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Phenomenological reliving and visual imagery during autobiographical recall in Alzheimer's disease

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Abstract

Multiple studies have shown compromise of autobiographical memory and phenomenological reliving in Alzheimer's disease (AD). We investigated various phenomenological features of autobiographical memory to determine their relative vulnerability in AD. To this aim, participants with early AD and cognitively normal older adult controls were asked to retrieve an autobiographical event and rate on a 5-point scale metacognitive judgments (i.e., reliving, back in time, remembering, and realness), component processes (i.e., visual imagery, auditory imagery, language, and emotion), narrative properties (i.e., rehearsal and importance), and spatiotemporal specificity (i.e., spatial details and temporal details). AD participants showed lower general autobiographical recall than controls, and poorer reliving, travel in time, remembering, realness, visual imagery, auditory imagery, language, rehearsal, and spatial detail – a decrease that was especially pronounced for visual imagery. Yet, AD participants showed high rating for emotion and importance. Early AD seems to compromise many phenomenological features, especially visual imagery, but also seems to preserve some other features.

Keywords

Alzheimer's disease; autobiographical memory; autooetic consciousness; phenomenological reliving; visual imagery

There is a substantial body of literature documenting impaired autobiographical memory in Alzheimer's disease (AD), an impairment that compromises social interactions, (Donix et al., 2010), sense of identity (Addis & Tippet, 2004), and phenomenological experience or the ability to relive past events (Dalla Barba, 1997; El Haj, Moroni, Luyat, Omigie, & Allain, 2014; Piolino et al., 2003; Rauchs et al., 2007, for a review, see El Haj, Antoine, Nandrion, & Kapogiannis, 2015a). Previous studies evaluated autobiographical memory through several protocols. For instance, Addis and Tippet (2004) assessed autobiographical memory in individuals with AD with the Autobiographical Fluency task (Dritschel, Williams, Baddeley, & Nimmo-Smith, 1992), a task assessing their ability to retrieve general and specific autobiographical memories. For general autobiographical memories, participants had 90 sec to produce as many names of people known to them as possible, whereas, for specific autobiographical memories, participants had 90 sec to produce as many personally experienced events as possible. Besides the Autobiographical Fluency task, Addis and Tippet (2004) administered the Autobiographical Memory Interview on which the

participants had to recall general autobiographical facts (e.g., name of secondary school) and specific autobiographical facts (Kopelman, Wilson, & Baddeley, 1990). Retrieval of specific autobiographical facts was evaluated with a scale ranging from 0 to 3 points and high scores referred to specific events situated in time and space. Through this assessment process, Addis and Tippett (2004) found decline of autobiographical recall in AD participants, especially, for retrieval of specific details. Mirroring these findings, reduced autobiographical specificity in AD was observed by other researchers who also administered the Autobiographical Memory Interview (Leyhe, Müllera, Miliana, Eschweiler, & Saura, 2009).

The decline of autobiographical specificity, as observed in individuals with AD, was reported by several studies using autobiographical assessment tools other than the Autobiographical Fluency task or the Autobiographical Memory Interview. For instance, Moses, Culpin, Lowe, and McWilliam (2004) assessed autobiographical recall of individuals with AD with the Autobiographical Memory Test of Williams and Broadbent (1986), in which an event is coded as specific if it occurs in less than a day. With this scoring system, Moses et al. (2004) found fewer specific autobiographical memories in AD participants than in healthy older adults, indicating overgenerality of autobiographical recall in AD. In the same vein, reduced autobiographical specificity was reported by Irish et al. (2011) who used the Autobiographical Interview (Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002). On this task, individuals with AD had to retrieve detailed autobiographical events and each event was analyzed according to its spatiotemporal specificity and phenomenological relevance, a concept referring to details describing emotion and thoughts. With this scale, Irish et al. (2011) observed significant disruption of autobiographical specificity and phenomenological reliving in AD. The present study expands upon this finding by investigating the nature of phenomenological decline in AD.

Phenomenological reliving, as triggered by retrieval of specific details, refers to re-experiencing past events and mentally travelling back in subjective time, a state that is termed *autonoetic consciousness* (Tulving, 2002). This subjective experience is critically involved in episodic recall and can be contrasted with *noetic consciousness*, or awareness of general information in the absence of any recollection, which is involved in semantic recall (Tulving, 2002). The distinction can be evaluated with the Remember–Know paradigm in which a “Remember” response can be provided when subjects succeed in recalling a specific event with the presence of phenomenological details (e.g., feelings, emotion, perceptions); by contrast, a “Know” response can be provided when subjects relive a feeling of familiarity without specific details (Gardiner, 2001). Using this paradigm, several investigations found alterations of phenomenological experience in individuals with AD (Dalla Barba, 1997; El Haj et al., 2014; Piolino et al., 2003; Rauchs et al., 2007). A similar conclusion is drawn by a series of studies employing assessments other than the Remember/Know paradigm. In these studies (Piolino et al., 2003; Rauchs et al., 2007; El Haj, Clément, Fasotti, & Allain, 2013; El Haj, Fasotti, & Allain, 2012a; El Haj, Postal, & Allain, 2012b), phenomenological experience was assessed with the TEMPau scale, attributing 0 points to an absence of memory or only general information, two points to a repeated/extended event if it was situated in time and space or one point if it was not, three points for a specific event with spatiotemporal details and four points if the latter event triggers phenomenological details

(e.g., feelings, emotion, perceptions) (Test épisodique de mémoire du passé, Piolino, Desgranges, & Eustache, 2000; Piolino et al., 2006). Taken together, a substantial body of literature supports the hypothesis that the phenomenological experience is disrupted in AD.

Overall, previous studies convincingly demonstrated that autobiographical memory declines in AD but failed to identify specific phenomenological elements and subjective features (e.g., reliving, back in time, remembering, emotion, or spatiotemporal specificity) that are selectively vulnerable in the disease. This shortcoming can be partially addressed with the Autobiographical Memory Interview on which the maximum score (i.e., 3 points) refers to specific events situated in time and space. Unfortunately, besides providing a comprehensive index of specificity, this scale does not allow assessing specificity characteristics (e.g., special or temporal information) that may be prone to forgetting in AD. The same thing can be said for the TEMPau scale which offers general evaluation of phenomenological experience without assessing specific phenomenological elements (e.g., back in time, emotion or perceptions). Finally, in a study by Moses et al. (2004) showing overgenerality of autobiographical recall in AD, specificity was based only on event duration and no further phenomenological details were assessed.

In addition, a core phenomenological concept, visual imagery, was barely assessed by these studies. According to Conway (2005), autobiographical memories are predominantly represented in the form of visual images. Visual imagery is also considered to be a defining element of the sense of recollection and phenomenological experience of autobiographical recall (Brewer, 1996). In line with this assumption, phenomenological experience was found to be fairly correlated with ratings of visual imagery (Rubin, Schrauf, & Greenberg, 2003). Further evidence about the link between visual imagery and autobiographical memory can be found in neurophysiological studies, showing activation in occipital lobes during autobiographical retrieval (e.g., Conway, Pleydell-Pearce, & Whitecross, 2001; Conway, Pleydell-Pearce, Whitecross, & Sharpe, 2003), as well as lesion studies, showing that damage to visual cortex leads to autobiographical decline (Rubin et al., 2003). Therefore, in this study, we decided to evaluate visual imagery in the setting of phenomenological experience of autobiographical recall in AD.

The aim of the present study was to identify specific phenomenological features (i.e., reliving, back in time, remembering, realness, visual imagery, auditory imagery, language, emotion, rehearsal, importance, spatial details, or temporal details) that were impaired in a cohort of participants with mild AD compared to controls. Based on the reviewed literature (Addis & Tippett, 2004; Dalla Barba, 1997; Donix et al., 2010; El Haj et al., 2012a, 2012b, 2013; Irish et al., 2011; Leyhe et al., 2009; Moses et al., 2004; Piolino et al., 2003; Rauchs et al., 2007), we hypothesized that individuals with AD would show poorer phenomenological experience, with especially poor visual imagery.

Method

Participants

The study included 27 subjects with probable AD (21 women and 6 men; *Mean* age = 71.41 years, *SD* = 5.46; *M* years of formal education = 8.44, *SD* = 2.42) and 30 healthy older

adults (23 women and 7 men; M age = 68.73 years, SD = 7.84; M years of formal education = 9.53, SD = 2.62). AD participants, meeting NINCDS-ADRDA (National Institute of Neurological and Communicative Disorders and Stroke–Alzheimer’s Disease and Related Disorders Association) criteria for probable AD (McKhann et al., 1984), were recruited from local retirement homes. Control participants were often the spouses, relatives or friends of the participants with AD. No differences were found between both groups in terms of age [$t(55) = 1.47$, $p > .10$] or years of formal education [$t(55) = 1.62$, $p > .10$].

All participants signed informed consent, which was approved by the URECA-University of Lille IRB. All participants were French native speakers and reported corrected-to-normal visual and auditory acuity. Exclusion criteria were: history of traumatic brain injury, cerebrovascular disease, or significant neurological or psychiatric illness. From the original sample of 34 AD participants, four participants were excluded from the study due to major visual impairment, two due to major auditory impairment and one due to inability to follow the instructions provided. Neuropsychological and clinical performance of all participants are described below and scores are depicted in Table 1.

Materials

Neuropsychological, clinical, and autobiographical tasks were administered in one or two sessions without predefined order since the experimenter was able to vary their order to reduce participant fatigue. In order not to influence their autobiographical performance, subjects were told that they were taking part in a study examining executive performance, as assessed with the neuropsychological battery.

Episodic memory—We used a French adaptation of the episodic memory task of Grober and Buschke (1987) (Van der Linden et al., 2004). The participants were asked to retain 16 words, each of which describes an item that belongs to a different semantic category. After assessment of immediate cued recall, there was a 20-sec distraction phase during which participants had to count backwards from 374. The distraction phase was succeeded by a 2-min free recall phase and the score obtained was retained as episodic score/16.

Executive function—We assessed inhibition, a core executive function (Miyake, Friedman, Emerson, Witzki, and Howerter (2000), with the Stroop task. This task consisted of three subtests: word reading, color naming, and color-word interference. In the word reading subtest, participants had to read 100 words printed in black ink, all words naming colors. In the color naming subtest, they had to name the color of 100 colored ink squares. In the color-word interference subtest, participants had to name the color of 100 color-words printed in incongruously colored ink (for instance, the word “red” was written in blue). Inhibition score referred to the completion time for the interference condition minus the average completion time for word reading and color naming. We also assessed another core executive function, working memory, with spans, during which participants had to repeat a string of single digits in the same order (i.e., forward spans) or in the inverse order (i.e., backward spans). Performances referred to number of correctly repeated digits.

Depression—The Hospital Anxiety and Depression Scale (HADS, Zigmond & Snaith, 1983) is widely used as a reliable screening instrument for depression and anxiety in individuals with AD. This assessment consists of 14 items, seven on a depression subscale and seven on an anxiety subscale. Each item was scored by the older adults and AD participants on a scale ranging from 0 (not present) to 3 (considerable). The maximum score on each subscale was 21 points and the cut-off for definite anxiety or depression was set at > 10/21.

Autobiographical memory—Autobiographical assessment is illustrated in Figure 1. We gave participants the following instruction “recount in detail an event in your life”, a simple instruction that is widely used to cue autobiographical recall in individuals with AD (El Haj et al., 2012a, 2012b; 2013; Fromholt et al., 2003; Piolino et al., 2000). Participants were allowed 5 min to describe their memories, and the duration was made clear to them so that they could structure, so far as possible, their memories accordingly. This time limit was adopted to avoid redundancy or distractibility and was found to be sufficient for autobiographical recollection in individuals with AD (El Haj et al., 2012a, 2012b, 2013).

After memory generation, we assessed phenomenological reliving by asking participants to rate on a five-point scale (0 = not at all, 1 = slightly, 2 = moderately, 3 = quite a bit, and 4 = extremely) metacognitive judgments, component processes, and narrative properties according to the Autobiographical Memory Questionnaire (AMQ, Rubin et al., 2003). Metacognitive judgments referred to reliving (i.e., “I feel as though I am reliving the original event”), experiencing being back in time (i.e., “I feel that I travel back to the time it happened”), remembering (i.e., “I can actually remember it rather than just knowing that it happened”), and experiencing a sense of realness (i.e., “I believe the event in my memory really occurred in the way I remember it”). Component processes referred to visual imagery (i.e., “I can see it in my mind”), auditory imagery (i.e., “I can hear it in my mind”), language (i.e., “I or other people are talking”), and emotion (i.e., “I can feel now the emotions I felt then”). Narrative proprieties included importance (i.e., “This memory is significant for my life”) and rehearsal (i.e., “Since it happened, I have thought or talked about this event”). Finally, and inspired by the AMQ, we assessed spatiotemporal specificity by including rating for spatial details (i.e., “I can recall the place where it occurred”) and temporal details (i.e., “I can recall the time when it occurred”). The validity of these ratings were corroborated by asking participants to provide specific spatiotemporal information.

Since some AD participants had difficulties with subjective ratings, further instructions were provided. For instance, when rating reliving and back in time, participants were informed that the 4th point on the scale corresponded to “as clearly as if the event was happening now”. Similarly, the experimenter explained that the 4th point on the evaluation scale of realness referred to “100% real”. Participants were also presented with printed scales and statements (Time New Roman 48) so they could read them before rating. In order to further reduce the assessment load, spatiotemporal elements were defined as any spatial (e.g., at my home, at the school) and temporal information (e.g., on the summer). Although all AD participants succeeded in providing required information, however, when possible, we verified the details and gist of the remember events with their relatives.

Besides evaluation of subjective experience, as rated by the participants, we assessed general autobiographical recall with the TEMPau scale (0 points = absence of memory or only general information, 1 point = repeated/extended event without spatiotemporal details, 2 points = repeated/extended event with spatiotemporal details, 3 points = events lasting less than a day with spatiotemporal details, 4 = events lasting less than a day with spatiotemporal and phenomenological details). To avoid a bias in scoring, a second independent rater rated a random sample of 20% of the data; an inter-rater agreement coefficient of 0.81 and higher was obtained (Shrout & Fleiss, 1979).

Results

We first compared differences on general autobiographical performance as assessed with the TEMPau scale. We then compared differences on phenomenological characteristics between AD participants and older adults and within each population. Due to the scale nature of variables and their abnormal distribution, non-parametrical tests were conducted. Between groups comparisons were performed using Mann-Whitney's U test and within groups comparisons were performed using Wilcoxon signed rank test. All comparisons are reported with effect size; $d = 0.2$ can be considered a small effect size, $d = 0.5$ represents a medium effect size and $d = 0.8$ refers to a large effect size (Cohen, 1988).

Poor general autobiographical recall in AD participants

Mann-Whitney's U tests showed poorer general autobiographical recall in AD than in control participants ($Z = -3.69$, $p < .01$, $d = 1.05$), with a Mean of 2.96 ($SD = .94$) and 3.73 ($SD = .45$), respectively.

Poor phenomenological reliving in AD participants (except for emotion and importance)

Phenomenological performances are depicted in Table 2. Relatively to controls, AD participants reported lower reliving ($Z = -2.46$, $p < .05$, $d = .55$), travel in time ($Z = -2.30$, $p < .05$, $d = .74$), remembering ($Z = -2.90$, $p < .01$, $d = .83$), realness ($Z = -3.33$, $p < .01$, $d = .92$), sl imagery ($Z = -5.74$, $p < .001$, $d = 2.46$), auditory imagery ($Z = -2.71$, $p < .01$, $d = .79$), language ($Z = -2.17$, $p < .05$, $d = .60$), rehearsal ($Z = -2.86$, $p < .01$, $d = .76$), spatial details ($Z = -3.51$, $p < .001$, $d = 1.01$), and temporal details ($Z = -3.19$, $p < .01$, $d = .91$). No significant differences were detected for emotion ($Z = -1.14$, $p > .1$) and importance ($Z = -1.16$, $p > .1$) between both populations.

Poor visual imagery in AD participants

For each population, we carried out Friedman's test to investigate differences in repeatedly measured phenomenological variables, this test showed significant differences for AD participants [$\chi^2(11, N = 27) = 78.83$, $p < .001$] and older adults [$\chi^2(11, N = 30) = 30.74$, $p < .01$].

Post-hoc signed rank tests by Wilcoxon, in AD participants, showed significant differences between reliving and remembering ($Z = -2.96$, $p < .01$, $d = .59$), reliving and realness ($Z = -2.67$, $p < .01$, $d = .62$), reliving and visual imagery ($Z = -4.00$, $p < .001$, $d = 1.20$), reliving and auditory imagery ($Z = -2.27$, $p < .05$, $d = .56$), reliving and emotion ($Z = -2.69$, $p < .01$,

$d = .54$), reliving and importance ($Z = -2.38, p < .01, d = .54$), reliving and temporal details ($Z = -1.99, p < .05, d = .40$), back in time and realness ($Z = -1.99, p < .01, d = .60$), back in time and visual imagery ($Z = -3.21, p = .001, d = .54$), back in time and emotion ($Z = -2.66, p < .01, d = .76$), back in time and importance ($Z = -2.63, p < .01, d = .77$), remembering and visual imagery ($Z = -2.38, p < .01, d = .69$), remembering and emotion ($Z = -3.84, p < .001, d = 1.45$), remembering and importance ($Z = -3.87, p < .01, d = 1.50$), realness and visual imagery ($Z = -2.32, p < .05, d = .71$), realness and emotion ($Z = -4.05, p < .01, d = 1.56$), realness and importance ($Z = -3.98, p < .001, d = 1.62$), visual imagery and auditory imagery ($Z = -2.25, p < .05, d = .71$), visual imagery and language ($Z = -2.86, p < .01, d = .95$), visual imagery and emotion ($Z = -4.31, p < .001, d = 2.26$), visual imagery and importance ($Z = -4.27, p < .001, d = 2.34$), visual imagery and rehearsal ($Z = -2.21, p < .05, d = .75$), visual imagery and spatial details ($Z = -2.91, p < .01, d = .98$), visual imagery and temporal details ($Z = -3.14, p < .01, d = 1.27$), auditory imagery and emotion ($Z = -3.52, p < .001, d = 1.44$), auditory imagery and importance ($Z = -3.84, p < .001, d = 1.45$), language and emotion ($Z = -3.72, p < .001, d = 1.31$), language and importance ($Z = -3.30, p < .01, d = 1.36$), emotion and rehearsal ($Z = -3.45, p < .01, d = 1.19$), emotion and spatial details ($Z = -3.64, p < .001, d = 1.16$), emotion and temporal details ($Z = -3.73, p < .001, d = 1.36$), importance and rehearsal ($Z = -3.56, p < .001, d = 1.22$), importance and spatial details ($Z = -3.37, p < .01, d = 1.19$), importance and temporal details ($Z = -3.55, p < .001, d = 1.19$). All remaining comparisons were non-significant. Taken together, these analyses showed lower rating for visual imagery relative to remaining phenomenological features in AD participants. Conversely, these participants showed higher ratings for emotion and importance.

Regarding control participants, post-hoc comparisons showed significant differences between reliving and remembering ($Z = -2.12, p < .05, d = .54$), reliving and realness ($Z = -2.06, p < .05, d = .57$), reliving and auditory reliving ($Z = -2.03, p < .05, d = .67$), reliving and language ($Z = -2.09, p < .05, d = .68$), back in time and auditory imagery ($Z = -2.21, p < .05, d = .63$), back in time and language ($Z = -2.31, p < .05, d = .64$), back in time and emotion ($Z = -2.06, p < .05, d = .50$), remembering and visual imagery ($Z = -2.36, p < .01, d = .70$), remembering and emotion ($Z = -3.83, p < .001, d = .91$), remembering and importance ($Z = -3.87, p < .001, d = .80$), realness and visual imagery ($Z = -2.15, p < .05, d = .64$), realness and emotion ($Z = -2.68, p < .001, d = .83$), realness and importance ($Z = -2.61, p < .01, d = .72$), visual imagery and auditory imagery ($Z = -3.19, p = .001, d = .21$), visual imagery and language ($Z = -3.29, p = .001, d = .86$), auditory imagery and emotion ($Z = -3.52, p < .001, d = 1.13$), auditory imagery and importance ($Z = -3.38, p < .001, d = .98$), auditory imagery and spatial details ($Z = -2.13, p < .05, d = .52$), language and emotion ($Z = -3.51, p < .001, d = 1.15$), language and importance ($Z = -3.41, p = .001, d = 1.07$), emotion and rehearsal ($Z = -2.59, p < .01, d = .72$), emotion and temporal details ($Z = -2.28, p < .01, d = .75$), importance and rehearsal ($Z = -2.21, p < .05, d = .61$), importance and temporal details ($Z = -2.28, p < .05, d = .63$). All remaining comparisons were non-significant. Taken together, these outcomes showed high rating for emotion in older adults. Regarding visual imagery, its rating was significantly more important than remembering, realness, auditory imagery, and language; no significant differences were detected between

visual imagery and remaining phenomenological elements (i.e., reliving, back in time, emotion, importance, rehearsal, spatial and temporal details).

Discussion

Our study aimed to assess the nature of phenomenological impairment that underlies the autobiographical decline in AD. When asked to retrieve autobiographical events, AD participants showed poorer autobiographical recall than controls. The phenomenological experience of AD participants was characterized by poorer reliving, travel in time, remembering, realness, visual imagery, auditory imagery, language, rehearsal, spatial details, and temporal details than controls, a decline that was especially pronounced for visual imagery. Yet, in a contradictory manner, AD participants showed higher ratings for emotion and importance.

Reduced autobiographical memory in AD has been the subject of considerable study (Addis & Tippett, 2004; Dalla Barba, 1997; Donix et al., 2010; El Haj et al., 2012a, 2012b, 2013; El Haj, Antoine, & Kapogiannis, 2015b, 2015c; Irish et al., 2011; Leyhe et al., 2009; Moses et al., 2004; Piolino et al., 2003; Rauchs et al., 2007). However, beyond documenting declines in general autobiographical recall and autobiographical specificity, this body of literature has provided a comprehensive rather than piecemeal attempt to investigate phenomenological reliving in individuals with AD. Our work fills this gap by assessing specific features of phenomenological experience, thanks to the Autobiographical Memory Questionnaire (Rubin et al., 2003). Using this instrument, we were able to observe low reliving for some phenomenological features and, controversially, high reliving for other phenomenological features in AD.

Regarding phenomenological features, our AD participants showed low rating for visual imagery, a defining element of the sense of recollection and phenomenological experience. Indeed, it has been widely suggested that autobiographical memories are dominated by visual imagery and that the retrieval of visual images is the core feature of autobiographical reliving (Brewer, 1996; Conway, 2009). In line with this idea, a study has shown poor autobiographical recall in healthy young participants with low ability to generate pictorial mental images of objects (Vannucci, Pelagatti, Chiorri, & Mazzoni, 2015).

Neuropsychological studies have also shown that lesions resulting in a loss of the ability to generate visual images also result in retrograde amnesia (Brown & Chobor, 1995; Greenberg, Eacott, Brechin, & Rubin, 2005; Ogden, 1993). For instance, Greenberg et al. (2005) reported the case of a patient with damage in the right occipital lobe along with the occipitotemporal junction who demonstrated difficulty generating visual images, as well as retrograde amnesia. In addition, neuroimaging studies have shown activation of visual brain areas during autobiographical recall (e.g., Viard et al., 2007; for a review, see, Piolino, Desgranges, & Eustache, 2009). Moreover, there is evidence of low autobiographical recall in blind individuals (Tekcan et al., 2014). These findings suggest visual processing as a core component of phenomenological reliving during autobiographical recall. Consequently, any decrease in the ability to generate visual images, as in the case of its poor rating in our AD participants, may compromise autobiographical recall and its phenomenological experience. A limited ability to generate and manipulate visual images may deprive individuals with AD

of the function is most needed in integrating the components of autobiographical experience into a whole coherent event.

Besides low visual imagery, our AD participants showed low reliving, travel in time, remembering, and realness. These outcomes reflect poor auto-noetic consciousness or the ability to experience past events and mentally travel back in subjective time (Tulving, 2002). In line with our findings, several studies have shown decreased auto-noetic consciousness in individuals with AD, supporting the idea of a disruption of recollection in AD (Dalla Barba, 1997; El Haj et al., 2014; Piolino et al., 2003; Rauchs et al., 2007; for a review, see, El Haj et al., 2015a). Another poor-rated phenomenological element in AD participants was auditory imagery. Imagery in modalities other than visual (e.g., auditory) may be present but less common in autobiographical remembering (Williams, Healy, & Ellis, 1999). Poor auditory reliving may also be responsible for the low score for the statement “I or other people are talking”. Another phenomenological feature that was rated low by AD participants was rehearsal. According to Conway (2009) repeated retrieval, or rehearsal, serves to shape autobiographical knowledge into patterns of accessibility, improving retrieval and availability of this knowledge. Rehearsal decline, as reported by our AD participants may hence limit the accessibility of autobiographical memories and consequently, their phenomenological reliving. This rehearsal decline may be due to reduction in social contacts, which limits opportunities for memories transmitting and memories telling. Similar to poor ratings for the above-mentioned phenomenological features (i.e., reliving, travel in time, remembering, realness, visual imagery, auditory imagery, language, and rehearsal), our AD participants showed decrease in spatiotemporal details. This is not surprising, since several reports demonstrated poor spatiotemporal recall in AD (El Haj et al., 2012a; Irish et al., 2011; Leyhe et al., 2009; Piolino et al., 2003). Due to their difficulty in retrieving specific spatiotemporal details of the encoding context, individuals with AD may retrieve events based on a feeling of familiarity rather than recollection, which may explain the decrease in autobiographical recall and its phenomenological experience.

Although showing low experience of many phenomenological features, AD participants demonstrated high ratings for emotion and importance. In a broad manner, studies suggest better recall for emotional information in AD, especially if self-related. In this body of research, Sundström (2011) asked AD participants to retain neutral items and emotional self-related items (i.e., gifts to the participants). Better recall was detected for emotional items than for neutral items. Also, Kalenzaga, Bugańska, and Clarys (2013) asked AD patients to rate neutral and emotional adjectives describing themselves. Better recall was observed for emotional adjectives than for neutral adjective. These outcomes suggest high recall for self-related emotional information in AD, which may explain the high emotional rating for autobiographical, or self-related, events in our participants. Another hypothesis to account for the high level of emotion and importance is that participants retrieved events that were highly relevant to their self-image, namely, self-defining memories or events that contributed to their life story and sense of identity (Blagov & Singer, 2004; Wood & Conway, 2006). This hypothesis should be however treated with caution since we did not investigate the self-defining nature for retrieved autobiographical events.

High emotional rating was not only observed in AD participants, but also in control older adults. This finding fits with studies showing high recall for emotional information in normal aging (e.g., Davidson, Cook, & Glisky, 2006; Davidson & Glisky, 2002). It is noteworthy that the age gap in episodic memory performance can be, somehow, narrowed by emotion (Kensinger, 2009). However, and unlike AD participants, older adults showed high visual imagery ratings. This is not surprising, since, unlike AD participants, older adults demonstrated substantial general autobiographical recall, as assessed with the TEMPAau scale.

Although our interpretation of the findings draws heavily on visual imagery, we caution the reader that this phenomenological aspect was only assessed with one item. Future studies should further investigate its involvement with a variety of tasks assessing visual imagery, as well as spatial ability, an ability that could be evaluated with the spatial subscale of the Survey of Autobiographical Memory (Palombo, Williams, Abdi, & Levine, 2013). The absence of spatial ability assessment may be considered as a crucial shortcoming for our visual imagery hypothesis. It is of note, however, that we controlled for visual acuity by including only participants with reported corrected-to-normal vision and excluding those with major visual impairments.

When trying to retrieve autobiographical events, individuals first access general descriptions, using these as transitional steps to narrow down their search for specific memories (Conway, 2005). This specificity triggers autonoetic consciousness or the phenomenological reliving of past events (Tulving, 2002). Individuals with AD are found to show difficulties on both specificity and phenomenological reliving. The present study contributes to these findings by highlighting decreases in many phenomenological features, but also preservation of some other features.

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References

- Addis RA, Tippet LJ. Memory of myself: Autobiographical memory and identity in Alzheimer's disease. *Memory*. 2004; 12:56–74. [PubMed: 15098621]
- Blagov PS, Singer JA. Four dimensions of SDM (content, specificity, meaning, affect) and their relationship to self-restraint, distress, and defensiveness. *Journal of Personality*. 2004; 72:481–511. [PubMed: 15102036]
- Brewer, WF. What is recollective memory?. In: Rubin, DC., editor. *Remembering our past: Studies in autobiographical memory*. Cambridge: Cambridge University Press; 1996. p. 19-66.
- Brown JW, Chobor KL. Severe retrograde amnesia. *Aphasiology*. 1995; 9(2):163–170.
- Cohen, J. *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Erlbaum Associates; 1988.
- Conway MA. Memory and the self. *Journal of Memory and Language*. 2005; 53:594–628.
- Conway MA. Episodic memories. *Neuropsychologia*. 2009; 47(11):2305–2313. [PubMed: 19524094]

- Conway MA, Pleydell-Pearce CW, Whitecross SE. The neuroanatomy of autobiographical memory: A slow cortical potential study of autobiographical memory retrieval. *Journal of Memory and Language*. 2001; 45:493–524.
- Conway MA, Pleydell-Pearce CW, Whitecross SE, Sharpe H. Neurophysiological correlates of memory for experienced and imagined events. *Neuropsychologia*. 2003; 41:334–340. [PubMed: 12457758]
- Dalla Barba G. Recognition memory and recollective experience in Alzheimer's disease. *Memory*. 1997; 5(6):657–672. [PubMed: 9497906]
- Davidson PSR, Cook SP, Glisky EL. Flashbulb memories for September 11th can be preserved in older adults. *Ageing, Neuropsychology, and Cognition*. 2006; 13:196–206.
- Davidson PSR, Glisky EL. Is flashbulb memory a special instance of source memory? Evidence from older adults. *Memory*. 2002; 10:99–111. [PubMed: 11798440]
- Donix M, Brons C, Jurjanz L, Poettrich K, Winiecki P, Holthoff VA. Overgenerality of autobiographical memory in people with amnesic mild cognitive impairment and early Alzheimer's disease. *Archives of clinical neuropsychology*. 2010; 25(1):22–27. [PubMed: 19955095]
- Dritschel BH, Williams JMG, Baddeley AD, Nimmo-Smith I. Autobiographical fluency: A method for the study of personal memory. *Memory and Cognition*. 1992; 20:133–140. [PubMed: 1565011]
- El Haj M, Antoine P, Nandrino JL, Kapogiannis D. Autobiographical memory decline in alzheimer's disease, a theoretical and clinical overview. *Ageing research reviews*. 2015a; doi: 10.1016/j.arr.2015.07.001
- El Haj M, Clément S, Fasotti L, Allain P. Effects of music on autobiographical verbal narration in Alzheimer's Disease. *Journal of Neurolinguistics*. 2013; 26(6):691–700.
- El Haj M, Fasotti L, Allain P. The involuntary nature of music-evoked autobiographical memories in Alzheimer's disease. *Consciousness and Cognition*. 2012a; 21:238–246. [PubMed: 22265372]
- El Haj M, Antoine P, Kapogiannis D. Similarity between remembering the past and imagining the future in alzheimer's disease: Implication of episodic memory. *Neuropsychologia*. 2015b; 66(0): 119–125. [PubMed: 25448861]
- El Haj M, Antoine P, Kapogiannis D. Flexibility decline contributes to similarity of past and future thinking in alzheimer's disease. *Hippocampus*. 2015c; doi: 10.1002/hipo.22465
- El Haj M, Moroni C, Luyat M, Omigie D, Allain P. To what extent does destination recall induce episodic reliving? Evidence from Alzheimer's disease. *Journal of clinical and experimental neuropsychology*. 2014; 36(2):127–136. [PubMed: 24409936]
- El Haj M, Postal V, Allain P. Music enhances autobiographical memory in mild Alzheimer's Disease. *Educational gerontology*. 2012b; 38:30–41.
- Folstein MF, Folstein SE, McHugh PR. "Mini-mental state": A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*. 1975; 12:189–198. [PubMed: 1202204]
- Fromholt P, Mortensen DB, Torpdahl P, Bender L, Larsen P, Rubin DC. Life narrative and word-cued autobiographical memories in centenarians: Comparisons with 80-year-old control, depressed, and dementia groups. *Memory*. 2003; 11:81–88. [PubMed: 12653490]
- Gardiner JM. Episodic memory and autoegetic consciousness: A first person approach. *The Royal Society*. 2001; 356:1351–1361.
- Greenberg DL, Eacott MJ, Brechin D, Rubin DC. Visual memory loss and autobiographical amnesia: A case study. *Neuropsychologia*. 2005; 43(10):1493–1502. [PubMed: 15989939]
- Grober E, Buschke H. Genuine memory deficits in dementia. *Developmental Neuropsychology*. 1987; 3:13–36.
- Irish M, Hornberger M, Lah S, Miller L, Pengas G, Nestor PJ, ... Piguet O. Profiles of recent autobiographical memory retrieval in semantic dementia, behavioural-variant frontotemporal dementia, and Alzheimer's disease. *Neuropsychologia*. 2011; 49(9):2694–2702. [PubMed: 21658396]
- Kalenzaga S, Bugajska A, Clarys D. Self-reference effect and autoegetic consciousness in Alzheimer disease: evidence for a persistent affective self in dementia patients. *Alzheimer Disease & Associated Disorders*. 2013; 27(2):116–122. [PubMed: 22596082]

- Kensinger EA. How emotion affects older adults' memories for event details. *Memory*. 2009; 17:208–219. [PubMed: 18608972]
- Kopelman, MD.; Wilson, BA.; Baddeley, A. *The Autobiographical Memory Interview*. Suffolk, U.K: Thames Valley Test Company; 1990.
- Levine B, Svoboda E, Hay JF, Winocur G, Moscovitch M. Aging and autobiographical memory: dissociating episodic from semantic retrieval. *Psychology and aging*. 2002; 17(4):677–689. [PubMed: 12507363]
- Leyhe T, Müllera S, Miliana M, Eschweiler GW, Saura R. Impairment of episodic and semantic autobiographical memory in patients with mild cognitive impairment and early Alzheimer's disease. *Neuropsychologia*. 2009; 47:2464–2469. [PubMed: 19409401]
- McKhann G, Drachman D, Folstein M, Katzman R, Price D, Stadlan EM. Clinical diagnosis of Alzheimer's disease: Report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. *Neurology*. 1984; 34:939–944. [PubMed: 6610841]
- Miyake A, Friedman NP, Emerson MJ, Witzki AH, Howerter A. The unity and diversity of executive functions and their contribution to complex 'frontal lobe' tasks: A latent variable analysis. *Cognitive Psychology*. 2000; 41:49–100. [PubMed: 10945922]
- Moses A, Culpin V, Lowe C, McWilliam C. Overgenerality of autobiographical memory in Alzheimer's disease. *British journal of clinical psychology*. 2004; 43(4):377–386. [PubMed: 15530208]
- Ogden JA. Visual object agnosia, prosopagnosia, achromatopsia, loss of visual imagery, and autobiographical amnesia following recovery from cortical blindness: case M.H. *Neuropsychologia*. 1993; 31(6):571–589. [PubMed: 8341415]
- Palombo DJ, Williams LJ, Abdi H, Levine B. The survey of autobiographical memory (SAM): A novel measure of trait mnemonics in everyday life. *Cortex*. 2013; 49(6):1526–1540. [PubMed: 23063319]
- Piolino P, Desgranges B, Belliard S, Matuszewski V, Lalevee C, De la Sayette V, Eustache F. Autobiographical memory and auto-noetic consciousness: Triple dissociation in neurodegenerative diseases. *Brain*. 2003; 126(10):2203–2219. [PubMed: 12821510]
- Piolino P, Desgranges B, Clarys D, Guillery-Girard B, Taconnat L, Isingrini M, et al. Autobiographical memory, auto-noetic consciousness, and self perspective in aging. *Psychology and Aging*. 2006; 21:510–525. [PubMed: 16953713]
- Piolino, P.; Desgranges, B.; Eustache, F. *La mémoire autobiographique: Théorie et pratique*. Marseille: Solal; 2000.
- Piolino P, Desgranges B, Eustache F. Episodic autobiographical memories over the course of time: cognitive, neuropsychological and neuroimaging findings. *Neuropsychologia*. 2009; 47(11):2314–2329. [PubMed: 19524095]
- Rauchs G, Piolino P, Mezenge F, Landeau B, Lalevee C, Pelerin A, ... Desgranges B. Auto-noetic consciousness in Alzheimer's disease: Neuropsychological and PET findings using an episodic learning and recognition task. *Neurobiology of Aging*. 2007; 28(9):1410–1420. [PubMed: 16846667]
- Rubin DC, Schrauf RW, Greenberg DL. Belief and recollection of autobiographical memories. *Memory & Cognition*. 2003; 31:887–901. [PubMed: 14651297]
- Shrout PE, Fleiss JL. Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin*. 1979; 86:420–428. [PubMed: 18839484]
- Sundström M. Modeling recall memory for emotional objects in Alzheimer's disease. *Aging, Neuropsychology, and Cognition*. 2011; 18(4):396–413.
- Tekcan A, Yılmaz E, Kaya Kızıloğlu B, Karadöller DZ, Mutafoğlu M, Aktan Erciyes A. Retrieval and phenomenology of autobiographical memories in blind individuals. *Memory*. 2014; 23(3):329–339. [PubMed: 24528249]
- Tulving E. Episodic memory: From mind to brain. *Annual Review of Psychology*. 2002; 53:1–25.
- Van der Linden, M.; Adam, S.; Agniel, A.; Baisset-Mouly, C.; Bardet, F.; Coyette, F. *L'évaluation des troubles de la mémoire: Présentation de quatre tests de mémoire épisodique (avec leur étalonnage)*

[Evaluation of memory deficits: Presentation of four tests of episodic memory (with standardization)]. Marseille: Solal Editeurs; 2004.

Vannucci M, Pelagatti C, Chiorri C, Mazzoni G. Visual object imagery and autobiographical memory: Object Imagers are better at remembering their personal past. *Memory*. 2015:1–16. ahead-of-print.

Viard A, Piolino P, Desgranges B, Chetelat G, Lebreton K, Landeau B, ... Eustache F. Hippocampal activation for autobiographical memories over the entire lifetime in healthy aged subjects: an fMRI study. *Cerebral Cortex*. 2007; 17(10):2453–2467. [PubMed: 17204823]

Williams JMG, Broadbent K. Autobiographical memory in attempted suicide patients. *Journal of Abnormal Psychology*. 1986; 95:144–149. [PubMed: 3711438]

Wood WJ, Conway M. Subjective Impact, Meaning Making, and Current and Recalled Emotions for Self-Defining Memories. *Journal of personality*. 2006; 74(3):811–846. [PubMed: 16684254]

Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica*. 1983; 67:361–370.

Figure 1.

After autobiographical generation, participants had to rate on a five-point scale metacognitive judgments, component processes, narrative properties, and spatiotemporal specificity.

Table 1

Neuropsychological and clinical characteristics of Alzheimer's disease (AD) participants and control participants

	Task	AD <i>n</i> = 27	Older adults <i>n</i> = 30
General Cognitive functioning	Mini-Mental State Examination (MMSE)	21.48 (1.85)***	27.97 (1.49)
Episodic memory	Grober and Buschke	5.63 (2.32)***	11.03 (3.11)
Inhibition	Stroop	58.96 (8.82)***	36.43 (10.40)
Working memory	Forward span	5.26 (1.40)**	6.58 (1.72)
	Backward span	3.67 (1.21)**	4.73 (1.62)
Anxiety	HADS	8.07 (2.18)**	5.90 (3.43)
Depression	HADS	8.70 (1.86)**	6.90 (2.22)

Note. Standard deviations are given between brackets; the maximum score on MMSE (Folstein, Folstein, & McHugh, 1975) was 30 points; the maximum score on the Grober and Buschke's (1987) task was 16 points; scores on the Stroop referred to reaction time; performances on the forward and backward spans referred to number of correctly repeated digits; the cut-off on the HADS (Hospital Anxiety and Depression Scale) was > 10/21 points; the difference with the following group was significant at: ** $p < .01$, *** $p < .001$; after checking for normality of distributions, comparisons were performed with Student's t-test (normal distribution).

Table 2

Phenomenological characteristics of autobiographical recall in Alzheimer's disease (AD) and older adults

	AD <i>n</i> = 27	Older adults <i>n</i> = 30
Reliving	3.70 (1.71)*	4.43 (.77)
Back in time	3.56 (1.39)*	4.40 (.81)
Remember/Know	2.78 (1.37)**	3.87 (1.25)
Real/Imagine	2.76 (1.26)**	3.93 (1.28)
Visual imagery	1.81 (1.41)***	4.60 (.76)
Auditory imagery	2.81 (1.39)**	3.80 (1.09)
Language	3.07 (1.21)*	3.77 (1.13)
Emotion	4.44 (.85) ^{n/s}	4.73 (.45)
Importance	4.41 (.69) ^{n/s}	4.63 (.49)
Rehearsal	2.93 (1.57)**	4.03 (1.29)
Space	3.15 (1.32)***	4.37 (1.06)
Time	3.11 (1.08)**	4.10 (1.09)

Note. Standard deviations are given between brackets; the maximum score was 4 points; ^{n/s} the difference with the following group was no-significant; the difference with the following group was significant at: ** $p < .01$, *** $p < .001$; after checking for normality of distributions, comparisons were performed with Student's t-test (normal distribution).