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The Influence of Normal Aging and Alzheimer's Disease in Autobiographical Memory Highly Related to the Self

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Objective: Autobiographical memory (AM) comprises autobiographical episodes (AE) and personal semantics (PS). Self-defining memories (SDMs) represent peculiar memories highly relevant to personality processes and constitute crucial source for the self. To date, no research has compared normal and pathological age-related changes in the AE and PS aspects of AM (including SDMs) and their link with the self. ***Method:*** Young adults, older adults, and patients with Alzheimer's disease (AD) were asked to retrieve 10 AEs, 10 PSs, and 10 SDMs based on identical cue-words and to complete a subjective self-concept scale measuring the degree of certainty and the valence of the self. Memory performance was evaluated for specificity and for emotional valence using quantitative scoring based on standard neuropsychological assessments. ***Results:*** Compared with young adults, older adults and AD patients demonstrated a deficit in AE; nevertheless, the three groups performed equally for PS. Remarkably, older adults did not differ from young adults for SDMs characterized by high episodicity (SDMe), unlike AD patients. Concerning the self-concept scale, the valence of the self was more positive in healthy subjects than in AD patients, the latter showing higher scores for the degree of certainty. Self-concept measures were correlated with AM scores, especially SDMe, in young and older subjects but not in AD patients. ***Conclusion:*** The implication of these findings is discussed to portray the differences between normal aging and AD concerning the link between AM and the self.

Keywords: autobiographical memory, aging, Alzheimer's disease, self-defining memories, self-concept, emotion

Autobiographical memory (AM) is a uniquely human memory system that constitutes the main content of the declarative self. It comprises autobiographical episodes (AE) and personal semantics (PS). The former refers to reexperiencing, as a mental time travel of the self (Tulving, 1985): concrete and specific items of personal information, rich in phenomenological details, that are closely related to unique events situated in a specific time and place (Piolino, Desgranges, and Eustache, 2009; Tulving, 2002). Visual mental imagery and emotional experience are critical phenomenological characteristics of AE retrieval (e.g., "the image of the sun shining down on the river when I reached the mountain summit"). The latter does not entail such reexperiencing and contains personal information, comprising general knowledge of personal facts (e.g., "My name is X," information about friends, and common locations), generalized memories of events encompassing both extended (e.g., "last summer vacation in the French Alps") and repeated (e.g., "my treks") events (Conway & Pleydell-Pearce, 2000; Humphreys, Murray, & Maguire, 2009). AE is associated with autonoetic consciousness, which gives rise to the sense of phenomenal recollection in the mental reenactment of previous personal events (Tulving, 2002; Tulving, Schacter, McLachlan, & Moscovitch, 1988), whereas PS is associated with noetic consciousness involving the awareness of general facts about personal events, accompanied by a sense of simply "knowing" without contextual details. This distinction was first proposed by Tulving and collaborators in 1988 to account for the performance of an amnesic patient (KC), who showed a sharp dissociation between preserved PS and altered AE. Neuroimaging data have confirmed the dissociation of neural substrates of AE and PS (see Martinelli, Sperduti and Piolino, in press).

Both autobiographical representations are important in grounding the self (Conway, 2005; Klein & Gangi, 2010; Tulving, 1993; Wilson & Ross, 2003). More specifically, Singer and collaborators (Singer, Rexhaj, & Baddeley, 2007; Singer & Salovey, 1993) described self-defining memories (SDMs) as a subcategory of personal memories that is "highly relevant to personality processes." SDMs exhibit features in common with AE, such as spatiotemporal specificity and phenomenological details, but they can also be more generic (summarized, describing "a series of events over several days, weeks, or months or blending repeated similar events separated in time into a single recollection" Singer et al., 2007, p. 887), sharing some features of PS. These memories help people to define clearly a self-image, explaining to others who

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they are (Blagov & Singer, 2004) and communicating about themselves to facilitate intimacy and self-knowledge (Thorne, McLean, & Lawrence, 2004).

Several authors have shown that normal aging and Alzheimer's disease (AD) affect the nature of AM by producing a shift from specific to more general AM retrieval, that is, from AE to PS (Cermak, 1984; Conway, Gardiner, Perfect, Anderson, & Cohen, 1997; Piolino et al., 2006). Aging affects particularly AE compared with PS (Piolino, Desgranges, Benali, & Eustache, 2002). In particular, older adults have difficulties in retrieving specific details, whereas they show an increase of generalized memories (Addis, Wong, & Schacter, 2008; Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002; Piolino et al., 2006; Piolino, Coste, et al., 2010; St. Jacques and Levine, 2007). In AD, one of the earliest symptoms is a deficit of anterograde episodic memory (Spaan, Raajimakers, & Jonker, 2003), followed by a retrograde impairment of AE (Donix et al., 2010; Eustache et al., 2004; Irish, Lawor, O'Mara, & Cohen, 2010, 2011; Kopelman, 1992; Meulenbroek, Rijpkema, Kessels, Olde Rikkert, & Fernándes, 2010; Piolino, Martinelli, et al., 2010). The latter is accompanied by a shift from a sense of remembering to a sense of just knowing (Piolino, Belliard, Desgranges, Perron, & Eustache, 2003). Murphy, Troyer, Levine, and Moskovitch (2008) showed that patients at preclinical stage of dementia (amnesic Mild Cognitive Impairment) are also characterized by a reduction of episodic details and an increase of generalized memories. Other studies, however, have also reported impaired PS in AD (Addis & Tippett, 2004; Graham & Hodges, 1997; Greene & Hodges, 1996; Greene, Hodges, & Baddeley, 1995; Ivanoiu, Cooper, Shanks, & Venneri, 2006; Leyhe, Müllera, Milliana, Eschweiler, & Saura, 2009). Two studies (Addis & Tippett, 2004; Kopelman, Wilson, & Baddeley, 1989) even showed a temporal gradient in the PS deficit, with a relative preservation of the most remote information. Greene et al. (1995) evaluated AM in patients with AD showing a PS deficit with no temporal gradient, whereas Ivanoiu, Cooper, Shanks, and Venneri (2004) demonstrated a deficit with a modest gradient for PS. Interestingly, in most of the studies showing a PS deficit in AD, PS was evaluated using questionnaires (e.g., the Autobiographical Memory Interview, Kopelman et al., 1989), asking patients to recall factual knowledge about their own past (such as names of acquaintances, information about school and jobs) with no reference to generalized autobiographical events, which constitute an entirely different source of PS. Moreover, these heterogeneous results could be partly attributable to the patients' different disease stages across studies.

Although the effect of normal aging and AD on AM has been extensively studied, few experiments have targeted SDMs in these populations. Singer et al. (2007), comparing SDMs in adults older than 50 to those of college students, showed that older adults' SDMs were more summarized and less detailed. In addition, they showed that the SDMs of older adults were more positive in emotional valence than those of younger adults. Nevertheless, there was no significant relationship between specificity of SDMs and valence. Another study conducted in aging (McLean, 2008) reported that SDMs in older adults had more thematic coherence and were mostly constituted by stories representing long-lasting statements, whereas the younger group recalled mostly stories about changes. The way SDM is affected in older adults and AD, compared with other forms of AM, is of considerable interest given the contribution of this type of memory to grounding and maintaining a sense of self (Conway, Singer, & Tagini, 2004).

Because AM is fundamental for a sense of self-continuity across time, deficits of this memory component should be followed by an impaired sense of self (Bluck, 2003; Conway, Meares, & Standart, 2004; Conway, Singer, et al., 2004; Klein & Gangi, 2010). However, in aging, despite AE impairment, spared PS is supposed to continue supporting the sense of self and continuity (Duval, Eustache, & Piolino, 2007; Piolino et al., 2006). On the contrary, several studies in AD have demonstrated severe AM deficits with a corresponding weakened sense of self (Addis & Tippett, 2004; Fargeau et al., 2011; Massimi et al., 2008; Orona, 1990). More specifically, Addis and Tippett (2004) reported, in AD patients, an impairment of the retrieval of AE and PS from childhood to early adulthood (autobiographical fluency for childhood events and early adulthood names) that was correlated with change in the self-concept (strength of self) as measured by the Tennessee Self-Concept Scale (TSCS, Fitts & Warren, 1996). On the other hand, Naylor and Clare (2008) failed to show a correlation between AM performances and self-concept in AD patients. Following the case of KR, who suffered from AD and presented accurate knowledge of an out-of-date version of her personality (due to an inability to update her personality traits self-knowledge), Klein, Cosmides, and Costabile (2003) proposed that the PS memory system would contain a subsystem devoted to the representations of personality traits.

To summarize, the distinction in AE and PS impairment is well documented in normal aging, whereas results are controversial in AD. Preliminary studies showed an effect of generalization of SDM in normal aging, but other studies are needed to further characterize this effect and no study to date has addressed this issue in AD.

The aim of our study was twofold: on the one hand, we aimed at investigating the effect of normal aging and AD on the retrieval of SDM compared with the retrieval of AE and PS; on the other hand, we wanted to address the link between AM impairment and the self-concept. With these aims, we asked young and older healthy subjects and AD patients to retrieve AEs, PSs and SDMs elicited by identical cue words. Moreover, we asked subjects to complete a subjective self-concept scale (TSCS). In line with Singer et al.'s (2007) findings of more summarized SDMs in normal aging, we predicted that older and AD subjects would retrieve less-detailed SDMs. Moreover, because both elderly groups normally show impaired AE, but differ in self-profile, which is spared in older adults (Duval et al., 2007) and compromised in AD (Addis & Tippett, 2004), we predicted that these memories would be differently linked to self-concept as assessed by TSCS in the two groups.

Method

Participants

Two groups of healthy subjects, 18 young adults (YA) and 16 older adults (OA) with no memory complaints, and one group of 10 patients presenting a clinical diagnosis of probable AD matched in age with the OA group participated at the study. A full description of the population is presented in Table 1. YA were under-

graduates at Paris Descartes University recruited through university advertisements; OA were autonomous and recruited through various senior associations. AD patients were recruited in Ile de France Hospitals, according to the criteria of the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (McKhann et al., 1984); they were all at a moderate level of dementia as assessed by the Mini Mental State Exam (MMSE) ($M = 18.80$, $SD = 1.81$; Folstein, Folstein, & McHugh, 1975). All the participants had more than 8 years of education. The absence of depression was screened using the Beck Depression Inventory (Beck, Steer, Bali, & Ranieri, 1996; BDI II, 21 items version; less than 14 was considered as a minimal range). Healthy older adults were also screened for dementia using the MMSE (more than 26/30) and for executive dysfunctions using the Trail Making Test (Reitan, 1958), including the measure of shifting ability. OAs had normative data according to their age group. We also verified that there were no neurological, medical or psychiatric disorders, substance abuse, or medications affecting cognition. The two older groups had a normal level of vocabulary performance according to the Mill Hill vocabulary scale (Deltour, 1993). All subjects gave their informed consent to the study, which was performed in compliance with the local ethics committee.

Autobiographical Memory Assessment

Materials and procedure. The duration of the testing ranged from 60 to 90 min for the healthy groups. Because of the longer duration of the testing and the fatigability of the AD group, the AM assessment was divided into two separate sessions, with several breaks. For all groups, the general instructions were presented to participants—these explained that participants would be required to recall personally experienced events and gave a clear definition of the three tasks (i.e., AE, PS, SDM) and the main differences between them, with several examples. Participants were asked to recall in detail personal events termed:

1. *Autobiographical episodes* (AE task): a vivid specific-event memory that occurred at a specific time and place, of short duration, lasting less than 24 hr, a single event they could relive with affective and perceptual details (e.g., my trekking day in Mont Rose when I was 16);

2. *Personal semantics* (PS task): knowledge of a repeated event that occurred several times in the past, a regular activity that used to occur at a routine time and place or a memory of an extended event that may describe a series of events over several days, weeks, or months without a precise moment in time (e.g., my weekend treks in the Alps when I was a child; my holidays in Italy 10 years ago);

3. *Self-defining memory* (SDM task): a vivid specific-event memory focused on lasting concerns or unresolved conflicts: a memory that could help to explain who one is as an individual and that one might tell someone else if one wanted that person to understand him or her in a profound way (e.g., the day when I really understood how revitalizing mountain hiking was to me).

In each assessment, we asked participants to retrieve a memory of a remote personal event (more than 5 years ago). We applied the same instructions previously used in other AM studies designed to examine the AE and PS aspects of AM based on single versus repeated/extended event retrieval (e.g., Addis, McIntosh, Moscovitch, Crawley, & McAndrews, 2004; Levine et al., 2004; Piolino, Coste et al., 2010). With regards to the instructions for the SDMs, we referred to the standard definition present in the literature (see Blagov & Singer, 2004; Singer & Salovey, 1993; Singer et al., 2007).

Subjects began the AM assessment with a training session to ensure they had fully understood the difference between each task; the time taken for each participant's training session therefore depended on how long they needed to gain a full understanding of the instructions. For the patients, the instructions and training were proposed on both sessions and could be repeated as much as they needed.

Each memory was cued by common words (e.g., family, profession, holidays, love). This procedure was preferred to free recall in order to improve comparability across the three tasks and in the

Table 1
Means and SDs of Demographics and General Neuropsychological Abilities

	YA ($n = 18$)	OA ($n = 16$)	AD patients ($n = 10$)	ANOVA/t value
Age (years)	22.16 (1.92)	75.18 (4.61)[a***]	76.30 (4.01)[a***]	$F(2, 41) = 1186{,}7^{***}$
Level of education (years)	13.61 (1.42)	13.18 (2.61)	10.30 (1.25)[a***,b**]	$F(2, 41) = 10{,}37^{***}$
Gender (male:female)	(8:10)	(6:10)	(1:9)	
Depression				
BDI (cut-off < 14/21)	2.94 (1.89)	7.18 (6.42)	8.40 (7.36)[a*]	$F(2, 41) = 3{,}68^{*}$
Semantic abilities				
Mill Hill		37.81 (3.16)	31.37 (5.78)[b*]	$t(24) = -2.09^{*}$
Executive functions				
TMTA (sec)		38.53 (9.42)	130.00 (63.82)[b***]	$t(24) = 5{,}53^{***}$
TMTB-A (sec)		56.40 (46.42)	151.00 (55.72)[b***]	$t(24) = 4.48^{***}$

Note. YA = young adult; OA = older adult; AD = Alzheimer's disease; BDI = Beck Depression Inventory; TMTA = Trail Making Test, part A; TMTB-A = Trail Making Test, part B minus part A.
[a] Scores show difference relative to the mean scores of control YAs. [b] Scores show difference in AD relative to the mean scores of control OAs.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

three groups and to facilitate memory retrieval in OA and AD patients. Generic cue words were chosen on the basis of previous works on AM assessment; such words are known to elicit memories for personal events in most subjects (Addis, Roberts, & Schacter, 2011; Piolino et al., 2002, 2006). Identical cues were presented for each task (10 AEs, 10 PSs, 10 SDMs) in white font (Courier New, 18) on a black screen. The duration of the stimulus presentation was self-paced. The word order within each task, as well as the presentation of each task between subjects, was randomly counterbalanced.

During each task, subjects were told to elaborate their memory and finally press a button to indicate that they had no more new details to add to the memory. Each memory was tape-recorded. The experimenter could press the button instead of the patient if necessary.

Scoring system of AMs. For each memory, we took into account the *structural nature* of each evocation, scoring each event on a nine-point episodic scale ranging from 0 to 8 according to uniqueness, shortness (under 24 hr), spatiotemporal situation, and the presence of specific contextual and phenomenological details. One point was given per attribute, except specific contextual details and phenomenological details, which were given 1 point or 2 points each depending on the richness of details (2 points for more than 1 detail; e.g., phenomenological details: −1 point for "My foot hurt"; −2 points for "I was cold, my foot hurt, and then I thought that everything was going to be okay"). This scale is quite similar to episodic memory scales used for normal subjects and patients in our foregoing studies (for a review, Piolino et al., 2009) and is based on previous scales (Baddeley, 1986; Kopelman et al., 1989). An additional criterion was considered for the SDM task. One point was given if the memory retrieval concerned "the kind of memory that powerfully conveys how one has come to be the person one currently is" (McLean, 2008, p. 257). This definition corresponds to memories that would help someone to explain who s/he is as an individual and that are important in shaping one's character and personality, eventually referring to how far s/he has integrated these experiences into her/his self-understanding.

Based on this scale, we calculated the percentage of AE, PS, and SDM by dividing the number of recalls for each task by the possible maximum (i.e., 10):

- for EAM, we summed the number of memories corresponding to a unique event, of short duration (lasting less than 24 h), localized in time and place, and containing a sum of at least two points for specific contextual and/or phenomenological details (minimum 6/8 points). It has been clearly established that the specificity of details is a critical property of autobiographical episodes (Conway, 2009; Levine et al., 2002; Piolino et al., 2009) (e.g., "When I was 23, I remember the first day I went to my university courses with my future boyfriend in a nearby town. We were listening to music in his car and we could see the sun rising over the mountains. I was so happy because I knew that I was going to spend at least 1 hr with him, just the two of us on the road, and we spoke about amazing things, drinking flavored tea that I was carrying in my thermos").
- for PS, we totaled the number of repetitive events (i.e., not unique but multiple) or lasting more than 24 h (i.e., not short but extended) (e.g., When I was a student, I used to go to the farm market every Saturday morning. I met my friends, and we usually had a coffee together talking about this and that).
- for SDM, we first totaled the number of memories corresponding to the definition of SDM (regardless of their score on the episodic scale), and second we calculated the number of SDMs scoring at minimum 6/8 points on the nine-point episodic scale, calling the latter "episodic SDM (SDMe) (e.g., "I can remember the day when I visited one of my friends who had just opened a little restaurant in a nice place, on a little road near a beautiful lake. We had a very pleasant dinner, and my friend often came to tell us about her joy because she had finally found a job that she loved. That day, I understood that I had to leave my job and do something that would make me happy. The week after, I quit my job and began another life").

We therefore calculated the percentage of AE, PS, SDM, and SDMe. We additionally calculated the percentage of positive memories for each assessment (i.e., AE, PS, SDM, and SDMe). A memory was considered as positive if it explicitly contained any word indicating positive feelings (e.g., "I felt good," "It was a great day," "I was so happy there," "It was one of the best experiences") compared with other memories considered as negative or neutral (McLean, 2008). The percentage of positive memories was calculated on the number of correct memories recalled in each category.

Two experts (one was blind to the hypotheses) rated each memory, and the interrater reliability was tested using Cohen's Kappa (κ) (Brennan & Prediger, 1981) on the scoring of memories in each condition. The results indicated adequate interrater agreement (EAM: $\kappa = .80$; PS: $\kappa = .91$; SDMs: $\kappa = .80$). In case of divergence between experts or scoring difficulty, the rating was discussed until a consensus was reached.

Subjective Self-Concept Assessment

At the end of the AM assessment, each subject fulfilled the Tennessee Self-Concept Scale (TSCS, Fitts & Warren, 1996: translated into French and validated in aging by Duval et al., 2007). This scale assesses the multidimensionality of the self over six domains (family, personal, social, moral, physical, academic) and contains 82 descriptive statements (e.g., "I am an honest person") that have to be rated on a 5-point scale (*always false, mostly false, partly false/partly true, mostly true, always true*) according to how well they match the participant's personality. To facilitate the use of this scale for AD patients, we modified its administration so that each item was read aloud by the examiner and patients indicated their responses on the scale printed on a separate sheet. Task instructions were repeated when necessary. We checked for the validity of responses based on the response incoherence score (discrepancy between responses to pairs of items with similar content) for each subject.

Two scores were computed: (1) the *degree of certainty* (for a comparable method, see Addis & Tippett, 2004; Naylor & Clare, 2008) was measured through the amount of responses rated 1 (*always false*) or 5 (*always true*) and reflected "the degree of certainty about the way one sees oneself, thus reflecting the extent to which a definite sense of identity is expressed" (Naylor & Clare, 2008, p. 595); and (2) we computed the total score of the TSCS, which reflects the global *valence of the self* (i.e., direction of the

self, Addis & Tippett, 2004) and adds up the separate TSCS scores of identity, satisfaction, and behavior. High scores indicate a positive self-concept.

Statistical Analysis

Because significant differences have been revealed between groups concerning education level and depression as assessed by the BDI (see Table 1), both characteristics were entered as covariates in all subsequent analyses.

We first carried out a series of analysis of covariance (ANCOVA) with Group (YA, OA, AD) as a between-subjects factor and Task (AE, PS, SDM) as a within-subjects factor on AM measures (*percentage of recall*). Two separate analyses were performed: one using the percentage of SDM, and the other, the percentage of SDMe. We additionally performed two one-way ANCOVAs (YA, OA, AD) on the measures of the TSCS (*degree of certainty* and *valence of the self*). To determine the direction of all differences, we carried out post hoc Tukey's tests. Effect sizes were represented with partial eta squared (η^2). In agreement with Guéguen (2009), we considered effect sizes as small for $\eta^2 < .06$, medium for $.06 \leq \eta^2 < .14$, and marked for $\eta^2 \geq .14$.

We then carried out, separately for each group, partial Bravais-Pearson correlations, controlling for education level and BDI scores, between measures of AM and the two scores computed for the TSCS (*degree of certainty* and *valence of the self*) to investigate the relationship between different forms of AM and self-concept (Addis & Tippett, 2004; Naylor & Clare, 2008).We were specifically interested in the links between positive AMs (AE, PS, SDM, and SDMe) and positive self-concept. An α of 0.05 was used for all statistical tests, but statistical threshold was also indicated using Bonferroni correction.

Results

Three Types of AMs for Groups

Results are presented for the percentage of recall on each task (Figure 1), as well as for percentage of positive memories (Figure 2).

The comparison of the percentage of AE, PS, and SDM indicated a significant main effect of group on the number of recall, $F(2, 39) = 14.43$, $p < .001$, $\eta_p^2 = .42$. Both the YA ($p < .001$) and OA ($p < .01$) groups performed better than AD; in turn YA performed better than OA ($p < .05$). The main effect of task, $F(2, 39) = 1.16$, $p = .31$, $\eta_p^2 = .02$, was not significant. The significant interaction between the two factors, $F(4, 78) = 11.15$, $p < .001$, $\eta_p^2 = .36$, was driven, as revealed by post hoc Tukey's tests, by a decreased performance in AD patients for the recall of AE compared with the YA and OA groups (both, $p < .001$), while, the OA group performed worse than the YA group for the AE ($p < .001$) (Figure 1). Moreover, the YA group showed no difference on the percentage of memories between the three tasks, whereas the OA and AD groups recalled less AE than PS and SDM ($p < .01$ and $p < .001$). In addition, the AD group recalled less SDM than PS ($p < .05$).

The same analysis carried out using the percentage of SDMe indicated a significant main effect of group on the number of recall, $F(2, 39) = 27.90$, $p < .001$, $\eta_p^2 = .59$. Both the AD ($p < .001$) and OA ($p < .01$) groups performed worse than YA. Additionally, the OA group was found to be less deficient than AD patients ($p < .001$). The main effect of task, $F(2, 39) = 2.29$, $p = .11$, $\eta_p^2 = .05$, was not significant. The significant interaction between the two factors, $F(4, 78) = 6.99$, $p < .001$, $\eta_p^2 = .26$, was driven, as revealed by post hoc *t* tests, by a decreased performance of AD patients for the recall of AE and SDMe ($p < .001$) compared with OA and YA; the OA group in turn performed worse than YA group only for the AE ($p < .01$) (Figure 1). Moreover, the YA group showed less SDMe than AE and PS ($p < .001$). The OA and AD groups recalled less AE than PS and SDMe ($p < .001$ and $p < .05$). In addition, they recalled less SDMe than PS ($p < .001$).

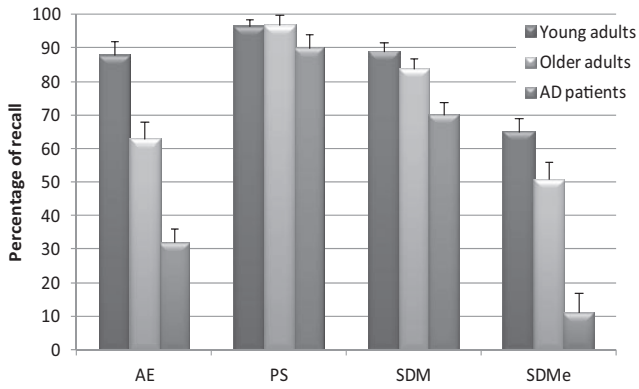

Figure 1. Percentage of recall (mean and error-type) for autobiographical episodes (AE), personal semantic (PS), self-defining memories (SDM), and episodic SDM (SDMe) in young adults, older adults, and AD patients.

The ANCOVA on the percentage of positive AMs yielded no main effect of group, $F(2, 39) = 2.73$, $p = .08$, $\eta^2 = .12$, or task, $F(2, 39) < 1$, but a marked significant interaction, $F(4, 78) = 3.47$; $p < .01$; $\eta^2 = .16$. The post hoc decomposition revealed that the percentage of positive PS was higher in the OA and AD groups compared with the YA group ($p < .01$), whereas it did not differ between the two older groups (Figure 2). Moreover, the YA group showed no difference on the percentage of positive memories between the three tasks, whereas the OA and AD groups recalled more positive PS than other positive memories (SDM, $p < .001$, for AO; AE, $p < .01$, for AD).

The same analysis, using the percentage of SDMe, yielded no main effect of group, $F(2, 39) = 1.34$, $p = .27$, $\eta^2 = .06$, or task, $F(2, 39) < 1$, but a marked significant interaction, $F(4, 78) = 5.70$; $p < .001$; $\eta^2 = .23$. The post hoc decomposition confirmed that the percentage of positive PS was higher in the OA and AD groups compared with the YA ($p < .05$), whereas it did not differ between the two older groups (Figure 2). Moreover, the YA group showed no difference on the percentage of positive memories between the three tasks, whereas the OA and AD groups recalled more positive PS than other positive memories (SDMe, $p < .001$, for AO; AE and SDMe, $p < .01$ and $p < .001$, for AD).

Subjective Self-Concept for Groups

Because results did not show significant pathological scores on the consistence of responses of AD, all the questionnaires could be

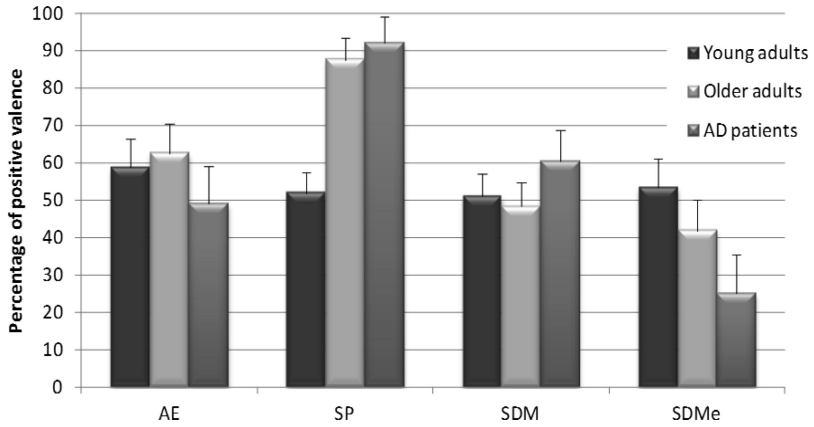

Figure 2. Percentage of positive memories (mean and error-type) for autobiographical episodes (AE), personal semantic (PS), self-defining memories (SDM), and episodic SDM (SDMe) in young adults, older adults, and AD patients.

reliably analyzed. Two separate ANCOVAs, with Group (YA, OA, AD) as between-subjects factor were carried out on the *degree of certainty* and *valence of the self*- scores. Figure 3 illustrates the two scores of the TSCS for the three groups. A significant effect of group, $F(2, 39) = 11.83$, $p < .001$; $\eta^2 = .41$, was found for the *degree of certainty*, with AD patients having a higher score than YA ($p < .001$) and OA ($p < .05$), and with OA having a higher score compared with YA ($p < .01$). We also found a marked effect of group, $F(2, 39) = 17.88$, $p < .01$; $\eta^2 = .51$, for the *valence of the self*, with OA having a higher score than the YA ($p < .05$) and AD patients ($p < .001$), and with the YA having a higher score than the AD patients ($p < .001$).

Correlation Between AMs and Subjective Self-Concept

The partial correlation (controlled for depression score and education level), between the *degree of certainty* and the *valence of the self*- scores of the TSCS and the percentage of positive memories for each measure of the AM assessments (AE, PS, SDM, SDMe) was calculated for each group separately (see Table 2).

For YA, there was a positive high partial correlation between the *valence of the self* and positive SDMe and between the *degree of certainty* and positive SDMe (rs = .60 and .61, $p < .01$). For OA, there were positive high partial correlations between the *valence of the self* and positive PS, SDM and SDMe (rs = .71 to .94, ps < .01 to .001). There was no significant correlation between the measures of AM and the *degree of certainty*. For the AD group, we did not find any significant partial correlations between AM measures and the two scores of the TSCS. Moreover, no significant correlation emerged between the MMSE and AE ($r = -.08$, $p = .832$), PS ($r = -.43$, $p = .213$), SDM (rs = $-.49$, $p = .147$), SDMe (rs = .21, $p = .548$), *degree of certainty* ($r = -.01$, $p = .965$) and *valence of the self* (r = .01, $p = .972$) of the self.

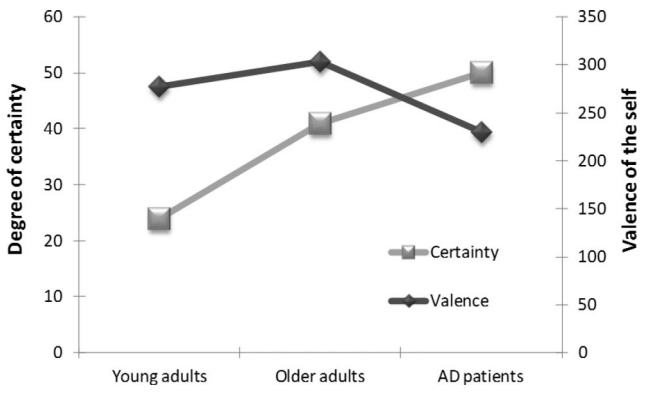

Figure 3. Degree of certainty and valence of the self on the Tennessee Self-Concept Scale for young adults, older adults, and AD patients.

Discussion

The main objective of this study was to examine the effects of normal aging and AD on the retrieval of SDMs compared with standard assessment of AE and PS and the link between this kind of memories and the self-concept.

SDMs Retrieval in Aging and AD

Our first hypothesis, in line with the findings of Singer et al. (2007), was that older adults and AD adults would have difficulty in retrieving detailed SDMs. Our results confirmed this expectation in AD patients only. Interestingly, OA showed spared SDMs retrieval, even characterized by high episodicity (SDMe), despite their deterioration of AE. Our findings also confirmed that SDMs mainly consist of rich episodic memories (e.g., uniqueness, shortness, and specific details called SDMe in the present study) in young adults (about 65% SDMe over SDMs) and to a lesser extent in older ones, as only 51% of SDMs were SDMe. These results are only partly in line with "the older adults' generalizing tendency" reported for SDMs by Singer et al. (2007), because this difference in our study was not significant.

Compared with AE, the preservation of SDMs characterized by high episodicity might indicate that older people can retrieve episodic memories better, as young adults do, when they are highly self-relevant (Conway, 2005; Duval et al., 2007; Singer et al., 2007). Indeed, episodic details are considered to be more difficult

Table 2
Partial Correlations (Controlling for Depression and Education Level) Between Each Group's Scores on the Self-Concept Scale and Positive AMs

	YA ($n = 18$)		OA ($n = 16$)		AD ($n = 10$)[a]	
Self	Certainty	Valence	Certainty	Valence	Certainty	Valence
AM						
AE	$.30^{p = .226}$	$.30^{p = .226}$	$-.49^{p = .054}$	$.37^{p = .158}$	$-.05^{p = .891}$	$.03^{p = .934}$
PS	***.56*$^{p = .015}$**	***.53*$^{p = .023}$**	$.47^{p = .066}$	***.94*$^{p = .000}$**	$-.51^{p = .132}$	$.16^{p = .659}$
SDM	$.39^{p = .109}$	$.34^{p = .167}$	$-.11^{p = .685}$	***.71*$^{p = .001}$**	$-.15^{p = .679}$	$-.16^{p = .659}$
SDMe	**$.60^{p = .008}$**	**$.61^{p = .007}$**	$.06^{p = .825}$	***.90*$^{p = .000}$**	$.42^{p = .226}$	$-.42^{p = .226}$

Note. Partial correlations in bold are significant ($p < .05$), partial correlations in italic remain significant after applying Bonferoni correction for multiple comparisons ($p < .05/24$: $p < .002$). AM = autobiographical memory; YA = young adult; OA = older adult; AD = Alzheimer's disease; AE = autobiographical episode; PS = personal semantics; SDM = self-defining memories; SDMe = SDM characterized by high episodicity.
[a] For AD, the partial correlations did not change after additional control of the Mini Mental State Exam.

to retrieve than PS elements in the hierarchical retrieval model of AM, because higher levels of self-knowledge give access to lower levels of event-specific sensory-perceptual episodic information (see also Conway & Pleydell-Pearce, 2000). Moreover, reaching episodicity can be challenging for OA because of age-related changes in prefrontal functions (Levine et al., 2004; Piolino, Coste, et al., 2010) that may impair searching operations, and as a result, stop the retrieval process at the level of nonspecific representations. Despite episodic deficits in normal aging (Levine et al., 2002; Piolino et al., 2006), our results concerning SDMe demonstrated that some episodic memories can persist. Probably, SDMe comprises characteristics (e.g., high level of rehearsal and of self-relevance, connection to other similar thematic memories, centrality to enduring goals of the self) that may enable OA to go beyond their difficulties to reach episodicity.

Our results in AD patients demonstrated that these mechanisms are not operational in patients because they tend to report less SDMes than healthy controls (11% over SDMs compared with 51% in elderly). These results remarkably illustrate that AMs highly relevant to personality processes and that constitute a key material for the sense of self are diminished in early to moderate stages of AD. They confirm previous evidence showing a weakened sense of self in AD (Addis & Tippett, 2004; Fargeau et al., 2011; Massimi et al., 2008; Orona, 1990) and extend it to SDMs. Our results also extend the impairment of AE in AD to the SDMe. This might be partly explained by the more accentuated impairment of AE in AD patients compared with healthy older adults (Donix et al., 2010; Eustache et al., 2004; Irish et al., 2010, 2011; Piolino et al., 2003; Piolino, Martinelli, et al., 2010). We can also hypothesize that contrarily to older adults, AD patients cannot rely on the connection with the self to reach episodicity when trying to recall SDMe (see below). In addition, we found a preservation of PS, unlike some studies demonstrating an impairment of PS in AD (Addis & Tippett, 2004; Graham & Hodges, 1997; Greene et al., 1995; Ivanoiu et al., 2006; Leyhe et al., 2009). It is important to note that in the present study, PS was assessed by the recall of generalized autobiographical events and not by the factual knowledge about personal past and is in line with AD's generalizing tendency reported for retrieval of specific events (AE and SDM) (e.g., 89% of SDMs were generic memories).

Emotional Valence of Autobiographical Memory and Self-Concept in Aging and AD

In order to further characterize the relationships between AM and the self, we investigated the correlation between our AM measures (AE, PS, SDM, SDMe), their positive valence and the self-concept (i.e., *valence of the self* and *degree of certainty*). In OA and AD patients, PSs were more positive compared with younger adults and compared with other types of AMs. We observed a higher *valence of the self* in the elderly compared with younger adults and even more compared with AD, whereas the *degree of certainty* was higher in AD compared with healthy adults (AD > OA > YA).

The existence of a greater proportion of positive PS in OA and AD compared with YA can be interpreted as a positivity bias. The existence of a positivity bias—older people would be more likely to retrieve positive memories than young people—is largely debated in the context of episodic memory using laboratory material (for a review, see Fernandes, Ross, Wiegand, & Schryer, 2008) and AM studies (Berntsen & Rubin, 2002; Comblain, D'Argembeau, & Van Der Linden, 2005; Kennedy, Mather, & Carstensen, 2004). A bias favoring positive laboratory material has also been demonstrated in AD patients (Werheid, McDonald, Simmons-Stern, Ally, & Budson, 2011). No study to date has investigated the existence of this bias taking into account the distinction between PS and AE in AM. Regarding SDMs or SDMe, we did not find a positivity bias effect in older adults or AD patients. The study of Singer et al. (2007) showed that the SDMs of older adults were more positive than those of younger adults (in emotional subjective ratings), but there was no significant relationship between specificity of SDMs and their positive valence, as observed in the present study. Overall, we confirm a positivity bias effect in aging and AD. Nevertheless, we were able to precise that this effect, in normal aging and AD, concerns essentially the semantic component of AM (generalized personal memories, PS). However, further studies are necessary to test whether this positivity effect is due to an increase of positive memories per se or a decrease in the access to negative memories (Holland & Kensinger, 2010).

Moreover, regardless the age of healthy participants, the *valence of the self* was positively highly correlated ($p < .01$) with positive AMs (PSs, SDMs, and SDMes in OA and principally SDMes in

YA). In young adults, the *degree of certainty* was also highly positively linked to positive SDMes. On the one hand, these findings nicely illustrate the links between AMs and self-concept and validate the definition of SDM, emphasizing its central connection with the self, especially as regards positive SDMe. We extended Klein & Gangi's (2010) suggestion of AE and PS as a potential source for identity to the case of SDMes. On the other hand, they suggest that in older subjects a positive self-concept is also highly connected to personal semantic aspects of AM, which in turn are generally positively reported (see above). This may represent a strategy based on the self favoring a positive sense of self in aging (Conway, Meares, et al., 2004; Conway, Singer, et al., 2004; Wood & Conway, 2006; see also Mather & Carstensen, 2005).

By contrast, in AD we did not find any significant correlation between AM and the two measures of the self-concept (*degree of certainty* and *valence of the self*) in line with Naylor and Clare (2008). This finding in AD supports the idea that self-concept can be considered as partially independent from PS and AE, as reviewed in pathological cases (Klein & Gangi, 2010). We also found higher definite sense of self (*degree of certainty* score) in AD compared with healthy aged adults as previously reported by Naylor and Clare (2008). More precisely, in their study, reduced awareness of memory functioning in AD was associated with a more positive and definite sense of self and poor AM. Thus, we can argue that a more definite sense of self indicated here a less nuanced and a more fossilized self-concept, as has been shown in acquired or developmental amnesic pathology (Klein & Gangi, 2010; Picard et al., in press). We furthermore observed a lower positive sense of self in AD (independently of the score of depression) in keeping with Addis and Tippett's (2004) results. These authors proposed that it might be the consequence of the integration, into the sense of self, of changes and impairments experienced during the illness. We can suppose that in cases of massive anterograde deficits, AM impact on the updating process of the self-concept could be implicit, as suggested by Klein and Gangi (2010).

Limits and Conclusion

Further studies could be undertaken to confirm and extend the present findings, in particular using free recall (instead of cue words) and additional standard coding in order to be closer to the original procedure of SDMs (Blagov & Singer, 2004; Thorne et al., 2004). Moreover, future studies in AD patients are required to examine in more details the links between AE, PS, SDM, and self, taking into account the heterogeneity of mnemonic anosognosia (Agnew & Morris, 1998). Finally, continuing this line of research seems to be valuable as regards memory training in normal aging or remediation in dementia patients (Alea, Vick, & Hyatt, 2010; Piolino, 2008; Serrano, Latorre, Gatz, & Montanes, 2004) through suggestion-employing methods relying on self-meaning and self-relevance and focusing on positive memories to enhance positive sense of self. Indeed, as reported by Jetten, Haslam, Pugliese, Tonks, and Haslam (2010), comparing healthy elderly subjects and patients suffering from dementia, loss of AM when associated with a disturbed sense of the self compromised well-being (see also Addis & Tippett, 2004; Cohen-Mansfield, Golander, & Arnheim, 2000; Fargeau et al., 2011).

In conclusion, the present study provides evidence that despite episodic memory deficits in normal aging, SDMs, even those characterized by high episodicity, are preserved. This is not true for AD patients. Moreover, the preservation of PSs and SDMs enables older healthy people to maintain a positive sense of self. By contrast, we reported impaired AM and self-concept in AD patients. These findings favor the development of cognitive remediation instruments based on the use of multifaceted forms of AM to protect the sense of self against the threats resulting from the onset and progression of AD.

References

Addis, D. R., McIntosh, A. R., Moscovitch, M., Crawley, A. P., & McAndrews, M. P. (2004). Characterizing spatial and temporal features of autobiographical memory retrieval networks: A partial least squares approach. *NeuroImage, 23,* 1460–1471. doi:10.1016/j.neuroimage.2004.08.007

Addis, D. R., Roberts, R. P., & Schacter, D. L. (2011). Age-related neural changes in autobiographical remembering and imagining. *Neuropsychologia, 49,* 3656–3669. doi:10.1016/j.neuropsychologia.2011.09.021

Addis, D. R., & Tippett, L. J. (2004). Memory of myself: Autobiographical memory and identity in Alzheimer's disease. *Memory, 12,* 56–74. doi:10.1080/09658210244000423

Addis, D. R., Wong, A. T., & Schacter, D. L. (2008). Age-related changes in the episodic simulation of future events. *Psychological Science, 19,* 33–41. doi:10.1111/j.1467-9280.2008.02043.x

Agnew, S. K., & Morris, R. G. (1998). The heterogeneity of anosognosia for memory impairment in Alzheimer's disease: A review of the literature and a proposed model. *Aging & Mental Health, 2,* 7–19. doi:10.1080/13607869856876

Alea, N., Vick, S. C., & Hyatt, A. M. (2010). The content of older adults' autobiographical memories predicts the beneficial outcomes of reminiscence group participation. *Journal of Adult Development, 17,* 135–145. doi:10.1007/s10804-009-9079-6

Baddeley, A. D. (1986). *Working memory*. Oxford, UK: Oxford University Press.

Beck, A. T., Steer, R. A., Ball, R., & Ranieri, W. (1996). Comparison of Beck Depression Inventories -IA and -II in psychiatric outpatients. *Journal of Personality Assessment, 67,* 588–597. doi:10.1207/s15327752jpa6703_13

Berntsen, D., & Rubin, D. C. (2002). Emotionally charged autobiographical memories across the life span: The recall of happy, sad, traumatic, and involuntary memories. *Psychology and Aging, 17,* 636–652. doi:10.1037/0882-7974.17.4.636

Blagov, P. S., & Singer, J. A. (2004). Four dimensions of self-defining memories (content, specificity, meaning, affect) and their relationship to self-restraint, distress, and defensiveness. *Journal of Personality, 72,* 481–511. doi:10.1111/j.0022-3506.2004.00270.x

Bluck, S. (2003). Autobiographical memory: Exploring its functions in everyday life. *Memory, 11,* 113–123. doi:10.1080/741938206

Brennan, R. L., & Prediger, D. J. (1981). Coefficient kappa: Some uses, misuses, and alternatives. *Educational and Psychological Measurement, 41,* 687–699. doi:10.1177/001316448104100307

Cermak, L. S. (1984). The episodic-semantic distinction in amnesia. In L. R. Squire and N. Butters (Eds.), *Neuropsychology of memory* (pp. 55–62). New York: Guilford Press.

Cohen-Mansfield, J., Golander, H., & Arnheim, G. (2000). Self-identity in older persons suffering from dementia: Preliminary results. *Social Science & Medicine, 51,* 381–394. doi:10.1016/S0277-9536(99)00471-2

Comblain, C., D'Argembeau, A., & Van Der Linden, M. (2005). Phenomenal characteristics of autobiographical memories for emotional and neutral events in older and younger adults. *Experimental Aging Research, 31,* 173–189. doi:10.1080/03610730590915010

Conway, M. A. (2005). Memory and the self. *Journal of Memory and Language, 53,* 594–628. doi:10.1016/j.jml.2005.08.005

Conway, M. A. (2009). Episodic memories. *Neuropsychologia, 47,* 2305–2313. doi:10.1016/j.neuropsychologia.2009.02.003

Conway, M. A., Gardiner, J. M., Perfect, T. J., Anderson, S. J., & Cohen, G. M. (1997). Changes in memory awareness during learning: The acquisition of knowledge by psychology undergraduates. *Journal of Experimental Psychology: General, 126,* 393–413. doi:10.1037/0096-3445.126.4.393

Conway, M. A., Meares, K., & Standart, S. (2004). Images & goals. *Memory, 12,* 525–531. doi:10.1080/09658210444000151

Conway, M. A., & Pleydell-Pearce, C. W. (2000). The construction of autobiographical memories in the self-memory system. *Psychological Review, 107,* 261–288. doi:10.1037/0033-295X.107.2.261

Conway, M. A., Singer, J. A., & Tagini, A. (2004). The self and autobiographical memory: Correspondence and coherence. *Social Cognition, 22,* 491–529. doi:10.1521/soco.22.5.491.50768

Deltour, J. J. (1993). Echelle de vocabulaire de Mill Hill de J. C. Raven. Adaptation française et normes comparées du Mill Hill et du Standard progressive matrices (PM 38) Manuel. Braine-le-Château, France: L'application des Techniques Modernes.

Donix, M., Brons, C., Jurjanz, L., Poettrich, K., Winiecki, P., & Holthoff, V. A. (2010). Overgenerality of autobiographical memory in people with amnestic mild cognitive impairment and early Alzheimer's disease. *Archives of Clinical Neuropsychology, 25,* 22–27. doi:10.1093/arclin/acp098

Duval, C., Eustache, F., & Piolino, P. (2007). Multidimensional self, autobiographical memory and aging. *Psychologie & Neuropsychiatrie du Vieillissement, 5,* 179–192.

Eustache, F., Piolino, P., Giffard, B., Viader, F., de la Sayette, V., Baron, J. C., & Desgranges, B. (2004). "In the course of time": A PET study of the cerebral substrates of autobiographical amnesia in Alzheimer's disease. *Brain, 127,* 1549–1560. doi:10.1093/brain/awh166

Fargeau, M. N., Jaafari, N., Ragot, S., Houeto, J. L., Pluchon, C., & Gil, R. (2010). Alzheimer's disease and impairment of the self. *Consciousness and Cognition, 19,* 969–976. doi:10.1016/j.concog.2010.06.014

Fernandes, M., Ross, M., Wiegand, M., & Schryer, E. (2008). Are the memories of older adults positively biased? *Psychology and Aging, 23,* 297–306. doi:10.1037/0882-7974.23.2.297

Fitts, W., & Warren, W. (1996). *Tennessee self-concept scale manual* (2nd ed.). Los Angeles, CA: Western Psychological Services.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12,* 189–198. doi:10.1016/0022-3956(75)90026-6

Graham, K. S., & Hodges, J. R. (1997). Differentiating the roles of 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. doi:10.1037/0894-4105.11.1.77

Greene, J. D. W., & Hodges, J. R. (1996). Identification of famous faces and names in early Alzheimer's disease: Relationship to anterograde episodic and semantic memory. *Brain, 119,* 111–128. doi:10.1093/brain/119.1.111

Greene, J. D. W., Hodges, J. R., & Baddeley, A. D. (1995). Autobiographical memory and executive function in early Alzheimer type. *Neuropsychologia, 33,* 1647–1670. doi:10.1016/0028-3932(95)00046-1

Guéguen, N. (2009). L'importance d'un effet: Méthodologie simple de détermination et d'évaluation de l' « effect size ». *European Journal of Scientific Research, 38,* 20–25.

Holland, A. C., & Kensinger, E. A. (2010). Emotion and autobiographical memory. *Physics of Life Review, 7,* 88–131. doi:10.1016/j.plrev.2010.01.006

Humphreys, M., Murray, K. L., & Maguire, A. M. (2009). Context and control operations used in accessing list-specific, generalized, and semantic memories. *Cognitive Psychology, 58,* 311–337. doi:10.1016/j.cogpsych.2008.10.001

Irish, M., Hornberger, M., Lah, S., Miller, L., Pengas, G., Nestor, P. J., . . . Piguet, O. (2011). Profiles of recent autobiographical memory retrieval in semantic dementia behavioural-variant frontotemporal dementia, and Alzheimer's disease. *Neuropsychologia, 49,* 2694–2702. doi:10.1016/j.neuropsychologia.2011.05.017

Irish, M., Lawor, B. A., O'Mara, S. M., & Coen, R. F. (2010). Impaired capacity for autonoetic reliving during autobiographical event recall in mild Alzheimer's disease. *Cortex, 47,* 236–249. doi:10.1016/j.cortex.2010.01.002

Ivanoiu, A., Cooper, J. M., Shanks, M. F., & Venneri, A. (2004). Retrieval of episodic and semantic autobiographical memories in early Alzheimer's disease and semantic dementia. *Cortex, 40,* 173–5. doi:10.1016/S0010-9452(08)70939-0

Ivanoiu, A., Cooper, J. M., Shanks, M. F., & Venneri, A. (2006). Patterns of impairement in autobiographical memory in the degenerative dementias constrain models of memory. *Neuropsychologia, 44,* 1936–1955. doi:10.1016/j.neuropsychologia.2006.01.030

Jetten, J., Haslam, C., Pugliese, C., Tonks, J., & Haslam, S. A. (2010). Declining autobiographical memory and the loss of identity: Effects on well-being. *Journal of Clinical and Experimental Neuropsychology, 32,* 408–416. doi:10.1080/13803390903140603

Kennedy, Q., Mather, M., & Carstensen, L. L. (2004). The role of motivation in the age-related positivity effect in autobiographical memory. *Psychological Science, 15,* 208–214. doi:10.1111/j.0956-7976.2004.01503011.x

Klein, S. B., Cosmides, L., & Costabile, K. (2003). Preserved knowledge of self in a case of Alzheimer's dementia. *Social Cognition, 21,* 157–165. doi:10.1521/soco.21.2.157.21317

Klein, S. B., & Gangi, C. E. (2010). The multiplicity of self: Neuropsychological evidence and its implications for the self as a construct in psychological research. *Annals of the New York Academy of Sciences, 1191,* 1–15. doi:10.1111/j.1749-6632.2010.05441.x

Kopelman, M. D. (1992). Storage, forgetting, and retrieval in the anterograde and retrograde amnesia of Alzheimer dementia. In L. Backman (Ed.), *Memory functioning in dementia* (pp. 45–71). Amsterdam: Elsevier Science Publishers.

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. doi:10.1080/01688638908400928

Levine, B., Svoboda, E., Hay, J. F., Winocur, G., & Moscovitch, M. (2002). Aging and autobiographical memory: Dissociating episodic from semantic retrieval. *Psychology and Aging, 17,* 677–689. doi:10.1037/0882-7974.17.4.677

Levine, B., Turner, G. R., Tisserand, D., Hevenor, S. J., Graham, S. J., & McIntosh, A. R. (2004). The functional neuroanatomy of episodic and semantic autobiographical remembering: A prospective functional MRI study. *Journal of Cognitive Neuroscience, 16,* 1633–1646. doi:10.1162/0898929042568587

Leyhe, T., Müllera, S., Miliana, M., Eschweiler, G. W., & Saura, R. (2009). Impairment of episodic and semantic autobiographical memory in patients with mild cognitive impairment and early Alzheimer's disease. *Neuropsychologia, 47,* 2464–2469. doi:10.1016/j.neuropsychologia.2009.04.018

Martinelli, P., Sperduti, M., & Piolino, P. (in press). Neural substrates of the self-memory system: New insights from a meta-analysis. *Human Brain Mapping*. Advance online publication. doi:10.1002/hbm.22008

Massimi, M., Berry, E., Browne, G., Smyth, G., Watson, P., & Baecker, R. M. (2008). An exploratory case study of the impact of ambient biographical displays on identity in a patient with Alzheimer's disease.

Neuropsychological Rehabilitation, 18, 742–765. doi:10.1080/09602010802130924

Mather, M., & Carstensen, L. L. (2005). Aging and motivated cognition: The positivity effect in attention and memory. *Trends in Cognitive Sciences, 9,* 496–502. doi:10.1016/j.tics.2005.08.005

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 Department of Health and Human Services Task Force on AD. *Neurology, 34,* 939–944. doi:10.1212/WNL.34.7.939

McLean, K. C. (2008). Stories of the young and the old: Personal continuity and narrative identity. *Developmental Psychology, 44,* 254–264. doi:10.1037/0012-1649.44.1.254

Meulenbroek, O., Rijpkema, M., Kessels, R. P. C., Olde Rikkert, M. G. M., & Fernández, G. (2010). Autobiographical memory retrieval in patients with Alzheimer's disease. *NeuroImage, 53,* 331–340. doi:10.1016/j.neuroimage.2010.05.082

Murphy, K. J., Troyer, A. K., Levine, B., & Moscovitch, M. (2008). Episodic, but not semantic, autobiographical memory is reduced in amnestic mild cognitive impairment. *Neuropsychologia, 46,* 3116–3123. doi:10.1016/j.neuropsychologia.2008.07.004

Naylor, E., & Clare, L. (2008). Awareness of memory functioning autobiographical memory and identity in early-stage dementia. *Neuropsychological Rehabilitation, 18,* 590–606. doi:10.1080/09602010701608681

Orona, C. J. (1990). Temporality and identity loss due to Alzheimer's disease. *Social Science & Medicine, 30,* 1247–1256. doi:10.1016/0277-9536(90)90265-T

Picard, L., Mayor-Dubois, C., Maeder, P., Kalenzaga, S., Abram, M., Duval, C., . . . Piolino, P. (in press). Functional independence within the Self-Memory System: New insights from two cases of developmental amnesia. *Cortex*.

Piolino, P. (2008). In search of the self: Theory and practice of autobiographical memory in Alzheimer's disease. *Encéphale, 34,* S77–S88. doi:10.1016/S0013-7006(08)73285-8

Piolino, P., Belliard, S., Desgranges, B., Perron, M., & Eustache, F. (2003). Autobiographical memory and autonoetic consciousness in a case of semantic dementia. *Cognitive Neuropsychology, 20,* 619–639. doi:10.1080/02643290242000899

Piolino, P., Coste, C., Martinelli, P., Macé, A., Quinette, P., Guillery-Girard, B., & Belleville, S. (2010). Reduced specificity of autobiographical memory and aging: Do the executive and feature binding functions of working memory have a role? *Neuropsychologia, 48,* 429–440. doi:10.1016/j.neuropsychologia.2009.09.035

Piolino, P., Desgranges, B., Benali, K., & Eustache, F. (2002). Episodic and semantic remote autobiographical memory in ageing. *Memory, 10,* 239–257. doi:10.1080/09658210143000353

Piolino, P., Desgranges, B., Clarys, D., Guillery-Girard, B., Tacconat, L., & Isingrini, M. (2006). Autobiographical memory, autonoetic consciousness, and self-perspective in ageing. *Psychology and Aging, 21,* 510–525. doi:10.1037/0882-7974.21.3.510

Piolino, P., Desgranges, B., & Eustache, F. (2009). Episodic autobiographical memories over the course of time: Cognitive, neuropsychological and neuroimaging findings. *Neuropsychologia, 47,* 2314–2329. doi:10.1016/j.neuropsychologia.2009.01.020

Piolino, P., Martinelli, P., Viard, A., Noulhiane, M., Desgranges, B., Eustache, F. (2010). [Physiopathology of autobiographical memory in aging: Episodic and semantic distinction, clinical findings and neuroimaging studies]. *Biologie Aujourd'hui, 204,* 159–179. doi:10.1051/jbio/2010011

Reitan, R. (1958). Validity of the Trail Making Test as an indication of organic brain damage. *Perceptual and Motor Skills, 8,* 271–276.

Serrano, J. P., Latorre, J. M., Gatz, M., & Montanes, J. (2004). Life review therapy using autobiographical retrieval practice for older adults with depressive symptomology. *Psychology and Aging, 19,* 272–277. doi:10.1037/0882-7974.19.2.272

Singer, J., Rexhaj, B., & Baddeley, J. (2007). Older, wiser, and happier? Comparing older adults' and college students' self-defining memories. *Memory, 15,* 886–98, 2007. doi:10.1080/09658210701754351

Singer, J. A., & Salovey, P. (1993). *The remembered self: Emotion and memory in personality*. New York, NY: Free Press.

Spaan, P. E. J., Raajimakers, J. G. W., & Jonker, C. (2003). Alzheimer's disease versus normal ageing: A review of the efficiency of clinical and experimental memory measures. *Journal of Clinical and Experimental Neuropsychology, 25,* 216–230. doi:10.1076/jcen.25.2.216.13638

St. Jacques, P. L., & Levine, B. (2007). Ageing and autobiographical memory for emotional and neutral events. *Memory, 15,* 129–144. doi:10.1080/09658210601119762

Thorne, A., McLean, K. C., & Lawrence, A. M. (2004). When remembering is not enough: Reflecting on self-defining memories in late adolescence. *Journal of Personality, 72,* 513–541. doi:10.1111/j.0022-3506.2004.00271.x

Tulving, E. (1985). How many memory systems are there. *American Psychologist, 40,* 385–398. doi:10.1037/0003-066X.40.4.385

Tulving, E. (1993). Varieties of consciousness and levels of awareness in memory. In A. Baddeley and L. Weiskrantz (Eds.), *Attention: Selection, awareness, and control* (pp. 283–299). Oxford, UK: Clarendon Press.

Tulving, E. (2002). Episodic memory: From mind to brain. *Annual Review of Psychology, 53,* 1–25. doi:10.1146/annurev.psych.53.100901.135114

Tulving, E., Schacter, 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, 1988. doi:10.1016/0278-2626(88)90035-8

Werheid, K., McDonald, R. S., Simmons-Stern, N. S., Ally, B. A., & Budson, A. E. (2011). Familiar smiling faces in alzheimer's disease: Understanding the positivity-related recognition bias. *Neuropsychologia, 49,* 2935–2940.

Wilson, A. E., & Ross, M. (2003). The identity function of autobiographical memory: Time is on our side. *Memory, 11,* 137–149. doi:10.1080/741938210

Wood, W. J., & Conway, M. (2006). Subjective impact, meaning making, and current and recalled emotions for Self defining memories. *Journal of Personality, 74,* 811–846. doi:10.1111/j.1467-6494.2006.00393.x

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