	.81
<b>Beliefs about Medicines (BMQ)</b>							
Necessity <i>(5 – 25)</i>	23.2 (2.04)	24	18 - 25	21.9 (3.26)	22.5	13 - 25	.24
Concerns <i>(5 – 30)</i>	16.8 (6.94)	13	9 - 28	13.8 (4.89)	13	7 - 23	.18
AUC	.23 (.21)	.14	.07 - .70	.33 (.28)	.25	.05 - .98	.33
<b>Depression (CES-D)</b>							
	13.1 (10.1)	10.5	3 - 38	8.88 (4.74)	8.50	3 - 20	.15

*Future positivity future focus, AUC, depression and BMQ Necessity analyses carried out using transformed variables (see section 4.3.2.1). All analysis carried out with 14 low adherers, except for AUC (N = 11) and BMQ Concerns (N = 13), and 24 high adherers, except past positivity (N = 23).*

Table 4.8 Means, standard deviations, medians and range of scores of EPT/EFT across low and high adherers, and significance of univariate analysis.

	Low adherers			High adherers			p
	M (SD)	Median	Min - Max	M (SD)	Median	Min - Max	
<b>Remember Task (EPT)</b>							
Clarity (5 – 35)	21.2 (6.06)	20	12 – 34.5	22.1 (5.96)	22.8	11 – 30.5	.67
MTT (2 – 14)	9.41 (2.21)	9	6.5 – 13.5	8.93 (3.22)	9.50	2.50 - 13	.66
EmR (1 – 7)	4.05 (1.59)	4	2 - 7	4.09 (1.43)	4.25	1 - 6	.93
Intensity (1 – 7)	5.32 (1.47)	5	2.5 - 7	5.19 (1.41)	5.50	2.5 - 7	.81
Valence (1 – 7)	4.91 (2.15)	5.50	1 - 7	5.66 (1.29)	5.50	2.5 - 7	.22
Distance (1 – 10)	7.14 (2.34)	7	2.5 - 10	5.52 (1.84)	5.50	2 – 9.50	.038*
Internal details	7.93 (3.90)	9	2.25 – 16.5	8.47 (5.46)	8.38	1.75 – 22.8	.78
External details	.73 (.71)	1	0 - 2	.67 (.84)	.50	0 - 3	.85
Ep. Richness (0 - 6)	2.34 (1.12)	2.50	1 - 4	2.31 (1.12)	1.88	.50 – 4.25	.93
<b>Imagine Task (EFT)</b>							
Clarity (5 – 35)	20.8 (5.21)	20.5	11 - 28	17.8 (6.68)	17.5	5.50 – 31.5	.21
MTT (2 – 14)	9.77 (2.80)	10	4.50 - 14	8.27 (3.51)	8.25	2 - 14	.23
EmR (1 – 7)	4.75 (1.44)	5.25	2.50 - 7	4.30 (1.91)	4.50	1 - 7	.51
Intensity (1 – 7)	5.27 (1.48)	5.50	2.50 – 6.50	5.18 (1.48)	5.50	2 - 7	.86
Valence (1 – 7)	5.36 (1.87)	5.50	1 - 7	5.48 (1.41)	5.75	2.50 - 7	.85
Distance (1 – 10)	5.36 (1.89)	5	2.50 - 9	6.09 (2.29)	6.50	1.50 - 10	.37
Internal details	4.50 (2.16)	3.75	1.75 - 8	4.94 (3.74)	4.38	.75 – 16.3	.72
External details	1.11 (1.30)	.50	0 – 3.75	.66 (.85)	.38	0 - 3.50	.24
Ep. Richness (0 - 6)	1.70 (.71)	1.50	.75 - 3	1.73 (.83)	1.50	.75 – 3.25	.94

MTT = Mental Time Travel, EmR/EmP = Emotional re-experiencing/pre-experiencing, Ep. Richness = Episodic richness. Due to missing data, all analyses conducted on 11 low adherers and 22 high adherers

### 4.3.2.3 Univariate analysis

As before, univariate analysis comparing low and high adherers across key variables was conducted prior to multivariate analysis, and Pearson correlations were used to explore the associations between key variables. Predictors of HbA1c, a measure of glycaemic control in diabetes, were also investigated.

**Adherence, temporal discounting and future self-connectedness.** As shown in Figure 4.11 amongst the adolescents with diabetes, low adherers did not exhibit significantly steeper discount rates,  $t(33) = -1.00, p = .33$ .

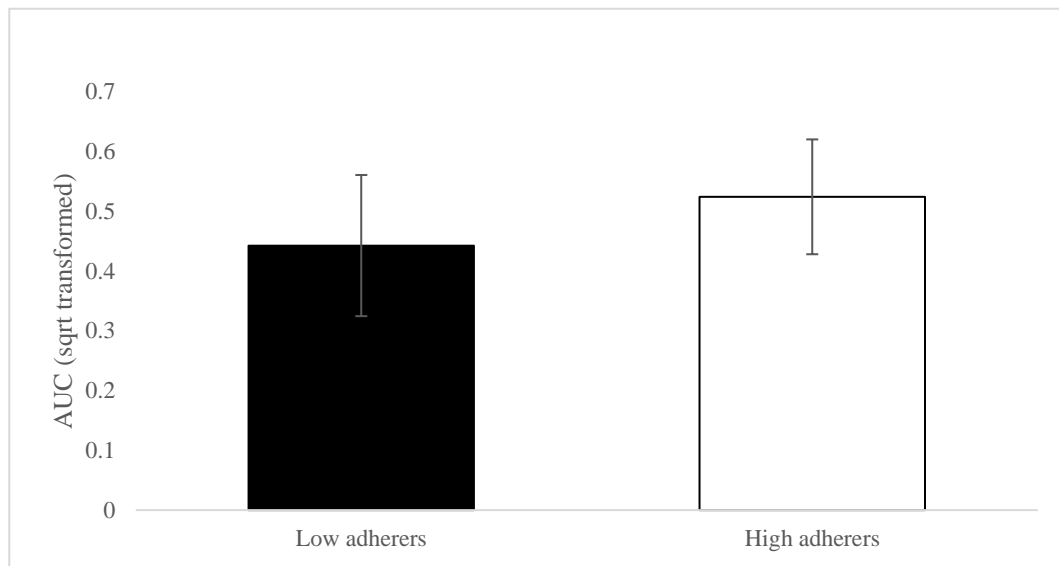


Figure 4.11 Discount rates in low and high adherers in adolescents with Type 1 diabetes (with 95% CIs).

Low adherers did, however, feel significantly less connected to their future selves than high adherers. This was true for both their overall ratings,  $t(36) = -3.21, p = .003, d = 1.08$ , and their average ratings of future self-connectedness,  $t(36) = -2.10, p = .043, d = .70$ . There was no significant association between closeness to the future self and discount rates ( $r_{(35)} = .18, p = .32$ ).

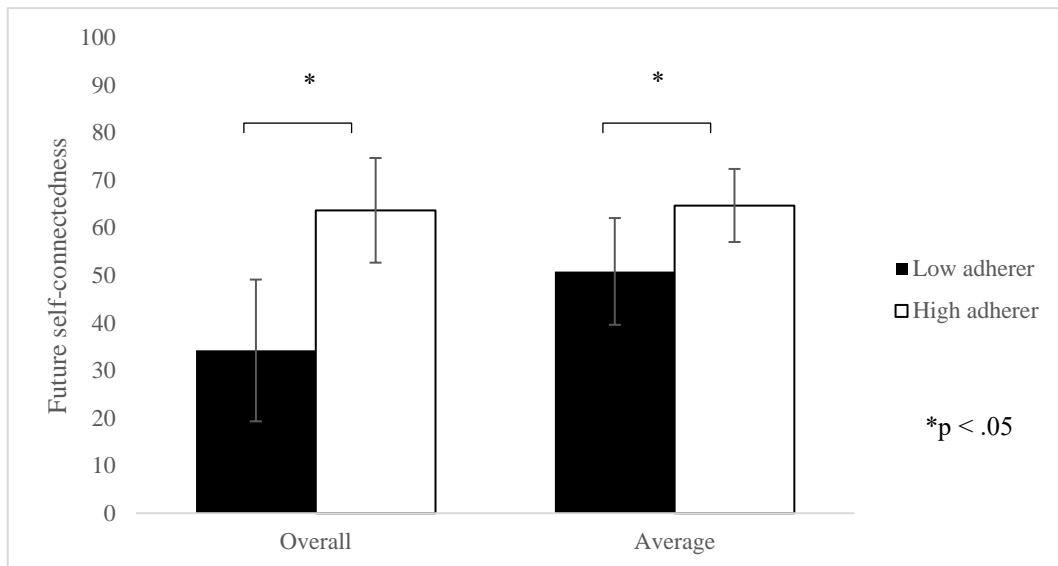


Figure 4.12 Ratings of "overall" future self-connectedness and average connectedness in adolescents with Type 1 diabetes. Average connectedness rating is based on all 4 dimensions: personality, hobbies, likes/dislikes and overall similarity in low and high adherers (with 95% CIs).

**Adherence, episodic past and episodic future thinking (EPT, EFT).** As can be seen in Table 4.8, low adherers felt their remembered events were farther away,  $t(31) = 2.17, p = .038, d = .77$ . However, there were no other significant differences between the low and high adherers in their past and future event narratives, or the phenomenology of their remembered and imagined events.

**Adherence, time attitudes and temporal focus.** There was no significant difference between the low and high adherers in terms of their positivity toward the future,  $t(36) = -1.39, p = .17$ , however they did report feeling significantly less positive about the present than high adherers,  $t(36) = -2.93, p = .006, d = .96$ . The groups did not differ significantly with respect to their attitudes toward the past,  $t(35) = -2.07, p = .085$ . Temporal focus did not differ between low and high adherers.



**Adherence, future thinking and depression.** There was no significant difference in depressive symptoms between low and high adherers, as measured by the adherence composite based on adolescent and parent self-report,  $t_{(36)} = 1.47, p = .15$ . Adolescents with diabetes who reported more depressive symptoms showed greater cognitive engagement with the past ( $r_{(36)} = .34, p = .036$ ), but not the present or future. Unsurprisingly, depressive symptoms were also associated with less positivity toward the past ( $r_{(35)} = -.51, p = .001$ ), present ( $r_{(36)} = -.52, p = .001$ ) and the future ( $r_{(36)} = -.54, p < .001$ ).

**Adherence and medication beliefs.** Although low adherers reported more concerns regarding their medication, they did not differ significantly from high adherers,  $t(18.6) = 1.39, p = .18$ . Additionally, low and high adherers did not differ significantly with regards to their necessity beliefs. However, adolescents with diabetes who reported greater concerns toward their medication did show a tendency to discount the future to a greater extent than those less concerned about their medication ( $r_{(34)} = -.47, p = .005$ ), and were less positive toward the future ( $r_{(37)} = -.35, p = .035$ ). They also felt somewhat less connected to their future selves, although this was not significant ( $r_{(35)} = -.30, p = .071$ ).

**Glycaemic control and future thinking.** Adolescents with poor glycaemic control, as determined by HbA1c levels, felt significantly more negative about the past, ( $r_{(35)} = -.36, p = .027$ ) and present ( $r_{(36)} = -.51, p = .001$ ), but not the future ( $r_{(36)} = -.15, p = .37$ ). HbA1c was also negatively associated with overall connectedness, although not significantly ( $r_{(36)} = -.31, p = .062$ ). Depression was not associated with HbA1c ( $r_{(36)} = .19, p = .26$ ), nor were adolescents' discount rates ( $r_{(35)} = .15, p = .40$ ).

#### 4.3.2.4 Multivariate analysis

Binary logistic regression was used to investigate possible independent predictors of adherence status to insulin in the adolescents with diabetes. For the subgroup of adolescents with diabetes, data was collected pertaining to their glycaemic control on the day of recruitment (as assessed by HbA1c), therefore multiple linear regression was used to explore possible independent predictors of glycaemic control.

**Predicting adherence status.** As before, variables were selected for multivariate analysis if they were significant at the level of  $p < .10$  in univariate analysis. The resulting preliminary effects model included: increasing past and present positivity, and increasing overall future self-connectedness. The final main effects model following backwards, stepwise logistic regression using Wald's method can be found summarised in Table 4.9.

This final model was significant,  $\chi^2 (2) = 13.7, p = .001$  and explained between 31% (Cox and Snell  $R^2 = .31$ ) and 42% (Nagelkerke  $R^2 = .42$ ) of the variance in adherence status. The Hosmer and Lemeshow test indicated good fit ( $p = .83$ ). Increasing future self-connectedness was a significant independent predictor of adherence status.

Table 4.9 Binary logistic regression predicting adherence status.

	<i>B</i>	<i>SE</i>	Wald	<i>df</i>	<i>p</i>	Odds Ratio	95% CI for Odds Ratio	
							Lower	Upper
Present positivity	1.29	.74	3.05	1	.081	3.61	.86	15.3
Overall	.035	.016	4.43	1	.035*	1.04	1.00	1.07
connectedness								
Constant	-6.22	2.91	4.57	1	.033*	.002		

\* $p < .05$

**Predicting glycaemic control (HbA1c).** Any variables associated with HbA1c at a level of  $p < .10$  was entered into a multiple linear regression model

(Bursac et al., 2008; Lebeau et al., 2016). To recap, HbA1c was significantly associated with socioeconomic status ( $p = .026$ ), parental reported responsibility for adherence ( $p = .022$ ), past positivity ( $p = .027$ ) and present positivity ( $p = .001$ ). Overall future self-connectedness was not significantly associated with HbA1c but met the threshold of significance for inclusion in the model ( $p = .062$ ), as did hospitalisation status ( $p = .08$ ). This model was significant,  $F(6,29) = 4.06$ ,  $p = .004$ , and explained 34% of the variance in HbA1c (*Adjusted R*<sup>2</sup> = .344).

*Table 4.10 Multiple regression predicting HbA1c.*

Variable	Model	
	<i>B</i>	$\beta$
Constant	143.0	
Hospitalised in period before study	3.01	.061
SES	-.010	-.18
Parental responsibility	-6.68	-.34*
Past positivity	-.029	-.001
Present positivity	-11.6	-.45
Future self-connectedness	-.025	-.045
Adjusted R <sup>2</sup>	.344	
F	4.06	
$\Delta R^2$	.46	
$\Delta F^2$	4.06	

\*  $p < 0.05$

$N = 36$

As shown in Table 4.10, the only significant predictor in this multivariate model was parental responsibility ( $p = .029$ ). Parental responsibility uniquely explained 10% of the variance in adherence status. In other words, when accounting for possible confounding factors, none of the key variables were significant independent predictors of HbA1c.

#### **4.4 Discussion**

This study sought to investigate the links between treatment adherence and future thinking in adolescents with chronic illness, and the results offer preliminary evidence to suggest that future-oriented cognition is related to treatment adherence in this population. Specifically, adolescents with low adherence discounted the value of future rewards more steeply during an intertemporal choice task, indicating that they were less future-oriented in their decision making, and also felt their present and future selves were less similar. However, neither temporal discounting nor future self-connectedness were independent predictors of treatment adherence when controlling for the influence of other determinants of adherence, such as depression and medication beliefs. Together, these findings suggest that the relationships between temporal discounting, future self-connectedness, and other known predictors of adherence are complex but that these links warrant further investigation in future studies.

As adolescents with low adherence were less future-oriented in the temporal discounting task, then it might be expected that they would also show less consideration toward the future more generally. Yet, the low adherers did not report thinking less about the future, did not find it more difficult to imagine the future during an EFT task, and were just as likely to recognize the long-term necessity of their treatment. This pattern of results seems to indicate that intentional nonadherence in chronically ill adolescents is not so much rooted in an inability to consider the future, or a failure to recognize the importance of adherence. Instead, these findings suggest that an adolescent's decision to adhere is more so influenced by the degree to which they discount the value of such distant rewards.

A third notable finding of this study pertains to the importance of medication concern beliefs. That adolescents with low adherence acknowledged the necessity of their treatments but felt more concerned about their medications than those with high adherence suggests that recognizing the importance of adherence is not enough to deter an adolescent from avoiding a treatment they perceive to be disruptive, confusing, or aversive. Concern beliefs were also correlated with a number of other key measures in this study. Adolescents with greater concern about their treatment felt less connected to their future selves, were more negative about the future, reported more symptoms of depression, and were less future-oriented in the temporal discounting task. Although the causal underpinnings of these relationships are unclear, these results suggest that treatment concerns could be an obstacle to both adherence and well-being in chronically ill adolescents.

#### **4.4.1 Adherence and discounting**

Treatment adherence is a crucial predictor of positive health outcomes in chronic illness, but the rewards to be gained from committing to self-management behaviours are typically situated in the distant future (Rapoff, 2010). In contrast, by failing to adhere, adolescents with chronic health conditions can circumvent treatments that are often disruptive and can lead to unpleasant side effects (Hanghøj & Boisen, 2014; Kyngäs et al., 2000). The choice to adhere or not might therefore be conceived of as an intertemporal trade-off between benefitting later or benefitting now. Consistent with this notion, adolescents in this study who reported low adherence to their treatments exhibited a greater preference for immediate rewards, while those less prone to nonadherence were more future-oriented in their decision making. This result not only replicates previous findings of an association between adherence and temporal discounting in adults with Type 1 (Stoianova et al., 2018) and Type 2

diabetes (Lebeau et al., 2016; Reach et al., 2011, 2018), but also demonstrates that the link between nonadherence and impulsive decision making extends to a mixed sample of adolescents with asthma, cystic fibrosis (CF), and T1 diabetes. That low adherers were more present-oriented in their decision making coincides with studies linking temporal discounting to other “*short-sighted*” or problematic behaviour, such as alcohol use (Field et al., 2007; Rossow, 2008), smoking (Audrain-McGovern et al., 2004; Reynolds & Fields, 2012), and gambling (Cosenza & Nigro, 2015). Most importantly, these findings, together with the studies cited above, accord with intuitions that failure to adhere to treatment in chronic illness may be due, at least in part, to the devaluation of future rewards.

In considering this conclusion, it is important to note that temporal discounting was not associated with adherence to insulin, or to HbA1c, when looking only at the adolescents with T1 diabetes. However, the effect size in the subgroup analysis ( $d = .37$ ) was comparable to that found in the analysis of the chronic illness group as a whole ( $d = .33$ ). Additionally, in a larger study of two hundred and sixty-seven young adults with T1 diabetes, Stoianova et al., (2018) found only weak, but significant, associations between discounting and glycaemic control ( $r = .18$ ), which is comparable to the association found in this study between discounting and HbA1c ( $r = .15$ ), which consisted of a substantially smaller subgroup of only thirty-eight adolescents with diabetes. It is therefore likely that this subgroup analysis lacked the power to detect a significant association between adherence, HbA1c, and discounting in such a small sample of adolescents with diabetes. Although Lansing et al., (2017) found a stronger correlation between discounting and HbA1c, their sample consisted exclusively of adolescents with poor glycaemic control, making it somewhat difficult to generalize their findings to the present study. With so few studies investigating the

links between adherence, HbA1c, and discounting in adolescents with T1 diabetes, it is important for future research to clarify whether temporal discounting contributes to nonadherence and poor glycaemic control in this specific population.

Another important point to note is that temporal discounting was not an independent predictor of adherence in the chronic illness group as a whole, when taking into account other influential determinants of adherence. Although this conflicts with the findings of previous research (Lebeau et al., 2016; Reach et al., 2011, 2018; Stoianova et al., 2018), these studies failed to control for the presence of treatment concern beliefs, which are a well-documented barrier to adherence (Horne et al., 2013), and which were related to low adherence in the current study. Furthermore, in contrast to previous research, the current study accounted for the influence of constructs like future self-connectedness and time attitudes on adherence.

The finding that adolescents' discount rates were related to but did not independently predict adherence when controlling for future self-connectedness, present and future time attitudes, concern beliefs, and depressive symptoms suggests that the link between adherence and discounting is more complex than initially hypothesised and requires further examination. It is also possible, as noted in section 4.3.1.4, that this study was unable to detect a significant relationship between temporal discounting and adherence in the multivariate analysis due to the presence of sparse data. If research with larger samples can better establish the pathways by which temporal discounting determines nonadherence, then this could have important implications for the design of future interventions. In fact, promising interventions are already in use which might improve adherence by, perhaps unintentionally, countering patients' tendency to discount the delayed rewards of

adherence (Jachimowicz et al., 2019). The implications these findings have for interventions will be returned to in Chapter 6 (General Discussion). Of course, although it is exciting to speculate on potential interventions, it is important to first gain greater understanding of the precise nature of the link between adherence and temporal discounting before development of potential interventions can begin.

#### **4.4.2 Adherence, future-self connectedness and EFT**

Temporal discounting was not the only future-oriented construct that related to adolescents' treatment adherence. Low adherers also felt less connected to their future selves, reflecting greater perceived dissimilarity between their present and future selves. Moreover, in the subgroup of adolescents with T1 diabetes, future self-similarity was an independent predictor of adherence status.

To the best of my knowledge, this is the first time a study has found there to be a link between perceived similarity to one's future self and adherence to treatment in chronic illness. This result is, however, consistent with a recent study that found future-self connectedness predicted healthy eating and exercise (Rutchick et al., 2018). Together, these findings support the notion that adolescents who feel connected to their future self will be more likely to prioritise their interests in the future. Future studies should more closely examine the role played by future self-connectedness in promoting health behaviour, both in patients with chronic illness and more broadly. One potential question that arises from this discussion is whether future self-connectedness might predict adherence to diet and exercise in adolescents with T1 diabetes, as these are important aspects of diabetes self-management (Goodall & Halford, 1991).



However, it should be noted that the link observed between future self-connectedness and adherence was selective. In this study, participants provided four judgements of future self-connectedness intended to assess different dimensions of future self-connectedness. Adolescents indicated how similar they felt to their future self in terms of personality, hobbies, likes and dislikes, and overall similarity. Although the former three ratings were not related to adherence, nor was the average score that was taken of all four of these ratings, participants' judgements of overall future self-similarity were related to adherence status. This might suggest that when asked to think about their future selves "*overall*", the adolescents in this study were thinking about dimensions of their future self that the other items failed to tap into, such as aspects of their future self that are specific to their illness. It could be that perceived similarity to these illness-specific dimensions of one's future self is what encourages better adherence, but perceived similarity to more generic dimensions does not.

This might also help to explain why future self-connectedness was related to adherence, but not to temporal discounting. This finding was unexpected, as it not only conflicts with the findings of Chapter 3, but also with a growing body of correlational and experimental research that has consistently shown that feeling connected to one's future self encourages greater prioritization of the future in decision making (see Urminsky, 2017). That future self-connectedness was related to adherence but not to temporal discounting is counterintuitive, as it suggests that adolescents in this study with greater future self-connectedness were more future-oriented in their adherence behaviour, but were not more future-oriented in the temporal discounting task. If adolescents' judgements of future self-connectedness were specific to illness dimensions of their future self, then it is possible that these

illness-specific dimensions might encourage better adherence but might not encourage future-oriented decision making in a task involving monetary rewards.

Alternatively, these results could indicate that, in chronically ill adolescents, future self-connectedness encourages adherence not because it discourages the devaluation of delayed rewards but by some other mechanism. One possibility is that feeling similar to one's future self leads to greater self-control by redirecting people's focus away from short-term demands and encouraging them to give greater consideration to the future consequences of their behaviour (Adelman et al., 2017). Adherence to treatment can be both demanding and burdensome, but requires sustained commitment to achieve any health benefit. It is therefore possible that feeling connected to one's future self might encourage adolescents to look beyond the immediate demands of their self-management regimens and to give greater consideration to the long-term consequences of nonadherence. Alternatively, if an individual feels disconnected from their future self, then they might have difficulty recognising how their future self will feel as a consequence of their current behaviour (Hershfield et al., 2012). Thus, chronically ill adolescents who feel connected to their future selves might be more likely to adhere because they are better able to recognise just how much the consequences of nonadherence will impact them emotionally and physically in the future. Investigating whether empathy for the future self is associated with adherence might allow future studies to address this question.

Of course, this is purely speculation, and the cross-sectional nature of this study makes it difficult to determine the direction of the relationships between future self-connectedness and adherence. An alternative explanation is that adherence promotes feelings of future self-similarity, given that the purpose of adherence is to maintain control over one's condition. Regardless, on the basis of the discussion

above, future research might consider developing a measure of future self-connectedness that is tailored for use in individuals with chronic illness and which takes into account both generic and illness-specific aspects of one's future self. Such a measure could be of considerable use in gaining greater insight into the link between adherence and future self-connectedness found in this study.

With respect to episodic future thinking (EFT), this study failed to find a relationship between chronically ill adolescents' self-reported adherence and EFT capabilities. There was also no association between EFT and temporal discounting. This conflicts with previous evidence showing that vivid simulation of the future encourages future-oriented behaviour (Bromberg et al., 2017; O'Neill et al., 2016) and future-oriented decision making in temporal discounting tasks (Bromberg et al., 2015). There was also no association between future self-connectedness and EFT, providing further evidence to support the notion that future self-connectedness and EFT are distinct constructs, as argued in Chapter 3.

The lack of relationship between EFT and the other future-oriented constructs measured here may be attributable to a task limitation. This study was conducted primarily in outpatient clinics during school hours. To take part, adolescents had to be accompanied by a parent or guardian, who were typically taking time away from other responsibilities to attend their child's clinic. Overall, the study took around 45 minutes to complete, and the "Remember/Imagine" task was administered last. Consequently, five adolescents had to leave the clinic before they could complete the task, due to time pressure. It is possible that there was similar pressure felt by other participants to complete the study as quickly as possible. As a result, the "*Remember/Imagine*" task, although employed successfully in the typically developing sample in Chapter 3, may not have provided an accurate reflection of

adolescents' EFT capabilities in this specific setting. In Chapter 5 (see section 5.3.1.4), a comparison of the total number of episodic and non-episodic details provided by chronically ill adolescents and matched controls shows that adolescents with chronic illness provided significantly fewer details in their descriptions of future events overall, lending additional support to the claim that this measure may have been of limited use in this specific setting. EFT measures that take less time to complete, such as sentence completion tasks (Anderson & Dewhurst, 2009; Raes et al., 2007), may be a potential alternative for future studies.

#### **4.4.3 Time attitudes, temporal focus and depression**

Adolescents' attitudes toward the future and their degree of cognitive engagement with the future were not related to treatment adherence. This is consistent with the findings of Chapter 3, in which future time attitudes and future temporal focus were not associated with temporal discounting in typically developing adolescents. These results lend further support to the argument that feeling positive about the future and thinking often about the future are insufficient in isolation to make adolescents more future-oriented in their decision making.

However, given the extant literature, it is still somewhat surprising that adolescents' attitudes toward the future did not predict adherence. It has been proposed that perceiving the future to be negative or hostile may serve to undermine future-oriented decision making (Bulley et al., 2016), and previous models of health behaviour emphasise the importance of patients' expectations for motivating adherence. For example, according to the Common Sense Model, the expectations patients have regarding the consequences of their illness are an important determinant of adherence (Leventhal et al., 2008). Some studies have shown that patients who expect their illness to have adverse consequences in the future are more

likely to engage in maladaptive coping, such as denial and avoidance (Hagger & Orbell, 2003), and consequently, negativity toward the future may be a barrier to adherence (Skinner et al., 2000). It was therefore unexpected that low adherers did not differ from high adherers in their positive feelings toward the future. However, it is important to note that the ATI-TA was designed for general use in adolescents (Worrell & Mello, 2007); it is not a measure of chronically ill adolescents' attitudes towards their illness in the future or its potential consequences. A measure of future time attitudes that is more specific to living with a chronic health condition might prove to be a more important predictor of adherence than simply attitudes towards the future more generally.

An additional unexpected finding was that although low adherers did not differ from high adherers in their attitudes toward the future, they did feel less positive about the present. Previous studies using the ATI-TA have reported strong associations between present positivity and future positivity (Andretta et al., 2014; McKay et al., 2015; Worrell et al., 2007). It is therefore surprising that, in this study, positive attitudes toward the present and positive attitudes toward the future were only weakly correlated. This, and the fact that depressive symptoms were more strongly associated with attitudes toward the present than the future, seems to suggest that adolescents with low adherence, despite feeling less positive about the present and despite reporting more depressive symptoms, still felt as optimistic and positive toward the future as high adherers. As explained by Zebracki and Drotar (2004), positive attitudes toward the future are not always realistic or adaptive; individuals with unrealistically positive attitudes toward the future often underestimate risks and tend to perceive themselves as invulnerable (Schwarzer, 1994). The future positivity found in this study in adolescents with low adherence may actually be cause for

concern, as these teens may perceive themselves to be less at risk as a result of their nonadherence.

The finding that low adherers felt less positive about the present and reported more depressive symptoms than high adherers is consistent with the documented links between psychosocial functioning and adherence (DiMatteo et al., 2000; Kongkaew et al., 2014). Poor self-esteem, low self-efficacy, and stress are commonly observed in chronically ill adolescents (Suris et al., 2004; Yeo & Sawyer, 2005), and are correlated with negativity toward the present in typically developing teens (Worrell & Mello, 2009; Andretta et al., 2014). In turn, these factors, and depressive symptoms, can create obstacles for self-management (DiMatteo et al., 2000; Kongkaew et al., 2014; Pinguart & Shen, 2011b). While the causal pathways between present time attitudes, depression, and poor adherence are still unclear, these results highlight the importance of taking adolescent well-being seriously when considering potential obstacles to adherence.

#### **4.4.4 Medication beliefs**

Previous research has consistently shown that patients are less likely to adhere to their treatment if they perceive it to be unnecessary (Bucks et al., 2009; Foot et al., 2016; Horne et al., 2013; Koster et al., 2015). Yet in this study, adolescents' necessity beliefs were not predictive of adherence. This may be because 92% of the chronically ill adolescents in this study endorsed strong necessity beliefs, a much higher proportion than reported in previous studies (Bucks et al., 2009; Koster et al., 2014). Regardless, this finding challenges the previously held assertion that patients who fail to adhere do so because they fail to understand the importance of their treatments (Horne & Weinman, 1999). As argued by Bartels and Urmitsky (2015), knowing and valuing the future are two distinct concepts. Short-sighted behaviour,

such as nonadherence, does not always arise from a lack of information about future outcomes, but may instead result from the devaluation of these outcomes. This aligns with the finding that low adherers in this study understood the necessity of adherence, but discounted the value of delayed rewards more steeply. These results also align with accounts of adolescent risk behaviour, which argue that adolescents are capable of grasping the long-term-impact of risk taking, but are more “*swayed*” by the prospect of potential gains than adults (Reyna et al., 2015). There is some speculation that nonadherence rates are higher in adolescents than in adults because young people lack the capacity to understand the long-term implications of nonadherence (Taddeo et al., 2008). If adolescents are capable of understanding the necessity of adherence, which the results of this study suggest, then future research might seek to explore whether age differences in nonadherence are attributable to age differences in discounting.

With regards to concern beliefs, low adherers were more concerned about the potential adverse effects of their treatment. Previous qualitative studies demonstrate that adolescents are understandably reluctant to adhere to treatments they perceive to be disruptive or aversive (Bregnballe, Schiotz, & Lomborg, 2011; De Simoni et al., 2017; Wamboldt et al., 2011). Although studies using the BMQ in adult samples have consistently shown that concern beliefs are predictive of nonadherence (Horne et al., 2013), fewer studies have used the BMQ in adolescent samples. One study found a relationship between adherence and concern beliefs in adolescents with asthma (Koster et al., 2014), while another did not report their results using the subscale, as they found it to have poor internal consistency (Bucks et al., 2009). These mixed findings suggest that there is a need to further examine the applicability of this subscale in adolescent samples.

Medication concern beliefs were also associated with a number of other key measures in this study. Adolescents with more concerns about their treatments felt less connected to their future selves and discounted the future more steeply in the temporal discounting task. The causal underpinnings of these relationships are unclear, and given that none of these constructs independently predicted adherence in a multivariate model, the interactions are likely complex. As already alluded to, anticipating the future to be threatening or hostile may serve to undermine future-oriented decision making (Bulley et al., 2016). It is possible then that an adolescent faced with the prospect of life-long commitment to a treatment they perceive to be harmful could represent such an aversive future, leading to greater temporal discounting. This would be consistent with the fact that adolescents with more concerns about their medicines felt less positive about the future, and reported greater depressive symptoms.

Regardless of the mechanism underpinning this association, the findings above highlight the importance of taking into account patients' treatment beliefs, as they may have implications for both adherence and well-being. As noted by Horne et al., (2013), some patients may perceive their medication to be ineffective or potentially harmful as a result of misconception; but for others, nonadherence is an informed choice made in response to a treatment that may be difficult to tolerate, for a variety of reasons. To better motivate adherence, there is a crucial need for communication and shared decision making between patients and physicians. It is important to not only explore possible inaccurate beliefs about treatment and to educate patients where possible, but to listen to and support those who voice worry and concern (Horne et al., 2013).



#### 4.4.5 Limitations

Although this study provides a preliminary insight into how future-oriented cognition relates to treatment adherence in adolescents with chronic illness, there are a number of limitations that should be acknowledged.

As there is no “*gold standard*” for assessing adherence, a multi-method approach is recommended (Modi & Quittner, 2006; Sabaté, 2003). This study intended to employ a composite measure of adherence that would include two self-report measures, from both adolescents and their parents, and a third, more objective measure of adherence using GP prescription issue records (Goodfellow et al., 2015). However, prescription issue data was available for only 47% of the adolescents in this study, precluding its inclusion in the composite measure. As a result, the findings of this study ultimately rely on self-reported adherence. Self-report measures of adherence can be vulnerable to memory bias and socially desirable responding (Stirratt et al., 2015), and may overestimate adherence rates (Taddeo et al., 2008). However, despite this, adherence status was related to HbA1c in the diabetes subgroup, as would be expected (Hood et al., 2009), providing some validation of the measure used. Moreover, self-report studies are still considered valid indicators of adherence (Hensen et al., 2009). Nonetheless, researchers seeking to further investigate the links between future thinking and treatment adherence should consider using more objective tests of adherence such as pill counts, electronic monitors, or prescription issue and refill records.

A second limitation concerns the fact that this study was conducted on a small, convenience sample of adolescents recruited mostly from outpatient clinics. Consequently, due to sample size limitations, this study may have lacked sufficient power to detect statistically significant relationships between key variables. It is also

difficult to rule out the presence of selection bias. Previous studies have shown there to be links between participation in research and better treatment adherence (Riekert & Drotar, 2002), while clinic attendance is also associated with adherence (Wood, Casey, Kolski, & McCormick, 1985). It is therefore possible that adolescents with very poor adherence would be less likely to attend clinics where recruitment took place and would be less likely to agree to participate. As a result, this study may have underestimated the relationship between adherence and future-oriented cognition. Despite this, significant differences were still observed between low and high adherers on the measures of temporal discounting and future self-connectedness.

It should also be noted that the adolescents in this study reported low levels of distress, high beliefs in the necessity of their medications, and only 18% had been hospitalised in the year prior to recruitment. It is therefore difficult to say whether this group of chronically ill adolescents is truly representative. Nonetheless, future studies should seek to determine if the relationship observed between treatment adherence and future-oriented cognition in this study generalises to other chronic conditions.

#### **4.4.6 Conclusion**

The results of this study indicate that adolescents with chronic illness who intentionally fail to adhere to their treatment are less future-oriented in their decision making, but do not spend less time thinking about the future, do not struggle to imagine the future vividly, and are as capable of recognizing the long-term importance of adherence as adolescents with high adherence. These results suggest that adolescents who struggle to adhere to their treatment do not lack knowledge or foresight, but simply perceive the immediate rewards of nonadherence to be of greater value than the long-term rewards associated with adherence. The results of

this study also suggest that adolescents with chronic illness who feel connected to their future selves are more likely to adhere to their treatments, but this relationship does not seem to be underpinned by temporal discounting. However, when controlling for other influential factors, such as medication concerns and depressive symptoms, neither future self-connectedness nor temporal discounting were independent predictors of nonadherence. It is clear that further investigation is needed to discern how these specific aspects of future thinking and other important determinants of adherence might interact to impact on an adolescent's decision to adhere.

Failure to adhere to treatment in chronic illness results in reduced quality of life, increased healthcare utilization (DiMatteo, 2004b; McGrady & Hommel, 2013; Rapoff, 2010; Taddeo et al., 2008), and is thought to cost the NHS £300 to £500 million each year (Hagan, 2015; Hazell & Robson, 2015). Ultimately, the results of this study offer hope for the discovery of new interventions designed to encourage chronically ill adolescents to make better decisions about their treatments by increasing the priority they give to the future and their future self. Doing so may have important benefits for patients, healthcare providers and society in general.

## Chapter 5. Future Thinking in Adolescents with Chronic Illness

### 5.1 Introduction

Living with chronic illness can be a challenge (Woodgate, 1998). By definition, chronic illness is prolonged in duration, rarely curable (Stanton et al., 2007), and can place an extraordinary burden on patients and their families (Wallander et al., 2003). This burden is particularly significant for chronically ill adolescents, who must navigate the “*storm and stress*” of normative adolescent development alongside the stress of living with and managing a chronic health condition (Suris et al., 2004; Woodgate, 1998; Yeo & Sawyer, 2005)

Chronic illness can create substantial obstacles for a young person’s physical, social, and emotional development (Stam, Hartman, Deurloo, Groothoff, & Grootenhuis, 2006; Suris et al., 2004; Taylor, Gibson, & Franck, 2008). As detailed in Chapter 2, treatment demands, illness complications, and frequent periods of hospitalisation can interfere with school, extracurricular activities, and the development and maintenance of peer relationships (Taylor et al., 2008; Quittner et al., 2000). Visible signs of illness and medication side effects can lead to altered body image and low self-esteem (Suris et al., 2004), and may mark teens as being different from their peers, increasing the risk of marginalisation (DiNapoli & Murphy, 2002; Yeo & Sawyer, 2005). Concerning long-term impact, there is evidence to suggest that the presence of chronic illness during adolescence can lead to behavioural and psychosocial difficulties in later life (Pless, Power, & Peckham, 1993), increasing the risk of school dropout (De Ridder et al., 2013), poor educational attainment (Champaloux & Young, 2015; Maslow, Haydon, McRee, Ford, & Halpern, 2011), and unemployment (Maslow et al., 2011; Packham & Hall,

2002). Thus, for many adolescents, the burden of chronic illness can have substantial consequences for immediate and long-term functioning.

Little is known about how chronic illness might impact on how an adolescent envisions the future. A young person faced with an unpredictable long-term prognosis, life-long commitment to treatment, and the prospect of deterioration might feel reluctant to think about, hope for, or plan for the future. Although studies suggest that chronically ill adolescents do feel concern for and uncertainty towards the future (Mullins et al., 2007; Mullins et al., 1997; Taylor et al., 2008), researchers have, to date, only speculated on what impact a prolonged, unpredictable, and possibly life-threatening illness might have on a young person's future thinking (Charmaz, 2002; Suris et al., 2004).

As emphasised throughout this thesis, future thinking, or future-oriented cognition, is considered to be crucial for various adaptive processes, including decision making, planning, and emotion regulation (Taylor et al., 1998). Future thinking is considered to be of particular importance during adolescence, when young people's hopes, plans, and goals guide decisions that can enhance, or restrict, opportunities in later life (Nurmi, 1991). Future thinking might also have important implications for chronically ill adolescents' self-management behaviour, as seen in Chapter 4. It is therefore important to clarify what, if any, impact chronic illness might have on an adolescent's future thinking. This is the ultimate aim of the following chapter.

### **5.1.1 Chronic illness and “*the future*”**

Research explicitly examining how adolescents think about their future in the context of chronic illness is scarce. However, a review of qualitative studies, all exploring

the lived experience of chronically ill adolescents, identified “*the future*” to be one of seven recurring themes in young people’s discussions of living with chronic illness, alongside “*friendship*”, “*family*” and “*school*” (Taylor et al., 2008). This is notable, as it demonstrates that the future is of interest and importance to adolescents with chronic illness, just as it is to typically developing teens (Nurmi, 1991; Nurmi et al., 1994).

However, unlike their healthy peers, chronically ill adolescents are presented with the unique challenge of envisioning a future that might be constrained or threatened by illness. In qualitative studies, such constraints are often the focus of adolescents’ discussions about the future. Often, young people worry about the potential impact of their illness on career prospects; specifically, how their condition might limit options and opportunities, or might lead to discrimination from potential employers (McEwan, Espie, Metcalfe, Brodie, & Wilson, 2004; Woodgate, 1998). Other times, their discussions centre on the fear of living independently (Iles & Lowton, 2008; McEwan et al., 2004), the fear of “*passing on*” their condition to their children (Galo et al., 1992; McEwan et al., 2004), or, in the case of conditions like cystic fibrosis (CF), the fear of transplantation, reduced fertility and reduced life expectancy (Iles & Lowton, 2008). Additionally, the unpredictable nature of most chronic health conditions, and lack of knowledge about their illness and its treatment, can lead adolescents to feel uncertainty about the near and distant future (Dodgson et al., 2000; Mullins et al., 2007; Mullins et al., 1997)

### **5.1.2 Chronic illness, depression and future thinking**

While our knowledge of how chronic illness impacts on adolescents’ future thinking is limited, the studies outlined above offer insight into how the prolonged, unpredictable, and demanding nature of chronic illness can lead to worry, fear, and

uncertainty in teens. There are suggestions in the literature that individuals become more oriented to the present when the future is perceived in this way. As discussed in previous chapters, it is thought that envisioning an uncertain or hostile future may serve to undermine people's motivation to behave in future-oriented ways, encouraging prioritisation of the present (see Bulley et al., 2016). Elsewhere, according to socioemotional selectivity theory (SST), when individuals sense their time in the future to be limited, such as in the case of old age or life-limiting disease, they tend to become more present-oriented (Carstensen, Isaacowitz, & Charles, 1999; Lockenhoff & Carstensen, 2004; Sullivan-Singh, Stanton, & Low, 2015). Thus, if an adolescent with chronic illness perceives their future to be uncertain, restricted, or life-threatening, then it seems plausible to argue that they might find it difficult to think about or imagine the future and might focus their attention on the present instead. As a result, it might be expected that an adolescent with chronic illness would think differently about the future than a typically developing adolescent. While research has yet to examine whether adolescents with chronic illness differ from their healthy peers in how they think and feel about the future, there is some evidence in the literature to suggest that this may be the case, as will be considered below.

Estimates suggest that adolescents with chronic health conditions are two to three times more likely to experience depression than their healthy peers (Eiser, 1990; Venning et al., 2008), owing to the unique burden of chronic illness (Suris et al., 2004). Depression is often conceived of as a sense of hopelessness for the future (Liu, Kleiman, Nestor, & Cheek, 2015), and as revealed in previous chapters, is linked to various aspects of future-oriented cognition. Perhaps most notably, depressive symptomatology is thought to contribute to "*faulty prospection*", or an

impaired ability to imagine the future (Roepke & Seligman, 2016). During episodic future thinking (EFT) tasks, in which individuals are asked to imagine and describe possible future events, depressed individuals tend to exhibit overgeneral future thinking, in that they imagine events that are less episodically detailed (Dickson & Bates, 2006; J. M. Williams et al., 1996; J. M. G. Williams et al., 2007). This is also true when depressed individuals remember past events (Williams et al., 2007).

Studies have also shown that individuals experiencing depression feel less connected to their future selves (Sokol & Eisenheim, 2016), a finding replicated in typically developing adolescents in Chapter 3. Individuals scoring high on measures of depressive symptoms have also been shown to discount the value of future rewards more steeply (Jarmolowicz et al., 2014; Pulcu et al., 2014) and, perhaps unsurprisingly, depression in young adults is associated with reduced positivity toward the future (McKay, Cole, & Andretta, 2016), and difficulty with anticipating positive future events for one's self (MacLeod & Conway, 2007).

These links between chronic illness and depression and between depression and future-oriented cognition lend tentative support to the argument that young people with chronic health conditions might think and feel differently about the future than typically developing teens. If adolescents with chronic illness are more vulnerable to experiencing depressive symptomatology than their healthy peers, as a result of the adversity they face, then this raises questions over whether they might also differ in their capacity to not only focus on and feel positively toward the future, but to vividly imagine the future, to feel connected to their future self, and to make decisions that prioritise the future.



### **5.1.3 Study aims and overview**

Ultimately, this chapter concerns how living with chronic illness might impact on adolescents' future thinking. Chronically ill and typically developing adolescents will be compared across a range of measures to explore whether differences exist in how adolescents with chronic illness think and feel about the future. Differences in past and present thinking will also be explored, to determine whether differences between the groups are specifically future-focused.

Given the importance of future thinking, it may be beneficial to determine whether certain conditions place greater constraints on adolescents' future thinking than others, as this may help identify adolescents with greater need for intervention. For example, it might be expected that a chronic condition such as cystic fibrosis (CF), which is associated with high degrees of treatment burden, reduced fertility and reduced life-expectancy (Iles & Lowton, 2008), might present more of a threat to how a young person sees their future than an illness like asthma, which although potentially life threatening, typically requires less time intensive management, and may be perceived as less life-limiting. Therefore, this chapter will seek to delineate differences in future thinking between three chronic conditions: asthma, cystic fibrosis (CF) and Type 1 (T1) diabetes.

This chapter is a continuation of the study outlined in Chapter 4. To recap, adolescents with a consultant confirmed diagnosis of asthma, cystic fibrosis (CF), or Type 1 (T1) diabetes completed measures of adherence (Medication Adherence Report Scale, MARS, Horne & Weinman, 1999), medication beliefs (Beliefs about Medications Questionnaire, BMQ, Horne & Weinman, 1999), depression (Centre for Epidemiological Studies Depression scale, CES-D, Radloff, 1977), temporal focus (Temporal Focus Scale, TFS, Shipp et al., 2009), time attitudes (Adolescent Time

Inventory Time Attitude scale, ATI-TA, Mello & Worrell, 2007), future self-connectedness and temporal discounting. Episodic memory and episodic future thinking (EFT) were assessed using the “Remember/Imagine” task, in which participants were asked to remember and imagine past and future events.

To investigate whether chronically ill and typically developing adolescents differ in how they think and feel about the future, adolescents with chronic illness were compared against age, gender, and SES matched control participants to explore differences in temporal discounting, future self-connectedness, time attitudes, temporal focus, episodic memory and EFT. This also allowed for illness-specific differences in future thinking to be explored by comparing each of the three chronic illness subgroups to the control group. In a separate analysis, illness-specific differences in future thinking were also examined by comparing adolescents with asthma, CF and T1 diabetes to one another on key measures. Differences in medication beliefs were also examined.

## **5.2 Methods**

### **5.2.1 Participants**

Chronically ill adolescents were those previously recruited for the study outlined in Chapter 4. In total, seventy-four adolescents with chronic illness (51% female) aged 12 to 17 years ( $M = 14.5$ ,  $SD = 1.62$ ) took part during outpatient clinics or inpatient stays at the Royal Belfast Hospital for Sick Children. Twenty adolescents had a diagnosis of asthma, sixteen a diagnosis of cystic fibrosis (CF), and thirty-eight a diagnosis of Type 1 (T1) diabetes. Control participants were taken from the sample of typically developing adolescents recruited for the study described in Chapter 3. To recap, one hundred and seventy-five adolescents (62% female) aged 11 to 18 ( $M = 14.8$ ,  $SD = 1.83$ ) were recruited from five schools in Northern Ireland. More details about the participants can be found in Chapters 3 and 4.

### **5.2.2 Measures**

All participants completed the same measures of temporal discounting, episodic past and future thinking (EPT and EFT), future self-connectedness, temporal focus, time attitudes and depressive symptoms that were described in Chapters 3 (Study 2) and 4. As described in Chapter 4, adolescents with chronic illness also completed additional measures of self-reported adherence and medication beliefs.

### **5.2.3 Procedure**

The process of recruitment and data collection for the typically developing and chronically ill adolescents can be found in sections 3.6.3 and 4.2.3 of Chapters 3 and 4, respectively.

### *5.2.3.1 Case-control matching*

**Pre-matching exclusion.** Participants were excluded from the matching procedure if they exhibited non-systematic temporal discounting (TD) data, were missing postcode data, or were missing any of the written past or future event narratives necessary for the assessment of episodic past and future thinking (EPT/EFT).

As in previous chapters, temporal discounting (TD) data was deemed non-systematic using criterion 1 from the algorithm described by Johnson and Bickel (2008). Based on this, data is considered non-systematic if any subjective value (of the delayed reward) was larger than the subjective value associated with the preceding delay by a magnitude greater than 20% of the delayed reward (i.e. £20). Five typically developing participants, and five chronically ill adolescents (one adolescent with asthma, one with CF and three with T1 diabetes) were identified as having non-systematic TD data using criterion 1, and so were excluded from the matching procedure. Participants missing postcode data were also excluded prior to matching, as this information was necessary to determine and match participants on the basis of socioeconomic status using the Northern Ireland Multiple Deprivation Measure (MDM; Northern Ireland Statistics and Research Agency, 2017). Four typically developing adolescents were excluded for this reason. Finally, in order to be able to compare the groups' episodic past and future thinking (EPT/EFT), the decision was made to exclude adolescents who failed to complete any of the written past or future event narratives. This decision was made on the basis that failure to provide a written description may have reflected lack of engagement with the study.

In the typically developing group, fifteen adolescents in total failed to complete all four event narratives, one of whom was previously excluded for having

non-systematic TD data. Therefore, fourteen typically developing participants were excluded due to missing EPT or EFT data. In the chronically ill sample, sixteen participants in total failed to generate all four event narratives, two of which were excluded due to non-systematic TD data. Therefore, fourteen participants with chronic illness (five adolescents with asthma, three adolescents with CF and six adolescents with diabetes) were excluded for missing EPT/EFT data. Following this, one hundred and fifty-two typically developing adolescents and fifty-five adolescents with chronic illness remained prior to the matching process.

**Matching procedure.** Case-control matching was achieved using a matching extension for IBM SPSS Statistics (see Taing & Carollo, 2014), with age, gender, and socioeconomic status (determined using the Multiple Deprivation Measure, MDM) set as control variables. Participants were individually matched with same-gender participants, who were within +/- 1.5 years in age, and who lived in areas ranked within one MDM quartile. This led to fifty-one successful matches, consisting of fourteen adolescents with asthma, twelve adolescents with CF and twenty-five adolescents with T1 diabetes. The four participants who remained unmatched were all from the diabetes subgroup. It was not possible to find a match for these participants by adjusting tolerance values, as this led to significant differences between the two groups on control variables.

Table 5.1 shows the baseline characteristics of the chronic illness group compared to the matched controls. Tables 5.2 to 5.4 show the baseline characteristics of each subgroup compared to the control group.

## 5.3 Results

### 5.3.1 Differences in future thinking between adolescents with chronic illness and matched controls

#### 5.3.1.1 Data pre-processing

**Outliers.** As in Chapter 4, outliers and skew for the main analysis were assessed separately by group (Tabachnik & Fidell, 2012; Field, 2013). Of the control participants, one scored more than 3 SD above the mean on the CES-D (depression). One past external details score was more than 3 SD above the mean. In the chronic illness group, one adolescent scored more than 3 SD above the mean on the CES-D. One average connectedness rating was more than 3 SD below the mean. One past positivity, one present and one future positivity score were all more than 3 SD below the mean. Of the EPT and EFT phenomenology ratings, one past valence and one future valence were more than 3 SD below the mean. One past internal and one past external details scores were more than 3 SD above the mean. These outliers were excluded for the purpose of analysis. No outliers were detected in the subgroup analysis.

**Normality and transformations.** As the main analysis involved a medium sized sample ( $50 < n < 300$ ), skewness or kurtosis z-scores of greater than +/- 3.29 were taken as evidence of non-normality (Kim, 2013). Discount rates (AUC) were positively skewed in the chronic illness group ( $Z\text{-skew} = 3.35$ ), as were depression scores ( $Z\text{-skew} = 4.42$  respectively). Square root transformations reduced the skewness of AUC in the chronically ill adolescents ( $Z\text{-skew} = 1.79$ ), and of CES-D scores ( $Z\text{-skew} = .23$ ). As the subgroup analysis consisted of smaller samples,  $Z\text{-skew}$  scores greater than +/- 1.96 were taken to indicate non-normal distributions. AUC scores were positively skewed in the asthma group and CF group ( $Z\text{-skew} =$

2.55 and 2.56 respectively), as were depression scores (Z-skew = 2.17 and 3.07).

Subgroup analysis was therefore also conducted using the square root transformed discount rates and CES-D scores, which effectively reduced the skewness of discount rates and depression scores in the asthma and CF subgroups.

### *5.3.1.2 Descriptives*

Table 5.1 shows the baseline characteristics of the two groups following the matching procedure. Age did not differ significantly between the chronic illness or control participants,  $t(100) = .025$ ,  $p = .98$ . Of the adolescents with chronic illness, 41% lived in areas ranked in the bottom quartile for deprivation in NI, compared to 26% of controls; however, there was no significant association between MDM quartile and group,  $\chi^2(3) = 6.34$ ,  $p = .096$ . Table 5.2, 5.3 and 5.4 show the baseline characteristics of each subgroup compared to the matched controls. Controls did not differ significantly from any of the three subgroups on the basis of age, gender or socioeconomic status (assessed using the MDM).

Descriptive statistics for key variables used in the main analysis are shown in Table 5.5. Descriptive statistics for participants' phenomenology ratings during EPT and EFT, and the ratings associated with the content of their written narratives are shown in Table 5.6. Finally, descriptive statistics for the three illness subgroups following the matching procedure can be found in Table 5.7.

Table 5.1 Baseline characteristics of adolescents with chronic illness and matched controls.

	Group		<i>p</i>
	Controls ( <i>N</i> = 51)	Illness ( <i>N</i> =51)	
<b>Age</b>			
Mean ( <i>SD</i> )	14.8 (1.65)	14.8 (1.62)	.93
Min - Max	12.6 – 17.9	12.1 – 17.9	
<b>Gender</b>			
Female <i>N</i> (%)	25 (49)	25 (49)	-
<b>Multiple Deprivation Measure (MDM)</b>			
<i>N</i> (%)			
< 25 %	13 (26)	21 (41)	.096
25 – 50 <sup>th</sup> %	19 (37)	10 (20)	
50 – 75 <sup>th</sup> %	15 (29)	12 (23)	
> 75 %	4 (8)	8 (16)	

Table 5.2 Baseline characteristics of adolescents with asthma and matched controls, and significance of univariate analysis.

	Group		<i>p</i>
	Controls ( <i>N</i> = 51)	Asthma ( <i>N</i> =14)	
<b>Age</b>			
Mean ( <i>SD</i> )	14.8 (1.65)	14.2 (1.34)	.21
Min - Max	12.6 – 17.9	12.4 – 16.5	
<b>Gender</b>			
Female <i>N</i> (%)	25 (49)	7 (50)	.95
<b>Multiple Deprivation Measure (MDM)</b>			
<i>N</i> (%)			
< 25 %	13 (26)	5 (36)	.63
25 – 50 <sup>th</sup> %	19 (37)	3 (21)	
50 – 75 <sup>th</sup> %	15 (29)	4 (29)	
> 75 %	4 (8)	2 (14)	



Table 5.3 Baseline characteristics of adolescents with CF and matched controls, and significance of univariate analysis.

	Group		<i>P</i>
	<b>Controls</b> ( <i>N</i> = 51)	<b>CF</b> ( <i>N</i> = 12)	
<b>Age</b>			
Mean ( <i>SD</i> )	14.8 (1.65)	15.5	<i>.14</i>
Min - Max	12.6 – 17.9	13.1 – 17.9	
<b>Gender</b>			
Female <i>N</i> (%)	25 (49)	5 (42)	<i>.65</i>
<b>Multiple Deprivation Measure (MDM)</b>			
<i>N</i> (%)			
< 25 %	13 (26)	5 (42)	<i>.71</i>
25 – 50 <sup>th</sup> %	19 (37)	3(25)	
50 – 75 <sup>th</sup> %	15 (29)	3 (25)	
> 75 %	4 (8)	1 (8)	

Table 5.4 Baseline characteristics of adolescents with diabetes and matched controls.

	Group		<i>P</i>
	<b>Controls</b> ( <i>N</i> = 51)	<b>T1 Diabetes</b> ( <i>N</i> =25)	
<b>Age</b>			
Mean ( <i>SD</i> )	14.8 (1.65)	14.7	<i>.89</i>
Min - Max	12.6 – 17.9	12.1 – 16.9	
<b>Gender</b>			
Female <i>N</i> (%)	25 (49)	13 (52)	<i>.81</i>
<b>Multiple Deprivation Measure (MDM)</b>			
<i>N</i> (%)			
< 25 %	13 (26)	11 (44)	<i>.07</i>
25 – 50 <sup>th</sup> %	19 (37)	4 (16)	
50 – 75 <sup>th</sup> %	15 (29)	5 (20)	
> 75 %	4 (8)	5 (20)	

Table 5.5 Means, standard deviations, medians, and range of scores of key variables between adolescents with chronic illness and matched controls, and significance of univariate analysis.

	Controls			Chronic Illness			<i>p</i>
	M ( <i>SD</i> )	Median	Min - Max	M ( <i>SD</i> )	Median	Min - Max	
<b>Connectedness (0 – 100)</b>							
Overall	62.7 (18)	66	17 - 100	59.6 (25.8)	62	0 - 100	.48
Average	61.6 (14.2)	63.3	21.5 – 88.3	64.8 (15.9)	66	20 - 100	.29
<b>Time Attitudes (1 – 5)</b>							
Past	3.72 (.61)	3.8	2.3 - 5	4.15 (.58)	4.2	2.3 - 5	<.001**
Present	3.87 (.49)	3.9	2.8 – 4.8	4.07 (.58)	4.2	2.7 - 5	.08
Future	3.62 (.56)	3.6	2.4 – 4.7	4.21 (.41)	4.2	3.2 - 5	<.001**
<b>Temporal Focus (1 – 7)</b>							
Past	4.43 (1.04)	4.5	2 - 6	3.54 (.88)	3.5	2 – 5.75	<.001**
Present	4.37 (.96)	4.5	2.5 – 6.25	4.85 (.96)	5	2.75 – 6.75	.013*
Future	4.52 (1.28)	4.5	2.25 – 6.75	4.24 (1.17)	4	1.75 – 6.75	.24
<b>AUC</b>	.36 (.28)	.26	.026 - .98	.25 (.20)	.16	.047 - .77	.033*
<b>Depression (CES-D)</b>	11.3 (7.26)	9	2 - 30	9.16 (6.76)	7.5	0 - 31	.073

*AUC and CES-D analysis carried out using transformed variables (see section 5.3.1.2). All analysis conducted on 51 control participants, except for depression (N = 50), and 51 adolescents with chronic illness, except for average connectedness ratings, past, present and future positivity scores (N = 50). \* p < .05 \*\* p < .001*

Table 5.6 Means, standard deviations, medians and range of scores of EPT/EFT, and univariate analysis between adolescents with chronic illness and controls.

	Controls			Chronic Illness			<i>p</i>
	M ( <i>SD</i> )	Mdn	Min - Max	M ( <i>SD</i> )	Mdn	Min - Max	
<b>Remember Task (EPT)</b>							
Clarity	25.4 (6)	26	10 - 35	22.8 (5.47)	23	11 - 34.5	.025*
MTT	9.87 (2.98)	10.5	2 - 14	9.43 (2.97)	9.50	2.50 - 14	.47
EmR	5.05 (1.50)	5	1 - 7	4.38 (1.54)	4.50	1 - 7	.029*
Intensity	5.32 (1.16)	5.50	2 - 7	5.40 (1.31)	5.50	2.50 - 7	.76
Valence	5.51 (1.43)	6	2 - 7	5.82 (1.25)	6.50	2.50 - 7	.25
Distance	4.76 (2.49)	4.50	1 - 10	5.42 (2.08)	5.50	1 - 9.50	.15
Internal details	11 (3.74)	11	3.75 - 19	8.81 (4.44)	9.50	2 - 22.8	.008*
External details	2.34 (1.46)	2.25	0 - 5	.61 (.74)	.25	0 - 3	<.001**
Ep. Richness	3.27 (.83)	3.25	1.50 - 5.50	2.61 (.94)	2.75	1 - 4.50	<.001**
<b>Imagine Task (EFT)</b>							
Clarity	22 (7.27)	22.5	6 - 35	20.3 (6.78)	20.5	5.50 - 31.5	.22
MTT	8.24 (3.89)	8.75	2 - 14	9.25 (3.07)	10	2 - 14	.15
EmR	4.24 (2)	4.50	1 - 7	4.51 (1.71)	4.75	1 - 7	.47
Intensity	4.86 (1.66)	5	1 - 7	5.88 (1.17)	6	2.50 - 7	.13
Valence	5.48 (1.15)	5.50	3 - 7	5.31 (1.29)	5.50	2 - 7	.082
Distance	5.49 (2.10)	5.50	1 - 10	5.22 (2.32)	5	1 - 10	.53
Internal details	6.84 (3.73)	6.25	1 - 15.8	5.69 (3.16)	5.25	.75 - 16.3	.095
External details	2.73 (1.65)	2.50	0 - 7.25	.80 (.95)	.5	0 - 3.75	<.001**
Ep. Richness	2.33 (1.04)	2.25	.75 - 4.50	2.01 (.91)	2	.50 - 4.75	.10

*MTT = Mental Time Travel, EmR/EmP = Emotional re-experiencing/pre-experiencing, Ep. Richness = Episodic richness. All analyses conducted on 51 control participants, except for future emotional pre-experiencing (N = 50), and 51 adolescents with chronic illness, except for past valence, past external details, future emotional pre-experiencing (N = 50) and future valence (N = 49).*

\* *p* < .05, \*\* *p* < .001

Table 5.7 Means, standard deviations, medians, range of scores of key variables in asthma, CF and diabetes subgroups following the matching procedure.

	Asthma (N=14)			CF (N=12)			Diabetes (N=24)		
	M (SD)	Mdn	Min - Max	M (SD)	Mdn	Min - Max	M (SD)	Mdn	Min - Max
<b>Connectedness (0 – 100)</b>									
Overall	57.7 (24.6)	60.5	0 - 87	63 (24.3)	68.5	22 - 97	59 (27.9)	62	0 - 100
Average	60.7 (19.1)	59	20 – 89.3	71.1 (12.6)	69.9	54.5 - 93	64.1 (13.4)	64.4	30 - 100
<b>Time Attitudes (1 – 5)</b>									
Past	4.19 (.77)	4.50	2.30 - 5	4.28 (.52)	4.30	3.30 - 5	4.06 (.48)	4.05	2.60 – 4.70
Present	4.16 (.66)	4.30	2.80 – 4.90	4.24 (.45)	4.25	3.10 - 5	3.93 (.59)	4.10	2.70 – 4.80
Future	4.28 (.47)	4.30	3.20 - 5	4.35 (.41)	4.25	3.60 - 5	4.11 (.37)	4.10	3.50 – 4.90
<b>Temporal Focus (1 – 7)</b>									
Past	3.68 (.95)	3.50	2 – 5.50	3.77 (.99)	4	2.25 – 5.50	3.36 (.78)	3.25	2 – 5.75
Present	4.89 (1.24)	5	2.75 – 6.75	4.40 (.85)	4.25	3.50 – 6.25	5.05 (.79)	5	3.75 – 6.25
Future	4.14 (1.51)	4.50	1.75 – 6.25	4.08 (1.07)	4	2.50 – 6.50	4.36 (1.03)	4	3 – 6.75
<b>AUC (0 - .98)</b>	.22 (.15)	.14	.047 - .61	.24 (.21)	.16	.054 - .77	.30 (.25)	.20	.047 - .98
<b>Depression (0 – 60)</b>	11.7 (9.17)	8	4 - 31	6.67 (7.10)	5.50	0 - 26	9 (4.63)	8	3 - 20

### 5.3.1.3 Temporal discounting and future self-connectedness

As seen in Figure 5.1, adolescents in the chronic illness group discounted delayed rewards more steeply than matched controls,  $t(94.8) = 2.16, p = .033, d = .46$ . There was no significant difference between the groups in their overall ratings of future-self connectedness,  $t(89.3) = .70, p = .48$ , or their average ratings,  $t(99) = -1.07, p = .29$ .

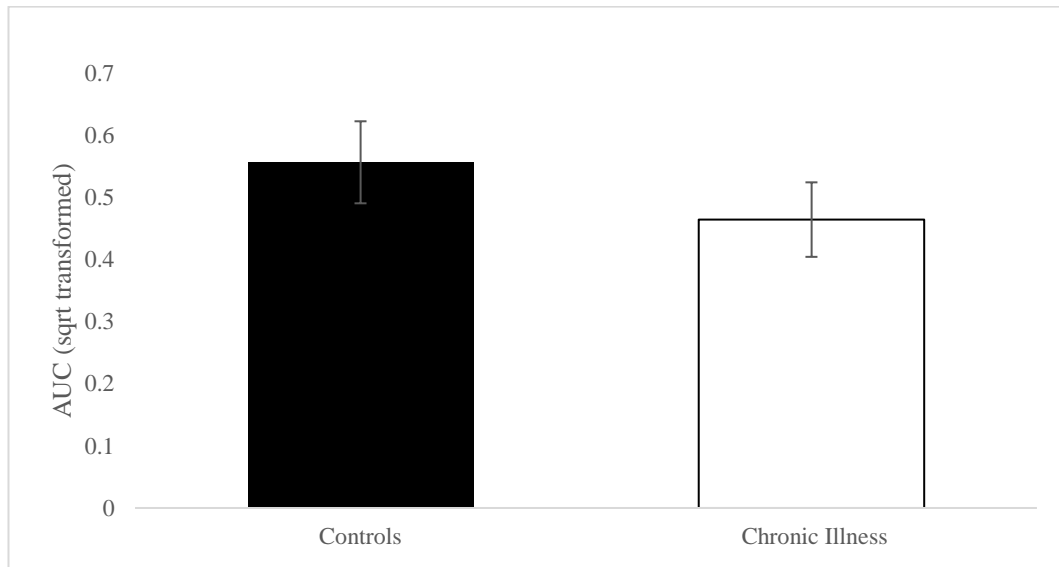


Figure 5.1 Discount rates in adolescents with chronic illness and matched controls (with 95% CIs).

Figure 5.2 shows the discount rates of the three illness subgroups compared to control participants. Independent t-tests failed to find a significant difference between any of the three subgroups and controls. However, it should be noted that the overall effect of the main group analysis above was weak (Ferguson, 2009), making it likely that this subgroup analysis lacked the power to detect a significant subgroup effect (Dijkman et al., 2009).

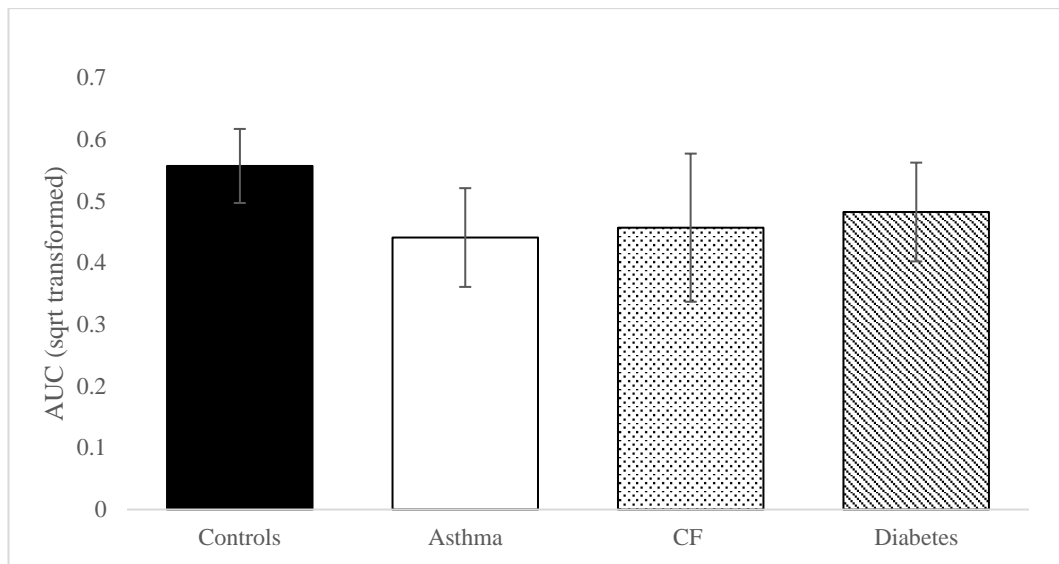


Figure 5.2 Discount rates in illness sub-groups and controls (with 95% CIs).

#### 5.3.1.4 Episodic past and future thinking (EPT and EFT)

In their narratives of imagined future events, the adolescents with chronic illness provided fewer internal details in their future event narratives (see Figure 5.4), however, the difference was not significant,  $t(100) = 1.69, p = .095$ . Although their written narratives lacked episodic richness, they also contained substantially less external details,  $t(80.1) = 7.21, p < .001, d = 1.42$ , indicating that, overall, the chronically ill adolescents' written narratives were less detailed than matched controls.

Upon further examination, and when taking into consideration the total number of details provided by participants in their written descriptions (i.e. after summing both episodic and non-episodic details provided by participants) it was determined that adolescents in the chronic illness group provided significantly fewer details overall in their written future event narratives ( $M = 6.49, SD = 3.31$ ) than matched controls ( $M = 9.56, SD = 3.72$ ),  $t(100) = 4.41, p < .001, d = .87$ .

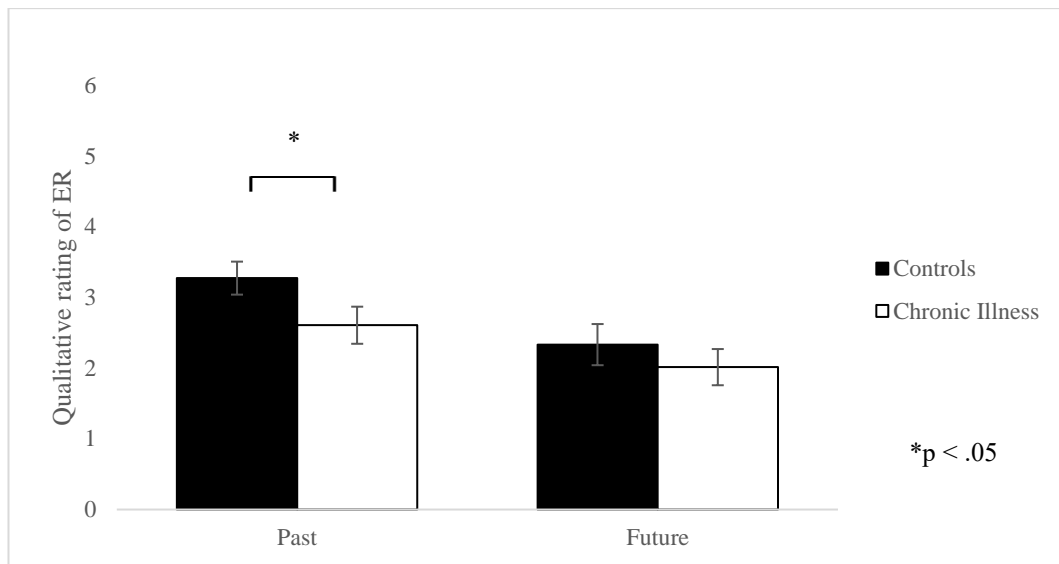


Figure 5.3 Episodic richness ratings of past and future event narratives in adolescents with chronic illness and matched controls (with 95% CIs).

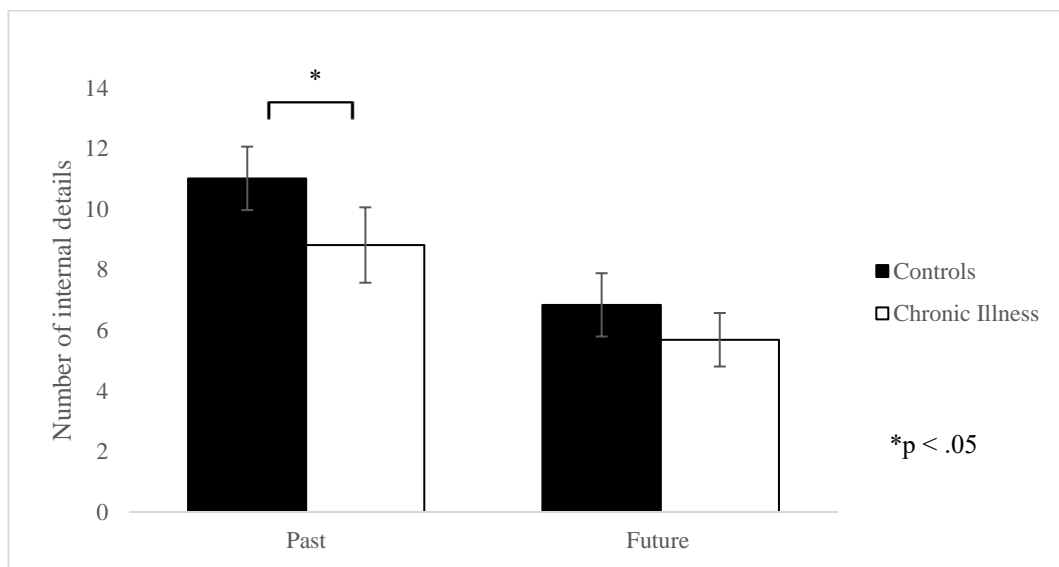


Figure 5.4 Internal details provided in past and future event narratives in adolescents with chronic illness and matched controls (with 95% CIs).

Although the control and illness groups did not differ in terms of their future-oriented narratives, in participants' written narratives of remembered past events, chronically ill adolescents remembered fewer episodic details,  $t(100) = 2.71, p = .008, d = .54$ , and generated less episodically rich narratives,  $t(100) = 3.80, p < .001, d = .74$ .

With respect to the phenomenology of participants' EPT and EFT, adolescents with chronic illness reported less clarity while remembering past events,  $t(100) = 2.23, p = .025, d = .45$ , but did not report less clarity while imagining future events,  $t(100) = 1.23, p = .22$ . Adolescents in the chronic illness group also reported feeling less like they were re-experiencing the emotions associated with their remembered past events,  $t(100) = 2.21, p = .029, d = .44$ . None of the three illness subgroups differed significantly from the control group on the EFT task (see Figure 5.5.)

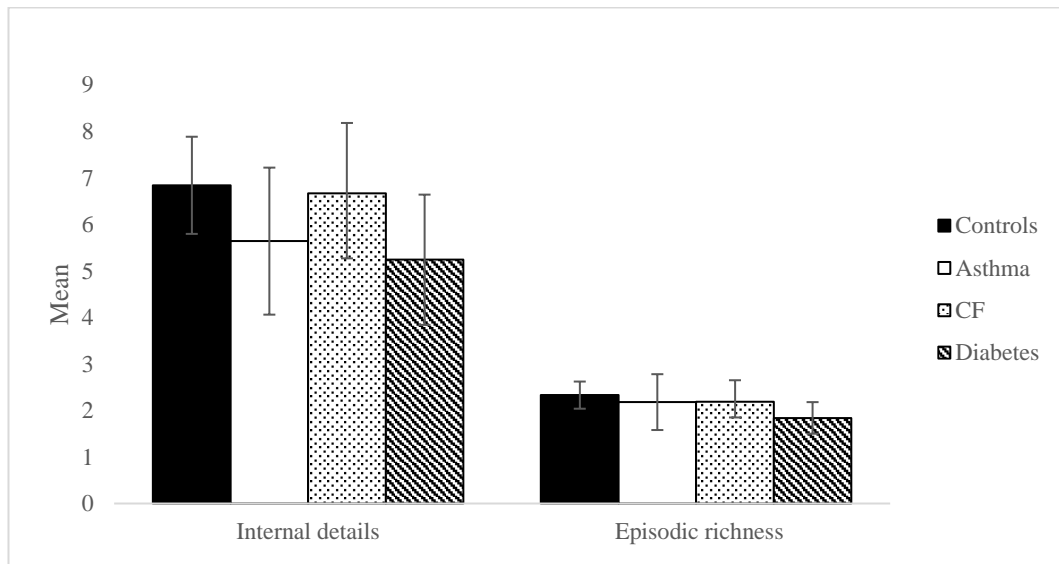


Figure 5.5 Internal details and episodic richness ratings of participants' future event narratives in illness sub-groups and matched controls (with 95% CIs).



### 5.3.1.5 Time attitudes and temporal focus

Compared to matched controls, adolescents in the chronic illness group reported feeling more positive about the future,  $t(99) = -6.06, p < .001, d = 1.2$ . With respect to the past and present, adolescents with chronic illness were more positive about the past than matched controls,  $t(99) = -3.66, p < .001, d = .72$ . Although chronically ill adolescents were also somewhat more positive about the present (see Figure 5.6), the difference was not significant,  $t(99) = -1.80, p = .075$ .

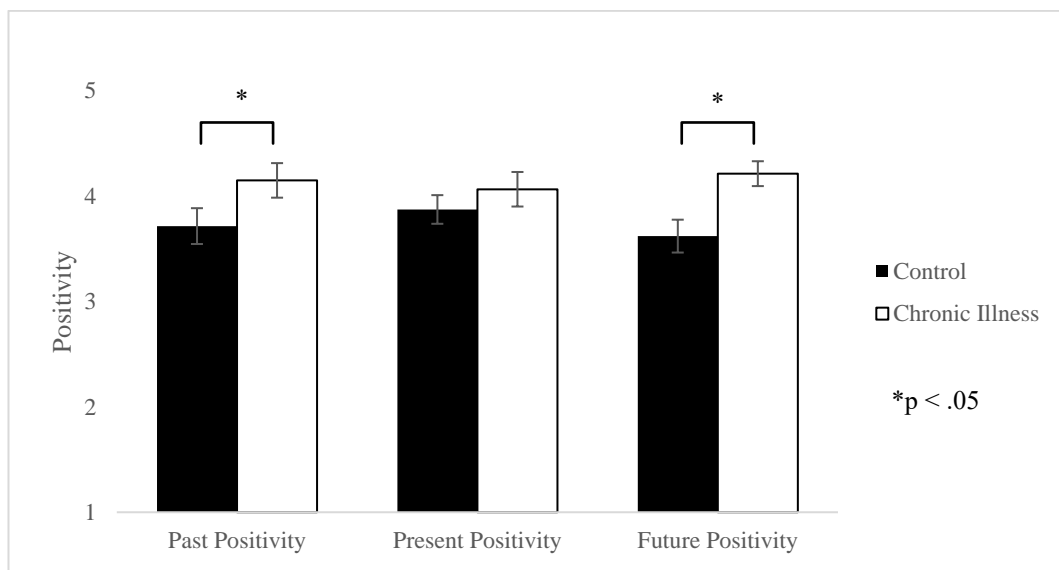


Figure 5.6 Time attitudes in adolescents with chronic illness and matched controls (with 95% CIs).

As shown in Figure 5.7, there was no difference between the two groups with respect to their degree of cognitive engagement with the future,  $t(100) = 1.19, p = .24$ .

Chronically ill adolescents did, however, report greater focus on the present than matched controls,  $t(100) = -2.54, p = .013, d = .50$ , and reported thinking less about the past than matched controls,  $t(100) = 4.61, p < .001, d = .92$ .

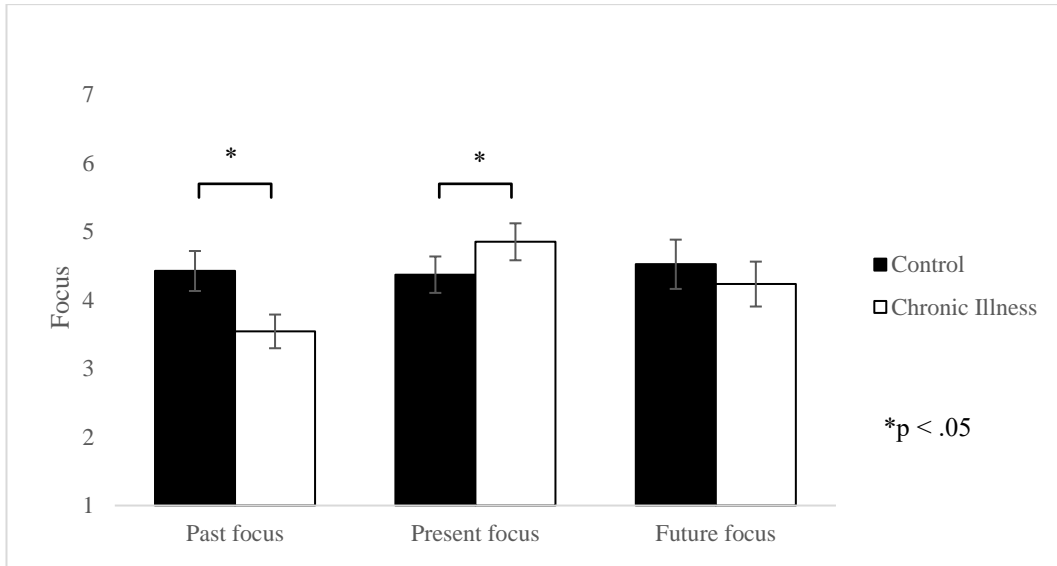


Figure 5.7 Past, present and future focus in adolescents with chronic illness and matched controls.

Looking at the subgroups, adolescents in the asthma group felt more positive about the future than adolescents in the control group,  $t(62) = 3.94, p < .001, d = 1.28$ . This was also true for the CF group,  $t(61) = 4.25, p < .001, d = 1.49$ , and diabetes group,  $t(74) = 3.99, p < .001, d = 1.03$ . Despite this positivity, none of the three subgroups differed from controls in terms of their cognitive engagement with the future.

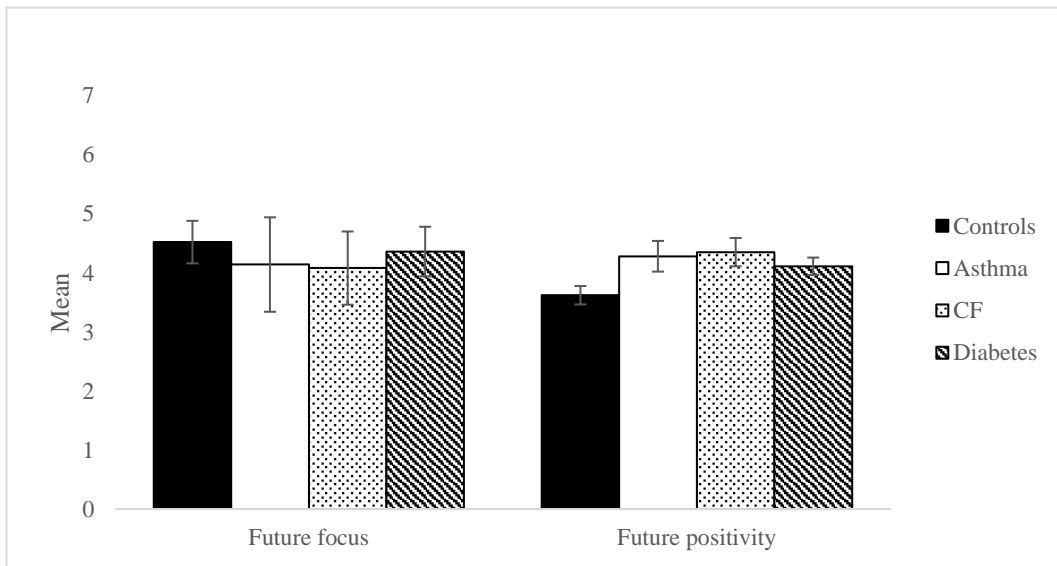


Figure 5.8 Future focus and future positivity in illness sub-groups and matched controls (with 95% CIs).

With respect to their attitudes toward the past, adolescents with asthma felt more positive about the past than matched controls,  $t(63) = 2.44, p = .017, d = .68$ . This was also true of adolescents in the CF,  $t(61) = 2.93, p = .005, d = .97$ , and diabetes subgroup,  $t(73) = 2.44, p = .017, d = .62$ . Only the adolescents with CF reported greater positivity toward the present compared to controls,  $t(61) = 2.39, p = .02, d = .79$ .

On the measure of temporal focus, adolescents with asthma reported spending less time thinking about the past than controls,  $t(63) = -2.42, p = .018, d = .74$ . This was also true for the diabetes subgroup,  $t(74) = -4.52, p < .001, d = 1.15$ . Adolescents in the diabetes subgroup also reported spending more time thinking about the present than controls,  $t(74) = 3.08, p = .003, d = .78$ . The asthma and CF subgroups did not differ significantly from the control group in terms of present focus.

### 5.3.1.6 Depression

Adolescents with chronic illness did not report more symptoms of depression than matched controls. In fact, overall, they scored lower on the CES-D, although this difference was not significant,  $t(98) = 1.81, p = .073$ .

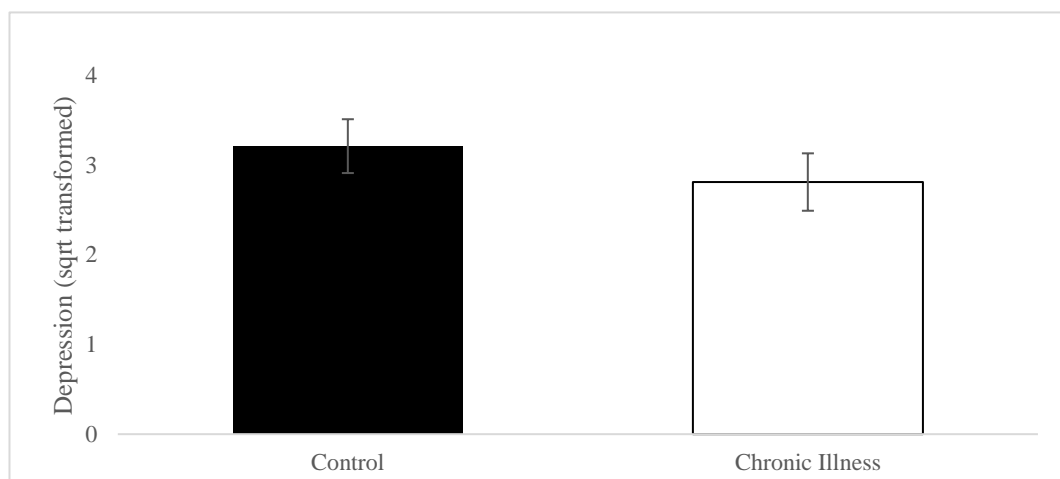
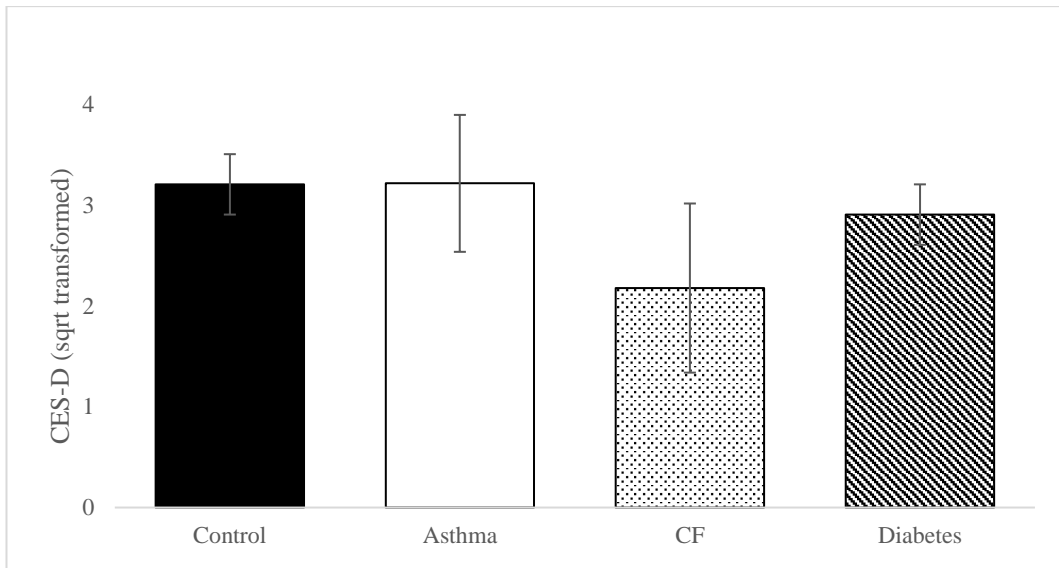


Figure 5.9 Depression scores in adolescents with chronic illness and matched controls (with 95% CIs).



*Figure 5.10 Depression scores in illness sub-groups and matched controls (with 95% CIs).*

### **5.3.2 Do adolescents with asthma, cystic fibrosis (CF) and Type 1 (T1) diabetes differ in their future thinking?**

#### ***5.3.2.1 Data pre-processing***

This separate analysis exploring illness-specific differences in future thinking between the three chronic conditions was conducted on all seventy-five chronically ill adolescents.

**Missing or non-systematic data.** As in Chapter 4, discounting data from five adolescents was excluded from analysis for being non-systematic. Data was considered non-systematic if any subjective value of the delayed reward was larger than the subjective value associated with the previous, shorter delay by a magnitude greater than 20% of the delayed reward (£20; criterion 1 from Johnson & Bickel, 2008). Five adolescents with diabetes, one adolescent with asthma, and one adolescent with CF failed to complete any of the four past or future event narratives due to time constraints. Two adolescents with diabetes, four adolescents with asthma and three adolescents with CF struggled to generate all four events, but did provide at least one past event narrative and one future event narrative. The ratings associated with these events were used for the purpose of analysis.

**Outliers.** In the asthma group, one AUC and one past internal details score were identified as being more than 3 SD above the mean. In the diabetes group, one BMQ Necessity, CES-D and future internal detail score were identified as being more than 3 SD above the mean. These outliers were excluded from the analysis.

**Normality and transformations.** As this analysis involved a medium sized sample ( $n < 50$ ), a z-skew or z-kurtosis of  $> +/- 1.96$  was taken as evidence of non-normality (Kim, 2013). Skewed key variables, the transformations used to reduce

skewness, and the skewness z-scores before and after transformation are summarised in Table 5.8.

*Table 5.8 Skewed variables and corresponding transformations.*

	Z-Skew before	Transformation	Z-Skew after
<b>Overall connectedness</b>			
Asthma	-2.26	<i>Square transformation</i>	-.49
CF	-1.56		.08
Diabetes	-.41		1.58
<b>Past positivity</b>			
Asthma	-1.10	<i>Square transformation</i>	-.45
CF	-.45		-.10
Diabetes	-2.65		-1.37
<b>Present positivity</b>			
Asthma	-2.36	<i>Square transformation</i>	-1.27
CF	-1.60		-.80
Diabetes	.49		.13
<b>AUC</b>			
Asthma	2.53	<i>Square root transformation</i>	1.16
CF	1.43		.86
Diabetes	3.14		1.54
<b>Depression</b>			
Asthma	3.43	<i>Logarithmic and constant (1) transformation</i>	1.45
CF	2.58		-1.13
Diabetes	4.33		.028
<b>BMQ Necessity</b>			
Asthma	-.08	<i>Square transformation</i>	.37
CF	-.14		.12
Diabetes	-2.34		-1.85

### 5.3.2.2 Descriptive statistics

Demographic variables and illness-related variables can be found summarised in Table 5.9. Table 5.10 shows descriptive statistics for the groups on key variables.

*Table 5.9 Baseline characteristics and univariate analysis of adolescents with asthma, CF and T1 diabetes.*

	Asthma (N = 20)	CF (N = 16)	Diabetes (N = 38)	<i>p</i>
<b>Age</b>				
Mean (SD)	14.1 (1.23)	15.4 (1.75)	14.4 (1.64)	.033*
<b>Gender</b>				
Female N (%)	10 (50)	7 (44)	21 (55)	.73
<b>Parental responsibility</b>				
Median (IQR)	3 (3 – 4)	3 (3 – 3.88)	3 (3 – 4)	.61
<b>Multiple Deprivation Measure (SES)</b>				
N (%)				
< 25 %	8 (40)	7 (44)	16 (42)	
25 – 50 <sup>th</sup> %	5 (25)	4 (25)	5 (13)	.55
50 – 75 <sup>th</sup> %	5 (25)	3 (19)	6 (16)	
> 75 %	2 (10)	2 (13)	11 (29)	
<b>Hospitalised in year prior?</b>				
Yes N (%)	3 (15)	6 (34)	5 (13)	.099
<b>Num. of prescribed medications</b>				
Median (IQR)	5.50 (5 – 6.75)	9.5 (6 – 11)	2 (2 – 2)	<.001**
<b>Other medical diagnosis?</b>				
Yes N (%)	16 (80)	9 (56)	12 (32)	.002*

*Categorical variables analysed using Chi-Square. Age was analysed using a One-Way ANOVA. The remaining descriptive variables, where the median is reported, were analysed using Kruskal-Wallis.*

\*  $p < .05$

\*  $p < .001$

### 5.3.2.3 Group differences in demographic and illness-related variables

As shown in Table 5.9, the illness groups did not differ significantly with respect to gender, socioeconomic status (SES), or hospitalisation status. The three groups did, however, differ significantly in age,  $F(2,71) = 3.58$ ,  $p = .033$ . Adolescents in the CF group were significantly older than adolescents in the asthma group ( $p = .034$ ), but

not those in the diabetes group ( $p = .074$ ). There was also an association between comorbidity status and illness group,  $\chi^2 (2) = 12.6, p = .002$ . Of the adolescents in the asthma group, 70% had a diagnosed comorbidity, which was most often (75%) allergy related. The median number of prescribed medications also differed significantly between the groups,  $\chi^2 = 66.3, p < .001$ , with adolescents in the CF group being prescribed the greatest number of treatments. Looking at the item “*This medicine disrupts my life*” from the BMQ Concerns subscale, 63% of adolescents with CF, 65% of adolescents with asthma and 59% of adolescents with diabetes agreed with this statement.

Age and number of medications did not significantly correlate with any of the measures of interest, nor did key variables differ between adolescents with and without a comorbidity. These demographic variables were therefore not explored as potential covariates when examining the differences between the three illness groups and measures of future thinking

#### ***5.3.2.4 Group differences on key variables***

To examine the main effect of illness group on key variables, a series of ANOVAs were conducted. Where the assumption of homogeneity was violated, Welch’s F is reported and Games-Howell used for post hoc comparisons due to unequal group size (Field, 2013). An adjusted omega squared formula was used to estimate effect size (Northern Arizona University, 2007). Only those results which showed a significant main effect of illness group are reported below.



Table 5.10 Means, standard deviations, medians, range of scores of key variables in asthma, CF and diabetes groups.

	Asthma (N=20)			CF (N=16)			Diabetes (N=38)		
	M (SD)	Median	Min - Max	M (SD)	Median	Min - Max	M (SD)	Median	Min - Max
<b>Connectedness (0 – 100)</b>									
Overall	58.3 (26.2)	64.5	0 - 87	61.6 (27.4)	69.5	0 - 97	52.8 (30.5)	58.5	0 - 100
Average	62.4 (19.6)	64.4	20 – 89.3	69.9 (13.5)	69.9	43.3 - 93	59.6 (20.5)	59.4	4.25 - 100
<b>Time Attitudes (1 – 5)</b>									
Past	4.04 (.78)	3.95	2.30 - 5	4.21 (.54)	4.30	3.30 - 5	3.93 (.78)	4	1.90 - 5
Present	3.98 (.79)	4.15	1.80 – 4.90	4.22 (.44)	4.25	3.10 - 5	3.92 (.66)	4.05	2.70 - 5
Future	3.68 (.58)	3.75	2.10 – 4.50	3.78 (.45)	3.80	2.80 – 4.50	3.67 (.48)	3.70	2.10 – 4.50
<b>Temporal Focus (1 – 7)</b>									
Past	3.45 (1.13)	3.50	1 – 5.50	3.80 (1.05)	4	2.25 – 5.75	3.50 (.90)	3.38	2 – 5.75
Present	4.69 (1.37)	5	1 – 6.75	4.55 (1)	4.25	3.50 - 7	4.95 (.86)	5	3.50 – 6
Future	3.95 (1.70)	4.25	1 - 7	3.98 (1.04)	4	2.25 – 6.50	4.45 (1.29)	4	2.50 - 7
<b>Beliefs about Medicines</b>									
Necessity (0 – 25)	19.2 (4.28)	18	12 - 25	21.1 (2.73)	21	17 - 25	22.6 (2.50)	23	16 - 25
Concerns (0 - 30)	15.3 (4.83)	15	6 - 23	12.2 (3.08)	12.5	8 - 17	14.8 (5.77)	13	7 - 28
AUC (0 - .98)	.16 (.10)	.13	.038 - .44	.37 (.32)	.22	.054 - .98	.30 (.26)	.20	.047 - .98
Depression (0 – 60)	12.2 (9.22)	9	4 - 39	7.50 (6.48)	6.50	0 - 26	9.68 (5.79)	9	3 - 32

**Temporal discounting.** A One-Way ANOVA determined that there was a significant main effect of illness type on discount rate (AUC), Welch's  $F(2, 32.5) = 4.20, p = .024, est. \omega^2 = .086$ . Post hoc comparisons using Games-Howell failed to find a significant difference between the three illness groups, although adolescents in the asthma group discounted somewhat more than adolescents with diabetes ( $p = .058$ ).

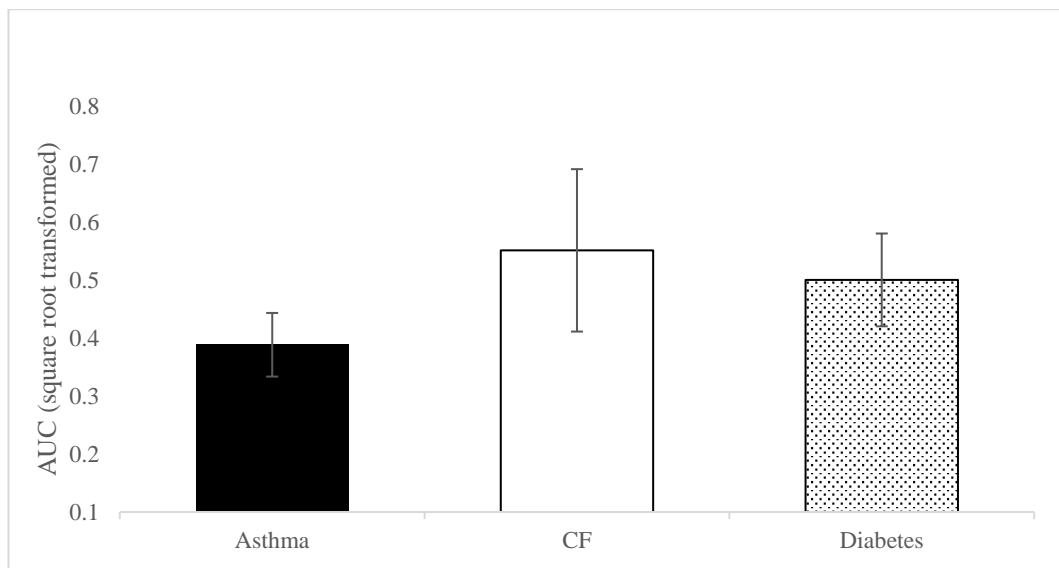


Figure 5.11 Discount rates in adolescents with asthma, CF and T1 diabetes (with 95% CIs).

**Medication beliefs.** There was a significant main effect of illness type on BMQ Necessity scores, Welch's  $F(2, 32.9) = 5.75, p = .007, est. \omega^2 = .12$  and BMQ Concern scores, Welch's  $F(2, 41.9) = 3.58, p = .037, est. \omega^2 = .066$ . Post hoc comparisons using Games-Howell determined that adolescents in the diabetes group recognised their medication to be of greater necessity than adolescents with asthma ( $p = .009$ ), but did not find any significant difference between the three groups in terms of their concern beliefs.

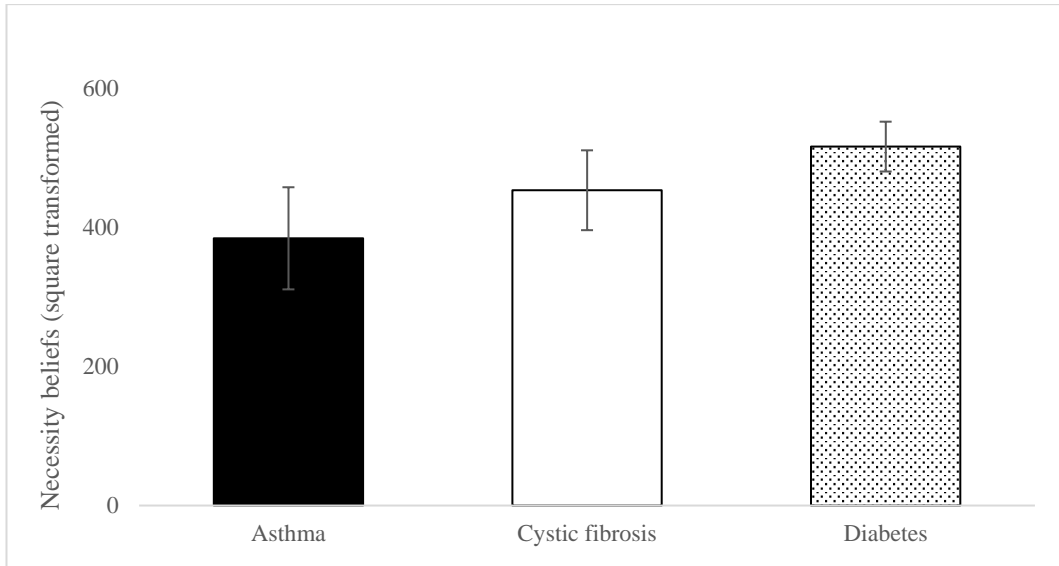


Figure 5.12 Medication necessity beliefs in adolescents with asthma, CF and T1 diabetes (with 95% CIs).

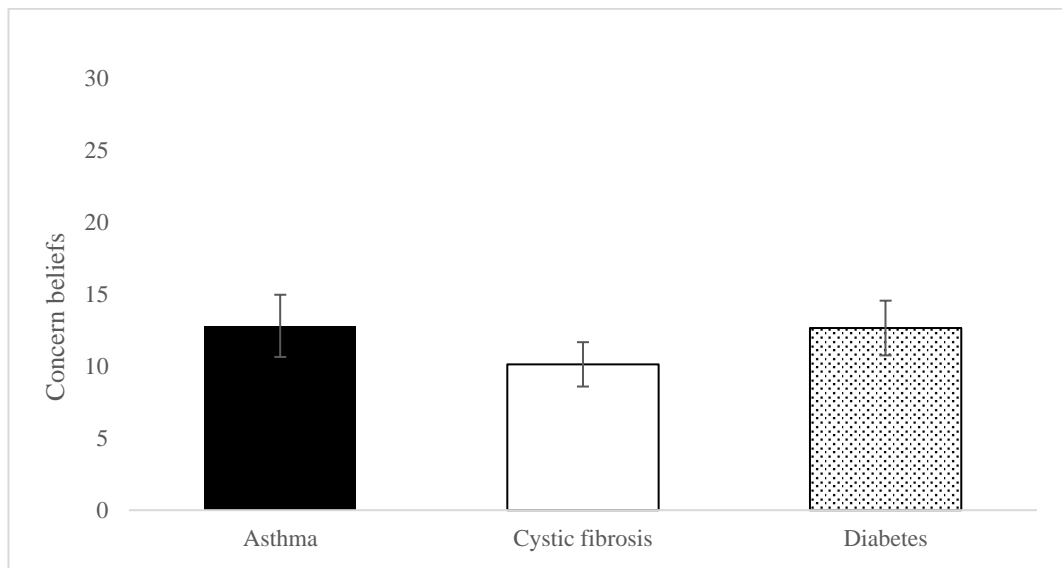


Figure 5.13 Medication concern beliefs in adolescents with asthma, CF and T1 diabetes (with 95% CIs).

## 5.4 Discussion

The ultimate aim of this chapter was to investigate, for the first time, the potential impact of chronic illness on adolescent future thinking. Overall, the results suggest that chronically ill and typically developing adolescents are strikingly similar in how they think and feel about the future. Adolescents with chronic illness did not differ significantly from matched controls in how connected they felt to their future selves, how often they thought about the future, or the episodic richness with which they imagined future events. Additionally, chronically ill adolescents did not report more depressive symptoms, nor did they feel more negatively about the future than their healthy peers. In fact, the opposite was true; adolescents with chronic illness felt significantly more positive about the future. Taken as a whole, these findings offer little support for the argument that adolescents might develop a view of the future that is pessimistic, bleak or hopeless as a result of living with and managing a chronic health condition. Similarly, adolescents with asthma, CF or diabetes did not differ from one another on various measures of future thinking, suggesting that there is little reason to believe these specific conditions impact differently on how adolescents think or feel about the future.

Adolescents with chronic illness did, however, report greater cognitive engagement with the present than healthy controls. Furthermore, during an intertemporal choice task, adolescents in the chronic illness group discounted the value of future rewards more steeply, reflecting less future-oriented decision making. Together, these results suggest that, despite feeling positive about the future, chronically ill adolescents may be more likely to focus on the present than typically developing young people and, perhaps more importantly, may be more inclined to

make short-sighted decisions that prioritise immediate gratification at the expense of their health in the future.

#### **5.4.1 An optimistic future**

Studies have consistently shown that there are elevated levels of depressive symptoms in adolescents with chronic illness (Bennett, 1994; Brady, Deighton & Stansfeld, 2017; Piquart et al., 2011). In this study, however, chronically ill and typically developing adolescents reported similar levels of depressive symptomatology. Additionally, adolescents with chronic illness felt more positive about the future than healthy controls. There are a number of possible reasons for this pattern of results.

Firstly, these unexpected findings could suggest that adolescents did not respond honestly to the measures of depression and future positivity due to social pressure. Prior to completing the study, adolescents with chronic illness, but not typically developing adolescents, were asked to give consent for their clinician to be informed if their responses on the CES-D subscale indicated concerning levels of depressive symptoms. Consequently, adolescents in the chronic illness group may have felt discouraged from responding honestly to this scale and may have felt a similar reluctance to indicate negativity on the measure of time attitudes. Even without such a barrier, adolescents with chronic illness tend to underreport depressive symptoms when compared to their parents (Piquart et al., 2011). Future studies exploring future thinking and depression in adolescents with chronic illness might consider utilising a multi-method approach that takes into account child, parent, and clinician ratings of depressive symptoms for these reasons.

Secondly, of the chronically ill young people recruited for this study, only 18% had been hospitalised in the year prior to recruitment. Hospitalisation status is a proxy for illness severity, which could be a moderator of depression in adolescent chronic illness (Bennett, 1994). If very few chronically ill adolescents in this study had what would be considered a “*severe*” illness, then this could explain the low levels of distress found in this study. The role of illness severity in future thinking might be an area for future research to address.

A third potential reason for these findings is that chronically ill adolescents might underestimate their risk of experiencing negative consequences as a result of their illness. As discussed in Chapter 4, positivity toward the future is not always realistic or adaptive, and individuals with unrealistic optimism tend to perceive themselves as invulnerable (Schwarzer, 1994). Therefore, the high levels of future positivity observed in this population compared to the typically developing teens might suggest that adolescents with chronic illness do not consider themselves to be at greater risk of adverse outcomes than their healthy peers. However, a more optimistic interpretation is that these results are simply evidence of resilience or adaptation. Early studies exploring psychological distress in young people with chronic illness note that young people with chronic illness often adapt remarkably well by developing effective coping strategies (Kellerman et al., 1980; Tavormina et al., 1976). The high levels of positivity observed in this group might simply reflect hope, which is thought to foster resilience, facilitate adaptive coping, and to protect against depression in adolescents with chronic illness (Griggs & Walker, 2016). It is entirely possible then that adolescents with chronic illness, despite the challenges facing them as they navigate adolescence with a chronic health condition, can preserve a view of the future that is positive and hopeful.

### 5.4.2 Prioritising the present

One aim of this chapter was to examine whether chronically ill adolescents, perhaps as a result of uncertainty or fear toward the future (Mullins et al., 2007; Taylor et al., 2008), might focus more on the present than typically developing adolescents. It was therefore not surprising that, in addition to spending more time thinking about the present, adolescents with chronic illness were more present-oriented in their decision making than healthy controls. However, it is unclear why the chronically ill adolescents in this study discounted more than typically developing young people, in light of other findings.

Envisioning a threatening or hostile future is thought to encourage greater prioritisation of immediate rewards in intertemporal decision making (Bulley et al., 2016), and feeling disconnected from one's future self and imagining the future with a lack of episodic richness are also thought to undermine future-oriented behaviour (Bartels & Rips, 2010; Bromberg et al., 2015; Hershfield, 2011; Peters & Büchel, 2010). As already discussed, adolescents in the chronic illness group felt more positive about the future than healthy controls, and both groups of adolescents were similar in how connected they felt to their future selves and how vividly they imagined the future during the EFT task. Furthermore, in Chapters 3 and 4, temporal discounting and present temporal focus were unrelated, making it unlikely that adolescents with chronic illness were more present-oriented in their decision making because they focus more on the present.

These findings do, however, align with what would be expected given socio-emotional selectivity theory (SST, Cartensen et al., 1999). SST posits that when people perceive their future to be limited, such as in the case of old age or life-threatening illness, people prioritise the present over “*diminishing future payoffs*”

(Cartensen et al., 1999). SST proposes that perceiving one's life to be limited leads to a shift in motivation towards maximising satisfaction and positive emotion (Lockenhoff & Carstensen, 2004). This could explain why adolescents in the chronic illness group were more present-oriented in their decision making, more focused on the present and more positive about the future. However, this interpretation is purely speculative, as this study did not assess the degree to which chronically ill and typically developing adolescents perceived their future to be foreshortened or limited. Scales designed to tap into this aspect of future thinking, such as the Future Time Perspective scale (Carstensen & Lang, 1996), might allow future studies to more carefully explore this possibility.

Given the well documented links between temporal discounting and risk taking (e.g. Bickel et al., 1999; Madden et al., 2011), it is concerning that adolescents with chronic illness discounted future rewards more steeply than matched controls in this study. While this is the first study to compare whether typically developing and chronically ill adolescents' differ in their tendency to discount future rewards, this result is consistent with studies showing that chronically ill adolescents are as likely, if not more, to engage in risk taking behaviour as their healthy peers (Choquet, Du Pasquier Fediaevsky, & Manfredi, 1997; Simpson, Janssen, Boyce, & Pickett, 2006; Suris, Michaud, Akre, & Sawyer, 2008; Suris & Parera, 2005). One study of over 7,500 adolescents found that those with a chronic illness were more likely to smoke and to have been involved in antisocial behaviour than those with no chronic illness (Suris et al., 2008). Another found higher rates of risky sexual behaviour amongst young people with chronic illness (Choquet et al., 1997).

It is particularly important to understand the determinants of risk taking in adolescents with chronic illness, as such behaviours can lead to serious adverse



health outcomes for these teens (Sawyer et al., 2008). The results of this study suggest that the tendency for chronically ill adolescents to behave in short-sighted ways may be underpinned by a preference for immediate rewards.

### **5.4.3 Illness-specific differences**

A secondary aim of this study was to investigate whether specific chronic conditions might impact differently on how adolescents think and feel about the future. While it might be assumed that adolescents with CF, who are not only faced with demanding and intrusive treatment regimens, but the prospect of transplantation and reduced life expectancy, might think and feel differently about the future than an adolescent with asthma, this study offers little evidence to support this claim. Adolescents with asthma, CF and diabetes responded similarly to measures of future self-connectedness, temporal discounting, future time attitudes, future temporal focus and EFT.

Although this may be due to the limited number of participants in each subgroup, the lack of illness-specific differences in future thinking may not be entirely surprising when certain features of the three illnesses are considered. Some clinicians have argued for a “*non-categorical*” approach to chronic illness (R. E. Stein & Jessop, 1982), asserting that the detrimental impact of chronic illness is not determined by specific characteristics of particular conditions, but is instead determined by more generic dimensions of illness, such as whether or not it is life threatening, unpredictable, intrusive or visible. All three of the conditions included in this study can be considered unpredictable (Higham et al., 2013; Kyngäs et al., 2000) and while CF is associated with a reduced life expectancy, asthma and diabetes are also potentially life threatening (Borus & Laffel, 2010; D’Amato et al., 2016). Furthermore, all three groups responded similarly to an item of the BMQ measuring

treatment intrusiveness (see section 5.3.2.3), and the groups did not differ in the number of adolescents who had been hospitalised in the year prior to recruitment, suggesting that adolescents across the three conditions experienced similar levels of treatment burden and severity. It is possible then that this study failed to find illness-specific differences in future thinking because the conditions included in this study share these common features. Future studies might seek to explore whether there might be larger differences between conditions that differ on these generic dimensions.

#### **5.4.4 Conclusion**

Overall, the findings of this study suggest that chronically ill and typically developing adolescents are remarkably similar in how they think and feel about the future. It seems that adolescents with chronic illness do not inevitably develop a view of the future that is threatening or hopeless as a result of the challenges they face. However, chronically ill adolescents may be more likely to focus their attention on the present and to prioritise immediate gratification when making decisions that concern the future. It is unclear why this might be, although it is possible that adolescents with chronic illness may perceive their future to be foreshortened, motivating them to focus on the here-and-now and to maximise present satisfaction. It is important for future research to clarify why chronically ill adolescents might be more inclined to discount the future, as such a tendency may lead these young people to make decisions that jeopardise their health in the future.

## **Chapter 6. General Discussion**

The aim of this final chapter will be to summarise the aims and key findings of Chapters 3, 4 and 5, and to discuss the implications the three studies described in these chapters have for our understanding of future-oriented cognition, its measurement in adolescence, and for potential future interventions designed to discourage myopic decision making and to improve adherence to treatment in adolescents with chronic illness. Following this, some limitations of the studies described in this thesis will be addressed. Finally, the chapter will end by looking to the future and outlining possible directions for future research.

### **6.1 Summary of aims and key findings**

Although the ultimate aim of this thesis was to investigate future thinking in adolescents with chronic illness, as outlined in Chapter 1, interest in future thinking and the role it plays in guiding adaptive decision making has spanned psychological disciplines, leading to the study of various future-oriented phenomena. Yet the future-oriented constructs evolving out of these domains are often investigated in isolation, raising questions about the nature of their overlap and their unique contributions to outcomes in adolescence. Therefore, before exploring future thinking in adolescents with chronic illness, this thesis aimed to draw together several diverse lines of research on future thinking in a developmental context by examining how different measures of future-oriented cognition relate to one another in typically developing adolescents. In doing so, this thesis sought to offer new insight into how different aspects of future-oriented cognition overlap in adolescence, and how they relate to short-sighted, impulsive decision making.

In Study 1 (Chapter 3), adolescents completed questionnaire measures of temporal focus, time attitudes, time orientation (importance) and time relation, as well as measures of episodic future thinking (EFT), future self-connectedness and temporal discounting. Although future time attitudes, future temporal focus and perceived future importance were all positively associated in this study, these measures did not relate to the amount of episodic detail adolescents provided during an EFT task, the degree to which they felt similar to their future selves, or their tendency to prioritise the future during an intertemporal choice task. Furthermore, there was no relationship between the measures of EFT, future self-connectedness or temporal discounting. Study 1 thus failed to replicate previously documented associations between EFT and temporal discounting in adolescents (Bromberg et al., 2015) and between future self-connectedness and discounting in adults (Bartels & Rips, 2010; Hershfield et al., 2011; Urminsky, 2017). These findings, or lack of, were attributed to potential shortcomings in the measures used to assess these constructs and subsequent revisions were made for the purposes of Study 2.

Using revised measures of EFT, future self-connectedness and temporal discounting, Study 2 (Chapter 3) found that adolescents who imagined the future with greater episodic richness were less impulsive, or more future-oriented, in the temporal discounting task, consistent with findings described by Bromberg et al., (2015). This was also true for adolescents who felt more connected, or similar, to their future selves, replicating and extending previous research in adults (Bartels & Rips, 2010; Hershfield, 2011; Urminsky, 2017). For the first time, EFT and future self-connectedness were shown to be distinct, but weakly related constructs that independently predict temporal discounting in typically developing adolescents. Again, as in Study 1, positive attitudes toward the future and cognitive engagement

with the future were associated, but were unrelated to the measures of EFT, future self-connectedness or temporal discounting.

Overall, the findings of Chapter 3 indicate that the different measures of future thinking utilised in these studies assess distinct future-oriented phenomena. Although the results of Study 2 suggest that vividly imagining the future and feeling connected to one's future self are linked in adolescence, both studies in Chapter 3 support the discrete nature of these two constructs. Additionally, EFT and future self-connectedness were independent predictors of temporal discounting, suggesting that EFT and future self-connectedness likely discourage impulsivity via different mechanisms. The results of Study 2 seem to indicate that only certain aspects of future thinking, specifically EFT and future self-connectedness, predict future-oriented decision making in typically developing adolescents. In contrast, across both studies, feeling positive about the future and thinking often about the future did not appear to be sufficient to encourage adolescents to prioritise the future in decision making.

An additional aim of Study 2 was to explore the link between future thinking and depression in adolescence, given that depressive symptomatology is associated with an impaired ability to imagine specific future events with episodic richness (Roepke & Seligman, 2016) and a tendency to discount future rewards (Jarmolowicz et al., 2014; Pulcu et al., 2014). Study 2 failed to replicate these specific findings. However, adolescents who reported more symptoms of depression felt less connected to their future selves, felt less positive about the future, and were more likely to imagine negative future events during the EFT task. Although these results suggest that depression may indeed negatively impact on aspects of adolescents' future-oriented cognition, the selective relationships observed between the measures of

future thinking and depressive symptoms in this study again highlights the distinct nature of these various future-oriented constructs.

Having established there to be a link between aspects of adolescents' future thinking and future-oriented decision making, this thesis next aimed to investigate the potential link between future thinking and treatment adherence in adolescents with chronic illness. As emphasised in earlier chapters, adherence to treatment is a critical predictor of future health outcomes (Rapoff, 2010). Nonadherence, however, offers a number of attractive, immediate rewards to adolescents. By failing to adhere, young people can avoid unpleasant side effects, fit in with their peers, and gain freedom from a restrictive routine (Hanghøj & Boisen, 2014; Kyngäs et al., 2000). The decision to adhere or not might therefore be conceived of as a choice between benefitting now or benefitting later, and intentional failure to adhere to treatment, regardless of the long-term consequences, might be underpinned by a short-sighted preference for immediate gain. In studies of adults with Type 1 and Type 2 diabetes (Lebeau et al., 2017; Reach et al., 2011, 2018; Stoianova et al., 2018), poor adherence is indeed associated with a tendency to discount future rewards more steeply. Therefore, one specific aim of the third study in this thesis was to determine whether intentional nonadherence in adolescents with chronic illness may be related to the tendency to discount delayed rewards.

Adolescents with a consultant confirmed diagnosis of asthma, cystic fibrosis (CF) or Type 1 (T1) diabetes completed the same measures of temporal focus, time attitudes, EFT, future self-connectedness and temporal discounting as used in Study 2 (Chapter 3). In addition to a questionnaire measure of adherence, which was completed simultaneously by patients and their parents, adolescents also completed measures of depressive symptomatology and medication beliefs, given that

depression, low necessity beliefs and high concern beliefs are known to be barriers to adherence (Bender, 2006; DiMatteo et al., 2000; Horne et al., 2013).

As expected, chronically ill adolescents who reported greater intentional nonadherence discounted future rewards more steeply during the temporal discounting task, reflecting a greater preference for immediate rewards, and also felt less connected to their future selves. However, neither temporal discounting nor future self-connectedness independently predicted adherence when controlling for other important predictors of adherence, such as depressive symptoms and medication concern beliefs. Somewhat unexpectedly, given the findings of Study 2 (Chapter 3), future self-connectedness was unrelated to participants' discount rates. Moreover, adolescents with low adherence did not report thinking less about the future, did not feel less positive about the future, did not struggle to imagine the future with episodic richness, and seemed equally capable of recognising the necessity of their medications compared to high adherers.

Unfortunately, due to limitations in sample size, it was not possible to explore the relations between future thinking and adherence in the asthma or cystic fibrosis subgroups, although analysis conducted on the subgroup of adolescents with T1 diabetes showed that future self-connectedness was an independent predictor of adherence. However, as speculated in Chapter 4, with only thirty-eight adolescents in this subgroup it is unlikely that there was sufficient power to detect significant relationships between adherence and the other key measures of future thinking, such as temporal discounting, in the adolescents with diabetes.

When taken as a whole, the results described in Chapter 4 seem to indicate that failure to adhere to treatment is not so much rooted in an adolescent's inability to consider the future, or a failure to understand the necessity of adherence, but more so

in a tendency to discount delayed rewards. However, as temporal discounting was not an independent predictor of adherence when controlling for other influential factors, it is likely that the relationship between adherence and discounting is more complex than initially hypothesised. The results also suggest that while adherence was related to adolescents' judgements of future self-connectedness in both the chronic illness group and in the smaller subgroup of adolescents with T1 diabetes, this link did not appear to be mediated by temporal discounting, making the potential mechanism by which future self-connectedness might motivate adherence unclear. That only future self-connectedness, and not EFT, was related to adolescents' adherence aligns with the findings of Studies 1 and 2, further underscoring the distinct nature of these two future-oriented constructs. Similarly, while positive attitudes and cognitive engagement with the future were associated, albeit weakly, neither of these measures were related to treatment adherence, further demonstrating that positivity toward the future and engagement with the future do not seem to predict future-oriented decision making in typically developing or chronically ill adolescents.

The final aim of this thesis was to explore the potential impact of chronic illness on future thinking by examining whether chronically ill adolescents might think or feel differently about the future than their healthy peers and, if so, whether the impact of chronic illness on future thinking might differ depending on the chronic condition in question. To achieve this, adolescents with chronic illness from the study described in Chapter 4 were compared to the typically developing adolescents from Study 2 (Chapter 3), after being matched on the basis of age, gender and socioeconomic status. Moreover, adolescents with asthma, CF and T1 diabetes were



compared against controls, and with each other, to explore illness-specific differences in future thinking.

Overall, the findings of Chapter 5 indicate that chronically ill adolescents are markedly similar to their healthy peers in how they think and feel about the future, despite the additional psychosocial challenges associated with living with, and managing, a chronic health condition (Suris et al., 2004; Yeo & Sawyer, 2005). Chronically ill adolescents did not think less about the future, feel less connected to their future selves, did not imagine the future with less episodic richness, did not report elevated levels of depression and, somewhat strikingly, actually reported greater positivity toward the future than healthy controls. Adolescents with chronic illness did, however, exhibit steeper discounting, reflecting a greater preference for immediate rewards and, furthermore, reported greater cognitive engagement with the present than their healthy peers. These findings suggest that, although adolescents with chronic illness may not inevitably develop an image of the future that is negative or bleak, they may still be vulnerable to “living in the present”, or making short-sighted decisions that could jeopardise their health in the future. When adolescents with asthma, CF and T1 diabetes were compared, both with each other and with healthy controls, there was little evidence to suggest that these conditions impact differently on how adolescents think and feel about the future.

In summary, results across all three studies clearly indicate that the different measures of future thinking employed in this thesis tap into very different future-oriented phenomena. Moreover, only certain aspects of future thinking seem to predict future-oriented decision making in adolescence. These findings have theoretical implications pertaining to how we conceptualise future thinking and its role in decision making and health behaviour, as well as methodological implications

concerning how certain aspects of future thinking are measured. This thesis also has theoretical implications pertaining to our understanding of intentional nonadherence in adolescents with chronic illness and the impact chronic illness might have on future thinking.

There may also be a number of practical implications arising out of these findings. The distinct nature of EFT and future self-connectedness has implications for how we characterise the effects of interventions designed to attenuate temporal discounting, and for how future interventions might be designed to better discourage short-sighted decision making and risk taking behaviour in adolescents. Moreover, the results of Chapter 4 indicate that temporal discounting and future self-connectedness may be potential targets for interventions designed to better motivate adherence in adolescents with chronic illness. These implications will be considered in greater detail in the sections that follow.

## **6.2 Theoretical implications**

### **6.2.1 What does it mean to be future oriented?**

As revealed in previous chapters, the various psychological disciplines that share an interest in future thinking have each focused their attention on the study of different, but often conceptually similar (Oettingen et al., 2018), future-oriented phenomena. Consequently, the cognitive, affective and behavioural constructs evolving out of these domains, and the instruments designed to assess them, tend to be investigated in isolation. With little understanding of how these constructs overlap, it is unknown whether different measures of future thinking tap into a single, underlying characteristic, sometimes referred to in the literature as *future orientation* (Robbins & Bryan, 2004; Steinberg et al., 2009; Zimbardo & Boyd, 1999). Despite this, there

is often an implicit assumption, particularly in the individual differences literature, that a person who is future-oriented in one capacity will also be future-oriented in another (McKay et al., 2018).

Findings from across all three studies provide little evidence to suggest that future orientation is a single trait or characteristic that extends across multiple future-oriented capacities. Instead, the findings serve to underscore the complex and multi-faceted nature of future-oriented cognition, demonstrating that there are several ways in which an adolescent can be oriented to the future. While Studies 1 and 2 show that adolescents who think positively about the future tend to think more often about the future, as is consistent with previous research (McKay et al., 2018; Shipp et al., 2009), there is little evidence from any of the three studies to suggest that such “future-oriented” teens would also imagine the future more vividly, feel more connected to their future selves, or exhibit greater patience when making decisions concerning the future. Moreover, future positivity and cognitive engagement with the future were more weakly associated in the sample of adolescents with chronic illness in Chapter 4. It is important for researchers to note that when referring to an individual as “*future-oriented*”, care should be taken to specify how exactly future orientation is being operationalised.

Of course, the studies in this thesis only explore the relationships between EFT, future self-connectedness, temporal discounting, time attitudes and temporal focus. It may still be worth investigating whether other future-oriented constructs overlap, as this could provide us with a more comprehensive understanding of how the numerous future-oriented constructs studied across the literature relate to one another theoretically, and might also facilitate in the reduction in the number of conceptually similar terms used throughout the literature.

### **6.2.2 Future thinking and decision making**

This thesis offers further insight into the links between future thinking, future-oriented decision making and future-oriented behaviour in adolescence. Given the tendency for young people to behave in short-sighted ways (Steinberg et al., 2009; Steinberg & Chein, 2015), it is crucial to identify factors that might discourage adolescents from making impulsive decisions that can have long-lasting consequences. As detailed in Chapter 1, research suggests that one adaptive function of future thinking is that it promotes greater consideration and prioritisation of the future in decision making (Boyer, 2008; Bulley & Irish, 2018; Suddendorf & Corballis, 2007; Zimbardo & Boyd, 1999). The results of this thesis, however, suggest that only certain aspects of future thinking encourage adaptive decision making in adolescence.

In particular, this thesis highlights the importance of feeling connected to one's future self. In Chapter 3, typically developing adolescents who felt more connected to their future selves were less likely to be impulsive, as assessed by a temporal discounting task. Then, in Chapter 4, adolescents with chronic illness who felt more connected to their future selves reported greater adherence to their prescribed treatments. Together, these findings indicate that adolescents who perceive their present and future selves to be highly similar are more willing to make decisions or behave in ways that prioritise their interests in the future. This is consistent with previous research in adults, in which future self-connectedness has been shown to predict discount rates (Bartels & Rips, 2010; Bartels & Urminsky, 2011; Hershfield et al., 2009), financial savings (Bryan & Hershfield, 2013; Hershfield et al., 2011), academic performance in college students (Adelman et al., 2017) and, more recently, engagement in health behaviours such as exercise and

healthy eating (Rutchick et al., 2018). This thesis, for the first time, extends this research to both typically developing and chronically ill adolescents and offers further evidence for the relationship between future self-connectedness and adaptive decision making.

However, when considering the link between future self-connectedness and temporal discounting, it should be noted that there were some discrepancies between Chapters 3 and 4. As discussed in Chapter 4, future self-connectedness was, against expectations, unrelated to temporal discounting in the adolescents with chronic illness. That is, although chronically ill adolescents who felt more connected to their future selves were more future-oriented in their tendency to adhere, they were not more future-oriented in the intertemporal choice task. If future self-connectedness does not encourage chronically ill adolescents to prioritise future rewards, then the mechanism by which future self-connectedness might motivate adherence is unclear. It is also unclear why future self-connectedness would be associated with discounting in typically developing adolescents, but not in chronically ill adolescents. As speculated in Chapter 4, it is possible that the measure of future self-connectedness used in these studies taps into features of chronically ill adolescents' future self that pertains to their illness. If so, these illness-specific dimensions of future self-connectedness might encourage adolescents with chronic illness to prioritise health rewards by adhering but might not motivate future-oriented decision making in a task involving monetary rewards. Moreover, this could mean that any inconsistency between Chapters 3 and 4 concerning the link between future self-connectedness and temporal discounting could be attributable to differences between the two groups of adolescents and how they responded to the measure of future self-connectedness.

Regardless of the discrepancies between these two studies, when taken as a whole, this thesis lends support to the notion that feeling connected to one's future self motivates adaptive, future-oriented decision making and behaviour, suggesting that future self-connectedness may be a construct of considerable interest to researchers studying impulsivity, risk taking and maladaptive behaviour in adolescence.

Future self-connectedness was not the only aspect of future-oriented cognition related to adolescents' decision making. It is thought that the capacity to construct vivid images of one's future supports decision making by providing a preview of the emotional significance of a future reward, thus countering its devaluation (Benoit et al., 2011; Boyer, 2008). As expected, the episodic richness with which typically developing adolescents imagined the future was shown to predict their tendency to discount future rewards in Study 2, successfully replicating previous research (Bromberg et al., 2015). It was therefore also expected that EFT would predict treatment adherence. However, Study 3 (Chapter 4) failed to replicate previous associations between EFT and discounting and, furthermore, EFT did not relate to treatment adherence. This might simply indicate that being able to generate rich and detailed descriptions of imagined future episodes is not a predictor of future-oriented decision making in adolescents with chronic illness. However, as noted in Chapters 4 and 5, the EFT task used in this study, although the same as in Study 2, may have been less accurate in the adolescents with chronic illness due to the unique setting in which recruitment took place (see section 6.3). Studies employing alternative measures of EFT might seek to clarify whether imagining a vivid future does indeed motivate patients to adhere to treatment. For now, at least, this thesis lends some support to previous research that suggests the capacity to imagine the

future with episodic richness facilitates future-oriented decision making in typically developing adolescents.

One notable finding concerning the link between future thinking and decision making is that future time attitudes and future temporal focus were unrelated to temporal discounting across all three studies and were not associated with adherence in the third study of adolescents with chronic illness. That is, positive attitudes toward the future and thinking often about the future alone did not seem to encourage prioritisation of the future in decision making. These results are consistent with previous research using these scales, in which time attitudes and temporal focus alone were unrelated to alcohol use (McKay, Andretta, & Cole, 2017; McKay et al., 2012). Together, these findings indicate that simply feeling positive about the future and thinking often about the future do not necessarily determine whether a young person will be short-sighted or impulsive in their decision making. Thus, simply urging young people to think about the future or feel optimistic about the future may do little to counter their tendency to engage in risk taking behaviour. These findings also have implications for debates over how best to measure time attitudes and engagement with the future, which will be discussed later in section 6.3.

### **6.2.3 Why do adolescents fail to adhere to treatment?**

As stated previously in Chapter 1, a number of health behaviour models have been applied to the context of chronic illness in an effort to understand why patients with chronic health conditions so often fail to adhere to treatment that is crucial for positive health outcomes. These models and frameworks, including the Health Belief Model (HBM, Rosenstock, 1974), the Theory of Planned Behaviour (Ajzen, 1991), Social Cognitive Theory (SCT, Bandura, 1986), the Common Sense Model of Self-Regulation (CSM, Leventhal, 2012) and the Necessity Concerns Framework (NCF,

Horne & Weinman, 1999), all propose that patients' beliefs and expectations about their illness and its treatment are core predictors of adherence behaviour. Although these models have acknowledged the importance of patients' expectations, which are inherently future-oriented, the links between future-oriented cognition and adherence have rarely been explicitly examined in previous research. As such, this thesis not only contributes to our understanding of the links between future thinking and decision making but, perhaps more importantly, it provides novel insights into when and why patients with chronic illness fail to adhere to their treatments.

According to the HBM and the CSM, if a patient anticipates that they will experience negative outcomes as a result of their illness, then they should be more motivated to adhere (Howard Leventhal, Phillips, & Burns, 2016; Rosenstock, 1974). It was therefore surprising that attitudes toward the future were unrelated to adherence. However, as discussed in Chapter 4, positive attitudes toward the future are not always realistic or adaptive; individuals with unrealistically positive attitudes toward the future often underestimate risks and tend to perceive themselves as invulnerable (Schwarzer, 1994). It is possible then that, despite scoring similarly on the measure of future time attitudes as adolescents with high adherence, the low adherers in this study were exhibiting a degree of unrealistic optimism. Despite this, these findings indicate that simply having positive expectations for the future may not be enough to motivate adolescents to prioritise their future health when making decisions about their treatments.

What seemed to be more important for predicting adherence than adolescents' attitudes toward the future was whether participants preferred immediate or delayed rewards during the intertemporal choice task, and whether they perceived their present and future selves as being similar. In Study 3 (Chapter 4), low adherers



discounted future rewards more steeply during the intertemporal choice task than high adherers, reflecting a greater preference for immediate rewards. When considered alongside previous studies of patients with T1 and T2 diabetes (Reach et al., 2011, 2018; Stoianova et al., 2018; Lebeau et al., 2016), these findings suggest that patients who fail to adhere do so, at least in part, because they are more prone to discounting the future health benefits of adherence. This also aligns with a rich body of work that has consistently found there to be associations between steep discount rates and maladaptive health behaviour (see Story et al., 2014). However, as will be discussed in section 6.6, there are still a number of uncertainties concerning the relationship between temporal discounting, treatment adherence and, in fact, health behaviours in general.

Low adherers also felt less connected to their future selves, which is consistent with the notion that if a young person feels that they have little in common with their future self then they will be less motivated to prioritise their future self when making decisions about their health (Rutchick et al., 2018). However, as already discussed, it is unclear why future self-connectedness would promote adherence if not because it counters people's tendency to discount future rewards (Bartels & Rips, 2010). One possibility, as speculated in Chapter 4, is that feeling connected with one's future self provides insight into how that future self will feel as a consequence of present behaviour (Hershfield et al., 2012). Thus, adolescents may be less likely to adhere if they perceive their present and future selves to be dissimilar because they fail to fully appreciate the emotional and physical consequences of nonadherence (Hershfield et al., 2012).

Together, these findings provide promising, preliminary evidence to suggest that future-oriented cognition may have an important role to play in motivating patients

to adhere to their treatments, which previous health behaviour models have neglected to account for. If future studies are able to better establish the precise nature of the link between temporal discounting, future self-connectedness and nonadherence, these factors could potentially be incorporated into existing health behaviour models and frameworks to provide a more comprehensive understanding of why patients fail to adhere. The implications these findings have for future interventions will be discussed in section 6.4.2.

#### **6.2.4 The impact of chronic illness on future thinking**

Finally, this thesis contributes to our understanding of the potential impact chronic illness has on a young person's future thinking. Given the psychosocial challenges facing chronically ill adolescents (Suris et al., 2004), and that chronic illness is thought to be a risk factor for psychological distress (Clarke & Currie, 2009), it was anticipated that the adolescents with chronic illness in Study 3 would think and feel differently about the future than their healthy peers. Rather strikingly, however, the results of Chapter 5 provide little evidence to suggest that chronic illness has an adverse impact on adolescents' future-oriented cognition. In fact, the findings of this study seem to suggest that young people with chronic illness can still preserve a view of the future that is positive and hopeful, despite the challenges facing them.

Adolescents with chronic illness may, however, be more likely to focus on the present than typically developing young people and may be more inclined to prioritise immediate gratification when making decisions that concern the future. Previous research examining the prevalence of risk taking behaviour amongst adolescents with chronic illness have noted that there is a commonly held assumption that teens with chronic health conditions are less likely to engage in risk taking

behaviours than their healthy peers (Choquet et al., 1997; Sawyer et al., 2007; Suris et al., 2008; Suris & Parera, 2005). However, the findings of these previous studies, alongside the results of this thesis, serve to challenge this assumption, suggesting that adolescents with chronic illness may, in fact, be more prone to behaving in short-sighted ways.

As adolescents with chronic illness did not seem to anticipate their futures to be more negative or hostile, it is difficult to say why they might exhibit a greater preference for immediate rewards or might think more often about the present than typically developing young people. However, as discussed in Chapter 5, perceiving one's life to be limited can lead to a shift in motivation towards maximising satisfaction and positive emotion (Lockenhoff & Carstensen, 2004). This could potentially explain why adolescents in the chronic illness group were not only more present-oriented in their decision making, more focused on the present and more positive about the future. This study did not assess the degree to which chronically ill and typically developing adolescents perceived their future to be foreshortened, but this might be an avenue for future research to explore. Crucially, if adolescents with chronic illness are more inclined to discount the future than their healthy peers, then it is important for future studies to gain insight into why this might be, since temporal discounting is linked to risky behaviours that have far greater health consequences for chronically ill adolescents than for their healthy peers (Audrain-McGovern et al., 2009; Bickel, Odum, & Madden, 1999; Jarmolowicz et al., 2014; Sawyer et al., 2008). For now, these findings may lend support to recent calls for young patients to be provided with standardised information regarding the specific consequences such behaviours can have on their conditions (Keyte, Egan, & Mantzios, 2019).

There was also little evidence to suggest that adolescents think or feel differently about the future depending on whether they have asthma, CF or T1 diabetes. These results may be attributable to limitations in the size of the three subgroups, which may have impaired the ability of this study to detect significant differences between them. Alternatively, as discussed in Chapter 5, it is possible that this study failed to find illness-specific differences in future thinking because these conditions share a number of common features. All three of the chronic conditions included in this study can be considered unpredictable (Higham et al., 2013; Kyngäs et al., 2000) and are either associated with a reduced life expectancy, such as in the case of CF, or are potentially life threatening (D’Amato et al., 2016; Glaser et al., 2012). Furthermore, all three groups felt their treatments were somewhat burdensome, and similar numbers of adolescents in each illness group had been hospitalised in the year prior to recruitment. Together, this suggests that regardless of diagnosis, adolescents across the three groups experienced similar levels of treatment burden and illness severity, perhaps explaining why there were no substantial differences in future-oriented cognition across the three groups.

### **6.3 Methodological implications**

#### **6.3.1 Future time attitudes and temporal focus**

If positivity toward the future and future focus are unrelated to risk taking or health behaviour, as the results of this thesis and previous research (McKay et al., 2012, 2017) would suggest, then this raises questions over whether these constructs should be measured separately at all in decision making and risk taking research.

A critique of Zimbardo’s Time Perspective Inventory (ZPTI, Zimbardo & Boyd, 1999) is that it integrates constructs such as time attitudes and temporal focus

with other individual differences factors, such as conscientiousness (Shipp et al., 2009). Using the ZPTI, future-oriented individuals have been shown to not only discount less (van den Bos et al., 2015), but to be less likely to engage in risk taking behaviour (Rothspan & Read, 1996; Zimbardo et al., 1997). However, when assessed separately, future positivity and future focus seem to have little bearing on decision making in adolescence, suggesting that other individual differences factors, as assessed by multi-dimensional measures like the ZPTI, may be more important for predicting engagement in impulsive or risky behaviour than attitudes and focus toward the future alone. Future research will be required to resolve the predictive utility of standalone measures of time attitudes and temporal focus compared to multiplex measures such as the ZPTI.

Alternatively, researchers have previously noted the limitations of using bivariate or correlational analyses when examining the relationships between time attitudes, temporal focus, and indicators of risk taking and impulsivity (Chishima, McKay, & Cole, 2017; McKay, Percy, et al., 2016; Wells, McKay, Morgan, & Worrell, 2018). As individuals are capable of focusing on the past, present, and future to different degrees and hold attitudes toward all three time periods simultaneously, it may be unhelpful to look at how individuals think or feel about the past, present, and future in isolation. Instead, it has been argued that person-centred analysis techniques, such as cluster analysis, may be of greater use, as these approaches account for scores on past, present and future subscales of measures like the Adolescent Time Inventory – Time Attitudes scale or the Temporal Focus Scale simultaneously (Shipp et al., 2009). There is evidence to support this position, with high powered studies demonstrating that time attitude profiles predict attitudes toward alcohol, level of alcohol use, and subjective life expectancy (McKay et al.,

2016). Studies have yet to examine the links between temporal focus profiles and impulsive decision making; however, temporal focus profiles have been shown to predict self-esteem, anxiety and depression symptomatology in adolescents (Chishima et al., 2017; McKay et al., 2017). In part due to sample sizes, exploring how time attitude and temporal focus profiles relate to short-sighted decision making in adolescence was beyond the scope of this thesis. However, whether such profiles may be of greater use in predicting future-oriented decision making than looking at each time period in isolation is a question that might be addressed in the future.

### **6.3.2 Assessing episodic future thinking (EFT)**

As stated earlier, Chapter 4 failed to replicate previously documented links between EFT and decision making. This finding may have implications for how best to measure this construct in future studies. Previous research has predominantly utilised standardised interview methods to assess individual differences in EFT (e.g. Addis et al., 2008). These methods allow for participants to be questioned or prompted by the interviewer to elicit further details about an imagined future event, but are often more difficult and time intensive to administer, with interviews taking up to three hours to complete in some studies (Miloyan & McFarlane, 2019).

In Study 2 (Chapter 3) and in Study 3 (Chapters 4 and 5), EFT was assessed by adapting the Child Autobiographical Interview (Willoughby et al., 2012) to create a novel task using a pen-paper format. This was to facilitate recruitment, allowing for data to be collected from typically developing adolescents in classroom settings. Using this measure, Study 2 successfully replicated a previously documented association between EFT and temporal discounting in typically developing adolescents (Bromberg et al., 2015). However, in Study 3, EFT was not associated with temporal discounting or treatment adherence in adolescents with chronic illness.

Moreover, EFT did not differ significantly between typically developing and chronically ill adolescents.

As discussed in Chapter 4, and as alluded to previously, the lack of association between EFT and other key measures in Chapters 4 and 5 may be because there were a number of unique challenges to using this task in the study with chronically ill adolescents. This particular study was conducted in outpatient clinics during school hours and required approximately 45 minutes of patients' and their parents' time. Of all the measures completed by participants, the EFT task was administered last, required the most effort, and a number of adolescents had to leave the clinic before they could complete the task due to time pressure. It is entirely possible that other participants felt pressured to complete the task as quickly as possible. Consequently, adolescents may not have performed during this task in a way that is truly reflective of their capacity to engage in vivid EFT. As discussed in Chapter 5, when the episodic and non-episodic details provided by participants in their written narratives of future events were summed, adolescents with chronic illness provided significantly fewer *total* details than typically developing adolescents, indicating their narratives were shorter and less detailed overall. This might suggest that the chronically ill adolescents were less engaged with the task, perhaps due to the reasons cited above.

This could suggest that using pen-paper format EFT tasks are of limited use in certain settings. Although this method offers a number of advantages over more time intensive interviews, the probes and prompts used in standardised interview measures tend to elicit more detailed descriptions from participants, which may allow for greater accuracy in assessing EFT. Although this task involved a single, standardised prompt (*"Is there anything more you can tell me about that event?"*),

interview methods allow for personalised prompts and probes, which may be of use in determining whether a young person is truly struggling to generate details for a specific event or whether they are simply disengaged from the task. Having said that, tasks that require less time to complete, such as sentence completion methods (Anderson & Dewhurst, 2009), may be another alternative for future studies in similar settings and under similar circumstances.

Despite these limitations, it is important to reiterate that when employed in Study 2, this task was capable of detecting an association between EFT and impulsive decision making in typically developing adolescents, even after controlling for other potentially important variables such as episodic memory skills and depression. Therefore, this task might still be of considerable use to researchers interested in further examining the link between EFT and decision making in typically developing adolescents.

#### **6.4 Implications for interventions**

This thesis may have important implications for our understanding of current interventions designed to attenuate temporal discounting through prompts to engage in EFT or by increasing perceived future self-connectedness. The findings may also offer insight into how future interventions might be developed to discourage myopic decision making in adolescence, and to motivate adherence to treatment in patients with chronic illness.

##### **6.4.1 EFT and future self-connectedness interventions**

As stated earlier, one aim of this thesis was to explore how various future-oriented constructs from across the literature overlap. Of particular interest was the relationship between EFT and future self-connectedness, as both have been shown to



attenuate temporal discounting (Bartels & Rips, 2010; Bulley et al., 2016; Hershfield, Wimmer, et al., 2009; Urminsky, 2017), and researchers have speculated that future self-connectedness might be, at least in part, determined by how vividly an individual imagines the future (Hershfield & Bartels, 2018). Promisingly, EFT and future self-connectedness were shown to be loosely related constructs that independently predicted discounting behaviour in Study 2 and were found to be distinct future-oriented phenomena across all three studies. These results call into question previous interpretations of interventions designed to attenuate temporal discounting by cueing EFT or by manipulating perceived future self-connectedness. Ultimately, however, these findings raise hope for new, more powerful interventions designed to improve adolescent decision making.

A number of interventions have been developed that aim to encourage future-oriented decision making via increasing perceived future self-connectedness. However, it could be argued that these same interventions might also work by prompting EFT. For example, writing a letter to the future self has been shown to deter participants from making delinquent decisions (van Gelder et al., 2013) and, more recently, to motivate participants to spend more time exercising (Rutchick et al., 2018). While writing a letter to one's future self might encourage greater prioritisation of the future due to, at least in part, changes in perceived future self-connectedness, it is also possible that imagining the act of reading the letter in the future, in other words engaging in EFT, is what leads to more adaptive decision making. Other interventions deliberately employ prompts used by EFT researchers with the aim of increasing perceived self-connectedness by manipulating the vividness of the future self (see Kaplan, Reed, & Jarmolowicz, 2016; Wu, Cheng, & Chiou, 2017). For example, Blouin-Hudon & Pychyl (2017) asked students to

regularly listen to an audio file designed to prompt them to imagine, with episodic detail, their future self at the end of the semester. The results showed that this manipulation reduced procrastination over academic tasks by increasing empathy felt for the future self. However, at the same time, their manipulation led to increases in perceived self-connectedness which were mediated by increases in the vividness of the future self. The results of Blouin-Hudon and Pychyl's study and those of Study 2 suggest that (1) the relations between EFT and future self-connectedness are complex, and (2) interventions designed to encourage future-oriented decision making might be made more effective by incorporating prompts to engage in EFT as well as using features designed to increase perceived self-connectedness.

Again, it is important to note that there was inconsistency between Chapters 3 and 4. The links between EFT, future self-connectedness and temporal discounting were not replicated in the study of adolescents with chronic illness (Chapter 4). However, as speculated earlier, the EFT task may have been somewhat limited in this sample and if, unlike typically developing adolescents, chronically ill adolescents are thinking about features of their future self that are illness related, then it is possible that future self-connectedness in this population is unrelated to impulsivity when assessed by an intertemporal choice task concerning monetary rewards. Further work will, of course, be needed to better establish the links between EFT, future self-connectedness and temporal discounting in both adolescents and adults, and in the context of chronic illness. However, the distinct nature of EFT and future self-connectedness was clear across all three studies, making it unlikely that these phenomena attenuate temporal discounting via identical underlying psychological processes. Thus, there may still be promise in incorporating both types of

interventions in the future to more effectively discourage short-sighted decision making in adolescence.

#### **6.4.2 Improving adherence**

The findings of this thesis may have promising implications for interventions designed to motivate patients with chronic illness to adhere to their prescribed treatments. Specifically, the results of Chapter 4, in addition to previous research, suggest that countering the tendency of patients to discount future rewards might better motivate them to adhere. Moreover, increasing the degree to which patients feel connected to their future selves might also be beneficial for encouraging adherence to treatment.

As discussed previously, the results of this thesis seem to indicate that failure to adhere to treatment may be due, at least in part, to a patient's tendency to discount future rewards. As such, interventions designed to counter this tendency might help to motivate patients to give greater priority to their health in the future, thus increasing their likelihood to adhere. Interventions already exist that might improve adherence by discouraging temporal discounting. One recent study of over 16,000 patients in the UK found that simply highlighting the personal costs of nonadherence on patients' medication boxes was enough to motivate better adherence (Jachimowicz et al., 2019). The researchers concluded that subsequent improvements in adherence were attributable to loss aversion, a phenomenon whereby individuals tend to be more motivated to avoid losses than to acquire equivalent gains (Jachimowicz et al., 2019). However, there is another possible interpretation. In their study of adults with T2 diabetes, Lebeau et al., (2017) found an association between adherence and discounting for rewards but failed to find a relationship between adherence and discounting for losses. This seems to indicate that the decision to

adhere is influenced more so by what patients think they might gain in the future (e.g. improved symptom control) than what they might lose in the future (e.g. reduced symptom control) (Lebeau et al., 2017). It might therefore be argued that, by highlighting the long-term costs of nonadherence to patients, Jachimowicz et al., (2019) also highlighted the long-term benefits of adherence. By making these distant rewards more salient or concrete, this could, arguably, also discourage patients from discounting the delayed benefits of adherence (Benoit et al., 2011; Peters & Büchel, 2010; Urminsky & Zauberger, 2015), increasing their motivation to adhere. Future research should seek to establish whether an intervention highlighting the benefits of adherence would be equally, if not more, effective as one that highlights the costs of nonadherence. Other existing interventions that might improve adherence by attenuating temporal discounting are those that seek to incentivise adherence using monetary rewards (Bilger et al., 2017; Long, Jahnle, Richardson, Loewenstein, & Volpp, 2012), although these have had limited success.

Increasing the connection that patients feel to their future selves might also be an effective way to improve adherence, according to the results of this thesis. However, very few studies have examined whether manipulating future self-connectedness improves health behaviour. One recent study, cited above, found that asking people to write a letter to their future self in 20 years' time subsequently led to increases in time spent exercising (Rutchick et al., 2018). Thus, using a simple intervention like the one above to heighten perceived future self-connectedness could also be beneficial in promoting adherence behaviour.

One caveat to this conclusion is that, as highlighted several times throughout this chapter, perceived future self-connectedness was not associated with temporal discounting in the adolescents with chronic illness in Chapter 4. However, this does

not rule out the possibility that such an intervention could still motivate adherence by some other mechanism. For example, as speculated previously, chronically ill adolescents who feel connected to their future selves might be more likely to adhere because they have greater insight into the physical and emotional consequences of nonadherence (Hershfield et al., 2012). To the degree that manipulations designed to increase future self-connectedness foster future-oriented decision making by increasing empathy felt for the future self (Blouin-Hudon & Pychyl, 2017), then strengthening the connection between patients' present and future selves might help them to fully recognise, and care about, the consequences of nonadherence, giving them greater motivation to adhere. Future studies might seek to explore the relationship between vividness of the future self or empathy for the future self and treatment adherence in adolescents with chronic illness. This could provide greater insight into the potential mechanism by which future self-connectedness promotes adherence.

Finally, the findings of this thesis have some implications for currently existing interventions that seek to promote adherence through education. These interventions aim to improve patient knowledge about their illness, its treatment and the necessity of adherence. While such interventions are undoubtedly important, they have been shown to be insufficient to promote adherence when delivered in isolation (Dean et al., 2010). The results of Chapter 4 seem to suggest that even adolescents who understand the necessity of their treatments may still be vulnerable to making decisions about their medication that are short-sighted. Educating adolescents on the long-term health benefits of adherence is unlikely to be an effective strategy on its own if an adolescent subsequently discounts the value of these future rewards in favour of those gained through nonadherence. Thus, incorporating strategies to

discourage adolescents from discounting the long-term health benefits of adherence might increase the effectiveness of existing interventions. Given the findings of Chapter 5, in which adolescents with chronic illness were more likely to discount future rewards, and previous studies showing elevated levels of risk taking in chronically ill adolescents (Choquet et al., 1997; Suris & Parera, 2005; Simpson et al., 2006; Suris et al., 2008), such interventions may be of additional benefit in this population.

## **6.5 Limitations**

It is important to address a number of limitations that have yet to be acknowledged in this chapter. Firstly, the cross-sectional nature of the studies described in this thesis make it difficult to draw confident conclusions about the causal relations between constructs or what the direction of causation may be. For example, that adolescents with chronic illness who felt more connected to their future selves were more likely to adhere to their medications could indicate, as hypothesised, that stronger connectedness motivates adherence. Alternatively, adhering to medication could lead an adolescent to feel their condition will be stable in the future, strengthening the sense of continuity they feel with their future self.

However, there is reason to believe that future self-connectedness is associated with adherence in the expected direction, given that experimental manipulations of future self-connectedness have been shown to encourage adaptive behaviour (Bryan & Hershfield, 2013; Hershfield et al., 2011; Rutchick et al., 2018; van Gelder et al., 2013). For example, asking participants to interact with visual representations of their “*future self*” using age-progressed virtual reality avatars can increase savings behaviour (Hershfield et al., 2011). In fact, simply asking people to consider the responsibility they have for their future self leads to greater financial

savings (Bryan & Hershfield, 2012). Increasing future self-connectedness has also been shown to discourage dishonest or unethical behaviour (van Gelder et al., 2013), and can motivate individuals to spend more time exercising (Rutchick et al., 2018). Thus, with these previous experimental studies in mind, there is reason to believe that future self-connectedness is related to treatment adherence in the expected direction.

Another potential shortcoming is that any conclusions drawn from Chapter 4 ultimately rely on a measure of treatment adherence that was based on adolescent and parent self-report. Self-report measures of adherence may overestimate adherence rates (Taddeo et al., 2008) and may be prone to memory bias and social pressure (Stirratt et al., 2015). It is therefore generally recommended that a multi-method approach is used to determine adherence (Modi et al., 2006). As discussed in Chapter 4, this study intended to triangulate three measures of adherence that would include two self-report measures, from both adolescents and their parents, and a third, more objective measure of adherence using GP prescription issue records (Goodfellow et al., 2015). However, prescription issue data was available for only 47% of the adolescents recruited for the study, precluding the inclusion of this data in the composite measure. Although this was disappointing, the composite measure of adherence, based on adolescents' and their parents' self-reported adherence, was shown to be related to glycaemic control in the diabetes subgroup, as would be expected (Hood et al., 2009), which provides some validation of this measure. Moreover, as recommended in the literature (Stirratt et al., 2015), a previously validated measure of adherence, the Medication Adherence Report Scale (MARS, Horne & Weinman, 1999) was used. This scale employs a number of techniques to encourage patients to respond honestly, such as phrasing items in a non-threatening

manner, assuring anonymity and confidentiality, and prefacing items with the following non-judgemental statement “*Many people find a way of using their medicines which suits them. This may differ from the instructions on the label or from what their doctor had said. Here are some ways in which people have said they use their medicines*”. Nonetheless, researchers seeking to further investigate the links between future thinking and treatment adherence should consider using more objective tests of adherence such as pill counts, electronic monitors, or prescription issue and refill records.

A third notable limitation concerns the sample size of the third study in this thesis. Initially, it was hoped that a large group of adolescents with asthma, cystic fibrosis and Type 1 diabetes would be recruited for the purposes of Chapters 4 and 5. However, it was difficult to achieve the sample size that was hoped for and previous, similar studies have also found it challenging to recruit large samples of chronically ill patients (e.g. Bucks et al., 2009; Reach et al., 2011). Consequently, this study may have lacked sufficient power to detect statistically significant relationships between key variables. Additionally, the small number of adolescents with asthma and CF meant that it was not possible to explore differences between low and high adherers in these two subgroups, nor was it possible to examine whether the links between future thinking and adherence were consistent across all three chronic conditions. Future research will be needed to clarify whether the associations between adherence and key variables such as temporal discounting and future self-connectedness extend to these specific populations or whether the relationship between future thinking and adherence might differ between chronic conditions.

Finally, as discussed in Chapter 4, this study was conducted on a convenience sample of adolescents with chronic illness who were primarily recruited from



outpatient clinics. As clinic attendance is associated with treatment adherence (Wood et al., 1985), as is participation in research (Riekert & Drotar, 2002), it is possible that adolescents with very poor adherence would be less likely to attend the clinics where recruitment took place and less likely to agree to take part. However, it could be argued that this possibility only makes it more impressive that this study observed there to be a relationship between adherence, temporal discounting and future self-connectedness. It is also notable that the adolescents with chronic illness reported low levels of distress, high beliefs in the necessity of their medication, and only 18% had been hospitalised in the year prior to recruitment. Moreover, these teens were more optimistic toward the future than healthy controls, a surprising finding considering the elevated levels of distress that previous research has found in chronically ill young people (DiMatteo et al., 2000; Piquart & Shen, 2011b). It is therefore difficult to say whether this sample of chronically ill adolescents is truly representative of the wider populations of adolescents with chronic health conditions. Future studies should, of course, seek to determine if these results generalise to other chronic conditions.

With continued advancements in treatment and care, adolescents with asthma, cystic fibrosis and Type 1 diabetes can expect to live fulfilling lives, but their likelihood of achieving positive outcomes is drastically undermined when they fail to adhere. Despite the limitations described above, this thesis provides initial evidence to suggest that future-oriented cognition plays a previously neglected role in motivating adherence in chronically ill adolescents and, more crucially, offers promising new insight into how these young people can be better encouraged to make decisions about their treatments that prioritise their health in the future.

## **6.6 Looking to the future – directions for future research**

A number of recommendations have been made throughout this chapter with respect to areas for future research. However, a number of key suggestions arising out of this thesis will be discussed below.

This thesis is the first to examine the relationship between episodic future thinking (EFT) and future self-connectedness in any age group. As speculated earlier, the results of this thesis, when taken as a whole, suggest that EFT and future self-connectedness likely attenuate temporal discounting via different psychological processes and that interventions designed to reduce impulsive decision making in adolescence might be made more effective by combining prompts to engage in EFT as well as elements designed to heighten perceived future self-connectedness. First, however, careful experimentation will be necessary to establish the nature and direction of the causal relationships amongst EFT, future self-connectedness and temporal discounting. Looking further into the future, researchers might seek to examine whether employing cues to engage in EFT or increasing perceived self-connectedness are as effective on their own as an intervention designed to target both EFT and perceived self-connectedness simultaneously. Given the potential implications such findings could have for future interventions targeting smoking, substance misuse and other risky behaviours in adolescence, this could be a particularly important avenue for future research to explore.

With regards to future self-connectedness, this construct was shown to relate to a number of measures of interest across the three studies. Adolescence is conceived of as a period in which the sense of self can change dramatically (Habermas & Bluck, 2000; Kroger et al., 2010; Sebastian et al., 2008), which may be even more true for adolescents with chronic health conditions (Hauser, Jacobson, Wertlieb, Brink, &

Wentworth, 1985). As future self-connectedness is thought to be undermined during periods of transition (Bartels & Rips, 2010), it is striking that perceiving one's present and future selves to be similar seems to be linked to both decision making and well-being in young people. To date, previous research on future self-connectedness has focused on adults (Hershfield, 2018), but the findings of this thesis indicate that future studies should examine the broader significance of self-connectedness during adolescence, in both typical and atypical populations.

Turning to temporal discounting, the results of this thesis, and those of previous studies (Lebeau et al., 2016; Reach et al., 2018, 2011; Stoianova et al., 2018), suggest that future interventions might improve adherence by attenuating the degree to which patients discount future rewards. However, the precise nature of the relationship between temporal discounting and treatment adherence remains elusive. The rate at which an individual discounts future rewards is considered to be an indicator of their preference for immediate gain when making intertemporal decisions (Green et al., 1994). As argued throughout this thesis, the decision to adhere or not to one's treatment can be considered an intertemporal decision, as it involves a trade-off between the benefits of nonadherence, which are immediate, and the benefits of adherence, which tend to be situated in the future. As such, the observation that patients who discount future rewards more steeply are also more likely to fail to adhere to their treatments would suggest these patients are more inclined to discount the future rewards of adherence, resulting in nonadherence.

However, despite the rich body of evidence that suggests discount rates are predictive of smoking, substance misuse and self-reported health status (see Story et al., 2014 for a review), research has yet to establish a causal pathway between temporal discounting and health behaviour (MacKillop & Munafò, 2016; Story et al.,

2014). Moreover, few longitudinal studies have been conducted to investigate whether steep discount rates are a precursor for maladaptive behaviour (Audrain-McGovern et al., 2009; Fernie et al., 2013; MacKillop & Munafò, 2016). It is therefore possible that temporal discounting is simply a marker for impulsive decision making, but not quite the direct mechanism by which maladaptive behaviour occurs. If this is the case, then interventions designed to improve adherence by reducing discount rates may be ineffective. It will be necessary to first determine whether there is a causal relationship between temporal discounting and nonadherence and, if so, what the direction of causation is. Prospective longitudinal studies may be one way to examine the causal link between discounting and treatment adherence, similar to those that have assessed the relationship between discounting and substance use in adolescence (Audrain-McGovern et al., 2009; Fernie et al., 2013).

It might also be interesting to explore whether the associations between discounting and adherence observed in this study would persist if a measure of discounting were used that asked participants to make intertemporal decisions about immediate and delayed health outcomes, rather than monetary outcomes. However, discounting tasks involving health outcomes often involve a level of abstract thought (Attema et al., 2018), which may make these types of tasks difficult for adolescents. Additionally, studies have found very weak associations between measures of monetary discounting and measures of health discounting (Story et al., 2014; Chapman, 1999), and only the former has been consistently found to predict health behaviour (Story et al., 2014). This may be because the processes involved in making decisions about one's health in the real world might differ radically from the processes involved when making hypothetical decisions during a discounting task

concerning health outcomes (Story et al., 2014). Nonetheless, exploring whether chronically ill adolescents who struggle to adhere to treatment also exhibit steeper discounting of health outcomes, could further our understanding of the relationship between temporal discounting and nonadherence, which, as previously highlighted, may have powerful implications for the development of future interventions.

## **6.7 Conclusion**

In summary, the studies described in this thesis contribute to our understanding of future-oriented cognition in adolescence and offers novel insights into the links between future thinking and future-oriented decision making in both typically developing and chronically ill adolescents.

Overall, the findings underscore the complex and multi-faceted nature of future thinking, demonstrating that there is more than one way for an adolescent to be oriented to the future. Moreover, the findings show that only certain aspects of “*future orientation*” seem to contribute to adaptive decision making in adolescence. With respect to typically developing adolescents, the results of this thesis suggest that interventions designed to discourage short-sighted decision making by countering temporal discounting might be made more effective by combining prompts to engage in EFT as well as heightening perceived connectedness with the future self.

Perhaps more importantly, this thesis sheds new light on our understanding of future thinking in chronically ill adolescents, demonstrating that failure to adhere to treatment is related to adolescents’ tendency to discount future rewards and the degree to which teens perceive their present and future selves as being similar. These findings seem to suggest that interventions designed to counter a patient’s tendency

to discount the future rewards of adherence, or which strengthen the connection that patients feel with their future selves, may help patients to prioritise the future when making decisions about their treatment. Although, future studies will be needed establish whether these aspects of future-oriented cognition are causally related to adherence. Finally, this thesis found little evidence to suggest that living with chronic illness during adolescence has an adverse impact on how chronically ill adolescents think or feel about the future. However, the results of Chapter 5 suggest that adolescents with chronic illness may be more likely to “*live in the present*” than their healthy peers and to make decisions that prioritise immediate gratification. Interventions designed to discourage short-sighted decision making might therefore be of additional benefit in this specific population.

Adolescence is a critical period of development, during which teens must begin to think about and plan for the future in order to make decisions that can have long-lasting consequences (Nurmi, 1991). Despite this, adolescence is also a time characterised by impulsivity and risk taking (Arnett, 1996); a fact that seemingly does not exclude adolescents with chronic health conditions (Yeo & Sawyer, 2005). Ultimately, the findings of this thesis offer hope for the discovery of new and effective interventions designed to encourage adolescents to make better decisions by increasing the priority they give to the future and their future self, a development that may have far reaching implications for adolescents’ achievement, health and well-being.

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## Appendices

### *Appendix 3.1. Letter of ethical approval for Study 1.*

22 December 2015

Ms Robyn McCue  
School of Psychology

Dear Robyn

**Full title of Study: The development of future thinking in adolescence.**

**PREC reference number: No 30-2015-16**

Thank you for your response to our request for further information regarding the above mentioned research application.

I can confirm that ethical approval has been granted for your project by the School of Psychology Research Ethics Committee, on behalf of Queen's University Belfast.

Please note that the Participant Information sheet should include an appended statement confirming ethical approval.

It is the responsibility of the Chief Investigator to ensure that the research has been recorded on the University's Human Subjects Research Database otherwise it will not be covered by the University's indemnity insurance. This database can be found in the 'My Research' section of Queen's On-line.

Yours sincerely

Dr Eugene O'Hare (Chair)  
Psychology Research Ethics Committee

cc: Dr Aidan Feeney




Appendix 3.2 Future self-continuity scale (Hershfield, 2011) used in Study 1 with instructions adapted from Bartels & Rips (2010).

**Task 1.**

We would like you think about the person you are now and the person you will be in 5 years.

*It might help you to think about the things that make you who you are: What is your personality like? What do love doing? What are your likes and dislikes? What would you like to achieve this year? How much do you think these things will change in 5 years?*

Do you think the person you are now (present-self) and the person you will be in 5 years (future-self) are similar? Once you - ve had a think, please look at the circles below. Please choose which pair of overlapping circles you think best describes how similar or connected you feel to yourself in 5 years.



The scale consists of a horizontal line with 10 tick marks. Below the line are 10 pairs of overlapping circles. The first pair on the left has no overlap. As the pairs move to the right, the circles overlap more, with the final pair on the right being a single, thick-lined circle. The text 'Not similar to me at all' is at the left end and 'Very similar to me' is at the right end.

*Appendix 3.3 Measure used to assess importance of the past, present and future in Study 1, adapted from the Adolescent Time Inventory (Mello & Worrell, 2007).*

**Task 3.**

In this task, we would like to see how important the past, present and future are to you. For each time period (past, present and future), please choose one of the circles which you think shows how important you think that time period is. Simply draw an x inside the circle you choose.

A larger circle means you think it is very important to you, and a smaller circle means you think it is less important to you.

**The past is...**

Not important to me at all | Very Important to me

**The present is...**

Not important to me at all | Very Important to me

**The future is...**

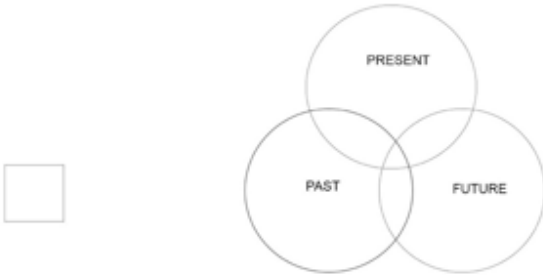
Not important to me at all | Very Important to me

The form consists of three identical sections, one for 'The past is...', 'The present is...', and 'The future is...'. Each section contains five circles of increasing size from left to right. Below each row of circles is a horizontal line with tick marks at the ends, labeled 'Not important to me at all' on the left and 'Very Important to me' on the right.

*Appendix 3.4 Measure used to assess time relation in Study 1, adapted from the Adolescent Time Inventory (Mello & Worrell, 2007).*

**Task 4.**

Please select one of the following pictures by placing an x in the box which you best demonstrate how you view the relationship between the past, the present and the future (please put an x in the box next to the picture you choose).



*Appendix 3.5 Debrief sheet provided to participants following Study 1.*

**The Development of Future Thinking in Adolescence.**

Thank you for participating in our study. Here is a little more information about it.

We already know that some teenagers who should be taking medicine because of long-term illnesses, do not take their medication as regularly as they should do. On the other hand, other ill teenagers do regularly take their medication. One potential difference between these two groups is in how they think about the future. Before we can test to see whether this is true, we have to see how young people without long-term illnesses think about the future.

To measure how you think about the future we asked you to answer questions about your attitudes to the past, the present and the future, and how similar you think the way you are now is to how you will be in the future. We also asked you to write about yourself in the future and to make some decisions about the value of money now and in the future. Studies of this money value task have shown that some people prefer a reward to be given to them immediately, even if it is a smaller amount, than to receive an even bigger reward at some point in the future. In other words, some people would prefer to be given £5 immediately than wait 1 week to get £10.

Psychologists have found that people who prefer smaller, immediate rewards are more likely to focus on the present, and are less likely to think about the future consequences of their behaviour. We want to see how your answers on this task relate to your answers on the other future thinking tasks that you completed.

We hope that the results from the study will help us find a way to encourage young people with long-term illnesses to take their medication more often. If you would like to receive more information about the study or learn of its results once it has been completed, please email me ([rmccue01@qub.ac.uk](mailto:rmccue01@qub.ac.uk)), or my supervisor ([a.feenev@qub.ac.uk](mailto:a.feenev@qub.ac.uk)). Thank you very much for taking part.

*Appendix 3.6 Letter of ethical approval for Study 2.*

1 November 2016

Ms Robyn McCue  
c/o School of Psychology

Dear Robyn

**Full title of Study: The development of future thinking in adolescence.**  
**PREC reference number: No 30-2015-16**

I write to advise you that the application for amendment to the above mentioned previously approved application, (as detailed in your letter to the Chair of 28th October 2016), has been approved by the School of Psychology Research Ethics Committee, on behalf of Queen's University Belfast.

It is the responsibility of the Chief Investigator to ensure that the research has been recorded on the University's Human Subjects Research Database otherwise it will not be covered by the University's indemnity insurance. This database can be found in the 'My Research' section of Queen's On-line.

Yours sincerely

Dr Eugene O'Hare (Chair)  
Psychology Research Ethics Committee

*Appendix 3.7 Instructions provided to participants before the “Remember/Imagine” task in Study 2 (and Study 3).*

**Instructions**

We would like you to tell us about two different events **that have happened to you in the past** and two different events you **imagine might happen to you in the future**. On the next page there is a list of events that you can use to help you think, but you can choose two events that are not on this list if you want.

There are only 3 rules:

1. The events you choose have to be ones where *you were personally there* and you took part in what happened.
2. You should think of an event that happened around the time period that we will give you (e.g. 'last month').
3. You should pick an event that happened *at a specific time, at a specific place*. The event you describe should take place over a couple of hours but should last no longer than a day. For example, you could describe a day where you visited Disneyland in Paris and had a hamburger for lunch, but we don't want you to describe a 2 week trip to France because that is not specific enough. Or perhaps you could describe a school sport's day where you imagine running in a race, coming first and then being given a gold medal by the principal.

We would like you to **write down as much detail about what you remember/imagine as you can**. We will ask you to describe one event first, and then we will ask some questions about the event, then we will ask you to describe the second event and so on.



*Appendix 3.8 List of events participants were provided with before the “Remember/Imagine” task in Study 2 (and Study 3).*

For example, you could choose...

- A birthday
- A school trip
- A sporting event
- Halloween
- Getting a pet
- A sleepover
- Winning an award
- Going to a concert
- Being on a plane or a train
- Something that happened on one day of a vacation
- A wedding
- Moving to a new home
- A graduation
- A school party or dance
- A boat ride
- A holiday party
- Your performance in a play, recital, or band

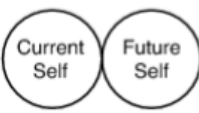


Appendix 3.9 Measure of future self-connectedness used in Study 2 (and Study 3).


Participants were first introduced to the overlapping circles representing their present and future selves before they were asked to rate future self-connectedness on four dimensions: personality, hobbies, likes/dislikes and overall.

Task 1.  
In this task, we would like you think about the **person you are now** (your present-self) and the **person you will be in 5 years** (your future-self).

These pictures will help you answer the questions:




The circles are not overlapping here, which means the present-self and the future-self are completely different.



The circles are completely overlapping here which means the present-self and the future self are exactly the same.

- Please rate how similar (by placing an x on the line below) you think your present-self and your future-self (in 5 years) are in terms of **personality**.

0 100



Completely different Exactly the same

*Appendix 3.10 Debrief sheet provided to participants following Study 2.*

**The Development of Future Thinking in Young People**

Thank you so much for participating in our study. Here is a little more information about it.

We already know that some teenagers who should be taking medicine because of long-term illnesses, do not take their medication as regularly as they should do. On the other hand, other ill teenagers do regularly take their medication. One potential difference between these two groups is in how they think about the future. Before we can test to see whether this is true, we have to see how young people without long-term illnesses think about the future.

To measure how you think about the future we asked you to answer questions about your attitudes to the past, the present and the future, and to rate how similar you think the way you are now is to how you will be in the future. We also asked you to write about yourself in the past and in the future and to make some decisions about the value of money now and in the future. Studies of this money decision task have shown that some people prefer a reward to be given to them immediately, even if it is a smaller amount, than to wait to receive an even bigger reward at some point in the future. In other words, some people would prefer to be given £5 immediately than wait 1 week to get £10.

Psychologists have found that people who prefer smaller, immediate rewards are more likely to focus on the present, feel less connected to their future selves, imagine the future less vividly and as a result, are less likely to think about the future consequences of their behaviour. We want to see how your answers on this task relate to your answers on the other future thinking tasks that you completed. We think that young people with long-term illnesses might think less about the future because it might seem frightening, and we want to see if this has an impact on whether they take their medications.

We hope that the results from the study will help us find a way to encourage young people with long-term illnesses to take their medication more often. If you would like to receive more information about the study or learn of its results once it has been completed, please email me ([rmccue01@qub.ac.uk](mailto:rmccue01@qub.ac.uk)), or my supervisor ([a.feeney@qub.ac.uk](mailto:a.feeney@qub.ac.uk)). Thank you very much for taking part.





**East Midlands - Leicester Central Research Ethics Committee**

The Old Chapel  
Royal Standard Place  
Nottingham  
NG1 8FS

Telephone: 0207 104 8115

29 August 2017

Dr Aidan Feeney  
Queen's University Belfast  
School of Psychology  
BT7 1NN

Dear Dr Feeney

<b>Study title:</b>	<b>Future Thinking and Medicine Use in Children and Adolescents with Chronic Illnesses</b>
<b>REC reference:</b>	<b>17/EM/0303</b>
<b>IRAS project ID:</b>	<b>231851</b>

Thank you for your submission of 25 August 2017, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Vice-Chair.

We plan to publish your research summary wording for the above study on the HRA website, together with your contact details. Publication will be no earlier than three months from the date of this opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to make a request to postpone publication, please contact [hra.studyregistration@nhs.net](mailto:hra.studyregistration@nhs.net) outlining the reasons for your request.

**Confirmation of ethical opinion**

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

<b>17/EM/0303</b>	<b>Please quote this number on all correspondence</b>
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With the Committee's best wishes for the success of this project.

Yours sincerely

**Mr Murthy Nyasavajjala**  
Vice Chair

Email: [nrescommittee.eastmidlands-leicestercentral@nhs.net](mailto:nrescommittee.eastmidlands-leicestercentral@nhs.net)

*Enclosures:* "After ethical review – guidance for researchers"  
*Copy to:* Paula Tighe  
Alison Murphy, Research & Development HSCNI

*Appendix 4.2 Letter of permission from the Belfast Health and Social Care Trust.*



**caring supporting improving together**

16 November 2017

Dr Aidan Feeney  
Senior Lecturer  
Queen's University Belfast  
School of Psychology  
Belfast  
BT7 1NN

Dear Dr Feeney

**Study Title:** Future Thinking and Medicine Use in Children and Adolescents with Chronic Illnesses

**HSC Trust Ref:** 17075AF-SW (Please quote this in all future correspondence)

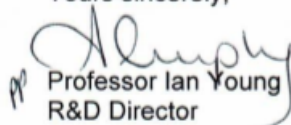
**REC Ref:** 17/EM/0303

**IRAS Ref:** 231851

I am pleased to advise that Belfast HSC Trust has given final Research Governance Permission for the above project to commence. Permission is granted for the duration of the project to 31/07/2018.

I wish you every success with your project.

Yours sincerely,

  
Professor Ian Young  
R&D Director

Cc: Professor Michael Shields Miss Robyn McCue Karen Hodgen

*Appendix 4.3 Letter granting permission for recruitment to be extended from July 2018 to October 2018.*



8<sup>th</sup> June 2018

Robyn McCue  
PHD Student  
Queens University  
Belfast

Dear Robyn,

Study Title: Future Thinking and Medicine Use in Children and Adolescents with Chronic Illnesses

Ref: 17075AF-SW

I am pleased to advise that Belfast HSC Trust has granted an extension to your placement agreement to work on the above study within the Trust.

The extension is granted until 31<sup>st</sup> October 2018

Good luck with the rest of your study

Kind regards

Alison Murphy  
Research Manager

*Appendix 4.4 Medication Adherence Report Scale (MARS) items provided to asthma participants. A version using the same items was also provided to participants' parents.*

## QUESTIONS ABOUT USING YOUR PREVENTER INHALER.

- Many people find a way of using their medications that suits them.
- This may differ from the instructions on the label or from what their doctor has said.
- We would like to ask you a few questions about how you use your inhaler.

Here are some ways in which people have said they use their inhaler. For each of the statements, please tick the box which best applies to you.

Your own way of using your medication	Always	Often	Sometimes	Rarely	Never
I only use it when I need it.					
I only use it when I feel breathless.					
I decide to miss out a dose.					
I try to avoid using it.					
I forget to take it.					
I alter the dose.					
I stop taking it for a while.					
I use it as a reserve, if my other treatment doesn't work.					
I use it before doing something which might make me breathless.					
I take less than instructed					

*Appendix 4.5 Medication Adherence Report Scale (MARS) items provided to diabetes participant to assess adherence to insulin. A version using the same items was also provided to participants' parents.*

## QUESTIONS ABOUT USING YOUR DIABETES MEDICINE.

- Many people find a way of using their medications that suits them.
- This may differ from the instructions on the label or from what their doctor has said.
- We would like to ask you a few questions about how you use your diabetes medicine.

Here are some ways in which people have said they use their medicines. For each of the statements, please tick the box which best applies to you.

Your own way of using your medication	Always	Often	Sometimes	Rarely	Never
I alter the dose.					
I forget to use it.					
I stop taking it for a while.					
I only use it when I experience symptoms.					
I decide to miss out a dose.					
I avoid using it if I can.					
I use it regularly every day.					

*Appendix 4.6 Medication Adherence Report Scale (MARS) items provided to CF participant to assess adherence to vitamins. A version using the same items was also used to assess adherence to enzymes and chest physiotherapy. These questionnaires were also provided to participants' parents.*

## QUESTIONS ABOUT USING YOUR VITAMINS.

- Many people find a way of using their medications that suits them.
- This may differ from the instructions on the label or from what their doctor has said.
- We would like to ask you a few questions about how you use your vitamins.

Here are some ways in which people have said they use their medicines.  
For each of the statements, please tick the box which best applies to you.

Your own way of using your medication	Always	Often	Sometimes	Rarely	Never
I alter the dose.					
I forget to use it.					
I stop taking it for a while.					
I only use it when I experience symptoms.					
I decide to miss out a dose.					
I avoid using it if I can.					
I use it regularly every day.					

*Appendix 4.7 Debrief sheet provided to participants following Study 3.*

**Thank you so much for participating in our study. Here is a little more information about it.**

We already know that some young people who are asked to take medication because of a long-term (chronic) illness, do not take their medication as regularly as their doctors would like them to. On the other hand, others do regularly take their medication. One potential difference between these two groups is in how they think about the future.

To measure how you think about the future, we asked you to answer questions about your attitudes to the past, the present and the future, and to rate how similar you think the way you are now is to how you will be in the future. We also asked you to write about yourself in the past and in the future and to make some decisions about the value of money now and in the future. Studies of this money decision task have shown that some people prefer a reward to be given to them immediately, even if it is a smaller amount, than to wait to receive an even bigger reward at some point in the future. In other words, some people would prefer to be given £5 immediately than wait 1 week to get £10.

Psychologists have found that people who prefer smaller, immediate rewards are more likely to focus on the present, feel less connected to themselves in the future, imagine the future less vividly and as a result, are less likely to think about the future consequences of behaviour (what might happen in the future as a result of their present decisions).

We think that some young people with chronic illnesses might think less about the future because the future might seem more frightening. We want to see if how you think about the future is related to your choices on the money task and whether this is related to how often you take your medicine.

We hope that the results from the study will help us find a way to encourage young people with long-term illnesses to take their medication more often. If you would like to receive more information about the study or learn of its results once it has been completed, please email me ([rmccue01@qub.ac.uk](mailto:rmccue01@qub.ac.uk)), or the Chief Investigator ([a.feeney@qub.ac.uk](mailto:a.feeney@qub.ac.uk)). **Thank you very much for taking part.**

*If you found that when answering the questions about the future or your mood this past week, you felt upset at any point, you might want to speak to someone you trust about how you've been feeling such as your parent/guardian, a sibling or your doctor (it helps to talk to someone). You can also call [ChildLine](http://www.childline.org.uk) on 0800 1111.*