AUTOBIOGRAPHICAL MEMORY AND SENSE OF SELF

by

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Abstract

Despite a strong theoretical tradition linking autobiographical memory (AM) and sense of self, there are few coherent, testable models which exemplify how these constructs relate. Without any clear theoretical starting point, research efforts have been fragmented, with different fields of psychology operating in relative isolation, using different methodological approaches and a confusing array of terminology.

This thesis attempted to bridge the gap between theory and research by proposing a novel framework that delineates sense of self along two dimensions: the subjective versus objective, and present versus temporally-extended aspects. The four resulting components are hypothesised to relate to AM in important, but very different, ways. Subjective sense of self provides a crucial precondition for episodic memory, which in turn is a prerequisite for phenomenological continuity. Episodic and semanticised AM are important for the formation and maintenance of mental representations of the self in present and across time.

In the most comprehensive assessment of sense of self that has been attempted within a single patient group, the model was used to guide a series of investigations in healthy older adults and those with amnestic Mild Cognitive Impairment (aMCI) and early-to-moderate Alzheimer's Disease (AD). Using a combination of well-established and novel techniques, two questions were explored: which aspects of sense of self were affected in AD and aMCI, and how did the particular profile of AM deterioration affect each aspect of sense of self.

The results revealed almost entirely preserved sense of self in aMCI, but an interesting patchwork of impairments in AD. Present-moment self awareness and beliefs about core continuity across time were retained, but deficits were revealed in self knowledge, as well as in the way the self was experienced and represented across time (semantic and phenomenological continuity). Relationships were revealed between these impairments and the AM deficits in this

group, including not only deterioration in specific-event (episodic) memory, but also other "experiential" AM (extended/repeated memories). Overall, these investigations demonstrated the utility of this framework in guiding an expansive body of research. It is hoped it may continue to provide a useful guide for much needed future investigations.

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AD	Alzheimer's disease
aMCI	Amnestic Mild Cognitive Impairment
AI	Autobiographical Interview
AM	Autobiographical memory
AMI	Autobiographical Memory Interview
COWA	Controlled Oral Word Association test
HC	Healthy control
MMSE	Mini-Mental State Examination
MTL	Medial Temporal Lobes
SAPM	Self Awareness in the Present Moment test
SocD	Social desirability
TST	Twenty Statements Test
VmPFC	Ventromedial prefrontal cortex

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Certification by Co-Authors

The undersigned hereby certify that:

- the above statement correctly reflects the nature and extent of the PhD candidate's contribution to this work, and the nature of the contribution of each of the co-authors; and
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Introduction

It is commonly assumed that an individual's sense of who they are is intimately connected to their memories of their life. This intuition is reflected in the familiar Hollywood cliché: the first concern of a person rendered amnesic is "Who am I?" The underlying presumption is that without memories of our past, we would be left with no sense of who we are. This same idea underpins the view that conditions associated with memory deterioration, such as Alzheimer's disease (AD), involve a gradual "unbecoming" (Fontana & Smith, 1989) or "loss of self" (D. Cohen & Eisdorfer, 1986; Downs, 1997).

The notion that autobiographical memory (AM) and sense of self may be related is not new. This association has been explored in the theoretical writings of philosophers and early psychologists, including John Locke (1690/1995), David Hume (1739/2003) and William James (1890), and there has been burgeoning interest from modern theorists wishing to re-examine how these constructs relate (Addis & Tippett, 2008; Bluck & Alea, 2008; Brewer, 1986; Conway, 2005; Conway, Singer, & Tagini, 2004; Kihlstrom, Beer, & Klein, 2003; Klein, 2010; Klein & Gangi, 2010; McAdams, 2001, 2008, 2013; Neisser & Fivush, 1994; Singer, 1995; Wheeler, Stuss, & Tulving, 1997; A. Wilson & Ross, 2003).

Despite abundant theoretical discussion, empirical investigations have been slow to develop. In part, this is due to the methodological difficulty of devising rigorous scientific methods to investigate seemingly ephemeral, metaphysical notions like the "self" (Baars, 2003; Martin, 2005; Zahavi, 2005). Although social psychology has provided decades of research into sense of self, providing many valuable insights into how people experience and conceptualise who they are (e.g., N. H. Anderson, 1968; Carver, 2012; Carver & Scheier, 1978; Fenigstein, Scheier, & Buss, 1975; Gough, 1960; Kuhn & McPartland, 1954; Markus & Kunda, 1986;

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Scheier, 1976; Wylie, 1974) behavioural studies with healthy individuals have been of limited use in illuminating the more ubiquitous, private and subjective aspects of sense of self, or their neural correlates. Some exciting methodological advances have begun to overcome these challenges. Neuroimaging methods have enabled researchers to measure brain activity while these subjective and previously inaccessible processes take place, allowing hypotheses to be formulated about the neural processes underlying sense of self and AM (F. I. Craik et al., 1999; D'Argembeau et al., 2008; Gillihan & Farah, 2005; Markowitsch, 2013; Martinelli, Sperduti, & Piolino, 2012; Moscovitch, Rosenbaum, Gilboa, Addis, Westmacott, Grady, McAndrews, Levine, Black, & Winocur, 2005; Georg. Northoff et al., 2006). Moreover, the use of social psychological methods with brain-damaged individuals has revealed the complex and subtle results of neural damage to both sense of self and memory (Addis & Tippett, 2004; Caddell & Clare, 2010, 2012; Eustache et al., 2013; Klein & Lax, 2010; Klein, Loftus, & Kihlstrom, 1996; Markowitsch, 2003; Martinelli, Anssens, Sperduti, & Piolino, 2013; Naylor & Clare, 2008; Stuss & Levine, 2002; Tanweer, Rathbone, & Souchay, 2010; Tulving, 1993).

A second major barrier to empirical progress has been theoretical. There has been a long-held conception of both the self and memory as unitary constructs: the self as a central operating mechanism or "ghost in the machine" (Ryle, 1949, pp. 15-16) and memory as a single information storehouse in the brain. Research with neuropsychological patients over the latter part of the 20th century revolutionised understanding of human memory, revealing it to be a complex system comprising many distinct facets with discrete neural networks involved in their operation (Moscovitch, Rosenbaum, Gilboa, Addis, Westmacott, Grady, McAndrews, Levine, Black, Winocur, et al., 2005; Penfield & Milner, 1958; Schacter & Addis, 2007; Squire & Zola, 1998; Tulving, 1984, 1985; Winocur, Moscovitch, & Bontempi, 2010). A parallel process has been taking place in relation to sense of self, with emerging conceptualisations of the self as having many interrelated but distinct components (Klein & Gangi, 2010; Leary & Tangney, 2012;

Markus & Wurf, 1987; McAdams, 2013; Neisser, 1988; Georg Northoff, 2013). These new theoretical understandings have allowed preliminary exploration of how these constructs contribute to and interact with one another (Addis & Tippett, 2008; Conway, 2005; Conway & Pleydell-Pearce, 2000; Haslam, Jetten, Haslam, Pugliese, & Tonks, 2011; Klein & Gangi, 2010; Klein & Lax, 2010; McAdams, 2001; Wheeler, et al., 1997; A. Wilson & Ross, 2003).

In this thesis, I attempt to progress empirical efforts in this area by proposing a novel framework for understanding sense of self, and then using this model as a framework to guide a series of empirical investigations into the relationship between AM and sense of self. Given the theoretical momentum just described, the need for another theoretical model might be questioned: Why not move beyond theorising and advance empirical efforts to test existing theories? The answer is that a large gap has opened between the theoretical and empirical literatures, precluding a comprehensive research programme. Commentators have argued that the theoretical literature is still grappling with the complexity and multiplicity of sense of self, leading to a proliferation of self-related terminology and discussions plagued by confusion and lack of agreement (Byrne, 1996; Harré, 1998; Klein & Gangi, 2010; Leary & Tangney, 2012; Legrand & Ruby, 2009; Lewis, 1991; Oyserman, 2004). To make matters worse, sense of self is a topic of interest within multiple sub-disciplines of psychology, each working in relative isolation. Thus, although notable efforts have been made to categorise the different aspects of sense of self (e.g., Gallagher, 2000; Harré, 1998; Klein, 2010; Klein & Gangi, 2010; Leary & Tangney, 2012; Lewis, 1991; Neisser, 1988; Oyserman, 2004; Singer, 1995) the available typologies are at times difficult to reconcile and apply within empirical research because they have been devised for different purposes and from within different disciplines (Caddell & Clare, 2013).

Left without any obvious theoretical starting point, researchers have tended to avoid theoretical discussions, instead relying on simplistic or problematic definitions of "self". Some have noted a tendency for researchers to circumvent definitional problems by relying on our shared phenomenological understanding of what self is, assuming that as we all have a sense of self, we therefore all know what it is (Byrne, 1996; Klein, 2010; Klein & Gangi, 2010; Klein & Lax, 2010; Metzinger, 2003). Researchers need clearly defined, well understood variables as well as testable predictions and hypotheses; however, the circularity is readily apparent. On the one hand, we cannot form conclusions about how to define sense of self, and its importance to AM, until we have good empirical evidence. On the other hand, robust empirical studies cannot be designed without a more precise approach to definition and greater theoretical clarity (Byrne, 1996; Caddell & Clare, 2010, 2013; Harré, 1998; Klein, 2010; Leary & Tangney, 2012; Legrand & Ruby, 2009).

The model proposed in this thesis is a simple two-by-two matrix which delineates sense of self along two dimensions: the subjective versus objective, and the present versus temporally-extended aspects of sense of self. Each of the four resulting components of sense of self are argued to relate to AM in important, but very different, ways. This model does not represent a new theoretical direction for the study of sense of self and AM; on the contrary, it is deeply grounded in the theoretical work of the past few decades. Its novelty, rather, is that it synthesises this theoretical groundwork and translates it into a form that is readily accessible for researchers wishing to examine the relationship between these constructs.

The model has a number of qualities that make it ideally suited for this purpose. First, it delineates key elements of sense of self that are theoretically of interest to AM, but have been poorly demarcated in empirical research. By disentangling these constructs, researchers will be able to examine and compare their individual association with AM. The model provides an overarching framework which locates these elements in relation to one another so that it is possible to generate clear predictions and testable hypotheses. Second, the model defines sense of self in a way that does not overlap with, or presuppose its relationship with, AM. Many existing models incorporate AM as one element of sense of self (e.g., Brewer, 1986; Klein & Gangi, 2010;

Martinelli, et al., 2012; Morin & Michaud, 2007; Neisser, 1988; Oyserman, 2004). While this is a legitimate perspective, blurring these constructs has at times led to an inability to discuss them in isolation. Moreover, treating them as inseparable constructs may neglect ways in which they are dissociable and therefore obscure important aspects of how they relate. Only by understanding sense of self as separate from AM can the relationship between them be fully explored. Finally, rather than emerging from a particular discipline, the model synthesises theory from across multiple sub-disciplines of psychology, including neuroscience, social psychology, cognitive psychology, developmental psychology, neuropsychology, personality psychology and clinical psychology. It is therefore applicable for use in studies using very different methodological approaches so that results can be compared across disciplines, and converging evidence can start to accumulate.

After setting out the proposed model of sense of self and its hypothesised relationship to AM, the remainder of this thesis will detail a series of empirical investigations, each exploring a different aspect of the model. These investigations are all part of an overarching study involving a single set of participants. This study uses a neuropsychological approach of taking a group with a known deficit in functioning, in this case memory impairments in amnestic Mild Cognitive Impairment (aMCI) and AD, and comparing their performance on various tasks with healthy older adults. These groups were selected because they demonstrate a range of ability in relation to AM: AD is characterised by significant memory impairments accompanied by deficits in other cognitive domains (McKhann et al., 1984), while aMCI is a condition involving memory deficits in the absence of dementia, and is suggested to provide a mid-point between normal aging and AD (Petersen, 2004). As such, these groups provide an opportunity to explore how sense of self is affected across a continuum of difficulties with AM.

While there are a number of specific hypotheses relating to each aspect of the model, there are two main questions that pervade all of these investigations. The first is which aspects of sense of self set out in the model are affected in AD and aMCI? An overall aim in designing this study was to provide one of the most comprehensive assessments of sense of self that has been attempted within a single patient group. Often studies have examined one or two aspects of sense of self, but none have examined enough different aspects in a single group to allow us to examine how they may relate to one another. The focus in the present study has therefore been on gaining an in depth assessment of each participant's sense of self, spanning all of the hypothesised aspects of sense of self.

The second main question for this study is how deterioration in AM affects the aspects of sense of self represented in the model. As will be described in Chapter 1, the neuroscientific literature suggests that a very wide range of neural regions are involved in mediating these aspects of sense of self. As many of these relevant regions are also affected in AD, it cannot be assumed that any deterioration in sense of self is necessarily related to deterioration in AM. By looking at the relationship between performance on various AM tasks and measures of sense of self, however, we can start to build a picture of which of these functions deteriorate together, suggesting that they may be related or overlapping functions, and which aspects of sense of self remain intact as AM deteriorates, suggesting that they are independent of AM. Before progressing to these investigations, Chapter 1 will set out the proposed model of sense of self, and use it as a framework to review existing literature regarding the relationship between sense of self and AM.

Chapter 1. Model of Sense of Self

Sense of self is often viewed as an essentially human characteristic, and is sometimes used synonymously with "personhood". In this discussion, however, sense of self will be distinguished from personhood, which is the quality of being a person, something possessed by virtue of one's status as a human being (Leary & Tangney, 2012; Strawson, 1999). Here, sense of self is conceptualised as the mental processes that provide one with feelings of singularity, coherence, individuality and unity which define one as a unique and particular human being (Damasio, 2003; Harré, 1998). This "sense" of self is not a quality that all human beings necessarily possess. This quality is likely to be mediated by neural processes that gradually develop during childhood, and could therefore be undermined by damage to relevant brain regions.[1]

The framework offered here highlights two dimensions of sense of self (see Figure 1.1). The first distinguishes between our conscious, phenomenological experience of selfhood (subjective sense of self) (Damasio, 2003; Gallagher, 2000; Leary & Tangney, 2012; Legrand, 2007; Lewis, 1991; Singer, 1995; Tagini & Raffone, 2010; Zahavi, 2005) and our mental representation of self, comprising all the things that we perceive and know about ourselves (content of self) (D'Argembeau, et al., 2008; Kihlstrom, et al., 2003; L'Ecuyer, 1992; Markus & Wurf, 1987; Oyserman, 2004). This division was famously posited by William James (1890), whose distinction between the psychological process which is the subject of knowing and experiencing (the I-self), and the object of this awareness (the me-self) has dominated the theoretical discussion around sense of self (e.g., Klein, 2012; Klein & Gangi, 2010; Leary & Tangney, 2012; Martin, 2005; McAdams, 1996; Mead, 1934; Singer, 1995; Tagini & Raffone, 2010; Troll & Skaff, 1997). Empirical literature has predominantly focused on the content of self, possibly because of the relative methodological ease of accessing the objective, tangible aspects

[1] This does not imply that an entity, 'the self', is reducible to brain processes. The ontological reality of the self (see Martin, 2005; Zahavi, 2005) is not of central concern to the present discussion.

of sense of self (Christoff, Cosmelli, Legrand, & Thompson, 2011; Legrand & Ruby, 2009; Markus & Wurf, 1987; Troll & Skaff, 1997). Although less accessible to empirical investigation, the “I-self” has a prominent position in many theoretical discussions, with some arguing that any complete understanding of sense of self must account for the pervasive phenomenological experience of selfhood (Baars, 2003; Gallagher, 2000; Klein, 2012; Leary & Tangney, 2012; Legrand & Ruby, 2009; Zahavi, 2005).

	Subjective sense of self (I -self)	**Content of self (Me-self)**
Present self **(Synchronic unity)**	*Subjective sense of self* • Prereflective self experience • Self awareness	*Self concept* • Conceptual self knowledge • Self esteem • Self image

Temporally extended self
 	
(Diachronic unity)
	Phenomenological continuity
	• Autonoetic consciousness
	    ○ Autonoetic recollection
	    ○ Autonoetic imagining
		Semantic continuity
		• Temporally extended self concept
		• Personal temporal chronology
		• Narrative Continuity

Figure 1.1:Model of sense of self.
Arrows indicate the hypothesised relationship between the proposed aspects of sense of self, with simpler functions suggested to be necessary precursors for more complex functions.

The division between me-self and I-self, while ubiquitous in the literature, is at times fraught with confusion. For example, the term “me-self” is sometimes used synonymously with the term “reflective consciousness”, implying that any reflective awareness of the self is part of the me-self (e.g., Esslen, Metzler, Pascual-Marqui, & Jancke, 2008; Mishara, 2007). This mapping, however, overlooks that self reflection involves two separate processes: the subjective, agentic experience involved in the reflective act, and the object or content of reflection (Carver, 2012; Morin & Everett, 1990). To use McAdams' (1996) terminology, the "I" should be seen as a process, the "me" as a product. Thus, in the present model the *capacity* for self-reflective thought (self awareness) is conceived as being part of the I-self, while the *content* of reflective thought (self concept) forms part of the me-self. This distinction is potentially important in research examining memory and sense of self, as there may be cases when the capacity for self reflection dissociates from the content of these reflections, for example, when there is deterioration in conceptual self knowledge but the capacity for introspection remains intact.

The second dimension in this framework distinguishes between those aspects of sense of self that relate to the present moment (present self) and those which are extended over time (temporally-extended self). Many discussions have emphasised the importance of elements of self that are "online" or accessible within the present moment (Gallagher, 2000; Markus & Wurf, 1987; Neisser, 1988). The unit of time comprising the "present" can vary depending on the aspect of self under investigation. In relation to subjective sense of self, it can be defined as the temporal "width" of consciousness (Postle, Steven, & Giulio, 2009) or slice of subjective reality determined by changes in goal attainment (Conway, et al., 2004). In relation to the content of self, the present may extend to some subjectively-determined period in one's life, with significant life changes demarcating this phase from those in the past (Conway, 2005; Conway, et al., 2004; D'Argembeau, et al., 2008). Many theories also emphasise that sense of self involves a temporally-extended aspect, involving past, present and future (Addis & Tippett, 2008; Chandler, Lalonde, Sokol, Hallett, & Marcia, 2003; Gallagher, 2000; James E. Marcia, 2003; Markus & Nurius, 1986; McAdams, 1996, 2001, 2013; Morin, 2006; Negele & Habermas, 2010; Neisser, 1988; Nelson, 1997; Sani, 2008; Troll & Skaff, 1997). The temporal extension of self is of particular theoretical interest in discussions relating to AM, which is inherently related to the past.

The present and temporally extended aspects of sense of self represent two elements of a central paradox of selfhood – how a multitude of functions can be experienced as a seamless whole (Dunkel, 2005; Klein & Gangi, 2010; McAdams, 2001, 2008). The first is the problem of self coherence or "synchronic unity"; how individuals can reconcile many disparate aspects of self into a single, unified experience within a particular moment. The second is the problem of self continuity or "diachronic unity"; how individuals can perceive themselves as being the same person over time despite the many ways in which they change. Another way to look at this problem is to say that the "self" refers to the mental processes and mechanisms that resolve this psychological paradox for the individual: sense of self consists of the processes that unify disparate experiences, levels of consciousness, behaviours, cognitions and mental representations into a coherent, unified whole. This is not to suggest that a single cognitive or neural mechanism performs this unification; rather there are multiple processes that act together to create the extraordinary unity that we experience as our sense of self. Within any particular moment, we experience a sense of unity in our conscious experience of selfhood (subjective sense of self), and in our mental representation of who we are (self concept). Across time, we experience unity both in our protracted experience of selfhood (phenomenological continuity) and in the way we mentally represent our self across time (semantic continuity).

The model assumes that these four elements of sense of self are theoretically and empirically separable. It also assumes, however, that these different elements are hierarchically related, both in terms of the development of these abilities in childhood as well as the brain states that mediate these functions. In the present model, the I-self is the conscious, reflective aspect of self that actively constructs the mental representation of self (Lewis, 1991; Martin, 2005; Morin & Everett, 1990; Singer, 1995), a process which McAdams (1996) refers to as "selfing".

Theoretical Link Between AM and Sense of Self

Autobiographical memory is a complex mental system which allows people to recollect information, events and experiences from their past (H. L. Williams, Conway, & Cohen, 2008). The system organises autobiographical information conceptually, chronologically and thematically (H. L. Williams, et al., 2008) and at many levels of abstraction, from vivid sensory, perceptual, emotional and conceptual details of particular moments, to high-level summaries of life periods (Barsalou, 1988; Conway & Pleydell-Pearce, 2000; Neisser, 1986). This organisation enables personal memories to be extracted and recombined in a variety of ways and for a variety of purposes (Addis, Pan, Vu, Laiser, & Schacter, 2009).

Two prominent theories of AM shed light on how this complex mental system may interact with sense of self. The first, proposed by Tulving and colleagues (Tulving, 1984, 1985, 2002, 2005; Wheeler, et al., 1997), focuses on episodic memory and its relationship to the subjective aspects of sense of self. Tulving's theory revolutionised the study of human memory by proposing two distinct memory systems. The episodic memory system allows a detailed, sensory perceptual re-experiencing of events from one's past, located within a particular place and time, while the semantic memory system consists of knowledge, facts and conceptual information about the world. Within the field of AM, semantic AM has been understood as the facts that relate to one's personal past, abstracted from the particular context from which the knowledge was acquired (Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002).

Although theoretically distinct, these types of memory are in practice difficult to tease apart, as any particular memory may contain elements of both (Levine, et al., 2002). What distinguishes these types of memory is that they are associated with fundamentally different states of consciousness (Tulving, 1985; Wheeler, et al., 1997). Episodic memory is associated with autonoetic (self-knowing) consciousness, which provides a recollective experience infused with a sense of one's self extended in time (Tulving, 2002, 2005). As such, episodic memories entail a vivid sensory-perceptual re-experiencing of the event, including first-person perceptions, thoughts and emotions that accompanied the original experience (Levine, et al., 2002; Markowitsch, 2003; Moscovitch, Rosenbaum, Gilboa, Addis, Westmacott, Grady, McAndrews, Levine, Black, Winocur, et al., 2005; Tulving, 2002, 2005; Vandekerckhove, 2009; Winocur, et al., 2010). In contrast, semantic memory is associated with noetic consciousness, which allows knowledge of various aspects of one's life without any recollective self experience (Tulving, 1985; Vandekerckhove & Panksepp, 2009).

Tulving's theory has been extremely influential for researchers examining the relationship between AM and sense of self by placing episodic memory at the epicentre of theoretical interest. By this view, episodic memory is the "highest" and most advanced form of memory which has evolved out of semantic memory (Tulving, 2002, 2005; Vandekerckhove & Panksepp, 2009). In contrast, semantic AM has tended to be seen as an inferior, deteriorated form of memory with less theoretical relevance to sense of self. Although both types of AM are self-related in the sense that their contents relate to "my" past, episodic memory is suggested to be particularly important to sense of self because it entails a direct, intimate and immediate sense that "I" experienced the event (Moscovitch, Rosenbaum, Gilboa, Addis, Westmacott, Grady, McAndrews, Levine, Black, Winocur, et al., 2005; Vandekerckhove, 2009; Wheeler, et al., 1997; Zahavi, 2005). Tulving has often emphasised the importance of subjective sense of self to episodic memory, stating that "episodic memory differs from other forms of memory in that its operations require a self. It is the self that engages in the mental activity that is referred to as mental time travel: there can be no travel without a traveler." (Tulving, 2005, pp. 14-15). Episodic memory also appears to provide an elegant solution to the problem of diachronic unity; by carrying the inherent "mineness" of the original experience into the present moment, episodic memories provide an unequivocal experience of one's continuing existence through time (Addis & Tippett, 2008; Klein, German, Cosmides, & Gabriel, 2004; Tulving, 1985; Wheeler, et al., 1997; Zahavi, 2005).

A second theory, proposed by Conway and colleagues (Conway, 2005; Conway & Pleydell-Pearce, 2000; Conway, et al., 2004), has broken with this tradition by emphasising the role of abstracted, "semanticised"[2] forms of AM in constructing and maintaining a coherent, stable mental representation of self. They suggest the primary function of the episodic memory system is to provide an accurate account of events to keep track of progress in goal attainment and learn from previous experience (Conway, 2005, 2009; Conway, et al., 2004). This system prioritises accurate "record-keeping" over the short term, recording enough information to ensure that daily activities are purposeful, rather than repetitive. As a result, episodic memories provide highly accurate records of discrete moments, but have minimal conceptual organisation and so tend to dissipate quickly (Conway, 2009).

Another, more phylogenetically recent, memory system (the "self memory system") is argued to have evolved to impose executive control over AM utilising fronto-temporal regions of the brain (Conway, 2005; Conway & Pleydell-Pearce, 2000). Building on the work of Barsalou (1988) and others, this theory suggests that AM comprises a hierarchically structured system, from highly abstracted summaries of one's whole life (life stories), knowledge relating to periods of one's life (lifetime periods), summaries of extended and repeated events (general events) and specific, sensory perceptual details of particular events (episodic details) (see also Brewer, 1986; Neisser, 1986; Singer, 1995). Any particular memory is constructed using elements from various levels of this "autobiographical knowledge base" (Conway & Pleydell-Pearce, 2000). For example, an event memory may contain vivid perceptual details (i.e., episodic details) while being grounded in conceptual knowledge about the period of life from which the event took place (e.g., lifetime period knowledge and general events). While episodic memories form the basis of AM,

[2] For the sake of brevity, all forms of AM that are abstracted from a particular place and time will be referred to as 'semanticised', although it is noted that Conway and colleagues suggest that this terminology does not tidily map on to their framework (see Conway & Pleydell-Pearce, 2000). This point is discussed at length in Chapter 2.

their conceptual organisation within the self memory system transforms them into AM and allows them to influence the conceptual self (Conway, et al., 2004; Singer & Blagov, 2004a).

Executive control over this system is exerted by the “working self”, a hierarchically-organised goal structure that drives behaviour, affect and cognition (Conway, 2005; Conway & Pleydell-Pearce, 2000). The working self maintains coherence in the “psychological present” by reducing discrepancies between the current goal hierarchy and perceptions of the self, and as part of this function it plays an active role in memory encoding, construction, storage and retrieval (Conway, et al., 2004). During both the encoding and later retrieval of memories in this system, executive control is used to shape memories to be consistent with the individual’s goals and beliefs about the self. Emergent from the interactions of the working self and the autobiographical knowledge base is a stable mental representation of self; the “conceptual self” (Conway, et al., 2004). The self-memory system suggests a complex, bidirectional relationship between self and memory: AMs are used to construct our mental representation of self; and the resulting conceptual self informs the way memories are accessed, stored and constructed (Conway, 2005; Conway, et al., 2004; A. Wilson & Ross, 2003).

Based on these theories, some hypotheses can be made about the relationship between AM and the proposed model of sense of self (see Figure 1.2). Tulving’s theory suggests that subjective sense of self provides a crucial precondition for episodic AM, which in turn is a prerequisite for a phenomenological continuity. Conway’s theory suggests that AM, and particularly its semanticised forms, should be important for the formation and maintenance of a coherent self concept in the present moment, and a continuous mental representation of self over time. The remainder of this chapter will develop these hypotheses and assess their merits in light of the available evidence.

	Episodic AM	Semanticised and Episodic AM
	Subjective sense of self (I -self)	**Content of self (Me-self)**
Present self (synchronic unity)	*Hypothesis: Subjective sense of self in the present moment is necessary for episodic memory*	*Hypothesis: Semanticised and episodic AM are important for a coherent self concept in the present moment*
Temporally Extended self (diachronic unity)	*Hypothesis: Episodic memory is essential for phenomenological continuity, which in turn contributes to diachronic unity*	*Hypothesis: Semanticised AM is essential for semantic continuity, which in turn contributes to diachronic unity*

Figure 1.2: Hypothesised relationship between the proposed elements of sense of self and AM.

The "I-self": Subjective Sense of Self in the Present Moment

A major hypothesis arising from the work of Tulving and colleagues is that episodic memory relies on a self-aware conscious state called "autonoetic consciousness" (Stuss, Rosenbaum, Malcolm, Christiana, & Keenan, 2005; Tulving, 2002, 2005; Vandekerckhove, 2009; Wheeler, 2004; Wheeler, et al., 1997). Wheeler et al. (1997, p. 335) describe autonoetic consciousness as the capacity to "mentally represent and to become aware of [one's] protracted existence across subjective time" and to "focus attention directly on [one's] own subjective experiences". Autonoetic consciousness consists of a subjective awareness of the self extended in time, including the past (autonoetic recollection) and the future (autonoetic imagining), but it is also argued to presuppose self awareness in the present moment (Keenan, Wheeler, Gallup Jr, & Pascual-Leone, 2000; Stuss, Picton, & Alexander, 2001; Wheeler, et al., 1997). Moscovitch and colleagues (1995; Winocur, et al., 2010) suggest that conscious awareness at the moment of the original experience is encoded by the medial temporal lobes and becomes an integral part of the memory trace, so that at retrieval one experiences the memory as something that was personally experienced. This perspective suggests that some form of present-moment subjective self experience is necessary for episodic memory, both at the time of encoding and retrieval.

Despite the theoretical importance of present-moment conscious self experience to autonoetic consciousness and episodic memory, very little work has directly explored this construct. As a result, there is uncertainty about what type of self experience is needed for episodic memory, and at what point in the encoding/retrieval process this might be required. In the empirical literature, autonoetic consciousness has been defined almost exclusively as a recollective experience, and operationalised using Tulving's (1985) "remember/know" paradigm, which requires participants to identify whether their memories are "remembered" or "known" (Gardiner, 2002; Gardiner & Byrne, 2008). If I "remember", there will be an accompanying conscious experience of mentally reliving the event (autonoetic consciousness); if I "know", there will be knowledge of the facts of the event without any ability to mentally place myself in that moment (noetic consciousness). This paradigm has been used extensively in neuropsychological studies to demonstrate selective deficits in the conscious recollective experience accompanying the retrieval of an event memory, while sparing the content of the memory itself (Clarys, Bugaiska, Tapia, & Baudouin, 2009; Java, 1996; Noulhiane et al., 2008; Piolino, Belliard, Desgranges, Perron, & Eustache, 2003; Piolino et al., 2003; Piolino et al., 2006; Rauchs et al., 2007; Tanweer, et al., 2010). It is clear, however, that this understanding of autonoetic consciousness solely as a recollective experience (autonoetic recollection), does not capture the broader theoretical understanding of autonoetic consciousness as a temporally-extended form of self awareness, involving past, present and future-directed elements. Studies of autonoetic recollection therefore cannot help us to understand what type of present-moment conscious self experience might be needed for healthy episodic memory.

The following sections will describe two hierarchically-related forms of present moment conscious self experience which may provide some clarity to these discussions: prereflective self experience and self awareness. The consciousness literature suggests that consciousness exist at various levels, with higher levels involving more complex brain states, being possessed by more complex organisms, being phylogenetically more recent and developing later in infancy (Lewis, 1991; Morin, 2006; Schooler, 2002; Stuss, et al., 2001; Vandekerckhove, 2009; Vandekerckhove & Panksepp, 2009). Although many levels of consciousness have been proposed, for the present purposes the lower levels can be classified as "prereflective", involving our immediate and ongoing sensory or perceptual stream of experience (Christoff, et al., 2011; Gallagher, 2000; Vandekerckhove & Panksepp, 2009), while higher, reflective levels of consciousness involve an explicit meta-awareness of the content of our subjective experience (Morin, 2006; Schooler, 2002; Stuss, et al., 2005; Vandekerckhove & Panksepp, 2009).

There is much confusion about these different levels of consciousness, which in part relates to the confluence of common and technical definitions of terms. For example, the terms "awareness" or "consciousness" are often used to mean that we have explicitly brought our experiences into mind, and that we can verbally describe them (e.g., Baars, Ramsoy, & Laureys, 2003; Moscovitch, 1995). A difficulty with this approach, however, is that research suggests that we are only intermittently conscious in this explicit, reflective sense (Carver, 2012; Schooler, 2002; Schooler, Reichle, & Halpern, 2004) and that the neural mechanisms that mediate explicit reflective awareness may be suppressed during many demanding, externally-directed tasks (Christoff, et al., 2011; Farb et al., 2007; Goldberg, Harel, & Malach, 2006; Gusnard, Akbudak, Shulman, & Raichle, 2001). To call this state "consciousness/awareness" therefore implies that we are not conscious/aware for the vast majority of our lives (Metzinger, 2003). The proposed model therefore follows the tradition of referring to this latter, reflective form of awareness as "self awareness" (Carver, 2012; Gallup, 1982; Lewis, 1991; Morin, 2006; Morin & Everett, 1990). The model suggests that both prereflective self experience and self awareness are essential for autonoetic recollection and episodic memory, and that impairments in either level of subjective sense of self should create problems with autonoetically re-experiencing one's past. Conversely, the model suggests that properly functioning episodic memory (and autonoetic recollection) is not an essential precursor to either type of conscious self experience, and that one could therefore retain full subjective experience of the world and reflective awareness of these experiences while possessing no ability to later recall these experiences via episodic memory.

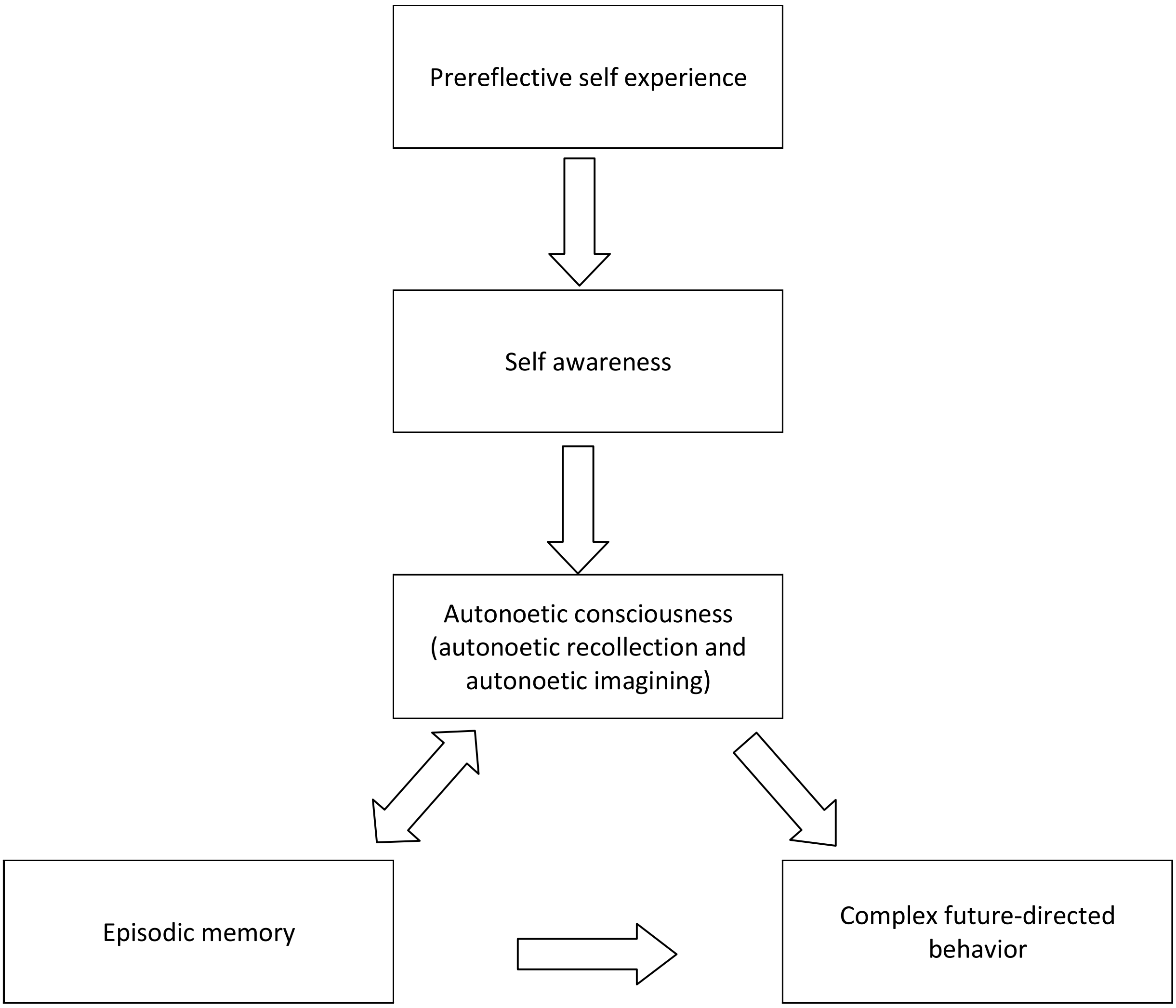


Figure 1.3: Hypothesised relationship between levels of subjective self and episodic memory. Simpler functions suggested to be necessary (though not sufficient) for more complex functions.

Prereflective Self Experience

Leary and Tangney (2012, p. 5) note that most people, at the heart of what they conceptualise as their essential self, sense that there is “an experiencing ‘thing’ inside their heads” that is the recipient of their thoughts, feelings and experiences. This intuition has led many theorists to incorporate the notion of an experiencing, agentic subject into their understanding of sense of self (Brewer, 1986; Christoff, et al., 2011; Damasio, 2003; Gallagher, 2000; Klein, 2012; Klein & Gangi, 2010; Leary & Tangney, 2012; Legrand, 2007; Legrand & Ruby, 2009; Neisser, 1988; Zahavi, 2005). Although some have challenged the notion that experience requires a “subject” (Hume, 1739/2003), there is in fact no need to posit a metaphysical entity which stands outside our stream of consciousness as the subject of these experiences (Baars, 2003; Dennett, 2001). Rather, prereflective self experience can be understood as an integral feature of our conscious experience of the world (Legrand, 2007; Zahavi, 2005). It is an inherently perceptual or embodied phenomenon, meaning that our bodily interactions with the world impart information about our physical existence, allowing us to directly experience ourselves as separate from our environment (Damasio, 2003; Gallagher, 2000; Legrand, 2006; Martin, 2005; Morin, 2006; Neisser, 1988; Vandekerckhove & Panksepp, 2009). It also involves a sense of ownership (i.e., my body and thoughts belong to me) and agency (i.e., I caused my thoughts and actions) (Gallagher, 2000; Leary & Tangney, 2012).

What characterises this mode of consciousness as a “self” experience is that it is imbued with a particular phenomenological “flavour” which confers an “immediate and automatic full ownership of experience” (Vandekerckhove & Panksepp, 2009, p. 1022). No matter what modality we are experiencing (e.g., sight, sound, taste, interoception), or what type of experience (e.g., thinking, remembering, knowing, feeling, dreaming), all of our experiences are pervaded by a subjective “mineness” which leaves us in no doubt that they are our own (Zahavi, 2005).

Precisely how the brain tags these diverse experiences such that they are experienced as "mine" is yet to be fully understood. It has long been postulated that a basic representation of our physical being in the world, sometimes referred to as a "proto self" or "bodily self", is provided by the extensive networks of exteroceptive neural circuits that monitor the sensory messages entering our bodies from the outside world, as well as the interoceptive and proprioceptive networks that monitor the internal environment of our bodies (Craig, 2003; Damasio, 2003; Georg. Northoff, et al., 2006; Parvizi & Damasio, 2001). An elusive question, however, has been how these networks are integrated into a unitary representation of the (bodily/sensory) self in a manner that could provide a cohesive, conscious self experience. One suggestion is that this function may be served by a comparator loop which compares efferent and reafferent messages from our bodily interaction in the world (Christoff, et al., 2011; Legrand, 2006, 2007; Legrand & Ruby, 2009). There may also be higher-level mechanisms that remap this basic somatosensory experience to provide a coherent self-representation.

Whatever the neural underpinnings of prereflective self experience, there are good theoretical reasons for thinking that it may have fundamental importance for episodic memory. If prereflective self experience is our ongoing stream of conscious experience, episodic memory provides a summary record of this stream (Brewer, 1986; Conway, 2009; Moscovitch, 1995; Penfield & Milner, 1958). A distinguishing feature of episodic memory is a rich reliving of past subjective experiences, and this ability requires the sensory-perceptual and internal aspects of the original experience to be encoded from a subjective, egocentric perspective (Levine, et al., 2002; Moscovitch, 1995; Wheeler, 2004). This subjective quality becomes an inherent feature of the memory when it is retrieved; it is this quality that confers episodic memory's characteristic "warmth and intimacy" (W. James, 1892). Just as one's current interactions in the world are pervaded by prereflective self experience, episodically remembered events from one's past carry the same phenomenological flavour of "mineness" into the present moment (Stuss, et al., 2005).

Prereflective self experience is therefore likely to be important both at the point of episodic memory encoding and retrieval. Without this, it may still be possible to retain information about past events (e.g.,, a child fell off a bike), but not remember it as a personally experienced event (e.g., *I* fell off my bike) (for a similar argument, see Klein, et al., 2004).

Tentative support for the hypothesis that subjective sense of self is essential for episodic memory is provided by studies of schizophrenia, a condition which some suggest may exemplify a breakdown in prereflective self experience (Gallagher, 2000; Klein, et al., 2004; Parnas, 2003; Parnas & Handest, 2003; Raballo, Saebye, & Parnas, 2009; Vogeley, 2003; Zahavi, 2005). Many characteristic symptoms of schizophrenia, including delusions, auditory hallucinations and thought insertion, could stem from a breakdown in sense of agency and ownership of experience. For example, if individuals are unable to experience agency over their private inner experiences, they may attribute their own thoughts to an external source (Gallagher, 2000; Vogeley, 2003). As the proposed model would predict, schizophrenia is also associated with deficits in episodic memory (Cuervo-Lombard et al., 2007; Danion, Huron, Vidailhet, & Berna, 2007; Huron et al., 1995; Riutort, Cuervo, Danion, Peretti, & Salamé, 2003). Danion et al. suggest that the critical memory impairment in schizophrenia is in autonoetic recollection. Thus, it is not necessarily the case that the memories themselves are missing or degraded in content, but that memories cannot be experienced in an episodic manner: from a subjective perspective, infused with a full and immediate sense of personal involvement. Klein et al. (2004) suggest that the memory deficits seen in schizophrenia relate to an inability to place oneself in the position of being the agent, owner or “experiencer” of a particular memory. This may lead to personal memories being incorporated into semantic memory as “facts” about the world or as events that happened to someone else. In some cases, this misattribution of memory may leave individuals unable to identify any memories as having been personally experienced (Klein, et al., 2004).

While this line of evidence provides some support for the hypothesised relationship between prereflective self experience and episodic memory, there are other plausible explanations for these findings. For more conclusive evidence, studies are needed which directly examine both prereflective self experience and episodic memory in these populations. Further investigation could explore different aspects of the subjective qualities of episodic memory within these populations, including vividness, sensory-perceptual, affective, or spatiotemporal details, and observer perspective (e.g., Irish, Lawlor, O'Mara, & Coen, 2008; Irish, Lawlor, O'Mara, & Coen, 2010; Piolino, et al., 2006; Sutin & Robins, 2007).

A challenge with conducting neuropsychological investigations into prereflective self experience is that such core deficits can render individuals unable to understand or describe their experiences (Parnas et al., 2005; Schultze-Lutter, 2009). Those with the greatest impairments in prereflective self experience are likely to be least able to communicate coherently about their experience, and therefore may often be excluded from studies requiring verbal reports. There are also methodological difficulties with using verbal reports to assess prereflective self experience. Firstly, verbal reports are generally retrospective, and so may not accurately reflect the state of consciousness at the moment of the original experience. This difficulty could be negotiated to some extent using a probing or thought-sampling paradigm which would more accurately assess present moment experience (e.g., Schooler, et al., 2004). Secondly, verbal reports about consciousness in fact rely on self awareness - that is, the state of being aware that one is aware, and being aware of the contents of one’s thoughts - and so involve an additional level of cognitive processing (Morin, 2006; Schooler, 2002). Some have questioned whether it is even logically possible to assess prereflective consciousness using verbal reports as this process necessarily transforms the experience into reflective consciousness (Mishara, 2007).

Although some interesting behavioural methods have developed for studying prereflective self experience (e.g., Parnas, et al., 2005; Philippi et al., 2012), a more fruitful and thorough approach for testing these hypotheses may be offered by combining such approaches with functional neuroimaging techniques, which would permit examinations of covert processes while bypassing problems of verbal reporting (see discussions by Christoff, et al., 2011; Legrand & Ruby, 2009; Tagini & Raffone, 2010). As the present investigation uses behavioural, neuropsychological techniques, it focuses instead on exploring the higher form of present-moment subjective self experience – self awareness (Chapter 3). As prereflective self experience is suggested to be an essential precursor to self awareness, we can assume that if self awareness is preserved in these memory-impaired populations, so too is prereflective self experience (for a similar argument, see Caddell & Clare, 2013).

Self Awareness

Self awareness is a conscious experience which possesses two important features. Firstly, it involves consciousness being directed inwardly as opposed to towards the external environment (Carver, 2012; Duval & Wicklund, 1973; Gallup, 1982; Lewis, 1991; Morin & Everett, 1990; Scheier, 1976). Secondly, it is a reflective, meta-conscious experience, which develops out of prereflective consciousness, but involves an additional capacity to observe, reflect, evaluate and focus attention on one's subjective experience (Carver, 2012; Leary & Tangney, 2012; Lewis, 1991; Morin, 2006; Schooler, 2002; Stuss, et al., 2001). This capacity is likely to involve the construction of mental models or meta-representations of the raw experience (K. J. W. Craik, 1943; Klein, et al., 2004; Schooler, 2002) including a mental model of the self which is used to guide behaviour (Stuss, et al., 2001; Stuss, et al., 2005). Self awareness is the capacity that allows us to introspect about our mental states, behaviour, and experiences (Keenan, Rubio, Racioppi, Johnson, & Barnacz, 2005; Leary & Tangney, 2012; Stuss & Levine, 2002) and communicate these subjective experiences to others (Goldberg, et al., 2006; Lewis, 1991; Schooler, 2002).

The capacity for self awareness starts to emerge during the second year of life, when children first demonstrate a range of abilities that appear to presuppose self awareness, including self-related emotions (e.g., embarrassment) (Lewis, 1993, 1995; Lewis, Sullivan, Stanger, & Weiss, 1989), the ability to recognise oneself in a mirror (Amsterdam, 1972; Bard, Todd, Bernier, Love, & Leavens, 2006; Harley & Reese, 1999; D. B. Johnson, 1983) and using first-person pronouns and pretend play (Lewis & Ramsay, 2004). Wheeler et al. (1997) suggest that the development of self awareness in childhood paves the way for full autonoetic consciousness and episodic memory (see also Vandekerckhove, 2009); however, the precise relationship between self awareness and autonoetic consciousness has not been elaborated (e.g., Keenan, et al., 2000).

The proposed model suggests that self awareness is a vital precursor to autonoetic consciousness and episodic memory (see Figure 1.3). One way to understand self awareness is as a meta-representational capacity that allows one to take the contents of conscious experience and use them flexibly for a variety of purposes – remembering, knowing, thinking, predicting, believing, feeling, doubting and pretending (Klein, et al., 2004; Leslie, 1987; Lewis & Ramsay, 2004). Leslie refers to this process as "decoupling" the primary representation from the mental state associated with its use. Without this meta-representational ability, the world is represented through the lens of prereflective consciousness ("noetic consciousness"; Tulving, 1985) and is understood literally, as semantic fact knowledge. Without self awareness, one would be unable to differentiate a mental representation that is "remembered" from other mental states (Klein, et al., 2004). Self awareness is therefore needed at the point of memory retrieval for a memory to be experienced as a subjectively remembered event from one's past (i.e., autonoetic recollection).

Present-moment self awareness may also play a role in exerting executive control over the episodic memory system, providing organisation and structure which enables recall (Conway, et al., 2004; Stuss, et al., 2005). Early experimental work on self awareness from the field of social psychology examined the changes to people's experiences and behaviour when they were experimentally induced to become the focus of their own attention (e.g., Carver, 1975; Carver & Scheier, 1978; Davis & Brock, 1975; Duval & Wicklund, 1973; Gibbons, Carver, Scheier, &

Hormuth, 1979; Macrae, Bodenhausen, & Milne, 1998; Scheier, 1976; Scheier & Carver, 1977; Wicklund & Duval, 1971). Analysing the diverse results of these studies, Carver (2012) suggests that self-focused attention has the effect of creating cognitive consistency, by reducing the discrepancy between what people think and how they act, or between what they expect and what they actually experience. He suggests that high levels of coherence between cognition and behaviour may only be possible when people are self aware. This perspective parallels Conway and colleagues' (Conway, 2005; Conway, et al., 2004) suggestion that the role of the working self is to create consistency between AM and the goals and self knowledge of the individual.

A large range of neural regions have been reported to be involved in self awareness, including cortical midline structures (cingulate, medial prefrontal and parietal cortices), lateral cortical regions (insula, lateral prefrontal and parietal cortices, temporal poles) and subcortical regions (hypothalamus, brainstem, colliculi, periaqueductal gray) (Georg. Northoff, et al., 2006). As many of these regions are also involved in a range of other functions, there is considerable debate over which are specifically involved in processing information about the self (Gillihan & Farah, 2005; Legrand & Ruby, 2009). Critics suggest that the neural diversity and overlap of functions found in the neuroscientific literature is partly due to a failure to adequately define the aspects of self under investigation and methodologically flawed approaches used to assess them (Klein, 2010; Legrand & Ruby, 2009).

Indeed, there are numerous neuroimaging paradigms to isolate self-reflection, including: viewing or rating personality traits (e.g., F. I. Craik, et al., 1999; S. C. Johnson et al., 2002; Kircher et al., 2000), rating the self-relevance of emotional stimuli (e.g., Goldberg, et al., 2006; Gusnard, et al., 2001; Ochsner et al., 2004), and examining one's own face (e.g., Devue et al., 2007; Keenan, et al., 2000). A difficulty with interpreting the neuroscientific literature is that such paradigms do not provide a pure measure of self awareness. This is partly because it is difficult to control for self-awareness in neuroimaging studies - even when engaged in tasks that are *prima* *facie* unrelated to the self, it is difficult to prevent a person from being self aware. An underlying problem is that the tasks used in such studies generally do not separate the conscious process of self reflection (self awareness) from the resulting mental representation of self (self knowledge). They also often fail to distinguish the reflective from the prereflective aspects of self experience, and the present moment versus temporally extended aspects of self awareness. A challenge for future work will be to develop paradigms able to differentiate the brain networks which mediate present-moment self awareness as opposed to these other functions.

Despite the apparent lack of specificity in this neuroimaging literature, medial prefrontal activity has been a ubiquitous finding in studies of self-reflective processes (Gusnard, et al., 2001; S. C. Johnson, et al., 2002; Macrae, Moran, Heatherton, Banfield, & Kelley, 2004; Mitchell, Banaji, & Macrae, 2005; Georg. Northoff, et al., 2006; van der Meer, Costafreda, Aleman, & David, 2010). There is also converging evidence from the neuropsychological literature that damage to the prefrontal cortex may create problems with both autonoetic recollection and self awareness (Levine, Freedman, Dawson, Black, & Stuss, 1999; Markowitsch, 2003; Rauchs, et al., 2007; Stuss & Levine, 2002; Stuss, et al., 2001; Stuss, et al., 2005; Wheeler, et al., 1997). Individuals with damage to prefrontal regions tend to perform well on standard tests of event memory, but demonstrate an impaired ability to autonoetically recollect these events (Levine, et al., 1999). For example Patient M.L., who suffered damage to the right ventral prefrontal cortex that severed fronto-temporal connections, retained some memories for life events prior to his injuries, but he reported “a feeling of subjective distance” from these memories and gave few “remember” responses on the remember/know paradigm used with a laboratory word-list task (Levine et al., 1998, p. 1956). Patient M.L. is also reported to suffer from diminished self awareness. Similar deficits are reported in other case studies of individuals with damage to anterior prefrontal regions (Levine, et al., 1999; Markowitsch, 2003; Stuss & Levine, 2002; Stuss, et al., 2001; Stuss, et al., 2005). On inspection, however, these claims relate to temporally extended forms of self awareness, including problems with goal-processing and self regulation, without specifically addressing present-moment self awareness.

A recent case study by Philippi et al. (2012) has challenged the idea that the medial prefrontal cortex is essential for self awareness. They report the case of Patient R. who suffered extensive damage to the prefrontal cortex, as well as the insula and medial temporal lobes, following herpes encephalitis. He was found to perform normally on a wide range of self awareness measures, including tests of agency, sensory/perceptual experience, self reflection and self recognition. Phillipi et al. suggest that this evidence undermines the view that the medial prefrontal cortex forms a "seat of self awareness" and suggests instead that a diverse range of regions, including the brainstem, thalamus, and posteromedial cortices, may serve this function. Although this is only one study, it does highlight that part of the ongoing difficulty in locating particular regions responsible for self awareness may be that self awareness is likely to be the result of complex interactions between networks of diverse brain regions.

While the localisation of the neural correlates of self awareness is a topic of continuing interest and controversy, the primary interest in the present discussion is in relation to the functional relationships that are suggested by the literature, and particularly, the possible relationship between AM and self awareness. There is an increasing body of evidence from human lesion studies to suggest that self awareness could be retained in the absence of episodic memory. Well-known medial temporal lobe amnesic H.M. was widely reported to have retained the capacity to reflect on his lived experiences with humour, emotion, and intellect (Corkin, 2002; Postle, et al., 2009). He once described his experience as constituting "the loss of memory, but not of reality" (Postle, et al., 2009, p. 336).[3] Another well-known amnesic, C.W., demonstrates a capacity to evaluate, describe, and agonise over, his present moment experience through his

[3] Interestingly, however, HM is reported to suffer a number of problems with monitoring his subjective experiences, such as hunger and pain, which could be interpreted as deficits in prereflective self experience (see Corkin, 2002).

conversations and diary entries, despite having no capacity to recall or form new episodic memories (B. A. Wilson, Kopelman, & Kapur, 2008; B. A. Wilson & Wearing, 1995). Similarly, K.C., who suffers complete impairment of episodic memory, is described as being "perfectly well aware of his timeless self – self in the present" (Tulving, 2005, p. 27).

Unfortunately, although such commentaries are common in the literature, there are very few cited examples of patients with medial temporal pathology who have been formally tested in relation to present-moment self awareness. One exception is provided by the case of Patient R, described above (Philippi, et al., 2012). In addition to the damage to medial prefrontal and insula cortices, Patient R. had sustained extensive damage to medial temporal regions and as a result suffered dense retrograde and anterograde amnesia. He nevertheless tested normally on a wide range of tests of self awareness, and participated in a compelling interview setting out not only a coherent understanding of abstract notions such as consciousness and awareness, but also cogent arguments for why he believes he possesses these qualities (see excerpt beginning of Chapter 3, p107). Given this literature, it is becoming increasingly apparent that the medial temporal lobes, and the episodic memory functions they mediate, are not essential to present-moment self awareness (c.f. Craig, 2009).

Although it appears that self awareness can operate in the absence of episodic memory, this should not be confused for evidence that episodic memory can persist in the absence of present-moment self awareness. In the cases described above, the primary pathology is in the medial temporal lobes and the resulting impairment is in episodic memory, leaving present-moment self awareness spared. However, neuropsychological and imaging studies suggest that properly functioning episodic memory relies on interactions between the medial temporal regions and a core neural network that includes the medial prefrontal, parietal and lateral temporal regions (Postle, et al., 2009). These regions include many of those suggested to be involved in self awareness, and also overlap with the "default network", a network of regions which have been implicated in a wide range of activities which appear to rely on self awareness, such as self projections, imagining the future, and theory of mind (for a review, see Schacter, Addis, & Buckner, 2007). These are also regions which have been shown to deteriorate in AD (Buckner, Andrews-Hanna, & Schacter, 2008; Buckner & Carroll, 2007). The present model predicts that, although self awareness would remain intact in the face of episodic memory problems caused by circumscribed damage to the medial temporal lobes, impairments in present-moment self awareness, caused by damage to relevant regions of this wider network, would lead to deficits in autonoetic consciousness, and therefore problems with episodic memory.

A perfect neuropsychological test for this hypothesis would be a double dissociation showing someone with circumscribed damage to the medial temporal lobes demonstrating impaired episodic memory but intact self awareness, while someone with preserved medial temporal regions but damage to the regions affecting self awareness demonstrating impairments in both episodic memory/autonoetic consciousness and self awareness. Due to the ongoing difficulty involved with defining the regions that mediate self awareness, such examples are difficult to find in practice. There is, however, indirect support for the hypothesised relationship between self awareness and deficits in autonoetic recollection from studies involving individuals with autistic spectrum disorders. Abnormalities in both self awareness and episodic memory have been reported in autism (Klein, et al., 2004; Lind, 2010), a developmental disorder which has been related to abnormalities in prefrontal regions (Ohnishi et al., 2000). Studies involving individuals with autism suggest impairments in the ability to assess their own emotions and mental states (Baron-Cohen, 1989; Ben Shalom et al., 2006; Frith & Happé, 1999) and use first-person pronouns (Jordan, 1989). Deficits in episodic memory are also reported (Lind, 2010), and specifically, in autonoetic recollection measured using the remember/know paradigm (Bowler, Gardiner, & Grice, 2000; Tanweer, et al., 2010).

Lind (2010) argues that deficits in autonoetic recollection in autism are due to a deficient cognitive representation of self (i.e., self concept), which she argues is necessary to allow memories to be tagged as self-relevant at the point of encoding (see also Howe & Courage, 1993). Lind notes, however, that deficits in self concept cannot fully explain deficits in autonoetic consciousness found in autism because these difficulties have also been reported in laboratory word-recall tasks (e.g., Bowler, et al., 2000), which are not "autobiographical" as such, and so should not rely on an intact self concept.

A suggestion arising from the proposed model is that impaired self awareness could explain the deficits in autonoetic consciousness found in these experiments. Although wordlist experiments involve memories that are not autobiographical in nature, items encoded by the episodic memory system should nevertheless require self awareness in order to be autonoetically re-experienced. Impaired self awareness could be part of a broader deficit in meta-cognition which some have argued to be characteristic of autism (Baron-Cohen, 1989). To examine this possibility, further studies are needed examining self awareness and episodic memory in autistic spectrum disorders, as well as in other populations suggested to involve deterioration in episodic memory and self awareness. Chapter 3 explores the hypothesised relationship between self awareness and episodic memory by investigating subjective sense of self in AD using multiple measures of self awareness including mirror self recognition (Buckner et al., 2005), personal pronoun use (Fazio & Mitchell, 2009), awareness of memory functioning (Souchay & Moulin, 2009) and awareness of personal preferences (Fellows & Farah, 2007).

The "Me-self": Content of Self in the Present Moment

The previous section conceptualised self awareness as the part of consciousness that is able to introspect, reflect and evaluate subjective experience; a reflective process which is assumed to involve the construction of mental models of the self. This section turns to the content of these mental models: the objective “me-self” (Singer, 1995) or self concept (Markus & Wurf, 1987; Oyserman, 2004). Self concept is quite literally “one’s concept of one’s self” (Kihlstrom & Klein, 1997, p. 6). Thus, in the same way that we have conceptual understandings about “dogs” or “plants”, so too we have a concept or collection of ideas about our “self” (Brewer, 1986; Kihlstrom & Klein, 1997; Leary & Tangney, 2012; Markus & Wurf, 1987; Neisser, 1988).

Self concept should not be confused with “personality”, which is the way the person behaves and is experienced by the external world, and encapsulates the “sum of a person’s aspects that make him or her psychologically distinct” (Leary & Tangney, 2012, p. 5). Self concept, in contrast, is the way individuals internally conceptualise who they are. Self concept is a broader concept, containing elements distinct from personality including affective or evaluative judgements relating to the self (self esteem), perceptual and sensory-motor representations of our physical selves (self image), motivational aspirations (goals), behavioural scripts and schemas, and information about one’s material possessions and social relationships (Markus & Wurf, 1987; McAdams, 1996; Singer, 1995). The present discussion will focus primarily on conceptual self knowledge, or the “conceptual self”, which consists of all the attributes, traits, beliefs, values, social status, roles, material positions and physical characteristics we attribute to ourselves (Conway, 2005; Conway, et al., 2004; Neisser, 1988).

Research from the disciplines of social and cognitive psychology has led to a converging understanding of the conceptual self as a multifaceted knowledge structure that is hierarchically organised and dynamic, with different elements being more important, salient and accessible at different times and in different contexts (Byrne, 1996; L'Ecuyer, 1992; Markus & Wurf, 1987; Oyserman, 2004; Singer, 1995). Conceptual self knowledge is likely to be stored as part of the semantic memory system (Brewer, 1986; Kihlstrom, et al., 2003; Kihlstrom & Klein, 1997; Martinelli, et al., 2012; Oyserman, 2004), but appears to recruit distinct neural regions from episodic and semantic AM (Martinelli, et al., 2012). There is still debate, however, over whether our knowledge about who we are (conceptual self knowledge) is dependent upon our ability to remember the facts and events from our past (AM).

Many theoretical discussions suggest that AM is likely to contribute to both the formation and maintenance of the conceptual self (Addis & Tippett, 2008; Addis & Tippett, 2004; Conway, et al., 2004; Haslam, et al., 2011; Kihlstrom, et al., 2003; Klein & Loftus, 1993b; Rathbone, Moulin, & Conway, 2008; A. Wilson & Ross, 2003). Conway (2005, p. 597) argues that the conceptual self is "…connected to autobiographical knowledge and the episodic memory system to activate specific instances that exemplify, contextualize, and ground their underlying themes or concepts". In particular, he suggests that memories from adolescence and early adulthood, known as the "reminiscence bump", play a critical role in supporting self knowledge. The reminiscence bump refers to the finding that, on free-recall tasks, individuals aged 35 and over consistently produce a greater number of memories formed during their teens and early adulthood (Fitzgerald, 1996; Rubin, Rahaal, & Poon, 1998). This robust finding has been demonstrated in numerous studies and across different cultures (Conway & Haque, 1999; Conway, Wang, Hanyu, & Haque, 2005; Rubin, 1998). Conway and others (Conway, 2005; Conway & Holmes, 2004; Conway & Pleydell-Pearce, 2000; Fitzgerald, 1988, 1996; Rathbone, et al., 2008) have argued that the reason for the reminiscence bump is that late teens and early twenties is the period during which a stable and enduring conceptual self emerges; during this time a greater number of memories that are relevant to identity formation are encoded and remain highly accessible for later retrieval (for alternative explanations, see Demiray, Gülgöz, & Bluck, 2009; Gluck & Bluck, 2007; S. M. J. Janssen & Murre, 2008). By this view, ongoing privileged access to these "self-defining memories" constrains, contextualises and grounds one's conceptual self knowledge (Singer & Salovey, 1993; Singer & Salovey, 1996).

In support of the claimed privileged accessibility of self-defining memories, and their link to the conceptual self, Conway and Holmes (2004) used a free-recall reminiscence task with older adults to demonstrate that the most accessible event memories from each decade of life corresponded to Eriksonian stages of identity development. To further explore this suggestion, Rathbone and colleagues (Chessell, Rathbone, Souchay, Charlesworth, & Moulin, 2013; Rathbone, et al., 2008; Rathbone, Moulin, & Conway, 2009) have examined the relationship between people's current conceptual self knowledge and the event memories accessible to support these beliefs. Their method requires participants to generate a number of self-descriptive statements, and for each one describe a number of specific events during which they felt that the self statement was "a significant part of their identity" (Rathbone, et al., 2008, p. 1405). Their results showed that the date that these memories took place clustered around the time that individuals reported that the statements had become a defining part of their self concept. Findings like these have been interpreted as evidence that as various aspects of the self develop, the AM system retains these memories as support for newly acquired aspects of the conceptual self (Conway, 2005; Conway & Holmes, 2004).

While these studies support the idea that the memories that people perceive as being important to their self concept are highly accessible, they cannot tell us whether such memories are essential to the formation of conceptual self knowledge. Prospective developmental studies would be needed to examine this issue. These studies also cannot tell us whether people in fact rely on AM to support and maintain their conceptual self in the present moment.

One extreme possibility (the "computational theory") is that our conceptual self knowledge at any given moment is "computed" using relevant behavioural exemplars from AM (Bower & Gilligan, 1979; Kihlstrom, et al., 2003; Klein & Loftus, 1993a, 1993b). Thus, in order to determine what sort of person I am, I must refer to memories of events from my past (e.g., sleeping through my alarm clock, procrastinating on tasks) and use these to make an online judgement ("I am lazy"). An alternative extreme (the "abstraction theory") is that conceptual self knowledge is abstracted from, and stored independently of, autobiographical event memories

(Kihlstrom, et al., 2003; Kihlstrom & Klein, 1997; Klein & Loftus, 1993a). By this view, I can know things about myself by referring to an abstracted mental representation of myself (e.g., I am lazy) without needing to reference past events stored in AM.

Klein and colleagues (Klein, 2010; Klein & Gangi, 2010; Klein & Lax, 2010) have presented a considerable body of evidence to suggest that one type of self knowledge, knowledge about personality traits, is functionally independent of episodic AM. If the computational theory were correct, one would predict that after thinking about their traits, individuals should have relevant episodic memories at the forefront of their minds. However, priming experiments have found that assessing the self-relevance of traits does not increase the speed at which people then access relevant memories (Klein & Loftus, 1990, 1993a), suggesting that access to trait information can occur without needing to retrieve behavioural exemplars from episodic memory.

Further support for the abstraction view has come from neuropsychological case studies, showing that it is possible for people with severe episodic memory impairments to retain accurate conceptual self knowledge (Klein, Cosmides, Costabile, & Mei, 2002; Klein & Lax, 2010; Klein, et al., 1996; Rathbone, et al., 2009; Tulving, 1993). These studies have examined the accuracy of self knowledge in people with episodic memory impairments by comparing their own assessment of their personality with the assessment made by a close friend or family member. The first study using this approach involved patient K.C., who had suffered severe retrograde and anterograde episodic memory loss following a motorcycle accident (Tulving, 1993). Despite undergoing dramatic personality change following the incident, and having no memory for any events from his past, K.C. could reliably report his post-accident personality. Similar findings have been reported in people with autism (Klein, Chan, & Loftus, 1999; Klein, Cosmides, Costabile, et al., 2002), head injuries (Klein, et al., 1996), and AD (Klein, Cosmides, & Costabile, 2003). Although the majority of these studies have used case studies, a recent study by Caddell and Clare (2012) replicated this latter finding in a group of 50 early AD and 50 healthy elderly individuals, finding no difference between the groups in the discrepancy between their own personality ratings and a family member's ratings.

These neuropsychological studies are important for two reasons. First, they demonstrate that having accurate knowledge of one's personality traits does not depend on the ability to retrieve episodic memories of the events that led to the creation of the self belief. Second, studies involving individuals with anterograde amnesia (Tulving, 1993) and developmental deficits in episodic memory such as autism (Klein, et al., 1999) demonstrate that it is possible to form new beliefs about one's personality traits without the ability to encode new episodic memories. In other words, neither the formation nor the maintenance of abstract trait self knowledge relies on episodic memory (Klein, 2010; Klein & Lax, 2010). Instead, Klein and colleagues suggest that abstract trait summaries about the self are stored in a specialised subsystem of semantic memory that is functionally independent of episodic memory and resilient to damage to neural regions supporting episodic memory (Klein & Lax, 2010).

It is important to note, however, these finding are relevant only to abstract personality trait descriptors (e.g., I am kind, I am outgoing). Although few studies have examined other varieties of conceptual self knowledge (e.g., social roles, physical attributes, values and preferences, context-specific self knowledge), those that have suggest that episodic memory may play an ongoing role in maintaining these aspects of the conceptual self. In their study of self knowledge in AD, Addis and Tippett (2004) used a spontaneous measure of self knowledge, the Twenty Statements Test (TST), which asks participants to describe themselves using statements beginning "I am..." (Kuhn & McPartland, 1954). By using a spontaneous measure, rather than a pre-generated checklist, this measure accesses a wider range of conceptual self knowledge. They found that the loss of childhood episodic memories was associated with a reduction in the overall number of statements generated on the TST (see also Haslam, et al., 2011) and with a greater proportion of "abstract" self statements. "Abstract" self statements include attributes that transcend particular situations and are common across contexts (e.g., I am kind) while “concrete” statements are tied to specific contexts (e.g., I take care of my friends when they are unwell) (Cousins, 1989). Tanweer et al. (2010) similarly reported both episodic memory impairments and the greater use of abstract self knowledge on the TST in individuals with Asperger’s syndrome.

The authors interpret these findings as suggesting that episodic memory impairments are associated with a tendency to use more decontextualised (abstract) trait descriptors and fewer contextualised (specific) descriptors, indicating that context dependent self knowledge is more reliant on episodic memory (see also Rathbone, et al., 2008). They hypothesise that an abstract framework of conceptual self knowledge may exist independently of the episodic memory system, but that episodic memories (particularly those from early life) may provide the detail needed for a rich and nuanced self understanding (Addis & Tippett, 2004; Tanweer, et al., 2010). In contrast to abstract self knowledge, concrete forms of self knowledge may require ongoing access to specific event memories (Rathbone, et al., 2008). This hypothesis is consistent with the suggestion of Klein and colleagues (Klein, 2010; Klein & Gangi, 2010; Klein & Lax, 2010) that abstract trait self knowledge is a particularly resilient form of self knowledge; this resilience may, in part, be because abstract trait knowledge is less reliant on episodic event memories than concrete self knowledge (Rathbone, Moulin, & Conway, 2008). Further investigation is needed to confirm this hypothesis, as the coding scheme used in these studies (see Rhee, Uleman, Lee, & Roman, 1995) classifies many different types of statements as abstract, and neither study provides a detailed breakdown of the types of abstract statements used by those with episodic memory impairments. In particular, exploration is needed to determine whether episodic memory impairment is indeed associated with deterioration in concrete self knowledge, or whether the greater use of abstract self statements instead reflects greater use of emotional and evaluative responses, which are also coded abstract, or simply impoverished or vague self knowledge (Caddell & Clare, 2010).

Semanticised AM and Self Knowledge

The discussion so far has focused on the role of episodic memory in supporting the conceptual self. This reflects the predominant focus of the empirical literature in this area. A question that has yet to be fully explored, however, is the role of semanticised forms of AM in maintaining conceptual self knowledge.

As described above, Conway's (2005; Conway, et al., 2004) theory emphasises the importance of semanticised AM in supporting and grounding the conceptual self, including knowledge at the level of life story, life chapters and general events. These abstracted forms of AM enable an individual to step back from the specifics of particular events and generalise patterns that occur across different situations, and are therefore likely to play a critical role in forming generalised beliefs about the self. Even self-defining memories, which are about specific events, are memories which have been thought about or retold many times, processed, reinterpreted and integrated into the life story, and may differ from the raw "episodic" representation of the original experience (Singer & Blagov, 2004b). This narrative processing of memories (e.g., making thematic links, extracting meaning and insight) may be critical to the transformation of AMs into an abstract conceptual self representation (Pasupathi, Mansour, & Brubaker, 2007). A model proposed by Haslam and colleagues (2011) suggests that specific events have an important role in creating new self knowledge, but that it is the semanticised AM that develops out of these event memories that serves to support and maintain self knowledge across the lifespan. The proposed model similarly hypothesises that semanticised AM plays an important role in forming and maintaining the conceptual self (see Figure 1.2).

It may be that semanticised AM can help to explain the relatively preserved self knowledge of those with episodic memory impairments. Even in cases of very dense retrograde amnesia, remnants of semanticised AM often remain, providing individuals with some knowledge about their past (Conway, 2005; Corkin, 2002). In such cases, self knowledge might be supported by these traces of semanticised AM (Addis & Tippett, 2008; Corkin, 2002; Rathbone, et al., 2008). This may also help to explain the finding of better preserved abstract self knowledge in AD and autism – perhaps semanticised AM, which may be better preserved in these populations (Martinelli, et al., 2013), plays a role in supporting abstract self knowledge, while impairments in episodic memory lead to deficits in specific (contextualised) forms of self knowledge.

Some support for the hypothesised relationship between semanticised AM and self knowledge is provided by Addis and Tippett's (2004) study of self knowledge in AD. They found that the loss of semantic AM for early life periods was associated with fewer self statements generated on the TST, and greater use of definite identity statements on another measure of self knowledge, the Tennessee Self Concept Scale. Haslam et al. (2011) similarly found correlations between strength of self knowledge (i.e., number of statements generated) on the TST and semantic AM for childhood, early adulthood and recent life periods in a group of older adults. Further support comes from a study by Rathbone, et al. (2009) who examined AM and self knowledge in P.J.M, an individual with focal retrograde amnesia. Although P.J.M found it very difficult to generate any episodic memories that could support her spontaneously-generated self statements, she was able to produce semantic AMs relevant to these beliefs. Further, these memories were temporally clustered around the time of the formation of each self statement, in the same way that previous studies with healthy individuals had found episodic memories to cluster around the emergence of self statements (Rathbone, et al., 2008). While these studies all provide some support for the hypothesised relationship between semanticised AM and conceptual self knowledge, they used measures of semantic AM that emphasise personal facts, such as the Autobiographical Memory Interview (Kopelman, Wilson, & Baddeley, 1990). Chapter 4 extends these findings by using methods which directly assess the different levels of semanticised AM proposed by Conway (2005; Conway & Pleydell-Pearce, 2000) so that their relationship to conceptual self knowledge can be assessed.

Self Continuity: The Self Extended in Time

The preceding sections have examined the self as it is experienced (the I-self) and known (the me-self) in the present moment. The other dimension of self proposed in the proposed model is its temporal extension; the continuity of self across time. A sense of continuity does not imply that one is unchanged, but rather expresses a deep conviction that, despite change, one continues to be the same person now as in the past, and will continue to be the same person into the future (Chandler, et al., 2003; Chandler & Marcia, 2003; Sani, 2008). This sense of continuity underpins many important features of complex human social behaviour, including our ability to act as moral agents responsible for our past and present actions, learn from past experiences, and plan for and behave in a manner that is relevant to the future (Sani, 2008; Schechtman, 1994).

Despite the theoretical importance of continuity to sense of self, it has received very little empirical investigation (Pasupathi, et al., 2007). A number of studies that ostensibly examine self continuity in fact explore the amount of change people perceive in their personalities (e.g.,Dunkel, 2005). Although perceived stability of personality may play a role in self continuity, these concepts are not interchangeable. A person may perceive that they have changed dramatically throughout their life, but nevertheless possess a deep conviction that they remain the same person (Chandler et al., 2003; Pasupathi, et al., 2007).

Only a handful of studies have examined self continuity directly. Troll and Skaff (1997) examined perceptions of continuity and change in very old adults (over 85), by asking a series of questions about the ways the participants believed they had changed and stayed the same. Despite the majority of participants reporting changes in their traits and characteristics, only one fifth felt that their core self had changed somewhat, and none reported that they were fundamentally a different person. A series of studies by Chandler et al. (2003) examined beliefs about personal persistence in adolescent young people (both First Nations and non-indigenous). All of the young people involved in the study were able to provide coherent explanations for why they believed they continued to persist as the same person across time, with the exception of severely suicidal young people, 83% of whom were unable to explain why they were the same person now as in the past. The authors' propose that a series of rapid developmental and social changes during adolescence exert pressure on young people's self concept, necessitating rapid amendment of their cognitive strategies to account for their continuity. When individuals are unable to keep up with these demands, their sense of personal persistence, and particularly their connection to a possible future, breaks down. The authors concluded that being able to account for self-continuity across time may be vital to the motivation to continue one's existence.

These studies provide a useful starting point for conceptualising what "self continuity" might mean, how it could be assessed, and what it might mean if it were to break down. They reveal that a core, persistent belief about ones continued existence across time ("diachronic unity") appears to be a pervasive feature of human experience. Being so fundamental may explain why self-continuity is so challenging to research; it is difficult to examine the preconditions and correlates of such an omnipresent feature of humanity. A particular focus for the present study was to examine whether the same pervasive sense of diachronic unity was evident in older adults with memory impairments.

The apparently ubiquitous nature of sense of continuity has long puzzled philosophers and psychologists alike; how are we able to see ourselves as the same person over time despite radical changes across the lifespan (Charmaz, 1994; Hume, 1739/2003; Locke, 1690/1995; Pasupathi, et al., 2007; Schechtman, 1994)? This difficulty appears easily resolved with reference to AM: we know that we are the same person now as in the past because we *remember* being the same person (Bluck & Alea, 2008). In this sense, AM appears to guarantee diachronic unity. Despite this intuitive link, it is by no means an *a priori* truth that possessing AM should confer a sense of continuity (Schechtman, 1994; Strawson, 2005). If I have changed a lot in my life, my memories could contain images of a very different person who does not closely resemble me physically, emotionally or behaviourally; such memories may not be sufficient to convince me that "I" am the same person now as in the past. Even more problematic is how my memories of the past could provide any conviction about my personal persistence into the future.

What is required is a theoretical explanation of *how* AM may contribute to diachronic unity. Addis and Tippett (2008) suggest two parallel mechanisms: first, we may simply experience our continuity through "mental time travel" (phenomenological continuity); second, we may create a sense of continuity by interpreting our lives through life stories (narrative continuity). They posit that while phenomenological continuity is largely reliant on episodic memory, narrative continuity could be sustained with semantic AM alone, although information from episodic memory may also contribute (Conway, 2005; Conway & Pleydell-Pearce, 2000). While this categorization provides a good theoretical starting point, narrative continuity is likely to be underpinned by simpler forms of self understanding which may endow a sense of continuity in their own right. For this reason, the present model refers to "semantic continuity", which includes all of the ways that people may mentally construct a sense of continuity, with narrative continuity being one such mechanism.

These two mechanisms may possibly explain Chandler et al.'s (2003) finding of diminished continuity in suicidal young people. Pasupathi et al. (2007) suggest that these suicidal teenagers may lack the ability to create coherent life narratives out of their memories, an ability normally just emerging at this age (Habermas & Bluck, 2000), thus leading to diminished narrative continuity. Another possibility is that suicidal young people may lack a sense of phenomenological continuity, due to the common finding of over-generalised memories and difficulty accessing specific, vivid, experience-near episodic memories in depressed and suicidal individuals (J Mark G. Williams, 1996; J Mark G. Williams et al., 2007; J Mark G. Williams & Broadbent, 1986). While it is not possible to assess the merit of these hypotheses from the available evidence, these explanations provide fruitful avenues for future investigation. The following sections will discuss these parallel mechanisms for self continuity in more detail.

Phenomenological Continuity and Episodic Memory

The possibility that diachronic unity is supported by the capacity to vividly re-experience oneself in the past is intuitively appealing. Just as I can know that my current experiences are my own because my subjective experience tags them as such, so too I can know that my episodically remembered past was experienced by “me”. This sentiment is clearly articulated in Locke’s (1690/1995) claim about the relationship between consciousness and identity: “as far as this consciousness can be extended backwards to any past action or thought, so far reaches the identity of that person; it is the same self now it was then; and it is by the same self with this present one that now reflects on it, that that action was done.” When one remembers the past episodically, the memory carries the phenomenological flavour of “mineness” through time (Zahavi, 2005). In line with Tulving’s (1985, 2002) theory, the proposed model hypothesises that the episodic memory system provides this phenomenological continuity of first-person conscious experience through the mechanism of autonoetic consciousness (see Figure 1.3). This capacity “affords individuals the possibility to apprehend their subjective experiences throughout time and to perceive the present moment as both a continuation of their past and as a prelude to their future” (Wheeler et al., 1997, p. 335). Vandekerckhove and Panksepp (2009, p. 1025) similarly argue that autonoetic consciousness is the basis of this uniquely human capacity to “mentally represent protracted existence, to possess and act with a sense of temporal continuity.”

Many theorists also suggest that autonoetic consciousness is vital to the capacity to use and interpret information in a manner that can support various aspects of complex human behaviour, including imagining the future (Addis, Pan, et al., 2009; Addis, Sacchetti, Ally, Budson, & Schacter, 2009; Addis, Wong, & Schacter, 2008; Schacter & Addis, 2007), self regulation, motivation and goal-directed behaviour (Carver, 2012; Levine, et al., 1998; Levine, et al., 1999; Stuss, et al., 2001; Stuss, et al., 2005; Vandekerckhove & Panksepp, 2009). Levine et al. (1999) argue that autonoetic consciousness supports self regulation by allowing behaviour to be guided by goals and information that are specific to the identity of the individual, rather than generic (semantic) knowledge about how one ought to behave. They report that with a loss of autonoetic consciousness, patient M.L. also exhibits many problems with self regulation which are expressed as contrived or stereotyped responses to unstructured situations. Similar deficits are reported in a number of other cases in the clinical literature, including Mr B (Stuss, et al., 2001; Stuss, et al., 2005) and patient K.C. (Tulving, 1985, 2005). The events of one's past may provide information that is used flexibly to guide behaviour in a personally appropriate manner when faced with unstructured situations (Levine, et al., 1998; Stuss, et al., 2005).

Autonoetic consciousness may be mediated by the "default network", a neuroanatomically defined brain network which is preferentially activated when people are not engaged in demanding, externally-focused activities (Buckner, et al., 2008; Gusnard, et al., 2001; Raichle et al., 2001). While the function of the default network is still a matter of debate, recent theories suggest that it may be to permit a range of capacities that involve shifting one's mental perspective (including remembering, imagining and conceiving other people's perspective) (Andrews-Hanna, 2011; Buckner & Carroll, 2007; Irish, Piguet, & Hodges, 2012) or self-generated thought (Andrews-Hanna, Smallwood, & Spreng, 2014). Buckner et al. (2008) suggest that episodic memories may provide the building blocks used by the default network to perform these various "self-projection" functions, allowing the self to exist beyond the present moment.

Unlike present-moment self awareness, which the present model suggests can persist in the absence of episodic memory, the clinical literature suggests that autonoetic consciousness and the phenomenological continuity it affords rely on episodic memory (see Figures 1.2 and 1.3). Tulving (1985, 2002, 2005) describes the case of K.C., who suffered severe anterograde and retrograde episodic memory loss after a closed head injury. Tulving argues that K.C. retains present-moment self awareness and would be able to pass the mirror test, but lacks an ability to mentally project himself in time: he is unable to report what he did immediately prior to his current activities, or what he is likely to do at a later time. When asked to describe his mental state when contemplating his past or future, he described it as “a big blankness...like swimming in the middle of a lake. There's nothing there to hold you up or do anything with” (Tulving, 1985, p. 4).

Similar observations have been offered C.W., who lacks any episodic memories, and who constantly reports that he is conscious for the first time (Postle, et al., 2009; B. A. Wilson & Wearing, 1995): “...this is the first sight I’ve had, the first taste I’ve had (sipping his coffee) it’s like being dead. Does anyone know what it’s like being dead? Answer, no.” (B. A. Wilson, et al., 2008, p. 534). A similar sense of temporal displacement is expressed by patient H.M. (Postle, et al., 2009, pp. 335-336): “Right now, I’m wondering, have I done or said anything amiss? You see, at this moment everything looks clear to me, but what happened just before? …It’s like waking from a dream; I just don’t remember…Every day is alone, in itself.” These cases clearly demonstrate a severe discontinuity of phenomenological experience. This deficit is not an inability to comprehend time, or to create an impersonal, conceptual understanding of the past and future; rather it is an inability to connect one’s present experience to the past or future (see also Klein, Loftus, & Kihlstrom, 2002).

While these deficits in phenomenological continuity are well documented, there have been few systematic explorations of how these deficits might affect these individuals’ subjective beliefs about their diachronic unity (Troll & Skaff, 1997), including their ability to logically account for how and why they remain the same person across time (Chandler et al., 2003).

One could argue that the cases cited above hint at some form of diachronic unity. As is evident from these excerpts, these men are clearly distressed that they are unable to remember their past. This distress expresses an appreciation that they *ought* to possess a mnemonic link to the past, which appears to presuppose some notion of themselves as temporally-extended beings.

Further, although these comments suggest a feeling of being marooned in the present moment (Postle, et al., 2009), their speech and thoughts are not restricted to the present moment as one might expect if one lacked any sense of temporal extension. H.M. was noted for repeatedly retelling the few (semanticised) AMs he had retained (Corkin, 2002). He also expressed emotions that related to his past and his future; anxiety about what might have happened before, and concern about how his present actions might impact upon the future. C.W. is noted for his preoccupation with his inability to recall the past and his previous "lack of consciousness", his attempts to find an explanation for memory failure and a tendency to confabulate past events (B. A. Wilson, et al., 2008; B. A. Wilson & Wearing, 1995). Their words and actions hint at an emotional and behavioural connection to their past and future in the absence of any episodic memories that could provide these links (for a similar model, see Bluck & Liao, 2013). Further evidence that this may be the case comes from a qualitative study involving seven individuals with primarily anterograde memory impairments (Medved & Brockmeier, 2008). Despite their memory impairments, and the resulting profound changes in their lives, the authors note that their interviews indicated "…an unimpaired sense of personal sameness" (p 478).

It would be useful for future studies to explore these affective and behavioural expressions of self continuity, for example, by investigating what type of emotional connection such individuals have with the past and future, and how daily behaviour (e.g., goal-directed behaviour, planning, moral decision making) may implicitly suggest a connection with past and future selves. Chapter 5 explores these questions by examining whether any loss of phenomenological continuity in AD and aMCI is accompanied by impaired subjective beliefs about diachronic unity.

Semantic continuity and AM

If individuals with severe episodic amnesia do indeed retain a subjective sense of continuity, it would provide some evidence for the suggestion that episodic memory, and the phenomenological continuity it affords, is not the sole mechanism providing diachronic unity.

Further evidence is provided by AM studies with healthy older adults. As people age, there is a deterioration in episodic AM, leaving semantic AM relatively preserved (Addis, et al., 2008; Levine, et al., 2002; Piolino, et al., 2010). This deterioration includes a decreased ability to produce specific event memories (Addis, et al., 2008; Levine, et al., 2002; Piolino, et al., 2010), an impaired ability to access details about source and context (McIntyre & Craik, 1987; Spencer & Raz, 1995) and a reduction in autonoetic recollection (Clarys, et al., 2009; Java, 1996; Piolino, et al., 2006). There is also a corresponding decrease in older adults' ability to vividly imagine themselves in the future (Addis, et al., 2008). If episodic memory were the only mechanism providing diachronic unity, age-related deterioration in autonoetic consciousness should result in a similarly diminished sense of continuity. In fact, studies suggest that people maintain a strong sense of perceived continuity into very advanced years (Troll & Skaff, 1997).

What might account for this persistent sense of diachronic continuity in the face of deteriorating autonoetic consciousness and episodic memory? The present model proposes that diachronic unity in older adults is supported, at least in part, by their retained semanticised AM. This section will describe three proposed forms of semantic continuity all of which are underpinned by semanticised AM.

Temporally-extended self concept. Conway and others (Brewer, 1986; Conway, et al., 2004) argue that the conceptual self is a rich and complex knowledge structure which is resistant to change and, as a result, is likely to provide a source of self continuity. As described previously, there is growing neuropsychological evidence that personality trait self knowledge is a particularly resilient form of self knowledge. Given its apparent independence of episodic memory (see The "Me-self": Content of Self in the Present Moment, above), Klein and Lax (2010) suggest that trait self knowledge could provide a persistent model of self that could support some form of continuity in cases of episodic memory impairments. This question remains untested, and investigation is needed to explore what form of continuity might be afforded by conceptual self knowledge in the absence of phenomenological continuity.

It is also unclear whether conceptual self knowledge in the present moment is all that is needed to support diachronic unity, or whether self knowledge over time is required. Self concept is argued to have a present element, comprising self perceptions that are relevant to the present moment, but also includes representations of past and future selves (Markus & Nurius, 1986; Markus & Wurf, 1987). It may be that constructing a temporal chronology of conceptual self knowledge is important for diachronic unity (Singer, 1995). Neuroimaging studies with healthy individuals suggest that present trait self-knowledge may be mediated by different neural processes than knowledge of past selves (D'Argembeau, et al., 2008) and neuropsychological evidence suggests that these aspects of self knowledge can be independently impaired. In some cases, individuals have lost their knowledge of themselves in the past, while retaining present self knowledge (Tulving, 1993). Conversely, AD appears to preferentially affect knowledge of the present self, leaving knowledge of past selves intact (Hehman, German, & Klein, 2005; Klein, et al., 2003). Chapter 5 examines whether distortions in either the stability of present self knowledge across time, or self knowledge relating to previous periods of one's life, are important for subjective self continuity.

Personal temporal chronology. Although the semantic memory system does not allow one to subjectively experience the past or future, some have speculated that it could nevertheless permit individuals to construct an *im*personal temporal chronology of the past and future that could support a conceptual understanding of oneself as a temporally extended being. Patient D.B., who has severe episodic memory deficits but largely preserved semantic memory, was not able to imagine personal future scenarios, but could imagine future events that did not involve him (Klein, Loftus, et al., 2002). Klein and Gangi (2010, p11) speculate that this ability to create an impersonal future using semantic memory could potentially support a sense of continuity by allowing D.B. to “infer his placement in a chronology of events without simultaneously being able to call up distinct, personal imagery of himself in that past and future.”

In addition to any such impersonal chronology, the present model proposes that individuals possess a personalised temporal chronology which could be even more important to diachronic unity. According to Conway’s model (Conway, 2005; Conway & Pleydell-Pearce, 2000), temporal organisation is an important organisational principle of information within the autobiographical knowledge base; and differences in temporal abstraction distinguish the different levels of AM proposed in that theory. Narrative theorists have similarly proposed that an important part of constructing a coherent life story is the ability to temporally locate events in relation to one another and in relation to the present moment (e.g., Habermas & Bluck, 2000; see Narrative identity, below). Specifically, individuals must be able to chronologically order memories using appropriate temporal signposts (“temporal coherence”) and structure their narratives using events which are culturally expected at various points in the life story (the “cultural life script”) (Berntsen & Rubin, 2004; Habermas & Bluck, 2000; Habermas, Ehlert-Lerche, & De Silveira, 2009).

An important question is whether a personal temporal chronology could be supported exclusively by semanticised AM, or whether it relies on intact episodic memory. If episodic memory is not required, those with episodic memory impairments should retain an ability to construct a personalised, semantic temporal framework for the past (and the future), even though their capacity to remember specific episodic events is impaired. To explore this possibility, Chapter 5 examines the possible role of a personal temporal chronology in supporting diachronic unity by examining the temporal coherence and use of the cultural life script in the life stories of those with aMCI and AD.

Narrative continuity. Both of these forms of semantic continuity (temporally-extended self knowledge and personal temporal chronology) are brought together in the creation of narrative continuity. Narrative theories of identity propose that individuals construct their sense of continuity by creating narrative accounts of their lives (Habermas & Bluck, 2000; McAdams, 1993, 1996, 2001; McLean, 2008; Pasupathi, et al., 2007; Reese, Yan, Jack, & Hayne, 2010; Singer, 2004; Singer & Blagov, 2004b). This ability is suggested to be a uniquely human capacity and one not fully achieved until late in adolescence (Habermas & Bluck, 2000; Habermas & de Silveira, 2008; Habermas, et al., 2009; Habermas & Paha, 2001; McAdams, 2001). The life stories that are produced are a hypothetical construct; there is no “grand narrative” for each person or something that could ever be produced definitively and in its entirety (McAdams, 2001; Pasupathi, et al., 2007). Rather, life stories consist of the constantly evolving ways that we thematically and temporally organise information about our lives (McAdams, 2008). When narratives are produced in practice, it is always in response to particular social-contextual demands, for particular purposes and within a particular normative, cultural context (McLean, 2005; Pasupathi, et al., 2007).

Within Conway’s self memory theory (Conway, 2005; Conway & Pleydell-Pearce, 2000), the life story is understood as the highest level of organisation for AM; but it can also be seen as providing integration, at the highest and most complex cognitive level, of AM with the conceptual self. In this way, narrative processes are argued to provide both synchronic unity, by integrating many disparate traits, characteristics and attributes into a coherent, unified self concept in any given moment, and diachronic unity, by reconciling the many selves that we present over time into a continuous and integrated self view (McAdams, 2001; Singer, 1995).

Autobiographical memories provide the building blocks that are used to construct life stories, but not all AMs are included in a life narrative; many are not important enough to be included within one’s life story (McAdams, 2001). Rather, the life story is a narrow selection of AM that collectively explains “how I came to be who I am” (Pasupathi, et al., 2007, p. 90). Furthermore, AM alone is not sufficient to confer a sense of continuity; rather, it is the transformation of memories into a coherent life story that creates narrative continuity (Habermas & Köber, 2014; McAdams, 2001; 2006; Pasupathi, et al., 2007; Singer & Blagov, 2004a). People actively use AM to create a sense of continuity, through reinterpretation and editing of what, and how, they remember (Conway & Pleydell-Pearce, 2000; Wilson & Ross, 2003). This transformation depends on the narrator's ability to create a coherent story by establishing thematic links between different components of one's past, explaining and rationalising changes that have taken place in the self concept, and linking life events to the present self concept (Habermas & Bluck, 2000; McLean, 2008; McLean & Pratt, 2006).

One of the main processes by which we transform our memories into life stories is called "autobiographical reasoning": the ability to make connections between the events of our lives as well as between the conceptual self and the experiences of one's past (Habermas, 2011; Habermas & Bluck, 2000; Pasupathi & Mansour, 2006). Without autobiographical reasoning, memories are simply strings of unrelated events which lack any sense of meaning or significance (Bohn & Berntsen, 2008; Habermas & Bluck, 2000; McAdams, 2001). Autobiographical reasoning does not only take place in the context of entire life stories, but also refers to the types of arguments or reasoning processes that can be applied to smaller segments of one's past, and serve to link these otherwise isolated memories into the larger, interwoven context of the life story schema (Habermas & Köber, 2014). An important feature of entire life stories is their "global coherence" (Habermas, 2011; Habermas & Bluck, 2000; Habermas & de Silveira, 2008), which is how well these narrative mechanisms function to integrate the events from across the life story into a thematically, temporally and causally coherent whole (for an alternative perspective on narrative coherence, which focuses on single event narratives, see Reese et al., 2011). According to Habermas and Bluck, the ability to construct a globally coherent life narrative is underpinned by a series of cognitive abilities which progressively develop throughout childhood and adolescence;

only once these abilities are achieved are young people able to form their narrative identity (Habermas, 2011; Habermas & Bluck, 2000).

Although episodic memory is arguably vital to the construction of life stories (e.g., Gallagher, 2000), the proposed model hypothesises that semanticised levels of AM (i.e., life periods and general events) are more important for constructing narrative continuity. This is partly because these abstracted levels of AM are able to synthesise larger amounts of information, and so provide a more efficient strategy for constructing a story about one's entire life (Thomsen, 2009). In addition, narrative theories suggest that it is the very process of abstracting, summarising and revising raw memories that allows AM to play its role in providing narrative continuity (McAdams, 2001; Pasupathi, et al., 2007; Schechtman, 1994; Singer & Bluck, 2001). The construction of a meaningful and insightful life narrative is a gradual process which involves highly specific memories being repeated and processed, using autobiographical reasoning, into abstracted summaries. This process provides distance and perspective from specific events, and ultimately confers a sense of continuity (Schechtman, 1994; Thomsen, 2009).

Unfortunately, a noted limitation in the narrative identity literature (Habermas & de Silveira, 2008) is that the research has focused on event-memories, such as self-defining memories, rather than examining whole life stories. It is therefore difficult to assess what role semanticised levels of memory might play in the construction of life narratives. The present model predicts that semanticised AM would form the major part of life narratives, and that autobiographical reasoning would most commonly be used in conjunction with these abstracted levels of memory. Some support for these predictions is provided by one of the few studies to have examined the levels of memory used in whole life stories. Using Conway and Pleydell-Pearce's (2000) model of AM, Thomsen (2009) found that the level of AM most commonly used in the life stories of older adults was "chapter" level memories (including lifetime periods and general events), with memories of specific events being used less frequently. The study also found that when autobiographical reasoning was used, it tended to be in conjunction with chapter-level memories rather than with specific events, suggesting that it is at this higher level of abstraction that autobiographical reasoning takes place. Blagov and Singer (2004) similarly found that event specific self-defining memories were less likely to contain meaning or insight than memory narratives that were more abstracted and summarised. To examine the hypothesised relationship between semanticised AM and narrative identity, Chapter 5 examines the levels of AM used in whole life narratives, rather than individual event memories, as well as the narrative techniques employed in the construction of these narratives.

If narrative continuity could be created using semanticised AM alone, this could provide a mechanism by which people with episodic memory deficits could retain diachronic unity (Rathbone, et al., 2009). It could be that even small pockets of semanticised AM would be sufficient to some form of narrative identity, provided these memories were woven into a cohesive, coherent life story. The few studies that have attempted to examine narrative identity in individuals with AD suggest that limited narrative abilities may remain even in the face of severe episodic memory deficits (Mills, 1997; Usita, Hyman, & Herman, 1998). There is also evidence of preserved, perhaps even enhanced, narrative abilities in healthy aging. Studies examining the types of details provided in the event memories of older adults suggest that a reduction in vivid episodic details is matched by a corresponding increase in semantic details (Levine, et al., 2002). This is partly due to a relative preservation of semanticised levels of AM in comparison to event-specific memory (Piolino et al., 2010) but also reflects an increase in narrative "padding" in the stories of older adults (L. E. James, Burke, Austin, & Hulme, 1998). Despite this verbosity, older adults' stories are judged by listeners to be better in terms of interest, "informativeness" and story quality, than the stories of younger adults, suggesting that this "padding" may reflect an improvement in their narrative abilities (L. E. James, et al., 1998). The greater emphasis that older adults place on communicating the broader context of life events may reflect an improved ability to interpret, evaluate and communicate the significance of the events of their lives (L. E. James, et al., 1998; Levine, et al., 2002).

In support of this hypothesis, studies suggest that in older adults there is a retained, and possibly enhanced, capacity to use narrative techniques to create a sense of continuity. Pasupathi and Mansour (2006) found an increase in the amount of autobiographical reasoning from early to middle adulthood followed by a plateau, or slight decline, after the age of 50 years. McLean (2008) similarly found that compared with younger adults, older adults' narratives include greater use of advanced forms of autobiographical reasoning, and more statements emphasising self-stability. It may be that this improved ability to create narrative continuity through life stories compensates for a reduction in phenomenological continuity resulting from diminished autonoetic consciousness and episodic memory.

Despite extensive research examining autobiographical reasoning as means for creating stability and continuity within stories, few studies have examined narrative continuity alongside independent measures of diachronic unity (for a recent attempt, see Habermas & Kober, In Press). The presence of autobiographical reasoning within stories, or a story's global coherence, is assumed to imply narrative continuity. Without an independent measure of diachronic unity, however, there is no way to assess how successful these narrative techniques are in supporting people's beliefs and perceptions about their self continuity; thus, the often stated importance of a coherent life story to self continuity remains hypothetical. Pasupathi et al. (2007) suggest that Chandler et al.'s (2003) self continuity interview could be used as an independent measure of self continuity in studies of narrative identity, allowing exploration of whether those who produce less coherent life stories also perceive themselves to be less continuous entities. If life story coherence is important for diachronic unity, those who score higher on measures of narrative coherence and autobiographical reasoning should also score higher on Chandler et al.'s interview.

Overall, there is a dearth of empirical research exploring self continuity, and resulting uncertainly about how different ways of conceptualising self continuity might relate. The present model proposes one possibility: that phenomenological continuity (supported by episodic memory) and semantic continuity (supported by semanticised AM) are two parallel mechanisms contributing to diachronic unity. It has yet to be determined, however, whether these mechanisms function independently or whether they interact in creating diachronic unity. For example, it is not yet known whether it is possible to maintain diachronic unity through a coherent life story in the absence of a phenomenological connection with one’s past; or whether a phenomenological connection with one’s past is possible in the absence of a coherent life narrative (see Strawson, 2005). In order to explore these questions, Chapter 5 examines the self continuity of memory-impaired and healthy older adults using multiple measures of self continuity, including measures of diachronic unity (Chandler et al., 2003; Troll & Skaff, 1997) and its relationship to both phenomenological and semantic continuity.

Conclusion

This chapter has attempted to bridge empirical and theoretical literature by proposing a simple framework for understanding sense of self. In relation to the subjective aspects of sense of self, the proposed model suggests that two levels of present-moment sense of self are both essential to healthy episodic memory. Episodic memory is argued to be a necessary precursor for temporally-extended self awareness (autonoetic consciousness) and the resulting phenomenological sense of continuity. In relation to the content of self, the model suggests that although some aspects of conceptual self knowledge (i.e., abstract trait knowledge) may be independent of episodic memory, episodic and semanticised AM play an important role in establishing and maintaining a coherent conceptual self. Semanticised AM is also suggested to support a number of forms of semantic continuity across time.

The proposed model is primarily driven by theoretical discussions about sense of self and AM. Although there is preliminary empirical support for this model, a number of areas of uncertainty remain. The major gap in understanding relates to a siloed approach within the empirical literature which has seen different aspects of sense of self and AM studied by different fields of psychology using very different methodological approaches and theoretical starting points. By working in isolation, the relationship between these constructs has remained elusive.

Particularly useful insights have been provided by the neuropsychological literature, which has demonstrated how dysfunction in various aspects of self experience and memory appear to be related to common neuropathology. Work with these clinical populations remains a useful method for exploring these questions, but there is now a need to move beyond inferences drawn from case studies to more systematic explorations in clinical populations. Studies are needed which examine multiple aspects of sense of self and AM within the same populations so that it is possible to build a better picture of how these constructs relate.

The remainder of this thesis will set out a series of empirical investigations of AM and sense of self guided by the proposed model. The overall motivation of these investigations is to test the main predictions of this model, while also addressing some of the limitations that have been identified in the current literature. As noted in the Introduction, one of these limitations is that very few studies have attempted to examine a wide range of aspects of sense of self in a single patient group. Studies have also been restrictive, however, in the range of methods used to assess sense of self, tending to use just one or two methodological approaches. Given the idiosyncratic nature of sense of self, the present study combines a wide range of well-used and novel methods in an attempt to canvas all of the proposed aspects of sense of self as well as different levels of AM. Importantly, these measures embrace a wide range of methodological approaches, including structured checklists and questionnaires, computer-based tasks which required no verbal reporting, and open-ended interviews which invited participants to express themselves as spontaneously and freely as possible.

When using open-ended approaches, the resulting data is similarly idiosyncratic and eclectic, and have therefore primarily been assessed in past studies using qualitative data analysis approaches. Although many interesting insights and hypotheses have been gained through qualitative studies of sense of self (Habermas & Bluck, 2000; McAdams, 2001), such analysis approaches are not generally appropriate for use with larger participant numbers or for testing hypotheses. The approach favoured in the present body of research was to find ways that this qualitative data could be reduced into a form that would allow quantitative statistical analysis, while still capturing its richness. One approach used in this study was a theory-driven content analysis (Burla et al., 2008; Lombard, Snyder-Duch, & Bracken, 2002), which involved developing a series of detailed coding manuals providing standardised rules for how participants' responses should be rated and classified. A team of independent coders were then tasked with coding the many different elements of the transcripts.

Before turning to the investigations of the specific components of the model, Chapter 2 will set out the general design of the overarching study, specifically focusing on how AM was assessed and measured, and the resulting AM profile of the participants involved. Chapters 3 and 4 describe investigations into the two present-moment aspects of sense of self, respectively, self awareness and self knowledge, and Chapter 5 examines two aspects of sense of self extended in time: phenomenological and semantic continuity. Each of these studies sets out to test the specific hypotheses relating to the aspects of sense of self in question, as well as addressing some of the gaps that have been highlighted in the present literature. Above all, however, these studies provide a broad, exploratory investigation of sense of self and AM which seeks to refine the proposed model, and generate new empirically-guided theory which may be used to inspire future work in this area, as covered in the general discussion presented in Chapter 6.

Chapter 2. Profile of Autobiographical Memory in Healthy and Memory-Impaired Older Adults

So, I was first born in 1936 and was born in the country, at a place called...
where the, Awanui. Yeah. And, that's near Kaitaia, that part of the country...
and 20 minutes later my twin brother was born.
So that's the start of my life.

Excerpt from life story interview. Participant 009b from AD group. MMSE = 21[4]

A central question of this thesis is how deterioration in autobiographical memory (AM) affects sense of self; more specifically, which types of AM are important to supporting and maintaining the various aspects of sense of self represented in the model. One issue is the relative importance of memories from different periods of an individual's life; another is the role that AM of different levels of abstraction may play in supporting sense of self. An important goal was therefore to use methods that could expand the focus of AM research beyond specific-event memory to examine a wide range of AM types. The present chapter sets out the method used to explore AM in this thesis, and the resulting AM profile of participants. It therefore provides the foundation for all of the remaining chapters.

Chapter 1 described two theoretical accounts of the relationship between AM and sense of self. The first, drawing on the work of Tulving and colleagues (Tulving, 1984, 1985, 2002, 2005; Wheeler, et al., 1997), suggests that episodic memory may have an important role in the subjective aspects of sense of self. The second, drawing on the work Conway and colleagues (Conway, 2005; Conway & Pleydell-Pearce, 2000; Conway, et al., 2004), suggests that both semanticised and episodic AM may have important roles in creating and maintaining the content of sense of self. One important way in which these theories differ is in the relationship they

[4] Details changed to protect participant's identity.

propose between episodic memory and other forms of AM. Tulving (2005) suggests that episodic memory is mediated by a fundamentally different memory system: one that only human beings possess, controlled by different brain regions, and associated with a fundamentally different form of consciousness from semantic memory. Although the episodic memory system is argued to rely and build upon the operations of the semantic memory system, semantic memory operates independently of the episodic memory system and can therefore operate unabated in cases of insult to the episodic memory system (Tulving, 2005).

Building on this work, another prominent theory of AM, the "transformation hypothesis" (Winocur, et al., 2010; Winocur, Moscovitch, & Sekeres, 2013), and its earlier form "multiple trace theory" (Moscovitch, Rosenbaum, Gilboa, Addis, Westmacott, Grady, McAndrews, Levine, Black, Winocur, et al., 2005; Moscovitch, Westmacott, et al., 2005; Nadel & Moscovitch, 1997), expounds on how these two memory systems may coexist. Memories are originally formed as episodic memories, and supported by the hippocampal complex which serves to bind the neural signature that mediated the conscious experience of the original event. Retrieval of this contextually rich memory relies on the hippocampal complex for the life of the memory. Over time, and multiple retrievals, the neocortex extracts the essential elements or "gist" of the original memory to produce a schematic, semanticised version of the memory, which is independent of the hippocampal complex. Although these parallel memory forms are similar in content, the semanticised version lacks any contextual or experiential richness. Both types of memory may coexist, with one or other taking prominence depending on the context and cues at the time of retrieval. As they rely on different brain regions for retrieval, they may also operate independently, with deterioration to the hippocampus selectively affecting episodic memory.

In contrast to perspectives which suggest relative independence of episodic and semantic memory, Conway and colleagues (2005; Conway & Pleydell-Pearce, 2000) propose a highly integrated, hierarchical structure for AM (see Figure 2.1). Similar to the transformation hypothesis, episodic memories are proposed to inform and provide details which are used to construct more abstracted memories. Importantly, however, more abstracted levels of AM are argued to provide the context, structure and temporal organisation for episodic memory, and serve an important function in guiding access to them in generative (i.e., effortful, deliberate) retrieval. Although it is possible to have "direct retrieval" of an episodic memory, where the memory is directly and immediately triggered by an external cue, in most cases, in order to access an event-specific memory one must traverse downward through the autobiographical database, often starting at the level of general events (i.e., extended and repeated events) (Conway & Pleydell-Pearce, 2000). This hierarchy of autobiographical information provides an essential "conceptual frame" for episodic memory, without which this type of memory lacks any personal meaning and is a nonsensical "free radical" (Conway, 2009).

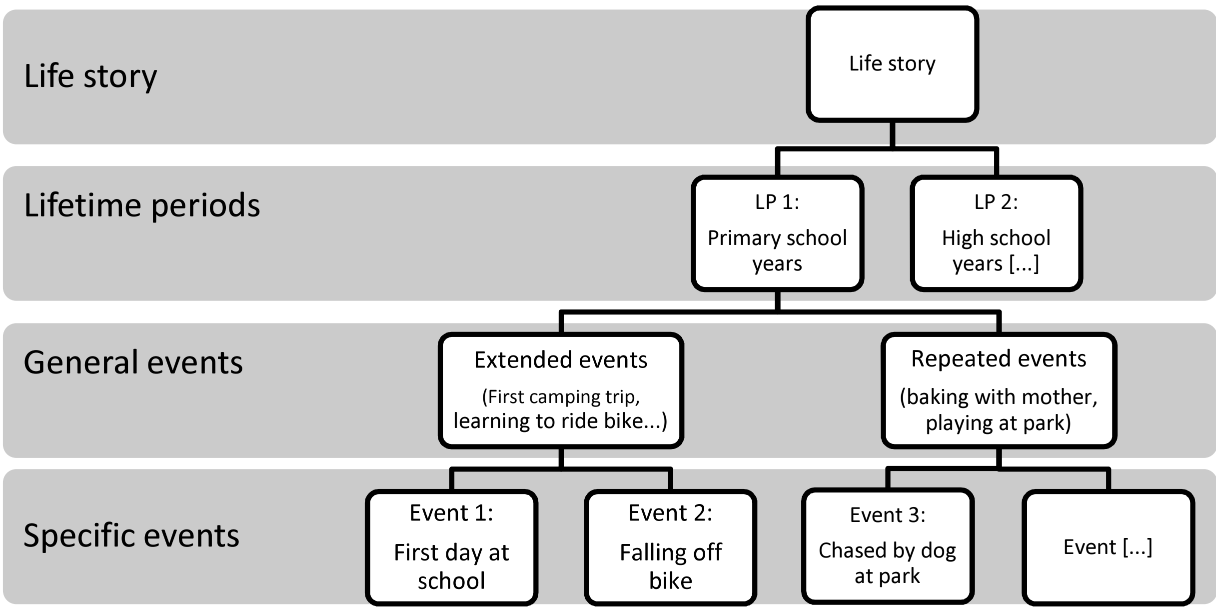


Figure 2.1. Hierarchical organisation of autobiographical memory (adapted from Conway, 2005; Conway & Pleydell-Pearce, 2000).

If this theoretical position is correct, a close relationship would be expected between episodic and semanticised levels of AM from within the same life period; engaging one level of AM should activate more specific memories from within the same life period, such that those who are able to provide more information at abstracted levels should be able to retrieve more event specific details from within that same period. In support of this suggestion, one study using an embedded autobiographical fluency task, engaging progressively more specific levels of memory, found a significant correlation between fluency for general events and specific events (Piolino, et al., 2010). There is also research demonstrating that when participants are asked to verbally report the contents of their thoughts during the process of retrieving a specific AM, lifetime period knowledge and general events are often accessed first before an event-specific memory is identified (Burgess, 1996; Haque & Conway, 2001), suggesting that retrieving an episodic memory often relies on access to more semanticised levels of memory.

There are, however, some important unanswered questions about how the semantic/episodic division proposed by Tulving (1985) and the transformation hypothesis (Winocur, et al., 2010) overlays the more complex AM hierarchy proposed by Conway and colleagues (for example, see discussion in Conway & Pleydell-Pearce, 2000). The simplest interpretation is that the event specific information at the lowest level of Conway's hierarchy corresponds to episodic memory, and is mediated by the hippocampus, while all other parts of the autobiographical knowledge base correspond to semantic memory and are mediated by the neocortex. This interpretation has been tacitly (though not explicitly) embraced by AM research which has used standardised definitions of "episodic memory" using the duration and specificity of the memory as its main defining characteristic (e.g., Haque & Conway, 2001; Kopelman, et al., 1990; Levine, et al., 2002; Martinelli, et al., 2013; St-Laurent, Moscovitch, Jadd, & McAndrews, 2014). Such definitions generally operationalise episodic memory using a time restriction of a few hours, or less than 24 hours. While this time restriction was likely to have originated as a convenient way to limit memories to those which are truly experiential and contextual, the short temporal duration has become an essential defining characteristic in theoretical writings about episodic memory (e.g., Conway, 2009).

These conventions have left a grey area in current understanding about varieties of AM that fall outside these methodological conventions. Often, memories that cover more than 24 hours are simply excluded from studies, or they are defined as “semantic”. In practice, however, many memories that extend beyond such time limits are contextually unique, rich and experiential, and should perhaps be included within the “episodic” definition (e.g., a woman’s three day child-birth experience). There do not appear to be any sound theoretical reasons to exclude these unique and contextually rich, but temporally extended memory forms as episodic, or for discounting the potential involvement of the hippocampus in mediating their retrieval.

These methodological considerations are underpinned by complex theoretical questions about whether other levels of AM in Conway’s hierarchy may share these essential “episodic” qualities, and therefore reliance on the medial temporal lobes (MTLs). For example, “extended memory”, as it is commonly operationalised, involves a spectrum from memories which are essentially strings of shorter episodic memories (e.g., a week-long overseas holiday), to those which are schematic representations of extended time periods (e.g., my first semester at university). Repeated memories may similarly include memories that involve vivid contextual, perceptual and personal details (e.g., Christmas mornings at Grandma’s) or highly routinised generic events (e.g., catching the bus, morning coffees) (Addis, McIntosh, Moscovitch, Crawley, & McAndrews, 2004). It is therefore unclear whether this level of “general events” from Conway’s hierarchy can be cleanly separated from episodic memory, as certain of these memories also encapsulate these vital recollective qualities.

Indeed, recent research supports the suggestion that different levels of AM form a spectrum from highly specific to highly semanticised. Piolino et al. (2010) demonstrated that older adults show graded deterioration in fluency for AM, with the greatest difficulties at the most specific (episodic) levels of AM, but with intermediary levels of AM (i.e., general memories) also affected. Neuroscientific evidence also indicates that there are overlapping neural networks involved in the retrieval of episodic and other levels of AM, including repeated memories (Addis, Cheng, Roberts, & Schacter, 2011; Addis, McIntosh, et al., 2004; Addis, Moscovitch, Crawley, & McAndrews, 2004). Importantly, repeated events also appear to active regions within the hippocampal complex, albeit to a lesser extent than episodic memories. The factors that modulate the degree of activation in the hippocampal complex, for both episodic and repeated memories, were the recollective quality of the memories, including the level of detail and the personal significance (Addis, Moscovitch, et al., 2004).

Such findings may appear at odds with the theoretical perspective of Tulving and the transformation hypothesis, which suggest that only episodic memory should be reliant on the hippocampal complex. It is important to note, however, that Tulving's theoretical writings have consistently emphasised memory *systems*, rather than *types* of memory (Tulving, 2005; Wheeler, et al., 1997). Precisely which types of memory are controlled by this system remains an open question. Although the transformation hypothesis relates more directly to types of memory, it also emphasises that it is the contextual details (St-Laurent, et al., 2014; Winocur, et al., 2010), and the recollective quality (Moscovitch, Westmacott, et al., 2005) of the memory that determines the involvement of the hippocampal complex. These theoretical perspectives therefore do not preclude the possibility that the hippocampal complex may be utilised, to a greater or lesser extent, to mediate recollection of other levels of AM; these other levels of AM are likely to be mediated by the hippocampal complex to the extent that they share these vital contextual details and recollective qualities.

Investigating AM in Alzheimer's Disease and Mild Cognitive Impairment

The investigation of AM in early-moderate AD and aMCI could potentially shed light on these questions because the primary neuropathology in these diseases resides in the MTLs (Braak & Braak, 1991, 1997; Buckner, et al., 2005; Nestor, Scheltens, & Hodges, 2004; Sexton et al., 2010). The transformation hypothesis would predict that the primary AM deficits should be to episodic memory, and that these deficits should be temporally ungraded, while semanticised forms of AM should be relatively preserved. This flat temporal gradient is expected because the retrieval of episodic memory from all points across the lifespan should continue to rely on the hippocampal complex, regardless of the age of the memory, while semanticised memory has been consolidated into the neocortex and no longer relies on the hippocampal complex (Moscovitch, Rosenbaum, et al., 2005; Moscovitch, Westmacott, et al., 2005; Nadel & Moscovitch, 1997; but see also Squire & Zola, 1998).

If the model proposed here is correct, however, and other levels of AM are also mediated by the hippocampal complex insofar as they involve critical contextual and experiential qualities, then AM deficits in the AD group should extend to other "experiential" levels of AM (i.e., some extended and repeated memories). In addition, evidence of a relationship between deterioration in different levels of AM may provide support for the suggestion that different levels of AM are highly interrelated (Conway, 2005; Conway & Pleydell-Pearce, 2000), with deterioration in episodic memory reducing the contextual detail available to construct higher levels of AM, and deterioration in abstracted levels preventing access to episodic memory.

To a certain extent, the firm separation of the semantic and episodic memory systems has been supported by the literature. Episodic memory impairments are well documented as characterising aMCI and AD, including deteriorated performance on tests of verbal learning (Bäckman, Small, & Fratiglioni, 2001; Gainotti, Marra, Villa, Parlato, & Chiarotti, 1998; Pozueta et al., 2011; Xie et al., 2010), tests of autobiographical event memory (Addis & Tippett, 2004; Bastin et al., 2012; Greene, Hodges, & Baddeley, 1995; Irish, et al., 2010; Leyhe, Müller, Milian, Eschweiler, & Saur, 2009; Martinelli, et al., 2013; Piolino, Desgranges, et al., 2003), the production of fewer and less specific AMs on free recall tasks (Fromholt & Larsen, 1991) and reduced autonoetic consciousness measured using the "remember/know" paradigm (Barba, 1997; Irish, et al., 2010; Rauchs, et al., 2007). Further, early episodic memory deficits in both aMCI and

AD have been linked to decreased volume and atrophy in MTL regions (Gilboa et al., 2005; Sexton, et al., 2010).

Contrary to the predictions of the transformation hypothesis, numerous studies have reported a temporal gradient in episodic memory deterioration in AD and aMCI, with more severe deterioration for later life periods compared with a relative preservation of memories from early life (Addis & Tippett, 2004; Greene, et al., 1995; Irish, et al., 2010; Leyhe, et al., 2009; Naylor & Clare, 2008; Piolino, Desgranges, et al., 2003). Some of these studies (e.g., Addis & Tippett, 2004; Leyhe, et al., 2009; Naylor & Clare, 2008) have used the Autobiographical Memory Interview (AMI), a measure which has been criticised for not precisely capturing the essential recollective qualities of episodic memory, such as perceptual richness and sense of re-experiencing (Moscovitch, Rosenbaum, Gilboa, Addis, Westmacott, Grady et al., 2005). Interestingly, when applying a stricter scoring procedure to the AMI which attempted to capture episodic detail, Piolino et al. (2003) demonstrated temporally-ungraded episodic memory decline in their AD group. To avoid these pitfalls, the present study uses the autobiographical interview (AI) which separates the episodic elements that are "internal" to the experience of the event, and the non-episodic elements that are "external" (Levine, et al., 2002). This is important because it is possible for a memory to be specific to place and time, and so meet the definition of episodic memory used in tests like the AMI, but nevertheless be devoid of rich contextual details which characterise true episodic memory. Using the AI with a group of AD patients, Addis et al. (2009) found deterioration in internal details across all life periods, with no temporal gradient.

Despite the support for the peculiar vulnerability of episodic memory in aMCI and AD, there is divergence in the literature as to whether other forms of AM may also be affected. Some studies have shown deficits only in episodic memory, with personal semantic AM relatively preserved in early-AD (Gilboa, et al., 2005; Martinelli, et al., 2013) and aMCI (Murphy, Troyer, Levine, & Moscovitch, 2008) while others have also found deficits in personal semantic memory (Addis & Tippett, 2004; Greene, et al., 1995; Leyhe, et al., 2009).

At least in part, these divergent findings relate to different methodological approaches for exploring semantic AM. A common approach has been to contrast episodic AM with “personal facts” (e.g., addresses and names from childhood, name of secondary school)(e.g., Kopelman, et al., 1990); however this approach does not capture the various levels of semanticised AM suggested in Conway’s hierarchy. Where other forms of AM have been investigated, either in AD or in healthy older adults, this has often been by eliciting a series of isolated memories according to predefined categories, for example, relating to ‘general memories’ (e.g., Addis, Moscovitch, et al., 2004; Martinelli, et al., 2013; Piolino, et al., 2010). A difficulty with this approach is that it assumes a strict division between different memory types, and that theory-driven definitions correctly isolate these divisions. One recent attempt to examine “general events” found no difference between an AD group and healthy controls on the number of memories generated (Martinelli, et al., 2013). However, that study did not separate extended and repeated memories, and also specifically included generic routines (e.g., catching the bus) in their definition.

Although there are certainly instances where testing specific hypotheses requires that studies elicit memories using predefined, theory-driven categories, at this early stage of understanding in relation to AM, there is a danger that these methodologically-based definitions come to shape our theoretical understanding about the divisions between memory types, and stand in for empirical truths about these distinctions. There is also a danger that many subtle points on the continuum of AM are missed, either because participants are not allowed to narrate memories that do not fit these definitions, or these memories are excluded from analyses. Asking participants to provide isolated events also does not allow for an exploration of how people move from one memory type to another, for example, which types of memory tend to trigger other types. Further, the technique of eliciting isolated memories of a predefined type requires an artificial approach to storytelling, which may not accurately reflect the way people access, retrieve and develop their AMs. This could be a particular problem for older adults who have a greater volume of memory to process and may therefore require more time and contextual build up to access and develop their stories. As noted in Chapter 1, studies examining the story-telling techniques of older adults suggest there is both an increase in narrative “padding” accompanied by an improvement in the perceived quality of the stories (L. E. James, et al., 1998), and it is possible that these well-practiced story-telling techniques may assist older adults in accessing AM. Many common laboratory techniques for assessing AM use strict time limits and predefined definitions, and may therefore remove this scaffolding. As a result, they may underestimate the memory ability of older people and those with memory impairments.

In contrast, the present study adopted a free-recall, life story approach to provide a more thorough assessment of the range of AM available in aMCI and early-to-moderate AD. This approach placed no restrictions on which levels of AM could be used, and therefore provided a more naturalistic assessment of the types of memory people use when recalling their lives as well as how these types of memory are woven together – which may reflect something about how they are stored and retrieved. Further, life story approaches offer participants the opportunity to tell their entire life story in an unhurried and unguided form, allowing them to develop themes and express their stories using their own narrative style. This approach may provide the best opportunity for older and memory-impaired adults to access whatever AM may be available.

Coding AM in the life stories. A challenge of using a life story approach is that having given participants a great deal of freedom in the way they tell their stories, there is a wealth of data that needs to be processed into a useable form. The present study adapts a coding method from Thomsen (2009), which divides the narrated stories into segments and then codes each on the basis of which type of memory was used. Although Conway and Pleydell-Pearce’s (2000) theory uses “general events” as a single category (see also Haque & Conway, 2001), this category in fact includes both extended and repeated memories. Thomsen combined extended and lifetime period memories into a single category. In the present study, however, lifetime period, extended and repeated memories were coded as distinct memory types in order to capture as wide a range of levels of AM as possible. As well as being a useful theoretical distinction, there is some evidence that extended and repeated events may be independent and qualitatively different types of AM, with distinct neural representations, as evidenced by differential changes in depression in these memory types (e.g., J Mark G. Williams & Broadbent, 1986; J Mark G. Williams & Dritschel, 1992).

Another coding challenge is how to demarcate where one type of memory ends and another begins. One approach (Fromholt & Larsen, 1991; D. K. Thomsen, 2009) is to divide the life story into smaller meaning-based memory units. The trouble with this approach is that any given "story" may contain a mixture of many different levels of AM from different levels of the hierarchy (Conway & Pleydell-Pearce, 2000; Haque & Conway, 2001) and therefore requires an arbitrary decision rule to ascertain the type of memory code to use for that unit. This approach may inadvertently underestimate the use of types of memory that are commonly embedded within other memory types. Another difficulty is that a very long memory unit (e.g., one involving many lines of text) would receive the same score as a very brief memory of just a few words. This approach may therefore underestimate the amount of the life story that is devoted to types of memory that are expressed in larger units, while overestimating the importance of types of memory that are commonly told in smaller units. Instead, the approach chosen in the present study was to divide the entire life story into roughly equal grammatical units (propositions) and then determine the type of memory used in each segment (Habermas, et al., 2009). This line-by-line approach allows for a finer-grain analysis of how different memory elements are woven together and allows a more accurate assessment of how much of the story was devoted to each type of memory.

Aims and Hypotheses

The aim of the present investigation was to provide one of the first attempts to assess the impact of aMCI and early-moderate AD on the wide range of levels of AM that have been proposed in the literature, in addition to “event-specific” episodic memory. Consistent with previous research, it was anticipated that the AD group would demonstrate marked, temporally ungraded deterioration in episodic memory, and in the autonoetic recollection of specific events. Deterioration was also predicted, however, in other “experiential” levels of AM, including extended and repeated memory. In contrast, it was anticipated that more semanticised levels of AM (i.e., lifetime period and personal fact information) would be relatively well preserved, however there would be deterioration in recent life periods reflecting a declining temporal gradient in semanticised AM. Finally, it was predicted that there would be a relationship between these different levels of AM, with the greater use of abstracted levels of AM (i.e., lifetime period, extended and repeated events) activating a greater number of episodic details for specific events within the same life period.

Methods

Participants

The study of AM described in the present chapter is part of an overarching study which is the foundation for all subsequent chapters in this thesis. The study involved 55 participants aged over 65 years, from three groups: 15 individuals with probable AD, 15 individuals with aMCI, and a control group of 25 healthy (non-memory impaired) older adults (HC group).

Participants in the AD and aMCI groups were recruited through outpatient memory clinics run through two public hospitals (North Shore and Greenlane hospitals) and two private memory clinics in Auckland, New Zealand. Potential participants were also identified by field staff from Alzheimer’s New Zealand, a community group supporting people with AD and their carers.

Potential participants were those with a medical diagnosis of aMCI or probable AD, with a dementia severity of mild to moderate, who were fluent English speakers, without any acquired language difficulties preventing communication, and able to give informed consent. Individuals meeting these criteria were identified by clinicians during routine appointments, and those who expressed an interest in the study were contacted directly by the researcher. Potential participants were excluded if they had a history of major head injury, cerebrovascular disease, neurological abnormality (other than AD/aMCI), alcoholism or drug dependence, psychiatric illness, or prolonged use of psychiatric medication. Participants in the AD group were required to have a dementia severity of mild to moderate, with a lower cut-off score of less than 10 out of 30 on the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975).

The HC group consisted of 25 healthy older adults recruited though advertisements and notices distributed through retirement villages and community groups involving older people. Interested individuals were sent a participant information form, and contacted by telephone by the researcher to arrange an interview time. The same exclusion criteria as described above also applied to the control group. In order to screen for undiagnosed dementia, participants in the control group were required to have an MMSE score of 25 or greater (Folstein, et al., 1975). Further, members of the HC group were questioned about their memory, and any who presented in ways that led the interviewer to suspect undiagnosed aMCI (e.g., complaining of severe deterioration in memory, appearing forgetful, performing poorly on MMSE memory component) were screened using a measure of episodic verbal learning, the Rey Auditory Verbal Learning test (Rey, 1964). Two individuals were screened in this manner, and one was removed from the HC group as a result of performing below age-stratified norms (Strauss, Sherman, & Spreen, 2006).

The demographic characteristics of the three groups are summarised in Table 2.1. The three groups did not differ significantly in terms of sex, $\chi^2_{(2)} = .69$, $p = .71$, age, $F_{(2, 52)} = 1.82$, $p = .17$, or years of education, $F_{(2,52)} = 2.39$, $p = .10$. As expected, there was a significant difference between the groups on general cognitive performance (MMSE score), $F_{(2, 18.11)} = 14.65$, $p < .001$ (Brown-Forsythe)[5], and verbal fluency (Controlled Oral Word Association score), $F_{(2,52)} = 6.17$, $p = .004$. Post hoc Games-Howell tests confirmed that both memory-impaired groups (AD: $p < .001$; aMCI: $p = .046$) scored significantly lower than the HC group on the MMSE, and the AD group also scored significantly lower than the aMCI group ($p = .002$). The AD group also scored significantly lower than both the HC and aMCI groups ($p \leq .01$) on COWA, although the aMCI group did not differ significantly from the HC group ($p = 1.0$).

Table 2.1. Demographic Characteristics of the Study Participants.

	HC group		*aMCI group*		*AD group*	
Number	25		15		15	
Sex (F/M)	13/12		6/9		8/7	
	M (SE)	Range	M (SE)	Range	M (SE)	Range
Age (years)	82.15 (1.51)	67-98	78.09 (1.61)	64-87	77.7 (2.79)	58-95
Education (years)	14.58 (.54)	9-19.5	13.97 (.81)	10-19	12.6 (.65)	7-18.5
MMSE	28.2 (.26)	26-30	26.87 (.46)*	24-30	20.87 (1.42)*	10-27
COWA	37.28 (2.43)	20 - 67	37.07 (2.58)	19 - 51	25.6 (2.46)#	14 - 44

Notes: M = Mean, SE = Standard Error of the Mean; MMSE = Mini-Mental State Examination; COWA = Controlled Oral Word Association test; SE = Standard Error of the mean; HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease.
* Significantly lower than HC group.
# Significantly lower than HC and aMCI groups.

Measures

Background interview. A brief background interview was conducted to assess educational history, screen for exclusion criteria including history of alcohol or drug dependence, and medical and psychiatric difficulties (see Appendix A). For those in the AD group, this information was checked with a family member who was present for the first part of the

[5] As there was unequal variance between the groups, the Brown-Forsythe F-statistic was used. See Method: Statistical Analysis.

interview. This process also allowed the researcher to speak informally and build rapport with the participants before the formal interview began.

Mini-Mental State Examination (Folstein, et al., 1975). The MMSE was used to assess general cognitive functioning and as a rough measure of dementia severity. The MMSE is a widely used screening tool for dementia (Lezak, 2004; Perneczky, Wagenpfeil, Komossa, Grimmer, & et al., 2006; Pozueta, et al., 2011). The MMSE includes questions to assess concentration, language and praxis, orientation to time and place, memory and attention span. A score of 24 has become the commonly used cut off for indicating dementia (Lezak, 2004), as the original validation studies found that no healthy individuals scored below this level (Folstein, et al., 1975). The maximum possible score is 30 points. The MMSE is reported to have high 24 hour test-retest reliability even when a different examiner was used, and a very high 4-week retest reliability for dementia patients (Folstein, et al., 1975).

Controlled Oral Word Association test (Lezak, 2004; Spreen & Benton, 1977). The COWA was administered to assess verbal fluency. The test requires participants to state as many words as possible starting with the letters F, A and S, with a one minute time limit given for each letter. Participants must not include proper nouns or use the same word starting with a different ending (e.g., “eat”, “eaten”, “eating”). Participants are scored one point for each word they generate, excluding repetitions. The scores for each of the three letter conditions (F, A and S) were summed to provide a COWA total score.

Life story interview. A life story interview was conducted with participants, using a format adapted from Negele and Habermas’ (2010) study with children. This approach provides a very broad initial question, and then leaves the participant to tell their story, uninterrupted and in their own words:

> *The main thing I would like to do today is for you to tell me your life story. I would like you to tell me about your whole life, from the time you were born until the present time. You might like to tell me about the most important events in your life and the biggest*

changes. You can tell me things that someone who doesn't know you might like to know about your life.

To adapt this method for use with older adults, the story was divided into four chapters: childhood (0-14 years), teenage years and early adulthood (15-25 years), middle adulthood (26-50 years), and late adulthood (51-present). These time periods were selected as a compromise between the need for roughly equal life periods, the need for as few time periods as possible to reduce the load of the interview on participants, and the need to use cleanly isolated theoretically important memory periods (such as childhood and the reminiscence bump). Participants were given 10 minutes to narrate each chapter. After each chapter, a description of a specific event memory that took place within this life period was requested, using the AI procedure (see below). In addition, a subgroup of 21 memory-impaired participants (11 from the aMCI group, 10 from the AD group) were asked to narrate a life story chapter and an AI event story for a recent adulthood life period (past five years).

In order to assist memory-impaired participants with the life story task, a brief summary of the task instructions along with the relevant life period was placed in front of them while they spoke (e.g., "Please tell me about your childhood: Birth to 14 years old"). If they stopped speaking for longer than 15-20 seconds, prompts were used to remind them of the task and to elicit more information (e.g., "Is there anything else that you can tell me about that period of your life?") If the participant appeared to have forgotten the task requirements, the initial instructions were repeated.

Coding for levels of AM in the life stories. The life stories were coded to assess the levels of AM that were used in constructing the stories, based on the theoretical model proposed by Conway (2005). The coding method involved three steps.

1. Each story was divided into separate propositions - a grammatical unit consisting of a main or subordinate clause with a subject and predicate (Habermas, et al., 2009).

2. Each proposition was coded as an AM (any memory relating to one's life and personal history), a non-autobiographical memory (any memory that does not relate to one's personal past, including facts and information about the world, history, public events, politics, society, general knowledge, facts about other people) or other type of statement (e.g., meta-comments, reflections, evaluations, questions, self descriptions, repetitions).
3. Each AM statement was coded as one of five types of AM, based on a coding scheme adapted from Thomsen (2009) (see Table 2.2).

Table 2.2. Levels of Autobiographical Memory (AM) Categories Used to Code Life Story Interview.

Level of AM	Description	Examples
Specific events	Singular events that the individual was personally involved in, that are less than 24 hours in duration	*That day I lost my wallet in the movie theatre* *Getting dressed for wedding.*
Extended events	Singular events that last for longer than 24 hours. They are chronological but, unlike specific events, may be broken or interrupted with gaps in the timeline.	*My holiday in Fiji* *Learning to drive* *Planning my wedding.*
Repeated events	Summaries of similar events which have occurred more than once.	*Walking to school* *Fishing trips with Dad.*
Lifetime period knowledge	Summaries of extended periods of a person's life, including statements and labels which define the period, personal knowledge, attitudes and evaluations relevant to the period.	*When I was at school...* *During the war...* *When I lived in Churchill Ave*
Personal facts	Knowledge and information about the individual devoid of any particular temporal context, abstracted from the specific occasion when the information was learned.	*My father's name was Brian* *I was born in Singapore.*

Autobiographical Interview (AI; adapted from Levine, et al., 2002)**.** Following each life story chapter, participants were asked to describe a specific event that occurred during that same life period. They were asked to identify an event that they personally experienced, that took place during the course of a particular day, and something which they "remember very vividly, or something that was emotionally or personally important." These instructions were chosen because "significant life events" may play an important role in sense of self. In addition, there is some evidence that highly emotional or personally significant events may be more resilient in aging and memory-impaired populations compared with other types of episodic memory (Martinelli, et al., 2013; Martinelli & Piolino, 2009; Mills, 1997)

Following Addis, Wong and Schacter (2008), participants were given a standard time limit of three-minutes to narrate their stories. In the present study, however, this approach was amended somewhat in order to recognise the possibility that older adults may take longer to access specific levels of AM, and also may take longer to "settle into" their stories by talking around a topic, explaining the historical and social context necessary to orientate the listener (Levine, et al., 2002). A strictly timed task, where the timer is started as soon as the instructions have been read out, could therefore underestimate the capacity of older adults to recall episodic events by demanding quick and immediate access to specific memory details, and requiring participants to amend and truncate their natural story-telling styles.

To address this possibility, a novel flexible-timing technique was used to ensure both a standard measure of three minutes, while also allowing participants time to build towards their stories. First, participants were given some time to work toward a specific event, by describing general background and contextual information, while the interviewer used general prompts to assist them to identify an appropriate time/place specific event (e.g., "Is there a particular event that you recall that took place during that time? Do you remember one specific occasion when this happened?"). If they were unable to identify an event, or the event they had identified was not specific to a time and place, the interviewer suggested events they had described as part of their life story.[6] If participants were still unable to produce an event, some typical life events relevant to each period were suggested (“Cultural Life Events”; Chapter 5, Appendix P).

Once they had identified an appropriate event, the interviewer would briefly restate the instructions and start timing (e.g., “I’d like you to tell me as much detail as you can about that event. Your three minutes start now”). Participants were prompted using general probes to provide a full and detailed account of their event (e.g., “What else to you remember about that event? Can you recall any other details?). To ensure a standard measure of three minutes of interview, if participants ran out of event specific material some of the contextual material from the start of their interview (prior to the start of the timer) was included in the transcript to make up to a total of three minutes. If the participant did not manage to identify a specific event story for that life period after six minutes of general discussion and probing, the first three minutes of the general discussion were used as the text for scoring purposes (see Figure 2.2).

Example 1: Three minutes of scene setting, followed by three minutes describing a specific event.

1 min	2 mins	3 mins	4 mins	5 mins	6 mins
	Scene setting			Specific Event	
				Text used in scoring	

Example 2: Three minutes of scene-setting followed by two minutes of describing specific event

1 min	2 mins	3 mins	4 mins	5 mins	6 mins
	Scene setting		Specific Event		
			Text used in scoring		

Example 3: Participant spoke for six minutes without achieving a specific event

1 min	2 mins	3 mins	4 mins	5 mins	6 mins
		Scene setting			
	Text used in scoring				

Figure 2.2: Examples of the flexible timing method applied in the Autobiographical Interview.

[6] Six participants from the aMCI and HC groups opted to use an event that they had described in their life stories. These participants were asked to re-narrate the story, using AI prompts to encourage more detail. In some cases, the participant was committed to using an event they had already described, but reluctant to re-narrate the story. In these instances, the text used for their AI event story was the material they had narrated during their life story, combined with additional text that they described following prompting (up to 3 minutes). This approach was judged to be a fairer representation of these participants’ ability to describe specific events compared with the alternative of scoring a 0 for that AI life period.

Coding the AI event stories. The event stories were coded using the standardised AI scoring procedure developed by Levine et al. (2002). For each story, the coder identified the central event (i.e., the event which was described in most detail) that was specific to a particular time (less than one day) and place. If more than one specific event was described, the event that the participant spoke about for the longest was chosen. Second, the story was divided into details, which are distinct segments of information. Finally, each of the details were classified as being "internal", episodic details which directly relate to the central event of the story (e.g., details about the event, the place, the time, perceptual detail and emotions and thoughts relating to the event); or "external", non-episodic details which are not part of the main event (including semantic details, repetitions and meta-cognitive statements). The numbers of internal and external details were tallied for each event story.

Remember/Know autonoetic consciousness task (Tulving, 1985). Following each AI event story, participants were asked to identify whether the event was one which they "remembered", which means that there the memory is accompanied by a conscious experience of mentally reliving the event, or simply knew that the event had occurred, meaning that there is knowledge of the facts of the event without any ability to mentally re-experience that moment. The task was administered in accordance with the instructions given by Piolino and colleagues (2003) who also used this task with AD participants and in relation to an AM task. First, the difference between remembering an event and knowing that an event took place was explained, and discussed with participants until the interviewer was satisfied that they understood the distinction (see Appendix B). Participants were then reminded of the AI event they had just described, and asked whether they remembered or knew about that event. They were also given a "guess" option if they were unsure whether it was remembered or known (Gardiner, 2002; Gardiner & Byrne, 2008).

Procedure

Coding procedure. The life story narratives and AI event stories were transcribed strict verbatim by a professional transcriber. They were ordered using blind, random numbering for the purposes of coding. The transcripts were coded by a team of independent coders who were trained to the coding manuals by the author. All coders were blind to group membership and, although they were aware of the broad topic matter of the study, were blind to the hypotheses relating to the codes they were applying. In addition to the levels of AM coding described in the present chapter, the life stories were also coded for indicators of narrative identity (See Chapter 5: Methods).

A single, primary coder was responsible for each separate coding exercise. Inter-rater reliability for AM measures is set out in Table 2.3. For both the AI and the levels of AM coding, reliability was calculated from double-coded transcripts using the intra-class correlation coefficient (ICC) (Gwet, 2012; Shrout & Fleiss, 1979). The ICC represents the degree of consistency that coders are able to achieve in applying ordinal scales. This measure was appropriate for these scales because the main question of concern was whether each primary coder was able to consistently and meaningfully apply their particular coding scheme, rather than attempting to demonstrate agreement between coders as would be necessary if multiple coders were used (Stemler, 2004). A threshold for reliability of $\alpha \geq 0.75$ was selected for the ICC, as this has been suggested as representing an excellent level of agreement (Fleiss, 1986).

For the levels of AM coding, reliability was established by using a second independent coder who double coded a random selection of 20% of the life story transcripts, balanced across group and gender. The second coder divided these stories into propositions and the reliability for segmenting the life stories was calculated. Next, the second coder assigned the type of proposition and the level of AM codes (see steps two and three described in Measures: Life story Interview above), to transcripts which had already been divided into propositions by the primary coder. This ensured that any difference between the coders in the levels of AM coding was due to differences in how they applied the codes rather than differences in how the stories were segmented. For the AI event stories, the ICC was calculated using a set of 26 training stories, which were coded by the primary coder and had previously been coded by an independent coder for the purposes establishing reliability in earlier studies (Addis, Sacchetti, et al., 2009; Addis, et al., 2008).

Table 2.3. Inter-Rater Reliability Measures (ICC) for Double Coded Transcripts.

	α		*α*
Life story interview		*Autobiographical Interview*	
Number of propositions	.99	Internal details	.95
Specific Events	.98	External details	.85
Extended Events	.89		
Repeated Events	.89		
Lifetime periods	.76		
Personal facts	.79		

Notes: ICC = Intra-class correlation coefficient (α)

General procedure. The procedure described here relates to the overarching research reported in this thesis, and therefore describes not only the elements that relate to this present chapter, but also the chapters that follow. A list of the measures used in the overall study, and the order in which they were administered during the interviews, is set out in Appendix C. Each of the measures of sense of self listed below is described in the relevant chapters that follow.

Ethics approval was obtained from the Northern Y Regional Ethics Committee. Written, informed consent was obtained from all participants as well as from the caregivers of the AD participants. Each participant was interviewed twice, with sessions held approximately one week apart. Interviews were conducted by the author, in participants' own homes. Each session lasted around 1 ½ - 2 hours, and included opportunities for participants to take breaks and rest.

Session 1 involved introducing the study and gaining informed consent, a brief background interview, assessment of awareness of memory deficits, the MMSE, the Self Awareness in the Present Moment task, the life story interview, the AI and the Remember/Know task. The AD group were asked to have a family member present for the first five minutes of the interview to confirm that consent was given willingly and with understanding. Session 2 started with a digital photograph being taken, followed by the preferences task (part 1), COWA, TST (present), self knowledge checklist, photo recognition task, preferences task (part 2), TST (Past), self continuity interview, and self consciousness questionnaire.

Statistical analysis

Statistical analyses were carried out using IBM SPSS Statistics 20. Analyses involving between and within-group differences were analysed using mixed-factorial Analyses of Variance (ANOVAs). When Mauchly's Test of Sphericity was violated, the Greenhouse-Geisser correction was used. Bonferroni pairwise comparisons were used to test for differences in significant within-subject main effects. For significant group effects, the Games-Howell (1976) post hoc test procedure was used as it has been found to be accurate with unequal sample sizes and unequal population variances while remaining a powerful test (Field, 2009; Howell, 2011; Keselman & Rogan, 1978).

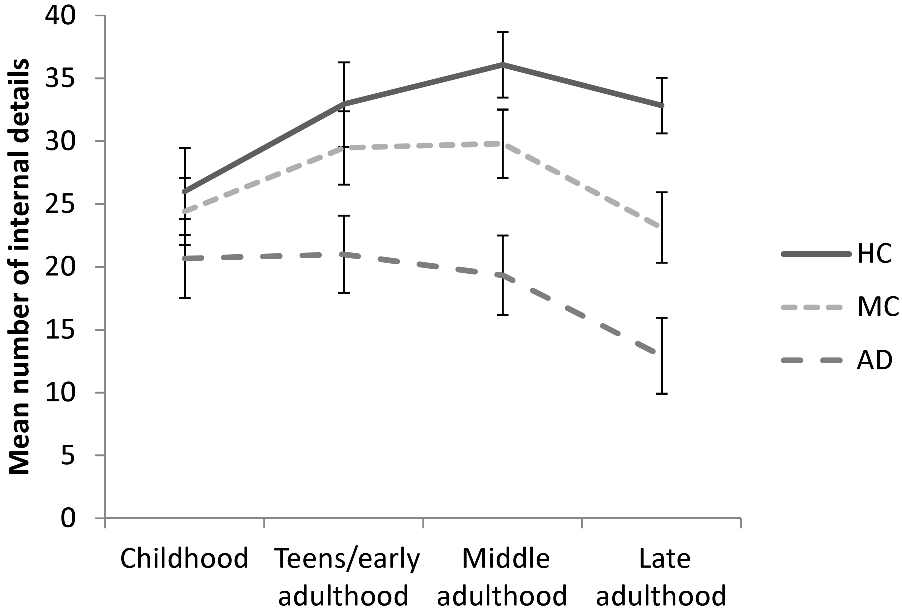
As three groups were involved in these comparisons, significant interactions involving "group" were broken down using a two step process. First, to determine which groups contributed to the interaction, either a series of Bonferroni corrected one-way ANOVAs for each level of the other variable were run or mixed-factorial analyses were computed for each group pairing to determine which pairings contributed to the interaction (HC/aMCI, HC/AD, aMCI/AD). In each instance, the approach which resulted in the fewest comparisons that clarified the nature of the interaction was selected. Second, these omnibus ANOVAs were followed-up using Bonferroni or Games-Howell pairwise comparisons, as appropriate. For one-way ANOVAs where there was unequal variance between the groups, the Brown-Forsythe F-statistic was used (Field, 2009). Group differences in relation to ordinal data was assessed using Kruskal-Wallis non-parametric tests, followed up with pairwise comparisons using Mann-Whitney U tests and correcting for multiple comparisons using a Bonferroni correction.

Correlations between AM measures were calculated using Pearson's partial correlations, controlling for general cognitive decline using MMSE and verbal fluency using COWA total score. Correlations involving ordinal data were calculated using the Spearman's rank order correlation coefficient (Spearman's rho). To correct for multiple comparisons, a Holm-Bonferroni (sequentially-rejective) procedure was used (Holm, 1979; Shaffer, 1995). According to this method, all *p*-values are ordered from lowest to highest, and each is considered sequentially. For the lowest *p*-value (p_1), the null-hypothesis (H_1) is rejected if $p_1 \leq \alpha/n$ (where $\alpha = .05$ and n = the number of tests performed); H_2 is rejected if $p_2 \leq \alpha/(n\text{-}1)$; H_3 is rejected if $p_3 \leq \alpha/(n\text{-}2)$ and so on. This procedure continues until a null hypothesis is accepted, at which point all further null hypotheses are accepted. This approach is slightly less conservative than the Bonferroni correction (Holm, 1979), however remains a conservative test, particularly in cases where many hypotheses are being tested and some are logically related (Shaffer, 1995).

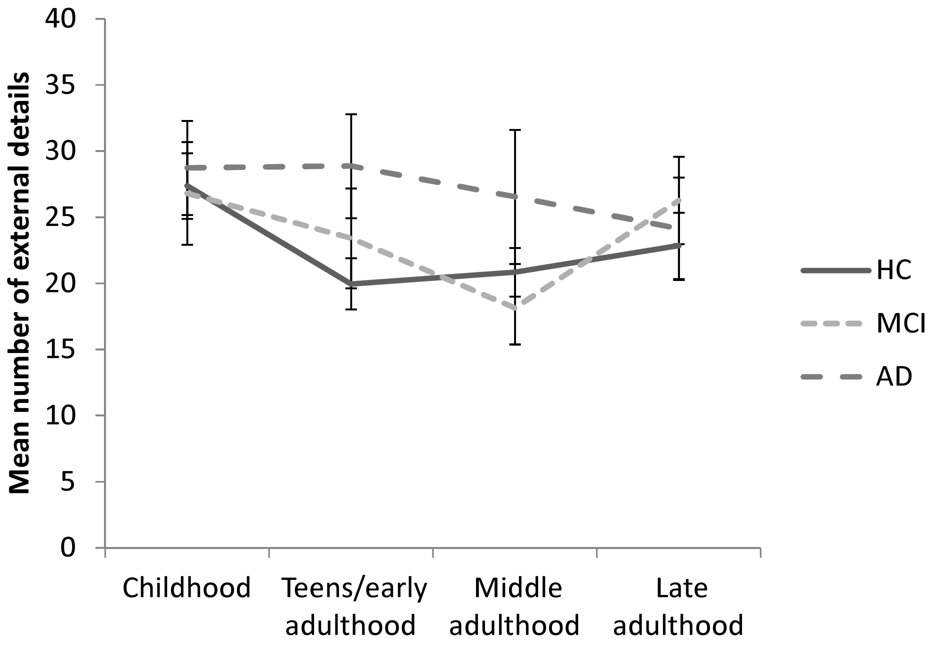
Results

Performance on the Autobiographical Interview

The number of internal and external details generated. To examine the hypothesis that the memory-impaired groups would demonstrate episodic memory deterioration, ungraded across the lifespan, the groups' performance on the AI task was compared. A mixed-factorial ANOVA assessed the difference between the groups on the number and type of details generated on the four AI event stories, with type of detail (internal, external) and life period (childhood, early, middle and late adulthood) as the within-subjects factors, and group (HC, aMCI and AD) as the between-subjects factor (see Figure 2.3). There were no significant main effects (all *p*-values > .15), but three significant interactions were found.



(a) Internal details



(b) External details

Figure 2.3: Mean number of (a) internal and (b) external details used in each of the Autobiographical Interview event stories by each group
HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, and AD = Alzheimer's disease. Error bars denote one standard error of the mean.

First, there was a significant interaction between group and type of detail, $F_{(2,52)} = 8.1$, $p = .001$ (see Figure 2.4). Post-hoc one-way ANOVAs confirmed a significant group difference in relation to internal, $F_{(2,52)} = 9.27$, $p < .001$, but not external details ($p = .41$). As hypothesised, Games-Howell post hoc comparisons confirmed that the AD group used significantly fewer internal details than either the HC ($p = .001$) or the aMCI groups ($p = .02$). The aMCI and AD groups did not differ on the number of internal details ($p = .17$), however a polynomial analysis indicated a significant linear trend, $F_{(1, 52)} = 18.53$, $p < .001$, indicating that the number of internal details decreased proportionally between the groups (HC > aMCI > AD). Next, a series of post hoc repeated measures ANOVAs examined each group for any differences in the type of details used (Bonferroni corrected alpha level set at $p < .017$). There was a significant difference in the type of detail used for the HC group, $F_{(1, 24)} = 8.32$, $p = .008$, but not for the aMCI group ($p = .10$), or the AD group ($p = .03$). Pairwise Bonferroni comparisons revealed that the HC group used a greater number of internal than external details in their stories ($p = .01$).

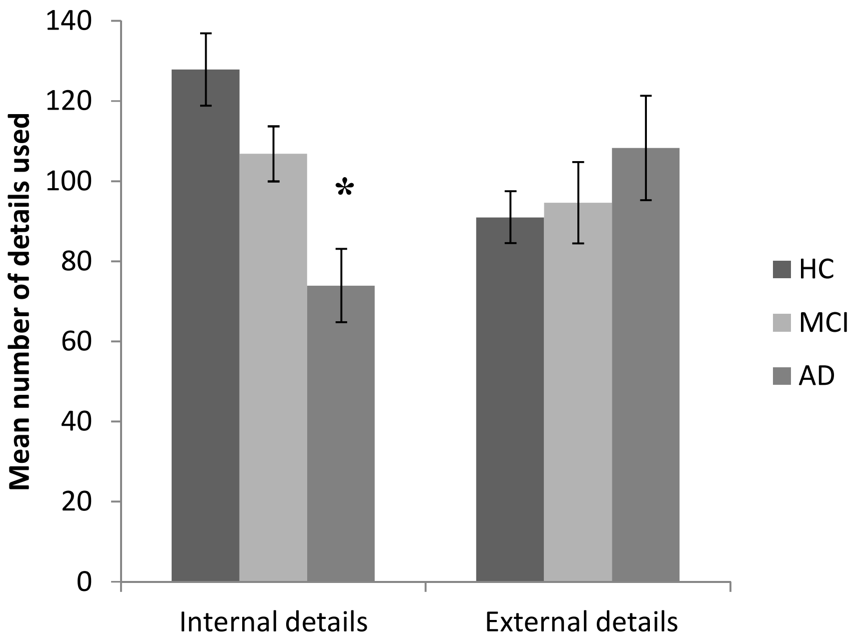


Figure 2.4: Mean number of details (internal, external) totalled across the four event stories of the Autobiographical Interview used by the three groups.
HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, and AD = Alzheimer's disease. Error bars denote one standard error of the mean. Significantly lower than HC group.*

Second, there was a significant interaction between group and life period, $F_{(6, 156)} = 2.3$, $p = .03$, suggesting a groups difference on the total number of details generated in each period (see Figure 2.5). To determine which groups contributed to this interaction, mixed-ANOVAs were conducted for each pairing. The interaction remained significant for the HC/AD pairing, $F_{(3, 114)} = 4.69$, $p = .004$, but not the HC/aMCI or AD/aMCI pairings ($p \geq .27$). Pairwise Bonferroni comparisons revealed that the AD group generated significantly fewer total details than the HC group on the middle ($p = .04$) and late ($p = .001$) adulthood, but not the childhood or early adulthood stories ($p \geq .44$). In addition, the AD group used significantly fewer details on the late adulthood story compared with the childhood or early adulthood stories ($p \leq .045$). The number of details did not differ across periods for the HC group ($p \geq .85$). Although this pattern suggests a temporal gradient for the number of details used by the AD group, with fewer details in more recent periods, this pattern was not specific to internal details, but applied also to external details.

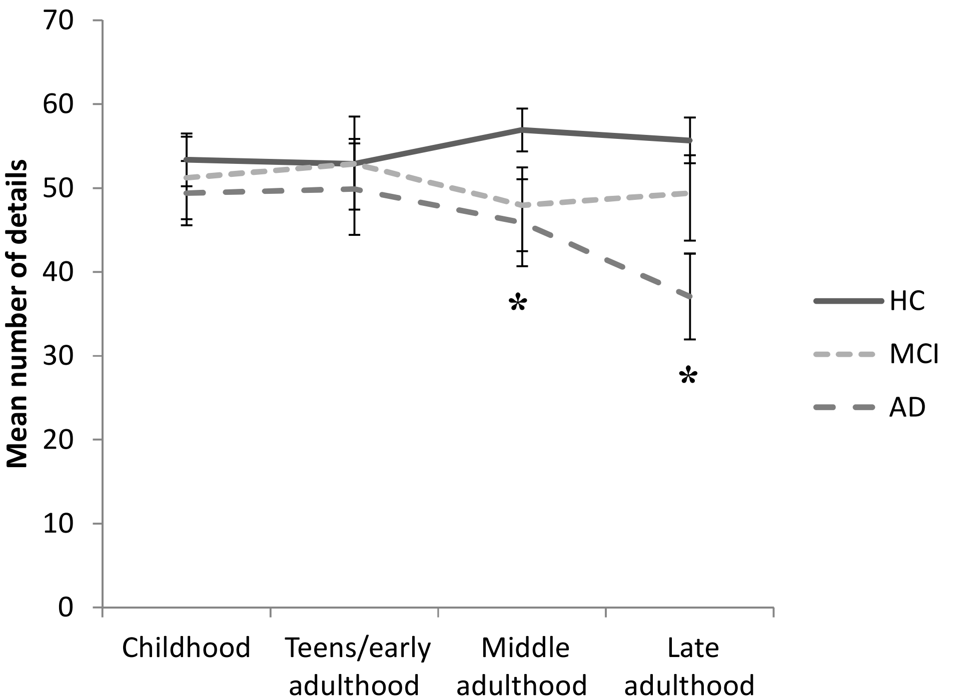


Figure 2.5: Mean number of details (combined internal/external) used in each of the four event stories of the Autobiographical Interview by each group.
*HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, and AD = Alzheimer's disease. Error bars denote one standard error of the mean. *Significantly lower than HC group.*

Finally, there was a significant interaction between life period and type of detail, $F_{(3, 156)}$ = 4.1, p = .01. Pairwise Bonferroni comparisons showed that this interaction was driven by a larger number of internal (M = 29.8, SE = 1.87) than external details (M = 21.65, SE = 1.8) in the middle adulthood period (p = .02). There was no difference between the types of detail used for any other life period (all p-values ≥ .2).

Percentage of internal details used. Although the groups did not differ significantly in relation to the total number of details used in their stories, they did differ in relation to the word count of their AI event stories, $F_{(2,52)}$ = 4.8, p = .01, with the AD group using significantly fewer words (M = 308, SE = 24.87) than the HC group (M = 399, SE = 19.27)(p = .02). To assess the possibility that the lower number of internal details used by the AD group was due to their shorter stories, a mixed-factorial ANOVA examined internal details as a percentage of the total number of details, with life period as the within-subjects factor, and group as the between-subjects factor. There was a significant main effect for group, $F_{(2,52)}$ = 10.21, p < .001, with post hoc Games-Howell analysis confirming that the AD group used a significantly lower number of internal details as a percentage of the total details used in the event stories (M = 39%, SE = 4.5) than either the HC (M = 58%, SE = 2.62) or aMCI groups (M = 54%, SE = 1.64)(all *p-values* ≤ .01). The aMCI group did not differ from the HC group (p = .6). These findings confirm that the AD group not only narrated event stories which used fewer internal details, but also fewer internal details in proportion to the total number of details they used.

There was also a significant main effect for life period, $F_{(3, 156)}$ = 5.99, p = .001. Bonferroni pairwise comparisons indicated that the middle adulthood event story contained a significantly higher percentage of internal details (M = 59%, SE = 2.85) than the childhood (M = 43%, SE = 3.13) and late adulthood (M = 46%, SE = 3.34) event stories (all p-values ≤.008). Although there was a slight decline in the percentage of internal details used by the two memory-impaired groups in the late adulthood period (see Figure 2.6), there was no significant interaction between group and life period (p = .08), indicating that the distribution of internal details across different life periods was similar for all of the groups.

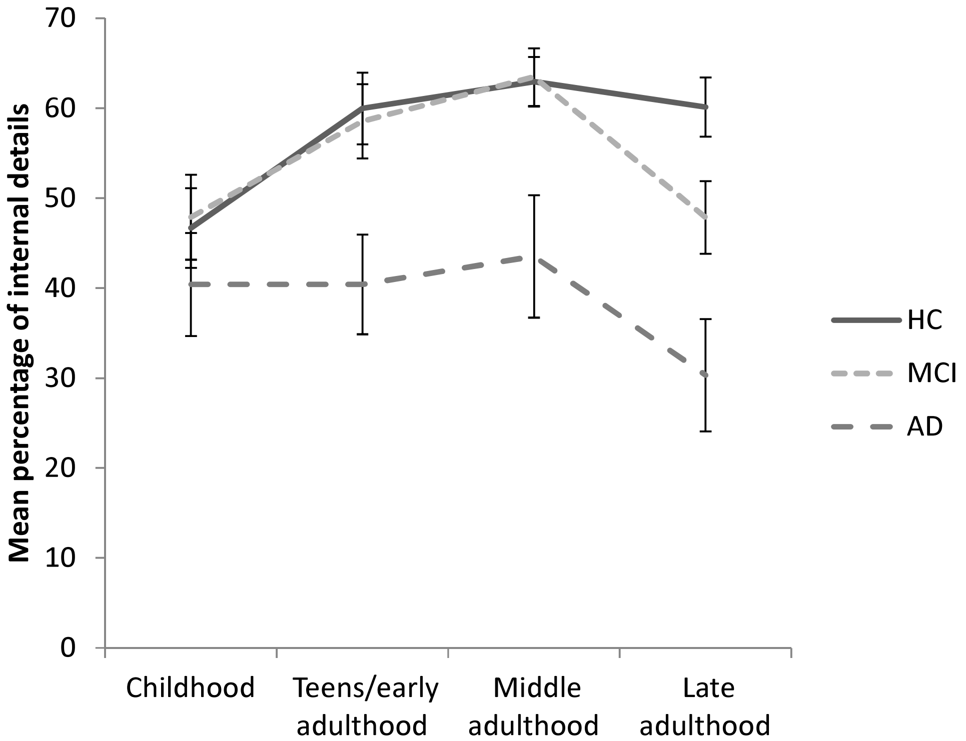


Figure 2.6: Mean number of internal details as a percentage of the total details used in each of the four event stories *of the Autobiographical Interview by each group.*
HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, and AD = Alzheimer's disease. Error bars denote one standard error around the mean.

Recent adulthood event story. In order to assess the possible temporal gradient in the internal details of the memory-impaired groups, the recent adulthood (past 5 years) AI event story that was completed by 21 memory-impaired participants was examined. A mixed-factorial ANOVA was conducted with lifetime period (childhood, early, middle, late and recent adulthood) as the within-subjects factor and group (aMCI/AD) as the between-subjects factor. The dependent variable was the number of internal details as a percentage of total details in each event story.

There was a significant main effect for group, $F_{(1, 19)} = 10.05$, $p = .005$, confirming that the AD group used a significantly lower percentage of internal details compared with the aMCI group across all life periods (see Figure 2.7). There was also a significant main effect for life period, $F_{(4,}$

$_{76)} = 2.79$, p =.03, however post hoc Bonferroni comparisons revealed a non-significant trend for the late adulthood life period to contain a lower percentage of internal details compared with the middle adulthood period (p = .05), but no other significant differences between the life periods (all p-values > .24). Importantly, the slight dip in percentage of details in the late adulthood life period, which hinted at a declining temporal gradient for the memory-impaired groups, did not continue to decline in the recent adulthood period. Overall, this pattern suggests that there was no temporal gradient in the percentage of internal details used by the two memory-impaired groups, and that a similar percentage of internal details were used across all five event stories. There was no significant interaction between life period and group (p = .83) suggesting that pattern of internal detail use across the different event stories was similar between the two groups.

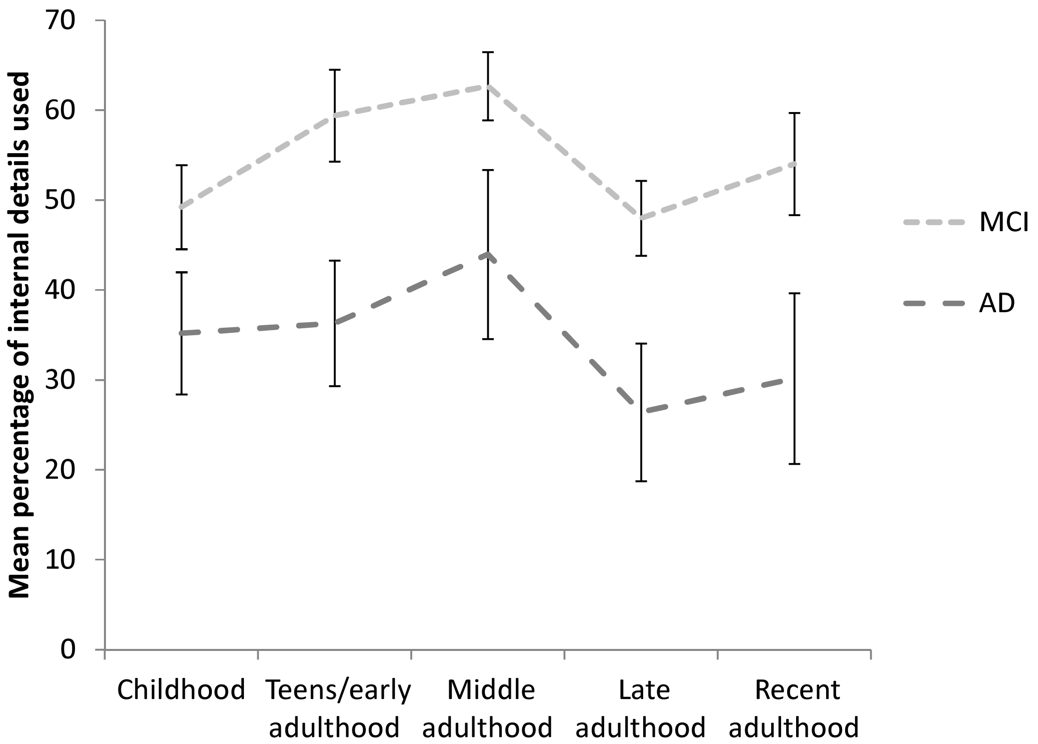


Figure 2.7: Mean number of internal details as a percentage of the total details used in each event story (including recent adulthood period) for the two experimental groups aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease). Error bars denote one standard error around the mean.

Autonoetic recollection. Autonoetic recollection was assessed by examining the number of AI event stories that participants indicated they "remembered" on the remember/know task. The distribution of each group in relation to the number stories "remembered" is shown in Table 2.4. The majority of participants in both the HC and aMCI groups reported that they "remembered" all four event stories, while only around half of the AD group did so.

Table 2.4. Percentage of Each Group Providing "Remember" Responses on 1, 2, 3 or 4 Autobiographical Interview Event Stories.

	Number of event stories that were "remembered"			
	≤1	2	3	4
HC group	0%	0%	12%	88%
aMCI group	0%	7%	20%	73%
AD group	13%	0%	40%	47%

Notes: HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, AD = Alzheimer's disease.

To test the hypothesis that the experimental groups would demonstrate poorer autonoetic consciousness, a Kruskal-Wallis non-parametric test was used to examine the difference between the groups in relation to the number of AI event stories reported as "remembered". There was a significant difference between the groups, $H_{(2)} = 8.43$, $p = .02$, with mean ranks of 32.38 for the HC group, 28.13 for the aMCI group, and 20.57 for the AD group. Consistent with the hypothesis, post hoc Mann-Whitney U tests (Bonferroni corrected alpha level set at $p < .017$) confirmed that the AD group used significantly fewer "remember" responses ($Mdn = 3$) than the HC group ($Mdn = 4$; $p = .004$). The aMCI group did not differ significantly from the HC or AD groups ($p \leq .14$).

Performance on the life story interview

Amount of AM used in the life stories. To examine whether there were any group differences in relation to the amount of AM used in constructing the life stories, the number of AM statements were compared with the number of non-autobiographical memory and other (non-memory) statements. A mixed-factorial ANOVA was conducted with group as the between-subjects factor and type of statement (AM, non-autobiographical memory, other) and life period (childhood, early, middle and late adulthood) as the within-subject factors.

There was a significant main effect for type of statement, $F_{(1.2, 62.54)} = 251.21$, $p < .001$, and Bonferroni pairwise comparisons confirmed that across all groups and life periods, AM statements were used most frequently ($M = 303.22$, $SE = 15.06$), followed by other (non-memory) statements ($M = 82.31$, $SE = 5.6$) and finally non-autobiographical memories ($M = 10.69$, $SE = 1.42$)(all p-values < .001). There were also significant main effects for group, $F_{(2,52)} = 5.02$, $p = .01$, and life period, $F_{(2.42, 125.62)} = 4.3$, $p = .01$, however these effects are best understood in relation to significant interactions between type of statement and group, $F_{(2.4, 62.54)} = 10.32$, $p < .001$, and type of statement and life period, $F_{(3.86, 200.73)} = 6.89$, $p < .001$. No other interactions (two- or three-way) were significant (all p-values $\geq .1$).

To examine the group by type of statement interaction (Figure 2.8), a series of post hoc one-way ANOVAs were run (Bonferroni corrected alpha level, $p <.017$). There was a significant difference between the groups in relation to the number of AM, $F_{(2, 52)}=9.09$, $p<.001$, and non-autobiographical memory statements, $F_{(2, 52)}=5.85$, $p = .005$, but not "other" statements ($p = .22$). Games-Howell pairwise comparisons confirmed that the AD group used significantly fewer AM statements in their stories than either the HC or aMCI groups ($p < .02$). The aMCI and HC groups did not differ on the number of AM statements ($p = 1.0$), and remarkably, given the length and variability of the life stories, these groups shared the same mean number of AM propositions. Both the AD ($p = .04$) and aMCI groups ($p = .005$) used significantly fewer non-autobiographical memory statements than the HC group, but did not differ from one another ($p = .98$).

Post hoc repeated-ANOVAs (Bonferroni corrected alpha level, $p < .017$) indicated that the type of statement by life period interaction was driven by a difference between the life periods in relation to the number of AM and "other" statements used ($p \leq .001$), but not in relation to non-autobiographical memory statements ($p =. 11$). Bonferroni pairwise comparisons revealed a drop in the number of AM propositions in the late-adulthood period (*M* = 60.02*, SE* = 3.81) compared with all other periods (Childhood: *M* = 68.82, *SE* = 3.99; Early adulthood: *M* = 71.8, *SE* = 4.15; Middle adulthood: *M* = 68.45, *SE* = 4.03)(all *p*-values <.02). The use of "other" statements was lowest in the middle adulthood chapter (*M* = 17.15, *SE* = 1.47), compared with the childhood (*M* = 23.67, *SE* = 1.83) and late-adulthood periods (*M* = 21.24, *SE* = 1.72)(all *p*-values ≤ .01).

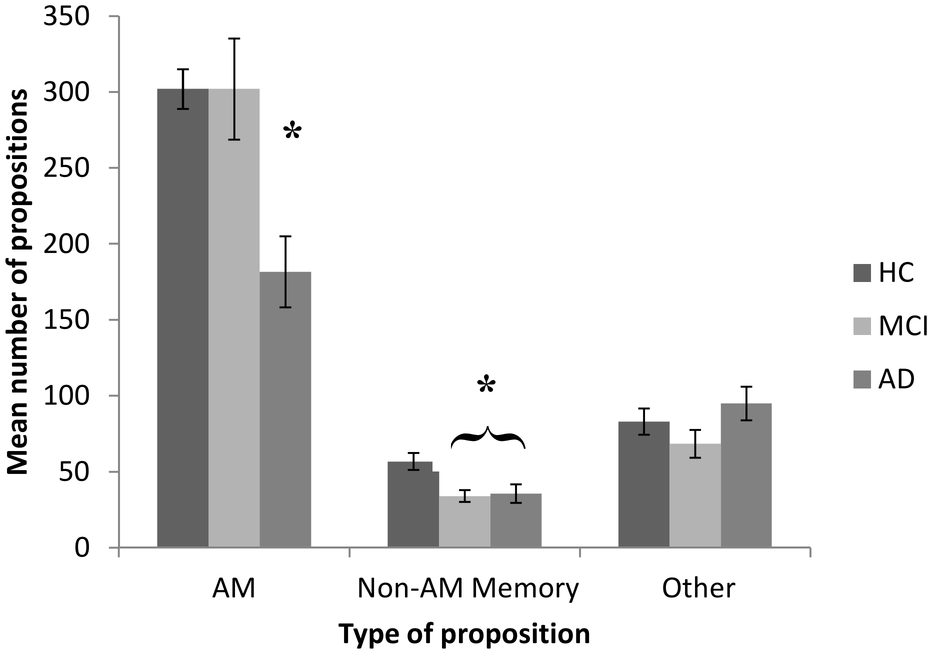


*Figure 2.8: Mean number of each type of proposition used in the life story by each group. AM = Autobiographical memory; Non-AM memory = Non-autobiographical memory, Other = Non-Memory statements, HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, AD = Alzheimer's disease. Error bars denote one standard error of the mean. *Significantly lower than HC group.*

Levels of AM used in the life story. The results above indicate that the AD group used fewer AM statements in constructing their life stories. It was hypothesised, however, that this deterioration in AM would not relate to all memory types, but would be restricted to "experiential" levels of AM (e.g., specific, extended and repeated events). To test this hypothesis, a mixed-factorial ANOVA was conducted with group as the between-subjects factor, and level of AM (specific event, extended event, repeated event, lifetime period, personal fact) and life period (childhood, early, middle and late adulthood) as the within-subjects factors. The dependent variable was the number of propositions using each level of AM as percentage of total propositions, in order to remove variability in relation to the length of the life stories.

There was a significant main effect for group, $F_{(2, 52)} = 13.33$, $p < .001$, with post hoc Games-Howell tests confirming that the AD group used significantly fewer AM propositions in their life stories as a percentage of total propositions (*M* = 58%, *SE* = 2.41) compared with either the HC (*M* = 69%, *SE* = 1.89) or aMCI groups (*M* = 74%, *SE* = 2.57) (all *p*-values ≤ .003). The difference between the HC and aMCI was not significant (*p* = .23). This effect was qualified by a significant interaction between level of AM and group, $F_{(3.81, 99.13)} = 3.04$, $p = .02$ (see Figure 2.9).

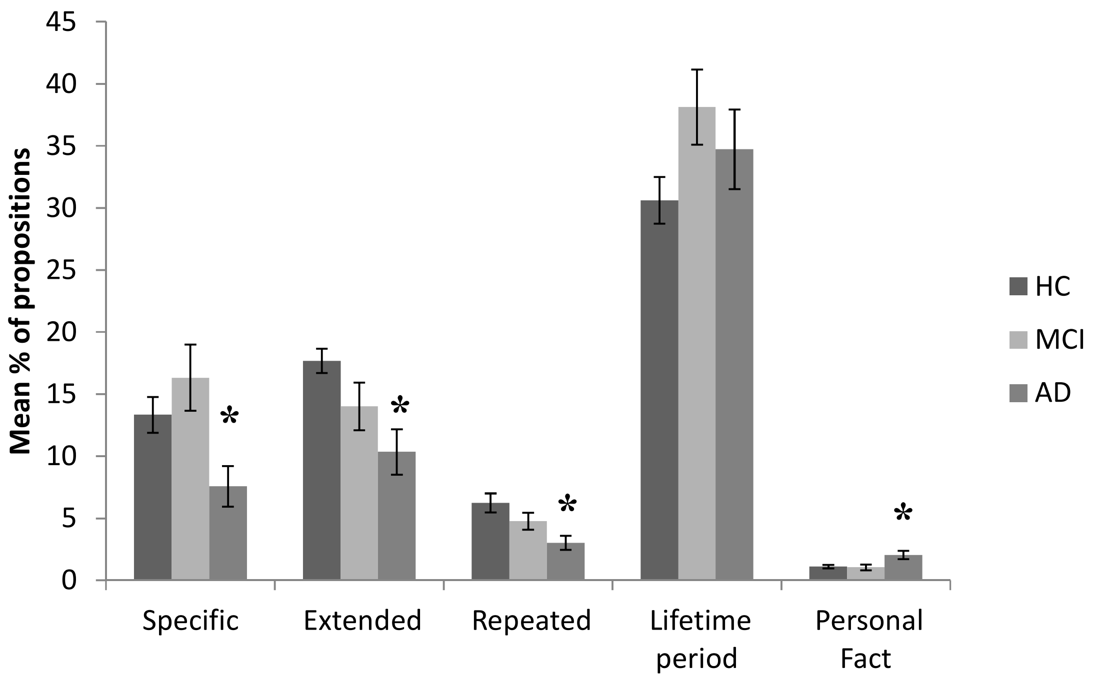


Figure 2.9: Mean number of propositions using each level of autobiographical memory as a percentage of the total number of propositions in the life story.
*HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, AD = Alzheimer's disease. Error bars denote one standard error of the mean.*Significant difference with HC group.*

To determine which groups contributed to this interaction, a mixed-factorial ANOVA was conducted for each group pairing (Bonferroni corrected alpha level set at $p < .017$). The interaction remained significant for the HC/AD pairing ($p = .016$), but not for the aMCI/AD ($p = .22$), or aMCI/HC pairings ($p = .04$). Consistent with the hypothesised deterioration in "experiential" AM types, pairwise Bonferroni comparisons confirmed that the AD group used a significantly lower number of specific, extended and repeated memory details as a percentage of total propositions than the HC group (all p-values $\leq .015$). They also used a significantly higher percentage of personal fact details compared with the HC group ($p = .005$). The percentage of lifetime period details used did not differ ($p = .24$).

There was a significant main effect for level of AM, $F_{(1.91, 99.13)} = 164.16$, $p < .001$. Post hoc Bonferroni comparisons revealed that lifetime period details made up the largest percentage of the life stories ($M = 34\%$, $SE = 1.51$) and personal fact details the smallest ($M = 1\%$, SE = .14) (all p-values $< .001$). The percentage of specific ($M = 13\%$, $SE = 1.15$) and extended event details ($M = 15\%$, $SE = .93$) did not differ significantly ($p = 1.00$), and both made up a larger percentage of the life stories than repeated events ($M = 5\%$, $SE = .45$)($p < .001$). There was also a significant main effect for life period, $F_{(2.36, 122.57)} = 10.04$, $p < .001$; however, this was qualified by a significant interaction between level of AM and life period, $F_{(6.03, 313.76)} = 7.21$, $p < .001$ (Figure 2.10). Pairwise Bonferroni comparisons revealed the same ordering of levels of AM was evident across all chapters except for the childhood chapter, in which there were significantly fewer extended event memories, and more repeated event and personal fact memories, than in other chapter (all p-values $\leq .004$). There was also a reduction in the number of specific event memories in the late adulthood chapter ($p = .03$). There was no significant three-way interaction ($p = .46$).

Finally, there was a significant interaction between and life period and group, $F_{(4.71, 122.57)} = 2.46$, $p = .04$ (see Figure 2.11). Consistent with the hypothesis of a declining temporal gradient in AM for the AD group, pairwise comparisons showed a significant reduction in the percentage of AM propositions used in the late adulthood period compared with the early and middle adulthood periods for the AD group ($p \leq .03$). There were no significant differences between the chapters for the HC or aMCI groups (all p-values $\geq .11$).

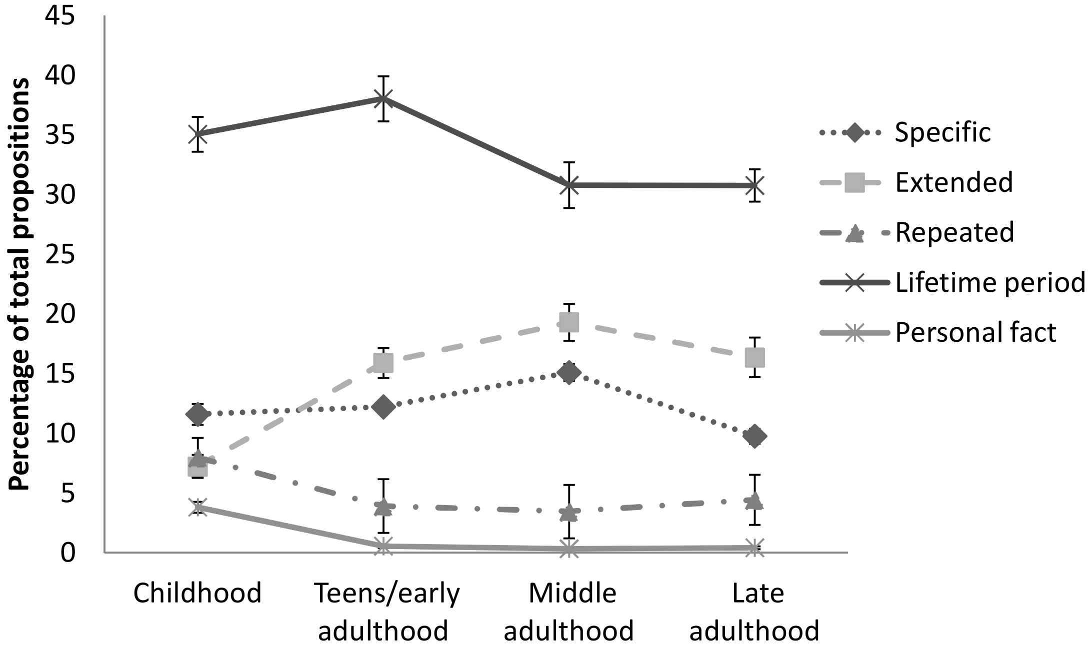


Figure 2.10. Mean percentage of proposition coded as each level of autobiographical memory in each life story chapter. Error bars denote one standard error of the mean.

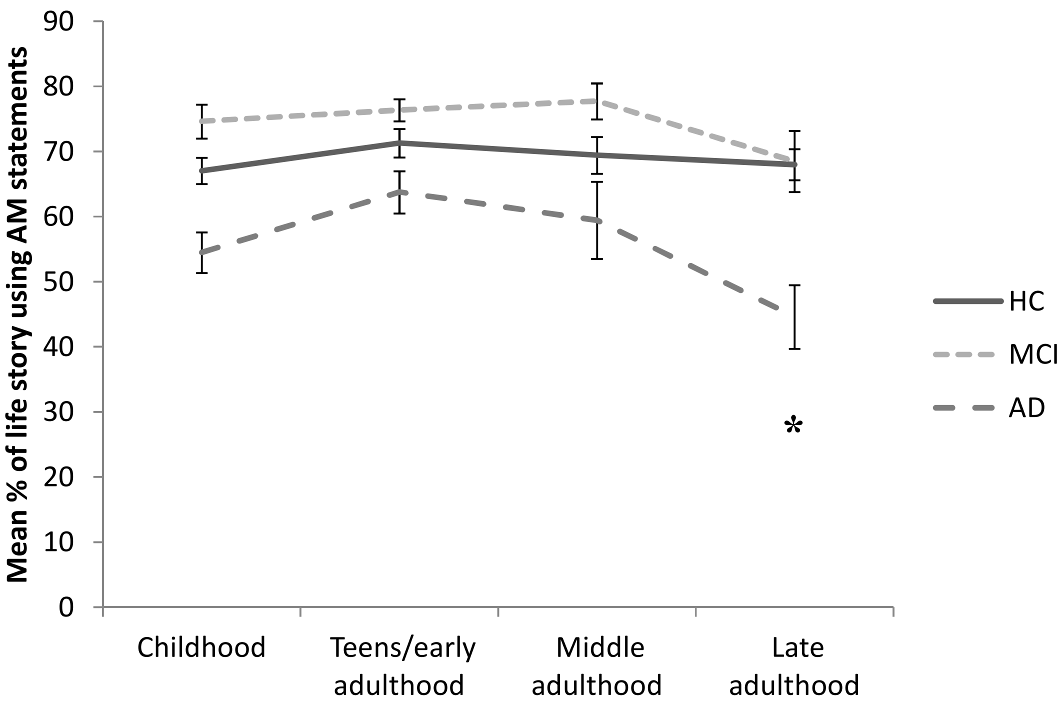


Figure 2.11: Mean number of autobiographical memory propositions, as a percentage of total propositions, used by each group in each life story chapter.
*HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, AD = Alzheimer's disease. Error bars denote one standard error of the mean.*Significant difference between late adulthood period and the early/middle adulthood periods for the AD group.*

Levels of AM in the recent adulthood life story chapter. To explore the possible temporal gradient in AM in the life stories of the memory-impaired groups, the stories of the twenty one memory-impaired participants who narrated a recent adulthood life chapter (past five years) were examined. A mixed-factorial ANOVA was conducted with lifetime period (childhood, early, middle, late and recent adulthood) as the within-subjects factor and group (aMCI/AD) as the between-subjects factor. Once again, the dependent variable was the number of each proposition using each level of AM as a percentage of total number of propositions.

There was a significant main effect for group, $F_{(1, 19)} = 10.87$, $p = .004$, confirming that relative to the aMCI group, the AD group used a significantly lower percentage of AM statements across all life story chapters. There was also a significant main effect for life period, $F_{(3, 57.01)} = 8.98$, $p < .001$, with post hoc Bonferroni tests showing that the recent adulthood period contained a lower percentage of AM statements compared with any other life period (all p-values $\leq .044$) with the exception of the late adulthood life period, which did not differ significantly from the recent adulthood period ($p = 1.0$) (Figure 2.12). This pattern suggests that for both memory-impaired groups, there was a temporal gradient for the percentage of AM statements, with lower use of AM details for the late and recent life periods. There was no significant interaction between life period and group ($p = .59$) suggesting that the declining temporal gradient was similar for both groups.

Finally, there was a significant main effect for level of AM, $F_{(1.81, 34.32)} = 94.33$, $p < .001$. Post hoc Bonferroni analysis confirmed that the same order of levels of AM that applied across the first four chapters also applied in relation to the recent adulthood life period (Lifetime period: $M = 36\%$, $SE = 2.3$ > Specific events: $M = 12\%$, $SE = 1.53$ > Extended events: $M = 10\%$, $SE = 1.32$ > Repeated events: $M = 4\%$, $SE = 2.3$ > Personal facts: $M = 1\%$, SE = .17)(all p-values $\leq .004$). There were no other significant two- or three-way interactions (all p-value $\geq .05$).

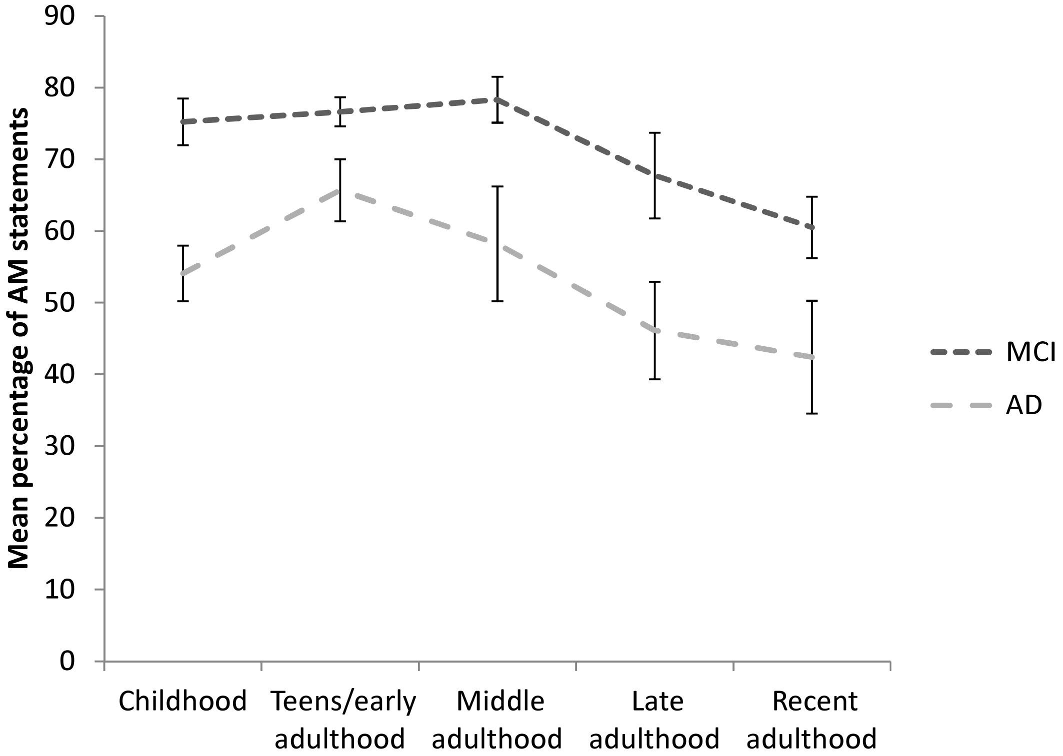


Figure 2.12: Mean number of AM statements as a percentage of total propositions used in each life story chapter (including the recent adulthood life chapter) for the two experimental groups. aMCI = amnestic Mild Cognitive Impairment, AD = Alzheimer's disease.

Relationship Between Different Levels of AM

To test the hypothesis that the ability to access event specific/episodic memories from a particular life period would be facilitated by the ability to access more semanticised levels of AM within the same life period, partial correlations were conducted between the two measures of specific event AM (number of AI internal details and number of specific memory propositions in the life story) and the use of extended, repeated and lifetime period details within the same life period. Personal fact memory statements were excluded due to the low use of this type of AM in the life stories. Correlations were conducted separately for each group.

The raw number of details or statements was used in the analysis, rather than the percentage of total propositions. This is because the hypothesis relates to the absolute amount of memory of each type that individuals have access to, rather than the relative amounts. If the hypothesis is correct, then an absolute decline in one type of memory should be accompanied by absolute decline in other types of memory, and therefore a positive correlation should be seen between these different memory scores. If proportional scores were used, a participant with across-the-board memory decline could have very similar proportional scores to a participant with high across-the-board memory scores. This would therefore obscure the relationship that exists between the raw scores. The difficulty with using absolute scores, however, is that many factors other than memory ability could affect the length of the stories, including verbal fluency, verbosity, and general cognitive decline. In order to control for any relationship between the memory scores resulting from these factors, partial correlations were conducted controlling for total word count of the life story and combined AI stories, total COWA and MMSE score.

After applying the Holm-Bonferroni correction (first-level corrected alpha level, $p < .002$), there were three significant correlations which appear to provide some evidence for the hypothesised priming effect (see Table 2.5). Within the HC group, there were significant positive correlations between the number of internal details in the AI middle adulthood story and the number of extended event details in the life story chapter of the same period ($p = .0018$). In this group, there was also a significant positive correlation between the number of internal details in the late adulthood life period and the number of repeated event details in the late adulthood life story chapter ($p = .001$). Within the AD group, there was a very strong and significant positive correlation between the number of specific details used in the early adulthood life story and the number of repeated event details used in the same life story chapter ($p < .001$).

In addition, there were also a number of marginally significant correlations ($p < .05$) which supported a similar, positive pattern of relationship between the measures of specific event memory and the number of extended/repeated memory propositions used in the life stories. There were marginally significant correlations in the HC group, between AI internal details and repeated event memory in the childhood life period ($p = .03$); in the aMCI group, between AI internal details and repeated event memory in the late adulthood life period (p = .01); and in the AD group between AI internal details and extended event memory in the late adulthood life period (p = .02). Contrary to this pattern, however, there was a marginally significant negative correlation for the AD group between the number of repeated event propositions and the number of AI internal details generated in the childhood life period (p = .049).

Table 2.5. Partial Correlations Between the Number of Extended, Repeated and Lifetime Period Propositions in Each Life Story Chapter and Measures of Specific Event Memory (Number of AI Internal Details/Number of Specific Event Propositions in Life Story) For Each Life Period.

	Measures of Specific Event Memory					
	HC group		*aMCI group*		*AD group*	
Number of AM propositions in life story	*AI Internal Details*	*Specific events*	*AI Internal Details*	*Specific events*	*AI Internal Details*	*Specific events*
Childhood period						
Extended events	.04	-.18	-.35	-.54	.39	.26
Repeated events	**.47^**	.04	-.18	-.44	**-.60^**	.14
Lifetime period	.03	-.29	.24	-.14	-.06	.07
Teens/early adulthood period						
Extended events	.41	-.08	-.30	.10	.27	.55
Repeated events	.21	-.07	.34	-.58	.41	**.90***
Lifetime period	-.33	**-.59^**	.05	-.54	-.28	-.32
Middle adulthood period						
Extended events	**.64***	-.05	-.23	-.53	.23	-.11
Repeated events	-.23	-.03	-.19	-.13	-.22	.44
Lifetime period	-.08	-.21	.15	-.28	.60	-.06
Late adulthood period						
Extended events	-.05	-.11	.22	-.02	**.67^**	-.07
Repeated events	**.65***	-.02	**.74^**	.26	.44	-.23
Lifetime period	.12	-.28	-.39	-.36	.15	-.46

Notes: Partial correlations controlling for total word count of the life story and Autobiographical Interview, Controlled Oral Word Association score and Mini-Mental State Examination Score. AM = Autobiographical memory; AI = Autobiographical Interview, HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease.
* Significant after Holm-Bonferroni correction (first-level corrected alpha level, p <.002)
^ Marginally significant after Holm-Bonferroni correction (p < .05)

There were no significant correlations between lifetime period details and either measure of specific event memory for any groups. There was, however, a marginally significant negative correlation for the HC group between lifetime period and specific event statements in the early adulthood chapter ($p = .005$).

Discussion

Although episodic memory deficits in AD and aMCI are well documented, little is known about the effects of these diseases on the wide range of AM types that have been proposed in the literature. Instead, empirical literature has tended to focus on the event-specific episodic and semantic ("personal fact") extremes of AM. Through the use of a life story method, the present study confirmed previous findings (Barsalou, 1988; D. K. Thomsen, 2009) that when allowed to freely narrate their lives, healthy adults tend to make predominant use of a range of AM forms which sit between narrowly defined semantic and episodic extremes (including extended and repeated events and lifetime period knowledge). It also extended these findings by showing that the same was the case for memory-impaired groups. It appears that these levels of AM provide an essential mechanism through which people understand, make sense of, and communicate their pasts, and therefore deserve far greater empirical attention. This study provides one of the first attempts to examine the effects of AD and aMCI on these intermediary levels of AM.

Profile of AM deterioration in AD

The present results support the expected pattern of episodic memory deterioration in the AD group, including deterioration in the ability to recall detailed events from all life periods (a lower number and percentage of internal details on the AI task compared with healthy controls), as well as deterioration in the phenomenological experience of remembering (fewer "remember" responses on the "Remember/know" task). Although the pattern of internal details used in the first four life periods appeared to indicate a slight, deteriorating temporal gradient, this pattern was not evident once the recent adulthood life period was included in the analysis. These findings therefore appear to support the predictions of the transformation hypothesis and Multiple Trace Theory (Nadel & Moscovitch, 1997; Winocur, et al., 2010) that the episodic memory deterioration following MTL pathology would be flat across the life-span.

A unique contribution of this study is to demonstrate that the memory deterioration in AD is not restricted to episodic memory, but extends to other levels of AM. Overall, the AD group used significantly fewer AM statements in constructing their life stories than either the aMCI or HC groups. As predicted, the AD group used a lower percentage of statements involving specific, extended and repeated events in their life stories, supporting the hypothesis that the "experiential" levels of AM would be preferentially affected in early-AD. In contrast, there was no difference between the groups on the percentage of lifetime period statements used, and the AD group used a slightly higher percentage of personal fact information, indicating that these semanticised levels of AM are more resilient to this disease.

When the recent adulthood life period was included in the analysis, there was a declining temporal gradient in the percentage of AM details used in the life stories for both the aMCI and AD groups. This finding is consistent with some previous investigations which have found a temporal gradient in semanticised AM in these groups (e.g., Addis & Tippett, 2004; Leyhe, et al., 2009), and also with the prediction of the transformation hypothesis (Winocur, et al., 2010) that the hippocampus may initially be involved in the formation of semantic memories, but become independent of the hippocampus once consolidated in the neocortex. It was not clear from the present investigation which levels of AM were driving this temporal gradient. The present model had suggested that "experiential" AM types would demonstrate a flatter gradient (i.e., uniform deterioration across the entire lifespan) because, like episodic memory, these should be reliant on the hippocampus for the life of the memory. As the general event coding categories used in the present study combined both perceptually rich and more semanticised variants, any such difference was likely to have been obscured. Future investigations could usefully examine whether a flatter gradient would be observed if these more "experiential" subtypes of extended and repeated memories were distinguished.

Profile of AM in the aMCI Group

In line with previous findings (Bastin, et al., 2012; Leyhe, et al., 2009; Murphy, et al., 2008), the aMCI group tended to perform below the HC group on episodic memory tasks, but in most cases did not differ significantly from either the HC or AD groups. In part, this may because three groups were included in the analysis, possibly lowering the power to detect significant differences between any two groups (see also Leyhe, et al., 2009). It is also possible, however, that the AI interview procedure used in the present study enhanced the performance of the aMCI group by requesting a "significant life event", a subset of episodic memory that is likely to be better preserved (Martinelli, et al., 2013; Martinelli & Piolino, 2009).

The aMCI group also performed well in the life story memory task. They produced the same mean number of AM propositions as the HC group, and did not differ significantly from the HC group on the percentage of any particular level of AM used in their stories. As predicted, there was evidence of preserved semanticised levels of AM, with a slight (though not significant) increase in the proportion of lifetime period knowledge compared with healthy controls. This finding extends previous studies which have demonstrated preserved external 'semantic' details in relation to event stories in aMCI (e.g., Bastin, et al., 2012; Murphy, et al., 2008), and suggests that a range of semanticised AM forms may be well preserved in aMCI. Contrary to the expected deterioration in "experiential" levels of AM in this group, there was no difference between the HC and aMCI groups in relation to extended and repeated levels of AM, and a slight (though not significant) increase in the percentage of specific memory propositions used in their life stories.

A number of factors may have contributed to the unexpected performance of the aMCI group. One issue is the heterogeneity of those with amnestic MCI. This diagnostic category encompasses a wide range of ability levels, including both individuals whose difficulties will remain exclusively in the domain of memory as well as those with preclinical dementia (Petersen, 2004). Anecdotal evidence from the clinicians involved in recruiting for this study suggests that those who receive a formal diagnosis of aMCI, as was required for inclusion in the present study, may be at the higher-functioning end of this spectrum, as those who seek medical assistance at the early stages of memory impairment tend to do so because of the demands from their work or active lifestyle. This may have obscured impairments in the aMCI group.

Second, the fact that many of those in the aMCI group were aware of their diagnosed memory difficulties may have created differences in the way that they approached the AM tasks. Although participants were not informed about the content of the interviews, they did know that they were participating in a study about autobiographical memory, and some participants commented that they had spent some time preparing for the interview by thinking about and discussing their memories. This sort of preparation may have facilitated their performance on certain aspects of the interviews, for example, allowing them to bring to mind route-learned stories to include in their life stories. This would explain the slight increase in specific levels of memory in the life stories of this group, as well as their generally good performance on the AI. Although the AI examines the amount of contextual detail, it cannot differentiate between details that have been learned and integrated into a well-rehearsed story from those that are remembered spontaneously as the story is narrated. To avoid this difficulty, future studies could attempt requesting multiple stories for each life period, using specific cues to probe for various types of contextual details, and more detailed questioning to assess the extent to which the memory is one which is consciously re-experienced.

The Possible Overlap Between Episodic Memory and Other Levels of AM

The finding of deterioration in non-episodic levels of AM (i.e., extended and repeated memory) in AD could be interpreted as a challenge to Multiple Trace Theory and the transformation hypothesis (Nadel & Moscovitch, 1997; Winocur, et al., 2010) which predicts that MTL damage should exclusively affect episodic memory. More accurately, however, these findings challenge methodological conventions which have tightly defined “episodic memory” as an event which last for less than 24 hours, and memories that relate to periods extending beyond a 24-hour period as “non-episodic” or “semantic”. Such conventions have contributed to a lack of understanding about how other hypothesised levels of AM might relate to episodic memory, and to the hypothesis that different neural systems might modulate semantic and episodic memory.

One explanation for the loss of extended and repeated AM in AD is that these forms of AM are in fact variations of episodic memory, mediated by the same neural regions (Addis, et al., 2011; Addis, McIntosh, et al., 2004; Addis, Moscovitch, et al., 2004). In the case of extended memories, they may simply link together a number of temporally-related episodic memories. Similarly, repeated memories may superimpose elements from a number of specific events into a single (summarised) event story. Indeed, it may be inaccurate to think of extended and repeated memories as qualitatively different types of AM; perhaps they are more accurately conceptualised as different ways of combining episodic memory details. If so, these reconfigured episodic details may be just as reliant on the hippocampal complex as “event specific” episodic memories, and therefore just as vulnerable in AD. This is not to say, however, that these other levels of AM are merely methodologically contrived variations of episodic memory which do not warrant separate attention. On the contrary, the present results indicate that these different ways of reconfiguring episodic details may be very important to the way that adults remember their lives, and are deserving of greater empirical and theoretical exploration. In particular, the definitions used to demarcate extended and repeated memories in fact include a spectrum of memory forms, extending from contextually rich memory to highly summarised schematic information. Further investigation is needed to determine at what point along this spectrum extended and repeated memories become reliant on the MTLs, and what qualities trigger this region’s involvement.

This chapter has proposed that these intermediary levels of AM rely on the MTLs (and are affected in AD) to the extent that they involve autonoetic consciousness – the ability to subjectively re-experience the past by mentally travelling back in time. Considerable ongoing research efforts are involved in investigating which aspects of mental time travel are mediated by the MTLs. Recent research suggests that the MTL's involvement may include the ability to recreate the perceptual richness of a memory (St-Laurent, et al., 2014), and the experience of "reliving" (Irish, et al., 2010). If it is the case that the role of the MTLs is to encode and retrieve the "experience*,* and the consciousness that accompanied it" (Moscovitch, Westmacott, et al., 2005, p. 369) the present findings hint at the possibility that this conscious re-experiencing may not be limited only to time/place specific events, but may also be carried into other AM configurations, with some extended and repeated memories also sharing this subjective, experiential quality (see also Addis, Moscovitch, et al., 2004).

Certainly, qualitative evidence from the present study supports the notion that extended and repeated memories may also involve mental time travel. There were some participants who were unable to recall an event specific memory when performing the AI, and so instead described a "repeated" event. They nevertheless rated these events as "very vivid and detailed" and claimed to be able to remember and re-experience these events. For example, participant 027b described a repeated event from her childhood involving a Friday evening routine of sitting in her lounge with her family and listening to a radio programme. She was unable to describe any specific occurrences of this event as "they all merge together", but after the theoretical distinction between remembering and knowing had been described to her, she insisted that she was able to "remember" this event, and could justify this by describing contextual details:

> Participant: I can think and I can see us sitting around...
> Interviewer [*repeating the question*]: So is that an event that you "remember", or that you just "know" had happened?
> Participant: Oh I remember them! Oh yes, oh yes indeed. And in quite a lot of detail. I can see the sitting room, you see, where the radio was and where we sat and listened...

In the present study, the relationship between the experience of mental time travel and these other forms of AM can only be touched upon, because recollective experience was only examined in relation to event specific stories as part of the AI. However, these findings certainly hint at the value of future investigations broadening the examination of the phenomenological qualities involved in "re-experiencing" a memory to other types of AM that extend beyond an arbitrary <24 hour definition.

The Role of Semanticised Levels of AM in Episodic Retrieval

Another question explored in this study was the relationship between different levels of AM. Across all groups, there was a pattern of positive correlations between the use of event specific memory (AI internal details and specific memory propositions in the life story) and the number of repeated and extended memories used within the same life period. This pattern of correlations appears to support the idea that the amount of specific event detail provided may have been facilitated by the accessibility of extended and repeated events from within the same life period, and that those who were able to access more information about these general events were also able to access a greater amount of detail in relation to specific events. This evidence is compatible with Conway and colleagues' (Conway, 2009; Conway & Pleydell-Pearce, 2000; Haque & Conway, 2001) theory in order to access event-specific details in generative retrieval, one must traverse downwards through the levels of the autobiographical database, and a common place for entering this hierarchy is at the level of general (i.e., extended and repeated) events.

It should be noted, however, that the pattern of correlation found here could also simply be due to the overlap, proposed above, between the mechanisms facilitating episodic memory and other "experiential" levels of AM. If indeed the MTLs mediate retrieval of some extended and repeated memories, one would also expect the pattern of relationship found here between deterioration in episodic, extended and repeated memory types. Nevertheless, these findings add to a growing body of evidence that episodic memory is an integral part of an interrelated hierarchy of AM (Burgess, 1996; Haque & Conway, 2001; Piolino, et al., 2010).

It is interesting to note, however, that in the present study, this was not a consistent positive relationship. In the AD group, there was a marginally significant negative correlation between the use of repeated event memory and the use of AI internal details, indicating that those in the AD group who used more repeated memories also tended to be able to generate fewer vivid, specific details in relation to their event stories. A possible explanation for this is that those who had greater event-specific episodic memory loss may have attempted to compensate for this by relying more heavily on generic, repeated memories in constructing their life stories. It is not possible to assess this possibility using the current results, however, as the coding method used did not differentiate between perceptually rich, experiential repeated memories and schematic, generic repeated events, but this finding again highlights the need for research examining nuanced subtypes of extended and repeated levels of AM.

The Use of Life Story Methods for Assessing AM

The present investigation highlights the value of using life narrative techniques to explore AM. Using non-restrictive methods to elicit AM, the present study was able to investigate memory types that have been largely neglected in the literature. Specifically, the results suggest that episodic, extended and repeated levels of AM may be closely related memory forms, all of which may be impacted in AD. The link between these levels of AM may be shared contextual and experiential qualities that are mediated by the MTLs; however further investigations are needed to confirm this suggestion.

A limitation of the life story method used in this study is that only memories that were given freely by the participant were examined, with no guided structure to elicit particular types of memory. A potential criticism is that where a participant used more or less of a particular type of memory, this cannot tell us whether there is a deficit in that type of memory, such that they would not be able to recall a memory of that type if prompted, but only that the person did not spontaneously provide that type of memory when narrating that story under those circumstances.

This criticism is likely to be a problem primarily in relation to the HC group, many of whom achieved a “ceiling effect” with the time limit of the life story chapters and had to cut short many chapters of their life stories. For many of these participants, it was evident that the particular stories they included were selected from a much wider range of stories that were available. Within that group, a smaller number of one type of memory is therefore unlikely to reflect an inability to access memories of this type, but rather a conscious choice that certain levels of AM were better suited the demands of the task. It is also possible, however, that this method disguised differences between the aMCI and HC groups by creating a ceiling effect for the HC group. Participants in the aMCI group may have been able to select and focus on the aspects of their lives that they did remember well without being required to remember aspects that were not well remembered.

In the case of the AD group, however, the majority of participants finished their stories well before the time limit, and were prompted (using general prompts) to determine whether there was any further material available. Although it is possible that more specific prompts could have elicited further memories, this as least indicates that these participants had no additional memories readily available. Comparing the groups, a lower number of a particular level of AM in the AD group does appear to reflect a “deficit” in the ability to freely access these memory types. It would nevertheless be useful for future studies to use methods which further pushed the limits of memory ability, for example, using autobiographical-fluency tasks for each level of AM (e.g., Dritschel, Williams, Baddeley, & Nimmo-Smith, 1992; Piolino, et al., 2010), or life story techniques which use specific prompts to elicit these different levels of AM, but in both cases tailoring these tasks to elicit more and less specific forms of extended and repeated memory.

The remainder of this thesis will focus on exploring the relationship between AM and sense of self. The present chapter has highlighted a pattern of AM impairment in AD which primarily affects event-specific episodic, extended and repeated memories across the lifespan, while leaving more abstracted levels of AM (lifetime period and personal fact information) relatively preserved. The question for the remainder of the thesis, then, is how this particular pattern of AM deterioration impacts upon the aspects of sense of self proposed in the model.

Chapter 3. Self awareness in the present moment

Interviewer: Would you say that you are aware of yourself right now?
R: I think so, yep.[...]
Interviewer: Do you think you can doubt your own existence?
R: No… you should always realize you are alive and existing.
Interviewer: What if I told you that you weren't here right now?
R: I'd say you'd gone blind and deaf.
Interviewer: How would it make you feel?
R: I would know that I am.

Excerpt from Philippi et al.(2012, p. 12), interview with Patient R. who suffered extensive damage to medial temporal lobes, insula and medial prefrontal cortex following herpes encephalitis.

The model proposed in this thesis suggests that two hierarchically related forms of present-moment self experience (prereflective self experience and self awareness) are both essential for autonoetic recollection and episodic memory (see Figure 1.3). This chapter sets out an empirical investigation of the latter, higher form of self experience (self awareness) in memory-impaired and healthy older adults. Specifically, it explores two hypotheses arising from the model: that present-moment self awareness is essential for episodic memory, but that the converse is not the case; properly functioning episodic memory and autonoetic recollection are not essential for reflective awareness of one's moment-to-moment experiences in the world.

These hypotheses rely on some assumptions about the neural underpinnings of episodic memory and self awareness. Essentially, the claim is that the neural regions mediating self awareness and episodic memory overlap, but in a manner that creates a one-directional relationship: for properly functioning episodic memory, both the MTLs and regions governing self awareness are needed. Converesly, the MTLs do not form part of the circuitry that governs self awarenesss, and self awareness can therefore operate without the MTLs and the episodic memory functions that they govern. The latter prediction is supported by neuropsychological literature that indicates that MTL pathology, and accompanying episodic memory deterioration, does not impact upon self awareness in the present moment (Philippi, et al., 2012; Postle, et al., 2009). Unfortunately, due to continuing debate over which regions mediate self awareness (outlined in Chapter 1), a perfect neuropsychological test for the former prediction using groups with selective damage to the regions of interest cannot be devised. Until a better neuroscientific model of self awareness if available, researchers must rely on investigations that examine the functional relationships between self awareness and episodic memory. Support for the hypothesis would amount to a pattern of results, across many studies, showing that deficits in self awareness are *always* accompanied by (a) deterioration in brain regions beyond the MTLs, and (b) profound episodic memory deficits, regardless of whether the MTLs are also affected.

From this perspective, an AD population provides a potentially fruitful opportunity to examine these hypotheses. Firstly, deficits in episodic memory are characteristic of all stages of AD (see Chapter 2). Secondly, there is evidence that deficits in episodic memory may relate to phased neural pathology, with early deficits thought to be primarily related to MTL pathology (Gilboa, et al., 2005) but with later deterioration in aspects of episodic memory (including loss of autonoetic consciousness) relating to pathology in other regions affected as the disease progresses, such as aspects of the default network, including the prefrontal cortex (Buckner, et al., 2005; Desgranges et al., 1998; Rauchs, et al., 2007). Thirdly, there is divergent evidence over whether AD may additionally involve a loss of self awareness. On the one hand, deterioration in various aspects of self awareness in AD have been widely reported in the literature, including diminished awareness of memory deficits (Clare, Markova, Verhey, & Kenny, 2005; Mograbi, Brown, & Morris, 2009; Morris & Mograbi, 2012; Souchay, 2007) and problems with self recognition (Biringer & Anderson, 1992; Biringer, Anderson, & Strubel, 1988; Fazio & Mitchell, 2009; Grewal, 1994; Mendez, Martin, Smyth, & Whitehouse, 1992). On the other hand, many studies which have argued that sense of self is well preserved in AD essentially appear to be relying on claims about preserved self awareness, as demonstrated through the continued use of self referential language (i.e., first-person pronouns) even in individuals with profound episodic memory impairments (Fazio & Mitchell, 2009; Hedman, Hansebo, Ternestedt, Hellström, & Norberg, 2012; Sabat, 2002; Sabat & Harré, 1992; Small, Geldart, Gutman, & Clarke Scott, 1998; Tappen, Williams, Fishman, & Touhy, 1999). There have been few systematic investigations capable of resolving these contradictory claims by identifying precisely which aspects of self awareness are affected, or how such deficits might relate to deterioration in AM.

If the present model is correct, then this pattern of results in AD can be interpreted in the light of the one-directional relationship that is proposed between self awareness and episodic memory. A prediction arising from this model is that the progression of AD (as it pertains to self awareness and episodic memory) could be characterised as having two phases. The first phase involves early deficits in the content and detail of episodic memory, while leaving self awareness unaffected. The second phase arises when pathology extends beyond MTL regions and affects regions directly supporting self awareness. Once self awareness is affected, this loss of self awareness should preclude autonoetic recollection and episodic memory.

Investigating self awareness in AD

Self-recognition paradigms. A primary method that has been employed to assess self awareness in AD is self-face recognition. The original paradigm for assessing self-recognition, devised by Gallup (1970, 1982), is to covertly mark a subjects' face, and place them in front of a mirror. Self recognition is demonstrated when the subject attends to the mark on their own face, using the mirror as a guide, rather than attending to the reflected image in the mirror. The rationale for self recognition as a measure of self awareness is that the ability to identify an external image as 'me' necessitates an understanding of myself as distinct from the environment, and the ability to take myself as the object of attention (Gallup, 1982; Klein, et al., 2004). There is also evidence that the development of self recognition in children is related to other indicators of self awareness, such as self-conscious emotions (e.g., shame, guilt and pride), pretend play, and personal pronoun usage (Lewis & Ramsay, 2004; Lewis, et al., 1989).

A number of studies have attempted to examine self awareness in AD using mirror or photographic recognition paradigms. Using small numbers of AD participants, Birringer and colleagues (Biringer & Anderson, 1992; Biringer, et al., 1988) found a marked deterioration in the capacity to self recognise, which coincided with an identifiable point in the moderate stages of disease progression; those with a Global Dementia Severity (GDS) rating of less than 6 maintained the ability to self recognise, while those at later stages of the disease started to lose this ability. Other studies (Fazio & Mitchell, 2009; Grewal, 1994; Gross et al., 2004; Mendez, et al., 1992) have since replicated this general pattern, with self recognition preserved in the early stages of the disease, but beginning to deteriorate in the moderate to late stages of AD. It is not known, however, how this deterioration maps onto the neural pathology in AD, or decline in episodic memory.

A difficulty in interpreting self recognition studies is that failure to self recognise cannot alone demonstrate a lack of self awareness. There are a number of reasons why someone may fail the test, including visual or perceptual problems, a lack of motivation, or a lack of semantic knowledge about mirrors/photographs (Caddell & Clare, 2010; Gillihan & Farah, 2005; Swartz, 1997). It is possible that the inability to self recognise in the later stages of AD may relate to a deficit in self knowledge rather than self awareness (Biringer, et al., 1988; Hehman, et al., 2005). Hehman, German and Klein (2005) reported that a woman with severe AD was unable to recognise recent photographs of herself, but retained the ability to recognise photographs from early periods in her life. They interpret these results as indicating a temporally-graded loss of self knowledge, resulting in an inability to update her mental representation of her appearance. Other measures of self awareness which do not rely on self-knowledge are therefore needed to determine whether the loss of self-recognition in moderate to late stage AD is in fact a result of diminishing self awareness.

Self recognition tasks nevertheless remain a useful measure of self awareness because, although failure cannot demonstrate the loss of self awareness, there is some agreement that explicit self-recognition (i.e., the ability to name oneself as the individual in an image) is sufficient to demonstrate self awareness (Craig, 2009; Keenan, et al., 2005; Klein, et al., 2004; Vandekerckhove & Panksepp, 2009). Although one can theoretically imagine an individual self-recognising despite impaired self knowledge about what they look like (e.g., by using the contingency of movement in a mirror task, or using contextual information in a photographic task) it is hard to imagine how the task could be successfully completed without the ability to take oneself as the object of reflection.

In the present study, the self recognition task is included as a kind of validation task; anyone who passes this test should be regarded as possessing some basic form of self awareness. As any ability to explicitly self recognise should constitute a demonstration of self awareness, it was important that the task maximised the possibility of sucess. Although some have suggested that the contingency of movement involved in a mirror task may assist with self-recognition (Biringer & Anderson, 1992) studies using photographic tasks have tended to demonstrate a higher degree of self recognition in AD (Caddell & Clare, 2010). This may be due to confusion and agitation that can result when people with AD are confronted with mirrors (Burns, Jacoby, & Levy, 1990; Fazio & Mitchell, 2009). Caddell and Clare (2010) also note that the type of decoy photographs used could affect the task difficulty, with decoys using complete strangers providing an easier test than decoys involving people that are known to the individual. The current study uses a photographic recognition paradigm with decoy photographs of complete strangers, but requires participants to correctly identify the image (e.g. “It is me”) in order to pass the test.

Linguistic measures of self awareness. Another way self awareness has been explored in AD is through the use of linguistic measures that assess first-person pronoun usage (e.g., I, me, my and mine). The rationale for this approach is that through the use of first-person pronouns we identify ourselves as the subject of our own thoughts, actions and experience, and outwardly reflect our inner, subjective experience in a way that could only be achieved by someone who possesses self awareness (Gallagher, 2000).

Researchers have used linguistic methods to argue for preserved self awareness in AD (Fazio & Mitchell, 2009; Hedman, et al., 2012; Sabat, 2002; Sabat & Harré, 1992; Small, et al., 1998; Tappen, et al., 1999). For example, Sabat and Harré (1992), Tappen, et al. (1999), and Hedman et al.(2012) report that individuals with moderate to severe AD made use of first-person pronouns in their speech in a manner which appeared coherent and meaningful. It is difficult to gauge whether this usage was ‘normal’, however, as no control groups were used in these studies.

A study by Small et al. (1998) compared the grammatical characteristics of speech in residents of a care facility with AD to staff at the same institution. Over a three-day period, they found that fewer than half of their severe-AD group used any personal pronouns. Among those who did use personal pronouns, however, they made greater use of first-person pronouns than second-person pronouns (e.g., you, your), and the ratio of first-person pronouns to other language categories (e.g., nouns) was higher for AD patients than for staff. The authors suggest that the reduced vocabulary of the AD group may increase their reliance on words that are more common in the English language, such as personal pronouns. Alternatively, they suggest that the increase in personal pronouns may be a reaction to challenges to identity faced in AD. Even though the experimental and control groups in Small et al.’s study are assessed in the same setting, the function and content of their language is unlikely to be equivalent: the AD group are being observed in their home environment, while the caregivers are at work and performing a specific professional role. Although the authors argue that residents have ample opportunity to respond to staff, and thus use second-person pronouns, it nevertheless appears that the professional role of staff could encourage the overuse of second-person pronouns and the less frequent use of first-person pronouns. Another study compared the personal pronoun usage of those with mild- to moderate-AD with healthy controls in an interview context and found that the rate of first person pronoun usage (i.e., number of personal pronouns per minute of conversation) was similar in these groups (Fazio & Mitchell, 2009).

A difficulty with interpreting these studies is that the use of first-person pronouns may not be necessary or sufficient to demonstrate self awareness (Small, et al., 1998). They are not necessary, because there are many examples of individuals with preserved self awareness who are unable to communicate this understanding with the outside world (e.g., someone with severe aphasia). Small et al. found that the severe AD patients in their sample who did not use any first-person pronouns demonstrated other evidence of preserved self awareness, for example, non-verbal conflicts with care staff in which patients physically defended their wishes over those of staff (see also Sabat & Harré, 1992). They are also not sufficient for demonstrating self awareness, because someone could use these words without meaning. It is possible that when those with late-stage AD use personal pronouns, this is not a meaningful reflection of self awareness, but mere verbal habit (Sabat & Harré, 1992). It is worth noting, however, that while none of these studies provide any formal measure of the cogency of first-person pronoun usage, many of these authors report that the use of personal pronouns by those with AD appeared coherent and meaningful (Hedman, et al., 2012; Sabat & Harré, 1992; Tappen, et al., 1999). Insofar as the use of first-person pronouns are used meaningfully, these studies appear to provide further evidence of widely preserved self awareness into the moderate stages of the disease. They therefore appear to support the suggestion that the early loss of episodic memory in AD does not impact on self awareness.

Describing present-moment experience. An alternative approach to assessing self awareness is to directly examine the capacity that personal pronouns stand proxy for; that is, a task which asks individuals to describe their subjective experience in the present moment. A meaningful response on such a task provides direct evidence that the person is able to reflect upon, and report, their subjective present-moment experiences.

Recent studies using present-moment description tasks have suggested a possible link between mental projection both backward (episodic memory) and forward (imagining the future) in time and the ability to describe one's present-moment experience using picture description tasks. These tasks are thought to capture the construct of self awareness because they require the individual to describe their present stream of conscious awareness, as experienced through the visual modality (Zeman, Beschin, Dewar, & Della Sala, 2012). One study examining imagining and remembering in older and younger adults used a picture description paradigm as a control task (Gaesser, Sacchetti, Addis, & Schacter, 2011). The task required participants to examine a picture and describe as many details as possible in a three-minute period, and therefore assessed participants' ability to describe their present-moment awareness of the visual scene. All three tasks were scored using an adapted AI scoring procedure (Levine, et al., 2002). Across all three conditions (past, present and future), older adults generated fewer 'internal' details, which are those which are directly relevant to the picture, memory or future scenario, and more 'external' details, which are those which are not directly relevant, compared with younger adults. Zeman, Beschin, Dewar and Della Sala (2012) compared the performance of seven amnesic individuals with seven healthy controls on their ability to describe the present and imagine the future. Their present-moment task involved participants describing two complex paintings and two real-life settings (a church and a room in a museum). The amnesic group described fewer details on both the present moment and future tasks, and a significant interaction indicating a more marked difference in relation to the present-moment condition.

These studies suggest a close link between the ability to describe one's present moment experience and mental projection into the past and future; but what might this relationship be due to? Gaesser et al. (2011) note the possibility that the difference between older and younger adults in their study could be explained by changes to some irrelevant (to memory) cognitive ability which underlies all three tasks (see also Zeman, et al., 2012). For example, all three tasks use visual stimuli, and so could be affected by difficulties with visual perception or imagery. In addition, neither study controlled for verbal fluency, which could impact performance on all three tasks and which may deteriorate in normal aging (Tombaugh, Kozak, & Rees, 1999). Zeman et al. also discuss the possibility that problems with narrative construction could affect performance on all three tasks. In particular, the task used by Gaesser et al. may have exacerbated differences in verbal abilities and narrative construction by using instructions that invited a detailed, narrative approach to describing the picture (e.g., "describe the different people, objects, and environment in the picture and their relationship to one another…What are the people doing? What do they look like? Where are they?)". Further, the AI scoring system, used in both studies, awards points to the number of details provided, which could reward better fluency. The authors note that differences in older and younger adults' communicative styles and goal could also influence the way they approach these tasks, leading older adults to emphasise "personal meaning rather than a precise reiteration of events" (Gaesser, et al., 2011, p. 83).)

Another possibility suggested by Zeman et al. (2012) is that the relationship between these three tasks could relate to a disruption in present-moment experience itself, which could in turn impact on past and future projection; however they argue that this unlikely given evidence from other studies that those with MTL amnesia demonstrate normal visual eye tracking and short term retention of information about complex visual scenes (Mayes, Downes, Shoqeirat, Hall, & Sagar, 1993; Ryan & Cohen, 2004). It also seems unlikely given the outcome of another picture-description study, reported by Race, Keane and Verfaellie (2011) who found that the performance of MTL amnesic patients was unimpaired on a picture-description task compared with healthy controls, whereas their performance was impaired on past and future description tasks. There are, however, two important differences between their study and that of Zeman et al. (2012). First, Race et al. specifically examined MTL amnesic disorders, while Zeman et al. included a range of amnesic disorders, relating to pathology in various neural regions. As predicted in the proposed model, those with deterioration limited to the MTLs should have marked difficulties with episodic memory and future projection, but preserved present-moment self awareness, which is consistent with Race et al.'s findings.

Such evidence does not, however, argue against the hypothesis in the present model that both episodic memory and imagining the future could require the capacity to reflect upon one's present experience (i.e., self awareness). As noted above, self awareness is a higher-level ability than prereflective self experience, and it is possible that one could have preserved experience in the present moment, but a disrupted ability to reflect upon and describe this experience (i.e., self awareness). In contrast, those with damage to regions directly affecting self awareness should demonstrate problems with all three abilities (past, present and future-directed reflection), which may explain the deterioration in the present-moment task reported by Zeman et al. Second, Race et al. did not use a pure "describe the present" task, but rather an narrative task which asked participants to imagine that a picture is a movie and then: "Imagine what the movie is about and tell a story about what's going on in the scene." This task requires participants to imagine what might have happened prior to the pictured event, and construct a story which gives meaning to the event depicted. It is therefore a more complex task than those used by Gaesser et al. and Zeman, et al., but also may not capture the construct of present-moment self awareness. Indeed, one could challenge whether any of these picture description tasks could adequately capture the construct of self awareness, as it is arguably possible to describe "what is happening in the picture" without any awareness that it is "my" subjective present-moment experience that I am describing.

Due to the methodological difficulties, none of the above studies adequately test the relationship between present-moment self awareness and episodic memory. The present study devised a novel Self Awareness in the Present Moment (SAPM) task which aimed to address some of these difficulties. First, the task uses the present-moment environment of the individual as the stimulus, and so is arguably more ecologically valid than a picture description task. Second, rather than assessing only a visual modality, the task assesses a range of different modalities directed to both the external environment (sight, hearing, and smell/taste/touch), and internal environment (inner/bodily sensory experience, thoughts and emotions). It is therefore less vulnerable to deficits in one sensory modality, and assesses self awareness more broadly. Third, the SAPM task is a thought listing technique, which simply asks individuals to list everything that is readily available within their present stream of consciousness (Cacioppo, von Hippel, & Ernst, 1997). The instructions avoid wording which might encourage descriptive narratives, remembering or imagining a story about these items. Finally, the scoring method reduced the potential influence of differences in narrative style and verbal fluency by scoring a point for each item listed rather than the number of details provided. Someone who gestured towards a flower pot and said “that...thing” would therefore receive the same score as someone who said “my beautiful blue flower pot which I brought back from Egypt”. Precise verbal descriptions were not needed, provided that the meaning was clear to the interviewer.

Loss of insight into memory deficits. While the aspects of self awareness examined so far have tended to suggest relatively preserved self awareness into the moderate stages of AD, it is well documented that awareness of memory deficits deteriorates in a proportion of individuals with AD (a symptom sometimes called loss of insight or anosognosia) (S. W. Anderson & Tranel, 1989; Clare, 2004; Clare, et al., 2005; Correa, Graves, & Costa, 1996; Mograbi, et al., 2009; Morris & Mograbi, 2012; Ott, Lafleche, Whelihan, Buongiorno, & et al., 1996; Sevush & Leve, 1993; Souchay & Moulin, 2009) (Rankin, Baldwin, Pace-Savitsky, Kramer, & Miller, 2005

Kramer, & Miller, 2005; Sevush & Leve, 1993). There is also evidence that individuals with aMCI may vary in their level of awareness of their memory deficits (Roberts, Clare, & Woods, 2009). There is some debate, however, as to the underlying cause of loss of insight into memory dysfunction, and whether this reflects a generalised loss of self awareness, or relates to domain specific lack of awareness with some other underlying cause (Clare, 2004; Schacter, 1990).

One possibility is that loss of insight in AD reflects a temporally graded loss of self knowledge, where the person holds on to a self understanding that predates their dementia and so excludes knowledge of their memory loss (Mograbi, et al., 2009; Morris & Mograbi, 2012). Another explanation is that loss of insight may relate to problems with autonoetic consciousness (Moulin, Perfect, & Jones, 2000; Souchay & Moulin, 2009). Moulin and colleagues suggest that in order to accurately reflect on one's memory functioning, particularly in relation to episodic memory tasks, the conscious experience of remembering is needed. The lack of awareness for memory functioning occurs when there is a disconnection between the medial temporal regions facilitating memory performance and the prefrontal regions facilitating autonoetic awareness (i.e., the conscious re-experiencing) of memory (Souchay & Moulin, 2009).

The two perspectives are potentially compatible: inaccurate understandings about memory deficits and disease status in AD may relate to problems updating one's self concept as it pertains to memory ability, which in turn relates to a lack of autonoetic consciousness, preventing accurate reflection about episodic memory performance. Clare and colleagues (Clare, 2003, 2004; Naylor & Clare, 2008) also highlight that the process of registering these deficits in real life is impacted by psychosocial factors. Those with AD must respond to the competing tensions of the desire to maintain coherence with their older self view and a need to make sense of incongruous daily evidence of their memory difficulties. Depending on the particular circumstances, history and coping mechanisms of the individual with AD, expressing less awareness about memory deficits may be a useful strategy in reducing these threats to identity (Clare, 2003).

The relationship between present moment self awareness (i.e., the ability to reflect on one's moment-to-moment experiences) and loss of insight into memory dysfunction remains unexplored; however all of these perspectives are compatible with the possibility that self awareness could remain relatively unimpaired in early- to moderate-AD, even in those who demonstrate a lack of insight about their memory deficits. It is predicted that those demonstrating a lack of insight will not necessarily show deterioration in other measures of self awareness.

Expressing subjective preferences. An ability which is closely related to, and arguably reliant on, self awareness is the ability to express one's subjective preferences. This ability is related to self awareness because it involves the capacity to integrate awareness of the external world (e.g., the cup of tea or coffee in front of you) with an awareness of one's current thoughts, desires, motivations and goals. This is likely to be a higher-level ability, however, because in addition to awareness of internal and external states, expressing preferences also requires a complex process of weighing up the subjective value of choices on the basis of one's current motivations, desires, needs, and goals in order to determine the best option in that particular moment and situation (Fellows & Farah, 2007). The capacity to express subjective preferences may also, therefore, relate to one's self knowledge.

Research using gambling paradigms has implicated the ventromedial-prefrontal cortex (VmPFC) in making decisions that involve uncertainty or ambiguity (Bechara, Damasio, Damasio, & Anderson, 1994; Bechara, Tranel, & Damasio, 2000; Dunn, Dalgleish, & Lawrence, 2006). Building on this work, Fellows and colleagues (Fellows & Farah, 2007; Henri-Bhargava, Simioni, & Fellows, 2012) provide evidence that the ability to make simple preference decisions, without uncertainty, is impaired in individuals with damage to the VmPFC. These individuals were found to make decisions just as fast as healthy individuals, and those with damage to other regions within the frontal cortex, but their choices lacked consistency, suggesting a random pattern of choosing. The authors conclude that the VmPFC may be vital to the ability to weigh preferences in relation to the goals and motivations of the self (see also D'Argembeau, 2013).

This paradigm for examining simple subjective preferences has not yet been used in aMCI or AD, however studies using gambling paradigms have indicated that in mild-AD, there is an impaired ability to make decisions under conditions of ambiguity and risk (Delazer, Sinz, Zamarian, & Benke, 2007; Sinz, Zamarian, Benke, Wenning, & Delazer, 2008). It is possible that these findings reflect deterioration in the underlying ability to make simple subjective decisions. There is also evidence that prefrontal regions, including VmPFC (Herholz et al., 2002), may begin to atrophy early in the course of AD, but accelerates as the disease progresses (Buckner, et al., 2005; Herholz, et al., 2002). Pathology in the VmPFC has also been implicated in lack of insight in dementia (Hornberger et al., 2012). Performance on the preferences task and deterioration in insight about memory deficits may therefore serve as indicators of VmPFC pathology.

Aims and Hypotheses

The goal of the present study was to provide a thorough investigation of self awareness in aMCI and early-moderate AD. In line with the proposed model, it was anticipated that those with aMCI and early-AD would perform as well as healthy older adults on a range of self awareness tasks, and that the severity of their episodic memory impairments would be unrelated to their performance on measures of self awareness. In the moderate-AD subgroup, given the likelihood that the disease pathology would have progress beyond the MTLs, it was anticipated that some participants may demonstrate deterioration in self awareness. In these participants, profound impairments were predicted both in a range of self awareness tasks, and in episodic memory and autonoetic consciousness. It was also predicted that in these individuals, the severity of their deficits in self awareness should be related to their deficits in episodic memory.

In addition, the relationship was examined between two tasks thought to relate to VmPFC pathology (the preferences task and the awareness of memory deficits task). Although it was not possible in the present study to assess VmPFC pathology, it was anticipated that those at the moderate stages of AD would demonstrate poor performance on both tasks.

Methods

Participants

Details about the participants involved in this study are described in Chapter 2: Methods.

Measures

Photographic self recognition. At the beginning of the second session, a digital head-and-shoulders photograph of the participant was taken, using a Canon PowerShot A520 digital camera. Photographs were taken with the participant against a plain background, from a distance of around 2-metres. The photograph was uploaded onto a Dell E6400 laptop, and pasted into a PowerPoint presentation format with pictures of two “decoy” older individuals of the same gender (see Appendix D). The three photographs were presented side by side, with the participant’s photograph placed on the right-hand side.

After a delay of around 30-45 minutes, participants were shown the three photographs and asked “Is there anyone in these photographs that you recognise?” If they answered “yes”, and correctly indicated their own image, this question was followed with “Who is that person?” If they answered “no”, this was followed with “One of these pictures is a photograph of you. Can you point to your photograph?”

First-person pronouns. First-person pronoun usage was assessed using the life story interview transcripts (not including the AI event stories). An independent rater examined the stories and recorded the number of times each of five first-person singular pronouns (I, me, mine, my, and myself) and four first-person plural pronouns (we, us, our, and ourselves) were used in the story. Conjunctions using these base words were also included (e.g., I’ll, I’d, we’ve). In the case of immediate repetitions (e.g., “I, I, I went into town...”) only the first utterance was counted.

Totals were calculated for the number of singular, plural and total first-person pronouns used, and proportional scores were calculated by dividing these with the total word count of the story.

Self awareness in the present moment (SAPM). The SAPM task (see Appendix E) consists of six questions: three asking participants to list what they were aware of in their external environment (sight, hearing, and smell/taste/touch), and three asking them to list what they were aware of in their internal environment (internal body sensations, emotions and thoughts). The instructions emphasised that the purpose was to assess the sorts of things the person noticed or was aware of, and that their task was to list as many relevant items as possible in one minute. For each modality, the interviewer asked "Can you tell me anything you can [see, hear etc] at the moment?*"* If the participant paused for more than ten seconds, or seemed to have forgotten the instructions, they were prompted: "Is there anything else you can [see, hear etc] at the moment?"

For each of the six questions, the interviewer recorded all items listed within one minute. Each meaningful and sensible response was scored one point. Repetitions were not scored. In relation to external stimuli, in order to ensure that the participant was not imagining items or listing them from memory, only items that could be verified by the interviewer were scored. If the participant listed an item that could not be verified by the interviewer (e.g., stating that they could see a "car" when inside a house), confirmation was sought after the timer had stopped ("Could you show me where you can see a car?"). The scores from the six domains were summed to create external and internal awareness subscores, as well as a global awareness score.

To control for verbal fluency, proportional scores which controlled for participants' performance on the COWA task were calculated. The six SAPM dimension scores (each of which represented a one-minute trial) were divided by the average of each participant's three COWA subscores (i.e., their average verbal fluency score for a one-minute period). These dimension subscores were summed to provide proportional SAPM internal, external and total scores.

Preferences task. The preferences task (Henri-Bhargava, Simioni, & Fellows, 2012) assesses people's ability to determine the subjective value of different options and express their preferences. Pairs of stimuli of the same type (e.g., apple and orange) are presented on a computer screen, and for each pair, participants are asked to choose which they would prefer. The original task, as used by Henri-Bhargava et al., included five sets of stimuli; however the present study included only four sets (fruit, vegetables, puppies and landscapes) to reduce overall timing and task demands for the participants. The "colour" stimulus set included in their original study was removed, as this had involved the largest number of errors by healthy controls (L.K. Fellows, Personal communication, September 2, 2010). Within each stimulus set, there are 12 images and all possible pair combinations were presented. The stimulus sets were displayed in blocks, as four separate conditions, with the images presented in the same order for all participants. To reduce task demands, the vegetables and landscapes conditions were presented early in session two, and the fruit and puppies conditions were presented near the end of that session.

The task was run using E-Prime professional (version 2.0) software, and presented on a Dell Latitude E6400 laptop with a 35 cm (14 inch) screen. Participants either selected their preferred option with a key press, or by pointing to the selected image on the screen so that the interviewer could key in their selection. At the start of each condition, the task instruction were presented on the screen and read out to participants. The instructions asked that for each trial (i.e., each presentation of two images) the participant choose which of the two images they preferred. They were asked to treat each choice independently, with no mention of the need to be internally consistent with previous choices (Henri-Bhargava, et al., 2012). Due to the overall emphasis on memory functioning in the present study, and the risk that participants may have misinterpreted the task as a memory test, an additional instruction was added: "You do not need to try to remember which item you chose in previous decisions."

The number of errors (erratic choices) made within each condition was the main dependent variable. Erratic choices are defined as those which defy the rule of transitivity, which means that if A is preferred over B and B over C, then A should also be preferred over C. Choosing C over A would therefore count as an erratic choice (Fellows & Farah, 2007; Henri-Bhargava, et al., 2012). In addition, a weighted score was also calculated, which took into account the gravity of these rule violations; for example, an erratic decision to choose an item that had been ranked number four in order of preference over an item ranked number three is a less serious violation than choosing an item ranked tenth over the item ranked second. Each of these scores (i.e., number of errors and weighted errors) could also be adjusted in order to break the ties between two or more items when they were ranked equally by the participant (i.e., they were chosen as the preferred item an equal number of times). In such instances, the individual trials involving these items were examined, and the item chosen most in these trials was given a higher rank. The raw (unadjusted) scores are more conservative, because they allow for the possibility that individuals may genuinely rank two or more items equally (Henri-Bhargava, et al., 2012). In total, then, there were four dependent variables for each condition: number of errors, weighted errors, number of errors (adjusted) and weighted errors (adjusted). To reduce the number of possible comparisons, these scores were averaged across the four conditions.

Awareness of memory deficits. A brief, structured interview was administered to the aMCI and AD groups to assess awareness of memory deficits, based on methods used by Loebel et al. (1990) and Sevush and Leve (1993). The interview consisted of a few simple questions asking whether participants thought they had problems with memory, and whether they suffered from an illness impacting on their memory (Appendix F). Due to time constraints, this brief assessment was favoured over lengthier approaches (see Clare, et al., 2005; Souchay, 2007).

Responses were scored on a three-point scale using a scoring method adapted from Sevush and Leve (1993): responses were scored “2” if they suggested a high level of awareness of deficits (i.e., they acknowledged problems with memory and an awareness of its severity); “1” if they indicated some awareness of problems but underestimated the severity (e.g., they acknowledged minor problems, but suggested these were akin to others their age or had always been a problem); and “0” if they showed a complete lack of awareness of memory impairments (e.g., denied any problems). Participants were not required to name their diagnosis correctly in order to score 2, because clinicians vary in their practice of whether and at what stage they inform patients of their diagnosis, and also because memory and word-finding difficulties may have made it difficult for some participants to remember these complex diagnostic details. They were, however, required to provide some recognition that their memory problems were greater than the normal aging experience, for example, by indicating that there had been a significant deterioration in functioning; by describing problems, challenges or changes that had occurred in their life as a result of their memory difficulties; or by mentioning that they had sought a medical opinion.

All transcripts were coded by the author. As the author had also interviewed participants, steps were taken to ensure that participant and group could not be identified. First, the hand-written transcripts were re-typed by an independent transcriber using blind numbering, and answers were ordered randomly, without the context of the rest of the interview. Second, coding took place a minimum of six months, and in most cases two years, following the interviews, so there was little chance of identifying which participant provided each response. Reliability was assessed using a random selection of 20% of the transcripts, double coded by an independent coder blind to the hypotheses of the study and group membership (ICC = 1.0).

Statistical analysis

All statistical analyses were carried out using IBM SPSS Statistics 20. Group differences were examined using mixed and one-way Analyses of Variance (ANOVAs) as appropriate (for details of how these analyses were applied, see Chapter 2: Methods). For one-way ANOVAs where there was unequal variance between the groups, the Brown-Forsythe F-statistic was used (Field, 2009).

Correlations were calculated using Pearson's partial correlations, controlling for general cognitive decline of participants using the Mini-Mental State Examination (MMSE). Correlations involving ordinal data were calculated using Spearman's rho correlations. The significance of correlations were determined using a Holm-Bonferroni (sequentially-rejective) procedure (Holm, 1979) to correct for multiple comparisons (Chapter 2: Methods).

In order to test predictions relating to the severity of disease progression, the AD group was subdivided using their MMSE score: those scoring below 21 were classified "moderate" (n = 7) and those scoring above 21 were classified as "mild" (n = 8)(Perneczky, et al., 2006).

Results

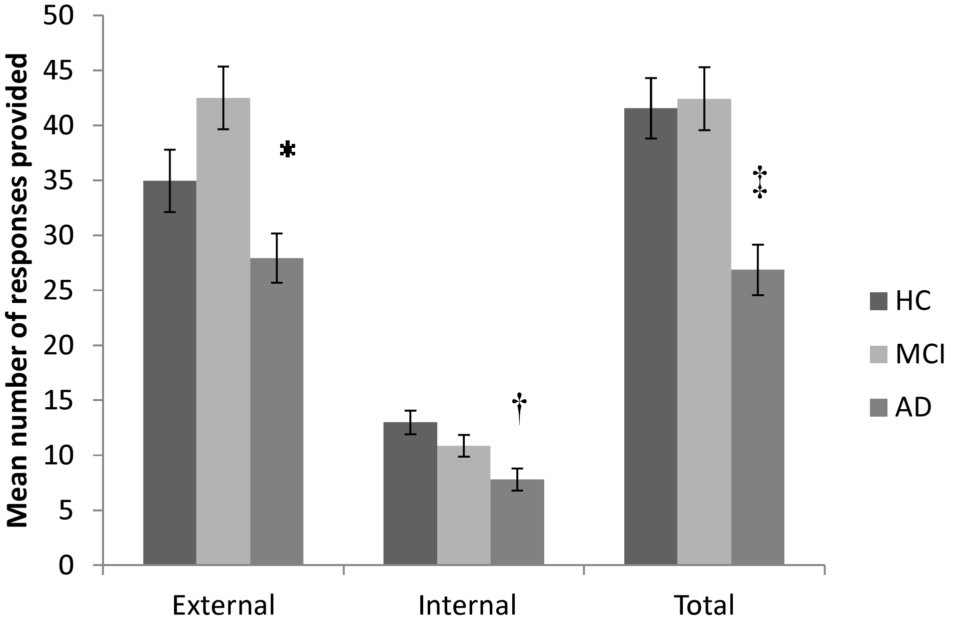
Performance on Self Awareness Measures

Photographic recognition task. Fifty two participants took part in the photographic recognition task. One individual from the aMCI group and two from the AD group were unable to complete the second session of interviews due to ill health. All but one participant were able to correctly identify their photograph on the first attempt. This was despite many AD participants being unable to recall that the photograph had been taken earlier in the interview. One participant from the AD group (Participant 040b) was unable to identify her image, and was unable to pick the correct image when informed that her photograph was among those displayed. This participant had the lowest MMSE score (MMSE = 10). One other participant also scored 10 in the MMSE, but unfortunately did not participate in the photographic recognition task due to ill health. An examination of Participant 040b's performance on other self awareness tasks is described below.

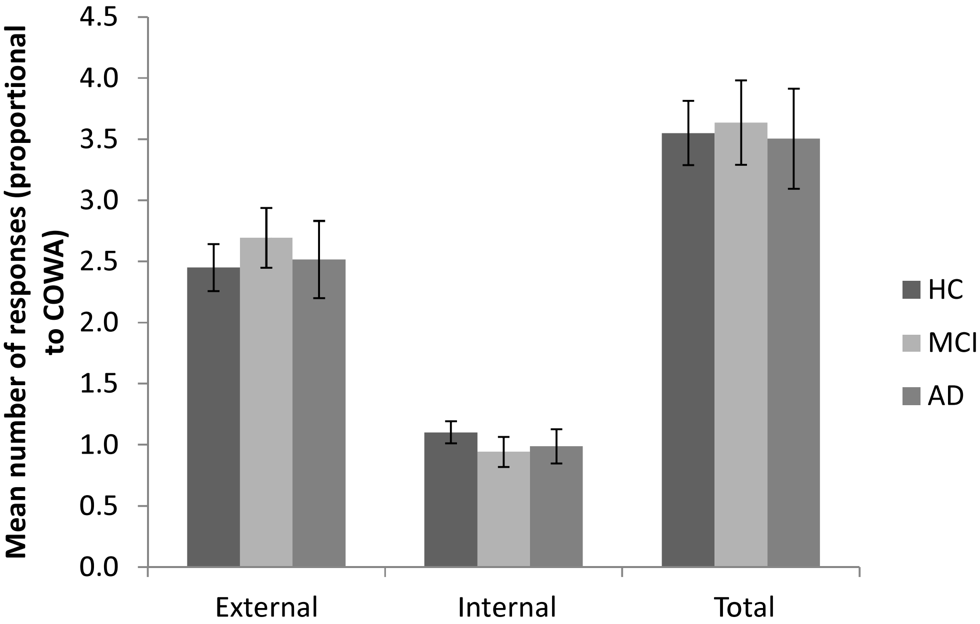
First-person pronouns. The first-person pronoun usage was calculated for all 55 participants using their life stories. In order to control for differences in verbal fluency, and the shorter stories of the AD group, proportional scores were used. A mixed-factorial ANOVA was conducted with type of pronoun (plural or singular) as the within-subjects factor and group (HC, aMCI, AD) as the between-subjects factor. There was a significant main effect for type of pronoun, $F_{(1, 52)} = 241.37$, $p <.001$, with all groups using a larger proportion of singular ($M = 6.3$, $SE = .19$) than plural ($M = 1.94$, $SE = .13$) pronouns. In line with the hypothesis of retained self awareness for the memory-impaired groups, there was no main effect for group ($p = .08$). In fact, the non-significant trend was for the AD group to use a larger proportion of first-person pronouns in their stories ($M = 8.49$, $SE = .36$) compared with the HC ($M = 7.86$, $SE = .19$) or aMCI groups ($M = 7.9$, $SE = .32$). There was no group by type of pronoun interaction ($p = .7$).

Self Awareness in the Present Moment task. All fifty five participants took part in the SAPM task. Raw scores and proportional scores (controlling for COWA) are set out in Figure 3.1.

First, the raw scores were examined. A mixed-factorial ANOVA was conducted with type of awareness (internal, external) as the within-subject factor and group (HC, aMCI, AD) as the between-subjects factor. There was a significant main effect for group, $F_{(2, 52)} = 5.35$, $p = .01$, with post hoc Games-Howell analysis showing that the AD group provided fewer responses than either the HC or aMCI groups ($p = .001$). The aMCI and HC groups did not differ ($p = .99$). There was also a significant main effect for type of awareness, $F_{(1,52)} = 290.48$, $p < .001$, indicating that participants across all groups tended to provide fewer internal ($M = 10.47$, $SE = .64$) than external responses ($M = 34.99$, SE = 1.65). These effects were moderated by a significant type of awareness by group interaction, $F_{(1,52)} = 5.42$, $p = .01$. Games-Howell pairwise comparisons showed that the AD group used significantly fewer external responses compared with the aMCI group ($p = .001$) and significantly fewer internal responses than the HC group ($p = .003$). The aMCI and AD groups did not differ in relation to internal or external scores (all p-values $\geq .13$).



(a) Raw SAPM Scores



(b) SAPM scores controlling for verbal fluency

*Figure 3.1. Mean number internal, external and total responses on the Self Awareness in the Present Moment (SAPM) task, (a) in their raw form, and (b) controlling for verbal fluency. COWA = Controlled Oral Word Association task. HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease. Error bars denote one standard error of the mean. * AD group significantly lower than the aMCI group. † AD group significantly lower than HC group. ‡AD group significantly lower than the HC or MCI groups.*

To assess whether these between-group differences related to verbal fluency, rather than to self awareness *per se*, the analysis was re-run using proportional scores which controlled for verbal fluency (see Method). Consistent with the hypothesis that the memory-impaired groups would have preserved self awareness, after verbal fluency was taken into account there was no significant main effect for group (p = .97), or interaction between group and type of awareness (p = .33), suggesting that the group differences found in the previous analysis are likely to have been a result of differences in verbal fluency. The main effect for type of awareness remained, $F_{(1, 52)}$ = 183.22, $p \leq .001$, confirming that across all groups, a greater number of external (M = 2.55, SE = .15) than internal (M = 1.01, SE = .07) responses were provided.

Preferences task. Fifty-three participants participated in the preferences task. Two participants (one from each of the AD and aMCI groups) did not participate due to ill health. In addition, four participants did not complete all of the conditions. Two HC participants were unable to complete all conditions due to visual impairments (one was unable to perform the landscapes condition, and both were unable to perform the puppies condition), and two AD participants were unable to complete all conditions due to fatigue (both missed the vegetables task, and one also missed the puppies task). So that all who participated could be included in the analysis, scores were averaged across the different conditions (see Method).[7] As it had been hypothesised that any difficulties with the preferences task in the AD groups would not be uniform throughout the AD subgroup, but rather would be due to a subgroup at the more severe end of disease progression, the AD group was divided into mild (n = 8) and moderate (n = 6)

[7] To assess whether there were any differences between the different conditions in terms of task difficulty, a mixed-factorial ANOVA was conducted with group (HC, aMCI, AD) as the between-subjects factor, and condition (fruit, landscapes, puppies, vegetables) as the within-subjects factor. Although this analysis showed significant main effects for condition, $F_{(2.4, 110.43)}$ = 5.33, p = .004, and group, $F_{(2, 46)}$ = 3.89, p = .03, there was no significant interaction between group and condition (p= .12), indicating that the groups did not differ in terms of which stimulus set they made more errors on. The average scores were therefore used in the main analysis.

severity subgroups for the purposes of this analysis (see Method). The performance of the four groups is summarised in Figure 3.2.

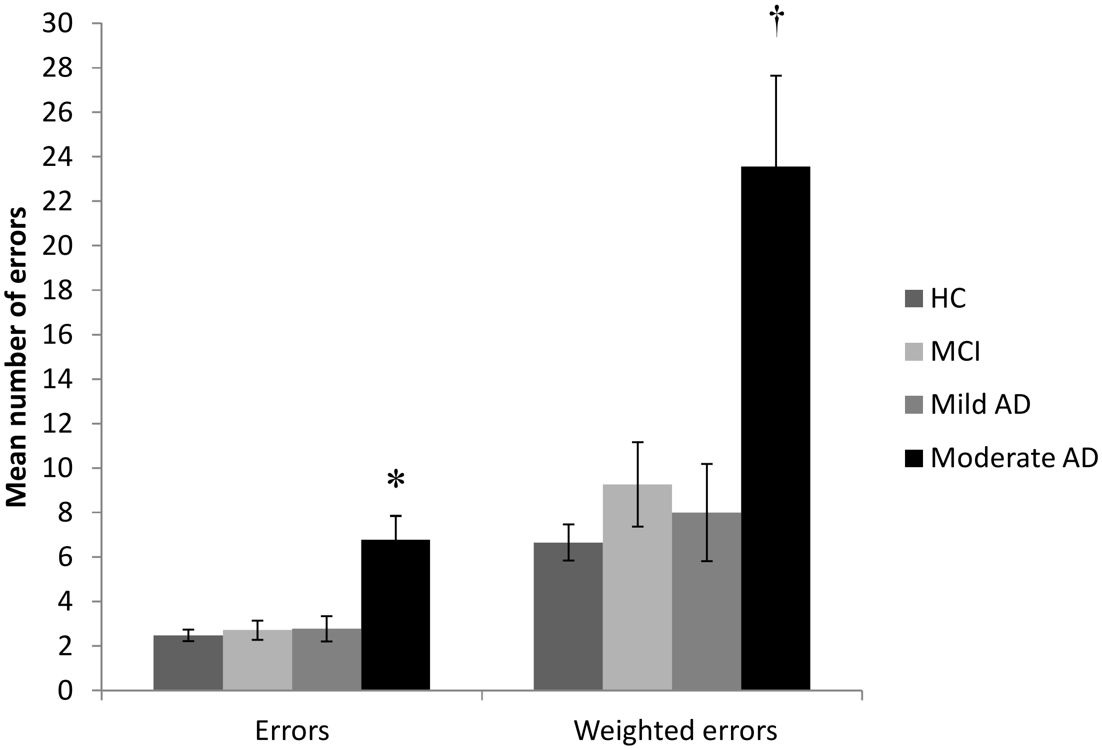


*Figure 3.2. Mean number of errors and weighted errors on the preferences task by each group. Scores are raw and averaged across the four stimuli sets Healthy control (HC), amnestic Mild Cognitive Impairment (aMCI), Mild-Alzheimer's disease (AD) and moderate AD groups. Error bars denote one standard error of the mean. * Significant difference between the moderate-AD group and all other groups. † Significant difference between the moderate-AD group and the HC and Mild-AD groups.*

Two one-way ANOVAs (Bonferroni corrected alpha level set at $p < .025$) were used to assess the difference between the groups (HC, aMCI, mild-AD, moderate-AD) on the number of errors and the number of errors weighted for the gravity of the errors (weighted errors).[8] There was a significant difference between the groups on the number of errors, $F_{(3, 52)} = 12.02, p <.001$. As hypothesised, Games-Howell pairwise comparisons revealed that the moderate-AD group

[8] Data were also analysed using the adjusted scores (number of errors and weighted errors) which uses the choices made by each participant within individual trials to break ties between equally ranked stimuli (see Method). As the overall pattern of results did not differ when using the adjusted scores, the only the raw score analysis is presented, which provides a more conservative measure (Henri-Bhargava, et al., 2012).
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made significantly more errors compared to the HC, aMCI and mild-AD groups (all p-values $\leq .046$). There was no significant difference between the other three groups in relation to the number of errors (all p-values $>.96$). There was also a significant difference between the groups on the number of weighted errors, $F_{(3, 15.2)} = 8.41$, $p = .002$ (Brown-Forsythe), with Games-Howell comparisons confirming that moderate-AD group made more serious errors compared to the HC or mild-AD group (all p-values $\leq .04$), and indicating a non-significant trend for them to make more serious errors compared to the aMCI group ($p = .058$). There was no significant difference between the HC, aMCI and mild-AD groups in relation to severity of errors (all p-values $>.59$). These findings are consistent with the hypotheses that performance on the preferences task was related to disease severity with impairments emerging only for the moderate-severity AD group.

Awareness of memory deficits. All participants in the aMCI and AD groups were assessed in relation to their awareness of their memory deficits (see Table 3.1). To allow a valid chi-square test, the "no awareness" and "moderate awareness" categories were collapsed. The chi-square test for independence showed that level of awareness was significantly related to group membership, $\chi^2_{(2)} = 13.89$, $p < .001$. All but one of the aMCI group demonstrated full awareness about memory impairments, with one showing just a moderate level of awareness. In contrast, 11 (73%) of the AD group showed some lack of awareness in relation to their memory deficits.

Table 3.1. Number (Percentage) of Participants in the aMCI and AD Groups Rated as Showing No, Moderate or High Levels of Awareness on the Awareness of Memory Deficits Interview.

	No awareness	Moderate awareness	High level of awareness
aMCI	-	1 (7%)	14 (93%)
AD	3 (20%)	8 (53%)	4 (27%)

Notes: aMCI = amnestic Mild Cognitive Impairment group, AD = Alzheimer's disease group.

To assess the possibility that awareness of memory deficits would be related to performance on the preferences task, Spearman's rho correlations were conducted between level of awareness and preferences task errors and weighted errors in both the aMCI and AD groups.

After applying a Holm-Bonferroni correction (first-level corrected alpha level, $p<.025$) there were no significant correlations in either group. Within the AD group, however, both correlations were marginally significant (number of errors, $r = -.54$, $p = .049$, number of weighted errors, $r=-.57$, $p = .03$), providing tentative support for the suggestion that those with lower awareness of their memory deficits tended to make more errors, and more severe errors, on the preferences task.

Participant 040b. As noted above, participant 040b was unable to self recognise on the photographic recognition task. As this is an important benchmark task for self awareness, this participant's performance across other measures was examined: firstly, to determine whether this failure on the mirror test in fact represented a general decline in self awareness, rather than deficits in some unrelated factor, and second, whether any decline in self awareness would be accompanied by deterioration in episodic memory as predicted by the present model. To assess these questions, z-scores were calculated for all of participant 040b's scores using the mean score for the AD group (excluding her own score) (see Table 3.2).

Participant 040b performed below the mean (both in relation to all the groups combined, as well as in relation to the AD group) on all measures of self awareness, except the proportion of first-person pronouns. She performed over a standard deviation below the AD group mean on the SAPM task (COWA adjusted), and was the third lowest performer on that task. She also scored .8 of a standard deviation below the AD group mean on the average number of errors on the preferences task. She was also one of three participants in the AD group who indicated no awareness of her memory deficits. Consistent with the trend for the AD group, this participant used a higher proportion of first-person pronouns in her life story compared with other participants (over 2 standard deviations above the AD group mean).

These findings indicate that participant 040b's problems with photographic recognition task may also reflect a broader impairment in self awareness. She was not, however, totally lacking in self awareness, as indicated by her ability to produce some sensible responses on the

SAPM task which indicated some cogent awareness of her present situation (e.g., "I'm lying in bed right now because I'm lazy, not because I am ill", "I have a mark or bruise on my hand").

Table 3.2. Participant 040b's Scores (Raw and Standardised) on Measures of Self Awareness and Episodic Memory Compared Against the Mean for the AD Group and Combined Groups.

	Participant 040b	AD Group†		Combined Groups ‡	
Self awareness tasks		*M(SE)*	Z-score	*M(SE)*	Z-score
Preferences task (Ave. raw scores)					
• Mean number of errors	6.67	4.33 (.81)	-.80*	3.01 (.28)	- 1.82*
• Mean weighted errors	17.33	14.46 (3.19)	-.25*	9.31 (1.09)	- 1.02*
First-person pronouns +	11.19	8.47 (.34)	2.20	8.02 (.15)	2.90
SAPM total score#	1.69	3.75 (.43)	-1.32	3.62 (.19)	- 1.43
Awareness memory deficits	No awareness	-		-	-
Mirror recognition	Fail	-		-	-
Episodic memory tasks					
Number AI internal details across 4 event stories	1	85.23 (5.78)	-4.04	112.23 (5.42)	-2.84
Number "Remember" responses	0	3.29 (.29)	-	3.67 (.10)	-

Notes: AD = Alzheimer's disease, M = Mean, SE = Standard Error of the Mean, SAPM = Self awareness in the present moment test; Ave = scores averaged across all four conditions; Weighted errors = Errors weighted by gravity of errors. AI = Autobiographical Interview.
* Where the raw score is the number of errors, z-score has been converted to a negative so that negative z-scores indicate worse performance, and positive scores indicate better performance.
†Mean scores of the AD group, excluding participant 040b.
‡Combined scores of all three groups (healthy control, amnestic Mild Cognitive Impairment, Alzheimer's disease), excluding participant 040b.
+Proportional to total number of propositions in the life story.
Proportional to COWA score

In order to assess the hypothesis that any reduction in self awareness should be accompanied by profound deterioration in episodic memory ability, participant 040b's episodic memory performance was also examined (see Table 3.2). Consistent with this hypothesis, she scored 4 standard deviations below the AD group mean for the total number of internal details generated in the four event stories. In fact, she had produced only one internal detail across the four stories she attempted, and did not claim to "remember" any of the events she narrated. This was the second lowest AI performance for all participants, second only to participant 010b who was unable to generate any internal details. As noted, participant 010b had the same MMSE score as participant 040b, but was unable to complete the photographic recognition test due to ill-health.

Relationship between episodic memory and present moment self awareness

To examine any relationship between performance on self awareness tasks and episodic memory, a partial correlation was undertaken controlling for general cognitive decline using MMSE score. Four self awareness measures were used in the analysis: SAPM total score (proportional to COWA), average number of errors and weighted errors (average, raw scores) on the preferences task, and proportion of first-person pronouns. These scores were correlated with the number of internal details in each of the four AI event stories. In addition, Spearman's rho correlations were calculated to examine the relationship between awareness of memory deficits and the number of AI internal details used in the aMCI and AD groups. The correlations were calculated for each group separately (see Table 3.3).

After applying a Holm-Bonferroni correction (first-level corrected alpha level, p <.003), there were no significant correlations. There were, however, three marginally significant correlations within the AD group, all with the early adulthood event story. This story was positively correlated with both the number of errors (p = .02) and the weighted errors (p =.01) on the preferences task, suggesting that those who provided a greater number of internal details in this story also tended to make a greater number, and more severe, errors on the preferences task. There was also a marginally significant positive correlation between the number of internal details in the early adulthood story and the number of statements made in the SAPM task (p = .009).

Table 3.3. Partial Correlations Between Measures of Self Awareness and the Number of AI Internal Details.

Number of AI internal details	Measures of self awareness				
	SAPM total#	*Preference task (Ave. raw scores)*		*First-person pronouns*+	*Awareness of memory deficits*‡
		Number of errors	*Weighted errors*		
HC group					
Childhood	.07	-.32	-.32	.2	-
Early adulthood	.18	-.26	-.32	.2	-
Middle adulthood	-.13	-.26	-.25	.24	-
Late adulthood	.05	-.26	-.37	.07	-
aMCI group					
Childhood	.33	.05	-.19	.00	-.28
Early adulthood	-.03	-.20	-.41	.00	.43
Middle adulthood	.49	.37	.28	-.07	-.19
Late adulthood	-.02	.09	.07	-.12	-.25
AD group					
Childhood	-.06	.01	.06	-.22	.18
Early adulthood	**.72^**	**.66^**	**.70^**	-.02	.16
Middle adulthood	-.42	-.26	-.18	.03	.32
Late adulthood	.51	.10	.05	-.35	.28

Notes: Pearson's partial correlations controlling for Mini-Mental State Examination (MMSE). AI = Autobiographical Interview; HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease. Ave. = scores averaged across all four conditions; Weighted errors = Errors weighted by gravity of errors
^ Marginally significant after Holm-Bonferroni correction ($p < .05$)
# SAPM = Self Awareness in Present Moment task. Score is proportional to Controlled Oral Word Association Test (COWA) score
+Score is proportional to total number of propositions in the life story.
‡Spearman's rho non-parametric correlations were calculated for awareness of memory deficits. Awareness of memory deficits interview only conducted with aMCI and AD groups.

To assess whether these marginally significant correlations applied across the AD group, or were specific to those with greater deterioration, separate correlation analyses were run on the mild- and moderate-severity AD subgroups. In relation to the SAPM correlation, this marginally significant correlation remained for the moderate-AD subgroup (r = .96, p = .008), but not the mild-AD subgroup (p = .66), suggesting that this relationship may only apply within the moderate-severity group. In relation to the preferences task, the reverse was the case: the marginally significant correlation remained for the mild-severity group (number errors: r = .86, p = .01; weighted: r = .88, p = .008) but disappeared for the moderate-severity group (p >.40), suggesting that this relationship may only apply within the lower-severity group.

Relationship between other levels of AM and present-moment self awareness

To assess whether the same pattern of correlations also applied to other "experiential" levels of AM, partial correlations (controlling for MMSE) were calculated between measures of self awareness and the number of extended and repeated memories used in the life stories (see Table 3.3). In addition, Spearman's rho correlations were calculated between awareness of memory deficits and the extended and repeated memory scores in the aMCI and AD groups.

There were no significant correlations after applying the Holm-Bonferroni correction (first-level corrected alpha level, p <.001), however consistent with the pattern found in relation to episodic memory, within the AD group there was a marginally significant positive correlation between repeated memory for middle adulthood and both the number, and severity, of preferences errors ($p \leq .01$). For both the HC and AD groups, there were also marginally significant correlations between the number of extended memories and the proportion of first-person pronouns used in the life stories; however these correlations were in different directions. For the HC group, this was a positive correlation showing that those who used a greater amount of extended memory in the late adulthood life period also tended to use a higher proportion of first-person pronouns in their stories (p = .04). For the AD group, this was a negative correlation, indicating that those who used a greater number of extended memory propositions in the early adulthood life period also tended to use fewer first-person pronouns (p = .02).

Table 3.4. Partial Correlations Between Measures of Self Awareness and the Number of Extended and Repeated Memory Propositions Used in Each Life Story Chapter.

	Number of AM Propositions in the Life Story							
	Childhood		*Early adulthood*		*Middle adulthood*		*Late adulthood*	
Self awareness scores	*EE*	*RE*	*EE*	*RE*	*EE*	*RE*	*EE*	*RE*
HC group								
SAPM total#	.13	.1	-.04	.08	.09	.04	-.02	.08
Pref. number errors†	-.16	-.01	-.21	-.14	.15	-.25	-.12	-.30
Pref. weighted errors†	-.22	-.06	-.29	-.11	.11	-.29	-.05	-.33
FP pronouns+	.13	.18	.33	.14	.33	.25	**.41^**	.21
aMCI group								
SAPM total#	-.07	.21	.31	-.23	.33	.05	.28	.27
Pref. number errors†	.1	.07	.52	-.37	.2	-.33	.34	.11
Pref. weighted errors†	-.03	.02	.52	-.42	.11	-.43	.24	.22
FP pronouns+	.07	.07	-.12	.04	-.28	-.35	-.25	-.51
Awareness of memory deficits‡	-.25	-.16	-.34	.21	-.31	.32	-.12	-.44
AD group								
SAPM total#	-.31	.28	-.34	.4	-.25	.17	.26	.15
Pref. number errors†	.15	-.3	.09	-.02	-.27	**.68^**	-.11	.02
Pref. weighted errors†	.16	-.34	.17	0	-.25	**.73^**	-.16	.02
FP pronouns+	-.3	.01	**-.63^**	-.39	-.46	-.25	-.45	-.23
Awareness of memory deficits‡	.26	**.72^**	**.55^**	.36	.51	-.06	.45	**.62^**

Notes: Partial correlations controlling for Mini-Mental State Examination (MMSE). AM = Autobiographical memory; EE = Extended event memory; RE = Repeated event memory; HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease;
^ Marginally significant after Holm-Bonferroni correction ($p < .05$)
# Self Awareness in the Present Moment (SAPM) score is pproportional to Controlled Oral Word Association (COWA) score.
† Pref = Preferences task; Weighted = Score weighted for gravity of error. Pref = preferences task. Scores used are raw (unadjusted) and averaged across the four conditions of the preferences task..
+ FP = First person. Score is pproportional to total number of propositions in the life story.
‡Spearman's rho non-parametric correlations were calculated for awareness of memory deficits. Interview conducted only with the aMCI and AD groups.

There was also a pattern of marginally significant correlations within the AD group between awareness of memory deficits and use of repeated memory statements used in the childhood (p = .003) and late adulthood periods (p = .01), and with the number of extended memory in the early adulthood life period (p = .03). It is likely, however, that these correlations were related to the general cognitive decline of the AD group, as MMSE correlated with both the memory scores and awareness of memory scores. This could not be partialled out in this instance as Spearman's rho non-parametric correlations were used for correlations with the awareness of memory deficits.

Discussion

This study provides the first systematic exploration of the relationship between AM and self awareness in AD and aMCI. It set out to examine two hypotheses arising from the proposed model: that self awareness does not rely on intact episodic memory, but that episodic memory does necessitate intact self awareness.

Self Awareness is Possible Without Episodic Memory

An important finding of this study was that self awareness was largely preserved in these memory-impaired groups. There was no evidence of deterioration on any self awareness tasks in the aMCI group, deterioration in the AD group was only in relation to awareness of memory deficits and on the preferences task (discussed below). With the exception of one participant (see discussion of participant 040b below), all memory-impaired participants were able to identify their own photograph from a number of decoys, and performed in line with healthy controls in relation to describing their present-moment experiences on the SAPM task and in relation to the use of first-person pronouns in their life stories. Although a significant difference was found in the raw performance of the groups on the SAPM task, this did not remain significant after controlling for verbal fluency. This indicates that the relationship between present-moment description tasks and mental projection reported in previous studies (Gaesser, et al., 2011; Zeman, et al., 2012) may also relate to verbal fluency.

Although one cannot place much weight on a finding of "no difference" between groups, there are certain factors in the present investigation that provide fairly strong evidence of "normal" performance by the AD group on these tasks. First, their preserved performance was not demonstrated only in relation to only one task, but rather a range of tasks using quite different methodological approaches and modalities of responding. Second, the AD group did not merely perform at a level that was statistically indistinguishable from healthy controls, but rather, achieved mean scores on all of these tasks that were at the same level or above those of the HC group. After removing participant 040b from the analysis, the AD group performed at the same level as the HC group on the mirror recognition task (i.e., successful identification for all participants), and achieved slightly higher mean scores on both the SAPM task (HC: $M = 3.55;$ $SE = .26$; AD: $M = 3.63$, $SE = .42$) and the first-person pronouns task (HC: 7.86, SE = .19; AD: $M = 8.6$; $SE = .34$). Finally, these findings must be seen in the context of the larger body of work encompassed by this thesis, in which the AD group demonstrated deterioration in many aspects of AM and general cognitive performance (as described in Chapter 2) as well as in other aspects of sense of self (described in later chapters). In this broader context, the preserved self awareness found in the present chapter appears to represent a striking island of preserved performance in the midst of deterioration in many other areas.

Given the marked deterioration found in episodic memory and autonoetic consciousness in this group, this finding provides at least provisional support for the hypothesis that self awareness does not rely upon functioning episodic memory; such impairments do not affect the ability to experience, reflect upon, and report their present-moment experiences in the world. This was further supported by the absence of any significant correlations between episodic memory performance and performance on these measures of self awareness.

One exception, however, was a marginally significant correlation between SAPM performance and the number of internal details provided in the early-adulthood event story. This indicates that AD participants who were able to better describe their present-moment experiences also tended to have better episodic memory for early adulthood events. This relationship could be due to unmeasured cognitive abilities, irrelevant to memory, that affected performance on both tasks. Alternatively, the correlation between the SAPM task and episodic memory could be seen as evidence against the proposed hypothesis that episodic memory is not needed for self awareness; perhaps this relationship indicates that deterioration in episodic memory, underpinned by MTL pathology, was contributing to deterioration in self awareness. If that were the case, however, this correlation should have been evident at both the early and moderate stages of the disease, because episodic memory deficits and MTL pathology emerge early in the disease (Addis & Tippett, 2004; Gilboa, et al., 2005; Greene, et al., 1995; Irish, et al., 2010; Leyhe, et al., 2009; Piolino, Desgranges, et al., 2003). In fact, however, the marginally significant correlation was present only in the moderate-AD subgroup, and not in the mild-AD subgroup. This finding is more consistent with the suggestion made in this chapter that AD may be characterised as having two distinct phases, with the first involving episodic memory deterioration and preserved self awareness, and the second involving primary deficits in self awareness which lead to a marked decline in episodic memory. In other words, the relationship between the SAPM task and episodic memory ability found in the moderate-severity AD group could be due to deterioration in self awareness leading to deterioration in episodic memory.

Self Awareness is Essential for Episodic Memory and Autonoetic Consciousness

Further tentative support for the hypothesis that self awareness is essential for episodic memory is provided by participant 040b who was the only participant to fail the photographic self-recognition task. She also performed below the mean (both for the combined groups and the AD group) on all other measures of self awareness, with the exception of first-person pronoun usage. It is certainly possible that deterioration in self knowledge could also have contributed to participant 040b's failure on the photographic recognition task (Hehman, et al., 2005).

Unfortunately the design of the present study does not permit a separate analysis of the contributions made by self knowledge and self awareness to this task. To do so, a more complex paradigm would be needed, for example combining an historical photographic self-recognition task such as that used by Hehman et al. with other measures of self awareness used in the present study. Nevertheless, the present findings provide corroborating evidence of deterioration across a number of different measures of self awareness, including those which do not require any self knowledge, and are therefore indicative of a core deficit in self awareness.

As predicted, participant 040b also demonstrated profound episodic memory impairments, even in comparison to others in the AD group, recalling only one internal detail across her entire lifespan, and exhibited no autonoetic recollection of any events. Overall, the pattern of deficits demonstrated by participant 040b is consistent with the suggestion that her neural pathology may have extended beyond the MTL into regions directly supporting self awareness, and this deterioration was accompanied by profound deterioration in episodic memory.

These inferences are only speculative, as a single case study cannot provide strong evidence for this hypothesis. There is also no brain imaging data available to support the claims about the probable course of this patient's pathology, and as all of the data is correlational, it cannot be used to draw conclusions about causal relationships. To properly test this hypothesis, prospective longitudinal studies would be needed which follow participants from early to severe stages of disease, tracking the order and developing relationship between these symptoms. Imaging studies would also be useful to assess the relationship between these symptoms and underlying neural pathology, and to test the prediction that only those with deterioration extending beyond the MTLs should demonstrate deterioration in self awareness, and that those individuals should, in addition, evidence severe episodic memory impairments.

Linguistic measures of self awareness. One anomaly found in participant 040b's pattern of diminished self awareness was the finding that she used a larger proportion of first person pronouns in her speech. If personal pronoun usage is indeed a marker for self awareness (Sabat, 2002; Sabat & Harré, 1992), this finding would appear to indicate that on this measure she was showing greater awareness than others in the AD group. However, her increased usage is consistent with the finding that the AD group as a whole demonstrated greater first-person pronoun usage than the other groups, and also with the increased usage of personal pronouns in AD reported by Small, et al. (1998).

One explanation is that personal pronoun usage is not a good indicator of self awareness – perhaps they are merely a verbal habit which remains in the speech of those with AD due to their simplicity and common usage in the English language. While the *increased* frequency of personal pronouns in those with AD is likely to relate to difficulties with more complex forms of language (e.g., reduced verbal fluency, word-finding difficulties etc), the present results suggest that it is unlikely that the retained use of personal pronouns by those with AD is a meaningless verbal habit; both the interviewer and coders considered that the personal pronoun usage of participant 040b, and all other AD participants, was meaningful and appropriate, as illustrated by the following passage from participant 040b's life story:

> Well, *I* was born and bred in Argentina, in South America, was from *my* Irish parents and, and *I* was born and bred in this country and *I* went to school in, in, in the, with the language - the Spanish language, but we spoke English at home and then went on, *I* went into the, to the nursing home. *I* went to Bridges Hospital Nursing Home and *I* did my nursing training there.

If we accept that the use of personal pronouns in those with AD is meaningful, and constitutes a demonstration of self awareness, another possible explanation for the preserved personal pronouns usage in participant 040b is that self awareness may be a graded ability, or one which has different expressions. The ability to self reference, either verbally through the use of first-person pronouns or through self-referential gestures, represents a very basic form of self awareness, and one which may underpin other aspects of self awareness. Indeed, some authors have classified first-person pronouns as a marker for prereflective self experience as opposed to reflective self awareness, because they serve as a direct marker for “my” experiential consciousness in a particular moment (e.g., Esslen, et al., 2008; Gallagher, 2000; Sabat & Harré, 1992). Within the present model, the use of first-person pronouns has been conceptualised as a marker of self awareness because the act of describing an experience using language demonstrates the ability to reflect, evaluate and communicate this direct personal experience. Nevertheless, self referencing is a form of self awareness that does not appear to necessitate any additional cognitive processing beyond the verbal (or gestural) expression of one’s inwardly directed consciousness.

In contrast, all of the other self awareness measures used in the present study appear to require an additional level of processing, and were affected in at least some AD participants. The self recognition task requires that self awareness is used to compare an external image to an internal model of self, and therefore requires integration between self awareness and self knowledge. The preferences task requires that one’s self-directed awareness is used to weigh the subjective value of external stimuli, and thus requires some self knowledge about one’s likes and dislikes. First-person pronouns, in contrast, do not require any self knowledge or model of self. Although these words are often used in conjunction with semantic personal facts and self knowledge (as in the example above) they can also be used meaningfully in the absence of any such knowledge. In this respect, along with other indexicals such as “here” and “now”, personal pronouns are “descriptively exceedingly thin” (Nichols, 2008, p. 523), meaning that one can make sensible statements and behave appropriately in relation to such statements even if one lacks any knowledge about what they refer to. Thus, it makes sense for me to say “I am in bed” even if have just awoken from a coma, and lack any knowledge about who “I” am (Nichols, 2008).

The SAPM task similarly does not require any particular self knowledge; however it does require the ability to accurately report one’s present stream of subjective awareness as it is guided in particular directions. In contrast, the personal pronouns task assesses only the number of times within a conversation an individual’s attention is directed to the self, regardless of the content or reason for the self-referential comment. Someone who finds attention and concentration difficult may find the SAPM task difficult, but could nevertheless score highly on a personal pronouns task if their mind-wandering was self-directed. The personal pronouns task is therefore an easier task, and may represent a more basic expression of self awareness than these other measures. If this is correct, self-reference may provide a last bastion of self awareness in those whose ability to apply this awareness in particular directed ways is beginning to diminish. These findings therefore add to a growing body of evidence that this basic self-referential capacity may persist in AD beyond a point when these more complex expressions of self awareness start to erode.

Awareness of memory deficits and personal preferences. The two exceptions to the finding of preserved self awareness in the AD group were poorer performance on the preferences task and impaired awareness of memory deficits. Although previous investigations using gambling paradigms have indicated that those with AD may demonstrate difficulties with making decisions under conditions of ambiguity and risk (Delazer, et al., 2007; Sinz, et al., 2008), this was the first study to use a structured quantitative paradigm (Henri-Bhargava, et al., 2012) to examine the ability to make simple preference decisions in AD. The present investigation found marked deterioration in the moderate-AD subgroup on the preferences task, both in relation to the number of errors and the gravity of those errors. Consistent with previous investigations (Clare, et al., 2005; Mograbi, et al., 2009; Morris & Mograbi, 2012; Sevush & Leve, 1993; Souchay, 2007), a large proportion of the AD group also demonstrated some or complete lack of awareness of their memory deficits.

As predicted, deterioration in these two areas appeared to predate deterioration on other measures of self awareness, indicating that they may be underpinned by different neural circuitry, or may represent higher-level abilities. The hypothesis proposed in this chapter was that deterioration in both capacities may be underpinned by common VmPFC pathology, which would start to emerge in the moderate-stages of AD. This prediction was based on findings of worsening pathology to VmPFC regions in AD (Buckner, et al., 2005; Herholz, et al., 2002), which has been related to problems with insight into memory deficits (Hornberger, et al., 2012), as well as a relationship between VmPFC pathology the ability to make simple preference decisions in other patient groups (Fellows & Farah, 2007; Henri-Bhargava, Simioni, & Fellows, 2012).

Tentative support for a relationship between these two abilities was found in marginally significant correlations between performance on the preferences task performance and awareness of memory deficits in the AD group, indicating that those with lower awareness of their memory deficits also tended to make a greater number, and more severe, errors on this task. If these correlations were in fact related to VmPFC pathology, one might have expected stronger, significant correlations. One factor that may weaken the relationship between performance on these tasks is that awareness of memory deficits, particularly as measured using patient reports as in the present study, is a complex phenomenon which may relate to many contributing factors. In particular, in addition to being a “symptom”, possibly underpinned by VmPFC pathology, the expression of awareness about memory deficits is likely to be shaped by psychological and social factors (Clare, 2003). Another factor that could have lessened the relationship in the present study was the use of a semi-structured interview to assess awareness of memory functioning (Loebel, et al., 1990; Sevush & Leve, 1993), which relies on a “clinician rating” to assess level of awareness. There are a number of limitations to such an approach, including that there is no ability using such a method to explore the potential gap between explicit and implicit awareness of deficits, that participants’ responses might be influenced by the context of the interview, and the level of awareness score is subject to clinician bias (Clare, et al., 2005). It is likely that other, lengthier assessment approaches would provide a more sensitive measure of awareness of memory deficits (for reviews, see Clare, et al., 2005; Souchay, 2007) which could better identify any relationship between this ability and the ability to make simple preference decisions in AD.

It was not possible in the present study to explore whether impairments in awareness of memory deficits in fact related to underlying VmPFC pathology in this moderate AD subgroup. It is possible that rather than being due to any such underlying pathology, the poor performance of the moderate AD group on the preferences task, and the correlations between this task and awareness of memory deficits, could instead be due to a general decline in performance between the mild and moderate groups (e.g., related to impaired attention, motivation or general cognitive performance). If this was the case, however, one might have expected a graded difference between the groups, with the mild-AD group performing a bit worse than the HC and aMCI groups, and the moderate-AD group performing worse again. Instead, the HC, aMCI and mild-AD groups all performed at a very similar level, scoring approximately the same mean number of errors for each condition (HC: M = 2.48; aMCI: M = 2.71, Mild AD: M = 2.78). In contrast, those in the moderate-AD group made, on average, over twice this many errors on each condition (M = 6.78). Notably, the level of performance of the moderate AD group is very similar to that of the VmPFC patient group in Henri-Bhargava et al.'s (2012) study (mean number of errors = 6). Nevertheless, in order to progress this issue, neuroimaging studies are needed in order to directly examine the relationship between the extent of VmPFC pathology in AD, performance on preferences tasks and level of awareness of memory deficits.

A marginally significant correlation was found in the AD group between early adulthood event memory and performance on this task. Interestingly, the relationship was a positive correlation, suggesting that those with better episodic recollection for this life period tended to make a greater number, and more severe, preferences errors. It is not clear why this should be the case, but it is interesting to note that Henri-Bhargava, et al. (2012) also found a trend for the number of errors made on an incidental memory test to be negatively correlated with errors on the preferences task. One possibility is that, in memory-impaired groups, those with better preserved memory are more inclined to use (unsuccessful) memory-based strategies when completing this task. Regardless of the explanation, this finding is consistent with the hypothesis that the impaired performance of the AD group on the personal preferences task was not due to their episodic memory impairments.

Summary. This chapter set out to examine a proposed one-directional relationship between episodic memory and self awareness, whereby episodic memory relies on properly functioning self awareness, but self awareness may persist in the face of severe episodic memory impairments. Despite the methodological limitations described above, the present study has contributed to the growing body of evidence in support of this position. In particular, by providing one of the first systematic investigations of self awareness in aMCI and AD, this study adds weight to previous findings that self awareness is generally well preserved in these memory-impaired groups, and therefore does not rely upon properly functioning episodic memory. This supports the notion (c.f. Nichols, 2008) that present-moment self awareness provides a core element of sense of self that would remain if memory was stripped away – the part of the mind that is able to ask "who am I?" even if the memory files that could provide the answer are empty.

Chapter 4. Self Knowledge in the Present Moment

1. I'm honest
2. I'm easy going
3. I like sport – rugby
4. I'm generous – not greedy
5. I try to be a gentleman
6. I like a joke – good sense of humour
7. I like my wife
8. I'm happy to help with this study
9. I'm healthy
10. I'm a bit slow – in my thinking. I have to stop and think now.

Excerpt from Twenty Statements Test, Participant 009b from AD group. MMSE = 21

A striking finding from neuropsychological investigations of amnesic individuals (Klein, Cosmides, Costabile, et al., 2002; Klein & Lax, 2010; Klein, et al., 1996; Rathbone, et al., 2009; Tulving, 1993) is that they appear to retain accurate self knowledge. On face value, this finding presents a real challenge to the suggestion that one's sense of self is reliant on AM: it appears that it is possible for an individual to know a great deal about who they are without any memories of the life events that shaped them.

Chapter 1 explored Klein and colleagues' (Klein, 2010; Klein & Gangi, 2010; Klein & Lax, 2010) theoretical interpretation of these findings, the abstraction theory, which suggests an underlying structure for self knowledge whereby personality trait knowledge comprises a specialised subsystem of semantic memory functionally independent of episodic memory and other forms of semantic memory. Two limitations with this theoretical position were discussed. First, although evidence has been presented suggesting that personality trait information is independent of episodic AM, as well as many types of semantic memory including personal facts (for reviews, see Klein & Lax, 2010; Klein, Loftus, et al., 2002), few studies have examined the relationship between conceptual self knowledge and the levels of semanticised AM proposed by

Conway and colleagues (Conway, 2005; Conway & Pleydell-Pearce, 2000). It is therefore not known whether these levels of AM may play a role in supporting self knowledge. Second, as the neuropsychological evidence for the abstraction theory primarily relies upon pre-generated checklists of personality trait adjectives (Caddell & Clare, 2012; Klein, et al., 2003; Klein, et al., 1996; Tulving, 1993), it is not known whether other categories of self knowledge may also be independent of episodic memory (e.g., knowledge about social roles, preferences, physical characteristics, emotions, evaluations etc). Studies using spontaneous measures of self knowledge suggest that deterioration in episodic and semanticised AM may impact on the amount of self knowledge available (Addis & Tippett, 2004; Eustache, et al., 2013), and episodic memory deterioration may have a particular impact on contextually specific self knowledge (Addis & Tippett, 2004; Tanweer, et al., 2010).

It is also not clear why personality trait knowledge would be stored in a manner that is different from other types of self knowledge. One suggestion is that quick access to personality trait information may serve an important social function (Klein, et al., 2003; Klein, Cosmides, Tooby, & Chance, 2002). The notion that privileged access to personality information may provide universal social benefits is questionable, however, given findings from cross-cultural research that abstract personality traits are a particularly westernised way of describing the self, with other cultures tending to emphasise socially oriented and contextualised descriptors (Cousins, 1989; Wang, 2001, 2004). It is therefore possible that some other underlying structure for self knowledge could better explain the finding of preserved personality trait self knowledge in amnesic individuals. The present investigation sought to expand on self knowledge accuracy approaches by devising a checklist including other types of self knowledge, in addition to abstract personality traits, so that it was possible to explore whether retained accuracy of self knowledge applied only to personality traits or also generalised to other categories of self knowledge.

Abstract Versus Specific Self Knowledge

It is possible that the preserved self knowledge accuracy reported in these neuropsychological studies relates not to the resilience of personality trait knowledge *per se*, but rather to the resilience of all contextually abstracted forms of self knowledge. Specifically, some have argued that a contextually abstracted framework of self knowledge may exist independently of the episodic memory system, but that episodic memories are important for providing the detail needed for a nuanced, contextually specific self understanding (Addis & Tippett, 2004; Eustache, et al., 2013; Tanweer, et al., 2010). This hypothesis is based on studies using spontaneous self description methods, such as the TST, which have found that those with episodic memory deterioration (caused by AD or Asperger's syndrome) tend to use fewer "specific" descriptions and rely more on "abstract" statements (Addis & Tippett, 2004; Tanweer, et al., 2010). Conversely, there is some evidence that those with semantic dementia, a condition primarily affecting semantic memory and leaving episodic memory relatively well preserved, may use a greater number of specific self descriptive statements (Hsiao, Kaiser, Fong, & Mendez, 2013).

The hypothesis that episodic memory may be particularly important for supporting contextually specific self knowledge is promising given theoretical models of AM, such as the transformation hypothesis (Winocur, et al., 2010), which suggest that it may be the contextual richness of episodic memory which is critical to the involvement of the MTLs; perhaps, too, it is the contextual specificity of self knowledge that determines whether episodic memory is involved. On closer inspection, the hypothesis in fact emerges from a particular interpretation of the TST coding scheme used in the studies by Addis and Tippett (2004) and Tanweer et al. (2010) to distinguish spontaneous self knowledge along an abstract/specific dimension (from Rhee, et al., 1995). This interpretation suggests that "abstract" self statements are those which include attributes that transcend particular situations and are common across contexts (e.g., I am kind; I am mathematical, I am European) while "specific" statements are those which are tied to specific contexts or situations (e.g., I look after my family members when they are unwell; I like to play bowls). Although this interpretation is well grounded in the social psychology literature from which that coding method was derived (e.g., Bond & Cheung, 1983; Cousins, 1989; Shweder & Bourne, 1984) Rhee et al.'s coding method does not permit such a precise interpretation of the abstract/specific dimension.

The first difficulty with using Rhee et al.'s (1995) method to isolate contextual specificity in TST responses is methodological. The coding method involves assigning each statement to a category (e.g., physical attribute, social identity, preference, personality trait etc) and each of these categories is pre-assigned as abstract or specific. This approach embeds the idea that these different "categories" of self knowledge represent a valid organising principle for self knowledge (see also Bond & Cheung, 1983; Cousins, 1989). Although these categories have utility in discussions about self knowledge, there is no empirical evidence that they map onto the way the brain stores and organises self knowledge, or that these categories could be neatly overlaid by a secondary abstract/specific division. In practice, this method means that the higher proportional use of abstract versus specific self knowledge in memory-impaired groups reported in the AM literature (Addis & Tippett, 2004; Tanweer, et al., 2010) could be better explained by an over (or under) use of certain categories of self knowledge that are pre-assigned as abstract (or specific); for example, a higher proportional use of abstract personality traits, emotional self descriptions, or evaluations. That finding could therefore potentially be better explained by Klein and colleagues' (Klein, 2010; Klein & Gangi, 2010; Klein & Lax, 2010) position outlined above, that personality traits represent a special category of self knowledge that are independent of episodic memory.

A second difficultly with the interpretation of Rhee et al.'s (1995) coding scheme is theoretical. On close inspection, that coding scheme does not exclusively encapsulate a "contextual" understanding of the abstract/specific dimension used in the AM literature, but also incorporates elements from other theoretical interpretations of this dimension. One is rooted in the idea that the concept of a person can either be grounded in the external, observable characteristics of the physical world, or relate to the internal, psychological person (Cousins, 1989; Shweder & Bourne, 1984). On that view, externally-oriented self knowledge, like social roles or physical characteristics, are seen to represent “specific” forms of self knowledge, while internally oriented self knowledge, like psychological traits and metaphysical statements, represent “abstract” forms of self knowledge (Cousins, 1989). This overlap of terminology is acknowledged by Rhee et al. (1995), and partly addressed in their attempt to code separately for abstract/specific and autonomous/social traits. Their scheme nevertheless perpetuates the conflation by assuming that certain externally oriented categories of self knowledge (e.g., social identities, physical attributes) are always more specific than others. Adding to the confusion, their method also integrates a third understanding of the abstract/specific dimension, which relates to whether an attribute is time dependent or independent (temporal abstraction). On this view, an attribute is “specific” if restricted to particular time-bound situations (e.g., “I am like this now, but not then”), and “abstract” if it applies across the lifespan (e.g., “I have always been like this”).

There are many examples of attributes that could be abstract along one dimension, but not another. For example, many physical characteristics (e.g., height, eye colour, facial features etc) are relatively stable across the lifespan and across different contexts (i.e., temporally and contextually abstract), but are coded “specific”, presumably because they are grounded in the physical world (i.e., externally directed). In contrast, personality traits are abstract in the sense of being internally directed, but within the scheme can be coded as “specific” if they apply only within particular situations (i.e., contextually specific) or if they have changed over time (i.e., temporally specific). This conflation of terms within the coding scheme means that it is impossible to assess whether the finding of less specific (more abstract) self knowledge in those with episodic memory impairments in the literature (Addis & Tippett, 2004; Tanweer, et al.,

2010) is due to difficulty with self knowledge that is externally directed, or that is contextually or temporally specific, or a mix of all of these elements.

A specific aim of the present investigation was to provide greater clarity to the abstract/specific dimension by teasing apart these various meanings. To this end, a novel coding method for the TST was devised which separately assessed the contextual and temporal specificity of statements. It was an open question whether the deterioration in specific self knowledge in AD found in previous investigations would apply across both of these abstract/specific dimensions. If there is a general difficulty with specific self knowledge in AD, with temporal and contextual abstraction representing particular examples of this pattern, then deterioration in accessing specific self statements of both types would be expected. Alternatively, these forms of abstraction may be unrelated, with one dimension driving the group difference.

The temporal specificity of self knowledge has not been addressed in previous empirical investigations. It is interesting to note, however, that temporal abstraction is a primary organisational principle underlying Conway and colleague's (Conway, 2005; Conway & Pleydell-Pearce, 2000) model of AM. As described in previous chapters, that model suggests AM is organised in a nested temporal hierarchy, with higher (more semanticised) levels of memory being more temporally abstracted (i.e., generalising across larger temporal units), and levels further down the hierarchy being more temporally specific (i.e., apply to smaller temporal units). An intriguing possibility is that self knowledge may be organised according to a similar principle, according to a temporally nested hierarchy (see Figure 4.1). Such parallel organisation would make sense if self knowledge and the autobiographical knowledge base are integrated knowledge structures, as Conway's theory suggests. Self knowledge from each temporal level of abstraction could be maintained and supported by autobiographical information from the corresponding level of abstraction, while at the same time providing essential self-related information to inform the memories from that level. On the other hand, there is also evidence that the temporal organisation of self knowledge may be disrupted in AD, in the form of outdated self knowledge. It is therefore possible that temporally-abstract self knowledge could be preferentially impacted by the disease, forcing those with AD to rely more heavily on outdated, temporally-bounded self knowledge.

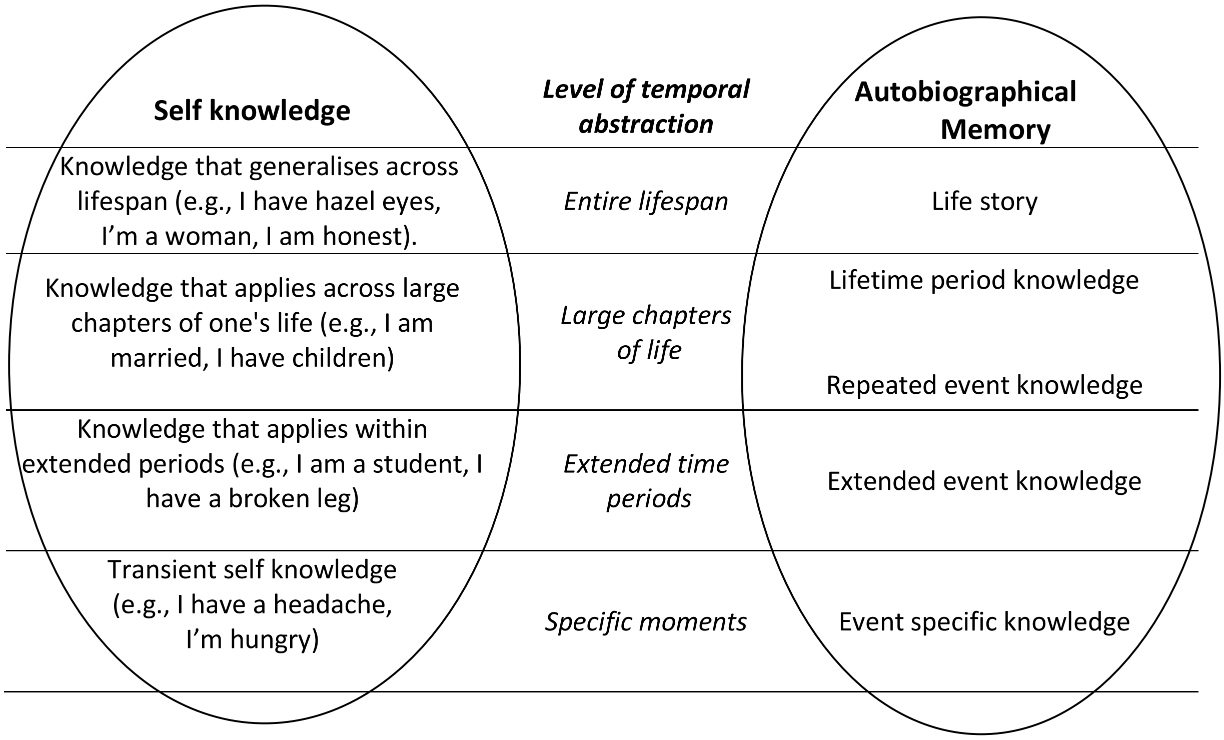


Figure 4.1: Hypothesised temporal organisation of self knowledge and its relationship with Conway's (2005) theoretical structure of autobiographical memory.

Self Knowledge in AD

Other than a loss of specific forms of self knowledge in AD, one of the main findings from previous research into spontaneous self knowledge in AD is a reduction in the number of self-descriptive statements generated (Addis & Tippett, 2004; Eustache, et al., 2013). Despite this, both of these studies reported no reduction in the complexity of spontaneous self knowledge, measured as the number of self knowledge categories that statements were sampled from. This finding indicates that those with AD may retain an ability to conceptualise themselves in broad terms despite a reduction in the number of statements they are able to generate.

There are, however, reasons to question whether the traditional administration of the TST is adequate to gauge the true magnitude of any difference in the strength and complexity of self knowledge in AD. First, there is ceiling effect with the TST, resulting from the fact that most healthy adults are easily be able to achieve 20 statements; it is therefore difficult to assess whether the full range and extent of healthy adult self knowledge is captured when the number of statements are limited to 20 (L'Ecuyer, 1992; Rentsch & Heffner, 1992; Watkins, Yau, Dahlin, & Wondimu, 1997). Second, it is possible that people with memory impairments may find a completely unguided task too difficult, and that they may have whole categories of self knowledge that are available but untapped because they cannot access them without prompts. The finding that those with AD generate fewer self descriptive comments could, therefore, relate not to a reduction in the strength of self knowledge, but rather to other difficulties that prevent them accessing the full range of self knowledge that is available (e.g., problems with motivation, concentration, verbal fluency). To provide a more comprehensive and accurate assessment of the strength and complexity of self knowledge in AD, a novel "supplementary" condition was devised for the present investigation, which used standardised prompts and did not limit the number of responses that could be used.

In terms of the accuracy of self knowledge in AD, although neuropsychological investigations have tended to show preserved accuracy of self knowledge in memory-impaired groups, studies involving AD participants have tended to reveal a more complex picture of self knowledge that is outdated, or frozen in time. Klein, Cosmides, and Costabile (2003) described patient KR, whose knowledge of her personality traits was highly correlated with her daughter's assessment of her pre-morbid personality, suggesting that she was unable to update this knowledge to reflect the ways she had changed since developing AD. Patient PH was similarly reported to demonstrate accurate but outdated trait self knowledge in relation to family member reports (Hehman, et al., 2005). As noted in Chapter 3, she was also unable to recognise current photographs of herself, but was able to recognise older photographs.

These results have also been replicated in group studies (for an exception, see Caddell & Clare, 2012, who found no deterioration in present self knowledge in early AD). Rankin et al. (2005) compared the accuracy of personality assessment (using discrepancy scores between participant and family-member reports on the Interpersonal Adjectives Scales) in patients with AD and fronto-temporal dementia with healthy age-matched controls. Those with AD were significantly less accurate than healthy controls in certain personality domains, although not to the same degree as those with fronto-temporal dementia. In both patient groups, inaccurate assessments bore a close resemblance to relatives' pre-morbid personality assessments. Using a spontaneous method, Eustache et al (2013) also found evidence of outdated self knowledge in a subgroup of AD participants, a subset of whom used self descriptive statements that were true of a previous life period. Interestingly, their AD group reported their ages to be an average of 14-years younger than their chronological age.

Part of the explanation for the outdated self knowledge in AD must relate to changes in the way those with AD express their behaviour and personality to those around them - if there was no such change, the family member's pre-morbid and current personality assessments would be the same, and no discrepancy would be found. Personality change is a symptom that is commonly noted by family members of those with AD (Bayles, 1991; Rankin, et al., 2005; Robins Wahlin & Byrne, 2011) and is likely to relate both to changes stemming from the disease itself, including cognitive changes, and also to changes in living, working and family circumstances that can accompany the development of AD. Rankin et al. (2005) challenge the notion that difficulty maintaining an up-to-date record of personality relates to the extent of personal change in AD. They note that, unlike those with fronto-temporal dementia, the areas of personality in which their AD group showed the greatest degree of unawareness did not closely mirror the personality facets in which family members reported the greatest change. Closer inspection, however, suggests that the overall pattern of results reported in that study are not incompatible with the suggestion that lack of awareness of current personality could have contributed, at least in part, to the degree of personality change in AD; for example, the only personality facet on which there was a significant change compared with healthy older adults (unassuredness/submissiveness) was also the only facet in which the AD group showed a significant lack of awareness. While that study indicates that other factors may play a role in the outdated self knowledge of those with AD, it is still an open question whether personality change may also contribute.

One obvious explanation for outdated self knowledge in AD would be the combined effects of change in personality and anterograde episodic memory impairments, which would make it harder for these individuals to update their self knowledge in response to events which provide evidence of personality changes. In a study combining behavioural and fMRI approaches, Ruby et al. (2009) found that those with AD were less accurate in their judgments of their own personalities when the first ("I think that I am...") and third-person assessments ("Caroline thinks that I am...") were combined. They also found that those with AD were less accurate in making third-person assessments about their relatives' personalities. In making judgements about the self, healthy younger and older adults tended to rely more on dorsal and ventromedial prefrontal cortices, regions associated with reflective/evaluative processes and episodic memory, while those with AD relied more on the intraparietal sulcus, a region associated with familiarity judgements. The authors suggest that outdated self knowledge in AD is due to a combination of episodic and semantic memory deterioration, and impairments in third-person perspective taking (theory of mind). Due to episodic memory deterioration, those with AD rely more on older, outdated semantic memory to make judgements about their personality. If these judgements are out of keeping with current behaviour (due to recent personality change) their anterograde episodic memory impairments may prevent them from integrating feedback on personality changes into their current self view. The only means available to assess their current traits would therefore be to infer other people's beliefs about them. In AD, however, the ability to infer other people's beliefs may also be impaired, preventing accurate assessment in relation to certain traits.

Evidence from the neuropsychological literature suggests that neither retrograde nor anterograde episodic memory deterioration can explain the phenomenon of outdated self knowledge in AD, because other population groups with severe episodic memory deficits (including those with MTL damage) seem able to maintain an accurate current perception of the self, even in the face of dramatic personality change (e.g., Klein, 2010; Klein & Lax, 2010; Klein, et al., 1996; Tulving, 1993). Klein and colleagues instead hypothesise that this inability to update self knowledge in AD relates to a temporally graded loss of trait self knowledge (Hehman, et al., 2005; Klein, 2010; Klein, et al., 2003), similar to the temporal gradient found in other aspects of semantic memory in AD (Westmacott, Freedman, Black, Stokes, & Moscovitch, 2004). This explanation amounts to the claim that those with AD cannot accurately report their current personality because this semantic information has been forgotten, or was never acquired in the first place. While plausible, this explanation does assume the particular structural theory of self knowledge described above – that knowledge about personality traits comprises a form of semantic knowledge which is stored separately from AM. The hypothesis therefore shares the concerns relating to this wider theory, including that it is not yet known whether other types of self knowledge are similarly independent of episodic memory, and that the independence of other levels of AM (i.e., extended, repeated and lifetime period memories) has not yet been assessed.

In fact, there is evidence that deficits in semanticised AM may contribute to outdated self knowledge in AD. Harrison, Therrien and Giordani (2005) examined "behaviours from past identities" in AD, a symptom which involves the individual behaving in ways that are relevant to past phases in their life (e.g., talking about a now-deceased spouse as though they were alive; getting dressed for a job in which they are no longer employed), and constitute a daily behavioural expression of one's self beliefs. They compared performance on the Autobiographical Memory Interview of AD participants who displayed this symptom with those who did not, matched for level of cognitive decline, and found that those displaying behaviours from past identities performed significantly worse on recent semantic memory. This finding seems to indicate that recent semantic AM may play an important role in maintaining up-to-date self knowledge. Interestingly, this study also suggests that outdated self knowledge may not be a universal symptom, but rather a symptom affecting an identifiable subset of AD patients.

In summary, the research suggests that maintaining an accurate current self knowledge requires a complex interaction of abilities. The degree of personality change that occurs in AD, the temporal gradient in semantic trait knowledge and/or semanticised AM, episodic memory loss, and impairment in non-mnemonic factors, like theory of mind, could all contribute to outdated self knowledge in AD. The present investigation explored some of these possibilities, including the role of deterioration of episodic memory and other levels of AM in outdated self knowledge, and the role of personal change (i.e., change in personality and other characteristics).

In addition to these issues, a possible criticism with checklist accuracy approaches was also explored, relating to the well-known tendency in self-report measures to report oneself in a socially-desirable manner (Robinson, Shaver, Wrightsman, & Andrews, 1991). In self-knowledge accuracy methods, a positive correlation between participant and family member ratings (i.e., "accurate" ratings) could be achieved if both parties describe a socially desirable person. If an individual with AD has retained their semantic knowledge about social desirability, then this tendency to report their traits in a socially desirable manner would make their self reports similar to those of a healthy individual; however, the reports of family members of those with AD may not align with these descriptions. This is because the type of personality change that tends to occur in those with AD is that their personalities move away from a "socially desirable" norm, for example, through a loss of conscientiousness and openness/agreeableness, and an increase in neuroticism (Robins Wahlin & Byrne, 2011).

The accurate but outdated self knowledge in AD could, therefore, be because their "socially desirable" self descriptions more closely match the description of their pre-morbid personalities reported by family members. If so, this preserved "accuracy" in relation to past ratings may not reflect retained pre-morbid self knowledge, *per se,* but rather retained semantic knowledge about an "ideal" (socially desirable) person. To assess this possibility, the present study separately assessed checklist items that were weighted in relation to social desirability and those which were neutral (see Method). If the preserved accuracy of past self knowledge in AD is indeed related to social desirability, then the pattern of better accuracy in relation to past (compared with present) family-memory ratings should occur only on the weighted items. On items which are neutral for social desirability, those with AD should demonstrate poor accuracy in relation to both present and past family ratings, because they would not benefit from knowledge about social desirability when rating these items.

Aims and Hypotheses

With a view to expanding understanding about the role of AM in supporting and maintaining self knowledge, the present study examined the accuracy and spontaneous expression of self knowledge in memory-impaired and healthy older adults. The aim was to provide one of the first investigations of self knowledge in aMCI and extend previous efforts to explore self knowledge in early-moderate AD. In line with previous findings, it was predicted that the AD group would demonstrate accurate, but outdated, self knowledge assessed using a self knowledge accuracy checklist, with participants' ratings more closely aligning with family-members' assessments of their premorbid personality. In order to explore the possibility that this pattern of retained (past) accuracy for self knowledge would extend to other categories of self knowledge (in addition to abstract personality trait knowledge), an expanded self knowledge accuracy checklist was developed , which included contextually specific personality traits, social roles, abilities, preferences, and physical characteristics. In addition, it was hypothesised that the amount of change in personal characteristics demonstrated by the AD group (as reported by family members) as well as the social desirability of checklist items may play a role in explaining this pattern of accurate but outdated self knowledge.

In relation to spontaneous self knowledge, in line with previous findings, it was predicted that the responses of the memory-impaired groups would indicate a loss of strength (fewer statements) and that this change would correlate with deterioration in episodic memory (fewer internal details on the AI). The study also sought to re-examine whether the complexity of self knowledge was affected in AD through the use of a novel, expanded version of the TST. Finally, in addition to the coding method used by Rhee et al. (1995), a novel coding method was used to explore whether contextually and temporally specific self knowledge were equally affected. It was predicted that the deterioration in spontaneous self knowledge would primarily affect specific forms of self knowledge, with abstract self knowledge relatively preserved.

Methods

Participants

Details about the participants used in this study are described in Chapter 2*:* Methods*.* The self knowledge checklist was completed both by the participants, and by a close family member who was identified by participants prior to the first interview. Forty five participants gave written, informed consent for their family member to complete the checklist, and all of those family members gave written consent before they completed the checklist.

Measures

Self-knowledge checklist. Self-knowledge accuracy was assessed using a checklist made up of 60 self-descriptive words and phrases, including 20 self-descriptive words or statements from 3 categories: abstract personality traits, specific (contextualised) personality traits, and other specific self descriptors. The 40 abstract and specific personality trait items were sourced from Anderson's (1968) norms for likeability and meaningfulness, and were selected to have high meaningfulness (scoring over 360). Twenty of these adjectives were amended by specifying a context (at home, with strangers, with close friends and with family) to create the "specific personality traits" category (e.g. "I am tidy when I am at home", see also Cousins, 1989). Checklist items from both the specific and abstract personality trait categories were evenly balanced for positively and negatively valenced traits, and the categories did not differ significantly on likeability (abstract: M=306, specific: M = 291; p = .76), or meaningfulness (abstract: M = 376; Specific: M = 372, p = .23).

The "other specific self knowledge" category comprised 20 words and phrases relating to types of self knowledge identified in studies using spontaneous methods (Cousins, 1989; L'Ecuyer, 1992; Rhee, et al., 1995): social roles, abilities, preferences, and physical characteristics. This category was balanced for positively and negatively worded statements to control for positive response bias. One statement (a brother/sister) was removed, because many participants found it confusing, leaving just 19 statements in this category.

The participants were given the list of descriptive statements (see Appendix G) and asked to assess, on a four-point scale (0 = Not at all; 3 = Definitely), how well the terms described them. As many of the participants had difficulty filling in a long form (e.g., reading, vision, writing), they were given the option to fill in the form by themselves, using paper and pen, or for the interviewer to read the questions aloud and record their responses. If the interviewer was reading the items aloud, the participant was also given a copy of the questions and scale to read.

The chosen family member was given two versions of the form: a "present" condition, which asked them to assess how well the term described the participant at the current time, and a "past" condition which asked them to assess how accurately each term described the participant as they were 10-years ago. In the case of relatives who lived with the participant, the form was filled in while the participant was completing the interview in a separate room. In the case of relatives who did not live with the participant, the form was posted to them, and they were instructed to fill in the form without discussing their answers with the participant. All family members were informed that their answers would be confidential and would not be shared with the participant.

*Scoring the self knowledge checklist***.** The self knowledge accuracy score for each participant was the correlation between the item-by-item ratings of the participant, and those of their family member. Separate correlations were calculated with the family member's current assessment (providing the "present" self knowledge accuracy score) and the family member's assessment of the participant 10-years ago (providing the "past" self knowledge accuracy score).

To address hypotheses relating to different categories of self knowledge, separate accuracy scores for each participant were calculated for each of the three categories of self knowledge (abstract personality traits, specific personality traits, and other self knowledge), using only the checklist items that were relevant to that category.

To address hypotheses relating to social desirability, the checklist items were divided into those which were weighted (either positively or negatively) in terms of social desirability (e.g., truthful, good at socialising, ungrateful, angry when with family) and those which were neutral (e.g., a New Zealander, a gardener). The items with a social desirability weighting were those which rated as likeable or unlikable using Anderson's (N. H. Anderson, 1968) likeability norms, as well as positively or negatively evaluative comments (21 "negative" items and 21 "positive" items). All other items were classified as neutral. For each participant, separate correlations were calculated between participant and family member ratings for items which were weighted and those which were neutral (including past and present conditions for each category).

Twenty Statements Test. Spontaneous self knowledge was assessed using TST (Kuhn & McPartland, 1954), which asks people to answer the question "Who am I?" in 20 statements.

Participants are instructed to give statements in the order they occur to them, and not to worry about the logic or importance of the statements.

The original format of the TST is written, but in order to accommodate participants with AD in the present study the instructions were read aloud, and the researcher transcribed the participants' responses verbatim. To assist participants with memory impairments, a card was placed in front of them with a summarised version of the instructions: "Who are you? Please describe yourself as completely as you can." (see Addis & Tippett, 2004; L'Ecuyer, 1992). If a participant stopped speaking for more than 10 seconds, they were prompted by the interviewer, "Is there anything else you would say about who you are?" The interviewer continued prompting until the participant indicated that they had no further material to add, or until 20 statements were achieved. There was no time limit for this task.

Following this unguided "Main" task, a novel "Supplementary" condition was administered (see Appendix H). In the supplementary task, participants were prompted to provide additional statements under six categories: personality; roles (e.g., family, work or community); social, religious or ethnic groups; activities they like or are good at; physical characteristics; and beliefs or values. These were selected because they are commonly mentioned in spontaneous self-description tasks as well as coding schemes for the TST (e.g. L'Ecuyer, 1992; Rhee, et al., 1995). For each of these categories, the participants were asked "Some people mention [*x*] when they are describing themselves. Is there anything you would like to say about that?" Participants were allowed to exhaust all available answers to each of these categories before they were asked about the next category, with no limit to the number of statements they could provide.

TST coding method. All scores were calculated for both the main and supplementary list, as well as combined total scores. The TST transcripts were coded for the following elements.

1. Strength of self knowledge. To assess strength of self knowledge (Addis & Tippett, 2004), the number of responses provided were counted separately for each list (main and

supplementary), and these scores were also summed to provide a total strength score. Nonsense responses and repeated responses were excluded.

2. Complexity and abstraction. Next, transcripts were coded according the coding scheme used by Rhee et al. (1995), in which each statement is assigned to one of 8 categories and 32 subcategories, with subcategories pre-designated as specific or abstract (see Appendix I). The number of subcategories was used as the measure of complexity of identity, as it provides a more sensitive measure than the number of categories.

Similar to the approach adopted by Addis and Tippett (2004) this coding scheme was amended to allow statements coded as evaluations or aspirations to be designated as either abstract or specific depending on whether they were qualified using specific contextual information. In the present study, a category was also added for “beliefs and values”, as this category has been identified in other studies using spontaneous measures of self knowledge (e.g. L'Ecuyer, 1992) and pilot work examining the data used in Addis and Tippet’s (2004) study indicated that statements relating to beliefs and values did not fit easily into any of the existing categories. Again, “beliefs” could also be coded as either specific or abstract, depending on whether they were qualified.[9]

Each statement could only be assigned to one category and subcategory. In cases where there were two or more parts to the self statement, the following rules were used to determine which category the statement should be assigned to. When statements contained several closely related meanings (e.g., “I am kind and caring”), only the first meaning was coded. If one statement was qualified/described by another from a different category (e.g. elderly lady, blonde waitress) code in relation to the main object of the statement (e.g. lady, waitress) rather than the describing or qualifying terms. Any statement that contained an evaluative descriptor (e.g.

[9] To ensure that these changes to the coding manual did not fundamentally alter Rhee et al.’s (1995) intensions relating to the abstract/specific designations, the data was also coded according to their original manual, and the main analyses were run using both sets of data (data coded using Rhee et al.’s original method not shown). All of the substantive findings reported in the results section were the same regardless of the coding approach used.

good/bad, positive/negative) was coded as an evaluation, regardless of what the evaluation was in relation to (e.g., activities, social roles, abilities, activities, social roles). When a statement combined a preference (i.e., like/dislike) with another category (e.g., social role, a beliefs/values or physical attribute) it was coded in relation to the other category rather than as a preference. When a statement combined a preference with another attribute (e.g. an activity) this was coded as a preference. Negations (e.g., Not a Christian) were assigned to the same category that would have been used if the same statement was described positively (e.g., Social identity – religion).

3. Temporal/contextual specificity. Finally, the transcripts were coded according to a novel Contextual/Temporal specificity coding scheme. Each statement on the TST was assigned to one of five categories (seven subcategories) which differed in relation to whether the attribute described was relevant to a number of different contexts (i.e., activity, place, person or setting) and time periods, or primarily relevant within a specific context and time period:

i. *One off* - attributes relate to a specific context/ moment in time (< one day) (e.g., I have a headache at the moment).

ii. *Specific time period (limited)* - attributes relate to a specific, limited-time period (≤ one year), and either:
   a) one context (e.g., "I've recently taken up swimming"), or
   b) two or more contexts (e.g., "I've been getting a lot of headaches recently")

iii. *Specific repeated context* - attributes relate to one specific context and either:
   a) occur repeatedly within a specific time period (time limited) (e.g., "I took up swimming when I retired"), or
   b) occur across the lifespan (time invariant) (e.g., " I like swimming").

iv. *Specific time period (extended)* - attributes relate to a specific, but extended time period (> one year) and no specific context (e.g., "I've been really happy since I retired").

v. *Abstract – universal* - attributes are not restricted to any particular time or context, but apply universally across the lifespan and different contexts (e.g. "I have brown eyes").

For the purposes of the present study, the subcategories were combined in two different ways to assess either the temporal or contextual specificity of the statements provided on each participant's list. The "Contextual Specificity" dimension contrasts the number of statements that were coded as contextually specific (i.e., those which apply in relation to a specific context; scale items 1, 2a, 3a&b), with the number of contextually abstract statements (i.e., those which apply across many contexts or have no context specified; scale items 4 and 5). The "Temporal Specificity" dimension contrasted the number of temporally specific statements (i.e., those which relate to a specific time period in the person's life; scale items 1, 2 a&b, 3a, 4) with the number of temporally abstract statements (i.e., those which relate across many time periods, or do not relate to any particular time period; scale items 3B and 5). Further details about the categories in this coding scheme, examples of the statements assigned to each, and how these categories were combined within the two dimensions, are set out in Appendix J.

TST coding procedure. The TST transcripts were coded by a single primary coder trained to the coding manual by the author. Inter-rater reliability was calculated against a random selection of 16 transcripts (20%) balanced across group and gender, double coded by a second independent coder. Both coders were blind to group membership and, while aware of the topic matter of the study, were blind to the specific hypotheses relating to the codes they were applying.

For ordinal scales and those which generated a frequency count for each participant, the intraclass correlation coefficient was used to assess reliability (for further details, see Chapter 2: Methods). As the temporal/contextual specificity coding used a nominal scale, Cohen's Kappa (J. Cohen, 1960) was used to assess the degree of consensus achieved between raters on which category each statement was assigned to (J. Cohen, 1960; Gwet, 2012; Stemler, 2004). The kappa statistic is a conservative measure of inter-rater reliability as it takes into account chance agreement. A threshold for reliability of $\kappa > 0.41$ was selected, using Landis and Koch's (1977) widely used criteria in which scores of 0.41-.0.60 represent moderate agreement, 0.61- 0.80

substantial agreement, and 0.81-1.00 almost perfect agreement (see also Stemler, 2004; Viera & Garrett, 2005). Inter-rater reliability statistics are reported in Table 4.1.

Table 4.1. Inter-Rater Reliability Measures for Double Coded Twenty Statements Test Transcripts, Using the Intraclass Correlation Coefficient (α) and Cohen's Kappa (κ).

Variable	*Score*	*Reliability* α
Strength	Number of statements	
	- Main list (max 20)	.899
	- Supplementary list (no limit)	.997
Complexity	Number of categories sampled (max 8)	
	- Main list	.863
	- Supplementary list	.859
	Number of subcategories sampled (max 32)	
	- Main list	.888
	- Supplementary list	.900
Abstract/specific	Number of statements coded abstract:	
Rhee et al (1995)	- Main list	.983
	- Supplementary list	.922
	Number of statements coded specific:	
	- Main list	.987
	- Supplementary list	.982
Contextual/Temporal specificity	Which of 5 categories each statement was assigned to on the Temporal /Contextual specificity scheme	K .770

Procedure

The general interview procedure is set out in Chapter 2: Methods. The TST was administered before the self knowledge checklist in order to prevent any influence on spontaneous self description from the structured checklist (c.f. Spitzer, Stratton, Fitzgerald, & Mach, 1966).

Statistical analysis

All statistical analyses were carried out using IBM SPSS Statistics 20 for Windows. Analyses involving between group and within group differences were analysed using mixed-factorial ANOVAs (for details of how these analyses were applied, see Chapter 2: Methods).

Group differences in relation to ordinal data were assessed using Kruskal-Wallis non-parametric tests, followed up with pairwise comparisons using Mann-Whitney U tests and correcting for multiple comparisons using a Bonferroni correction.

So that self knowledge accuracy scores could be used as the dependent variables in inferential statistics, the correlations between the participant and family members' ratings were transformed using Fisher's (1925) r-to-z transformations (Cox, 2008). Correlations of r = 1.0 are equal to z = infinity, so in such cases the z value for r = .999 was used (z = 3.8) in their place.

To explore relationships between AM variables and measures of self knowledge, Pearson's partial correlations were calculated separately for each group, controlling for general cognitive decline using the MMSE. In the case of correlations involving the TST, the COWA total score was also used to control for decline in verbal fluency, as both the TST and the memory tasks are verbal tasks with a generative component. The significance of correlations were determined using a Holm-Bonferroni (sequentially-rejective) procedure (Holm, 1979) to correct for multiple comparisons (see Chapter 2: Methods).

Results

Performance on Self Knowledge Accuracy Checklist

Fifty two participants completed the self knowledge checklist, however only 45 participants had a family member available to complete the corresponding form (HC: n = 20; aMCI: n = 12; AD: n = 13).

To test the hypothesis that the self knowledge of the AD group would be accurate, but outdated, and to explore whether this pattern would extend across different types of self knowledge, a mixed-factorial ANOVA was conducted with condition (past or present) and type of self knowledge (abstract trait, specific trait, other) as the within-subjects factors, and group (HC, aMCI and AD) as the between-subjects factor. The dependent variable was the (z-transformed) correlations between participant and family-member ratings, calculated separately for checklist items relating to each category of self knowledge (abstract personality trait items, specific personality trait items, and other self knowledge items).

There were significant main effects for condition, $F_{(1, 42)} = 7.07$, $p = .01$, and group, $F_{(2, 42)} = 3.9$, p = .03, and a significant condition by group interaction, $F_{(2, 42)} = 4.95$, $p = .01$ (see Figure 4.2). To investigate which pairs of groups contributed to this interaction, the analysis was rerun for each pairing (i.e., HC and aMCI, aMCI and AD, and HC and AD) (Bonferroni corrected alpha level set at $p < .017$). The interaction between condition and group remained significant only between the AD and HC pairing, $F_{(1, 30)} = 7.82$, $p = .009$. Consistent with the hypothesis of accurate but outdated self knowledge, pairwise Bonferroni comparisons showed that the AD group's ratings were significantly less accurate in relation to the present than the past condition ($p = .001$), whereas the HC group did not differ between conditions ($p = .98$). The AD group's rating were also significantly less accurate than the HC group in the present condition ($p = .002$), but the groups did not differ in relation to the past condition ($p = .47$).

Importantly, there were no significant main effects for type of self knowledge ($p = .21$),or significant interactions between type of self knowledge and condition ($p = .2$) or type of self knowledge, condition and group ($p = .5$), although the interaction between type of self knowledge and group neared significance ($p = .08$). This indicates that the overall pattern of accurate but outdated self knowledge in the AD group was consistent across all three categories.

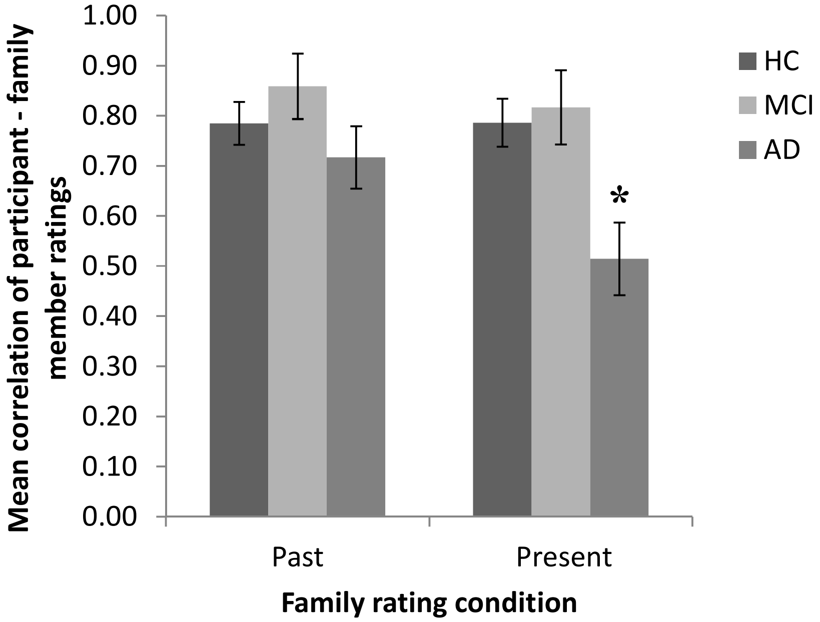


Figure 4.2: Mean correlation between participants' ratings on the self knowledge checklist, and family members' past (10-years ago) and present ratings, for each group.
*HC = Healthy control, aMCI =- amnestic Mild Cognitive Impairment, AD = Alzheimer's disease. Correlations (r-values) are transformed using a Fisher's r-to-z transformation. Error bars denote one standard error around the mean.*AD group significantly lower than HC group, and present condition significantly lower than past for AD group.*

Amount of personal change. To explore the hypothesis that the amount of change in personal characteristics may contribute to inaccurate present self knowledge in AD, the (absolute) discrepancy between the family member's past and present ratings was calculated for each participant. A one-way ANOVA showed a significant difference between the groups on the amount of change reported by family members, $F_{(2, 43)} = 15.85$, $p < .001$. Post hoc Games-Howell tests confirmed that the AD group were rated as having changed significantly more over the past ten years ($M = 34.46$, $SE = 3.52$) than either the HC ($M = 17$, $SE = 1.99$) or aMCI groups ($M = 16.54$, $SE = 1.8$)($p = .001$). The HC and aMCI groups did not differ significantly ($p = .98$).

The accuracy of each participant's ratings (self vs family member present discrepancy score) was next correlated with the amount of change reported for each participant (family member past vs present discrepancy scores). Within the AD group, there was a significant negative correlation, $r = -.79$, $p = .002$, indicating that participants who were least accurate in their present ratings were also those rated as having changed the most. There was no significant correlation in the aMCI (r = -.33, p = .28) or HC groups (r =-.15, p = .54).

If the pattern of accurate but outdated self knowledge for the AD group was driven by the amount of personal change, then the items that family members rated as changing most should also be the items on which participants were least accurate. Consistent with this prediction, there was a significant correlation between the amount of change family members reported in relation to each item (i.e., discrepancy between family member present vs past rating) and the amount of inaccuracy in relation to each item (discrepancy between participant vs family member present ratings), r=.46, p <.001. Together, these findings appear to suggest that the amount of personal change in the AD group was a contributing factor in their outdated self knowledge.

Social desirability. To explore whether social desirability may play a role in the accurate but outdated self knowledge of those with AD, correlations between participant and family member ratings were separately calculated for checklist items which were weighted in relation to social desirability (SocD-Weighted) and those which were neutral (SocD-Neutral), providing four separate conditions: SocD-Weighted present, SocD-Weighted past, SocD-Neutral present and SocD-Neutral past. If the AD group's retained knowledge about social desirability is contributing to their higher accuracy in relation to past compared to present family-member ratings, then the higher accuracy should only be seen in the SocD-Weighted past conditions, while poor accuracy would be expected in the other three conditions. As described above, this is because knowledge of social desirability would not assist them with accuracy on the SocD-neutral items, nor with accuracy on present items (SocD-Weighted or Neutral) as the current characteristics of the AD group are less likely to be rated by family members as aligning with a socially-desirable norm.

A mixed ANOVA was conducted with social desirability (SocD-Weighted, SocD-Neutral) and family member's rating condition (present, past) as the within-subjects' factors, and group (HC, aMCI, AD) as the between-subjects' factors (see *Figure 4.3*). There were significant main effects for group, $F_{(2, 42)} = 4.04$, $p = .03$, condition, $F_{(1\ 42)} = 5.16$, $p = .03$, and a significant interaction between social desirability and condition, $F_{(1, 42)} = 8.06$, $p = .007$. These effects were qualified by a significant three-way interaction between social desirability, condition and group, $F_{(2, 42)} = 3.55$, $p = .04$.

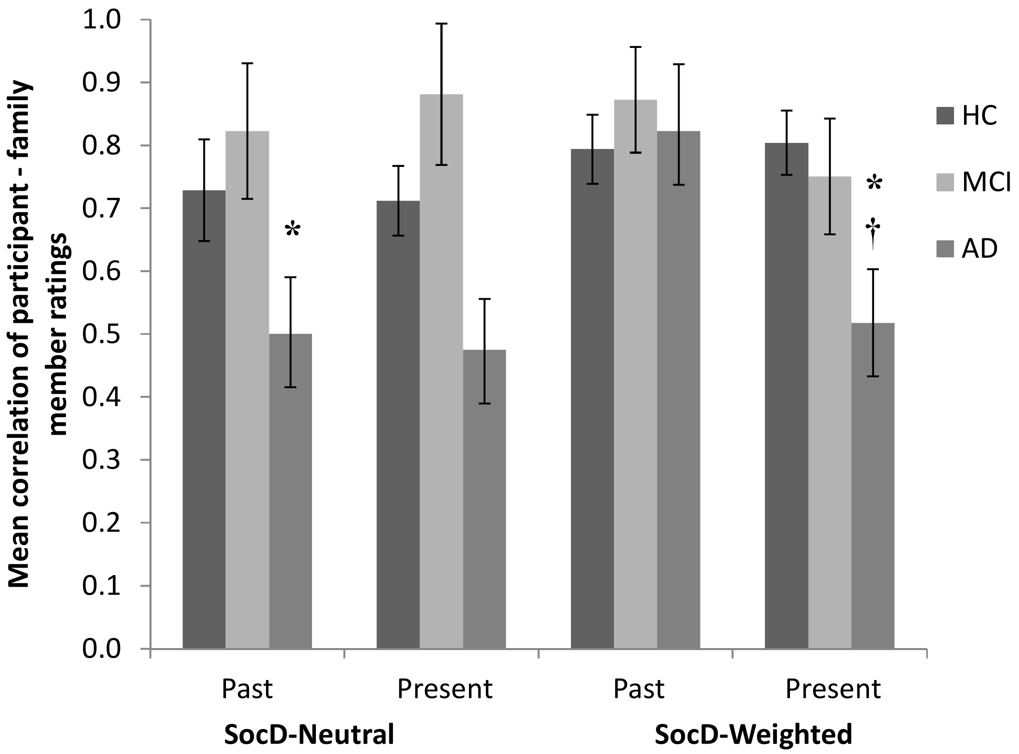


Figure 4.3*: Mean correlation between participants' ratings on the self knowledge checklist and family members' past (10-years ago) and present ratings, calculated separately for items which are weighted (SocD-Weighted) or neutral (SocD-Neutral) in relation to social desirability. HC = Healthy control, aMCI =- amnestic Mild Cognitive Impairment, AD = Alzheimer's disease. Correlations (r-values) are transformed using Fisher's r-to-z transformation. Error bars denote one standard error of the mean.*AD significantly less accurate than HC. † Present rating significantly lower than past for AD group on SocD-Weighted items.*

To determine which groups contributed to this interaction, the analysis was re-run for each pair of groups (Bonferroni corrected alpha level, $p < .017$). The three-way interaction remained significant between the HC/AD groups, $F_{(1, 30)} = 7.34$, $p = .01$, but not the aMCI/HC ($p = .08$) or aMCI/AD pairings ($p = .13$). Consistent with the hypothesis that the social desirability of checklist items may have contributed to past accuracy, Bonferroni pairwise comparisons indicated that on SocD-Weighted items, the AD group were less accurate in relation to the present than the past family ratings (p <.001). This discrepancy between past and present accuracy for the AD group did not hold for SocD-Neutral items (p =.71). In contrast, for the HC group there was no discrepancy between past and present accuracy for either SocD-Neutral or SocD-Weighted items ($p \geq .76$). On the SocD-Weighted items, the AD group were significantly less accurate than the HC group in relation to the family-member's present ratings (p = .004), but not their past ratings (p = .79). For the SocD-Neutral items, the AD group were less accurate than the HC group in relation to past ratings (p = .02) and there was also a non-significant trend for less accuracy in the case of present ratings (p = .079).

Overall, this pattern appears consistent with the hypothesis that knowledge of social desirability might have assisted with the AD group's accuracy in relation to their family members' past ratings, indicating that these apparently accurate past ratings are supported by semantic knowledge about social desirability.

Relationship Between Self Knowledge Accuracy and AM

*Episodic memory and self knowledge accuracy***.** To examine whether deterioration in episodic memory plays any role in the loss of accuracy of self knowledge, partial correlations (controlling for MMSE) were conducted between the accuracy of present self knowledge (i.e., the z-transformed correlations between participant and family member present ratings on the self knowledge checklist) and the number of internal details used in each of the four AI event stories, as well as the number of specific event statements used in each of the life story chapters (see Table 4.2). In order to address the potential confounding influence of socially desirable self knowledge, highlighted above, only the checklist items that were neutral in relation to social desirability were used in calculating the participant-family member correlations.

Table 4.2. Partial Correlations Between the Accuracy of Present Self Knowledge (Social Desirability Neutral Items) and Measures of Specific Event Memory (Number of AI Internal Details and Number of Specific Event Proposition in Each Life Story Chapter).

	Accuracy of Self Knowledge†		
Specific event memory	*HC*	*aMCI*	*AD*
Childhood			
AI internal details	**.65***	-.31	-.08
Specific event details	**.50^**	.10	-.13
Early adulthood			
AI internal details	**.46^**	-.01	.10
Specific event details	.26	.26	.34
Middle adulthood			
AI internal details	**.52^**	.04	.20
Specific event details	.13	.04	.40
Late adulthood			
AI internal details	.28	.29	.01
Specific event details	.13	**.70^**	.11

Notes: Partial correlations controlling for general cognitive decline using Mini-Mental State Examination score. AI = Autobiographical Interview; HC = Healthy control group; aMCI = amnestic Mild Cognitive Impairment group; AD = Alzheimer's disease group.
†The z-transformed correlation between participant and family-member (present) ratings on the self knowledge checklist items which were neutral in relation to social desirability.
* Significant after Holm-Bonferroni correction (first-level corrected alpha level, p <.006)
^ Marginally significant after Holm-Bonferroni correction (p < .05)

After applying a Holm-Bonferroni correction for multiple comparisons (first-level corrected alpha level, p <.006), there was just one significant correlation. In the HC group, the number of internal details provided in the childhood AI event story was positively correlated with the accuracy of self knowledge (p = .003). Consistent with this, in the HC group there were also marginally significant correlations between the accuracy of self knowledge and specific event details in the childhood life story chapter (p = .03), as well as internal details in the early (p = .048) and middle adulthood (p = .02) event stories. For the aMCI group, there was also a marginally significant correlation between the number of specific event details in the late adulthood life period and the accuracy of self knowledge (p = .02). There were no significant correlations for the AD group. This indicates that episodic memory may have played a role in the self-knowledge judgments of healthy adults, but not in the AD group.

Semanticised levels of AM and self knowledge accuracy. An alternative hypothesis is that other levels of AM may support self knowledge. To assess this possibility, partial correlations (controlling for MMSE) were conducted between the accuracy self knowledge (z-transformed correlations between participant/family member present ratings on self knowledge checklist), and the number of extended, repeated and lifetime period memory statements used in each life period (see Table 4.3). Once again, only the self knowledge items that were neutral in relation to social desirability were included in the participant-family member correlations.

Within the AD group, there was a strong, significant correlation between the number of extended event propositions in the early adulthood life story chapter and the accuracy of self knowledge ($p < .001$). Consistent with this, there were also marginally significant correlations between self knowledge accuracy and extended event memory for the middle adulthood period for the AD group, and the early adulthood period for the HC group (all p-values $\leq .05$).

Table 4.3. Partial Correlations Between the Accuracy of Present Self Knowledge (Social Desirability Neutral Items) and the Number of Extended, Repeated and Lifetime Period Propositions Used In Each Life Story Chapter.

	Accuracy of Self Knowledge†		
Number of AM propositions in life story	*HC*	*aMCI*	*AD*
Childhood			
Extended events	.09	.04	-.07
Repeated events	.26	.05	-.08
Lifetime periods	-.12	.36	-.14
Early adulthood			
Extended events	**.46^**	.36	**.86***
Repeated events	.31	-.12	.32
Lifetime periods	.07	-.34	-.17
Middle adulthood			
Extended events	.32	.10	**.58^**
Repeated events	.13	-.09	.18
Lifetime periods	-.11	-.42	-.07
Late adulthood			
Extended events	.00	.11	.17
Repeated events	.28	.09	.06
Lifetime periods	-.04	-.33	.18

Notes: Partial correlations controlling for general cognitive decline using Mini-Mental State Examination score. HC = Healthy control group; aMCI = amnestic Mild Cognitive Impairment group; AD = Alzheimer's disease group.
† The z-transformed correlation between participant and family member (present) ratings on the self knowledge checklist items which were neutral in relation to social desirability.
* Significant after Holm-Bonferroni correction (first-level corrected alpha level, p <.003)
^ Marginally significant after Holm-Bonferroni correction (p < .05)

Spontaneous Self Knowledge

Spontaneous self knowledge was assessed using the TST, which was completed by fifty three participants (HC: n = 25, aMCI: n = 14 aMCI, AD: n = 14). Two participants (one AD and one aMCI) were unable to complete the TST due to health difficulties which prevented them from completing their second interview.

Categories sampled. Table 4.4 sets out the mean percentage of TST statements that were sampled from each category represented in Rhee et al's (1995) coding scheme. A mixed-factorial ANOVA was conducted to examine any group differences in the distribution of these categories, with category (physical, social identities, attributes, evaluations, beliefs, emotions, universal descriptions, other) and condition (main, supplementary) as the within-subject factors and group (HC, aMCI, AD) as the between-subject factor. The dependent variable was the number of statements from each category as a proportion of the total number of statements.

Table 4.4. The Mean Percentage of Statements From Each Category on the Main and Supplementary Lists of the Twenty Statements Test (TST).

	Mean Percentage (SE) of TST Statements					
	Main list			Supplementary list		
	HC	*aMCI*	*AD*	*HC*	*aMCI*	*AD*
Physical	8 (1.50)	6 (2.84)	10 (2.44)	7 (1.28)	8 (1.68)	6 (2.24)
Social	14 (2.37)	14 (3.60)	24 (4.32)	17 (2.15)	16 (2.62)	17 (3.90)
Attribute	54 (3.54)	64 (6.87)	47 (5.92)	49 (3.29)	53 (3.85)	50 (3.96)
Evaluation	13 (2.34)	11(2.36)	8 (2.88)	9 (1.40)	9 (1.92)	7 (2.00)
Belief	5 (2.06)	1 (0.77)	0 (0.36)	14 (1.52)	11 (1.70)	11 (2.71)
Emotion	4 (0.87)	3 (0.88)	6 (2.57)	2 (0.52)	2(0.86)	4 (2.31)
Universal	0	1 (0.77)	0	0	0	0
Other	2 (0.66)	0 (0.36)	4 (1.94)	1 (0.48)	2 (1.37)	3 (2.04)

Notes: SE = Standard Error of the Mean; HC = Healthy Control group, aMCI = amnestic Mild Cognitive Impairment group; AD = Alzheimer's disease group.

There was a significant main effect for category, $F_{(2.41,\ 120.42)} = 217.07$, $p <.001$, with post hoc Bonferroni tests showing that attributes were the most commonly sampled category, followed by social identities; and that universal descriptions were the least common category (all *p-values* $\leq .006$). There was also a significant category by condition interaction, $F_{(2.87,\ 143.55)} = 5.06$, $p = .03$, driven by an increase in the proportion of "belief" statements made on the supplementary list ($p <.001$) and a decrease in the number of emotion statements ($p = .03$). This is likely to be because beliefs were one of the categories explicitly prompted in the supplementary list, while emotions were not. There were no other significant main effects or interactions ($p > .2$), and importantly, no group by category interaction, suggesting that the distribution of responses across categories was similar for the three groups.

Complexity of self knowledge. The complexity of self knowledge was assessed by examining the number of subcategories sampled on the main and supplementary lists of the TST. The distribution of each group in relation to number of subcategories is set out in Figure 4.4.

To test the hypothesis that the experimental groups would demonstrate lower complexity in their spontaneous self descriptions, Kruskal-Wallis non-parametric tests examined the difference between the groups in relation to the number of subcategories sampled on each list. There was a significant difference between the groups in relation to the supplementary list, $H_{(2)} = 10.93$, $p = .004$, and a non-significant trend in relation to the main list, $H_{(2)} = 4.69$, $p = .096$. Consistent with the hypothesis, pairwise Mann-Whitney U tests (Bonferroni corrected alpha level, $p < .017$) confirmed that the AD group sampled significantly fewer subcategories on the supplementary list (*Mdn* = 7.5) than either the HC (*Mdn* = 12) or aMCI (*Mdn* = 10.5) groups ($p \leq .004$). There was no significant difference between the HC and aMCI groups ($p = .50$). It appears that the AD group generated fewer subcategories in their self descriptions, and this difference became significant on the supplementary list, where the number of statements was unrestricted.

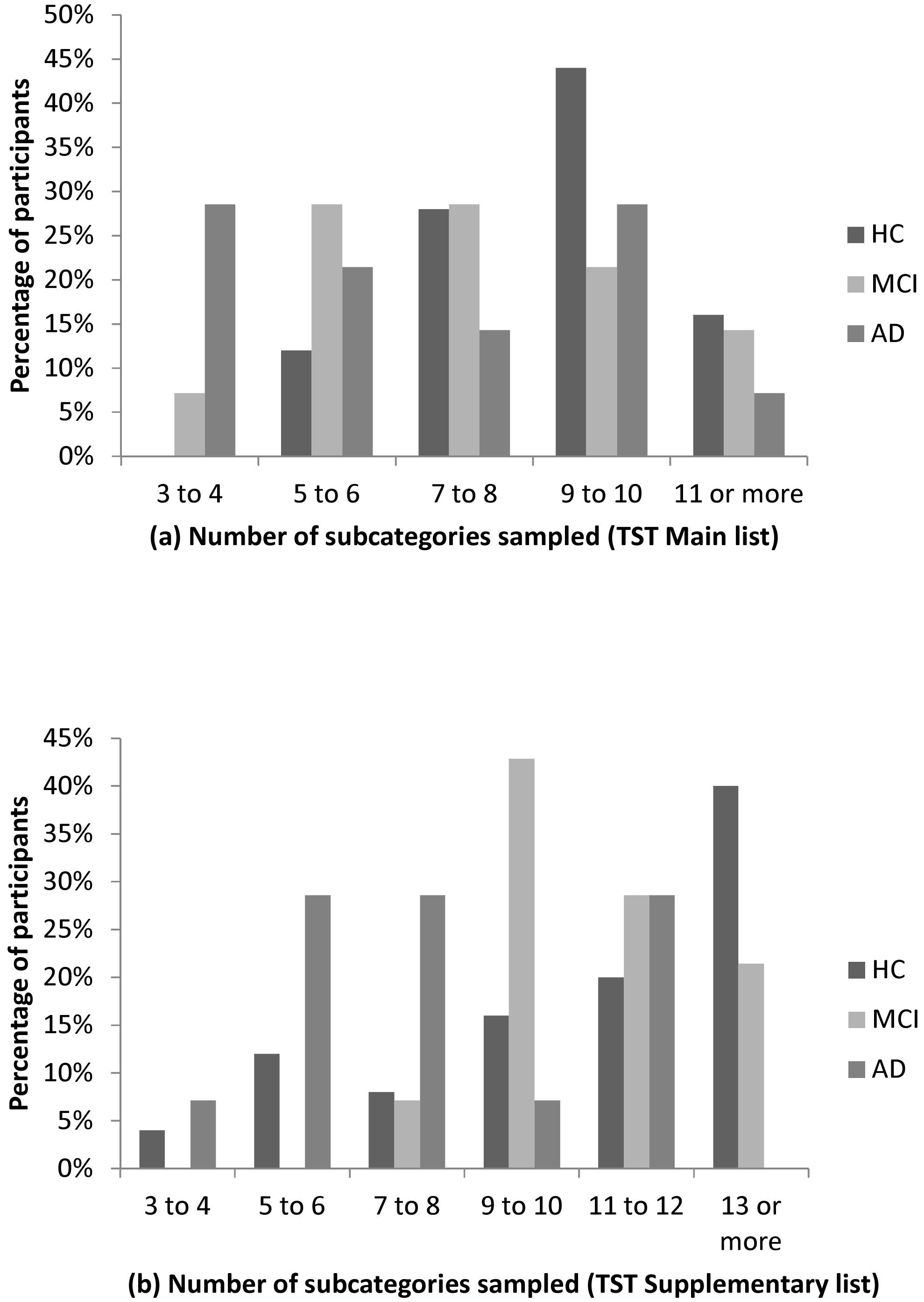


Figure 4.4. Percentage of participants from each group sampling each number of subcategories on the (a) Main and (b) Supplementary lists of the Twenty Statements Test (TST). HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, AD = Alzheimer's disease.

Strength of self knowledge. In order to compare the groups on the strength of self knowledge (number of statements generated) across the main and supplementary lists, a mixed-factorial ANOVA was conducted with condition (main or supplementary) as the within-subjects factors and group (HC, aMCI, AD) was the between-subjects factor. There was a significant main effect for group, $F_{(2,50)} = 8.14$, $p = .001$. In line with the hypothesised reduction in strength of self knowledge, post hoc Games-Howell tests showed that the AD group produced significantly fewer self-descriptive statements across the two lists (M = 31.79, SE = 2.98) than either the HC (M = 45.4, SE = 2.15)(p = .003) or the aMCI groups (M = 44.14, SE = 2.5)(p = .01). The HC and aMCI groups did not differ significantly on the number of statements generated (p = .92).

There was also a significant main effect for condition, $F_{(1,50)} = 10.1$, $p = .003$, although both effects were qualified by a significant interaction between group and condition, $F_{(2,50)} = 3.42$, $p = .04$) (see *Figure 4.5*). To explore this interaction, the analysis was rerun for each pairing combination of groups. The interaction remained significant for the AD/HC, $F_{(1, 37)} = 5.35$, $p = .03$, and AD/aMCI pairings, $F_{(1, 26)} = 7.16$, $p = .01$, but not the HC/aMCI pairing (p = 1.0). Bonferroni pairwise comparisons showed that the AD group used fewer statements than the HC group across both main and supplementary lists ($p \leq .008$) and fewer than the aMCI group in the supplementary (p = .002) but not the main list (p = .13). Both the HC and aMCI groups used a significantly greater number of statements in the supplementary list than the main list ($p \leq .002$), while the AD group used the same number of statements across both lists (p = .68).

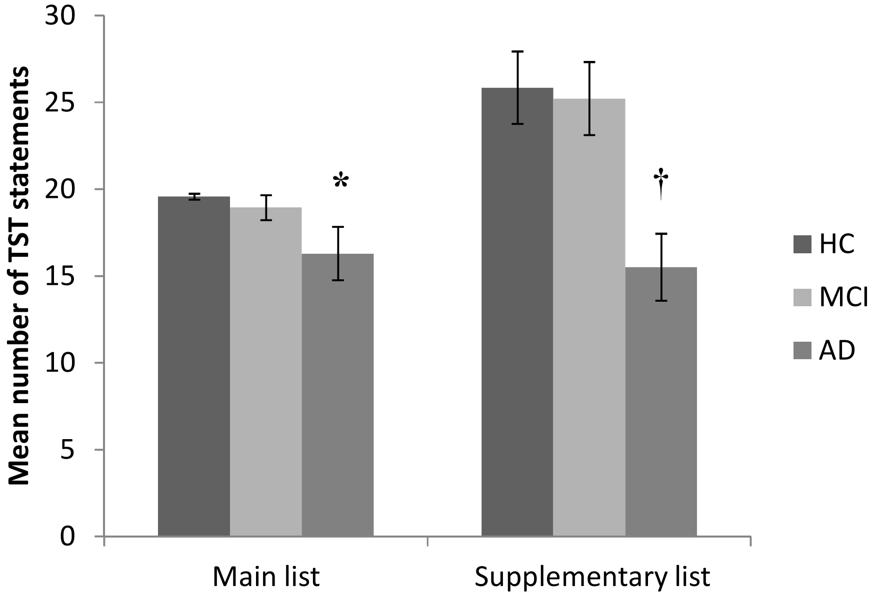
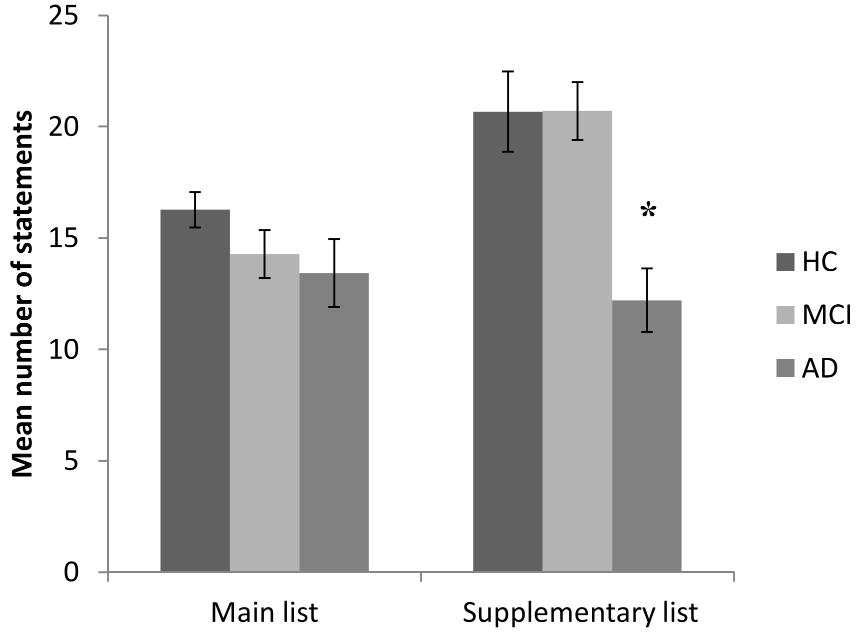


Figure 4.5. *Mean number of statements produced on the main and supplementary lists of the Twenty Statements Test (TST) by each group.*
*HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, AD = Alzheimer's disease. Error bars denote one standard error around the mean. * AD group significantly lower than HC group; †AD group significantly lower than HC and aMCI groups.*

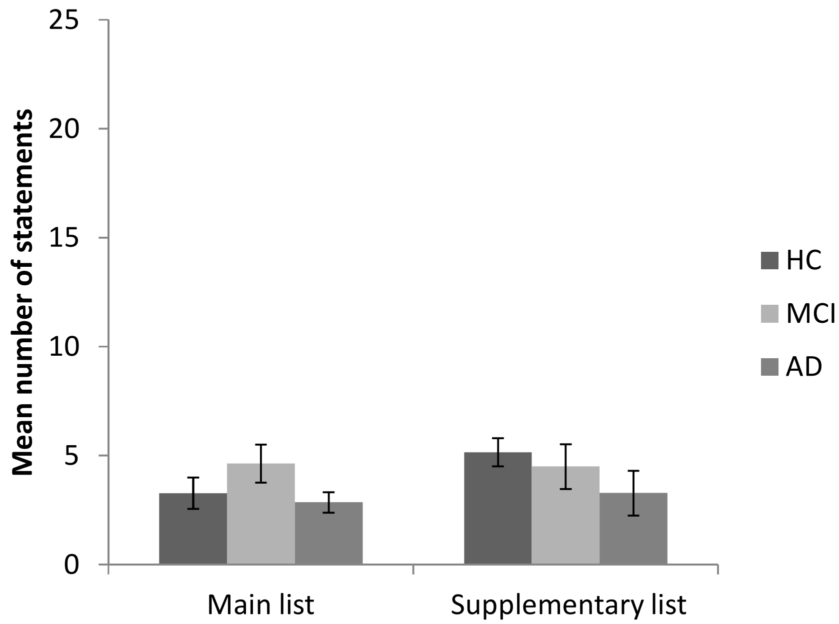
Specificity/abstraction of self knowledge. To examine the hypothesis that the memory-impaired groups would use fewer "specific" self statements in their TST responses, the number and percentage of abstract versus specific self statements were assessed using three different approaches (see Method): Rhee et al.'s (1995) abstract/specific dimension, the contextual specificity subscale and the temporal specificity subscale of the novel Contextual/Temporal coding scheme (Appendix J). To assess the group differences in relation to these dimensions, a series of mixed-factorial ANOVAs were conducted with group (HC, aMCI, AD) was the between-subjects factor, and condition (main or supplementary) and type of statement (abstract/specific) as the within-subject factors. This basic form of ANOVA was run three times, using each of the alternative abstract/specific dimensions in turn as the "type of statement" within-subjects factor. As the form of the analysis was the same as that used above, the group, condition and group by condition effects were the same for each of these analyses (see Strength of self knowledge above); the effects that are of interest for the present discussion are the main effects and conditions relating to type of statement, which are set out below.

1. Rhee et al's (1995) abstract/specific dimension. First, the analysis was run contrasting the number of statements that were coded as abstract or specific using Rhee et al.'s coding scheme (see *Figure 4.6*). There was a significant main effect for the type of statement, $F_{(1, 50)} = 240.88$, $p < .001$, with post hoc Bonferroni analysis showing that across all of the groups and both lists, participants used a greater number of specific self statements ($M = 33.4$, $SE = 1.47$) than abstract self statements ($M = 8.1$, $SE = .69$)($p < .001$). There was also a non-significant trend for a group by type of statement interaction ($p = .06$), and a significant group, type of statement and condition interaction, $F_{(2, 50)} = 3.29$, $p = .046$. To determine whether the group by condition interaction differed according to the specificity of statements, the analysis was rerun separately for each type of statement (abstract, specific). The interaction remained significant only for specific statements, $F_{(2, 50)} = 4.29$; $p = .02$, indicating that there was no difference between the groups in relation to abstract statements. Consistent with the hypothesised reduction in specific self statements, post hoc Games-Howell analyses showed that the AD group used fewer specific statements in the supplementary list than the HC or aMCI groups ($p \leq .01$). The groups did not differ on the number of specific statements on the main list ($p \leq .19$).

To assess whether the AD group's lower use of specific statements in the supplementary list was simply due to the overall lower number of statements produced by this group, a mixed ANOVA was conducted using the percentage of specific statements as the dependent variable. This time, there were no significant main effects for group ($p = .94$) or condition, ($p = .39$), and no interaction between condition and group ($p = .15$), indicating that the percentage of specific self statements used was similar across groups (see Table 4.5). This suggests that the AD group were not in fact producing fewer specific statements in proportion to the overall number of statements that they were generating.



(a) "Specific" statements on the TST



(b) "Abstract" statements on the TST

Figure 4.6. *Mean number of statements on the main and supplementary lists of the Twenty Statements Test (TST) coded (a) specific or (b) abstract using Rhee et al.'s coding.*
HC = Healthy control, aMCI =- amnestic Mild Cognitive Impairment, AD = Alzheimer's disease Error bars denote one standard error around the mean. AD group significantly fewer statements than the HC or aMCI groups.*

Table 4.5. The Mean Number of Statements Coded 'Specific' Using Rhee et al.'s (1995) Coding Method as a Percentage of the Total Number of Statements Generated on Each List of the Twenty Statements Test (TST.

	Mean Percentage (SE) of TST Statements		
	Main list	Supplementary list	Total
HC	83 (4)	79 (2)	81 (2)
aMCI	75 (5)	84 (3)	80 (3)
AD	80 (5)	82 (4)	81 (4)

Notes: SE = Standard Error of the Mean; HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, AD = Alzheimer's disease).

2. Contextual specificity. The mixed ANOVA was rerun using the number of contextually-specific versus abstract statements (using Contextual Specificity coding scheme) as the "type of statement" within-subjects factor. There was a significant main effect for type of statement, $F_{(1, 50)}$ = 46.87, p < .001, with post hoc Bonferroni analysis indicating that participants across all groups and conditions tended to use fewer contextually-specific statements (M = 14.67, SE = 1.16) and more contextually-abstract statements (M = 25.85, SE = 1.36)(p <.001). Importantly, however, there were no significant interactions for group and type of statement, or group, type of statement and condition (all *p-values* ≤ .54). To remove the possible confound of total number of statements, the analysis was also run using the number of contextually-specific statements as a percentage of the total number of statements. This analysis showed no significant main effect for group or interaction between group and condition (all *p-values* ≤ .76). Consistent with the raw data, these findings indicate that there was no significant difference between the groups in relation to the contextual specificity of their self descriptions.

3. Temporal specificity. The mixed-factorial ANOVA was run contrasting the number of temporally-abstract versus temporally-specific statements (using Temporal Specificity coding scheme) as the type of statement within-subjects factor. There was a significant main effect for type of statement, $F_{(1, 50)}$ = 23.77, p < .001, qualified by a significant interaction between group and type of statement, $F_{(2, 50)}$ = 6.18, p = .004 (see *Figure 4.7*). To examine this interaction, the analysis was rerun for each group pairing, and remained significant for the HC/AD, $F_{(1, 37)} = 12.19$, $p = .001$, and aMCI/AD pairings, $F_{(1,26)} = 4.6$, $p = .04$, but not the HC/aMCI pairing ($p = .32$). Bonferroni pairwise comparisons showed that the AD group used significantly fewer temporally-abstract statements compared with either the HC or aMCI groups ($p \leq .003$), but did not differ from these groups in relation to temporally-specific statements ($p \leq .72$). The HC and aMCI groups also used a significantly larger number of temporally-abstract than temporally-specific statements ($p \leq .004$), while the AD group used very similar numbers of each ($p = .93$). This finding runs opposite to the hypothesis that the AD group would use fewer temporally-specific statements. There was no significant condition by type of statement interaction ($p = .16$), although the group, condition and type of statement interaction neared significance ($p = .08$).

To assess whether the AD group's lower use of temporally-abstract statements in the supplementary list was due to the lower number of statements overall, a mixed ANOVA was run using the proportional data (see *Figure 4.7*), again with condition (main, supplementary) as the within-subjects factor and group (HC, aMCI, AD) as the between-subjects factor. The percentage of temporally abstract statements was the dependent variable (rather than percentage of temporally specific statements, as in the previous analyses) because it was in relation to the number of temporally-abstract statements that the AD group differed from the other groups. There was a significant main effect for group, $F_{(2, 50)} = 4.23$, $p = .02$. Consistent with the raw data analysis, post hoc Games-Howell comparisons indicated a marginally significant trend for the AD group to use a lower percentage of temporally-abstract self knowledge compared to the HC group ($p = .05$). This suggests that the AD group were not only producing fewer temporally-abstract statements, but fewer in proportion to the overall number of statements they were generating. There were no significant main effects for condition, ($p = .58$), and no interaction between condition and group ($p = .08$).

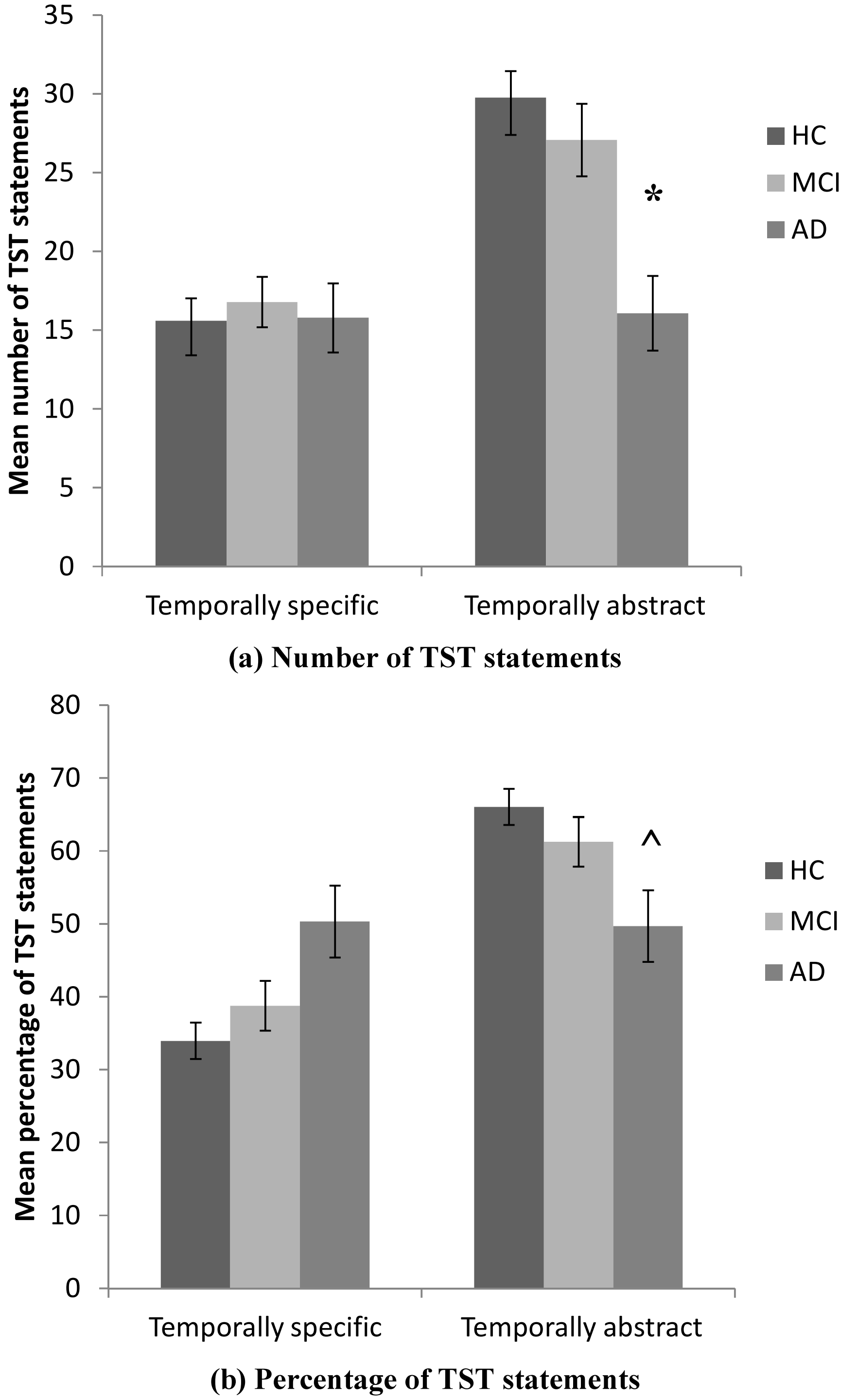


Figure 4.7. *Mean (a) number and (b) percentage of total Twenty Statements Test (TST) statements coded temporally-specific versus abstract using Temporal specificity coding scheme. HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, AD = Alzheimer's disease. Error bars denote one standard error around the mean.* Significantly lower than HC/aMCI groups; ^ Marginally significant difference (p = .05) between AD and HC groups.*

Summary. The analysis above found no significant difference between the groups on two of the three abstract/specific dimensions measured: the Rhee abstract/specific and the contextual specificity dimension. Although the raw data using Rhee et al.'s (1995) coding scheme suggested a lower number of specific statements were used by the AD group, the percentage of abstract versus specific statements did not differ significantly between the groups. These findings challenge the hypothesis that there is a deterioration in contextually-specific self knowledge in AD. There was, however, a significant difference found in relation to the number and percentage of temporally-abstract self statements. Contrary to expectations, the AD group tended to use a lower number, and proportion, of temporally abstract self statements.

Relationship between spontaneous self knowledge and AM. To explore the relationship between spontaneous self knowledge and AM, partial correlations were conducted, controlling for MMSE and COWA. To minimize the number of correlations, total TST scores were used, and the self knowledge variables showing group differences were included: strength (number of statements), complexity (number of subcategories), percentage of temporally abstract responses.

To examine whether deterioration in episodic memory may have contributed to the deterioration in self knowledge in the AD group, correlations were conducted with the number of internal details on each AI event story and the number of specific event details in each life story chapter (Table 4.6). There were no significant correlations for any of the groups after applying a Holm-Bonferroni correction (first-level corrected alpha level, $p < .002$). In the AD group, however, there were a series of marginally significant correlations; between both strength and complexity of self knowledge and the number of specific events in the childhood life story chapter ($p <.02$), and between the percentage of temporally abstract statements and the number of specific event details provided on the late adulthood life period ($p = .005$).

Table 4.6. Partial Correlations Between Measures of Specific Event Memory (Number of AI Internal Details and Number of Specific Event Propositions Used in Each Life Story Chapter) Memory and Scores on the Twenty Statements Test (TST).

	Measures of Specific Event Memory							
	Childhood		Early adulthood		Middle adulthood		Late adulthood	
TST Scores	*Internal details*	*Specific events*	*Internal details*	*Specific events*	*Internal details*	*Specific Events*	*Internal details*	*Specific Events*
HC								
Strength †	.24	.08	.11	-.07	.13	.10	-.00	**-.43**^
Complexity‡	.13	-.11	.21	-.22	.04	-.06	-.19	-.38
% Temporally abstract	.37	.31	-.11	.00	-.10	.06	.32	-.04
aMCI								
Strength †	.08	.40	-.08	.53	.43	.43	-.09	.32
Complexity‡	-.25	.00	-.16	.27	.01	.21	-.26	.00
% Temporally abstract	.05	.17	-.32	.05	.16	.43	.07	.36
AD								
Strength †	.25	**.66**^	.14	-.29	.11	.53	-.09	.02
Complexity‡	-.10	**.68**^	.32	-.09	-.34	.52	-.17	.02
% Temporally abstract	.15	.08	.56	.20	-.07	.02	.13	**.75**^

Notes: Partial correlations controlling for general cognitive decline using Mini-Mental State Examination score and verbal fluency using Controlled Oral Word Association score.
HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, AD = Alzheimer's disease.
† Strength measured as number of statements generated in both lists of the TST
‡Complexity measured as number of subcategories sampled, across both lists of the TST
^ Marginally significant after Holm-Bonferroni correction ($p < .05$)

Second, partial correlations were conducted with the number of extended, repeated or lifetime period details used in each life story chapter to examine the possibility that changes in other levels of AM may contribute to differences in spontaneous self knowledge (Table 4.7). There were no significant correlations, after applying the Holm-Bonferroni correction (first-level corrected alpha, $p < .001$). There was, however, a marginally significant positive correlation in the AD group between strength of self knowledge and the number of lifetime period details in the childhood chapter ($p = .04$), which provide further tentative support for the role of childhood AM in relation to the strength of self knowledge. In the HC and aMCI groups, there were only a series of marginally significant negative correlations: between complexity of self knowledge and extended event memory in the childhood period (HC: $p = .001$), strength of self knowledge and lifetime period knowledge in the middle adulthood period (HC: $p = .03$), and strength of self knowledge and repeated memory in the early adulthood life period (aMCI: $p = .04$).

Table 4.7. Partial Correlations Between the Number of Life Story Propositions Using Each Level of AM and Scores on the Twenty Statements Test (TST)

	Number of AM Propositions in the Life Story											
	Childhood			*Early Adulthood*			*Middle adulthood*			*Late adulthood*		
TST Scores	*EE*	*RE*	*LP*	*EE*	*RE*	*LP*	*EE*	*RE*	*LP*	*EE*	*RE*	*LP*
HC group												
Strength †	-.35	-.10	.11	.08	-.04	.18	.26	-.23	**-.46^**	.05	.00	.07
Complexity‡	**-.64^**	-.23	.07	-.04	-.19	.04	-.10	-.30	-.15	-.12	-.12	-.29
Temporally abstract %	.33	.43	-.04	.34	.03	-.09	.28	.30	-.31	.10	.28	.04
aMCI group												
Strength †	-.15	.10	-.09	.40	**-.60^**	-.27	-.05	-.23	-.31	.22	-.21	-.00
Complexity‡	.12	.47	-.40	.35	-.30	-.49	.16	-.28	-.56	.25	-.44	-.08
Temporally abstract %	-.21	-.32	.14	.40	-.33	.06	-.01	-.21	-.38	.29	.38	.07
AD group												
Strength †	.23	.21	**.60^**	-.52	-.25	.35	-.46	.38	.38	-.32	.13	.37
Complexity‡	.19	.39	.18	-.05	-.03	-.17	-.30	.30	-.02	-.19	-.33	.00
Temporally abstract %	.08	-.26	.21	-.01	.16	-.17	-.08	.38	-.06	.13	-.12	-.32

Notes: Partial correlations controlling for Mini-Mental State Examination and Controlled Oral Word Association scores. AM = Autobiographical memory; EE = Extended event memory; RE = Repeated event memory; LP = Lifetime period memory; HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, AD = Alzheimer's disease.
† Strength measured as number of statements generated in both lists of the TST
‡Complexity measured as number of subcategories sampled, across both lists of the TST
^ Marginally significant after Holm-Bonferroni correction ($p < .05$)

Discussion

This chapter set out to investigate the possible role of AM in supporting and maintaining self knowledge in healthy and memory-impaired older adults. As one of the first formal investigations of self knowledge in aMCI, the present findings indicate that self knowledge in this group is well preserved, with no apparent deterioration in the accuracy or spontaneous expression of self knowledge. The results also confirm many previous findings relating to the changes that may take place to self knowledge in AD, including deterioration in the accuracy of present self knowledge, and a reduction in the strength and complexity of spontaneous self knowledge. Tentative support was also found for a relationship between AM for childhood and early adulthood periods and some aspects of self knowledge. These findings will now be discussed in detail, along with some ways in which the present results extend and challenge previous literature relating to self knowledge in AD.

The Accuracy of Self Knowledge

Consistent with previous findings (Hehman, et al., 2005; Klein, et al., 2003; Rankin, et al., 2005), the present results indicate a pattern of accurate but outdated self knowledge in AD. By expanding the self knowledge checklist to include many categories of self knowledge, the present study demonstrated that this pattern was not restricted to abstract personality trait knowledge, but also extended to other forms of self knowledge including specific (contextualised) personality trait knowledge, physical characteristics, abilities, social roles and preferences. This finding challenges the notion that personality trait knowledge is a special form of self knowledge (Klein, 2010; Klein & Gangi, 2010; Klein & Lax, 2010), and suggests that some other underlying structure may better explain the finding of preserved self knowledge accuracy in memory-impaired populations. To confirm this, future studies involving other memory-impaired populations could similarly use checklist accuracy formats which assess a wider range of self knowledge beyond personality traits.

In contrast to previous findings (Rankin, et al., 2005), there was also evidence that the amount of personal change that takes place in AD may be a factor contributing to their outdated self knowledge. Within the AD group, those who were reported by family members to have changed the most were also those who demonstrated the greatest inaccuracy in relation to family-members' present reports. In addition, across all groups, the items which family members reported the greatest change also showed the greatest degree of inaccuracy in relation to the present-time family reports. This provides tentative support for the idea that keeping up with the extent of personality change may be a factor contributing to outdated self knowledge in AD. Until this important issue is better understood, it is difficult to assess which other factors in AD may contribute to the inaccurate present self knowledge.

An intriguing question is whether the same degree of personal change could similarly cause difficulties for memory-healthy older adults in maintaining accurate current self knowledge. When looking at an item-by-item level across all of the groups, there was a significant correlation between the degree of change family members reported in checklist items, and the level of accuracy in participants' reports, possibly indicating that it was the degree of personal change, as well as group membership, that was driving the inaccuracy of self knowledge. Although the present study did not find any correlation between the degree of accuracy and degree of change in the HC group, this may simply be because the HC group had not experienced very much change. It may be that if healthy older adults did experience significant changes in their personal characteristics, they too would have difficulty accommodating these. Neuroimaging evidence suggests that when making self-personality judgements, older adults tend to rely less on regions used for episodic memory and inferential reasoning processes than younger adults (Ruby, et al., 2009), possibly because they have greater confidence in this knowledge, and therefore have less need to think through their answers and verify them against recent experiences. It may be that these strategies for accessing self knowledge would make it difficult for older adults to accommodate extensive personal change. Indeed, there is also evidence that older adults place a greater emphasis on stability in relation to the self than younger adults (McLean, 2008). To assess this possibility, future research could compare older adults who have undergone considerable personal change with those who have remained more stable to assess whether they similarly experience difficulties maintaining an accurate record of current self knowledge.

Another important finding of the present study was that this pattern of retained accuracy for past self knowledge only applied to items that were weighted for social desirability; on items that were neutral for social desirability the accuracy of the AD group was equally poor in relation to present and past family-member ratings. One explanation for this finding is that the apparently preserved past self knowledge found in those with early-to-moderate AD may relate to preserved semantic knowledge about social desirability. This finding alone does not discount the possibility that there may be preserved but outdated self knowledge in AD; it is important to note, for example, that there is also evidence of outdated self knowledge in domains which do not appear to be affected by social desirability, including self-face recognition (Hehman, et al., 2005), reporting of age (Eustache, et al., 2013) and behaviours from past identities (Harrison, et al., 2005). Nevertheless, the present findings do call to question the notion of perfectly preserved past self knowledge in AD, and highlight the importance of future investigations taking into account the social desirability of the items being assessed.

The Spontaneous Expression of Self Knowledge

The results of this study replicated previous findings that those with AD are not able to generate as many self-descriptive statements as healthy older adults (Addis & Tippett, 2004; Eustache, et al., 2013). Through the use of a novel, supplementary TST task which used specific prompts, the present study also demonstrated that the use of prompting did not reduce this difference. On the contrary, the HC and aMCI groups were greatly assisted by prompting, and tended to produce more statements on the supplementary task, while prompting did not assist the AD group. This indicates that the lower number of self descriptive statements is not due to difficulties spontaneously generating categories of self knowledge, but rather appears to reflect a real inaccessibility or loss of self knowledge.

Like previous investigations (Addis & Tippett, 2004; Eustache, et al., 2013), there was no significant difference found between the memory-impaired and healthy groups in relation to the number of subcategories that were accessed on the traditional administration of the TST. There was, however, a difference in relation to the novel, supplementary task used in the present study, on which the AD group provided significantly fewer subcategories. It could be that those with AD had exhausted their self knowledge by the time this second task was administered. Alternatively, it could be that the prompting in the second task encouraged greater complexity of self knowledge in the HC and aMCI groups that was just not possible for the AD group. Perhaps by simply allowing an unlimited number of statements, this supplementary task removed the ceiling effects of the traditional TST task and permitted healthy individuals greater scope to develop and describe their self knowledge. Whatever the reason for this difference, it appears that the supplementary task delineated the limits of self knowledge available to those in the AD, suggesting that when healthy older adults are allowed to fully elucidate their self knowledge, there is a difference not only in the number but also the range of self descriptive statements available to those with AD. It is interesting to note that although the AD group sampled fewer subcategories, there was no difference between the groups on which categories they were sampling from, suggesting that any reduction in complexity does not represent a systematic loss of entire categories of self knowledge, but rather a finer-grained loss of the amount and range of knowledge available.

Relationship Between Self Knowledge and AM

Although many aspects of self knowledge had changed in AD, the evidence was less clear as to whether these changes related to AM deterioration. There were no significant correlations found between the accuracy of present self knowledge and episodic memory performance in the AD group, suggesting that deterioration in current self knowledge accuracy was not related to episodic memory deterioration in this group. Interestingly, however, within the HC group there was a significant relationship between the accuracy of self knowledge and childhood episodic memory performance (both the number of AI internal details used in the event story and the use of specific event memory in the life story), as well as marginally significant correlations with the number of AI internal details used in the early and middle adulthood stories. This pattern could indicate that, due to their episodic memory deterioration, those with AD are less likely to rely on episodic memory when assessing their personal characteristics, perhaps relying more heavily on familiarity-based judgements as suggested by Ruby et al. (2009). It is important to note, however, that the AD group did not retain either past or present accuracy on items that were neutral for social desirability, which were the subject of this particular line of investigation, suggesting perhaps that familiarity-based strategies were not successful for them.

In support of the hypothesis that other levels of AM may also play a role in supporting self knowledge, there was a strong, significant relationship between the accuracy of present self knowledge and the amount of extended event memory used in the early adulthood life story chapter in the AD group; the same pattern was supported by a serried of marginally significant correlations in the HC and AD groups. This finding suggests that memory for extended events, particularly from early adulthood, may play an important role in supporting and maintaining present self knowledge accuracy. To date, there has been very little research into the role of this type of AM in supporting self knowledge, but this finding suggests that further investigations is warranted. As noted in Chapter 2, extended event memory showed marked deterioration in the AD group. It may be extended memory is a particularly useful configuration of AM for supporting and maintaining self knowledge, because it not only shares many characteristics with episodic memory, including close, experiential richness, but also covers longer time periods, thus providing a useful way to capture, summarise and express life events that were formative in creating one's sense of identity. A recent investigation into the functions of AM, as expressed within the memory narratives of healthy adults, has similarly suggested that extended event memory may play an important self-defining role (Waters, Bauer, & Fivush, 2013). It would be useful for future investigations to explore subtypes of extended memory to assess which are important for supporting self knowledge (e.g., memories that are essentially a series of related specific events versus schematic summaries of extended periods of life).

Although there were no significant correlations found between strength or complexity of self knowledge and any measures of AM, a number of marginally significant correlations were found which align with previous research. In the AD group, there were marginally significant correlations between both strength and complexity of self knowledge and the number of specific memory statements, as well as the number of lifetime period statements, used in the childhood life story chapter. These results parallel previous findings of correlations between strength of self knowledge and both event and semantic AM in childhood and early adulthood periods (Addis & Tippett, 2004; Haslam, et al., 2011). The present findings therefore provide further support for the suggestion that deterioration in specific and semanticised forms of AM from one's early life may impact the amount and range of self knowledge available. This may partially explain the intact self knowledge of the aMCI group, as the present findings suggest that memory for these early life periods is well preserved in aMCI (see Chapter 2).

The Specificity versus Abstraction of Self Knowledge

Another important goal of the present investigation was to clarify the relationship between episodic memory deterioration and the reduction in specific forms of self knowledge which has been reported in previous studies (Addis & Tippett, 2004; Tanweer, et al., 2010), by exploring a number of alternative interpretations of the abstract/specific dimension. Consistent with Addis and Tippett's (2004) study, those with AD produced a lower number of specific self statements as coded using Rhee et al.'s (1995) characterisation. This difference did not persist, however, when proportional measures were used. It appears that in the present AD group any reduction in specific statements was due to the lower number of statements provided overall. Similarly, there was no difference between the groups when using the novel contextual specificity coding scheme, which was devised to more precisely isolate the contextual specificity of self knowledge. The present findings therefore do not support the hypothesis that episodic memory deterioration preferentially impacts contextually specific forms of self knowledge.

One difference between the present study and that reported by Addis and Tippett (2004) is that the AD group in the present study produced a greater number of statements on the main list (M = 16.29) compared with the group in their study (M = 11.55). Subtle differences in participants, interview context and technique (e.g., the amount of non-specific prompting provided, the duration, other measures which had preceded the TST) may have increased the number of statements achieved by the present group. It may be that the additional statements provided by the AD group in the current study disproportionately increased the number of specific statements. In support of this suggestion, there was a strong, positive correlation between the number of statements provided on the main list and the percentage of specific statements used in the AD group (r =.70, p = .01), suggesting that those who provided more statements also tended to provide a greater proportion of specific statements. A tentative explanation is that contextually specific self knowledge may be less readily accessible for those with AD, and that more time and prompting is required to access this form of self knowledge.

A surprising result from the present investigation was the nature of difference in the temporal specificity of self knowledge in the AD group, measured using the novel Temporal/Contextual Specificity coding method. Contrary to the hypothesised reduction in all specific forms of self knowledge, the AD group in fact demonstrated well preserved temporally-specific self knowledge (e.g., I'm an elderly lady; I've got no energy anymore; I used to enjoy going to children's school things), but a decline in the number and proportion of temporally-abstract self statements (e.g., I enjoy the sky/planets; I'm an affectionate person; I have curly hair) compared with healthy older adults and those with aMCI. This finding indicates that those with

AD were less likely to describe themselves in ways which applied across the lifespan. It is unlikely that this pattern was due to differences in the categories of self knowledge sampled by the AD group (e.g., attributes, physical characteristics, social identities) because the proportion of statements sampled from these categories did not differ between the groups. Nevertheless, future investigations could examine whether particular subcategories of temporally abstract statements are used less frequently by those with AD (e.g., temporally invariant traits or preferences etc).

It is possible that this pattern of results is not due to a reduction in temporally abstract statements *per se,* but rather reflects an overall reduction in self-descriptive statements, accompanied by proportionally greater reliance on temporally-specific statements. One variety of temporally-specific statement which occurred in the responses of the AD group were those which reflected an awareness of changes in general health and aging (e.g., “I’m getting older”, “I can’t do as much as I used to”, “My health isn’t what it was”) as well as comments specifically relating to changes in cognitive and memory functioning (e.g., “I have memory problems now”, “I don’t like what is happening to me”). Another type of temporally-specific statement was those which reflected a self concept grounded in a previous time period, for example, childhood (e.g., “I grew up in Brazil”, “I was a very good choir boy”) or a pre-morbid adult period (e.g., “I was a teacher”, “I used to play tennis a lot”). The present investigation did not examine whether these “awareness of change” or “connection to the past” comments were more common in the AD group, but this would be a fruitful avenue for future investigations. Both of these types of responses were also reported by Eustache et al. (2013): 6 of their 16 AD participants included reflective comments about their present condition or identity (e.g. stating that they no longer knew who they were) and 4 included outdated statements that related to previous stages of life.

These possibilities both speak to disjointedness in continuity of self concept, though in quite different ways. The former suggest an awareness of changes that are taking place, and the impact these changes may have on the aspects of the self that have previously provided continuity of self concept. It would be interesting for future studies to explore whether such comments are more common in those with better awareness of their memory deterioration. The latter variety of statements indicate a connection to a past, outdated, version of the self, which may be particularly common in a subset of AD patients who have been identified in previous research as displaying “behaviours from past identities” (Harrison, et al., 2005). An interesting possibility is that this link to previous time periods could relate to the temporal gradient in semanticised AM, found in the present study as well as previous research (Addis & Tippett, 2004; Leyhe, et al., 2009), which may link those with AD to the self knowledge that is relevant to previous, better remembered time periods. Future studies could further examine the temporal abstraction of self knowledge by using coding methods which can distinguish the particular temporal period of temporally specific statements (e.g., current time, recent past, distant past).

While no significant correlations were found between AM and the loss of temporally abstract self knowledge, there was a marginally significant correlation with the use of specific event details in late adulthood in the AD group. This indicates that those who included fewer specific events in the later life chapter also provided a lower proportion of temporally abstract self statements. It may be that memory for this later life period supports the continued use of statements that have remained continuous across the lifespan, and that an inability to recall later life events leaves individuals less certain about whether these life-long characteristics remain applicable. Unfortunately, the large time period covered by this late-adulthood life period does not differentiate whether it was memory for a pre-morbid period that was important or memory of the recent, post-illness period. Future investigations could assist by providing finer divisions for this late-life period.

An important contribution of the present study is to highlight that apparently small changes to research methods can reveal previously obscured ways in which self knowledge may be affected in AD. For example, the present study has advanced understanding about outdated self knowledge in AD by including a wider range of categories of self knowledge, and taking into account the amount of personal change in individuals and the social desirability of checklist items. Deficits in the complexity of spontaneous self knowledge and in the use of temporally abstracted self knowledge were revealed by using a novel supplementary TST condition and coding scheme. This discussion has in turn described various ways in which these methods could be expanded to explore some of the questions that have arisen from the present findings. Ultimately, these methodological challenges reflect the fact that the study of self knowledge still in its infancy. In order to reveal the true nature of self knowledge deficits in AD, or any other condition, it is vital that researchers continue to strive for new and better ways to assess self knowledge.

Chapter 5. Self Continuity

Interviewer: Do you feel that you are the same person now as you were when you were in your early 20s?

Participant: Yes, oh yes! I don't know, I don't know why. I feel like I'm the same.

Interviewer: What do you think makes you the same person? How would you explain how one and the same person could act in so many different ways but still be the same person?

Participant: I feel the same.

Extract from Self Continuity Interview. Participant 010b from AD group. MMSE = 10

The intuitive link between sense of self and AM is perhaps strongest in relation to self continuity. The act of remembering oneself in the past instantly links the present individual to their past self: mentally, emotionally, and experientially. This link is so clear, so readily demonstrable, that it is difficult to imagine a theory of self continuity that does not incorporate a mnemonic element. The few studies that have explored people's subjective beliefs about their continuity suggest that a firm sense of persistence across time is fairly ubiquitous both across cultures and across the lifespan (e.g., Chandler, et al., 2003; Troll & Skaff, 1997); they also point to the potentially catastrophic consequences of any deterioration in these beliefs (Chandler, et al., 2003; Hsiao, et al., 2013). To date, however, there has been very little empirical research into the cognitive mechanisms that serve to support diachronic unity, and what role is played by AM.

A primary aim of the present chapter was to examine two parallel mechanisms through which AM may serve to support diachronic unity (Figure 5.1). First, episodic memory and autonoetic consciousness are suggested to allow one to re-experience one's past (and imagine one's future) thus affording a sense of phenomenological continuity. It was suggested in Chapter 1 that although this ability to mentally project oneself into the past may contribute to diachronic unity, it may not be essential. This hypothesis was based on neuropsychological case studies involving individuals with dense episodic amnesia which seem to hint at a retained belief about their own continuity (Medved & Brockmeier, 2008; Philippi, et al., 2012; Postle, et al., 2009; B. A. Wilson, et al., 2008).

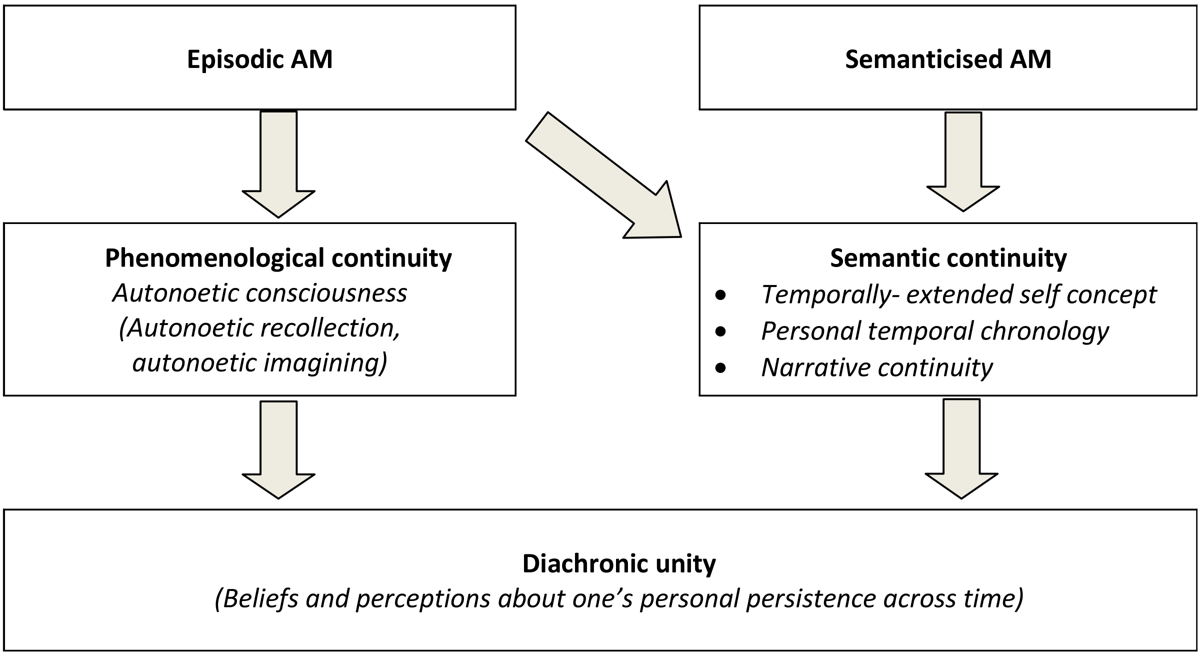


Figure 5.1.Model of the temporally extended self, showing two mechanisms for self continuity, and their proposed relationship to diachronic unity.

The present investigation sought to extend these findings by providing a formal investigation of diachronic unity in aMCI and AD. If pheonomenological continuity is essential for diachronic unity, the marked deterioration in episodic memory and autonoetic consciousness found in those with AD should lead to a corresponding deterioration in their subjective beliefs about personal continuity. Alternatively, if those beliefs are unimpaired in AD, this provides some evidence that episodic memory, and the phenomenological continuity it affords, is not the sole mechanism supporting diachronic unity. The second way AM may serve to support subjective diachronic unity is through semantic continuity, which includes various ways we use memories to mentally construct an explanation about who we are and have been across time (including temporally-extended self concept, personal temporal chronology and narrative identity). This study sought to examine how these aspects of semantic continuity were affected by deterioration in AM, and how any such deterioration may in turn impact upon diachronic unity.

Assessing Diachronic Unity

As described in Chapter 1, two main studies have explored subjective beliefs about persistence across time. Troll and Skaff (1997) examined beliefs about self continuity in older adults by asking two simple questions: "In what ways have you always been the same?" and "In what ways have you changed over the years?" They attempted to separate perceived changes in the content of self (e.g., characteristics and traits) from beliefs about whether one's essential person was still the same. From the perspective of the present study, the latter directly captures beliefs about diachronic unity, while the former captures beliefs about continuity of self concept (i.e., temporally-extended self concept) which in turn may impact on subjective beliefs about diachronic unity.

The other method for assessing diachronic unity, provided by Chandler et al.'s (2003) study with young people, adopted a more overtly philosophical approach of asking individuals to articulate an explanation for their self continuity. Participants were presented with a literary passage involving a character who undergoes considerable personal change (e.g., Jean Valjean in *Les Miserables*), and asked to explain why the character was still the same person by the end of the story. Participants were then asked to reflect on the ways that they had changed throughout their own lives, and explain why they were fundamentally the same person despite these changes. This approach provides a way not only to tap into one's subjective beliefs about diachronic unity, but also to explore the cognitive strategies underlying these beliefs. It is not known how these two ways of approaching beliefs about continuity might relate: for example, whether a sophisticated logical rationale for one's self continuity is necessary in order to sustain a firm belief about one's continuity across time. There is evidence from Chandler et al.'s work, however, that lacking a clear explanation for self continuity may be associated with suicidal tendencies.

In the present study, both of these approaches were combined to create a comprehensive "self continuity interview". The general aim of the interview was to guide participants to think about, and describe, their subjective beliefs about how they have changed and remained the same over their lives, whether they continue to consider themselves to be the same person, and the reasons underlying these beliefs.

In order to adapt these approaches for use with older and memory-impaired participants, the fictional story, which had been used as the focal point of Chandler et al.'s (2003) interview as a way to elicit thoughts about stability and change, was replaced with an amended version of the TST (Kuhn & McPartland, 1954). This novel TST (Past) task asked participants to describe who they were in their early 20s, and was conducted directly after the TST (present) task (see Chapter 4: Methods). The aim of this method was to provide a concrete point of comparison for the much older participants involved in the present study, inviting a direct comparison between participants own descriptions of themselves in the present and past before proceeding to the self continuity interview. It also provided a more direct, potentially less confusing way to engage participants with AD in a discussion about self continuity, compared with the more abstract approach of using a fictional story. As well as providing a focal point for the self continuity interview, the TST (past) task was used to assess temporally-extended self concept (see below).

Assessing Semantic Continuity

Temporally-extended self concept. One hypothesised source of diachronic unity is self knowledge (e.g., Brewer, 1986; Conway, et al., 2004). It is possible that retained self knowledge could help to explain self continuity in those with episodic memory deterioration (Klein & Lax, 2010). As this possibility has not been tested, however, it is not clear what aspect of self knowledge would provide this sense of continuity. The present study explored two theoretical perspectives relating to the role self concept might play in diachronic unity.

The first is that one's knowledge about past versions of the self is important to diachronic unity; specifically, one may maintain a sense of continuity by holding on to a clear mental representation about what one was like in the past, and being able to link that past self representation to current self knowledge. To assess this possibility, the present study asked participants to provide a spontaneous self-description of who they were in their early twenties, using the novel TST (past) task described above, and also asked participants to describe the ways in which they had changed and stayed the same since this time. The life period of early 20s was chosen because it is thought to be an age at which both adult personality and identity begin to stabilise (Costa & McCrae, 1988; Erikson, 1959; James E Marcia, 1980; McAdams, 2001), and memories of this period are argued by some to be particularly important for supporting self concept (Conway, 2005; Conway & Holmes, 2004; Conway & Pleydell-Pearce, 2000; Fitzgerald, 1988, 1996; Rathbone, et al., 2008). If knowledge of a past self is indeed important to diachronic unity, then this is a life period that is likely to play an important role. Any deterioration in knowledge about one's young adult self (e.g., weaker, less complex etc) should lead to a corresponding decrease in diachronic unity. Further, those who believe they have remained more stable in terms of their traits, characteristics and attributes should also possess stronger beliefs about their core persistence across time (i.e., diachronic unity).

The ability of those with AD to describe their past, young adult selves has not been examined. It is possible, however, that this past self knowledge could be relatively well preserved, given evidence that the accuracy of past self-knowledge is better than that of present self knowledge (e.g., Hehman, et al., 2005; Klein, et al., 2003; for a review, see Chapter 4), and that this early-adulthood life period is better recalled than recent periods due to the temporally-graded AM loss in AD (Addis & Tippett, 2004; Greene, et al., 1995; Irish, et al., 2010; Leyhe, et al., 2009; Naylor & Clare, 2008; Piolino, Desgranges, et al., 2003).

A second theoretical possibility is that it is not a representation of one's past self that is important to self continuity, but rather the stability of one's current self concept. There is some evidence that those with AD may retain a fairly stable self concept across a matter of weeks using both checklist (Klein, et al., 2003) and spontaneous (Eustache, et al., 2013) formats. There is also evidence that stability in relation to checklist formats may persist over periods of up to 20 months (Clare, et al., 2013); however stability in spontaneous self knowledge over longer periods has not been examined. The present study explored the longer-term stability of self knowledge in these memory-impaired groups by comparing the self descriptions (both spontaneous and using a checklist format) of a subsection of participants across a two-year period. If stability of current self knowledge is important to diachronic unity, those who demonstrate greater stability across this time period should also express stronger beliefs about their continuity across time.

Narrative continuity and personal temporal chronology. Until fairly recently, a central assumption of narrative identity theory has been that the process of constructing a coherent, meaningful life story out of one's memories is an adaptive ability, possibly through its link to creating sense of continuity (Habermas & Bluck, 2000; McAdams, 2001). This interpretation of narrative identity theory would suggest that those who are able to construct "better" life narratives should also possess a stronger sense of diachronic unity.

More recent theoretical and empirical investigations have started to challenge this assumption of uniform benefit, instead suggesting that the benefit of narrative processes like autobiographical reasoning may depend on many complex factors (Greenhoot & McLean, 2013; Habermas & Köber, 2014; McLean & Mansfield, 2011). Some have suggested that qualitative differences in how autobiographical reasoning is used may have an important impact on the resulting mental health outcomes, for example, the type of autobiographical reasoning used, the type of events that are involved in these reasoning processes, and the particular interpretation provided by the narrator (Banks & Salmon, 2012; Dunlop & Tracy, 2012; Lilgendahl & McAdams, 2011). Others have suggested that the usefulness of autobiographical reasoning may depend on the particular characteristics and circumstances of the narrator, including their age, personality, the context in which they are narrating their story, and their current life circumstances (Habermas & Köber, 2014; McLean & Mansfield, 2011)

Although there is growing evidence regarding the importance of these subtle features of autobiographical reasoning to wellbeing and mental health, there is very little evidence indicating how these issues may relate to diachronic unity. In perhaps the first attempt to examine the relationship between diachronic unity and narrative identity, Habermas and Kober (In Press) found that the amount of autobiographical reasoning in the life narratives of healthy adults' correlated positively with a sense of self-continuity (measured using a four item-scale assessing feeling of familiarity with themselves in the past), but only in those who had experienced serious disruptions in their lives ("biographical disruptions"). The authors suggest that narrative continuity may be important to diachronic unity only when this sense of continuity is challenged in some way (see also Habermas & Köber, 2014).

No studies have yet investigated whether a loss of AM may itself constitute such a challenge, or whether constructing a life story capable of supporting diachronic unity is even possible in the face of such memory loss. The few studies that have attempted to examine narrative identity in AD suggest that limited narrative abilities may remain even in the face of severe AM deficits (Mills, 1997; Surr, 2006; Usita, et al., 1998). Although these studies did not provide any formal analysis of the use of autobiographical reasoning or the global coherence of narratives, their reports provide some hints about how the quality of the narratives may be affected. Surr notes that the majority of their AD participants narrated stories which "integrated the whole of their life from the past to the present…" and appeared to be "...setting their present experiences in the context of their past in order to maintain a sense of self" (Surr, 2006, pp. 1727-1728). This description is strikingly similar to descriptions of autobiographical reasoning, providing a tentative suggestion that this capacity may also be preserved to some extent in early stages of the disease.

These studies also touch on some difficulties with the narratives created by those with AD, including an inability to narrate all or part of a life story (Surr, 2006), producing stories that were fragmented and repetitive (Mills, 1997), or that lacked detail in the description of specific events (Usita, et al., 1998). Usita et al.found that although the life stories of their healthy participants were consistently chronologically ordered and included culturally important life events (e.g., marriage, having children), the stories of those with AD were not. Using Habermas and Bluck's (2000) terminology, these reports seem to suggest that the life stories of those with AD lack temporal coherence and the framework for a cultural concept of biography (i.e., a cultural life script). Within the present model, both of these abilities are suggested to provide a personal temporal chronology. Another study, however, found that participants with dementia were more likely to include culturally important life events in their stories than healthy adults (Fromholt & Larsen, 1991), suggesting that this important organisational structure for AM may be fairly resilient in AD. As neither of these studies provided any measures of temporal coherence or the cultural life script, it is difficult to assess these conflicting claims.

A goal for the present study was to provide formal measures of both autobiographical reasoning and global coherence in order to assess the extent to which these narrative processes are affected in AD. More importantly, it aimed to address the relationship between these measures of narrative continuity and diachronic unity. If the quality of narrative identity, and/or the ability to construct a personal temporal chronology, are indeed important for diachronic unity, those who score higher on measures of global coherence and autobiographical reasoning would also be expected to express more certainty about their continuity across time.

To assess the use of autobiographical reasoning in life stories, "self-event connections" were examined. Self-event connections are a well-studied form of autobiographical reasoning which involve the creation of connections between one's conceptual self and the events of one's life (McLean, 2008; McLean & Fournier, 2008; Pasupathi & Mansour, 2006). They are suggested to create continuity either by emphasising elements of personal stability overtime (stability connections), or by explaining how and why an individual has changed as a result of life events (change connections) (McLean, 2008; Pasupathi & Mansour, 2006; Pasupathi, et al., 2007).

The second marker of the quality of narrative identity examined was the “global coherence” of life stories (Habermas, 2011; Habermas & Bluck, 2000). Global coherence may be regarded as a more complex marker of narrative quality than autobiographical reasoning, because autobiographical reasoning concerns links made between the self and particular events within the story, while global coherence concerns the ability to link and integrate many events into a cohesive whole. Habermas and Bluck (2000) describe four main elements that contribute to the global coherence of a life narrative. “Causal coherence” involves explaining how different elements of the story led to, brought about or were dependent upon other elements, including how aspects of the self were affected by events in one’s life, and how one’s personality contributed to the events that occurred. “Thematic coherence” is the extent to which a narrative provides interpretive links within the story by identifying higher-level similarities, motifs and metaphors that provide meaning and cohesion to the story. In addition, global coherence includes two features that facilitate the personal temporal chronology of the narrative. “Temporal coherence” concerns the ability to temporally locate, order and sequence events in relation to each other and within the wider context of one’s life. “Cultural concept of biography” concerns the degree to which one’s story incorporates culturally accepted rules about which elements are important to include in one’s life story. These cultural expectations around the life story are suggested to form a “cultural life script”, which provides the skeletal structure for life stories.

Aims and Hypotheses

The present study aimed to provide the first systematic exploration of sense of continuity in those with aMCI and early-moderate AD. By using a range of novel and pre-existing measures of self continuity, it sought to examine how these different ways of conceptualising self continuity might relate, and how they may be differentially affected by memory deterioration in these conditions. More specifically, the present investigation sought to examine two hypothesised mechanisms through which AM may contribute to individuals' subjective beliefs about continuity: phenomenological continuity and semantic continuity. Based on this model, it was predicted that deterioration in phenomenological continuity alone should not lead to deterioration in diachronic unity, provided that semantic continuity was well preserved. The evidence reviewed above, however, indicated that there may also be deterioration in aspects of semantic continuity in AD (particularly personal temporal chronology and narrative identity). According to the proposed model, deterioration in both semantic and phenomenological continuity should in turn lead to deterioration in diachronic unity.

Methods

Participants

Most of the data used in the present chapter come from the main study described in this thesis. Details about the main study participants are described in Chapter 2*:* Methods.

In addition to the main study (Time 1), certain measures used in the present study were taken from a longitudinal follow-up interview (Time 2) involving a sub-section of the participants involved in the main study. Twenty five participants involved in the original study agreed to participate in this longitudinal follow-up, which took place between 18 months and 2 years after the main study (*M* = 21.5 months, range 18.9-23.7 months). The demographic characteristics of those involved in the longitudinal follow-up interview are summarised in Table 5.1.

Table 5.1. Demographic Characteristics of the Participants Involved in the Longitudinal Follow-Up Study

Group characteristics	*HC*	*aMCI*	*AD*
n.	20	3	2
Sex (F/M)	11/9	2/1	2/0
Mean age in years	82.7 (1.65)	76.5 (5.5)	81.0 (6.56)
Mean years of education	14.55 (.59)	14.5 (1.5)	14.0 (.58)
Mean MMSE score	27.6 (.39)	26.0 (1.0)	21.0 (2.08)
Mean months between Time 1 and Time 2 interviews	21.9 (.19)	19.2 (.19)	20.8 (1.90)

Note: M = Mean; Standard error of the mean indicated in parentheses. HC = Healthy control group; aMCI = amnestic Mild Cognitive Impairment group; AD = Alzheimer's disease group.

Measures

Measures of diachronic unity (Self continuity interview). Diachronic unity was assessed at both Time 1 and Time 2 using a semi-structured "self continuity interview", which incorporated elements from the approaches used by Chandler et al. (2003) and Troll and Skaff (1997) (Appendix K). Responses were transcribed verbatim by the interviewer. Although the interview was divided into separate questions, these were highly interrelated and participants often provided answers to one question which had relevance to other parts of the interview. The entire self continuity interview transcript was therefore analysed when applying each of the separate coding elements below.

Perceived continuity. The perceived continuity question asked participant whether they believed that they were still the same person as they were in their early 20s. The yes/no responses to this question were recorded; however some participants responded "yes and no" or "maybe". For the purposes of most analysis, "yes" responses were coded 3, "yes and no" responses coded 2, and "no" responses coded 1 (i.e., higher scores indicated greater continuity). For some analyses these mid-way answers were collapsed with the "no" responses in order to create a dichotomous variable. If participants provided an explanation for their answer, this text was transcribed verbatim, and coded as part of the “Continuity in the I-self/Me-self”, or “Continuity explanation”, responses as appropriate (see below).

*Continuity in the I-*self *and Me-self.* Participants were next asked how they believed they had changed, and how they believed they had remained the same since they were in their early 20s. An independent coder read through the responses to identify elements that related to the “I self” (the essential, core self, the underlying essence of who you are, the inner entity) versus the “me self” (the attributes that one uses to describe oneself, e.g., traits, attributes, physical and personality descriptions, behaviour, likes and dislikes, values and beliefs). The coder then scored each set of responses using two three-point scales (an I-self and a me-self scale) based on a coding method from Troll and Skaff (1997). This method assessed perceptions of change versus continuity, with higher scores indicating a greater perception of continuity: a score of “1” indicated a perception of fundamental change, “2” indicated some change, and “3” indicated a firm perception of continuity (no change) (see Table 5.2, and Appendix L).

Table 5.2. Summary of the I-self and Me-Self Subscales Used to Score the Continuity Question.

Score	I-self continuity subscale	Me-self continuity subscale
1. Fundamental change	Indicates a perception of fundamental change in the core self (e.g., "The person I used to be is no longer there")	Indicates a perception of fundamental change one’s attributes (e.g., "I have changed in so many since I was young – personality, the way I look and act, the people I associate with”)
2. Some change	Indicates a perception of some change in the core self or uncertainty about core continuity (e.g., "Not exactly the same person...You’re different but the same – it’s hard to explain ")	Indicates a perception of some change in attributes (e.g., “In my intellectual interests I'm pretty much the same; but I’ve changed in appearance.”)
3. No change	Indicates a firm perception of continuity in the core self (e.g., “I feel my essence has always been the same.”)	Indicates a firm perception of stability in attributes. (e.g., "I’ve always been calm, composed…independent. I’m just the same now.”)

Notes: Coding scheme adapted from Troll and Skaff (1997).

Continuity explanation. The last part of the self continuity interview asked participants to explain the reasons why, given the many changes that had taken place in their lives, they still considered themselves to be the same person (adapted from Chandler et al., 2003):

> *What I now want you to do now is to think about the reasons that you consider yourself to be the same person that you were when you were a young adult. What do you think makes you the same person? I want you to explain these reasons. How would you explain how one and the same person could act in so many different ways but still be the same person?*

Responses were coded using a simplified version of Chandler et al.'s (2003) coding scheme that used a five-point scale to grade the complexity or sophistication of the response.[10] These levels of sophistication varied in relation to how well the participant's continuity explanation grapples with, and accounts for, the realities of change and continuity in a person over time. Very simple responses (level 1) highlight easily identifiable, surface qualities of the self that have remained the same across time (e.g., particular physical features or simple personality traits) while ignoring or downplaying elements of the self that have changed. Answers that are more sophisticated (and therefore scored higher) are those which integrate ways that the self may have changed while also identifying factors that maintain self continuity. Continuity explanations that are scored at the highest levels of sophistication are those which identify a core element of the self which has remained unchanged despite (perhaps considerable) change in more surface attributes (level 4), or are able to demonstrate a meta-awareness of the paradox of continuity by weighing up a number of possible explanations that could be used to account for change and continuity in the self (level 5) (see Table 5.3, and Appendix M).

[10] Chandler et al.'s (2003) original method used two parallel scales, one designed for "essentialist" response types, and one for "narrativist" response types. These response types represent fundamentally different metaphysical understandings that people may hold about self continuity, and were devised to capture differences between First Nations Canadian perspectives on continuity (represented by the narrativist scale) and a more westernised understanding (represented by the essentialist scale). Each scale provides a way to rate the complexity of responses within that particular metaphysical framework. In the present study, the primary coder was trained to apply both scales, but in practice found that all of the responses were easily coded using the essentialist scale. The essentialist scale was used exclusively in the present analysis.

Table 5.3. Summary of the Coding Scheme Used to Score on the Continuity Explanation Question

Level of sophistication	*Description*	*Examples*
Level 1	Response describes simple, surface elements of the self that have not changed, while ignoring aspects that have changed.	I just seem to do the same things. If people talk to me I talk to them, if people need help I help them. Always been the same.
Level 2	Response attempts to engage with the problem that people appear to change by suggesting that apparent changes are in fact aspects of the self that were present from the start but have never been seen until now.	When I was with my ex-husband, it really brought out my angry side. It's still there but now I don't have to be that way so much.
Level 3	Response acknowledges the effects of time as the agent of growth and development of pre-existing traits.	I am the same person, I have just grown. The experiences of my life have brought out a mature version of me.
Level 4	Response attempts to solve the problem of change/continuity by proposing a core, underlying essence of the self which remains unchanged despite change in surface attributes.	Spiritually – your body changes but spiritually you stay the same.
Level 5	Response provides a "meta answer" which indicates that whatever explanation the person may have to the problem of self continuity is simply one theory among many.	There are many ways you could answer that. I have the same brain. Also, a lot of the attitudes you had when you were little....You remember what you were. This also gives you continuity...Your genes don't change....attitudes stay with you / born in you?

Notes: Coding scheme adapted and simplified from Chandler et al. (2003).

Measures of temporally-extended self concept.

TST (Past). A novel TST (Past) task was administered at both Time 1 and Time 2. This task was based on the traditional TST task (Kuhn & McPartland, 1954) which had been administered at an earlier point in the interviews (see Chapter 4: Methods). The key difference in the TST (Past) task was that the instructions asked participants to describe what they were like when they were in their early 20s (Appendix K). The instructions were read aloud, and the researcher transcribed the participants' responses verbatim. To assist participants with memory impairments, a card was placed in front of them with a summarised version of the instructions. If a participant stopped speaking for more than 10 seconds, they were prompted by the interviewer, "Is there anything else you would like to say about who you were in your early 20s?" The interviewer continued prompting until the participant indicated that they had no further material to add, or until 20 statements were achieved. There was no time limit for this task. In contrast to the TST (Present) task, which included main and supplementary (prompted) conditions, the TST (Past) task included only an unprompted condition which allowed a maximum of 20 responses.

The number of responses provided was used as a measure of strength of past self knowledge, and number of subcategories sampled was used as a measure of complexity of past self knowledge (Chapter 4: Methods). Although the task was administered at both time points, the present investigation examined only responses collected as part of the main study (Time 1).

Test-retest stability of present self-knowledge. To assess the stability of participants' self concept, two measures of present self knowledge (the self knowledge checklist and the TST (present)) were administered both as part of the main study (Time 1) and as part of the longitudinal follow-up interview (Time 2). Details about these measures and how they were administered are set out in Chapter 4: Methods.

1. *TST (test-retest).* A novel coding scheme was developed to assess the stability of participants' spontaneous TST (Present) self descriptions over the two-year period (see Appendix N).[11] The coding scheme examined whether statements that had appeared on TST (present) list at Time 2 (on either the main or supplementary lists) had also been listed at Time 1, or were new to the person's self concept (i.e., had not been listed at Time 1). The main score of interest was the percentage of Time 2 statements that had also been

[11] The coding method that was used to guide the coding process was more complex than this, as it also assessed whether statements had become more or less central to a person's self concept over time. This method is described in detail in Appendix x. For the purposes of the analyses set out in this chapter, the more nuanced codes were collapsed to create a single, combined category which included all of the statements that appeared on the Time 2 list and also on the Time 1 list.

listed on the Time 1 list. In addition to statements which were listed verbatim on both lists, statements were counted as present at both time points if they were closely linked or related, for example by providing a specific example of a general statement (e.g., Time 1: I like sport; Time 2: I love rugby), by providing a different angle on the same topic area (e.g., Time 1: I do a bit of gardening; Time 2: I enjoy gardening); or by suggesting change or growth within a particular area (e.g., Time 1: I am overweight; Time 2: I have lost a lot of weight recently).

2. *Self-knowledge checklist (test-retest).* The test-retest stability of the self knowledge checklist was assessed by calculating correlations between each participant's Time 1 and Time 2 responses on the checklist. These correlations were transformed using Fisher's (1925) r-to-z transformations (Cox, 2008) so that they could be used in inferential statistics (see Chapter 4: Methods).

Measures of narrative identity. The narrative identity of participants was assessed by coding their life stories (see Chapter 2: Methods) for a number of markers of narrative identity.

1. Self-event connections (Appendix O). The life story interviews were coded to identify statements which used self-event connections, drawing on definitions developed by Pasupathi and colleagues (Pasupathi & Mansour, 2006; Pasupathi, et al., 2007). Self-event connections were defined as any statement which explicitly draws a connection between the narrator's self-concept and the events they are narrating. Two types of self-event connections were identified in the text. Self-event "stability" connections were those which suggested that a pre-existing quality of the self explained, or was illustrated by, an event (e.g., "I decided to go overseas because I've always been really adventurous"; "This event shows how persuasive I am"). Self-event "change" connections were those which explained how and why the narrator had changed as a result of life events (e.g., "After that, I became a lot more wary of other people"). The dependent variable was the number of each type of statement used in the life stories.

2. Global Coherence. (Appendix P). The global coherence of the life stories was assessed using a coding manual adapted for the present study from an original manual developed by Habermas and Diel (2005; see also Habermas & de Silveira, 2008), translated from German and amended by Reese and Suggate (E. Reese, personal communication, May 31, 2010). The coding scheme required a rater to read through the life story, and assess how well it achieved three aspects of global coherence. The temporal coherence score assessed the degree to which the rater was able to follow when, and in what order, events within the story took place. The causal coherence score assessed the degree to which the rater understood how the narrator had changed throughout their story (in terms of personality, circumstances or outlook), and how the events in the story explain this change. The thematic coherence score assessed how well particular elements within the story were linked or positioned in relation to one another. A single, independent coder rated each life story chapter for each type of coherence, and scored the text on a four-point scale, from 0 (indicating very low coherence) to 3 (indicating a very high level of coherence). As well as chapter-by-chapter scores, the scores from each chapter were summed to provide a measure of each type of coherence for the life story as a whole.

3. Cultural life script (Appendix Q). The life stories were assessed to determine whether they included cultural life script events. The list of events used in the present study was generated by reviewing a number of studies which had surveyed large numbers of individuals to assess which life events were judged to be important to the life stories of a typical individual (Berntsen & Rubin, 2004; Bohn & Berntsen, 2008; Habermas, 2007; Steve M. J. Janssen & Rubin, 2011; Rubin, Berntsen, & Hutson, 2009; Tekcan, Kaya-Kızılöz, & Odaman, 2012; Dorthe Kirkegaard Thomsen & Berntsen, 2008). To avoid bias created by the survey method used, or the demographic characteristics (e.g., culture and age group) of the participants involved in any one study, an event was included on this present study's list of cultural life events only if it had been identified in at least three of these studies. Thirty event categories met this criterion. Some event categories were slightly tailored for a New Zealand context (e.g., "enter daycare" was amended to "enter daycare, kindergarten or preschool"; "College" was changed to "University or Tech").

Each life story was read by a single, independent coder to assess whether it contained any mention of each of the events categories on the list (present/absent). An event was considered "present" in the story if it was mentioned as a personal event that occurred to the narrator, but not if it was a story involving someone else (e.g., "Divorce" would be coded as present if the narrator mentioned their own divorce, but not if they described the divorce of a close relative or friend). The number of event categories mentioned in the life story was tallied, providing a score for the number of cultural life script categories sampled by each participant.

The number of new occurrences of each event category was also counted. Events were counted as new occurrences if they described a new element in the story from within the same life script category (e.g., attending two separate high schools, the birth of successive children), not if they described another occurrence of the same event (e.g., mentioning their marriage to the same person in several places). The number of new occurrences was tallied across event categories, providing a score for the number of cultural life script events mentioned by each participant.

Two of the codes ("Get a job" and "Settle on career") proved difficult to distinguish for the coders, so were combined into a single category. Seven events were mentioned so infrequently in the stories that reliability could not be calculated (begin walking, learning to talk, baptism, puberty, leaving home, first sex, and empty nest), and were therefore removed from the analysis. For each of the remaining 22 event categories, inter-rater agreement for the present/absent ratings across participants was calculated using Cohen's Kappa (see Coding Procedure, below): four showed moderate agreement (range: .43 - .59), seven showed substantial agreement (range: .64-.77) and ten had a near-perfect agreement (range: .82-1.0). The kappa for the most frequently used event (Get a Job/Settle on career) could not be calculated because this event was present in almost every life story, and one coder had not used the "not present" code for any transcripts. There was only one story on which the coders disagreed, and the percent agreement was very good (94%), as was the intraclass correlation for the number of occurrences of this event (ICC = .96).

Coding Procedure

A team of independent coders were involved in the coding the various elements of the present study: the self continuity interview; the life stories for self-event connections, global coherence and cultural life script; the TST (Past) and TST (test-retest) tasks. All coders were blind to group membership and, although they were aware of the general topic matter of the study, they were not aware of the hypotheses relating to the coding manuals they were applying. For each separate coding exercise, a single, primary coder was responsible for coding all of the transcripts. Coders were trained to the manuals by the author, and trial coding exercises were conducted using training examples to ensure that reliability was satisfactory before the transcripts were coded.

Reliability was established for each coding exercise by using a second independent coder who double coded a random selection of 20% of the transcripts. In one case (the self continuity interview) the double coding was conducted by the author, who had also interviewed participants. To ensure that the participant and group could not be identified, the hand-written transcripts were re-typed by an independent transcriber using blind numbering, and answers were ordered randomly, without the context of the rest of the interview. In addition, double coding took place a minimum of six months, and in most cases over two years, following the interviews, so there was little chance of identifying which participant provided each response.

For ordinal scales and those which generated a frequency count for each participant, the intraclass coefficient was used, while for nominal scales, Cohen's Kappa was used (J. Cohen, 1960; Landis & Koch, 1977) (see Chapters 2 and 4: Methods). The reliability statistics for each coding element are set out in Table 5.4.

Table 5.4. Inter-Rater Reliability Measures (ICC) for Double Coded Transcripts.

	α		α
Self-continuity interview		*Global coherence*	
I-Self	.91	Temporal	.89
Me-self	.87	Causal	.88
Continuity explanation	.96	Thematic	.75
Autobiographical reasoning			*Kappa*
Self-Event Change	.77	TST (test-retest)	.88
Self-Event Stability	.83	Cultural life script event categories (present/absent)	Range: .43- 1.0

Notes: ICC = Intra-class correlation coefficient (α)

General Procedure

Main study (Time 1). The Time 1 interviews took place in accordance with the procedure set out in Chapter 2: Methods. A list of the measures used in the main study, and their order of administration, is set out in Appendix C. Unless otherwise stated, the analyses described in this study used data collected as part of this main study.

Longitudinal follow-up (Time 2). One part of the analysis in this present study (the *Test-retest stability of present self-knowledge*), involved a comparison between data collected as part of the main study and data collected in the longitudinal follow-up interviews (Time 2) held between 18 months – 2 years after the main study. Ethics approval for the longitudinal follow-up study was obtained from the Northern Y Regional Ethics Committee. Like the Time 1 interviews, all Time 2 interviews were conducted by the author, in participants' own homes. Participants were interviewed once, for around 1 ½ to 2 hours. Informed consent to be contacted in relation to the longitudinal follow up was collected during the main study interviews, and written consent to participate was obtained at the beginning of the Time 2 interview.

The primary measures of interest from Time 2 were the TST (Present) task and the self knowledge checklist, both of which were compared to the same tasks at Time 1 using coding and analysis methods described above. In addition, the Time 2 interviews included many of the measures and interview procedures that had been included at Time 1, including an assessment of awareness of memory deficits, the MMSE, the Self Awareness in the Present Moment task, a shortened life story and AI process, the COWA, TST (Past) and the self continuity interview.

Statistical analysis

All statistical analyses were carried out using IBM SPSS Statistics 20 for Windows. Frequency data were analysed using Chi-square tests for independence. Group differences were examined using mixed and one-way ANOVAs as appropriate (for details of how these analyses were applied, see Chapter 2: Methods). Where there was unequal variance between the groups, the Brown-Forsythe F-statistic was used (Field, 2009). Group differences in relation to ordinal data were assessed using Kruskal-Wallis non-parametric tests, followed up with Mann-Whitney U tests correcting for multiple comparisons with a Bonferroni correction.

Correlations were calculated using Pearson's partial correlations, controlling for control general cognitive decline of participants using MMSE and verbal fluency using COWA score (from Time 1 or Time 2 as relevant). Spearman's rho correlations were calculated for ordinal data. The significance of correlations were determined using a Holm-Bonferroni (sequentially-rejective) procedure (Holm, 1979) to correct for multiple comparisons (Chapter 2: Methods).

Results

Diachronic Unity (Self Continuity Interview)

Fifty three participants completed the self continuity interview. One participant from each of the AD and aMCI groups was unable to complete the interview due to fatigue, and so excluded from the analysis. To examine participants' subjective beliefs about diachronic unity, three elements of the self continuity interview were examined: "yes/no" responses to the perceived continuity question; responses to questions about continuity, rated in relation to beliefs about I-self and me-self continuity; and the continuity explanations, rated for level of sophistication.

Perceived continuity. For the "perceived continuity" question, participants were asked: "Do you feel that you are the same person now as you were when you were in your early 20s?" The participants' "yes/no" responses to this question were analysed using a chi-square test for independence (see Table 5.5). Four participants (two each from the HC and aMCI groups) had answered "yes and no" to this question. In order to enable a valid chi-square test, and to reflect the uncertainty regarding continuity reflected in this response, these were combined with the "no" responses. Although the percentage of those responding "no" to the perceived continuity question was slightly higher in the HC group, there was no significant relationship revealed between group and type of response, $\chi^2(2) = .19$, $p = .91$.

Table 5.5. Number (Percentage) of Participants Responding "Yes" or "No" to the Perceived Continuity Question.

	Yes	No
HC group	11 (44%)	14 (56%)
aMCI group	7 (50%)	7 (50%)
AD group	7 (50%)	7 (50%)

Notes: HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease.

Continuity in the I-self and me-self. The self continuity interview asked participants to describe the ways they felt they had changed or stayed the same since their early 20s. Their responses were separated into aspects which related to continuity in I-self (core) and me-self (traits and characteristics), and rated for whether these responses indicated no, some or fundamental change. The distribution of each group in relation to these ratings is set out in Figure 5.2. The responses of three participants could not be coded in relation to one of the subscales: two participants (one from each of the HC and aMCI groups) provided no information relevant to the I-self subscale, and one participant from the AD group provided no information relevant to the Me-self subscale. These participants were excluded from the relevant portion of the analysis.

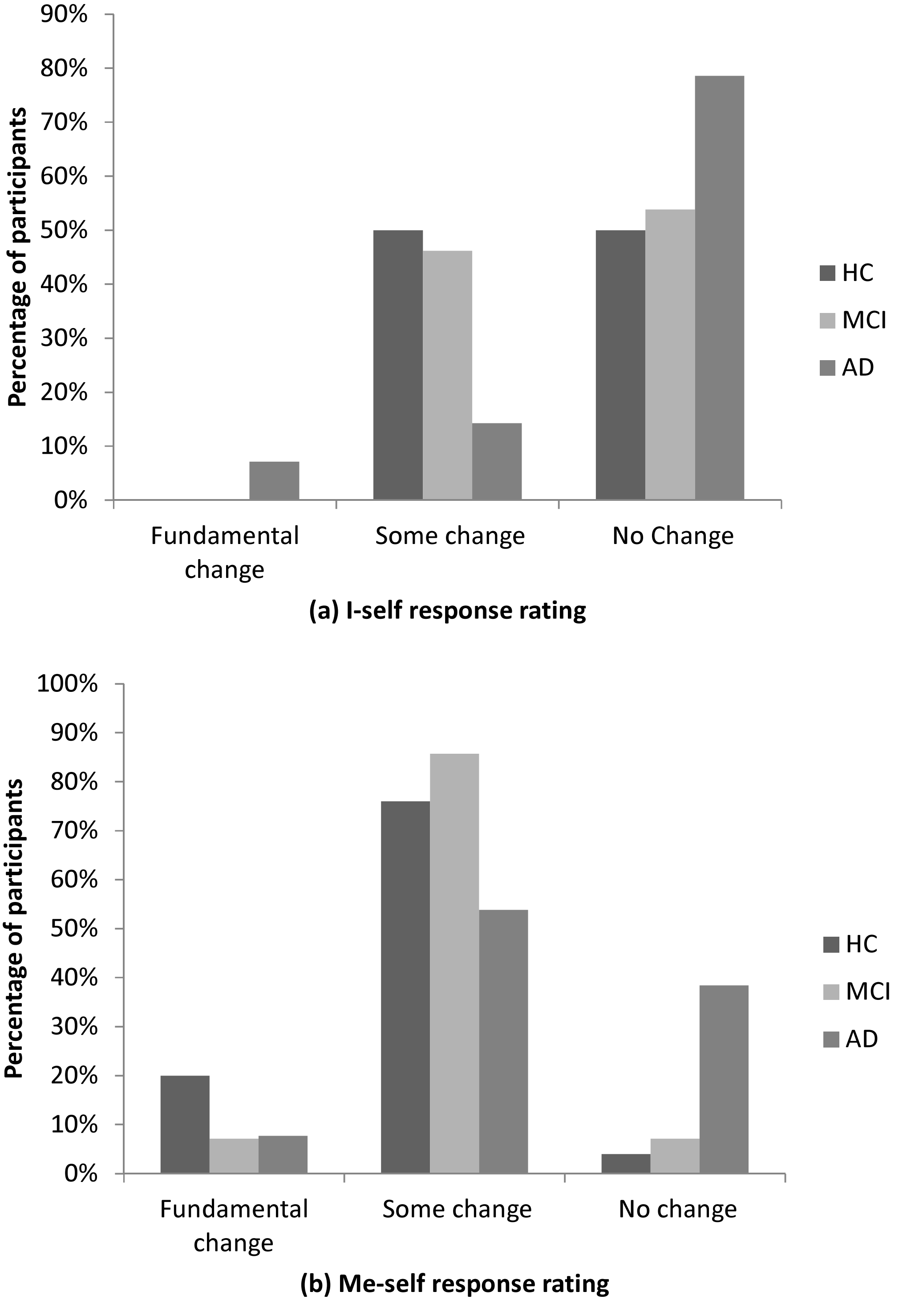


Figure 5.2. Percentage of participants from each group providing each response type on (a) the I-self rating scale, and (b) the Me-self rating scale of the self continuity interview.
HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease.

Kruskal-Wallis non-parametric tests were used to assess whether the groups differed in relation to the degree of I-self or me-self continuity expressed in their responses. There was no significant difference between the groups in relation to the ratings for degree of I-self continuity, $H_{(2)} = 2.34$, $p = .31$. There was, however, a significant difference between the groups in relation to the degree of me-self continuity expressed in their responses, $H_{(2)} = 6.82$, , $p = .03$, with a mean rank of 22.9 for the HC group, 26.5 for the aMCI group, and 33.42 for the AD group. Pairwise Mann-Whitney U tests (Bonferroni corrected alpha level set at $p < .017$) revealed that the AD group's responses tended to be rated as expressing greater me-self continuity than the responses of the HC group ($p = .016$). The degree of me-self continuity expressed in the responses of the aMCI group did not differ significantly from the HC or AD groups (all p-values $\leq .28$).

Continuity explanation. Participants' continuity explanations were rated to assess their sophistication on a five-point scale, with scores of "1" indicating the lowest level of sophistication and scores of "5" indicating the highest. The distribution of each group in relation to their scores on the continuity explanation is set out in Figure 5.3.

This shows that 50% of the AD group (compared with 16% of the HC group and 14% of the aMCI group) provided explanations for their continuity that were at the simplest level of sophistication. Responses at this simplest level (score level 1) focus on simple, surface attributes to account for self continuity while ignoring ways in which the individual may had changed, as illustrated by the following response from a participant in the AD group:

> If I was walking down the road, and saw someone bashing their dog or kid, I'd stop them. I've always done that. If someone was old and in a wheel chair, I'd help them. Always the same if someone needed help I'd help them.

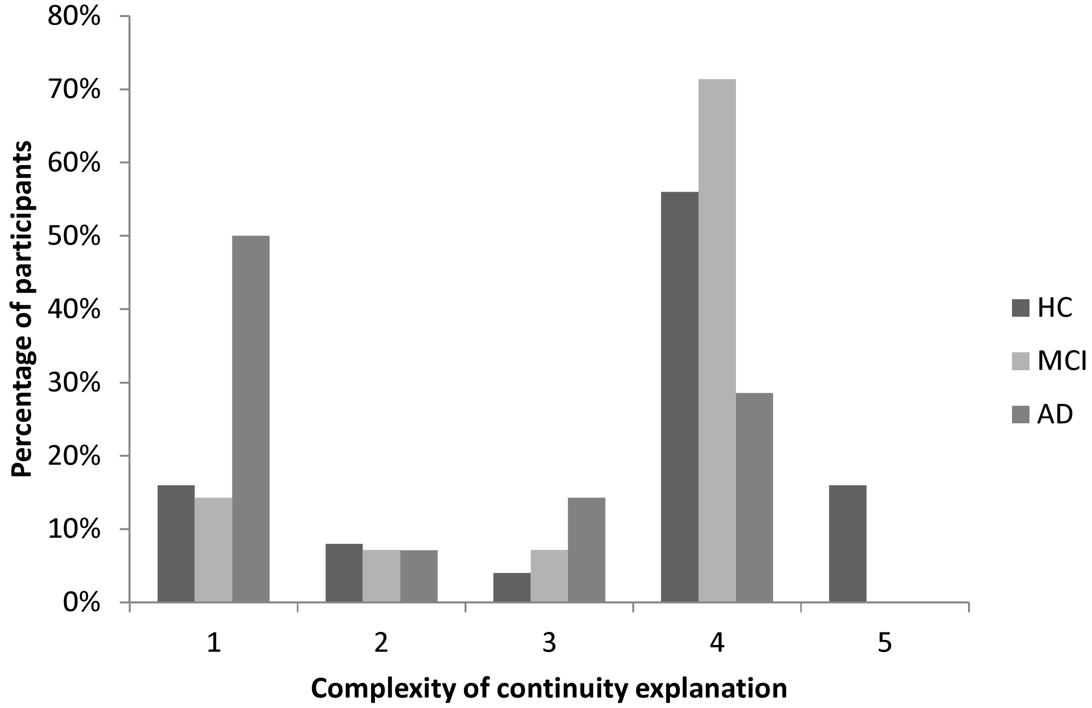


Figure 5.3. Percentage of participants from each group providing each level of sophistication of response on the continuity explanation. HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease. Scores of 1 represent the lowest level of sophistication, while scores of 5 indicate the highest level of sophistication.

In contrast, around 70% of both the HC and aMCI groups provided responses at the highest two levels of sophistication (compared with just 30% of the AD group). Such responses were able to grapple with the realities of how the individual had changed while still identifying some core attributes which accounted for self continuity (level 4), or weigh up many competing explanations for self continuity (level 5), as illustrated by the following excerpt from a member of the aMCI group (scored level 4):

> My experience has increased but my physical self has decreased, aged. My brain problems/memory has changed my outlook. I get depressed sometimes. I am not enjoying looking forward. [My parents]… set standards for me. Not deeply religious, but stronger religious feelings than I had and they brought me up on those standards. And that has been a strong steer for me through my life. Attitudes and values.

To examine any differences between the groups in relation to the sophistication of their continuity explanations, a Kruskal-Wallis non-parametric test was conducted. There was a significant difference between the groups on the sophistication of their continuity explanations, $H_{(2)} = 8.8$, $p = .01$, with pairwise Mann-Whitney U tests (Bonferroni corrected alpha level set at $p < .017$) confirming that the continuity explanations of the AD group were scored as significantly less sophisticated (*Mdn* = 1.5; mean rank = 17.54) than those of the HC group (*Mdn* = 4; mean rank = 31.26; $p = .01$). There was also a non-significant trend for the AD group to have lower scores than the aMCI group (*Mdn = 4;* mean rank = 28.86; $p = .02$). No significant difference was found in the scores for the aMCI and HC groups ($p = .57$).

A possible criticism of this method of assessing diachronic unity is that the task is a very difficult one, and the lower sophistication in the AD group's continuity explanations could relate to a number of factors including general cognitive decline, loss of verbal fluency, or lack of insight. Spearman's rho correlations were conducted to assess these possibilities, but no significant correlations were found for any of the groups between the sophistication of continuity explanation scores and MMSE, COWA or awareness of memory deficits (all p -values > .12).

Relationship between different aspects of diachronic unity. The analysis above indicates a divergence in the diachronic unity of the AD group, who demonstrated high confidence in their beliefs about their continuity over time (perceived continuity, I-self continuity, and me-self continuity) but an impaired ability to construct a sophisticated justification for their continuity across time. It appears that these measures may represent different facets of diachronic unity that are differentially affected in AD.

To further explore this possibility, Spearman's rho correlations examined the relationship between different aspects of diachronic unity (perceived continuity, I-self continuity, and continuity explanation; see Table 5.6. The me-self continuity subscale was not examined here, as this was assessed as part of the temporally-extended self concept, below.

Table 5.6. Spearman's Rho Correlations Between Measures of Diachronic Unity

	I-self continuity	Continuity explanation
HC group		
Perceived continuity	**.60***	-.02
I-self continuity	-	-.35
aMCI group		
Perceived continuity	-.02	-.04
I-self continuity	-	.15
AD group		
Perceived continuity	.52	**-.61***
I-self continuity		**-.54^**

Notes: HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease.
*Significant after Holm-Bonferroni correction (first-level corrected alpha level, p <.02)
^ Marginally significant after Holm-Bonferroni correction (p < .05)

After applying the Holm-Bonferroni correction (first-level corrected alpha level, p <.02), there was a significant positive correlation between perceived continuity and I-self continuity within the HC group (p = .002), demonstrating that those who indicated greater certainty that they remained the same person also tended to provide responses which indicated higher I-self continuity. Consistent with this finding, there was a trend towards significance for a positive correlation between these items in the AD group (p = .06). This indicates that both of these items were assessing a similar, though not identical, construct.

Within the AD group, there was a significant negative correlation between the continuity explanation and perceived continuity (p = .019), as well as a marginally-significant negative correlation between continuity explanation and I-self continuity (p = .047). This indicates that those within the AD group who provided more sophisticated explanations for their continuity also tended to express less certainty over whether they remained the same person over time. This tends to support the suggestion that perceived and I-self continuity may represent different facets of diachronic unity from the continuity explanation. It is interesting to note that while the overall pattern of correlations appeared to be similar in the AD and HC groups, the correlations with the aMCI group did not follow the same pattern.

Relationship Between Phenomenological Continuity and Diachronic Unity.

As described in Chapter 2, the AD group showed marked deterioration in both episodic memory (the number of internal details provided on the AI event stories) and autonoetic consciousness (the number of "remember" responses provided on the remember/know task). In order to examine any relationship between these markers of phenomenological continuity and diachronic unity, Spearman's rho correlations were conducted between three measures of diachronic unity (perceived continuity, I-self continuity and continuity explanation), the total number of "remember" responses, and the number of internal details provided in each AI event story (see Table 5.7). There were no significant correlations between these measure for any of the groups, after applying the Holm-Bonferroni correction (first-level correction, $p<.003$).

Interestingly, however, there was a consistent pattern of marginally significant negative correlations between I-self continuity and markers of phenomenological continuity. There was a marginally significant negative correlation between I-self continuity and the number of AI internal details provided in the late adulthood period ($p=.03$) for the HC group, and with the number of AI internal details provided on the middle adulthood life period for the AD group ($p = .02$). There was also a marginally significant negative correlation between I-self continuity and the number of "remember" responses in the aMCI group ($p = .03$). The correlations between "remember" responses and I-self continuity, while not significant, were in the same, negative direction for all three groups. Overall, this surprising pattern of results suggests that participants from all three groups who were better able to re-experience their pasts (i.e., demonstrated better phenomenological continuity) tended to express *less* certainty about their diachronic unity.

Table 5.7. Spearman's Rho Correlations Between Measures of Diachronic Unity (Scores on Self Continuity Interview) and Markers of Phenomenological Continuity (Number of Remember Responses and Number of AI Internal Details).

	Markers of Phenomenological Continuity				
	Number "R" responses	*Number of internal details on the AI*			
Measures of Diachronic Unity		*Childhood*	*Early adulthood*	*Middle adulthood*	*Late adulthood*
HC group					
Perceived continuity	-.31	-.17	-.09	.14	-.33
I-self continuity	-.38	-.37	-.21	.06	**-.44^**
Continuity explanation	.31	.35	**.40^**	.03	.34
aMCI group					
Perceived continuity	.06	-.52	.04	.17	-.32
I-self continuity	**-.61^**	.02	-.02	-.29	-.33
Continuity explanation	-.01	.25	-.30	.12	-.09
AD group					
Perceived continuity	-.39	-.36	.21	-.41	-.27
I-self continuity	-.30	-.31	.09	**-.60^**	-.11
Continuity explanation	.22	**.54^**	-.23	.48	.05

Notes: AI = Autobiographical Interview; "R" = remember responses on Remember/Know task. HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease. ^ Marginally significant after Holm-Bonferroni correction ($p < .05$)

Conversely, there was a consistent pattern of marginal, positive correlations between the sophistication of the continuity explanation and the number of internal details provided in the event stories. For the AD group, this correlation was in relation to the childhood period (p = .048), while for the HC group, there was a marginal correlation in relation to the early adulthood event story (p = .046). This pattern suggests that those who were less able to vividly recollect these event stories also tended to construct less sophisticated explanations to justify their self continuity, and may support the suggestion that deterioration in phenomenological continuity contributes to deterioration in this aspect of diachronic unity in the AD group.

Relationship Between Diachronic Unity and Other "Experiential" Levels of AM

In Chapter 2, a relationship was reported between episodic memory, autonoetic consciousness, and extended and repeated levels of AM. It was proposed that this association may indicate that the ability to re-experience the past autonoetically may not be restricted to specific events, but may also be an integral feature of these other levels of AM. If so, these levels of memory may also confer a sense of phenomenological continuity. To explore whether other levels of "experiential" AM would demonstrate a pattern of relationship with diachronic unity similar to that reported above in relation to these other markers of phenomenological continuity, Spearman's rho correlations were calculated. The three measures of diachronic unity (perceived continuity, I-self continuity and continuity explanation) and the number of extended and repeated memory propositions used in each life story chapter were included in the analysis (see Table 5.8).

Within the AD group, there was a significant negative correlation between perceived continuity and the number of extended event details provided in the childhood chapter (p <.001), indicating that those who recalled more extended memory details from this period were more likely to state that they were not the same person as had been in their early 20s. Similarly, in the aMCI group there was a marginally significant negative correlation between perceived continuity and the number of repeated event details provided in the early adulthood period (p = .03). Consistent with this pattern, there were marginally significant negative correlations between I-self continuity and the use of repeated event details in the childhood life period for the aMCI group (p = .046), and in the late adulthood life period (p = .03) for the HC group. Overall, this pattern replicates the findings described above in relation to episodic memory: those with better extended and repeated AM tended to express greater uncertainly regarding their core continuity across time.

There were no significant correlations between the continuity explanation and the use of extended or repeated memory in the life stories. Nevertheless, within the AD group, there was a marginally significant positive correlation between the continuity explanation and the use of repeated event propositions in the late adulthood chapter (*p* =.03), supporting the pattern reported above, that more sophisticated scores on the continuity explanation were associated with better memory performance.

Table 5.8. Spearman's Rho Correlations Between Measures of Diachronic Unity and the Number of Extended and Repeated Memory Propositions Used in Each Life Story Chapter.

	Number of AM Propositions in the Life Story							
Diachronic unity	Childhood		Early adulthood		Middle adulthood		Late adulthood	
	EE	*RE*	*EE*	*RE*	*EE*	*RE*	*EE*	*RE*
HC group								
Perceived continuity	.06	-.32	-.01	-.28	.09	-.26	.12	-.33
I-self continuity	-.02	-.34	-.26	-.03	-.20	-.38	.06	**-.44^**
Continuity explanation	.26	-.27	.29	.19	.04	.19	-.13	.17
aMCI group								
Perceived continuity	-.19	.06	-.12	**-.58^**	-.28	-.04	-.14	-.48
I-self continuity	**-.56^**	.10	-.15	-.21	-.12	-.36	-.15	-.42
Continuity explanation	.01	.24	.48	-.28	.50	-.10	.52	-.26
AD group								
Perceived continuity	**-.82***	-.27	-.43	.18	-.48	.12	.16	-.33
I-self continuity	-.40	.10	-.14	.33	-.36	.27	.42	.02
Continuity explanation	.52	-.08	.39	-.27	.40	-.04	-.40	**.58^**

Notes: AM = Autobiographical memory; EE = Extended event; RE = Repeated event; HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease.
* Significant after Holm-Bonferroni correction (first-level corrected alpha level, *p* <.001)
^ Marginally significant after Holm-Bonferroni correction (*p* <.05)

Semantic continuity

Temporally-extended self concept. Temporally-extended self concept was examined in two different ways. First, participants' spontaneous descriptions of their self in the past (as a young adult) were examined using the TST (Past) task. Second, the stability of participants' present self knowledge was examining by assessing the test-retest stability of a subset of participants responses on the TST and the self knowledge checklist between the main study and a two-year longitudinal follow-up.

TST (Past). The performance of the three groups on the TST (Past) task is summarised in Figure 5.4. A one-way ANOVA assessed any group differences in relation to the strength of past self knowledge (i.e., number of statements generated on the TST (past)). There was a significant difference between the groups, $F_{(2, 50)} = 6.0$, $p = .01$, with post hoc Games-Howell comparisons showing that the AD group provided significantly fewer statements compared with the HC group ($p = .01$). There was also a non-significant trend for the AD group to use fewer statements than the aMCI group ($p = .055$). The HC and aMCI groups did not differ significantly ($p = .96$). These findings are consistent with the pattern found in relation to TST (present) in Chapter 4, and suggest that the strength of the AD group's past and present spontaneous self descriptions were both impaired. The strength of past self knowledge was not significantly correlated with MMSE ($p = .97$) or COWA scores ($p = .37$) in the AD group.

The complexity of responses on the TST (past) task (i.e., number of subcategories sampled) was also assessed using a non-parametric Kruskal-Wallis test. This indicated no significant difference between the groups in relation to the number of subcategories they sampled in their TST (past) responses, $H_{(2)} = 2.62$, $p = .27$.

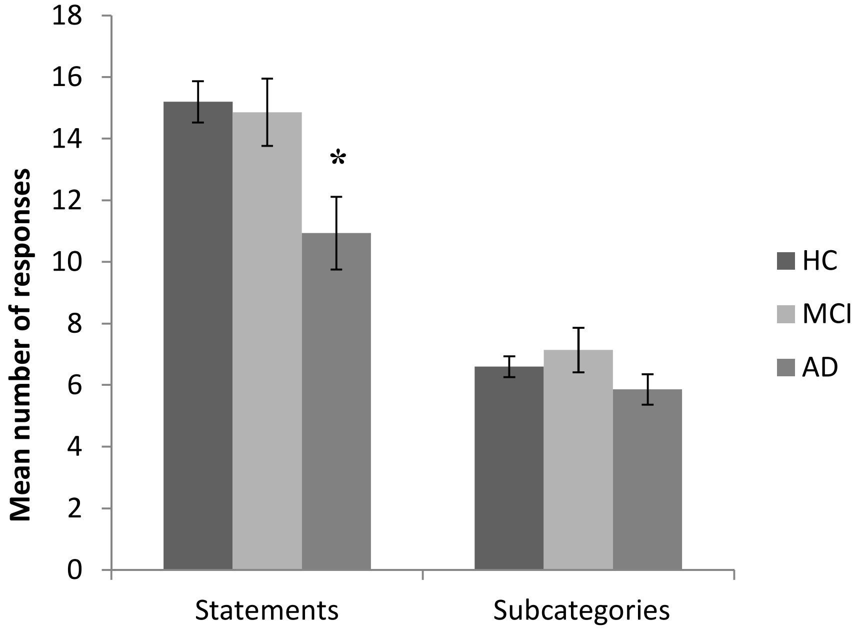


Figure 5.4. Mean number of statements and subcategories generated on the Twenty Statements Test (Past) task by each group.
*HC = Healthy controls, aMCI = amnestic Mild Cognitive Impairment, AD = Alzheimer's disease. Error bars denote one standard error of the mean. * Significantly lower than HC group.*

Test-retest stability of present self-knowledge. The stability of present self knowledge was assessed by examining the test-retest performance on the TST (present) and ratings on the self knowledge checklist. Twenty five participants completed the TST (present) task at both Time 1 and Time 2 (HC: n = 20; aMCI: n = 3; AD: n = 2). Due to the small number of participants in the AD and aMCI groups, they were combined into a single "memory-impaired" group (n = 5).

First, the total number of statements (across both the main and supplementary lists) generated on the TST (present) task at Time 1 versus Time 2 were compared. A Wilcoxon signed-ranks test indicated a significant reduction in the number of statements generated by the HC group between Time 1 (*Mdn* = 44) and Time 2 (*Mdn* = 36) (Z = -3.233, p = .001). There was no significant difference for the memory-impaired groups between the Time 1 (*Mdn* = 42) and Time 2 (*Mdn* = 27), however there was a non-significant trend for a difference (Z = -1.75, p = .08). This indicates that they may have been a tendency for both groups to use fewer TST (present) statements at Time 2 compared with Time 1.

Second, the stability in the content of TST (present) self descriptions was assessed by using a novel TST test-retest coding scheme, which examined the content of responses to distinguish statements that were used at both time points from those which were used at only one time point. This analysis revealed that the Time 2 responses of the healthy and memory–impaired groups included a very similar percentage of statements that had been used previously at Time 1 (see Table 5.9). A Mann-Whitney U Tests indicated that there was no significant difference between the groups in relation to the percentage of TST (present) statements used at Time 2 that has also been used at Time 1 (p = .92). Similarly, there was no difference between the groups in relation to the percentage of statements used at Time 1 that were not repeated at Time 2 (p = .37).

Finally, the test-retest stability of participants' ratings on the self knowledge checklist were examined by calculating for each participant the correlations (z transformed) between their Time 1 and Time 2 ratings (see Table 5.9). A Mann-Whitney U Tests indicated no significant difference between the HC and memory-impaired groups in relation to the correlations between their Time 1 and Time 2 ratings (p = .68).

Table 5.9. The Stability of Present Self Knowledge Across a Two-Year Period

	HC group (n = 20)	*Memory-impaired group* (n = 5)
TST (test retest)		
Mean % of Time 2 statements also used at Time 1	37 (2.06)	38 (2.59)
Mean % of statements used at Time 1, not Time 2	67 (2.43)	71 (1.78)
Self knowledge checklist		
Mean z-transformed correlation between self ratings at Time 1 and Time 2	1.07 (.09)	1.12 (.11)

Notes: Standard error of the mean indicated in parentheses. TST = Twenty Statements Test; HC = Healthy control, Memory impaired = combined amnestic Mild Cognitive Impairment and Alzheimer's disease.

Narrative identity and personal temporal chronology.

Self-event connections. To compare the amount and type of autobiographical reasoning used in the Time 1 life stories, a mixed-factorial ANOVA was conducted with life period (childhood, early adulthood, middle adulthood, late adulthood) and type of self-event connection (change, stability) as the within-subjects factors, and group (HC, aMCI, AD) as the between-subjects factor. The dependent variable was the number of self-event connections in each chapter as a proportion of the total number of propositions used in that chapter (see Figure 5.5).

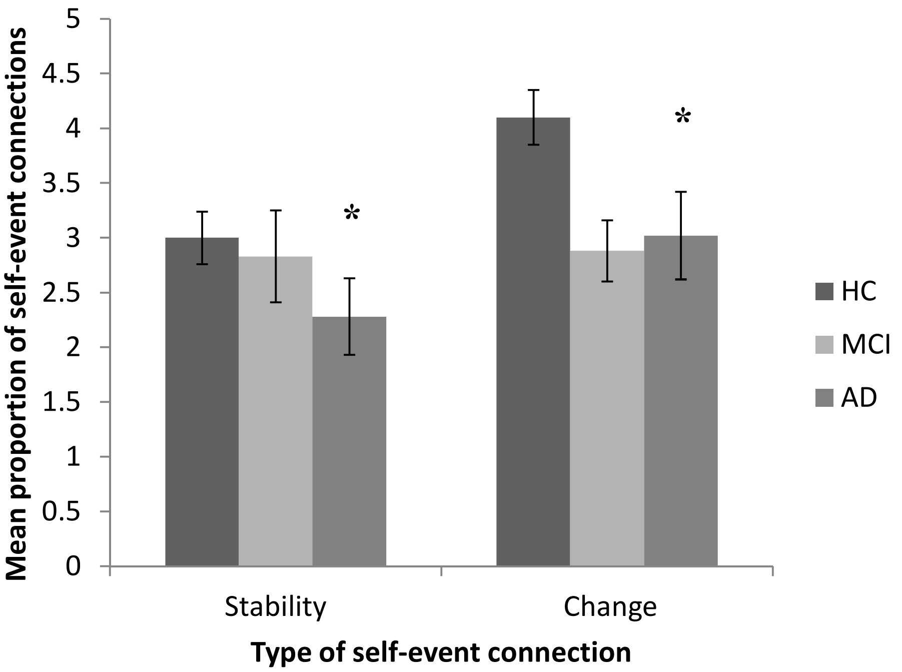


Figure 5.5. Mean number of self-event connections in the life stories as a proportion of the total number of propositions for each group. HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, AD = Alzheimer's disease. Error bars denote one standard error of the mean. AD group significantly lower than HC group for total proportion of self-event connections.*

There was a significant main effect for group, $F_{(2, 52)} = 4.7$, p = .01, with post hoc Games-Howell comparisons showing that the AD group used a significantly lower proportion of self-event connection in their life stories ($M = 5.31$, $SE = .52$) compared with the HC group ($M = 7.10$, SE = .36; $p = .02$). The aMCI group did not differ significantly from either the HC or AD groups ($M = 5.70$, $SE = .56$; all p-values $\leq .16$). There was a also a significant main effect for type of self-event connection, $F_{(1, 52)} = 5.74$, $p = .02$, with participants from all groups tending to use a larger proportion of change ($M = 3.47$, $SE = .19$) compared with stability ($M = 2.76$, $SE = .18$) connections. There were no other significant main effects or interactions (all p-values $\geq .12$).

Global coherence. A mixed ANOVA examined the difference between the groups on the global coherence of their stories, with type of coherence (temporal, causal, thematic) and life period (childhood, early, middle and late adulthood) as the within-subject factors and group (HC, aMCI, AD) as the between-subject factor. There was a significant main effect for group, $F_{(2, 52)} = 19.64$, $p < .001$, with the stories of the AD group rated significantly less coherent than either the HC or aMCI groups (all p –values $< .001$; Games-Howell). The aMCI and HC groups did not differ ($p = .44$). There was also a significant main effect for life period, $F_{(3,156)} = 1.11$, $p < .001$, with the early adulthood period showing greater coherence than other chapters (all p –values $< .01$). Finally, there was a significant main effect for type of coherence, $F_{(2, 104)} = 101.85$, $p < .001$, with all groups scoring highest on thematic (all p –values $< .001$), followed by temporal and finally causal coherence ($p = .04$).

There was a significant interaction between group and type of coherence, $F_{(4, 104)} = 9.00$, $p < .001$ (see Figure 5.6). The analysis was rerun for each group pairing, and the interaction remained significant for all three pairs (all p-values $\leq .001$). Pairwise Bonferroni comparisons showed that the HC and aMCI groups scored higher than the AD group on both temporal and thematic coherence (all p-values $\leq .004$). In relation to causal coherence, however, both the AD and aMCI groups scored lower than the HC group (all p-values $\leq .01$). All three groups scored significantly higher on thematic compared with causal or temporal coherence (all p-values $< .001$), but only the aMCI group scored lower on causal compared with thematic or temporal coherence (all p-values $< .001$). No other pairwise comparisons were significant ($p = 1.00$). These results indicate that while the AD group scored lower on all forms of coherence, the aMCI group showed a specific deficit in relation to causal coherence.

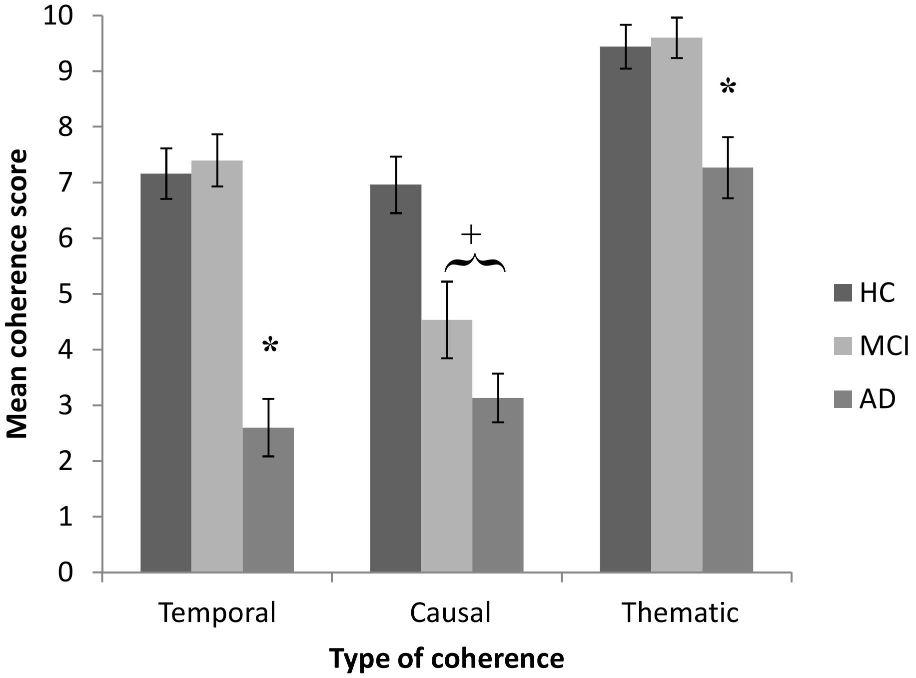


Figure 5.6. *Mean score for each type of coherence (temporal, causal and thematic) across the whole life story, for each group. HC = Healthy control, aMCI = amnestic Mild Cognitive Impairment, AD = Alzheimer's disease. Errors bars denote one standard error around the mean.*AD significantly lower than HC/aMCI groups; +Significantly lower than HC group.*

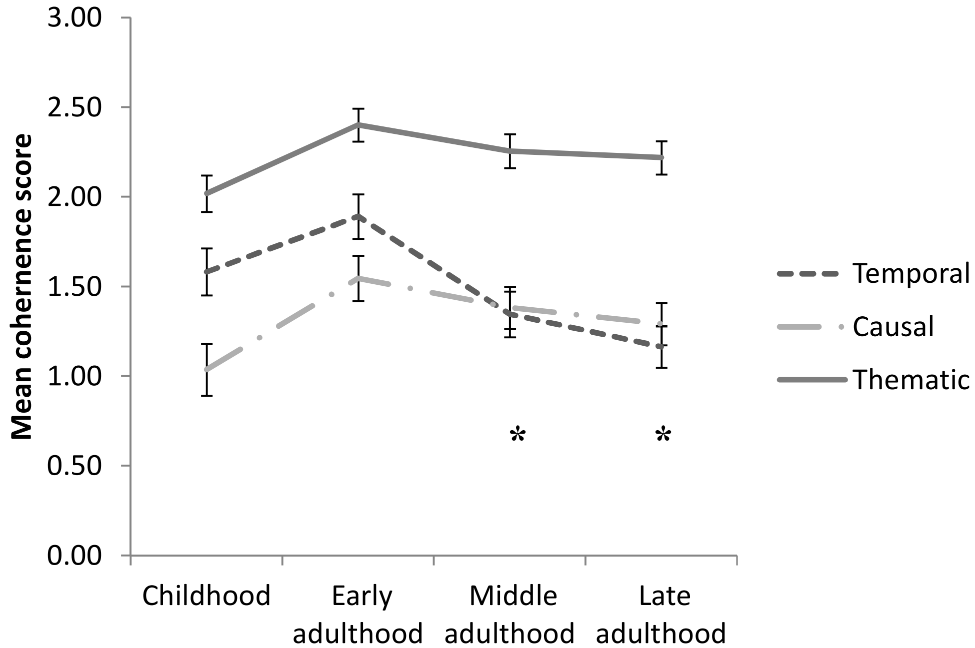


Figure 5.7. *Mean score for each type of coherence (temporal, causal and thematic) for each chapter of the life story, averaged across the three groups. Errors bars denote one standard error around the mean.* Temporal coherence significantly lower in middle and late adulthood periods compared with childhood and early adulthood.*

Finally, there was an interaction between type of coherence and chapter, $F_{(6, 312)} = 6.56$, p <.001, which was largely due to a slight reduction in temporal coherence for the latter two life periods (all p- values <.001) compared with the early adulthood chapter. There were no other significant interactions (all *p-values* ≥ .25; see Figure 5.7).

Cultural life script. In addition to temporal coherence (examined as part of 'Global Coherence' above) another important factor involved in constructing a personal temporal chronology in life narrative is the cultural life script. The mean number of cultural life script events and number of categories sampled by the groups in their life stories is set out in Table 5.10.

Table 5.10. The Mean Number and Proportion of Cultural Life Script Events and Event Categories Used in the Life Stories of Each Group

	HC group *M(SE)*	*aMCI group* *M(SE)*	*AD group* *M(SE)*
CLS events			
Number	16.80 (.96)	16.53 (1.50)	12.20 (1.78)
Proportion†	3.88 (.23)	4.61 (.57)	4.80 (.83)
CLS categories			
Number	10.56 (.51)	9.93 (.83)	8.27 (1.19)
Proportion†	2.46 (.12)	2.77(.33)	3.27(.53)

Notes: CLS = Cultural life script; M = Mean, SE = Standard error of the mean; HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease. † Score is proportional to the total number of propositions used in the life story.

To explore the difference between the groups on the use of cultural life script events in the life story, one-way ANOVAs were conducted on both the number of cultural life event categories sampled as well as the total number of cultural life events mentioned in the life story. After applying a Bonferroni correction for multiple comparisons (corrected alpha level = .025) there was no significant difference between the groups in relation to the number of cultural life script categories sampled, $F_{(2, 32.39)} = 1.89$, $p = .17$, or the number of events used in the life stories, $F_{(2,52)} = 3.41$, $p = .04$. In the latter case, however, this approached significance.

It is possible that the non-significant trend for the AD group to use fewer cultural life script events in their stories related to the shorter overall length of the stories they narrated. To assess this possibility, the analysis was rerun using the number of cultural life script events and event categories sampled as proportion of the total number of propositions used in the life stories. Again, there was no significant difference between the groups on either number of categories sampled, $F_{(2, 25.63)} = 1.38$, $p = .27$, or the total number of events used in the life stories, $F_{(2, 27.86)} = .80$, $p = .46$ (Brown-Forsythe). This indicates that the memory-impaired groups did not differ from healthy controls in their use of cultural life script events in their stories.

Relationship Between Diachronic Unity and Semantic Continuity

Temporally-extended self concept and diachronic unity. To assess whether there was any relationship between knowledge of past self and diachronic unity (perceived continuity, I-self continuity, and continuity explanation), Spearman's rho correlations were conducted (see Table 5.11). In addition to strength and complexity (number of subcategories) of past self knowledge, me-self continuity was included in the correlational analysis, as this is a measure of the extent to which the individual perceives that their self concept has changed since their early 20s.

There were no significant correlations after applying the Holm-Bonferroni adjustment (first-level corrected alpha level, $p < .006$). There was, however, a marginally significant correlation between I-self continuity and the complexity of TST (past) in the AD group ($p = .01$), indicating that those providing more complex descriptions of their past self also tended to express a stronger sense of core continuity across time. In addition, there were marginally significant positive correlations between me-self and I-self continuity in the HC ($p = .007$) and between me-self and perceived continuity in the AD group ($p = .048$). This pattern suggests that individuals who described themselves as having greater continuity in their traits and characteristics also tended to express greater core continuity. This pattern of results provides tentative support for the idea that knowledge of past self may play a role in this aspect of diachronic unity.

Table 5.11. Spearman's Rho Correlations Between Measures of Past Self Knowledge and Measures of Diachronic Unity.

	Measures of past self knowledge		
	TST (Past)		Me-self continuity
Diachronic unity	*Strength (number of statements)*	*Complexity (number of. sub-categories)*	
HC group			
Perceived continuity	.19	.09	.35
I-self continuity	-.09	-.28	**.53^**
Continuity explanation	.23	.32	-.30
aMCI group			
Perceived continuity	.10	.00	.31
I-self continuity	-.13	.13	.39
Continuity explanation	.11	.21	.00
AD group			
Perceived continuity	-.09	.15	**.56^**
I-self continuity	.32	**.66^**	.53
Continuity Explanation	-.10	-.40	-.30

Notes: TST = Twenty Statements Test. HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease. ^ Marginally significant after Holm-Bonferroni correction (p <.05)

To examine whether there was any relationship between the stability of self concept and diachronic unity, Spearman's rho correlations were calculated between the measures of test-retest stability (Percentage of TST (present) Time 2 statements also used at Time 1, and z-transformed correlations between participants' Time 1 and Time 2 rating on the self knowledge checklist) and three measures of diachronic unity as assessed at Time 2 (I-self continuity, perceived continuity and continuity explanation). Due to the small number of participants in the AD and aMCI groups, correlations were only examined within the HC group (see Table 5.12).

After applying a Holm-Bonferroni correction (first-level corrected alpha level, p <.008), there was a significant positive correlation between the continuity explanation and test-retest stability on the self knowledge checklist (p = .001). This indicates that those in the HC group who had higher correlations between their Time 1 and Time 2 ratings on the self knowledge checklist tended to provide more sophisticated explanations for their continuity across time.

Table 5.12. Spearman's Rho Correlations Between Measures of Stability of Self Knowledge (Test-retest) and Measures of Diachronic Unity at Time 2 for the Healthy control group (n = 20).

	Measures of Diachronic Unity (Time 2)		
Self knowledge test retest scores	*I-self continuity*	*Perceived continuity*	*Continuity explanation*
TST (test retest)†	-.20	-.40	-.21
Self knowledge checklist (test retest)‡	.04	-.02	**.72***

† The percentage of Time 2 statements that were also used at Time 1 on the Twenty Statements Test (Present)
‡ The correlation (z-transformed) between each participant's Time 1 and Time 2 responses on the self knowledge checklist.
* Significant after Holm-Bonferroni correction (first-level corrected alpha, $p < .008$)

Diachronic unity, personal temporal chronology and narrative identity. To examine the relationship between narrative identity and diachronic unity, Spearman's rho correlations were conducted between the measures of diachronic unity and six measures of narrative identity: the number of self-event stability and change connections used in the life story; ratings for temporal, causal and thematic coherence; and the number of cultural life event categories sampled (see Table 5.13). To control for differences in the length of the life stories, the measures of cultural life events and self-event connections were proportional to the total number of propositions used.

After applying a Holm-Bonferroni correction (first-level adjusted alpha, $p < .003$) there was one significant negative correlation between perceived continuity and causal coherence within the AD group ($p < .001$), indicating that those who produced stories that were more causally coherent were also more inclined to state that they were not the same person they were in their early 20s. Consistent with this finding, there was also marginally-significant negative correlations between perceived continuity and the number of self-event stability connections in the AD group ($p = .02$), and between I-self continuity and temporal coherence in the aMCI group ($p = .026$). Overall, this pattern indicates that those with better narrative identity (i.e., stories with greater global coherence and greater use of self-event connections) tended to express lower certainty about their core continuity.

Table 5.13. Spearman's Rho Correlations Between Measures of Narrative Identity in the Life Stories and Measures of Diachronic Unity

Measures of diachronic unity	Measures of narrative identity					
	Proportion of self-event connections[#]		Global coherence scores			*Cultural life script* †
	Stability	*Change*	*Temporal*	*Causal*	*Thematic*	
HC group						
Perceived continuity	-.19	.21	.07	-.03	.02	.31
I-self continuity	-.07	-.31	-.06	-.38	-.14	.05
Continuity Explanation	.18	.11	.32	.36	.33	**.44^**
aMCI group						
Perceived continuity	.06	-.36	.10	.09	-.05	.14
I-self continuity	.45	-.12	**-.61^**	-.11	-.39	.45
Continuity Explanation	.20	-.15	-.31	.38	-.27	-.44
AD group						
Perceived continuity	**-.62^**	-.51	-.47	**-.84***	-.46	-.12
I-self continuity	-.17	-.06	-.29	-.50	-.43	-.15
Continuity Explanation	**.72^**	.41	**.58^**	**.54^**	.31	.22

Notes: HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease. # Number of self-event connections as a proportion of total propositions in the life story.
* Significant after Holm-Bonferroni correction (first-level corrected alpha level, $p < .003$)
^ Marginally significant after Holm-Bonferroni correction ($p < .05$)
†Number of cultural life script categories sampled in the life story, as a proportion of the total number of propositions used.

There was also a consistent pattern of marginally significant positive correlations between the continuity explanation and quality of narrative identity. More sophisticated continuity explanations were associated with the greater use of self-event stability connections (p = .004), and greater temporal (p = .03) and causal coherence (p = .049) within the AD group, and with the greater use of cultural life script events (p = .03) in the HC group. This indicates that those with better narrative identity also tended to provide more complex explanations for self continuity.

Relationship between narrative identity and AM. To assess the relationship between the quality of narrative identity and AM, a series of partial correlations were conducted controlling for general cognitive decline (MMSE) and verbal fluency (COWA). The memory variables included were the number of propositions describing specific, extended and repeated events and lifetime period knowledge. In order to minimize the number of possible correlations, only life story total scores were used rather than examining each chapter separately. The measures of narrative identity used were the number of self-event stability and change connections used in the story, and total ratings of temporal, causal and thematic coherence. Total numbers (rather than proportional scores) were used for both the autobiographical reasoning measures and AM scores, as the question of interest was whether the absolute amount of each type of memory was related to the absolute amount of autobiographical reasoning.

There were no significant correlations after applying a Holm-Bonferroni correction (first-level adjusted alpha level, $p < .003$) (see Table 5.14). There was, however, a consistent pattern of marginally significant correlations across all three groups which appeared to support a relationship between the use of "experiential" levels of AM in the life story and the quality of narrative identity. Within the HC group, there were marginally significant correlations between the use of extended events and both causal coherence ($p = .005$), and the number of self-event stability connections ($p = .009$). There was similarly a marginally significant correlation between the use of extended events and thematic coherence in the AD group ($p = 01$), as well as between the use of specific event details and self-event change connections in that group ($p = .048$). There were also marginally significant relationships between the use of repeated events and self-event stability connections in the HC group ($p = .03$), and self-event change connections in the MCI group ($p = .048$). Overall, this pattern appears to indicate that those who used fewer of these experiential levels of AM in their life stories also tended to use less autobiographical reasoning and score lower on measures of narrative coherence.

Table 5.14. Partial Correlations Between Levels of Autobiographical Memory (AM) Used In the Life stories and Quality of Narrative Identity.

Number of AM statements in life story	Measures of narrative identity: Number of self-event connections		Global coherence scores		
	Stability	Change	Temporal	Causal	Thematic
HC group					
Specific events	.08	-.20	.05	-.05	-.04
Extended events	**.53^**	.37	.18	**.56^**	.19
Repeated events	**.46^**	.22	-.11	.11	.02
Lifetime period	.18	.10	-.10	-.11	.05
MCI group					
Specific events	.54	.43	-.06	.32	.42
Extended events	.38	.55	-.30	.00	.03
Repeated events	-.09	**.58^**	.10	-.32	.31
Lifetime period	-.18	.44	.36	.06	**.60^**
AD group					
Specific events	.38	**.56^**	-.49	.32	.47
Extended events	.46	.04	-.05	.54	**.67^**
Repeated events	.40	.22	-.29	.23	.41
Lifetime period	.43	.34	-.35	-.15	-.02

Notes: Partial correlations controlling for Mini Mental State Examination and Controlled Oral Word Association scores. HC = Healthy control; aMCI = amnestic Mild Cognitive Impairment; AD = Alzheimer's disease. ^ Marginally significant after Holm-Bonferroni correction ($p < .05$)

Discussion

This study provides one of the first systematic investigations of sense of continuity in memory-impaired older adults. It set out to explore these individuals' subjective beliefs about their continuity across time, as well as two theoretical mechanisms through which AM may support these beliefs: phenomenological and semantic continuity.

Diachronic Unity in AD and aMCI

A central finding of this study was that the memory-impaired groups did not differ significantly from healthy older participants in relation to their subjective beliefs about their core continuity (i.e., perceived continuity and I-self continuity). The vast majority of both healthy and memory-impaired participants expressed strong views that they remained the same essential person as they were in their early 20s. This finding of preserved core continuity is consistent with qualitative evidence from previous studies that those with memory impairments may nevertheless retain a deep conviction about their continuity across time (Medved & Brockmeier, 2008; Philippi, et al., 2012; Rathbone, et al., 2009).

Despite apparently preserved beliefs about core continuity, the present investigation suggested a divergence between this type of diachronic unity and the ability to construct a convincing justification for these continuity beliefs, as measured using Chandler et al.'s (2003) continuity explanation. The AD group provided explanations for their continuity over time that were significantly less sophisticated than those of the healthy and aMCI groups, with half of the AD group providing answers that relied on superficial, surface characteristics to justify stability and ignoring or downplaying aspects of personal change. These results suggest that a coherent and sophisticated rationale for one's continuity is not necessary in order to maintain a strong conviction that you continue to be the same person across time; even very simple continuity explanations, replicating the type of responses provided by young children in Chandler et al.'s study, may be sufficient to sustain beliefs about core continuity in this memory-impaired group.

In fact, the present results indicated that for those in the AD group, less sophisticated continuity explanations were associated with *greater* certainty about core continuity. One possible explanation is that simplistic, "change ignoring" continuity explanations provide a way to support a sense of continuity without needing to grapple with the realities of personal change, and focus instead on superficial aspects of personal consistency, as illustrated by the following response:

> I can't see myself being very different now. I just am like I am. If people talk to me I'll talk to them. I'm a mother, I help people.... I just seem to do the same things. If people talk to me I talk to them, if people need help I help them. Always been the same.

Focusing on superficial aspects of consistency may be a useful strategy for maintaining a strong conviction about core continuity for those with AD. As described in Chapter 4, this group were reported by family members to have undergone considerably more personal change compared to the healthy and aMCI groups. Despite this change, however, the AD group were significantly more likely to emphasise greater continuity in the me-self overtime (i.e., traits and characteristics) compared to healthy controls. A related suggestion has been made by Clare and colleagues (Clare, 2003, 2004; Naylor & Clare, 2008) in relation to lack of awareness about memory deficits. They suggest that reduced awareness may provide an important strategy for reducing threats to identity for certain individuals. It should be noted, however, that there was no correlation found in the present investigation between the lack of awareness of memory deficits and the use of more simplistic continuity explanations. It is also possible that the focus on stability rather than change in the responses of the AD group may relate to their memory deficits, and an inability to recollect the nuanced ways they have changed and stayed the same across the lifespan. This possibility was supported by the finding of marginally significant correlations between the use of specific and repeated memories in the life stories of those with aMCI and AD and the use of self-event change statements – this relationship could be indicative of less engagement with, or awareness of, change in those with poorer memory.

Another possibility is that the perceived continuity and I-self continuity measures used in the present study do not directly assess beliefs about core continuity, but rather assess the level of engagement that a participant has with difficult questions about self continuity. The direct questions regarding persistence and continuity used in the present study (e.g., do you believe you are the same person? In what whys have you changed?) appear to directly address questions about core continuity, and yet, someone could respond to these questions in a manner that indicates essential changes to who they are while nevertheless continuing to believe that these changes have occurred to the same, unifying "me". When individuals express less conviction about their core continuity on these measures, for example, by describing themselves as being "a fundamentally different person", this may not be a marker for uncertainty or degradation in their beliefs about core continuity, but rather an indication of intelligent engagement with the enigmatic challenges of self continuity. It is difficult to know how to distinguish such an answer from one in which the individual has lost the ability to see themselves as the same person extending across time – a true loss of self continuity. Those individuals who indicated such doubts about their core continuity (thus scoring lower on perceived and I-self continuity) may have in fact have been attempting to explore the difficult questions of change and continuity over the life time at a deep, philosophical level, which in turn allowed them to produce more sophisticated explanations for their continuity.

These issues indicate that further methodological work is needed to determine how best to assess diachronic unity. Further work is needed with groups who are likely to have true disruptions in their subjective beliefs about self continuity (e.g., suicidal populations, Chandler et al., 2003; Hsiao et al., 2013) in order to determine whether they provide qualitatively different types of answers regarding their diachronic unity.

Relationship between phenomenological and diachronic unity. As reported in Chapter 2, the AD group showed impaired phenomenological continuity, including a loss of internal details in their event stories and fewer event stories reported as "remembered". Although the present investigation found no significant correlations to support a relationship between phenomenological continuity and diachronic unity, a consistent pattern of marginal correlations did emerge. In both the AD and HC groups, phenomenological continuity was positively correlated with the sophistication of continuity explanations, but negatively correlated with beliefs about core continuity (i.e., perceived and I-self continuity). A very similar pattern of correlations was evident in relation to the use of extended memory details in the life story. These results indicate that those who were less able to vividly re-experience their past tended to emphasise greater stability in their core self, and yet provided less sophisticated explanations for why they continued to remain the same person.

These surprising results make more sense in the light of the discussion above regarding the divergence between core continuity and continuity explanation within the AD group. The negative relationship between phenomenological continuity and core continuity may be because those who were able to vividly remember their past (better phenomenological continuity), were better able to call to mind the ways that they had changed, evolved and adapted across time, leading either to uncertainty about core continuity, or to deeper reflection and contemplation about questions of self continuity. At the same time, this phenomenological access to the past may have enabled more nuanced and subtle explanations for how and why they persist as individuals. Perhaps those with a dimmer recollection of the past were protected from the stark realities of personal change, and also from the necessity of constructing coherent explanations that can integrate the paradoxical influences of personal change and continuity. Alternatively, for those who are less able to re-experience their past, there may be a greater need to emphasise stability in order to protect their sense of continuity.

Semantic Continuity in AD/aMCI

Temporally-extended self concept. This chapter explored two possible ways in which temporally-extended self concept may function to support diachronic unity. The first was that knowledge of one's self in the past, specifically of one's young adult self, might provide a basis for diachronic unity. The AD groups' descriptions of their young adult selves were weaker (i.e., fewer statements) than the healthy or aMCI groups, in a manner similar to their present self descriptions. There was no difference between groups in terms of the complexity (number of subcategories sampled) of their young-adult self descriptions. It is important to note, however, that the TST (Past) task only used the traditional TST administration, which allowed a maximum of 20 statements. The present study, as well as other investigations of present self knowledge (Addis & Tippett, 2004; Eustache, et al., 2013), have failed to reveal a difference in the complexity of present self knowledge using the traditional administration of the TST. As discussed in Chapter 4, the present investigation did reveal a difference in the complexity of present self knowledge when using a novel, supplementary TST condition which used prompts and allowed an unlimited number of responses. It is possible that a difference in complexity of past self knowledge would similarly be revealed if an extended TST (Past) task was used.

Although no significant relationships were found between strength or complexity of past self knowledge and measures of diachronic unity, the pattern of marginal correlations provided tentative support for the suggestion that knowledge of one's past self may play a role in subjective beliefs about continuity. Specifically, within the AD group, those whose descriptions of their young-adults selves were more complex (i.e., used a larger number of subcategories) also tended to emphasise greater I-self continuity across their life, suggesting that access to a wider variety of information about one's young self may help to maintain greater certainty about core continuity. In addition, in both the HC and AD groups, those who emphasised greater me-self stability also emphasised greater I-self stability across their lives. This finding is consistent with the suggestion above that greater certainty about core-continuity continuity, particularly for the AD group, may be accompanied by greater emphasis on ways the me-self has remained stable, and less focus on changes in one's traits and characteristics across the lifespan.

The second theoretical perspective on temporally-extended self concept explored was that stability in one's current self knowledge may play a role in diachronic unity. The stability of self knowledge was assessed across a two-year interval, both using a spontaneous self descriptions and a self knowledge checklist format. Although there appeared to have been a slight reduction in the strength of present self descriptions (i.e., the number of TST (present) statements used) over this time period, this reduction applied to both the healthy and memory-impaired groups, and was only significant in the case of the healthy control group. The reduction may have been due to an increase in age of participants, or even due to subtle differences in interview technique between the two time periods. In terms of the content of spontaneous self descriptions, the novel TST test-retest coding scheme suggested that the two groups reused a very similar percentage of their self descriptive statements at the second time point (HC: $M = 37\%$, memory impaired, $M = 38\%$).

Similarly, the correlations between participants' Time 1 and Time 2 ratings on the self knowledge checklist did not differ between the groups, and in fact appeared was slightly (though not significantly) higher for the memory-impaired group.

Due to the small number of memory-impaired participants who participated in the longitudinal follow-up interviews, no strong conclusions can be drawn from these findings. In particular, only 2 AD participants participated, which is too few to have a meaningful between groups comparison. Nevertheless, these findings provide tentative, preliminary indication that the memory loss in early AD and aMCI may not impact on the ability to maintain stable present self knowledge. This is consistent with previous studies which have suggested stable self knowledge over a manner of weeks (Clare, et al., 2013; Eustache, et al., 2013; Klein, et al., 2003). The suggestion of stable self knowledge is also backed up by the finding that in relation to the main study findings, the AD group indicated a significantly greater sense of me-self continuity on the self continuity interview (i.e., continuity in their traits and characteristics across their lives) compared with healthy controls, with their responses placing greater emphasis on ways they had remained the same and less emphasis on ways they may have changed.

Although there were not enough memory-impaired participants to investigate the relationship between the stability of present self knowledge and diachronic unity in AD or aMCI, there was a significant relationship found in the HC group between the test-retest stability of ratings on the self knowledge checklist and the sophistication of continuity explanation. Overall, these findings provide tentative support for the hypothesis that temporally-extended self concept, both in relation to knowledge of past selves and stability of present self knowledge, may contribute to this aspect of diachronic unity.

Narrative identity and personal temporal chronology. The present analysis revealed a number of differences between the narrative identity of memory-impaired and healthy older adults. There was a general reduction in the quality of the narratives produced by the AD group, including fewer self-event connections (both change and stability) in their life stories, as well as a reduction in the temporal, causal and thematic coherence. These findings indicate that the AD group were making fewer links between the events they included in their stories and their self concept, and that they were less able to convey to an independent listener the temporal order of events, the causal links between the elements of the story, and the overarching motifs and lessons that wove the story together. The pattern of marginally significant correlations found between "experiential" levels of AM (i.e., specific, extended and repeated) and the quality of narrative identity may indicate that these are the levels of memory in which AR is likely to take place. As these forms of memory deteriorate in AD, so too may the ability to link and integrate elements within the story into a coherent narrative.

Interestingly, although the aMCI groups' stories had maintained temporal and thematic coherence, there was a significant reduction in the causal coherence of the life stories of this group, indicating that they were less able to explain the causal links between events, or between these events and their self concept. This may indicate that causal coherence, at least as it was measured in the present investigation, requires a more complex form of reasoning than the other types of coherence, and is affected earlier in the disease process. Habermas and De Silveira (2008) report that causal coherence develops steeply during adolescence, and is more complex than temporal coherence. Although they suggest that causal coherence is less complex than thematic coherence, and demonstrate that thematic coherence does not steeply increase until after age 16, it is interesting to note that their findings suggest causal coherence is almost absent in the stories of younger children, while a basic level of thematic coherence is present.

Alternatively, it is possible that the impaired causal coherence of the aMCI group may relate to the acute awareness that many of those in the aMCI group possessed about their memory loss, leading to a difference in the way these individuals approached their stories. For example, in attempting to remember all of the details of their stories, they may have focused more deliberately on including important dates and events than on providing any meta-narrative to link the stories together. In addition, the effort of producing these life stories, including trying to remember the events and their temporal order, may have required greater cognitive energy for those with aMCI leaving less to expend on more complex aspects of the story like causally linking events. Further work could explore these possibilities by using a guided autobiographical reasoning assessment using prompts to elicit these different reasoning processes.

The present findings also revealed some deterioration in the personal temporal chronology of those with AD. Consistent with reports that the narratives of those with AD may lack chronological ordering (Usita, et al., 1998), the life stories of the present AD group were rated as having lower temporal coherence than the stories of the other groups. This indicates deterioration in the ability to convey the absolute and relative temporal ordering of events thought their life narratives. While this could relate to difficulties in ordering and sequencing events in the process of story construction, an interesting possibility is that this difficulty reflects a disruption in the temporal organisation of AM itself.

Despite this, the use of the cultural life script was well preserved in the life stories of those with AD. Although there was a non-significant trend for those with AD to use fewer cultural life script events, after taking into account the length of their stories, there was no difference between the groups in relation to the number of cultural life script events, or event categories, used. This is consistent with the findings of Fromholt and Larsen (1991) and suggests that those with AD may largely retain their cultural knowledge about which events should be included in a life story.

An interesting possibility is that the organisational structure provided by the cultural life script, and the memories linked to it, may be relatively more resilient than other types of AM, perhaps due to the important socio-cultural function of these memories. This culturally generated script may play an important role in structuring and organising the last remnants of AM in AD (Berntsen & Rubin, 2004). It is important to note, however, that the measure used in the present study only addressed whether the events were mentioned in the story, and not the detail or accuracy of the stories. It is possible that AD participants retained knowledge about the script (i.e., awareness that a given type of event should be included in their life story) but not any accuracy or detail about the event itself. The resilience of cultural life script events may also be due to the list of events being weighted to the first half of life, and particularly the early-adulthood "reminiscence bump" period (Berntsen & Rubin, 2004). The temporal gradient in semanticised AM of the AD group may spare memory for these early life events. To assess these possibilities, future investigations should explore the detail and accuracy of the cultural life events included in the stories of those with AD, and whether there is any difference in the recall of cultural life events from different life periods.

Relationship Between Narrative Identity and Diachronic Unity. The present findings suggest a complex relationship between narrative continuity and diachronic unity. First, within the AD group, there was a consistent pattern of positive, marginally significant correlations between the sophistication of the continuity explanation and the quality of narrative identity, including the greater use of self-event stability connections, and greater temporal and causal coherence of life stories. This finding provides tentative support for the suggestion that the ability to construct a quality life narrative, which links one's AMs into a coherent narrative that can explain the development of the self across time, was associated with more sophisticated explanations for why one continues to remain the same person. An intriguing possibility, in line with the present model, is that this association reflects a causal relationship: that the ability to weave a high-quality life narrative scaffolds the ability to understand and explain one's continuity across time. The fact that this relationship was only present in the AD group is consistent with Habermas and Kober's (2014) suggestion that autobiographical reasoning may be necessary for diachronic unity only when there are disruptions to continuity. A diagnosis of AD, and the accompanying personal and circumstantial changes, may constitute such a disruption. In the face of such disruptions, any deterioration in the ability to weave AM into a coherent narrative may contribute to an impaired ability to understand, at a higher conceptual level, why they remain continuous beings over time.

It is also possible, however, that what may underlie these relationships is cognitive decline in AD which is not directly related to memory, but affects both the construction of quality life narratives and successful engagement in the continuity explanation task. Interestingly, the loss of sophistication in continuity explanation in the AD group was not significantly correlated with general cognitive decline (MMSE) or verbal fluency (COWA), suggesting that other factors were involved. Nevertheless, there may be more subtle reasoning processes affected, not captured by simple measures like the MMSE. To assess this possibility, a control paradigm could be used in future investigations which requires a similar, but non-self related reasoning exercise (e.g., explaining the continuity of animals or inanimate objects over time) in order to determine whether it is the ability to engage in such logical reasoning processes that is affected, or whether there are specific deficits in explaining one's own continuity.

Although better narrative identity was associated with increased sophistication of continuity explanation, it was not associated with greater certainty about core continuity. On the contrary, in the AD group a significant negative relationship was found between the causal coherence of life stories and certainty about whether they remained the same continuous person. This finding was supported by a pattern of marginal correlations in the AD and HC groups relating lower core continuity with increased causal coherence and use of self-event connections. These findings parallel those reported above in relation to phenomenological continuity: better memory performance (in this case, better integration of AM into a life narrative) was associated with more sophisticated continuity explanations but less certainty about core continuity.

A limitation of the current investigation is its focus past-facing continuity. Recent theories have postulated that the adaptive function of the episodic memory system may not relate to reliving the past, but rather in being able to imagine, and therefore plan for, the future

(Suddendorf, Addis, & Corballis, 2009; Tulving, 2005; Tulving & Szpunar, 2009), and neuroscientific work has established a connection between the ability to remember one's past and the mental projection of oneself forward in time into the imagined future (Addis, Pan, et al., 2009; Addis, Sacchetti, et al., 2009; Addis, et al., 2008; Schacter & Addis, 2007). It may be that the ability to mentally project oneself forward in time plays a vital role in self diachronic unity.

Research into future projection has primarily focused on the role of episodic memory; however there are studies which suggest that semanticised AM may play an equally important role. Patients with semantic dementia, who have profound semantic memory deficits but largely preserved episodic memory, have been found to be as deficient at imagining personalised future scenarios as individuals with AD, suggesting that semanticised AM may provide the scaffolding that allows episodic memory details to be recombined into novel future scenarios (Irish, et al., 2012). There is also evidence that fundamental breakdowns in sense of continuity can arise from problems with the ability to mentally project oneself forward in time in semantic dementia, and may be associated with suicidal behaviour (Hsiao, et al., 2013). This future-facing aspect of self continuity, and its association with semantic and episodic memory ability, is an important area for future investigation.

Summary

The model set out in this chapter proposed that phenomenological and semantic continuity provide two parallel mechanisms through which AM supports diachronic unity. Although a thorough investigation of this model, for example, using sophisticated hierarchical modelling techniques, was beyond the scope of a study of this size, some important insights were gained.

Underlying the complex pattern of findings in the present study was a divergence between the two aspects of diachronic unity investigated: beliefs about core continuity over time (i.e., perceived and I-self continuity) versus the sophistication of continuity explanations. The AD group had maintained the former, but showed deterioration in the latter. Within the AD group, those who scored higher on measures of core continuity also provided less sophisticated explanations for their self continuity, were less able to vividly re-experience the events of their lives (i.e., lower phenomenological continuity), and less able to use their AM as a vehicle to explore how they came to be the person they are through their life narratives (i.e., worse narrative continuity). If core continuity is taken as the key marker of diachronic unity, then these findings appear to run contrary to the proposal that narrative continuity and phenomenological continuity support are important. Conversely, if the sophistication of continuity explanation is taken as the key marker of diachronic unity, then the present findings provide tentative support for the proposed model. Less sophisticated continuity explanations were associated with poorer episodic memory for early life periods in both the AD and HC groups (i.e., lower phenomenological continuity) and poorer narrative identity.

The interpretation suggested here for these apparently paradoxical findings is that deep engagement with issues of self continuity may be indicated both by more sophisticated responses on the continuity explanation, and by responses to questions about core continuity that indicate and appreciation of personal change across the lifespan. If so, these results suggest that deep engagement with the events of one's past both experientially (i.e. though phenomenological continuity) and through the use of life narratives may facilitate deep engagement with questions of self continuity as evidenced through sophisticated responses on the continuity explanation and expressing less conviction about core continuity. When the connection with one's remembered past is diminished, as in AD, this may contribute to a less sophisticated understanding about personal continuity; one which over-emphasises superficial aspects of stability and fails to integrate an understanding of change. Further work is needed to investigate whether this apparent lack of engagement with the paradox of self continuity in AD is due to an inability to remember personal change, or may serve an important protective mechanism for those with AD in protecting diachronic unity in the face of tremendous personal change.

Chapter 6. General Discussion

This thesis has proposed a novel model for understanding sense of self, and then used this framework to guide a series of empirical investigations into the complex relationship between sense of self and AM. The underlying aims of these investigations were firstly, to provide one of the most comprehensive assessments of sense of self ever attempted within a single patient group to assess which aspects of sense of self are affected in AD and aMCI, and secondly, to explore how the particular profile of deterioration in AM in these groups affected each aspect of sense of self. This chapter discusses each of these questions in turn, with particular focus on integrating the findings across the different parts of the model, the theoretical and methodological implications, and areas where future studies are needed.

Profile of Sense of Self in AD and aMCI

Sense of Self in AD

The findings of this thesis revealed an interesting patchwork of preserved and impaired elements of sense of self in mild-to-moderate AD. The overall pattern of group differences found in this study, and how they relate to the proposed model, are set out in Figure 6.1.

In line with previous investigations (Biringer & Anderson, 1992; Biringer, et al., 1988; Fazio & Mitchell, 2009; Grewal, 1994; Hedman, et al., 2012; Mendez, et al., 1992; Sabat, 2002; Sabat & Harré, 1992; Small, et al., 1998; Tappen, et al., 1999) the present findings indicate that present-moment self awareness is well preserved in aMCI and early-moderate AD, including a retained ability to self recognise and use personal pronouns appropriately and meaningfully as a means to self reference. The study has also extended these findings by demonstrating a preserved ability to reflect upon and describe present-moment conscious experience across a number of modalities using a novel self awareness in the present moment task.

<table>
<tr><th></th><th>Subjective sense of self (I -self)</th><th>Content of self (Me-self)</th></tr>
<tr><td>Present self</td><td>Self awareness
Impaired
• Expressing subjective preferences (moderate-severity subgroup)
• Awareness of memory deficits

Preserved
• Self-face recognition (except for most impaired participant)
• Describing present-moment experiences
• First-person pronouns usage</td><td>Self knowledge
Impaired
• Lower accuracy for self knowledge (social desirability neutral), including:
- Present self knowledge
- Past self knowledge
• Spontaneous self knowledge
- Lower strength and complexity
- Fewer temporally abstract statements

Preserved
• Accuracy for past (socially desirable) self knowledge
• Type of spontaneous self knowledge used:
- Number of temporally specific (restricted in time) statements
- Which categories were sampled
- Proportion of contextually abstract vs specific statements</td></tr>
<tr><td rowspan="2">Temporally extended self</td><td>Phenomenological continuity

Impaired
• Autonoetic consciousness
• Episodic detail used in event stories
• Number of specific event memories used in life stories</td><td>Semantic continuity
Impaired
• Strength of spontaneous descriptions of past (20 year old) self
• Quality of narrative identity in life stories:
- Number of self event connections
- Global coherence of stories

Preserved
• Complexity TST (Past)
• 2 year test-retest stability of self knowledge checklist and TST (present)
• Beliefs about stability of characteristics across life span (Me-self continuity)
• Use of cultural life script in life story</td></tr>
<tr><td colspan="2">Diachronic unity
Preserved:
• Beliefs about core continuity across life span (I-self and perceived continuity)
Impaired
• Sophistication of explanation for self continuity across time</td></tr>
</table>

Figure 6.1. Summary of impaired and preserved aspects of sense of self in Alzheimer's disease. TST = Twenty Statements Test.

GENERAL DISCUSSION

The investigation of self awareness has also revealed new evidence of deficits in the ability to express subjective personal preferences in moderate-severity AD. This ability relates to self awareness, because it relies on the capacity to assess one's current thoughts, desires, motivations and goals, but is likely to be a higher-level ability, requiring a complex process of weighing up the subjective value of choices in light of information gained through self awareness, as well as longer-term self knowledge about one's preferences, in order to determine the best option in that particular moment and situation (Fellows & Farah, 2007). D'Argembeau (2013) suggests that the VmPFC may serve a specialised role in weighing the subjective value or significance of stimuli, and deficits in this ability have been reported in individuals with damage to this region (Fellows & Farah, 2007; Henri-Bhargava, Simioni, & Fellows, 2012). While the involvement of VmPFC pathology could not be tested directly in the present investigation, the results did show that impaired performance occurred only in the moderate stages of AD progression, a point in the disease progression when pathology may extend to prefrontal regions (Buckner, et al., 2005; Herholz, et al., 2002). Further work is needed to explore the possibility that deterioration in simple preference decisions in AD may be underpinned by pathology to the VmPFC, particularly in light of evidence from other studies of a relationship between pathology in this region and lack of memory awareness (Hornberger, et al., 2012).

In contrast to findings of well preserved self awareness in early-moderate AD, a number of deficits in present self knowledge were revealed. Consistent with previous studies (Hehman, et al., 2005; Klein, et al., 2003; Rankin, et al., 2005; Ruby, et al., 2009), the accuracy of current self knowledge (measured using family reports) was lower for those with AD than for healthy older adults and those with aMCI. The present investigation extended these findings by demonstrating that problems with present self knowledge accuracy extended beyond knowledge of abstract personality traits to include a range of other categories (e.g., social roles, physical characteristics, preferences). In addition, the results suggested that the degree of inaccuracy was related to the extent of personal change, with those rated by family members as having changed more over the past 10 years demonstrating greater inaccuracy. Difficulties with maintaining up-to-date self knowledge may relate, in part, to difficulty keeping up with the changes in personality, roles and circumstances which accompany the disease. It would be useful for future studies to explore the extent to which sudden personal changes may present difficulties for the accuracy of self knowledge for any older adult; however, it is likely keeping up with such change would be particularly difficult for those with AD due to wide-ranging cognitive difficulties they face, including theory of mind (Ruby, et al., 2009) and AM deterioration, as explored below.

The present results also replicated previous findings of preserved pre-morbid self knowledge in AD (Hehman, et al., 2005; Klein, et al., 2003; Rankin, et al., 2005), but further analysis indicated that this apparent preservation only applied to socially-desirable self knowledge. It was suggested that the apparent preservation of past self knowledge in AD may relate to preserved semantic knowledge about social desirability, which may artificially increase the similarity between self reports and family-member ratings of pre-morbid personality. Once items that were weighted for social desirability were removed from the analysis, the AD group demonstrated equally poor accuracy in relation to past and present self knowledge. This deterioration in past self knowledge is also supported by the finding, reported in Chapter 5, of reduced strength (fewer statements) of the past self descriptions in the AD group. These findings challenge the commonly held view that past self knowledge is generally well preserved in AD, and suggest that further investigation is needed to resolve which aspects of past self knowledge might be retained and which have been lost in AD.

Consistent with previous findings, this investigation has found that those with AD tend to provide fewer self-descriptive statements (Addis & Tippett, 2004; Eustache, et al., 2013). A novel, supplementary TST task demonstrated that this weaker self knowledge was not assisted by prompting, indicating that this reduction is not simply due to difficulties accessing knowledge in an unguided context, but to a genuine reduction in the amount of information available to describe the self. This novel task also demonstrated that a lower number of subcategories were sampled in the self descriptions of those with AD, indicating a reduction in the complexity of self knowledge that has not previously been revealed through methods that restrict the number of self-descriptive statements (e.g., Addis & Tippett, 2004; Eustache, et al., 2013). These findings highlight the importance of using tasks that eliminate ceiling effects for healthy control groups, pushing them to the limits of their abilities, so that more subtle deficits in sense of self can be revealed.

Despite these difficulties, the type of self-descriptive statements used by those with AD did not differ from the other groups. Their descriptions used a similar proportion of different categories of self knowledge as other groups, and contrary to previous findings (Addis & Tippett, 2004), there was no difference in the contextual specificity of the statement used, assessed using two different coding methods. This pattern of results adds to other recent findings that the content of self knowledge is not greatly affected at this early-to-moderate stage of the disease (Caddell & Clare, 2012; Eustache, et al., 2013); instead, it appears that it is primarily the amount and breadth of information that is affected.

A surprising exception, however, is the finding that the AD group describe themselves using fewer temporally abstract statements (invariant in time, e.g., I have always been a hard worker), but the same number of temporally-specific statements (restricted in time, e.g., “I used to live on a farm”, “I’m starting to go deaf”). This finding challenges a recent claim by Eustache and colleagues (2013) that AD may primarily affect the short term, transient aspects of self knowledge which allow one to represent uniqueness and change in the self from day-to-day while preserving the longer-term representations of how one has remained continuous over time. This suggestion was based on their findings that the self knowledge of their AD participants was very stable across a two-week period, and that some of their self knowledge was outdated (knowledge about current age). The present findings support and extend their results that the self knowledge of those with AD may be fairly stable by demonstrating stable test-retest performance (for a small number of participants) over a 2-year period. The present study has also demonstrated that those with AD may retain strong beliefs about their continuity over time, both in relation to their traits (the me-self continuity scale) and their core continuity (perceived and I-self continuity). However, the present results do not support the claim that this stability arises from a greater use of temporally-abstracted self statements; it appears that the reverse may be true, that those with AD use fewer temporally-abstract statements and rely more on temporally-specific statements.

The explanation suggested in Chapter 4 for this apparent decrease in temporally abstract self knowledge is that this finding might reflect the overall reduction in strength of self knowledge accompanied by an increase in the proportion of temporally specific self knowledge. That increase could be due to the greater use of emotional/reflective comments about recent personal changes (e.g. relating to concerns about age, health, the disease and changing circumstances), or an increase in the number of outdated, past-focused statements (see also Eustache, et al., 2013). Given the finding of retained self awareness in AD, another possibility is that more of their self statements may relate to material that is available within their present-moment awareness (e.g., “I have a mark or bruise on my hand”). Whatever the explanation, these findings indicate that the temporal abstraction of self knowledge may be a fruitful avenue for future research. In particular, more qualitative analysis of the self descriptions of those with AD would be useful to extract the subtle differences in the meaning of statements at different levels of abstraction. In addition, it would be useful to explore whether there is any relationship between the use of self knowledge of different levels of temporal abstraction and the disruptions in self continuity found in this group.

In particular, this study has found marked deterioration in both phenomenological and semantic continuity; the two mechanisms proposed in the model as jointly contributing to diachronic unity. First, as anticipated, considerable deterioration was found in phenomenological continuity, with the AD group demonstrating less ability to vividly recollect events from their past and fewer events reported as "remembered" (i.e. autonoetic consciousness). Second, deterioration was found in aspects of semantic continuity, including problems with temporally-extended self concept (weaker past self knowledge), personal temporal chronology (temporal coherence of life stories) and narrative continuity (less autobiographical reasoning and lower global coherence in the life stories). There are also aspects of semantic continuity that appear well preserved, including the stability of present self knowledge, a preserved belief about the consistency of characteristics across the lifespan, and a preserved use of the cultural life script in the life stories.

Despite the deficits found in phenomenological and semantic continuity, those in the AD group tended to express strong beliefs that they remained the same core person across their lives. There was, however, marked deterioration in the complexity of the explanation they were able to provide to justify this sense of continuity, with their answers tending to rely on superficial characteristics that had remained stable across the lifespan, while ignoring the complexities of personal change. These results suggest an interesting divergence between the two aspects of diachronic unity, and further work is needed to investigate precisely how these aspects relate, and how best to measure diachronic unity. As noted in Chapter 5, it was not uncommon for healthy older adults to demonstrate philosophical curiosity about self continuity, by freely exploring fundamental ways they had changed across the lifespan and expressing uncertainty about whether they remained "the same person". Future studies could explore these apparently "normal" explorations of discontinuity, their relationship to mental health and wellbeing, and ways to separate them from pathological expressions of self continuity, for example, in suicidal populations (Chandler, et al., 2003).

An important feature of the present model that enabled such a thorough and comprehensive investigation of sense of self in AD is that it separates AM from sense of self so they can be explored as related but separate variables. This approach contrasts with many other theoretical treatments of sense of self which incorporate AM as an integral aspect (e.g., Brewer, 1986; Klein & Gangi, 2010; Martinelli, et al., 2012; Morin & Michaud, 2007; Neisser, 1988; Oyserman, 2004). The separation in the present model was a useful and important step in exploring the theoretical relationship between these variables, allowing clear hypotheses to be devised about their possible relationship, enabling methodological approaches that could be used to investigate these questions and permitting coherent interpretation of results.

While this separation has many benefits, the alternative perspective - an integrated understanding of AM as an essential feature of sense of self – may be useful for future studies seeking to explore the emotional impact of AD. The overlap in these constructs was evident in the fear expressed by many study participants who were anticipating impending memory deterioration, and the grief of family members dealing with the reality of this loss. For these individuals, the loss of important personal memories constituted direct evidence of a loss of "self", quite apart from any further impact this loss may have on aspects of sense of self like self knowledge and narrative identity. For example, one participant's wife broke down in tears when she realised that her husband of 45 years could not remember their wedding day. Similarly, the adult child of one participant was distressed to discover that her mother could not remember her birth. Some of this sadness may also relate to the loss of a relational aspect of sense of self, which has been proposed in some models (Neisser, 1988; Georg Northoff, 2013; Sabat, 2002). Studies have also explored the social function of AM (Waters, et al., 2013; A. Wilson & Ross, 2003). Such models may provide a more appropriate theoretical perspective to guide investigations concerning ways the relational self may be affected by the loss of shared memories in AD.

Sense of self in aMCI

This study has provided the first broad investigation of sense of self in aMCI, and represents an important step in understanding the impact of this condition. Overall, very few significant differences were identified between the way those with aMCI and healthy older adults experienced and conceptualised their sense of self. The main exception was deterioration found in the narrative identity of those with aMCI, with the life stories of the aMCI group being rated lower in relation to causal coherence compared to the HC group. The deterioration in "causal coherence" suggests that the aMCI group were less able to convey, through their life stories, how different elements of the story led to, brought about or were dependent upon other elements, including how aspects of the self were affected by life events (Habermas, 2011; Habermas & Bluck, 2000). This deficit may indicate that even the modest deterioration in AM in the aMCI group was sufficient to erode their understanding about how events within their stories related to one another. Alternatively, as noted in Chapter 5, causal coherence may represent a more difficult aspect of narrative identity, or those with aMCI may approach their narratives in a different way.

Given the hierarchical relationship hypothesised between different elements of sense of self in the proposed model, it is perhaps unsurprising that narrative identity should be the one area in which problems were identified for the aMCI group. The present model assumes both that the I-self actively constructs the content of self (Lewis, 1991; Martin, 2005; 1996, 2011; Morin & Everett, 1990; Singer, 1995), and that the temporally-extended aspects of sense of self rely on present moment aspects of self experience and self knowledge. Consistent with other theoretical perspectives (McAdams, 2001, 2013; Singer, 1995), the present model has proposed that narrative identity is among the highest and most complex form of sense of self. Studies have sometimes examined higher forms of sense of self and their relationship to AM without considering the contribution that might be made by lower forms of sense of self (the phenomenological and present-moment elements) (for a similar argument, see Caddell & Clare, 2013; Raffard et al., 2010). For example, studies that have reported disruptions in narrative abilities in AD (Mills, 1997; Usita, et al., 1998) have not investigated whether these problems are underpinned by disruptions in simpler forms of self experience (e.g. self awareness or self knowledge). By assessing each aspect of this model in turn, the present investigation has been able to rule out the possibility that deterioration in narrative identity in the aMCI group is due to primary deficits in lower forms of sense of self.

Nevertheless, it is possible that there may be minor changes to sense of self in aMCI that the present study was not sensitive enough to detect. First, as described in Chapter 2, the gap between the performance of the HC and aMCI groups may have been affected by the heterogeneity of the aMCI diagnosis, the possibility that the group used in the present investigation may have represented a high-functioning subgroup of those with aMCI. Second, the small numbers involved in the present study, due to difficulties recruiting participants who met the right diagnostic criteria, may have limited its power to detect small differences in the aMCI group and subtle relationships between variables. This was a particular issue given the overarching goal to assess the relationship between so many aspects of sense of self and AM. Despite any possible loss of power, the deliberately expansive focus has enabled an exploratory investigation into questions that would not have been possible if only limited aspects of sense of self were examined, and has highlighted potential areas of interest for future researchers.

This study appears to indicate that if there are difficulties with sense of self in aMCI, these are likely to be relatively minor. It is important to be clear, however, that the focus of the study was on the ability to experience and conceptualise sense of self in a coherent manner, and not about the impact of aMCI (or AD) on the content of self beliefs or self esteem, or on well being and mental health. Although these questions were not formally addressed, during the interview process a number of individuals in the aMCI group expressed distress, fear, confusion, and even despair about their condition. For example, one participant finished his life story with the following, tongue-in-cheek but dramatic closing statement:

> No, I think I'm looking forward from now, forward, because we're--we've pretty well planned what we are going to do; there'll be no more bullshit trying to find a job, and all that, and we will um, have a gentle retirement. And when I've gone crazy, far enough, I'm gonna get a revolver and go BOOM!

Although the study indicates that this group's ability to conceptualise and experience a coherent sense of self was not greatly affected by memory deterioration, it is important that future work explore how the emotional impact of memory loss, and an aMCI diagnosis, are represented in the content of spontaneous self knowledge or through life narratives.

The Relationship Between AM and Sense of Self

The second major focus of this study was to examine the relationship between AM and the aspects of sense of self proposed in the model, including hypotheses arising from two theoretical models of AM proposed respectively by Tulving (1984, 1985, 2002, 2005) and Conway and colleagues (Conway, 2005; Conway & Pleydell-Pearce, 2000; Conway, et al., 2004), as well as specific hypotheses arising from the literature relating to each aspect of sense of self. As well as the anticipated deterioration in event-specific episodic memory and autonoetic consciousness in AD, the present investigation has importantly found deficits in other "experiential" levels of AM, including extended and repeated memory. The focus was therefore to examine not only the impact of deterioration in episodic memory, but also deterioration in extended and repeated levels of AM, on the various aspects of sense of self.

Aspects of Sense of Self that May Be Independent of Experiential AM

The first question of interest concerns the aspects of sense of self that appear to have remained intact in the AD group. A tentative inference that can be drawn from these findings is that these aspects of sense of self are not reliant on fully-functioning episodic, extended or repeated levels of AM. Great caution is needed in interpreting these findings because there are a number of reasons why the AD group may not have shown deterioration on these tasks, and it cannot be assumed that a finding of no difference between the groups demonstrates that there is no impairment in the ability. Such a finding could be due to various other factors, including insufficient power or measures that are not sensitive enough to detect differences. Nevertheless, when interpreted in the light of the growing body of evidence surrounding sense of self in AD, these findings add weight to the suggestion that there are a number of aspects of sense of self which remain intact in the early-moderate stages of the disease, and therefore appear to be relatively resilient to the early memory deterioration that is taking place.

In particular, there are two striking areas of preserved sense of self that warrant further consideration. One is present-moment self awareness which, as described above, was found to be well preserved in the present study as well as in many previous investigations of AD. These findings are also consistent with neuropsychological case studies indicting well preserved self awareness in patients with dense episodic memory deterioration due to MTL pathology (Philippi, et al., 2012; Postle, et al., 2009). The interpretation of these findings proposed here is that there may be two phases of deterioration in AD: the MTL pathology characteristic of early AD leaves self awareness intact, but deficits in self awareness may start to occur once pathology extends to regions which directly control self awareness. Further work is needed to confirm this hypothesis, including mapping deterioration in self awareness onto the neural pathology that takes place in AD. This work could both contribute to, and be informed by, broader neuroscientific efforts to identify the neural underpinnings of self awareness.

A second notable area of preserved performance was diachronic unity, and specifically, the AD group's apparently retained beliefs about their core continuity. Similar expressions of continuity have been reported in previous investigations of populations with episodic memory impairments (Medved & Brockmeier, 2008; Philippi, et al., 2012; Rathbone, et al., 2009), and this study supports the hypothesis that episodic memory (as well as extended and repeated levels of AM) may not be necessary to support such beliefs. It was hypothesised that one of the ways that memory-impaired groups might compensate for deterioration in episodic memory would be through various forms of semantic continuity. In support of this suggestion, some aspects of semantic continuity were preserved in the present AD group, including preserved stability of self knowledge over time, preserved beliefs about the continuity of the me-self, and a preserved ability to construct a life story using a cultural life script; it is possible that these retained aspects of semantic continuity may go some way to explaining preserved diachronic unity in this group.

An intriguing possibility, however, is that the preserved core continuity of the AD group does not relate to preserved memory function at all, but instead is underpinned by their preserved self awareness. Damasio (2003), proposes that organisms are provided with a sense of bodily continuity by the same neural mechanisms that confer an internal representation of the body (e.g. the interoceptive senses including kinaesthesia, vestibular senses, vicersal sense and the sense of the internal milieu of our bodies) which is an aspect of prereflective self experience. In addition to providing a representation of moment-to-moment experience, he suggests that these mechanisms may serve to provide a stable (prereflective) conscious experience of one's body across time.

Building on this possibility, it may be that the uniquely human capacity to reflect on one's present-moment conscious experiences (i.e., self awareness) could provide a higher-level extension to this experience (see also Craig, 2009). These two vestiges of preserved sense of self in AD could therefore be related; by retaining the ability to experience and reflect on one's current moment-to-moment experience ("I am") one may additionally retain an ability to reflect beyond that current temporal time slice in a manner that extends one's ownership of consciousness and experience across time ("I have been, and I will be"). It has long been postulated, most famously by Descartes (1637/1960), that the ability to think and reflect may constitute evidence of one's metaphysical existence. This same reflective capacity may additionally provide confidence in one's continued existence across time. Importantly, this is not the same as claiming that diachronic unity requires autonoetic consciousness – the ability to mentally project oneself into past remembered or future imagined experiences. The claim here is that self awareness could allow a form of mental projection that does not rely on any particular content from memory or imagination, but instead relies on the ability to reflect itself as evidence of protracted experience. This possibility was hinted at in the responses provided by some AD participants in the self continuity interview, who used phrases like “I just am” or “I feel the same” to justify their feelings of continuity across time.

This possibility could be explored as part of neuroscientific efforts to understand the self-related functions of the default network (e.g., Andrews-Hanna, et al., 2014; Buckner, et al., 2008; Gusnard, et al., 2001; Raichle, et al., 2001; Schacter, et al., 2007). Although episodic memory may provide the building blocks for many of the default network’s “self-projection” functions (Buckner et al., 2008), an interesting avenue for future investigations is self-generated thought in the absence of episodic memory, and how this may relate to beliefs about self continuity.

Aspects of Sense of Self That May Rely Upon AM

A more complex question explored in this thesis was whether the deterioration in aspects of sense of self found in the AD group was related to the deterioration they had experienced in AM. This relationship certainly cannot be assumed, as AD is by definition a condition involving cognitive decline that goes beyond memory deficits (McKhann, et al., 1984) many of which might independently explain the problems in sense of self.

In order to better isolate relationships between aspects of sense of self and AM, controlled correlational analyses have been used throughout the investigations to assess various proposed relationships. Such correlations cannot demonstrate causal relationships; for this, longitudinal studies would be needed to track the order of symptom development and relate these to brain-imaging data. These correlational findings must be interpreted with particular caution given that many of these correlations were only marginally significant after correcting for multiple comparisons. Nevertheless, the pattern of positive correlations found in the two memory-impaired groups indicate tentative support for relationships that could usefully be followed up in future studies (see Table 6.1).

Table 6.1. Summary of Significant and Marginally Significant (p < .05) Correlations Between Different Levels of AM and Proposed Aspects of Sense of Self in Memory-Impaired Groups.

	Aspect of sense of self		
Deterioration in…	*Self awareness*	*Self knowledge*	*Temporally-extended self*
Event specific/ episodic	AD • Reduced performance on SAPM (moderate AD)	AD • Reduced strength TST • Reduced complexity TST • Fewer temporally abstract self descriptions MCI • Accuracy of self knowledge (SocD neutral)*	AD • Lower proportion of self-event change connections • Increased belief in core (I self) continuity* • Less sophisticated continuity explanation*
Extended/ repeated AM	AD • Reduced awareness of memory deficits	AD • Accuracy self knowledge (SocD neutral)*	AD • Less sophisticated continuity explanation • Reduced thematic coherence AD/MCI • Increased core (I self/ perceived) continuity MCI • Lower proportion of self-event connections *

Notes: AM = Autobiographical memory, AD = Alzheimer's disease, MCI = amnestic Mild Cognitive Impairment. SAPM = Self awareness in present moment task; SocD = social-desirability.
**Correlation also found in HC group*

Deterioration in specific-event memory (including internal details in AI event stories and use of specific events in the life stories) was found to be associated with decline in all aspects of sense of self. In support of previous findings of a relationship between episodic memory and self knowledge (Addis & Tippett, 2004; Haslam, et al., 2011; Tanweer, et al., 2010), the present investigation has found relationships between deterioration in episodic memory and a reduction in the amount and variety of information available to describe one's self (lower strength and complexity on the TST), a lower proportion of temporally-abstract self descriptions, and reduced accuracy of self knowledge (social-desirability neutral). This pattern is consistent with the hypothesis that vivid recollection of specific events plays an important role in maintaining present self knowledge. Although some have suggested that certain types of self knowledge (namely, abstract personality trait knowledge) may be independent of episodic memory (Klein, 2010; Klein & Gangi, 2010; Klein & Lax, 2010), there was no indication in the present AD group that personality trait knowledge was better preserved than other types of self knowledge.

Deterioration in episodic memory was also associated, in the present study, with aspects of the temporally-extended self, including less sophisticated explanations for continuity and a lower proportion of self-event change statements in the life story. It was originally hypothesised that deterioration in episodic memory should not, alone, lead to deterioration in diachronic unity, because semanticised memory, and the semantic forms of continuity they support, may be sufficient to maintain beliefs about personal persistence. The findings indicate a more complex picture. First, the association found between episodic memory and narrative identity indicates that episodic memory may indeed play a role in semantic continuity. Second, the findings indicate that diachronic unity is not a unitary construct; it may be that episodic and semanticised AM contribute to different aspects of beliefs and experience of unity over time.

As hypothesised, this study has also found relationships between aspects of sense of self and "semanticised" levels of AM. Extended and repeated levels of memory were associated with deterioration in many aspects of sense of self, including reduced accuracy of self knowledge, reduced complexity of continuity explanation and increased strength of beliefs in core continuity, lower use of self-event change statements, and thematic coherence. This is one of the first investigations to explore the impact of deterioration in these "experiential" levels of memory on sense of self, and supports recent findings that these memory forms may play an important role in supporting and maintaining sense of self in healthy adults (Waters, et al., 2013). In Chapter 2, it was argued that these levels of memory may share many common qualities with event-specific episodic memory, including experiential qualities and rich perceptual details. It could be that it is memories that possess these qualities, rather than event specific memory *per se*, that are important for many aspects of sense of self. In support of previous investigations examining the function of different levels of AM, these finding indicate that one such purpose may be to inform and maintain a coherent sense of self.

Although the pattern of significant and marginally significant correlations found in this study related to AM from across the lifespan, deterioration in memories for childhood and early adulthood periods appeared to be particularly important. This adds weight to previous investigations and theoretical claims that memories from this period may play a particularly important role in supporting sense of self (Addis & Tippett, 2004; Conway, 2005; Conway & Holmes, 2004; Conway & Pleydell-Pearce, 2000; Fitzgerald, 1988, 1996; Rathbone, et al., 2008). The present investigation extended these findings, firstly, by demonstrating that both specific event and semanticised (extended, repeated and lifetime period) AM from these periods are important to sense of self, and secondly, by showing links not only with self knowledge (strength and complexity of TST, accuracy of self knowledge), but also with self awareness (moderate-severity AD group only) and diachronic unity (the sophistication of continuity explanations).

On the whole, this investigation found less support for the hypothesised role of lifetime period knowledge in sense of self. There were, however, some relationships indicated: specifically, the lower use of lifetime period knowledge was associated with reduced strength of self knowledge in the AD group and decreased thematic continuity in the aMCI group. It is important to note, however, that there was little deterioration in lifetime period knowledge for either of the experimental groups; it appears that these schematic summaries of large periods of life may provide an important last bastion of autobiographical knowledge for those with AD.

Given that lifetime period knowledge also formed the major building blocks of the life stories for all three groups (see also D. K. Thomsen, 2009), it is certainly possible that this type of memory could play an important function in supporting sense of self. It may be that many preserved aspects of sense of self in these memory-impaired groups are supported by retained lifetime period knowledge. To explore such questions, studies are needed with groups likely to show deficits in semanticised forms of AM, such as those with semantic dementia (Piolino, Belliard, et al., 2003; Piolino, Desgranges, et al., 2003).

Conclusion

There is something inherently human about both the capacity to contemplate who you are and the capacity to remember your past. This thesis has argued that the common intuition that these capacities are intimately related is correct, but that this association is not straightforward. Rather, there are many facets to both AM and sense of self which interact in complex and subtle ways. Unravelling this relationship is not merely of academic interest, but may be pivotal to understanding many aspects of complex human behaviour, including imagining and planning for the future, understanding the mental states of others, complex goal-directed behaviour, moral behaviour and self regulation.

This thesis has taken some important steps towards expounding this relationship by proposing a simple framework for understanding sense of self, and demonstrating the utility of this model in providing a comprehensive assessment of sense of self in healthy and memory-impaired older adults. By systematically exploring the different facets of sense of self, this research has provided initial support for many of its predictions and claims, while also highlighting areas of uncertainty where further work is needed. Psychological models are, by definition, attempts to capture rich, highly complex constructs within simple heuristic frameworks. To be useful, they must reduce complexity, and as such researchers must always remain cognizant that the models they use to guide investigations are imperfect, simplified representations of the reality they study. Nevertheless, such heuristics are imperative to scientific progress, because they enable quick understanding of terminology and relationships, facilitate communication between researchers and disciplines, and provide theoretical scaffolding for devising hypotheses and interpreting empirical results. It is in this way that the present work can perhaps be seen to have made the greatest contribution - by suggesting a simple framework for conceptualising sense of self, and by demonstrating its utility for guiding a broad and comprehensive programme of research. It is hoped that this model may provide a useful bridge between the empirical and theoretical literature concerning sense of self and AM, and may be used to guide future investigations into this important area.

Appendices

Appendix A: Background Interview

1. Schooling
- How old were you when you left school?_______________(Years)
- What did you do after you left school? (Jobs? Education?) __________________________
- Did you go on to do any other sort of education, courses or classes? (Where? How long?)

____
____
____

2. Drug and alcohol use
- Do you drink at all? How much alcohol do you drink in a typical week? ______(No. units/week)
- Were you ever a heavy drinker?...Y/N
- Has there ever been a time in your life when a prescription medication, or a non-prescription drug, has been a problem for you? For example, you may have had difficulty stopping a medication that you were on (E.g., sleeping tablets, or Valium).............Y/N

3. Past psychiatric history
- Have you had a time in your life where you experienced problems with your mental health, for instance depression, anxiety, schizophrenia?..Y/N
- Have you ever required treatment for any emotional, nervous or psychiatric illness?.....Y/N

4. Do you have any history with any of these medical conditions:
- Head injuries?...Y/N
- Stroke?..Y/N
- Major heart problems?..Y/N
- Major surgery? (e.g., heart bypass surgery)....................Y/N
- Seizures / fits?...Y/N

5. What medications are you currently on?

Appendix B: Remember/Know task

[Following each AI event story]

Now I would like to ask you about what it is like for you when you recall this event.

When we recall things that have happened to us, sometimes we can actually remember the event whereas other times we simply know that the event took place. If we remember that something happened, we can almost relive the event, as though we have mentally travelled back in time. We can re-experience the event that took place, for instance by feeling the emotions that we felt and seeing the things that we saw in our minds. On the other hand, sometimes we can know that an event happened to us even though we are not actually able to remember it. We can tell someone what happened, because we know what took place, but we are unable to re-experience the event in our minds.

In the case of the memory you have just described, would you say that you remember the event, or that you just know that the event happened?

Appendix C: Protocol for Main Study

Session 1 **~1 ½ hours**

1.Introductory activities
i) Participant information sheet explained/written consent given
ii) Participant history
iii) Assessment of awareness of memory deficits

2. Self awareness in the present moment

3. Mini mental state examination

4. Life story interview process, for each life period:
i) Life story interview
ii) Autobiographical interview
iii) Remember/Know Task

Session 2 *(Conducted approximately one week later)* **~1 ½ hours**

6. Digital photograph taken

7. Preferences task (part 1)

8. Verbal fluency (COWA)

9. Twenty Statements Test (Present)
i) Main list (unprompted)
ii) Supplementary list (prompted)

10. Photographic recognition task

11. Self-knowledge checklist

12. Preferences task (part 2)

13. Twenty statements test (Past)

14. Self-continuity interview

Appendix D: Stimuli for Photographic Self-Recognition Task

The two decoy photographs (gender matched – female version shown) were positioned to the left and centre, and the participant photograph was inserted to the right.

Appendix E: Self Awareness in the Present Moment

I would like to ask you some questions about what you are aware of at the moment. There are no right or wrong answers - these questions help me to understand what sorts of things you notice and are aware of. I will ask you a question, and then give you one minute to tell me as many things as you can that you are aware of. For instance, if I said, “can you tell me anything you can see on the table?”, you might say “a pen, some paper, a cup”, and so on until I tell you to stop. Do you have any questions? OK, let’s start. [Prompt if silent for more than 10]

	Score
1. Can you tell me anything you can see in the room around us at the moment*? (Prompt - Is there anything else you can see?)*	
2. Can you tell me anything you can hear at the moment? *(Prompt - Is there anything else you can hear?)*	
3. Can you tell me anything you can smell, taste or feel at the moment? *(Prompt - Is there anything else you can smell, taste or feel?)*	
4. Can you tell me any sensations that you have in your body at the moment? For instance, any tension, hunger or thirst, heat or cold? *(Prompt – Are there any other sensations in your body that you are aware of?)*	
5. Can you tell me any emotions that you are aware of at the moment? For instance, you might be feeling happy, frustrated, bored, excited? *(Prompt – Are there any other emotions that you are aware of?)*	
6. Can you tell me anything that you are thinking about at the moment? For instance, you might be thinking about the questions I am asking you, or something else on your mind. *(Prompt - Is there anything else you are thinking about?)*	

Appendix F: Assessment of Awareness of Memory Deficits

Adapted from Loebel, et al. (1990) and Sevush and Leve (1993)

Do you think you have any problems with your memory?..Y/N

(If needed, prompt with...)

Do you have any difficulties remembering things? ....Y/N

Can you recall things as well as you always could? ....Y/N

(If yes)

Do you think the problems with your memory are serious? ....Y/N

Do your memory problems interfere with your daily life? ....Y/N

(For everyone)

Are you suffering from a disease or illness affecting your memory? ....Y/N

Appendix G: Self-Knowledge Checklist (Participant Version)

I am going to show you some words and phrases that people sometimes use to describe themselves. For each item, please tell me which answer best indicates how well this describes you.

0 Not at all	1. Somewhat/ sometimes	2 Mostly	3 Definitely

1. Truthful
2. Ungrateful
3. Humorous
4. Lazy
5. Energetic
6. Friendly with strangers
7. Timid with strangers
8. Ill-mannered with strangers
9. Talkative with strangers
10. Attentive to strangers
11. A brother/ sister *[removed]*
12. Involved in the community
13. Religious
14. A New Zealander
15. A gardener
16. Critical
17. Persuasive
18. A worrier
19. Curious
20. Impulsive
21. Dominating with friends
22. Moody with friends
23. Self confident with friends
24. Argumentative with friends
25. Gossipy with friends
26. Good at fixing things
27. Good at socialising
28. A musical person

29. Finds maths difficult
30. Good at crafts
31. Indecisive
32. Materialistic
33. Persistent
34. Complaining
35. Careful
36. Patient when with family
37. Angry when with family
38. Emotional when with family
39. Punctual when with family
40. Selfish when with family
41. Tall
42. Unhealthy
43. Attractive
44. Poor eyesight
45. Overweight
46. Inconsistent
47. Creative
48. Envious
49. Thoughtful
50. Irresponsible
51. Efficient when at home
52. Clumsy when at home
53. Thrifty when at home
54. Tidy when at home
55. Sloppy when at home
56. Enjoys food
57. Fond of animals
58. Enjoys outdoor activities
59. Enjoys reading
60. Enjoys watching television

Appendix H: Twenty Statements Test (Supplementary task)

Now that you have described yourself, I want to list some categories that people sometimes mention when they are describing themselves, and see whether you have anything else you would like to add.

Some people mention [*item from list below*]. Is there anything you would like to say about that?

- Personality____
- Roles (e.g. family, work or community)____
- Social, religious or ethnic groups they identify with ____
- Activities they like or are good at ____
- Physical characteristics____
- Beliefs and values____

Appendix I: Abstract/Specific Coding Scheme for TST

Adapted from Rhee, et al. (1995) and Addis and Tippett (2004)

1. Physical characteristics	
i. Descriptive (short, pretty)	Specific
ii. Age	Specific
iii. Factual (height, weight, eye colour, hair colour)	Specific
iv. Physical condition (health status, sight, losing memory, can't do as much as I used to).	Specific
2. Social identities	
i. Role status – roles assigned by society/culture, e.g. student, pensioner, housewife, citizen, taxpayer. More formal than self-ascribed identities, which are a choice.	Specific
ii. Group membership (belong to a bowling club, member of Rotary)	
iii. Family information (sister, father)	
iv. Self-ascribed identities (musician, dancer)	
v. Religion (Christian, Buddhist, Anglican)	
vi. Occupation (salesperson, retired)	
vii. Origin (from Hong Kong, born in Timaru)	
viii. Ethnicity, race, nationality (a New Zealander, Scottish)	
ix. Gender	
x. Name	
3. Attributes	
i. Activities (activities participate in, habits)	Specific
ii. Preferences (includes activities and interests that are prefaced with enjoys, likes, dislikes, fond of). If it is a social role (like to be a mother) code as the social identity.	Specific
iii. Aspirations (wishes, hopes, dreams, future orientation, negative predictions)	
• Specific –contextualised (want to be a better cricket player), temporal (used to wish I was richer) or socially bound (hope to spend more time with my family)	Specific
• Abstract (e.g. want to be a better person, want to be happy)	Abstract
iv. Personality traits	
• Specific–contextualised (at home, in certain situations), temporal (sometimes, usually, used to be, try to be) or social (with someone, with my family).	Specific
• Abstract (e.g. kind, honest, intelligent)	Abstract
4. Evaluative descriptions (abilities, evaluations, reflections)	
i. Specific (good at maths, good listener, have many friends, good mother)	Specific
ii. Abstract / Reflective (good abilities, good life, decent human being, lucky person)	Abstract
5. Beliefs/values (Includes statements that indicate someone's priorities and values in life, as well as statements that suggest an underlying moral code	
i. Specific – contextualized (people should be generous when there are tragedies), temporal (honesty is important, but not at the cost of people's feelings) or socially bound (I try to be a good role model to my Grandchildren)	Specific
ii. Abstract - (e.g. people should be kind, value honesty, Christian values are important)	Abstract
6. Emotional states	
i. Specific – contextualized (happy to be living here, sad about memory loss), temporal (unhappy at the moment, happy some of the time) or social (in love with my wife)	Specific
ii. Abstract (worried, afraid, happy)	Abstract

7. Global descriptions	
i. Universal descriptions (human being, earthling, Child of God)	Abstract
ii. Existential descriptions (me, myself, a unique creation)	Abstract
8. Other/Peripheral information	
i. Immediate situations, states (tired, hungry)	Specific
ii. Present residence (live at home)	Specific
iii. Others' descriptions (e.g. describing other people, or how other people describe me)	Specific
iv. Possessions (clothes, car)	Specific

Appendix J: Temporal/Contextual Coding Method for TST

The abstract/specific scale assesses whether an attribute is relevant to a number of different ***contexts*** (i.e. places, activities, settings) and ***time periods,*** or whether it is primarily relevant within a specific context and moment in time. Each statement on the TST should be assigned one of the five categories (and seven subcategories) from the table below. If there are two parts to the statement, determine which part is the most important (i.e. contains the main attribute being described) and code on this basis. Codes are combined either according to the Temporal or Contextual specificity sub-scales (columns to the right).

	Description (Examples)	**Temporal scale**	**Contextual scale**
1 One off	Attribute relates to a specific moment in time (< 1day) and specific (one –off) context (e.g., I have a headache, I'm feeling happy today, I'm wearing a blue shirt, I'm hungry)	Sp	Sp
2 Specific time period (limited)	Attribute relates to a specific, limited time period (≤ 1 yr), and:		
	A) One context (e.g., I've recently taken up swimming, I moved into this house a few months ago, I just started a new job)	Sp	Sp
	Or B) Two or more contexts (e.g., I've been getting a lot of headaches recently, I'm pregnant, I'm sad I'm losing my memory)	Sp	Abs
3 Specific repeated context	Attribute relates to one specific context and either:		
	A) occurs repeatedly within a specific time period (time limited) (e.g., I took up swimming when I retired, I used to work at the post office)	Sp	Sp
	Or B) occurs across the lifespan (time invariant) (e.g., I like swimming, I hate public speaking, I'm really calm in emergencies)	Abs	Sp
4 Specific time period (extended)	Attribute relates to a specific, but extended time period (> 1 year) and no specific context (e.g. I've been really happy since I retired, I am a mother, I am an old person, I have grey hair	Sp	Abs
5 Abstract – universal	Attribute is not restricted to any particular time or context, but applies universally across the life span and many contexts. (e.g., I have brown eyes , I am kind/ extroverted /happy, I am a man, I am Chinese)	Abs	Abs

Notes: Abs = Abstract, Sp = specific,

Appendix K: Self Continuity Interview

1. 1. TST past (adapted from Kuhn & McPartland, 1954; L'Ecuyer, 1992)
Now that you have told me about the type of person you see yourself as being now, I would like you to describe what sort of person you were when you were a young adult, in your early 20s. I would like you to try and give me as many sentences or statements as you can to describe what you were like in your 20s, up to 20 statements if possible. Try and make each answer different. Tell me the answers in the order they occur to you. Don't worry about logic or importance. Your statements could start with "I was..."

2. *Perceived Continuity:* Do you feel that you are the same person now as you were when you were in your 20s?

Y/N

3. *I-self and Me-self continuity* (*adapted from Troll & Skaff, 1997)*

In what ways do you think that you have always been the same person?

In what ways do you think you have changed over the years?

4. Continuity Explanation (adapted from Chandler et al., 2003]

What I now want you to do now is think about the reasons that you consider yourself to be the same person as you were when you were a young adult. What do you think makes you the same person? How would you explain how one and the same person could act in many different ways but still be the same person?

Appendix L: I/Me-Self Continuity Coding Method

The purpose of this coding scale (adapted from Troll & Skaff, 1997) is to determine how similar (continuous) the person feels in relation to their younger self. It separates aspects of the response that relate to the I-self (core, essential self experience), and the me-self (our beliefs about ourselves, the traits and attributes we assign to ourselves). These aspects are theoretically distinct, meaning that one could perceive change in one and continuity in the other.

Read through the whole transcript and identify elements that relate to the "I self" versus elements that relate to the "me self". Then score each of these elements as described below. Leave score blank for that scale if there the answer does not address that aspect of the self.

i) I-self scale: Responses which relate to the "core" self - the underlying essence of who the person is, the inner entity. The I-self scale assesses the extent to which participants believe that they are still the same essential, core person they have always been.

1. **Fundamental change** - Indicates a perception of fundamental change in the core self. The person perceives no continuity of core self. E.g. "The person I used to be is no longer there" and "I feel I've become a very different person", " I don't recognize who I used to be.", "The events of my life have totally changed me"

2. **Some change** - Indicates a perception of some change in the core self or uncertainty about the continuity of the core self. E.g. "Not exactly the same person ..You're different but the same – it's hard to explain ", "I don't know whether I'm different" "I wouldn't think so. No one is. You change a lot as you get older and experience life." Only to some extent"

3. **No change** - Indicates a firm perception of continuity in the core self. They perceive that they are still exactly the same person now as they were when they were 20. E.g. "I didn't change. I'm still the same person" "Always been the same. About everything." "I feel my essence has always been the same."; You know you're the same person. Your thinking has changed but you know you're the same."

ii) Me-self scale: "Me" responses relate to the attributes that one uses to describe oneself (e.g. traits, attributes, physical, personality descriptions, behaviour, likes/dislikes, values/beliefs etc).

4. **Fundamental change -** Indicates a perception of fundamental change one's attributes. The person perceives no continuity in these attributes. E.g. "I have changed in so many ways since I was young – my personality, the way I look and act, people I associate with. It's all changed.", "I used to be very active. Now I'm handicapped so I have to be more passive." I'm a much nicer and calmer person now. I used to be so anxious. That has really changed me."

5. **Some change -** Indicates a perception of some change in one's attributes. This is more likely to be a 'growth' or development in traits rather than a discontinuity/complete change, or a change in some attributes and continuity in others. E.g."I don't feel so critical of myself. In my intellectual interests I'm pretty much the same; changed in appearance." . "I can notice how I've grown in all areas."

6. **No Change -** Indicates a firm perception of continuity. Perceive that their characteristics, traits and attributes are still exactly the same as they were when they were in their 20s. E.g. "I've always been calm, composed. Very stylish and composed and independent. I'm just the same now."

Appendix M: Continuity Explanation coding scheme

Adapted from Chandler and Marcia (2003, pp. 28-42) [12]

Levels	Description	Decision rule	Examples
Level 1: Simple Inclusion	Answers scored 1 will simply list elements (features, characteristics) of the self that have not changed, while ignoring parts that have changed. Such answers will focus exclusively on sameness over time and ignore or downplay change. The focus is on surface qualities (e.g. physical features or simple personality/ traits) which have been fairly stable and use these to base the claim for self continuity.	*Does the person's answer ignore or deny actual (or possible) change to the self? If yes, score 1, if no (i.e. they do acknowledge actual or possible self change), score higher.*	I just seem to do the same things. If people talk to me I talk to them, if people need help I help them. Always been the same. One just is the same. You are born with a particular personality. You are who you are. Circumstances have an influence, but you don't change personality.
Level 2: Topological Accounts	Answers scored 2 attempt to engage with the problem that people appear to change, but discount this change as merely surface/ appearance changes. Answers suggest that apparent change or novel developments of the self are in fact aspects of the self present from the start but never been seen until now. People don't really change, they just show different aspects of themselves in different circumstances. All aspects of the self are all simultaneously present in the person, but different parts are more or less visible at different times.	*Does the person's answer suggest different aspects/characteristics of the self, but suggest that these are simply revealed in different contexts due to external factors? If yes, score 2, of no, score higher.*	"I could be very outgoing at times. I had to be because of my work. I've always been able to act that way if I need to but I still feel like the same shy kid, I just keep it to myself." "When I was with my ex-husband, it really brought out my angry side. Its still there but now I don't have to be that way so much."
Level 3: Preformist Accounts	Answers scored 3 acknowledge the effects of <u>*time*</u> in their answers, insofar as time is the agent of growth and development of pre-existing traits. They are happy to acknowledge change in people, but only by arguing that some kernel of this characteristic was present from the start and developed over time. The emergence of this new aspect of self was inevitable given the traits there at the beginning.	*Does the person's answer suggest development or growth of the self overtime, which has stemmed from some kind of essential core (whether it be genetic inheritance, upbringing, foundational values etc)? If yes, score 3, if no score higher.*	"I am the same person, I have just grown. The experiences of my life have brought out a mature version of me." "because of my upbringing. That shaped me and my life and the things I've done have added to that and allowed me to improve. I've become wiser." I have more confidence. When you get older you think better, you're wiser. You think you know everything when you're young.

[12] This coding scheme was originally devised to distinguish between two different types of responses that people might give to this question (Essentialist vs narrativist) as well as the sophistication or complexity of the response. These represent two entirely different philosophical/cultural paradigms for approaching the problem of self continuity. For the present study, only the essentialist track was included (see Method: Chapter 5).

Levels	Description	Decision rule	Examples
Level 4: Frankly Essentialist Accounts	Answers scored 4 attempt to solve the problem of change/ continuity by proposing some core, underlying essence of the self which remains unchanged despite considerable change in more surface attributes. This may be compared to a genotype (the basic genetic blue print) vs the phenotype (the way that genetic blueprint has expressed itself given the particular circumstance), or to thinking of an unchanging eternal soul which persists and remains unchanged.	*Does the person's answer suggest something foundational and unchanging that consists of the 'true self", while acknowledging change in surface attributes?*	Core consistency is around mores and values. Although I've changed, my core values have stayed the same. Spiritually – your body changes but spiritually the same and getting better.
Level 5: Revisionist Accounts	Answers scored 5 are a "meta answer" which capture some awareness that whatever response the person may have to the question is somehow provisional and simply one theory among many. Answers of this type suggest that the question itself is one that they may never know the answer to. The answer may suggest that their sense of continuity is itself something that may change over time.	*Does the answer attempt to weigh up competing answers to the question, or give some acknowledgement that there may be alternative responses?*	There are many ways you could answer that. I have the same brain. Also, a lot of the attitudes you had when you were little, picked up from your parents, stay with you (e.g. kindness, thrift). My circumstances also haven't changed much, e.g. economically. You remember what you were. This also gives you continuity. I am still the person who met my uncle coming home from war. You do things/think things because of what's happened in your past. Your genes don't change. I can always remember feeling sorry for animals/children. These attitudes stay with you / born in you? Personality stays the same. My friends are still all the same people too.

Appendix N: TST Test-Retest Coding Method

The TST was administered at two time points, time 1 (T1) and time 2 (T2) approximately two years apart. At each time point, two conditions were administered. The first (Main list) was a spontaneous, unguided task in which participants could list as many statements or sentences as they could come up with to describe who they are (up to 20). The second (supplementary list) was a guided task in which participants were prompted to provide additional information about how they describe themselves. For each participant, there were four lists:

- *Main list T1* – assumed to represent most important aspects of the person's self concept at T1.
- *Supplementary list T1* –assumed to represent less important aspects of the person's self concept at T1.
- *Main list T2* - assumed to represent most important aspects of person's self concept at T2.
- *Supplementary list T2*- assumed to represent less important aspects of the person's self concept at T2.

The purpose is to assess whether statements that appear on each list at T2 were also listed at T1, or are new to the person's self concept. For each statement that the person has made at the present time (T2), there are eight possible ways that the statement might relate to their self concept at the previous time point (T1). Read through the T2 list, and for each statement assign one of the following codes:

1. **On the main list at both T2 and T1**: These statements are of primary importance to the person's self concept now and in the past. The statements do not have to be identical, or use the same words, but do have to express the same basic idea or information about the person (e.g. I enjoy being with my Grandchildren/I am happy when I'm with my Grandchildren; I'm healthy/ I'm in good health; Reasonably intelligent/Bright) **CODE: 1,1**
2. **On the main list at T2, but the supplementary list at T1**: These statement have become more important to the self concept since the previous time. **CODE: 1,2**
3. **On the main list at T2, but not on either list at T1**: These statements are new to the person's self concept, and of primary importance **CODE: 1,0**
4. **On the main list only at T2, but linked in some way to statements on either list at T1**: These statements are new to the person's self concept, but relate somehow to a statement that was part of the person's self concept at T1. The linked statements could be specific examples of general statements (e.g. T1- I like sport/T2- I love rugby) a different angle on the same topic area (e.g. T1 – I do a bit of gardening/ T2 – I enjoy gardening, T1-I am a crewman on a boat/ T2 – I love sailing) or could suggest change or growth since the previous time (e.g. T1 - I am overweight / T2 – I used to worry about my weight, but not now; T1 - I would like to study/ T2 – I am studying gardening) **CODE: 1,L**
5. **On the supplementary list at T2, but the main list at T1:** These statement have become less important to the self concept since T1 **CODE: 2,1**
6. **On the supplementary list at T2 and T1:** These statement are of secondary importance to the person's self concept both now and in the past **CODE: 2,2**
7. **On the supplementary list at T2, but not on either list at T1**: These statements are new, and of secondary importance to the person's current self concept **CODE: 2,0**
8. **On the supplementary List at T2, and linked in some way to statements on either list at T1**: These statements are new to the person's self concept, but have developed out of something that was in the person's self concept at the earlier time (see examples above). **CODE: 2,L**

Appendix O: Autobiographical Reasoning Coding Method

Adapted from Pasupathi & Mansour, 2006; Pasupathi, et al., 2007.

The purpose of this coding schedule is to describe how to identify two different types of self-event (SE) connections in the life stories. SE connections are statements which draw a connection between one's sense of self and the events of one's life.

Read through each life story. Identify and highlight places where these types of autobiographical reasoning take place.

i) SE Stability.

Any statements which highlight a stable or pre-existing quality of the self and suggest that this explains, or is illustrated by, an event. (e.g. "This event shows what a nice person I am", "I actually had problems with the teachers throughout school, because I am someone who doesn't like to adapt himself."(Habermas & Paha, 2001). In these statements, the SELF explains, causes or is illustrated by an EVENT. These statements serve to maintain a stable sense of self by highlighting continuity of traits and attributes through the life story.

This code also includes statements which suggest that, although the event appears to indicate some new quality, this quality (or the event itself) should be dismissed or ignored. In other words, the statement dismiss or disregard unusual events or behaviour in order to eliminate any pressure they may create to change the self concept. (Note – these 'dismiss' statements are probably quite uncommon) (e.g. When I was overseas, I became quite an angry person, but this was to do with how sick I was I think.).

ii) SE Change.

These are any statements which explain how an event caused or illustrates a change in the individual, or in their self-concept (broadly defined, including personality, traits, characteristics, emotional disposition, self-understanding, ways of thinking, beliefs and values) (see (Lilgendahl & McAdams, 2011) (e.g. "If I hadn't joined the sports-club then, I wouldn't have friends now and I would still be a shy person." (Habermas & Paha, 2001).

Also includes events which reveal a pre-existing but previously unrecognized quality of myself (that is, it brings about a change in one's self concept or self perception). (e.g. A scene from War of the Roses, a Michael Douglas movie, pinpointed what I felt for many years but did not realize. It was a need for freedom.', (Pasupathi, et al., 2007))

Appendix P: Global Coherence Coding Method

Adapted from coding manual developed by Tilmann Habermas & Verena Diel, Goethe University of Frankfurt, 22 June, 2005. Translated and adapted by Elaine Reese, University of Otago, 2012

1) Temporal coherence (Temporal orientation)

The degree to which the rater was able to follow the temporal sequence/absolute timing of events in life. This scale indicates how well the narrative temporally orientates the audience. A very good temporal orientation is given when the events lying next to one another are given in chronological sequence, or when the narrator gives exact details about time, dates, ages etc. In very poor temporal orienting, the listener is absolutely unable to recognise when and in which sequence the events took place.

Rating scale:

0. It is not recognisable when and in which sequence events took place
1. It is often not recognisable when and in which sequence events took place
2. It is mostly recognisable when and in which sequence events took place
3. It is crystal clear when and in which sequence events took place

2) Causal coherence (Developmental consequentiality)

The degree to which the rater understood how past experiences explained how the personality, life or outlook of the narrator had changed and what the turning points and motives for these developments were. This scale indexes how great the meaning of the events that took place in that life chapter is for the development of the narrator's personality. Here it is particularly relevant if the described events involve changes in attitudes and behaviour.

Rating scale:

0. No change in personality, life or outlook is described. No causal link is made between the events described and personality, life or outlook. No meaningful development of personality, outlook or life is described except for external changes.
1. Meaningful change is scarcely recognisable, except in certain places. Some attempt is made, in isolated instances, to causally link events to changes in personality, life or outlook.
2. Personality development is fairly meaningful, but not comprehensive. Events are linked to changes in personality, life or outlook, although not consistently throughout the narrative.
3. The development of personality, life or outlook is presented with turning points and motives. The story comprehensively links key events with changes in personality, life or outlook.

3) Thematic coherence (Plausible transitions)

The degree to which implicit or explicit plausible links between events were provided, as opposed to events following each other in an unrelated way. This scale indicates how well or inadequately single narrated events (i.e. particular elements within the life story) are placed in relation to one another. This is not a question of whether a life theme is gatherable from the narration, but rather whether the single events are oriented to one another. A lack of coherence is recognisable when completely unrelated events are put in a sequence. However, if there are flowing and comprehensible transitions between the events, which are placed in relation to one another, then a higher coherence would be scored.

Rating scale:

0. The events weave in a totally unrelated order
1. Events weave in a somewhat unrelated order, however, from time to time the relations between events are indicated
2. Events are placed in relation to one another, but sometime relations between events are not clear
3. Events are placed in relation with each other and there are flowing transitions between them

Appendix Q: List of Cultural Life Events

1. Own birth
2. Begin walking
3. Learning to talk
4. Baptism
5. Daycare/kindergarten/ preschool
6. Begin school
7. High school
8. First friend(s)
9. Adolescence/Puberty
10. First kiss or first boy/girl friend
11. Leave home
12. Tertiary education (University/Tech/ apprenticeship)
13. Fall in love
14. First sexual experience
15. Get job
16. Become adult (enter adulthood)
17. Settle on career
18. Marriage
19. Having Children
20. Buy house
21. Long trip
22. Serious disease or illness
23. Other's death
24. Divorce
25. Empty nest
26. Retirement
27. Grandchildren
28. Parents' death
29. Partner's death
30. Own death

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