

## Memory of myself: Autobiographical memory and identity in Alzheimer's disease

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A number of theories posit a relationship between autobiographical memory and identity. To test this we assessed the status of autobiographical memory and identity in 20 individuals with Alzheimer's disease (AD) and 20 age-matched controls, and investigated whether degree of autobiographical memory impairment was associated with changes in identity. Two tests of autobiographical memory (Autobiographical Memory Interview, autobiographical fluency) and two measures of identity (Twenty Statements Test, identity items of the Tennessee Self Concept Scale) were administered. AD participants exhibited significant impairments on both memory tests, and changes in the strength, quality, and direction of identity relative to controls. Impairments of some components of autobiographical memory, particularly autobiographical memory for childhood and early adulthood, were related to changes in the strength and quality of identity. These findings support the critical role of early adulthood autobiographical memories (16–25 years) in identity, and suggest autobiographical memory loss affects identity.

A number of theories from the domains of philosophy and social and cognitive psychology posit a relationship between autobiographical memory and processes of identity (e.g., Parfit, 1984; Schechtman, 1996). Autobiographical memory is thought to contribute to trait self-knowledge and to self-narratives, enabling the integration of past and present selves and contributing to the sense of continuity of identity. The view that autobiographical memory contributes to identity leads to the prediction that a loss of autobiographical memory will affect one's sense of identity (e.g., Hirst, 1994). As yet, few empirical studies have directly investigated these issues, in particular whether individuals with autobiographical mem-

ory impairments experience changes in identity. In this paper we describe a study that investigates the status of autobiographical memory and identity in individuals with Alzheimer's disease (AD) and age-matched control subjects, and which also looks at whether degree of autobiographical memory impairment is associated with changes in a number of aspects of identity.

Current neuropsychological views of autobiographical memory typically involve two relatively independent components: personal incident memory and personal semantic memory (e.g., Baddeley, 1992; Dritschel, Williams, Baddeley, & Nimmo-Smith, 1992; Kopelman, Wilson, & Baddeley, 1989, 1990). Personal incident memory

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refers to the episodic memory component of autobiographical memory, that is, memory for a specific personal event, including detailed contextual information such as time and place. Personal semantic memory is memory for personal information that is not event-based, for example, names of friends and facts such as where one went to school. This distinction within autobiographical memory has been empirically supported, with documented differential impairments of personal semantic memory (e.g., Eslinger, 1998) and of personal incident memory (e.g., Kitchener, Hodges, & McCarthy, 1998; Tulving, Schacter, McLachlan, & Moscovitch, 1988).

Although memory impairments in AD have long been of great interest to researchers, this interest has only recently expanded to include retrograde memory deficits. Significant impairments of personal incident memory have been documented in all major studies investigating the status of autobiographical memory in AD (Dall'Ora, Della Sala, & Spinnler, 1989; Dorrego et al., 1999; Fromholt & Larsen, 1991; Fromholt, Larsen, & Larsen, 1995; Graham & Hodges, 1997; Greene & Hodges, 1996; Greene, Hodges, & Baddeley, 1995; Kopelman, 1989; Sagar, Cohen, Sullivan, Corkin, & Growdon, 1988). Temporal gradients of impairment (i.e., differing levels of impairment over different lifetime periods relative to age-matched control subjects) of personal incident memory were found in most studies (Dorrego et al., 1999; Graham & Hodges, 1997; Greene et al., 1995; Kopelman, 1989; Sagar et al., 1988), although Fromholt and colleagues and Dall'Ora et al. did not find this. Personal semantic memory was investigated in only four studies, all of which found significant impairment in AD (Graham & Hodges, 1997; Greene & Hodges, 1996; Greene et al., 1995; Kopelman, 1989). Only Kopelman, however, reported, a temporal gradient of impairment of personal semantic memory. To summarise, the current literature, albeit small, indicates that individuals with AD are likely to have impairments of autobiographical memory, and therefore AD patients may provide a suitable population with whom to investigate questions regarding the relation between autobiographical memory and identity.

Before undertaking such investigations, it is necessary first to understand, or define, the term "identity". Indeed, empirical research in this area has been hindered by the lack of a consensus of definition of identity and a lack of communication between relevant subdisciplines such as neu-

ropsychology and social psychology. Frequently, the term identity is used interchangeably with terms such as self-concept, adding to the confusion, as self-concept is often used as a more general construct, of which identity is only one part (e.g., Fitts, 1965; George, 1990). For the purposes of this study, identity will be viewed in this way, that is, as a subcomponent of self-concept along with self-esteem and behaviour. Within this framework, identity itself can also be broken down into different components: self-knowledge and narratives (Robinson & Taylor, 1998). Self-knowledge refers to self-identifications and perceptions about oneself, for example, knowledge of one's traits. The narrative component of identity comprises stories about oneself, one's life and experiences. Quantitative measures of identity have tended to focus on self-knowledge, in particular, trait self-knowledge. For example, one commonly used measure of identity is the Tennessee Self Concept Scale (Fitts, 1965; Fitts & Warren, 1996), where trait statements are rated for self-descriptiveness. Narrative identity is not easily quantified, and typically qualitative measures are used to assess this. The Twenty Statements Test (Kuhn & McPartland, 1954), however, does allow for some quantification of narrative identity. This commonly used measure of identity requires individuals to respond to the question, "Who am I?". While not a pure measure of narrative identity, this does allow individuals to generate responses that may include information from both narratives and self-knowledge.

Other important characteristics of identity include multidimensionality, coherence, and continuity over time. It is generally accepted that identity is multidimensional, although there is debate as to what particular dimensions exist. For example, these dimensions may include moral, personal, physical, social, and family dimensions (Fitts, 1965), different identities for different social contexts (e.g., Deaux, 1992), or different identities over the lifespan, for example, the past, present, and future selves (Damasio, 1999) and possible selves (Markus & Nurius, 1986). Despite being multidimensional, identity has an overall coherence which gives a sense of unity rather than the subjective perception that one's identity is fragmented (Turner, 1982).

Adding to this sense of coherence is the quality of continuity over time. Individuals perceive themselves as essentially the same person they were in the past, despite changes in their roles and life-situations (Chandler & Lalonde, 1995). The

sense of continuity is thought to be achieved through the integration of past, present, and future selves (Damasio, 1999; Gallagher, 2000), possibly through a process of creating a coherent life story or self-narrative (McAdams, 1988). Markus and Nurius (1986) propose that changes are integrated into one's identity as being a "possible self". As this "change" was always essentially part of one's identity, the individual has a sense of continuity despite change. Robinson and Taylor (1998), however, assert that a continuous identity is the product of a continuity bias, which allows for the reconstruction or re-editing of events and memories so that they form a smooth, predictable story. Continuity and the extension of one's identity over time, however constructed, is a process that inherently involves autobiographical memory.

By providing knowledge of one's traits and one's experience over time, autobiographical memory is thought to enable the integration of past and present selves and contribute to the sense of continuity of identity. The relation between autobiographical memory and identity may be bi-directional, with identity influencing the selection, reconstruction, and interpretation of autobiographical memories (Barclay & DeCooke, 1988; Conway & Pleydell-Pearce, 2000; Robinson & Taylor, 1998). Commonly, however, the focus of theories conceptualising the relationship between autobiographical memory and identity, such as psychological continuity theory and the narrative self, has been on autobiographical memory as a medium for identity processes such as self-composition (Barclay, 1996; Barclay & Smith, 1993) and the construction of narratives (e.g., Schechtman, 1994, 1996).

Psychological continuity theory builds on Locke's (1694/1970) hypothesis that "as far as this consciousness can be extended backwards to any past action or thought, so far reaches the identity of that person" (p. 181). This claim has been developed into a more elaborate theory in which identity is conceptualised as a product of psychological continuity and connectedness, which in turn is a product of links between the self in the past ( $t_1$ ) and the self in the present ( $t_2$ ) (Parfit, 1984; Shoemaker, 1984). Autobiographical memory has a clear role in the constitution of identity, enabling connections between discrete moments in consciousness, and, if lost, it would follow that one's identity would also be lost or significantly changed.

Schechtman (1994, 1996) questions whether simple connections between discrete autobiographical memories could underlie identity. Her view is that the connections between autobiographical memories are much more complex, and that individuals frequently condense autobiographical memories of a certain life period into a narrative composed of the essential features. By this account identity is constructed through the process of narrating, during which individuals subjectively perceive and interpret their autobiographical memories, integrating and condensing them into a coherent story (Barclay & Smith, 1993; Schechtman, 1994, 1996). This allows individuals to see particular autobiographical memories as part of an integrated whole. The coherence of a narrative contributes to the sense of continuity—continuing interests, life themes, traits, experiences—and identity.

Fitzgerald (1988, 1996, 1999) has elaborated on the hypothesised link between autobiographical memory and narrative identity in his account of the reminiscence bump. The reminiscence bump refers to the over-representation of autobiographical memories from early adulthood (i.e., 16–25 years) present in recall tasks. In his self-narrative hypothesis, Fitzgerald argues that the intense self-oriented activity of forming a stable identity during early adulthood produces vivid autobiographical memories, which serve as benchmarks in the organisation of one's narrative identity. Moreover, if one's identity remains stable throughout adulthood, and if identity guides the recall of autobiographical memories (e.g., Conway & Pleydell-Pearce, 2000), it is possible that self-defining adolescent autobiographical memories may be more available for recall because they link directly with the identity representations influencing recall (Fitzgerald, 1996). The work of Holmes and Conway (1999), which linked specific Eriksonian stages in identity development (e.g., developing a relationship identity in one's twenties) with reminiscence bumps for corresponding autobiographical memories (e.g., memories with relationship content show a bump in one's twenties) supports this theory.

If autobiographical memory does contribute to identity as proposed in the theories just described, it follows that a loss of this memory will affect one's identity. Hirst (1994) surmised that individuals with retrograde memory impairments effectively lose their "pre-onset autobiographies", and thus should also experience great changes in

their identity. Additionally if there is a link between early adulthood autobiographical memories and identity, as predicted by the self-narrative hypothesis (e.g., Fitzgerald, 1988, 1996, 1999), it is likely that a loss of these memories will have a greater impact on the integrity of identity.

Reports from caregivers and patients are consistent with a loss of identity accompanying memory impairment (e.g., Della Sala, Freschi, Lucchelli, Muggia, & Spinnler, 1996; Mills, 1998; Orona, 1990, 1997). Case D.V. (Della Sala et al., 1996), for example, described a major loss of identity accompanying an extensive loss of retrograde autobiographical memory. He reported being aware that he was "a 'new person', just beginning to build up a biographical self" (p. 228) and felt emotionally detached from autobiographical memories that he subsequently relearned. Although to date, changes of this nature (i.e., reports that the person is no longer themselves) have typically been limited to subjective observations, there is no question that these perceptions are a source of great distress to caregivers.

Empirical investigations of this issue, however, have focused only on the relation between autobiographical memory and the self-knowledge component of identity, specifically trait self-knowledge. Using a conceptual priming paradigm, Klein and Loftus (1993) investigated the exemplar model (e.g., Bower & Gilligan, 1979), which posits that trait self-knowledge is based directly on exemplars of behaviour in personal incident memories. However, recalling a personal incident memory did not decrease latencies in tasks involving trait self-knowledge, suggesting that behavioural exemplars may not have a role in trait self-knowledge. Tulving (1993) and Klein, Loftus and Kihlstrom (1996) came to similar conclusions following the evaluation of trait self-knowledge in two individuals with impaired personal incident memory using a trait-descriptiveness task. A close family member or partner independently completed the same task (about the impaired person), and the two sets of responses were correlated. Impaired personal incident memory did not significantly alter responses on these trait self-knowledge tasks. Thus the authors of all three studies concluded that personal incident memory does not have a significant role in the access to, or recal of, trait self-knowledge, which Klein and Loftus argue is based on abstract summaries represented in personal semantic memory. Interpretation of the single-case data is not, however,

entirely straightforward. The impairment of personal incident memory in one case was not extensive, meaning that premorbid personal incident memories may still have been involved in the activation of trait self-knowledge (Klein et al., 1996). Additionally, the sparing of personal semantic memory in both cases may have enabled the relearning of a factual knowledge of past experiences, albeit without experiential qualities (e.g., O'Connor, Butters, Miliotis, Eslinger, & Cermak, 1992; Stuss & Guzman, 1988), which could also contribute to trait self-knowledge. Finally, even if the results of these studies clearly demonstrated that personal incident memory is not involved in the activation of trait self-knowledge, it may nevertheless be important for other aspects of identity, such as narratives.

The AD population presents an opportunity to study directly the impact of changes in both personal semantic and personal incident memory on identity. To date, few studies have investigated the status of identity in AD, although in clinical settings the carers of AD patients frequently report that the AD person is no longer themselves. The apparent change in the personality of the AD individuals (e.g., Jacomb & Jorm, 1996) can be very distressing and difficult for family to accept, as very often they believe the changes equate to the loss of the person they once had a relationship with and knew. Of those studies that have addressed identity in AD, none has looked at the effect of autobiographical memory loss on aspects of identity such as the strength, quality, complexity, and direction of identity, possibly because the theoretical and methodological challenges of this research question are great. When assessing identity in an AD sample, issues associated generally with elderly populations which are likely to impact upon identity must be considered. These include changes in living arrangements, autonomy, marital status, occupational status, abilities, health status, physical appearance, and sexual function (Charmaz, 1997; Heidrich, 1998; Whitbourne, 1998). For this reason, it is critical that the status of identity is also evaluated in a closely matched elderly sample. Assessing sense of identity in an AD population additionally requires consideration of the changes associated with AD that may affect an individual's identity independently of autobiographical memory, such as changes in cognitive abilities (other than autobiographical memory) which are in conflict with self-expectations and previous abilities. Such

changes may also affect evaluative and reflective abilities and hence task performance.

In one of the very few studies of identity in AD, which involved a qualitative analysis of interviews with family members of AD sufferers, loss of identity emerged as a major theme (Orona, 1990, 1997). Relatives perceived dramatic changes in the individual's identity, personality, and behaviours over the course of AD, and interpreted these changes as signs that the individual's identity had been lost, that "the Alzheimer's person has ceased to be the person he/she once was" (Orona, 1990, p. 1252). Unfortunately, the AD patients themselves were not interviewed directly for their knowledge or perceptions. Furthermore, although there was qualitative evidence of identity loss in AD, there was no discussion of the mechanisms that were at least associated with, if not the cause of, the loss of identity. Mills (1998) investigated narrative identity in eight individuals with dementia, with a focus on the links between emotions and autobiographical memory. All eight subjects reported some loss of narrative identity, which Mills suggests is linked to a loss of autobiographical memory, although this was not investigated directly.

In the following study we administered two tests of autobiographical memory and two tests of identity to a group of mild-to-moderate AD subjects and to closely matched elderly control subjects. The autobiographical memory tasks (the Autobiographical Memory Interview, AMI, and an autobiographical fluency task) provided measures of personal incident and personal semantic memory in three different lifetime periods. The identity tasks (the Twenty Statements Test and the Tennessee Self Concept Scale) enabled us to derive measures of the strength, quality, complexity, and direction of identity. Specifically, on the Twenty Statements Test the strength of identity was assessed by the number of responses generated; quality of identity, by the abstractness of responses; and complexity of identity, by the number of categories and subcategories sampled in the responses (as defined by Rhee, Uleman, Lee, & Roman, 1995). On the Tennessee Self Concept Scale, the quality of identity was assessed by the number of vague responses and number of definite responses (as defined in the Method section); and direction of identity (i.e., the degree to which one's identity is positive or negative) was indicated by the Total Identity Score and by the Identity Subscores for each of five domains of identity (personal, family, social, moral, physical).

Together, these measures enabled us to document and compare the status of autobiographical memory and identity of AD patients relative to healthy elderly people, and to test whether the loss of autobiographical memory is related to changes in these specific aspects of identity. Our predictions were that loss of autobiographical memories from the early adulthood period in particular, would result in measurable changes in aspects of identity.

## METHOD

### Subjects

#### *AD participants*

The AD group comprised 20 individuals (13 female, 7 male) between the ages of 66 and 90 years ( $M = 75.45$ ,  $SD = 7.06$ ). Of these participants, 17 were living in their own homes (5 alone and 15 with family members) while 3 were living in residential care facilities. All were recruited from the Memory Clinic of North Shore Hospital, Auckland, New Zealand. All had a diagnosis of probable AD according to NINCDS-ADRDA criteria (McKhann et al., 1984). Participants with a history of major head injury, stroke or cerebrovascular disease, acquired language problems preventing communication, neurological abnormality other than AD, alcoholism or drug dependence, psychiatric illness, or prolonged use of psychiatric medication were excluded. Participants were also required to be fluent in English. All had normal general medical, neurological, and blood chemistry screening tests. AD participants were required to be in the mild-to-moderate stages of the disease process, as assessed by scores on the Mini-Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975). The lower cut-off used for moderate impairment in this study was 10 out of 30. The mean score on the MMSE for AD participants was 19.85 ( $SD = 3.15$ ), with a range of 13–24. Of the 21 AD participants originally recruited, one was excluded because his expressive aphasia was so severe it prevented adequate communication of responses.

#### *Control participants*

A total of 20 healthy elderly volunteers (13 female, 7 male), who ranged in age from 65 to 88 years ( $M = 75.20$ ,  $SD = 6.81$ ), comprised the control group. Control group participants were inde-

pendent-living members of the community recruited through contacts with elderly groups in the community, and one participant was the spouse of an AD group participant. The same exclusionary criteria as just described were applied to control participants. In addition, a score of 24 out of 30 or better on the MMSE was used as the cut-off for inclusion as a control participant to screen for undetected dementia (Cullum, Smernoff, & Lord, 1991; Folstein et al., 1975). Of the 24 control group participants originally recruited, 2 were excluded because of a history of stroke, and 2 were excluded because of MMSE scores of 23.

Demographic characteristics of the AD and control groups are presented in Table 1. The groups did not differ significantly in terms of gender,  $\chi^2(1, N = 40) = 0, p = 1.000$ , age,  $t(38) = .11, p = .910$ , or years of education,  $t(38) = -.90, p = .380$ . As expected, a significant difference between groups on the MMSE was found,  $t(38) = -9.44, p < .001$ .

**Materials**

***Autobiographical memory***

*The Autobiographical Memory Interview (AMI) (Kopelman et al., 1989, 1990).* The AMI is a structured interview which assesses both personal semantic and personal incident memory. The personal semantic schedule assesses participants' recall of personal facts (e.g., name of secondary school), over three lifetime periods: childhood, early adult life, and recent adult life. The total possible score for each lifetime period is 21. The autobiographical incidents schedule assesses participants' recall of specific personally experienced incidents, requiring the recall of three personal incidents from each of the three lifetime periods. Each incident is scored out of three for specificity according to criteria published with the AMI, and the total possible score for each lifetime

period is 9. An independent rater, blind to group membership, also scored all of the personal incidents memories. Inter-rater correlations were calculated, and the resulting coefficient was .82. This is comparable to the reliability coefficients reported in the AMI manual (.83 to .86). If a difference in scores between the two sets of ratings existed, the average score was taken.

One modification was made to the standard administration of the AMI. Questions in the "recent adult life" section were changed to sample memories from the past 5 years rather than the past year, with the aim of assessing the period prior to the onset of AD (e.g., "Recall an incident involving a relative or visitor in the past five years" rather than "the last year"). The aim of this change was to control for the confounding effects of possible anterograde memory impairment which typically occurs in AD, and which is likely to have affected storage of new memories during the previous year. No attempts were made to check for confabulation, given the conclusion of Kopelman and colleagues that confabulation is not a major concern when administering the AMI to AD populations (Kopelman 1989; Kopelman et al., 1990). They investigated the veracity of responses on the personal semantic schedule for individuals with AD, and report an accuracy of 94.2% (although verification of responses on the autobiographical incidents schedule could not be obtained).

*Autobiographical Fluency (Dritschel et al., 1992).* Autobiographical fluency assesses the ability to generate both personal semantic and personal incident memories. For the personal semantic fluency section, participants are required to produce as many examples as possible of names of people known to them in a 90-second period. This task is repeated for three lifetime periods: childhood, early adult life, and recent adult life. Participants are required to produce as many

**TABLE 1**  
Demographic characteristics of AD and control group participants

Measure	AD participants			Control participants		
	M	SD	Range	M	SD	Range
Age (years)	75.45	7.06	66-90	75.20	6.81	65-88
Education (years)	12.35	3.28	6-19	13.45	4.46	7-26
MMSE score	19.85	3.15	13-24	28.15	1.57	25-30

MMSE = Mini Mental State Examination.

names as possible, even if surnames are not known, and no details about the named people are required. Names that are repeated within or between lifetime periods are only scored the first time they are given.

For the personal incidents fluency section, participants are required to produce as many personally experienced events as possible in a 90-second period. This task is repeated for the three lifetime periods. No great detail is required for each reported event; only a brief description is required so as to distinguish it from other reported events. Participants are encouraged to report any memory of an event even if vague. If the description given is of a non-specific event that may have occurred a number of times (e.g., "going hunting with Dad") it is only scored as one event.

### **Identity**

*Twenty Statements Test (Kuhn & McPartland, 1954).* The Twenty Statements Test requires participants to give 20 statements in response to the question "Who am I?". The traditional administration is written. Participants write their 20 "I am ..." statements, with instructions to give the answers about themselves only, and to write all answers in the order they occur to them without worrying about logic or importance. For the purpose of this research, the Twenty Statements Test was adapted in a number of ways to accommodate individuals with AD. Instead of a written format, the Twenty Statements Test was administered verbally, and therefore the instructions were adapted for verbal administration. Prompts indicating possible types of responses (e.g., characteristics, roles, abilities) were added to the instructions used for all participants to ensure that individuals with AD understood adequately what the task required of them. Responses were recorded verbatim by the researcher until 20 responses were recorded.

Each response was coded according to a modified version of the coding scheme used by Rhee et al. (1995). Responses are classified into four categories of identity: Attributes, social identities, evaluative descriptions, and physical descriptions. Each category is further divided into subcategories, and each subcategory is classified as either specific (i.e., qualified with some specific detail) or abstract (i.e., responses that are general or reflective and lacking in specific details). In cases where a response contained more than one distinct meaning, only one meaning was coded

following the guidelines given by Rhee et al. Nonsense responses and repeated responses are not coded. The following scores were calculated from the coded responses of each individual: the total number of responses (a measure of strength of identity); the percentage of responses that were coded as abstract (a measure of quality of identity); and the number of categories and subcategories sampled in the responses of an individual (measures of complexity of identity). An independent rater, blind to subject group, also coded all of the responses. Inter-rater correlations were calculated for all of these scores, with the resulting coefficients ranging from .73 to .99. These compare favourably to those reported by Rhee and colleagues (.76 to 1.00). If a difference in scores between the two sets of ratings existed, the average score was taken.

*Tennessee Self Concept Scale: Second Edition (Fitts & Warren, 1996).* The Tennessee Self Concept Scale: Second Edition measures three components of the self-concept (identity, satisfaction, and behaviour) over five domains (personal, family, social, moral, and physical). It consists of 82 descriptive statements which are rated for self-descriptiveness on a 5-point true-false scale (always false, mostly false, partly false and partly true, mostly true, always true). Only the 21 items measuring the identity component of self-concept were used in the present study. To facilitate the use of this scale with individuals with AD, the administration to all participants was modified. Instead of a written questionnaire, each item was simultaneously read aloud and presented on a laminated card consisting of the self-descriptive statement and the 5-point true-false scale. Task instructions were repeated when necessary, and responses were recorded by the researcher. A number of scores were calculated. First, the Total Identity Score (sum of all items measuring identity, maximum 105) and five Identity Subscores—personal, family, social, moral, and physical—were used as measures of the direction of identity. For each of these identity scores, a higher score indicates a more positive identity. As there was an unequal number of items comprising individual Identity Subscores, each subscore was converted to an index out to 60, to enable direct comparisons. (This entailed multiplying the personal subscore by 2.4, the family subscore by 3, the social subscore by 4, the moral subscore by 3, and the physical subscore by 2.4.) Second, the numbers of vague responses, that is, a response of "3"

(“partly false and partly true”), and the number of definite responses, that is, responses of “1” (“always false”) or “5” (“always true”), on the 21 identity items were used as measures of the quality of identity.

**Procedure**

Ethics approval was obtained from the Auckland Ethics Committee. Written informed consent was obtained from all participants and from the caregivers of all AD participants when appropriate. Each testing session began with the gathering of background educational and medical information, followed by the administration of the MMSE and the experimental tasks. During the administration of all tests, participants were able to go at their own pace, except for autobiographical fluency, which was timed. Participants were able to rest at many points during testing, if required, and were also offered the option of breaking the testing into two sessions. One control participant chose to complete testing over two consecutive days.

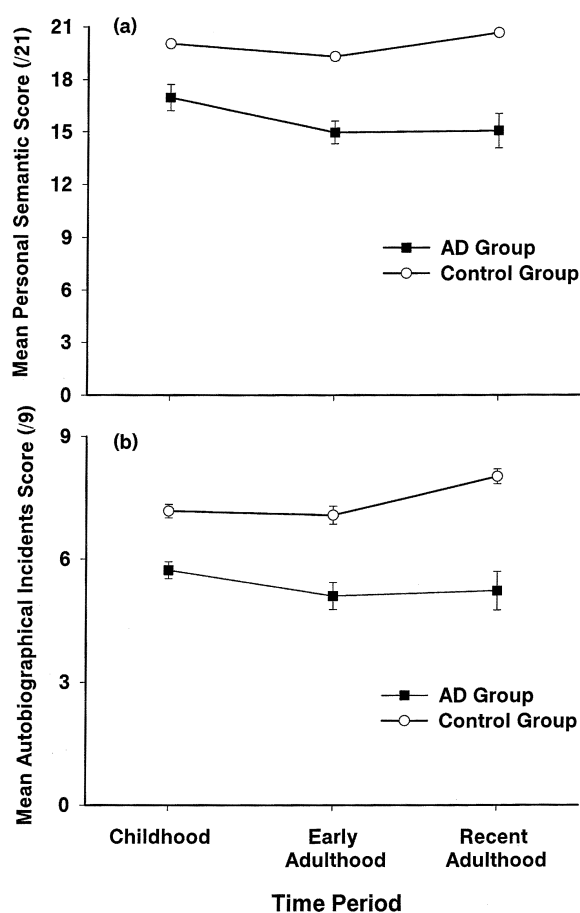
**RESULTS**

**Autobiographical memory**

To investigate whether individuals with AD exhibited impairments in the personal semantic and personal incident components of autobiographical memory, and whether a temporal gradient of impairment was evident for these components, performances on these two components of both autobiographical memory tests were analysed using repeated measures analysis of variance (ANOVA), with group (AD, control) a between-subjects factor, and time period (childhood, early adulthood, and recent adulthood) a within-subject factor. Post-hoc Newman-Keuls tests were used to analyse significant interactions.

**Autobiographical Memory Interview**

*Personal semantic memory.* Figure 1a illustrates the results for the personal semantic schedule across the three lifetime periods for the two groups, and shows that the AD group generally performed more poorly than the control group. This was confirmed by the repeated measures ANOVA, which revealed a significant main effect of groups,  $F(1,38) = 38.73, p < .001$ , and time



**Figure 1.** Performances of the AD and control groups across three lifetime periods on the (a) personal semantic and (b) autobiographical incidents schedules of the AMI. The bars indicate the standard error for each group at each time period.

period,  $F(2,38) = 5.84, p = .004$ . A significant group by time period interaction was also found,  $F(2,38) = 5.01, p = .009$ . Post-hoc Newman-Keuls tests revealed that the recall of control participants was better for recent adulthood compared with early adulthood ( $p = .050$ ), consistent with the recency effect evident in the normal lifespan distribution of autobiographical memories (Rubin, Wetzler & Nebes, 1986). Recall of childhood autobiographical memories was not significantly different from early adulthood ( $p = .203$ ) or recent adulthood ( $p = .272$ ). The recall of AD group participants was significantly poorer for recent adulthood ( $p = .001$ ) and early adulthood ( $p = .002$ ) compared with childhood, but there was no significant difference in recall for recent adulthood and early adulthood ( $p = .860$ ). This is consistent with a temporal gradient of impairment with no benefit of recency (i.e., poorer recall for

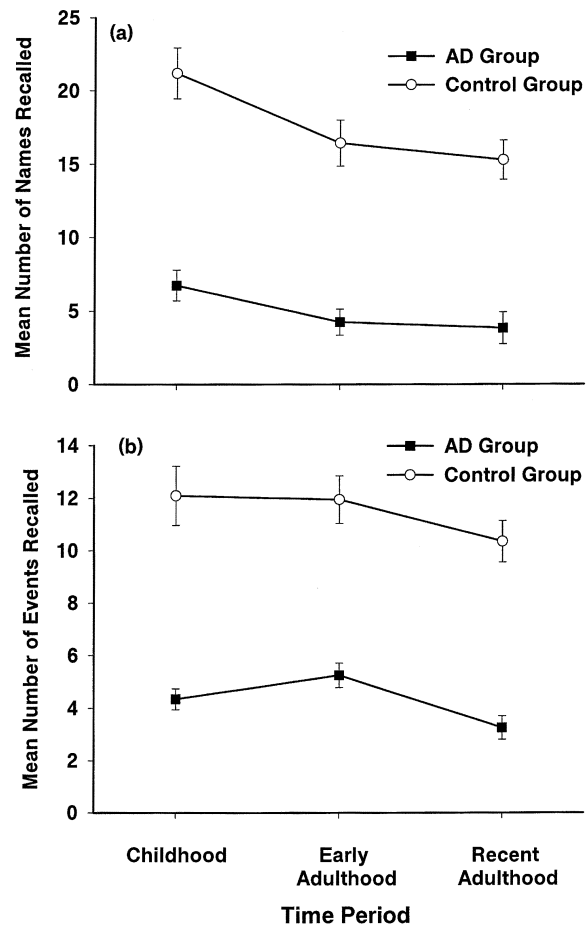
recent autobiographical memories compared with remote autobiographical memories).

**Autobiographical incident memory.** Figure 1b shows the performance of the two groups on the autobiographical incidents schedule across the three time periods. A repeated measures ANOVA again revealed a significant main effect of group,  $F(1, 38) = 59.45$ ,  $p < .001$ , with the AD group performing more poorly overall than the elderly control group. There was no significant effect of time period,  $F(2, 38) = 2.26$ ,  $p = .112$ , but there was a significant group by time period interaction,  $F(2, 38) = 3.48$ ,  $p = .036$ . Post-hoc Newman-Keuls tests revealed that the recall of control participants was significantly better for recent adulthood than early adulthood ( $p = .030$ ) and childhood ( $p = .023$ ), but there was no significant difference between recall of childhood and early adulthood memories ( $p = .785$ ). This is consistent with a recency effect, as was found on personal semantic memory. AD participants showed no significant differences for recall between any of the time periods.

### Autobiographical fluency

**Fluency for names.** The mean group scores on autobiographical fluency for names in each time period are shown in Figure 2a with the AD group again performing more poorly than the control group. The repeated measures ANOVA confirmed that this difference was significant, with a significant main effect of group,  $F(1, 38) = 64.70$ ,  $p < .001$ , and a significant main effect of time period,  $F(2, 38) = 15.21$ ,  $p < .001$ . However, no significant interaction was found between group and time period,  $F(2, 38) = 1.68$ ,  $p = .193$ .

**Fluency for events.** Figure 2b illustrates the mean performance of the two groups on autobiographical fluency for events in each time period. The repeated measures ANOVA revealed a significant main effect of group,  $F(1, 38) = 59.88$ ,  $p < .001$ , with the AD group performing more poorly than the control group overall. There was also a significant main effect of time period,  $F(2, 38) = 10.12$ ,  $p < .001$ , but no significant interaction between group and time period,  $F(2, 38) = 0.79$ ,  $p = .458$ , indicating that the pattern of performance of the two groups across the time periods was not different.



**Figure 2.** Performances of the AD and control groups across three lifetime periods on autobiographical fluency for (a) names and (b) events. The bars indicate the standard error for each group at each time period.

## Identity

### Strength of identity

To test whether strength of identity differed between the AD and control groups, an independent samples  $t$ -test was used to compare the number of responses generated on the Twenty Statements Test. The Levene's test of homogeneity of variance indicated that the variances of the two groups were not equal,  $F(1, 38) = 16.48$ ,  $p < .001$ , so variances were not pooled, appropriate degrees of freedom were calculated (25.99), then rounded (Howell, 1997). There was a significant difference between the number of responses of AD and control group participants,  $t(26) = -5.37$ ,  $p < .001$ , with the AD group participants producing significantly fewer responses ( $M = 11.68$ ,  $SD = 5.07$ ) than control group participants ( $M = 18.33$ ,  $SD = 2.21$ ).

### Quality of identity

The AD group made a significantly higher percentage of abstract responses ( $M = 37.94$ ,  $SD = 17.44$ ) than the control group ( $M = 25.70$ ,  $SD = 10.82$ ) on the Twenty Statements Test,  $t(38) = 2.67$ ,  $p = .011$ . Consistent with this, a Mann Whitney  $U$  test revealed a significant difference in the number of vague responses (i.e., responses of 3) made by the two groups on the Tennessee Self Concept Scale,  $p(U = 121, N_1 = N_2 = 20) = .033$ , with AD group participants having a significantly higher number of vague responses ( $Mdn = 4$ , interquartile range = 5) than control group participants ( $Mdn = 3$ , interquartile range = 3). Furthermore, a Mann Whitney  $U$  test showed that the AD group participants made a significantly smaller number of definite responses (i.e., responses of 1 or 5),  $Mdn = 9$ , interquartile range = 7.5 than the control group participants ( $Mdn = 14.5$ , interquartile range = 10.5) on the Tennessee Self Concept Scale,  $p(U = 95, N_1 = N_2 = 20) = .005$ .

### Complexity of identity

Assessment of complexity of identity involved two measures derived from the Twenty Statements Test: First, the number of categories of identity sampled in the responses (maximum of 4), and second, the number of subcategories of identity sampled in the responses (maximum of 13). Chi-square tests were used to investigate whether the frequency of individuals in each group who sampled a larger number of categories and subcategories differed. To enable a valid chi-square test, the four cells of the variable, number of categories sampled, were collapsed: Numbers of individuals who sampled one or two categories of identity were combined, and those who sampled three or four categories were combined. There was no significant difference in the frequency of AD and control group participants who sampled either one or two categories, or, three or four categories,  $\chi^2(1, N = 40) = .42$ ,  $p = .519$ .

For the variable, number of subcategories sampled, once again cells were collapsed to enable a valid chi-square test. Individuals who sampled six or fewer subcategories were combined, and those who sampled more than six subcategories were combined. Once again there was no significant difference in the frequency of AD and control participants whose responses sampled high numbers subcategories of identity and those who sampled low numbers of subcategories,  $\chi^2(1, N = 40) = 3.60$ ,  $p = .058$ . On this occasion, how-

ever, there was a non-significant trend ( $p = .058$ ) in the predicted direction, with 13/20 control participants sampling more than six subcategories, whereas 13/20 AD participants sampled six or fewer subcategories.

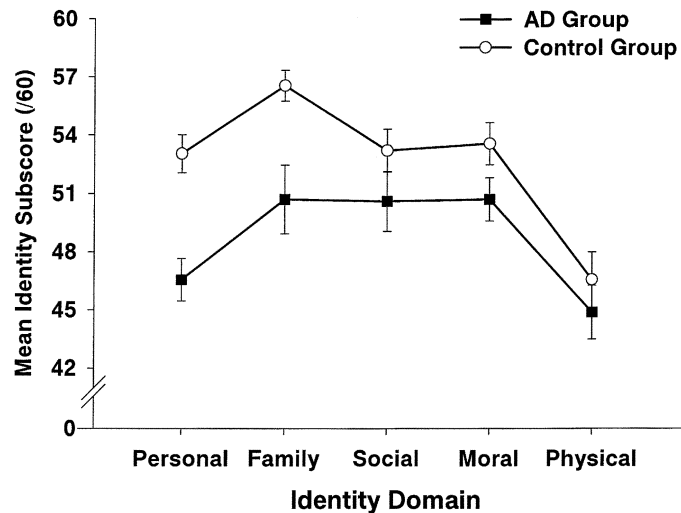
### Direction of identity

The direction of identity (i.e., from positive to negative) was measured by scores from the Tennessee Self Concept Scale; higher scores indicated a more positive identity. An independent samples  $t$ -test revealed a significant difference in the Total Identity Scores of the AD and control group participants,  $t(38) = -3.68$ ,  $p < .001$ , with significantly lower Total Identity Scores for AD group participants ( $M = 84.55$ ,  $SD = 6.14$ ) than control group participants ( $M = 91.50$ ,  $SD = 5.78$ ).

Figure 3 shows the performance of the two groups on the five Identity Subscores (personal, family, social, moral, and physical) from the Tennessee Self Concept Scale. Although the AD group has generally lower scores, the pattern of scores across the five subscales appears similar in the two groups. This was confirmed by results from the repeated measures ANOVA, with Group (AD, control) a between-subjects factor, and Subscore (personal, family, social, moral, and physical) a within-subject factor. There was a significant main effect of Group,  $F(1, 38) = 12.78$ ,  $p = .001$ , with the Identity Subscores of the control group significantly higher overall ( $M = 52.58$ ,  $SD = 5.80$ ) than the those of the AD group ( $M = 48.68$ ,  $SD = 6.63$ ). A significant main effect of Subscore was also found,  $F(4, 38) = 15.27$ ,  $p < .001$ . Post-hoc Newman-Keuls tests revealed that the physical identity subscore was significantly lower than all four other identity subscores: personal ( $p < .001$ ); family ( $p < .001$ ); social ( $p < .001$ ); and moral ( $p < .001$ ). The family identity subscore was also significantly higher than the personal identity subscore ( $p = .003$ ). No other comparisons were significant. Importantly, there was no significant interaction between group and subscore,  $F(4, 38) = 1.84$ ,  $p = .123$ , confirming that although the scores of the AD group were lower overall than the control group, there was no significant difference in the pattern of subscores between the two groups.

### Relation between autobiographical memory and identity

To investigate our prediction that impairment of autobiographical memory (particularly early



**Figure 3.** Identity subscores on the Tennessee Self Concept Scale for the AD and control group participants. The bars indicate the standard error for each group at each subscore.

adulthood memories) would result in changes in identity, partial correlations followed by hierarchical regression analyses were carried out. First, partial correlations were calculated between the performance of the AD group on tests of autobiographical memory and components of identity, controlling for global cognitive decline as assessed by MMSE scores. To reduce the large number of potential correlations we considered only identity variables for which there was significant change in the AD group compared to the control group. To maximise power further, and also to minimise redundancy amongst the identity variables, we calculated intercorrelations between the five identity variables and reduced to one any pair with an absolute correlation coefficient of  $r = .70$  or higher. Two correlations met this criterion: Tennessee Self Concept Scale Total and number of definite responses on this scale ( $r = .72$ ), and Tennessee Self Concept Scale Total and number of vague responses on this scale ( $r = -.73$ ). Tennessee Self Concept Total was removed, leaving a total of 4 identity variables and 12 measures of autobiographical memory. Partial correlations between the same variables were also conducted on the data of the control group.

The correlation matrix for the AD group is presented in Table 2. Partial correlations controlling for MMSE score revealed significant correlations between the measure of strength of identity (total number of responses on the Twenty Statements Test) and autobiographical fluency for early adulthood names,  $r = .568$ ,  $p = .011$ , and autobiographical fluency for childhood events,  $r =$

$.504$ ,  $p = .028$ . Quality of identity, as measured by the percentage of abstract responses on the Twenty Statements Test, was significantly negatively correlated with one measure of autobiographical memory, childhood autobiographical incidents on the AMI,  $r = -.528$ ,  $p = .035$ . Of the two other sets of correlations involving quality of identity, no significant associations between the number of vague responses on the Tennessee Self Concept Scale and any of the 12 measures of autobiographical memory were found. However, the number of definite responses on the Tennessee Self Concept Scale was significantly negatively correlated with childhood personal semantic memory on the AMI ( $r = -.526$ ,  $p = .021$ ), autobiographical fluency for childhood names ( $r = -.473$ ,  $p = .040$ ), and autobiographical fluency for early adulthood names ( $r = -.488$ ,  $p = .034$ ). Thus the poorer an individual's performance on both test measures of childhood personal semantic memory and one measure of early adulthood personal semantic memory, the higher the number of definite responses made on the Tennessee Self Concept Scale.

Partial correlations controlling for MMSE score conducted on the data of the control group, revealed only one significant correlation between the 12 measures of autobiographical memory and 4 measures of identity. Autobiographical fluency for childhood events was significantly correlated with number of vague responses given on the Tennessee Self Concept Scale ( $r = .458$ ,  $p = .049$ ).

The second component of the analyses involved hierarchical regression analyses on the

**TABLE 2**  
Correlation matrix showing AD group partial correlations between identity measures and autobiographical memory measures controlling for MMSE

Identity measure	AMI—personal semantic			AMI—autobiographical incidents		
	Child	Early	Recent	Child	Early	Recent
TST Total	.335	.109	.329	.149	.196	.303
TST Abstract	.002	.229	-.199	-.528*	.105	-.433
TSCS Vague	.081	-.192	.169	.002	-.138	.062
TSCS Definite	-.526*	-.088	-.204	.076	-.146	-.323

Identity measure	Autobiographical fluency—names			Autobiographical fluency—events		
	Child	Early	Recent	Child	Early	Recent
TST Total	.273	.568*	.378	.504*	.325	.378
TST Abstract	-.185	-.032	.139	.269	.047	-.045
TSCS Vague	.248	.426	-.031	-.243	-.079	.348
TSCS Definite	-.474*	-.489*	-.094	.130	-.360	-.324

TST = Twenty Statements Test, TSCS = Tennessee Self Concept Scale.  
\**p* < .05.

data of the AD group, conducted to investigate whether scores on identity variables were directly influenced by significantly associated components of autobiographical memory. Each regression analysis sought to control initially for global cognitive decline by entering MMSE in the first block. The second block of variables entered comprised the components of autobiographical memory significantly associated with the specific identity variable, followed by a third block of variables, namely the remaining autobiographical memory variables. Separate regression analyses were conducted for the two autobiographical memory tests. We fully acknowledge that these regression analyses can, at best, be considered preliminary, given the small sample size contributing to the data set.

**Autobiographical memory and strength of identity**

A regression analysis was conducted to investigate whether strength of identity was directly influenced by autobiographical fluency for early adulthood names and autobiographical fluency for childhood events. This revealed, first, that the regression model comprising MMSE and a constant (block 1) did not produce a significant *R*<sup>2</sup> change over a model containing only a constant, *R*<sup>2</sup> change = .032, *F*(1, 18) = 0.600, *p* = .459. The addition of autobiographical fluency for early adulthood names and autobiographical fluency for childhood events in block 2 resulted in a significant improvement in the model predicting

strength of identity, *R*<sup>2</sup> change = .397, *F*(2, 16) = 5.57, *p* = .015. Autobiographical fluency for early adulthood names approached significance as a predictor of total number of responses on the Twenty Statements Test, Beta (standardised) = .431, *p* = .056. The addition of the remaining four autobiographical fluency variables (block 3) to the model did not produce a significant *R*<sup>2</sup> change = .037, *F*(4, 12) = 0.209, *p* = .928. To check whether the significant *R*<sup>2</sup> change found following entry of the second block of variables reflected only the more general effect of adding fluency variables to the model, we reversed the order of entry of blocks 2 and 3. Even when entered in block 2, the four autobiographical fluency variables not significantly associated with strength of identity did not produce a significant *R*<sup>2</sup> change to the model, *R*<sup>2</sup> change = .251, *F*(4, 14) = 1.226, *p* = .344.

**Autobiographical memory and quality of identity**

The regression procedure conducted to investigate whether percentage of abstract identity responses on the Twenty Statements test was predicted by recall of childhood autobiographical incidents on the AMI, showed first that the *R*<sup>2</sup> change (.009) associated with the MMSE model was not significantly different from a model containing only a constant, *F*(1, 18) = 0.171, *p* = .684. When AMI childhood autobiographical incidents was entered there was a significant improvement in the model predicting abstract identity respon-

ses,  $R^2$  change = .276,  $F(1, 17) = 6.57$ ,  $p = .020$ . Furthermore childhood autobiographical incidents of the AMI was a significant predictor of percentage of abstract identity responses, Beta (standardised) =  $-.55$ ,  $p = .020$ . Thus the poorer a person's recall of childhood autobiographical incidents, the higher their percentage of abstract responses on the Twenty Statements Test. The addition of the remaining five AMI variables to the model did not result in a significant  $R^2$  change: (.246),  $F(5, 12) = 1.257$ ,  $p = .343$ .

Number of definite responses on the Tennessee Self Concept Scale was significantly negatively associated with variables from both autobiographical memory tests. The first regression procedure tested whether recall on the childhood personal semantic memory on the AMI significantly influenced the number of definite identity responses given. As in the previous analyses, the  $R^2$  change (.008) associated with the MMSE model was not significantly different from a model containing only a constant,  $F(1, 18) = 0.143$ ,  $p = .710$ . When AMI childhood personal semantic recall was entered there was a significant improvement in the model,  $R^2$  change = .274,  $F(1, 17) = 6.49$ ,  $p = .021$ . Childhood personal semantic recall was also a significant predictor of number of definite responses on the Tennessee Self Concept Scale, Beta (standardised) =  $-.55$ ,  $p = .021$ . Thus the poorer a person's recall of childhood personal semantic memories, the greater the number of definite identity responses they gave. The addition of the remaining five AMI variables to the model did not result in a significant  $R^2$  change: (.194),  $F(5, 12) = 0.889$ ,  $p = .518$ .

The second regression procedure tested whether autobiographical fluency for childhood names and autobiographical fluency for early adulthood names significantly influenced the number of definite identity responses given on the Tennessee Self Concept Scale. As already noted, addition of MMSE scores failed to produce a significant improvement in the model. When the two autobiographical fluency measures of personal semantic memory were entered, however, there was a significant improvement in the model,  $R^2$  change = .322,  $F(2, 16) = 3.850$ ,  $p = .043$ . The addition of the remaining four autobiographical fluency variables to the model did not produce a significant  $R^2$  change: (.214),  $F(4, 12) = 1.404$ ,  $p = .291$ . Once again we checked whether the significant  $R^2$  change found following entry of the second block of variables reflected only the gen-

eral addition of fluency variables to the model by reversing the order of entry of blocks 2 and 3. Entering the four autobiographical fluency variables not significantly associated with direction of identity in block 2 still did not produce a significant  $R^2$  change to the model:  $R^2$  change = .379,  $F(4, 14) = 2.166$ ,  $p = .126$ .

## DISCUSSION

Patients with AD were impaired on both personal semantic and personal incident memory on two different autobiographical memory tasks (the AMI and autobiographical fluency). These findings are consistent with the small number of previous studies of autobiographical memory in AD, all of which documented an impairment of personal incident memory (Dall'Ora et al., 1989; Dorrego et al., 1999; Fromholt & Larsen, 1991; Fromholt et al., 1995; Graham & Hodges, 1997; Greene & Hodges, 1996; Greene et al., 1995; Kopelman, 1989; Sagar et al., 1988); and, when studied, personal semantic memory (Graham & Hodges, 1997; Greene & Hodges, 1996; Greene et al., 1995; Kopelman, 1989).

The AD group participants showed a temporal gradient of loss for personal semantic memory on the AMI, such that recall of recent adulthood and early adulthood memories was poorer than recall of childhood personal semantic memories. Additionally, the control group exhibited a recency effect: The recall of autobiographical memories was better for recent adulthood than early adulthood. These patterns of performance for both groups have only been reported in one previous study (Kopelman, 1989); the few other studies of personal semantic memory in AD did not find a temporal gradient of impairment for this component of autobiographical memory (Graham & Hodges, 1997; Greene & Hodges, 1996, Greene et al., 1995). However, the level of dementia of the AD participants (assessed by the MMSE) in studies that did not find a temporal gradient was more mild than in the present study. This suggests that a temporal gradient of impairment of personal semantic memory may develop as AD progresses from the earliest stages. Unfortunately Kopelman, who also found a temporal gradient for personal semantic memory in AD, used a different measure of dementia severity (the Gresham Memory and Orientation Questionnaire), making direct comparison difficult. On this scale, however, the mean score of AD subjects was 17.6/43

(range 9–31) compared to the control group mean of 40.4/43 (range 37.5–43), which certainly suggests that their AD sample was not of a “mild” severity level, consistent with the aforementioned hypothesis.

If autobiographical memory is impaired to the extent that a temporal gradient is evident for personal semantic memory on the AMI, a temporal gradient of impairment of personal incident memory would also be expected. However, the AD group did not exhibit a strict temporal gradient of impairment on the autobiographical incidents schedule, even though they performed at a poorer level overall than the control group and even though the interaction between group and time period was significant. Dall’Ora et al. (1989) and Fromholt and Larsen (1991) also did not find a temporal gradient of impairment, but several other studies of autobiographical memory in AD have found such a gradient (e.g., Dorrego et al., 1999; Graham & Hodges, 1997; Greene et al., 1995; Kopelman, 1989; Sagar et al., 1988). In our study the significant interaction was the result of a recency effect for control subjects who had better recall for recent adulthood than early adulthood and childhood. Recency effects for the recall of personal incidents have not previously been documented in the performance of control subjects on the AMI, but they have been found in free recall (Anderson & Conway, 1997; Rubin et al., 1986) and cued recall (Sagar et al., 1988) of personal incident memory. When the performance of the AD group on recall of personal incident memory (i.e., the autobiographical incidents schedule of the AMI) is considered directly in relation to the performance of the control group, the absence of an effect of time period on recall does reflect a failure to show the benefit of recency that is present in the performance of controls. In this sense—that is, a failure to perform better on the recall of memories in recent adulthood—the AD group does exhibit a mild temporal gradient in their impairment of personal incident memory.

On the autobiographical fluency tasks for names and events, we found no evidence of a temporal gradient of impairment, consistent with other studies that have used this task to assess autobiographical memory in AD (Greene et al., 1995). This may reflect the greater speed of cognition required in fluency tasks, a task-demand that would affect performances for all three lifetime periods and may increase variance to a level that masks an existing temporal gradient (Greene

et al., 1995). Notably, however, the autobiographical fluency tasks define “recent adulthood” as the previous two decades rather than the previous year used in the conventional administration of the AMI, or past 5 years in the AMI modification used in this study and some previous studies (Graham & Hodges, 1997; Greene et al., 1995). Use of a 20-year timeframe would mask a temporal gradient if the differential impairment initially affected memories for a shorter period (say a 10-year period). On the other hand, this duration of “recent adulthood” may simply be more successful in controlling for the contaminating effects of any anterograde memory impairments in AD populations than the 5-year modification used on the AMI. If so, the results on the autobiographical fluency tasks may be demonstrating that there are no true temporal gradients of impairment of remote autobiographical memories.

In summary, for the purposes of this study the unequivocal findings of impairment of personal semantic and personal incident memory in the AD group are most relevant for investigating whether impairment of autobiographical memory is associated with changes in aspects of identity.

The AD group showed changes in a number of aspects of identity compared to an elderly control group. AD group participants generated fewer responses on the Twenty Statements Test than control participants, suggesting that identity becomes weaker in AD. This is consistent with both the reports of caregivers and qualitative studies which report a loss of identity in AD (Mills, 1998; Orona, 1990, 1997), although it is possible that an impairment of fluency or generative abilities could impact on the ability to generate “I am ...” statements on the Twenty Statements Test independently of the integrity of identity itself.

Individuals with AD experienced changes in the quality of their identity. On the Twenty Statements Test AD participants generated a higher percentage of abstract responses, and on the Tennessee Self Concept Scale made more vague responses (3s) and fewer definite responses (1s and 5s) than control subjects. Thus, all measures of quality of identity indicated that the responses by AD participants on identity measures (which included a free recall and recognition format) were more abstract, more vague, and less definite.

Interestingly, the complexity, or breadth, of identity was less affected in the AD group, with no

significant group differences in the number of categories or subcategories sampled in self-generated responses on the Twenty Statements Test. Even though the responses of AD participants were fewer in number and more abstract in nature, they still sampled a comparable range of content. However, additional instructions included to ensure all participants understood the task may have inadvertently influenced this outcome, as these included prompts referring to possible categories of responses. This may have activated the same categories of identity in both AD and control groups participants, which could have obscured a difference in the ability of the AD group to access spontaneously the same breadth (or complexity) of responses. Indeed, group differences on the measure, number of subcategories sampled, in responses on the Twenty Statements Test did approach significance ( $p = .058$ ). Number of subcategories sampled is a finer-grained measure, and additionally exemplars at this level were not provided in the instructions.

The identities of AD subjects were more negative than their elderly counterparts, with lower scores on the Total Identity Score and the Identity Subscores of the Tennessee Self Concept Scale. Changes and impairments experienced in AD affect many aspects of one's life and identity, including cognitive abilities, daily living skills, activities, social relations, self-perceptions, and self-esteem. Given this, the more negative assessments of all such aspects of identity in AD individuals are not surprising. Indeed, when describing themselves some AD participants had integrated these changes, such as decreased cognitive abilities, into their sense of identity, reflected in statements about feeling limited and having "lost confidence" in what they can do. Additionally, coming to terms with any chronic or terminal disease may cause an "awakening to death" as their own death becomes more possible to them (Charmaz, 1997), as well as lessening one's orientation to the future (Heidrich, 1998), which is theorised to be an important aspect of identity (Markus & Nurius, 1986). The reality of having a disease such as AD, particularly when insight is still relatively preserved, along with the global decline of many aspects of oneself and one's life, are all likely contributors to the more negative sense of identity experienced in AD.

The similarity between the two groups in the structure of identity over the five Identity Subscores (albeit at a lower, or more negative, level for the AD group) was less expected (see Figure

3). Although there appears to be a greater relative drop in AD scores on the personal and family subcomponents, this was not statistically significant. In this sample of individuals with AD the relative structure of the subcomponents of identity was preserved, paralleling age-associated changes in identity seen in the elderly control group, such as a more negative sense of personal and physical identity than family, social, and moral identity (Whitbourne, 1998).

In summary, individuals with autobiographical memory impairments in this study have experienced changes in some, but not all, aspects of identity. However, this alone does not tell us whether the loss of autobiographical memory itself affected their sense of identity, or whether other aspects of AD were responsible for this. In other words, was the degree of autobiographical memory impairment in our AD sample directly associated with changes in aspects of identity? Perhaps not surprisingly, the answer to this question is complex. Clearly, there is not a simple one-to-one relationship between impairment of autobiographical memory and changes in identity. Our results do indicate, however, that changes in some measures of autobiographical memory in this AD group influenced changes in some aspects of their identity.

In particular, there were significant associations between childhood and early adulthood autobiographical memory, and strength of identity (Twenty Statements Test total), and two measures of quality of identity (abstract responses on the Twenty Statements Test, and use of definite responses on the Tennessee Self Concept Scale). In total there were six significant correlations out of 48 (with 2.4 expected by chance alone). Although this is above chance, it is not comfortably so. To probe further the importance of these correlations, we undertook hierarchical regression analyses to see whether these components of autobiographical memory did influence the associated identity variables in the AD group. The analyses showed that each model predicting levels of these particular identity variables (strength and two measures of quality) was significantly improved only by the addition of those childhood and early adulthood autobiographical memory variables that were significantly associated with identity variables (and no other autobiographical memory variables).

Further support for concluding that degree of impairment on these autobiographical memory variables directly influences components of iden-

tity in this AD group, was the lack of such associations in the control group (only 1 out of 48 significant correlations). In addition, the possibility that global cognitive decline underlies the AD associations seems remote, given that MMSE scores were effectively partialled out of the correlations and the hierarchical regressions. Although we were unable to partial out the effects of impaired fluency in the same way, there is some evidence that the results are not due solely to impairments in fluency *per se*. Certainly not all autobiographical fluency variables were significantly correlated with the identity variables, which might have been expected if the fluency component itself was the underlying cause of the associations. Furthermore, adding the non-significant autobiographical fluency variables to the hierarchical regressions in either the second or third block (after MMSE) did not result in significant improvement of the predictive models.

In summary, our data are consistent with the prediction that degree of impairment on some measures of autobiographical memory directly influenced some components of identity. Having said this, we wish to acknowledge that these findings have to be considered preliminary only, particularly given the relatively small sample size and the cross-sectional nature of the study. Even so, they provide an interesting source of input into specific issues about the relation between autobiographical memory and identity. To highlight these issues we will discuss the significant associations found between specific measures of autobiographical memory and specific measures of identity in the light of current theoretical views of the relationship between these two constructs. In particular, we focus on the importance of memories from late childhood and early adulthood in identity, as predicted by the self-narrative explanation of the reminiscence bump (Fitzgerald, 1988, 1996, 1999). We will also consider the relative contribution of personal semantic and personal incident memories to components of identity.

First, strength of identity (number of responses on the Twenty Statements Test) was significantly related to childhood personal incident memory on the AMI and autobiographical fluency for early adulthood names. The more impaired these components of autobiographical memory, the weaker the strength of identity. Additionally, these memory measures significantly improved the model predicting strength of identity. These data fit well with the reminiscence bump phenomenon

and the hypothesis that autobiographical memories from late childhood and early adulthood (16–25 years) are closely linked with identity (Fitzgerald, 1988, 1996, 1999). Impairment of memories from this usually well remembered period of early adulthood could conceivably weaken the self-report of identity as the usual “bump” in free recall responses would be diminished. Consistent with this view are the findings of Fromholt and colleagues, who used free-recall methods to investigate directly the reminiscence bump in AD, and found that the greatest decrease in memories relative to controls is in bump memories (Fromholt & Larsen, 1991; Fromholt et al., 1995). Unfortunately, we were unable to explore the integrity of the reminiscence bump in our AD group, as two of the lifetime periods in autobiographical fluency (our generative measure of autobiographical memory), childhood (0–20 years) and early adulthood (20–40), effectively cut across the reminiscence bump period of 16 to 25 years.

Two measures of quality of identity (percentage of abstract responses on the Twenty Statements Test, and use of definite responses on the Tennessee Self Concept Scale) were significantly correlated with performances on measures of autobiographical memory. First, the poorer the recall of childhood personal incident memories on the AMI, the higher the percentage of abstract responses on the Twenty Statements Test, with childhood personal incident memory a significant predictor of the abstract quality of identity. Again, this finding is consistent with the proposed importance of the late-childhood—early-adulthood period (16–25 years) in identity processes (e.g., Fitzgerald, 1988, 1996, 1999). In this case, the association suggests that the autobiographical memory of childhood events has a role in providing the details needed to generate specific identity statements, and that impairment of this component of autobiographical memory results in more abstract and less specific statements. This is consistent with the behavioural exemplar theory (Bower & Gilligan, 1979), which posits that personal incident memories provide the details of one’s identity, for example, how one acted in a particular situation.

In this AD group, however, poorer recall of personal semantic memory from childhood (on both memory measures) and early adulthood (on autobiographical fluency only) was related to a higher frequency of definite responses on the Tennessee Self Concept Scale. These results

indicate that early personal semantic memories also make a contribution to the quality of identity, although the direction of these associations was somewhat surprising given that overall the AD group produced a lower frequency of definite responses than the control group. The direction of the group differences implies that use of definite responses is a marker of preserved identity and autobiographical memory, yet within the AD group greater impairment of early personal semantic memories was associated with greater use of these. These apparently conflicting results may reflect a change in the balance of the contribution of personal semantic and personal incident memory to identity in AD. In an individual with unimpaired autobiographical memory, personal semantic memory may contribute the overview of oneself in a variety of incidents to identity (akin to the abstract summaries proposed by Klein & Loftus, 1993), whereas personal incident memory may provide the specific details of one's identity (as proposed in the behavioural exemplar theory, Bower & Gilligan, 1979). By this account, individuals with preserved autobiographical memory verify definite statements about themselves based on a survey of both personal semantic and personal incident memories. However, if abstract summaries are lost or degraded, there will likely be, first, an overall effect of reducing the number of definite (or certain) statements verified about oneself. The more impaired a person's personal semantic memory becomes, however, the more likely it may become that self-descriptions will be based on a single relevant incident still available from personal incident memory, resulting in the more frequent use of extreme "always" or "never" responses. In summary, our findings suggest that both behavioural exemplars and abstract summaries may contribute to the quality of identity responses on free recall and recognition measures.

In overview, this study confirmed that both personal semantic and personal incident memory are significantly impaired in AD. Changes in the strength, quality, and direction of identity in AD subjects compared with age-matched control subject were documented for the first time, as well as the relative preservation of the structure of identity. These results provide some support for a relationship between the impairment of childhood and early adulthood autobiographical memories (both personal semantic and personal incident) and changes in the strength and quality of identity, consistent with Fitzgerald (1996). Perhaps most

importantly, this study represents a first step towards quantifying and understanding the identity changes in AD that are reported so frequently by caregivers and are so often a source of distress. The sense that "the Alzheimer's person [ceases] to be the person he/she once was" (Orona, 1990, p. 1252), may indeed reflect, at least in part, changes in that person's identity. Having said this, it is important to remain aware of the distinction between the declaration of identity (by either recall or recognition methods), as addressed in this study, and the underlying core sense of identity or continuity of self, which may differ.

While these findings provide input into understanding how autobiographical memory impairment may drive identity changes in AD, they also indicate that these two constructs do not map directly onto each other. Other factors associated with AD, such as awareness of cognitive deficits, are also likely to influence sense of identity. Indeed, many AD participants included such deficits in their self-descriptions. Also, although changes in identity were not simply related to global cognitive decline in AD, the impact of specific cognitive deficits may additionally affect the measurement of identity. Certainly in this study we cannot completely eliminate the possibility that changes in identity measured in the AD sample reflect, to some extent, an impairment of the cognitive processes utilised when responding to our identity tasks (even though these included both free recall and recognition measures). For example, frontal dysfunction, which can underlie impairments in fluency, generation of responses, and retrieval processes, may affect both the access and articulation of one's identity on measures such as those used in this study, yet not change an individual's subjective sense of who they are. Future research will benefit by including measures to assist the delineation of these factors, whilst the employment of longitudinal designs may be more able to determine whether the relationship between autobiographical memory and identity is indeed a causal one.

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## REFERENCES

- Anderson, S.J., & Conway, M.A. (1997). Representations of autobiographical memories. In M.A. Conway (Ed.), *Cognitive models of memory. Studies in cognition* (pp. 217–246). Cambridge, MA: MIT Press.

- Baddeley, A.D. (1992). What is autobiographical memory? In M.A. Conway, D.C. Rubin, H. Spinnler, & W.A. Wagenaar (Eds.), *Theoretical perspectives on autobiographical memory* (Vol. 65, pp. 13–29). Dordrecht, Netherlands: Kluwer.
- Barclay, C.R. (1996). Autobiographical remembering: Narrative constraints on objectified selves. In D.C. Rubin (Ed.), *Remembering our past. Studies in autobiographical memory* (pp. 94–125). Cambridge: Cambridge University Press.
- Barclay, C.R., & DeCooke, P.A. (1988). Ordinary everyday memories: Some of the things of which selves are made. In U. Neisser & E. Winograd (Eds.), *Remembering reconsidered: Ecological and traditional approaches to the study of memory* (pp. 91–125). New York: Cambridge University Press.
- Barclay, C.R., & Smith, T.S. (1993). Autobiographical remembering and self-composing. *International Journal of Personal Construct Psychology*, 6, 231–251.
- Bower, G.H., & Gilligan, S.G. (1979). Remembering information related to one's self. *Journal of Research in Personality*, 13, 420–432.
- Chandler, M.J., & Lalonde, C.E. (1995). The problem of self continuity in the context of rapid personal and cultural change. In A. Oosterwegel & R.A. Wicklung (Eds.), *The self in European and North American culture: Development and processes* (Vol. 84, pp. 45–63). Dordrecht, Netherlands: Kluwer Academic Publishers.
- Charmaz, K. (1997). Identity dilemmas of chronically ill men. In A. Strauss & J. Corbin (Eds.), *Grounded theory in practice* (pp. 35–62). Thousand Oaks, CA: Sage Publications.
- Conway, M.A., & Pleydell-Pearce, C.W. (2000). The construction of autobiographical memories in the Self-Memory System. *Psychological Review*, 107, 261–288.
- Cullum, C.M., Smernoff, E.N., & Lord, S.E. (1991). Utility and psychometric properties of the Mini Mental State Examination in healthy older adults. *Abstract in Journal of Clinical and Experimental Neuropsychology*, 13, 88–89.
- Dall'Ora, P., Della Sala, S., & Spinnler, H. (1989). Autobiographical memory. Its impairment in amnesic syndromes. *Cortex*, 25, 197–217.
- Damasio, A.R. (1999). *The feeling of what happens. Body and emotion in the making of consciousness*. New York: Harcourt Brace & Company.
- Deaux, K. (1992). Personalizing identity and socializing self. In G.M. Breakwell (Ed.), *Social psychology of identity and the self concept* (pp. 9–33). London: Surrey University Press.
- Della Sala, S., Freschi, R., Lucchelli, F., Muggia, S., & Spinnler, S. (1996). Retrograde amnesia. No past, new life. In P.W. Halligan & J.C. Marshall (Eds.), *Method in madness: Case studies in cognitive neuropsychiatry* (pp. 209–233). Hove, UK: Psychology Press.
- Dorrego, M.F., Sabe, L., Cuerva, A.G., Kuzis, G., Tiberti, C., Boller, F., & Starkstein, S.E. (1999). Remote memory in Alzheimer's disease. *Journal of Neuropsychiatry and Clinical Neurosciences*, 11, 490–497.
- Dritschel, B.H., Williams, J.M.G., Baddeley, A.D., Nimmo-Smith, I. (1992). Autobiographical fluency: A method for the study of personal memory. *Memory and Cognition*, 20, 133–140.
- Eslinger, P.J. (1998). Autobiographical memory after temporal lobe lesions. *Neurocase*, 4, 481–495.
- Fitts, W.H. (1965). *Manual for Tennessee Self Concept Scale*. Los Angeles, CA: Western Psychological Services.
- Fitts, W.H., & Warren, W.L. (1996). *Tennessee Self-Concept Scale* (2nd edn.). Los Angeles, CA: Western Psychological Services.
- Fitzgerald, J.M. (1988). Vivid memories and the reminiscence phenomenon: The role of a self-narrative. *Human Development*, 31, 261–273.
- Fitzgerald, J.M. (1996). The distribution of self-narrative memories in younger and older adults: Elaborating the Self-Narrative Hypothesis. *Aging, Neuropsychology and Cognition*, 3, 229–236.
- Fitzgerald, J.M. (1999). Autobiographical memory and social cognition. In T.M. Hess & F. Blanchart-Fields (Eds.), *Social cognition and aging* (pp. 143–171). San Diego, CA: Academic Press.
- Folstein, M.F., Folstein, S.L., & McHugh, P.R. (1975). 'Mini-Mental State', practical methods for grading the cognitive state of patients for clinicians. *Journal of Psychiatry Research*, 12, 189–198.
- Fromholt, P., & Larsen, S.F. (1991). Autobiographical memory in normal aging and primary degenerative dementia (dementia of Alzheimer type). *Journal of Gerontology: Psychological Sciences*, 46, 85–91.
- Fromholt, P., Larsen, P., & Larsen, S.F. (1995). Effects of late-onset depression and recovery on autobiographical memory. *Journal of Gerontology: Psychological Sciences*, 50, 74–81.
- Gallagher, S. (2000). Philosophical conceptions of the self: Implications for cognitive science. *Trends in Cognitive Neuroscience*, 4, 14–21.
- George, L.K. (1990). Social structure, social processes, and social psychological states. In R.H. Binstock & L.K. George (Eds.), *Handbook of aging and the social sciences* (3rd edn., pp. 186–204). San Diego, CA: Academic Press.
- Graham, K.S., & Hodges, J.R. (1997). Differentiating the roles of the hippocampal complex and the neocortex in long-term memory storage: Evidence from the study of semantic dementia and Alzheimer's disease. *Neuropsychology*, 11, 77–89.
- Greene, J.D.W., & Hodges, J.R. (1996). The fractionation of remote memory. Evidence from a longitudinal study of dementia of Alzheimer type. *Brain*, 119, 129–142.
- Greene, J.D.W., Hodges, J.R., & Baddeley, A.D. (1995). Autobiographical memory and executive function in early dementia of Alzheimer type. *Neuropsychologia*, 33, 1647–1670.
- Heidrich, S.M. (1998). Older women's lives through time. *Advances in Nursing Science*, 20, 65–75.
- Hirst, W. (1994). The remembered self in amnesics. In E. Neisser & R. Fivush (Eds.), *The remembering self: Construction and accuracy in the self narrative* (pp. 252–277). New York: Cambridge University Press.
- Holmes, A., & Conway, M.A. (1999). Generation identity and the reminiscence bump: Memory for

- public and private events. *Journal of Adult Development*, 6, 21–34.
- Howell, D.C. (1997). *Statistical methods for psychology* (4th Edn.). Belmont, CA: Duxbury Press.
- Jacomb, P.A., & Jorm, A.F. (1996). Personality change in dementia of the Alzheimer type. *International Journal of Geriatric Psychiatry*, 11, 201–207.
- Kitchener, E.G., Hodges, J.R., & McCarthy, R.A. (1998). Acquisition of post-morbid vocabulary and semantic facts in the absence of episodic memory. *Brain*, 121, 1313–1327.
- Klein, S.B., & Loftus, J. (1993). The mental representation of trait and autobiographical knowledge about the self. In T.K. Srull & R.S. Wyer (Eds.), *Advances in social cognition. The mental representation of trait and autobiographical knowledge about the self* (Vol. 5, pp. 1–49). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.
- Klein, S.B., Loftus, J., & Kihlstrom, J.F. (1996). Self-knowledge of an amnesic patient: Toward a neuropsychology of personality and social psychology. *Journal of Experimental Psychology: General*, 125, 250–260.
- Kopelman, M.D. (1989). Remote and autobiographical memory, temporal context memory and frontal atrophy in Korsakoff and Alzheimer patients. *Neuropsychologia*, 27, 431–460.
- Kopelman, M.D., Wilson, B.A., & Baddeley, A.D. (1989). The Autobiographical Memory Interview: A new assessment of autobiographical and personal semantic memory in amnesic patients. *Journal of Clinical and Experimental Neuropsychology*, 11, 724–744.
- Kopelman, M., Wilson, B., & Baddeley, A. (1990). *The Autobiographical Memory Interview*. Windsor, UK: Thames Valley Test Company.
- Kuhn, M.H., & McPartland, T.S. (1954). An empirical investigation of self-attitudes. *American Sociological Review*, 19, 68–76.
- Locke, J. (1694/1970). *An Essay Concerning Human Understanding* (2nd edn.). Yorkshire: The Scholar Press.
- Markus, H., & Nurius, P. (1986). Possible selves. *American Psychologist*, 41, 954–969.
- McAdams, D.P. (1988). *Power, intimacy, and the life story. Personalological inquiries into identity*. New York: Guilford Press.
- McKhann, G., Drachman, D., Folstein, M., Katzman, R., Price, D., & Stadlan, E.M. (1984). Clinical diagnosis of AD: Report of the NINCDS-ADRDA Work Group under the auspices of the Department of Health and Human Services Task Force on AD. *Neurology*, 34, 939–944.
- Mills, M.A. (1998). *Narrative identity and dementia: A study of autobiographical memories and emotions*. Aldershot, UK: Ashgate Publishing.
- O'Connor, M., Butters, N., Miliotis, P., Eslinger, P., & Cermak, L.S. (1992). The dissociation of anterograde and retrograde amnesia in a patient with herpes encephalitis. *Journal of Clinical and Experimental Neuropsychology*, 14, 159–178.
- Orona, C.J. (1990). Temporality and identity loss due to Alzheimer's disease. *Social Science and Medicine*, 30, 1247–1256.
- Orona, C.J. (1997). Temporality and identity loss due to Alzheimer's disease. In A. Strauss & J. Corbin (Eds.), *Grounded theory in practice* (pp. 171–196). Thousand Oaks, CA: Sage Publications.
- Parfit, D. (1984). *Reasons and person*. Oxford: Clarendon Press.
- Rhee, E., Uleman, J.S., Lee, H.K., & Roman, R.J. (1995). Spontaneous self-descriptions and ethnic identities in individualistic and collectivist cultures. *Journal of Personality and Social Psychology*, 69, 142–152.
- Robinson, J.A., & Taylor, L.R. (1998). Autobiographical memory and self-narratives: A tale of two stories. In C.P. Thompson, D.J. Herrmann, D. Bruce, J.D. Read, D.G. Payne, & M.P. Togliola (Eds.), *Autobiographical memory: Theoretical and applied perspectives* (pp. 125–143). Mahwah, NJ: Lawrence Erlbaum Associates Inc.
- Rubin, D.C., Wetzler, S.E., & Nebes, R.D. (1986). Autobiographical memory across the lifespan. In D.C. Rubin (Ed.), *Autobiographical Memory* (pp. 202–221). New York: Cambridge University Press.
- Sagar, H.J., Cohen, N.J., Sullivan, E.V., Corkin, S., & Growdon, J.H. (1988). Remote memory function in Alzheimer's disease and Parkinson's disease. *Brain*, 111, 185–206.
- Schechtman, M. (1994). The truth about memory. *Philosophical Psychology*, 7, 3–18.
- Schechtman, M. (1996). *The constitution of selves*. London: Cornell University Press.
- Shoemaker, S. (1984). Personal identity: A materialist's account. In S. Shoemaker & R. Swinburne (Eds.), *Personal identity* (pp. 67–132). Oxford: Basil Blackwell Publisher.
- Stuss, D.T., & Guzman, D.A. (1988). Severe remote memory loss with minimal anterograde amnesia: A clinical note. *Brain and Cognition*, 8, 21–30.
- Tulving, E. (1993). Self-knowledge of an amnesic is represented abstractly. In T.K. Srull, & R.S. Wyer (Eds.), *Advances in social cognition. The mental representation of trait and autobiographical knowledge about the self* (Vol. 5, pp. 147–156). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.
- Tulving, E., Scachter, D.L., McLachlan, D.R., & Moscovitch, M. (1988). Priming of semantic autobiographical knowledge: A case study of retrograde amnesia. *Brain and Cognition*, 8, 3–20.
- Turner, J.C. (1982). Towards a cognitive redefinition of the social group. In H. Tajfel (Ed.), *Social identity and intergroup relations* (pp. 15–40). Cambridge: Cambridge University Press.
- Whitbourne, S.K. (1998). Physical changes in the aging individual: Clinical implications. In I.H. Nordhus, G.R. Vandenbos, S. Berg, & P. Fromholt (Eds.), *Clinical geropsychology* (pp. 79–108). Washington, DC: American Psychological Association.