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Personal semantic and episodic autobiographical memories in Korsakoff syndrome: A comparison of interview methods

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ABSTRACT

Objective: The temporal gradient in patients with Korsakoff's syndrome has been of particular interest in the literature, as many studies have found evidence for a steep temporal gradient, but others have observed more uniform remote memory impairment across all past time periods. Inconsistencies might be the result of the nature of remote memory impairment under study (i.e., nonpersonal or autobiographical memory) and of methodological differences in the examination of remote memory loss. The aim of this study was to examine whether differences between autobiographical memory interview (AMI) and autobiographical interview (AI) procedures influence the presence of a temporal gradient in semantic and episodic autobiographical memory in Korsakoff patients. *Method*: The procedure used in the present study combined the AMI and AI into one study session. We compared the performance of 20 patients with Korsakoff's syndrome and 27 healthy controls. First, participants were asked to recall knowledge from different life periods. Second, participants were asked to recall memories from five life periods. Thirdly, participants were asked to rate their subjective experience of each event recalled on a 5-point scale. Finally, we analyzed the findings in terms of all the memories recalled versus the first memory from each life-period only. *Results*: Both the AMI and the AI showed a temporally graded retrograde amnesia in the Korsakoff patients for personal semantic and episodic autobiographical memories. The pattern of amnesia in Korsakoff patients was not affected by examining only one event per life-period. Subjective ratings of recalled memories were largely comparable between the groups. *Conclusions*: The findings were generally consistent across the AMI and AI. Varying the number of events did not affect the pattern of the gradient. Hence, the temporal gradient in Korsakoff patients is not an artefact of either the AMI or the AI method.

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Introduction

Korsakoff's syndrome is a chronic neuropsychiatric disorder, typically resulting from nutritional (thiamine) depletion following years of chronic alcohol abuse. It is characterized by severe learning and memory impairments (Cermak, Butters, & Goodglass, 1971; Kopelman, Thomson, Guerrini, & Marshall, 2009; Squire, 1982). The most prominent symptom is anterograde amnesia, but remote memory is affected as well. This includes nonpersonal information (public information, such as news events and famous faces) and events from autobiographical memory (Albert, Butters, & Brandt, 1981; Kopelman, 1989; Kopelman, Stanhope, & Kingsley, 1999; Zola-Morgan, Cohen, & Squire, 1983). The loss of memories in Korsakoff patients can extend back years, sometimes even several decades (Kopelman, 1989; Moscovitch, Nadel, Winocur, Gilboa, & Rosenbaum, 2006). This relative sparing of early

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memories and a disproportionate loss of more recent ones is commonly referred to as a "temporal gradient." The temporal gradient in patients with Korsakoff's syndrome has been of particular interest in the literature, as the majority of studies have found evidence for a steep temporal gradient, but others have observed more uniform remote memory impairment across all past time periods (see Race & Verfaellie, 2012, for a review). Inconsistencies might be the result of the nature of remote memory impairment under study (i.e., nonpersonal or autobiographical memory) and of methodological differences in the examination of remote memory loss (Race & Verfaellie, 2012).

Early studies examining remote memory loss for nonpersonal information in patients with Korsakoff's syndrome sometimes showed a steep temporal gradient (Albert et al., 1981; Seltzer & Benson, 1974), and sometimes a flat gradient (Mair, Warrington, & Weiskrantz, 1979; Sanders & Warrington, 1971). The absence of a gradient in these studies has been explained by the low levels of performance of the patients across all time periods (i.e., floor effects; Race & Verfaellie, 2012). The temporal gradient for autobiographical memories has been examined to a lesser extent than the gradient for nonpersonal information. Autobiographical memory is typically divided into semantic and episodic components (Tulving, 1972). The semantic component refers to "facts" that are not tied to a single event, for example knowing that you used to go camping on holidays. The episodic component refers to personal events that a person is able to reexperience in a detailed spatial and temporal context. Previous studies mainly examined personal semantic memory (sometimes known as semantic autobiographical memory), and a temporal gradient for personal semantic information has been repeatedly demonstrated (Kopelman, 1989; Kopelman et al., 1999, 2009). To the authors' knowledge, only relatively few studies have investigated patients' ability to remember episodic events from their personal past, using a Crovitz procedure and Autobiographical Memory Interview (AMI; Butters & Cermak, 1986; Kopelman, 1989; Kopelman et al., 1999; Zola-Morgan et al., 1983). Although the results of these studies suggested that the temporal gradient extends to episodic autobiographical memory, more research is needed because the findings may relate to the particular technique used.

Assessment of autobiographical memory is more complicated than assessment of remote memory for publically available knowledge, as this latter type can be tested using information that is widely available and is easily verifiable (Squire & Cohen, 1982). A few methods have been proposed to assess autobiographical memory. Crovitz and Schiffman (1974) developed a task that required participants to retrieve a specific memory of a past incident in response to a cue-word. This method is still used to date, but a number of limitations have been pointed out. First, the design might be problematic for use in patients with severe memory deficits, as it asks participants to generate events from the cues, hence placing large executive demands on them. Second, the procedure does not wholly distinguish between episodic and semantic autobiographical recall (Dritschel, Williams, Baddeley, & Nimmo-Smith, 1992; Rabbit & Winthorpe, 1988). Third, the results might reflect a person's predisposition to recall from a certain life period (or periods), although in some studies, participants were asked to recall from specific life periods (Graham & Hodges, 1997; Levine, 2004; Philippi et al., 2015).

Kopelman, Wilson, and Baddeley (1990) developed the AMI to overcome these limitations. The AMI samples recall for autobiographical incidents (episodic memory) and personal semantic facts (semantic memory), specifically from three different life periods (childhood, young adulthood, and recent life). This provides an evaluation of the temporal gradient for episodic and personal semantic memory, irrespective of any bias to respond from particular life periods. Moreover, the interview requires participants to recall memories concerning commonly experienced events, rather than to respond to a list of cue words (Kopelman et al., 1990). An apparent advantage of the AMI is that, by including schedules for both episodic and semantic memory, these memory processes can be directly compared. On the other hand, it has been argued that separating episodic and semantic memory might be somewhat artificial, as these processes often operate in tandem (Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002). It has also been noted that the two schedules of the AMI were unmatched in terms of task difficulty, content, and sensitivity (Levine, 2004; Murphy, Troyer, Levine, & Moscovitch, 2008; Piolino, Desgranges, Benali, & Eustache, 2002).

Levine et al. (2002) developed an Autobiographical Interview (AI), which extracted indices of semantic and episodic autobiographical information from each recollected memory. Participants were asked to recall memories from five life periods. A detailed scoring method was used: All recalled elements were categorized as "internal" details (episodic recollection) or "external" details. It should be noted that "external" details included personal semantic memories, but they also included a number of different components: semantic details, repetitions, metacognitive statements, editorializing (for example: "That doesn't matter"), and details of (episodic) events or factual information that were not part of the main event. Therefore, the total number of external details did not represent a purely semantic measure, and this may affect the pattern of results. Examining the individual detail category "semantic details" rather than the composite "external details" could be a solution to this (Fuentes & Desrocher, 2013; Levine et al., 2002; St. Jacques & Levine, 2007; Willoughby, Desrocher, Levine, & Rovet, 2012). Moreover, users of the AI often only ask participants to recall one memory for each life period, as in the Levine et al. (2002) paper, whereas the AMI samples three memories per life period. Barnabe, Whitehead, Pilon, Arsenault-Lapierre, and Chertkow (2012) suggested that requesting two or more events per life period might be more likely to produce a temporal gradient, whereas recalling just one event might reflect the rehearsal effect of a repeatedly retrieved memory. Race and Verfaellie (2012) suggested that "additional insight into the pattern of remote autobiographical memory impairment in patients with Korsakoff's syndrome could be gained by studies that use more sensitive measures to evaluate the richness and detailed nature of patients' extended autobiographical narratives" (p. 111). To our knowledge, the AI has not yet been used in patients with amnesia due to Korsakoff's syndrome.

Some autobiographical memory studies have included rating scales in order to evaluate the impact of additional factors that might affect autobiographical retrieval and the temporal gradient. For example, Buchanan, Tranel, and Adolphs (2006) employed the Crovitz procedure, and asked participants to rate their memories for pleasantness, emotional intensity, vividness, rehearsal, personal significance, and confidence on 7-point rating scales. This is potentially useful because, for example, emotion may modulate ageing effects in episodic memory (St. Jacques & Levine, 2007). Moreover, it has been demonstrated that patients with semantic dementia were more likely to remember autobiographical episodes that were high in autobiographical significance than episodes of low significance, although patients with damage to the medial temporal lobe (MTL) did not exhibit this bias (Westmacott, Black, Freedman, & Moscovitch, 2004). Examination of emotional significance on autobiographical memory recall has not been examined as such in patients with Korsakoff syndrome. However, a previous study examining flashbulb memories in Korsakoff patients suggested that Korsakoff patients are capable of remembering highly emotional events (Candel, Jelicic, Merckelbach, & Wester, 2003).

The aim of this study was to examine whether differences between the AMI and AI procedures would influence the presence or absence of a temporal gradient in semantic and episodic autobiographical memory in Korsakoff patients. To date, the AMI and the AI have never been compared in patient groups other than patients with medial temporal lobe damage due to Alzheimer's disease or mild cognitive impairment (MCI; Barnabe et al., 2012). In doing this, we analyzed "semantic details" instead of "external details" on the AI to ensure that we had a purer measure of personal semantic memory. Moreover, we examined whether varying the number of memories to be recalled from each life period affected the pattern of the gradient. Last, we incorporated subjective rating scales for the retrieved life events, based on Buchanan et al. (2006), to see whether emotionally enhanced memories affected the pattern of recall in the Korsakoff patients.

Our specific aims were:

(1) To see whether or not we obtained a temporal gradient on either task (AMI, AI) in the Korsakoff patients.
(2) To see whether the AI would be more sensitive than the AMI to episodic autobiographical memory differences between the groups.
(3) To see whether the tests would differ with respect to the slope of the temporal gradient.

Method

Participants

We recruited 20 patients with Korsakoff's syndrome at the Centre of Excellence for Korsakoff and Alcohol-Related Cognitive Disorders of

Vincent van Gogh Institute for Psychiatry in Venray, the Netherlands. The criteria for alcoholic Korsakoff's syndrome (Kopelman et al., 2009) had to be met: a disproportionate memory disorder with evidence of a history of Wernicke encephalopathy, and a history of malnutrition or thiamine deficit. This diagnosis was consistent with the International Classification of Diseases–10th Revision (ICD–10; World Health Organisation, 1992) amnesic syndrome, due to use of alcohol, and also with *Diagnostic and Statistical Manual of Mental Disorders–Fifth Edition* (DSM–5; American Psychiatric Association, 2013) alcohol-induced major neurocognitive disorder as established by neurological, psychiatric, neuroradiologial, and neuropsychological examinations. Patients' family and medical records provided background information (including drinking history). All patients were abstinent from alcohol for at least 6 weeks at the time of testing. None of the patients had any evidence of other brain pathology that would account for their memory deficit. None of the participants met the proposed clinical criteria for alcohol-related dementia (Oslin, Atkinson, Smith, & Hendrie, 1998).

The control group consisted of 27 healthy participants. Exclusion criteria were the presence of subjective memory complaints, a history of neurologic disease, psychiatric disorders, or medical conditions that may affect cognitive function. The experimenter screened the controls on these criteria (self-reports by the participants). All participants were native Dutch speakers, who lived independently in the community. The controls were recruited by word of mouth.

The groups were matched with respect to age, $t(45) = 0.57$, $p = .569$, estimated IQ, $t(44) = -1.00$, $p = .321$, measured with the National Adult Reading Test (Schmand, Bakker, Saan, & Louman, 1991), and sex distribution, $\chi^2(1) = 0.34$, $p = .854$. The control group had a higher mean educational level than the Korsakoff group (Verhage, 1964; $U = 126$, $Z = -2.40$, $p = .017$). Memory performance of the Korsakoff group and controls was evaluated with the Dutch version of the Rivermead Behavioural Memory Test—Third edition (RBMT–3; Wester, Van Herten, Egger, & Kessels, 2013) to assess anterograde everyday memory problems, and the Dutch News Events Test (AMV; Meeter, Eijsackers, & Mulder, 2006), to measure retrograde amnesia for semantic material. The Korsakoff group was impaired on the RBMT–3, $t(45) = -10.04$, $p < .001$, and the AMV (all *ps* ≤ .001) compared with the controls. A summary of the results is presented in Table 1.

Table 1. Participant characteristics.

Participants and tests	Group: Control (n = 27)	Korsakoff (n = 20)	p
Demographic information			
Age (years)	56.5 (7.9)	57.8 (7.2)	*ns*
Sex distribution (men/women)	21/6	16/4	*ns*
Education (level)	5 (3)a	4 (5)a	<.020
Abstinence (months)		6.2 (4.9)	
Neuropsychological tests			
NART-IQ	93.4 (13.6)	89.1 (15.3)	*ns*
RBMT–3: Global Memory Index	94.0 (16.1)	57.0 (3.9)	<.001
AMV Total	17.1 (7.5)	5.7 (6.2)	<.001
AMV '80s	6.6 (2.7)	2.9 (3.1)	<.001
AMV '90s	5.7 (2.8)	1.6 (2.3)	<.001
AMV '00s	4.8 (2.7)	1.5 (2.7)	<.001

Note. Mean scores with standard deviations in parentheses; NART-IQ = IQ as measured with the National Adult Reading Test; RBMT–3 = Rivermead Behavioural Memory Test–Third Edition; AMV = Amsterdam Media Questionnaire.
[a]Median and range are displayed.

Procedure

The Dutch version of the AMI was used (Meeter & Murre, 2003). The English-language version of the AI was translated to Dutch by the first author. Two expert researchers with knowledge of the topic pointed out inadequate expressions/concepts and discrepancies in the translated interview. An independent bilingual translator, without knowledge of the topic, translated the instrument back to English. A comparison between the original and the translated interview showed no important differences in content. The translated AI was piloted on a healthy participant.

Following Barnabe et al. (2012), the procedure used in the present study combined the AMI and AI into one interview, and therefore differs slightly from the typical procedures. The rationale for modifying the procedure was that there was one testing session only; we wanted to avoid interference between the two tasks, and to arrange that the scoring procedures for both interviews could be applied to the same set of answers. The total administration was recorded (using a voice recorder) by the experimenter, and all memories were transcribed by the experimenter. Patients' memories were checked using information from medical files and reports from the medical staff to control for confabulations.

The participants were asked to recall knowledge from different life periods (childhood, young adulthood, recent period), based on the complete set of 43 questions from the AMI personal semantic schedule. For example, they were asked to retrieve the name of their high school. Immediately after this, autobiographical event memory was assessed by asking the participants to recall two events from each of five life periods, as in the standard AI procedure, but asking for two events per life period instead of one. Following Barnabe et al. (2012), the last life period included the past 5 years as opposed to only the year immediately before testing. The purpose of this was to examine more recent retrograde memories—that is, for premorbid events.

As recommended in the AI and AMI manuals, it was emphasized that the events had to be specific in time and place. The participants were allowed to speak freely, without a time limit. The examiner used only the following prompts: "Please go ahead" and "Yes." Following the AI manual, if the participant was unable to produce an event, a list of typical life events was presented to prompt recall of specific events. After the participants had finished retrieving each memory, the examiner determined whether the description of the event was detailed enough (i.e., a specific event, including time and place). If not, following the method of the AI (Levine et al., 2002), general probes were administered in order to clarify instructions or for eliciting more details. An example of such a probe is: "Is there anything else you could tell me?" There was no limit to the number of times general probes could be presented.

Immediately after recollection of a detailed episodic memory, participants were asked to rate subjective experience for each event on 5-point scales. These were ratings of pleasantness, emotional intensity, vividness, rehearsal, personal significance, and confidence. The experimenter briefly repeated the recently retrieved memory to the participant for each of the six different rating scales. The experimenter also presented the participant with a visual representation of the rating scale as a mnemonic device.

Scoring

The AMI personal semantic schedule was scored according to the instruction manual (Kopelman et al., 1990). A maximum of 21 points could be obtained for each of the three life periods (childhood, young adulthood, recent period), resulting in a maximum total score of 63. This was the AMI score for personal semantic memory. The recalled episodic events were scored according to both the AMI and AI procedures. According to the AMI procedure, recalled events can be given a score ranging from 0 (*a response based on general knowledge; or no response*) to 3 (*a detailed personal event that is specific in time and place*), as described in the AMI manual (Kopelman et al., 1990). Since two events per life-period were asked, a maximum AMI score of 6 could be obtained per life-period. This was the AMI score for episodic autobiographical memory.

For the AI scoring, instructions from the AI protocol were followed (Levine et al., 2002). Details directly belonging to the main event were considered internal details. The total number of internal details constituted the AI measure for episodic autobiographical memory. We examined the semantic component of the AI in two ways. First we looked only at the semantic details—that is, details containing factual information, such as general knowledge and general information specific to the person, but not, for example, metacognitive statements, to keep the AI measure for personal semantic as purely semantic as possible. Subsequently, we also looked at external details as a whole (this included semantic details, repetitions, metacognitive statements, and editorializing).

One rater completed the total scoring procedure (AMI and AI scoring) for all participants. A second rater (who was blind for group membership) randomly completed the total scoring procedure for one half of the participants. Inter-rater reliability was examined. Before performing the scoring, both raters were given the AI reliability training, using a training program supplied by B. Levine. The mean reliability of our two raters compared with "professional raters" on the scoring examples from the training was .84, with a median of .90. Next, the raters scored the transcribed memories in a counterbalanced order to control for order and group effects.

Statistical analysis

A two-way mixed reliability analysis (absolute agreement) was executed to examine inter-rater reliability. Intraclass correlation coefficients

(ICCs) were calculated per life period for the scores as obtained with the AMI and AI. Interpretations of the coefficients were based on guidelines proposed by Cicchetti (1994).

Repeated measures analyses of variance (ANOVAs) were performed to examine personal semantic and episodic autobiographical memories as measured by the AMI and AI, with group as between-subjects factor (two levels: Korsakoff, control) and life period as within-subject factor with three levels for AMI personal semantic memory: childhood, early adulthood, and recent period. For the other analyses, there were five levels: childhood, adolescence, early adulthood, middle age, and the recent period. For AI personal semantic memory analysis, the mean number of semantic details per life period was calculated. We also ran the analysis with the mean number of *external* details per life period. Results for "semantic details" and "external details" were essentially similar. AI episodic autobiographical memory was analyzed in terms of the mean number of internal details per life period. Polynomial planned comparisons were used to further examine the effects. Performing the same analyses for nonpersonal semantic memory (using AMV scores) was not possible, because of floor effects in the Korsakoff group (see Table 1). We also included educational level as a covariate in the above analyses to examine whether the episodic and semantic autobiographical memory scores were influenced by differences in educational level between the two groups.

To examine whether the temporal gradient diminished when only one event per life period was used, repeated measures ANOVAs with polynomial planned comparisons were run again, examining personal semantic and episodic autobiographical memories with only scores from the first recalled event included.

Finally, we examined the "Buchanan" subjective ratings, where an event had actually been recalled. When a Korsakoff patient failed to recall an event, this rating could not be obtained.

Results

Inter-rater agreement

ICCs, as estimates of inter-rater reliability, were calculated between two raters on the AMI and AI, and the results are presented in Table 2. The ICC for the number of internal details on the AI was good. ICCs for the number of semantic details on the AI, for AMI incident schedule, and for AMI personal semantic schedule were excellent.

Table 2. Inter-rater reliability (intraclass correlation coefficients) between two raters on the Autobiographical Memory Interview and Autobiographical Interview.

Interview method	ICC
AI	
Internal details	.61
Semantic details	.87
AMI	
Episodic incident schedule	.94
Personal semantic schedule	.99

Note. ICC = intraclass correlation coefficient; AMI = Autobiographical Memory Interview; AI = Autobiographical Interview.

Personal semantic memory

The results obtained with external and semantic details were highly consistent. The results for external and semantic details are presented in Figure 1. The results of the analyses are presented in the Supplementary data section. Only the results obtained with the *semantic* details analysis are presented here. Figure 2 shows the mean personal semantic memory scores and standard errors as obtained on the AMI and AI. Significant main effects of group were found on the AMI, $F(1, 43) = 112.21$, $p < .001$, $\eta_p^2 = .72$, and AI, $F(1, 45) = 4.13$, $p = .048$, $\eta_p^2 = .08$, with the Korsakoff group having lower personal semantic scores than the control group. Significant interactions between group and life period were found for the AMI, $F(2, 42) = 21.24$, $p < .001$, $\eta_p^2 = .50$, and AI, $F(4, 42) = 2.97$, $p = .030$, $\eta_p^2 = .22$. Both the AMI, $F(1, 17) = 10.00$, $p = .006$, $\eta_p^2 = .37$, and AI, $F(1, 19) = 5.93$, $p = .025$, $\eta_p^2 = .24$, showed significant decreasing linear trends in the Korsakoff group, indicating the presence of a temporal gradient. Both interviews demonstrated no significant linear trend for the control group, indicating that recollection of personally semantic information was relatively stable across life periods in this group. We also included educational level as a covariate in the above analyses and found a significant contribution when examining AMI personal semantic scores across time, $F(2, 41) = 2.57$, $p = .037$, $\eta_p^2 = .14$. However, when controlling for the effect of educational level, a significant group by life period was still found, $F(2, 41) = 17.25$, $p \leq .001$, $\eta_p^2 = .46$. No significant contribution of

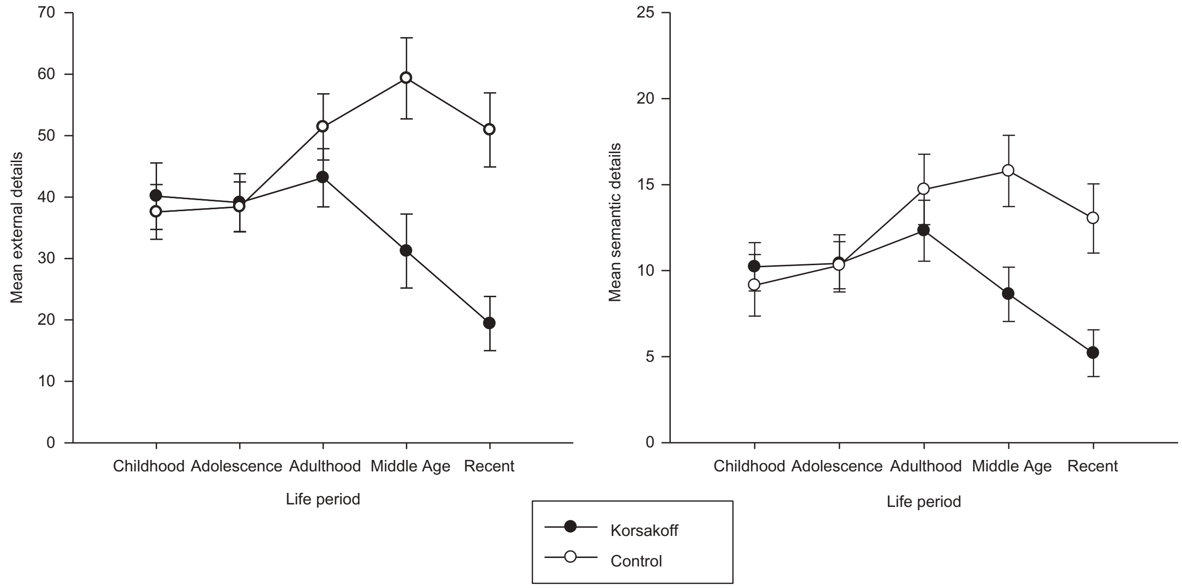

Figure 1. External detail (left panel) and semantic detail (right panel) scores obtained with the autobiographical interview (AI). Error bars represent the standard error of the mean.

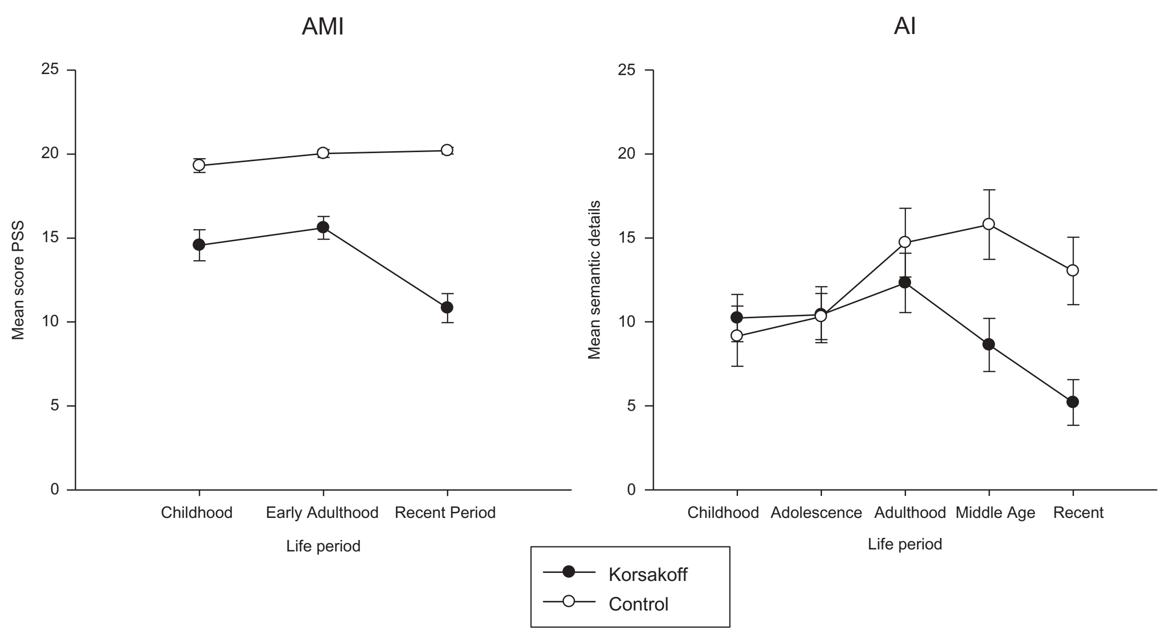

Figure 2. Scores on the personal semantic schedule (PSS) from the Autobiographical Memory Interview (AMI; left panel) and number of semantic details obtained with the Autobiographical Interview (AI; right panel). Error bars represent the standard error of the mean.

educational level was found when examining semantic details obtained on the AI.

Episodic autobiographical memory

Figure 3 shows the mean episodic autobiographical memory scores and standard errors of the groups as obtained on the AMI and AI. Significant main effects of group were found when using both the AMI, $F(1, 45) = 67.39$, $p < .001$, $\eta_p^2 = .60$, and AI, $F(1, 45) = 82.39$, $p < .001$, $\eta_p^2 = .65$. The Korsakoff group recalled fewer episodic details than the controls. Significant interactions between group and life period were found on both the AMI, $F(4, 42) = 6.52$, $p < .001$, $\eta_p^2 = .38$, and the AI, $F(4, 42) = 8.60$, $p < .001$, $\eta_p^2 = .45$. Significant decreasing linear trends in the

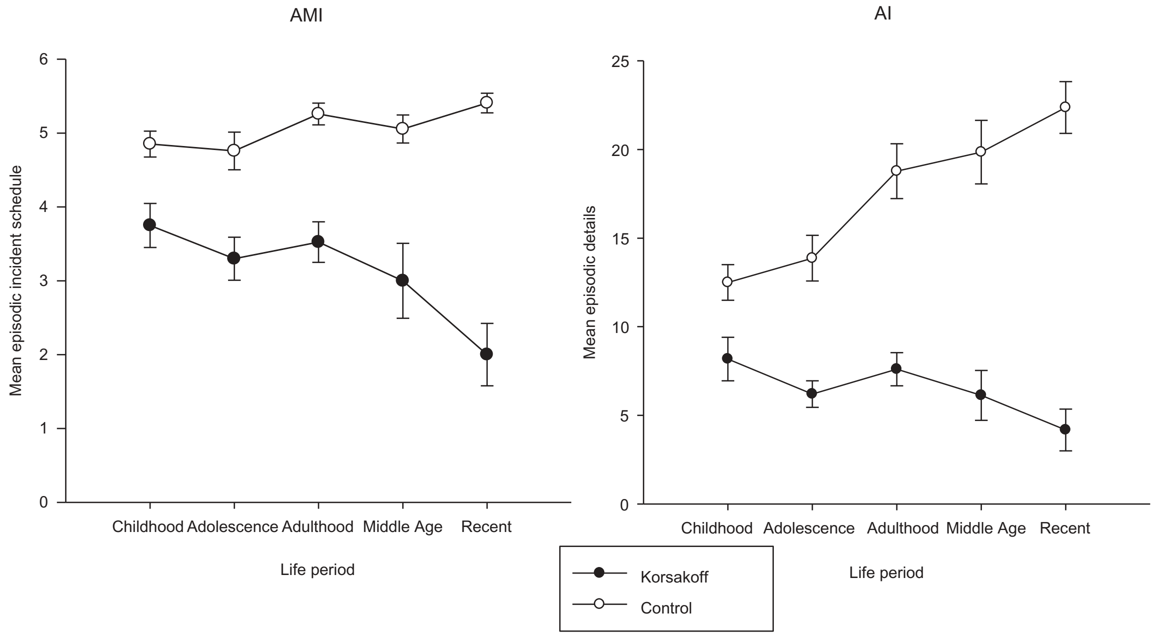

Figure 3. Scores on autobiographical incident schedule from the Autobiographical Memory Interview (AMI; left panel) and number of internal details obtained with the Autobiographical Interview (AI; right panel). Error bars represent the standard error of the mean.

Korsakoff group were found for both the AMI, $F(1, 19) = 10.69$, $p = .004$, $\eta_p^2 = .36$, and the AI, $F(1, 19) = 5.27$, $p = .033$, $\eta_p^2 = .22$, again consistent with a temporal gradient. A significant trend was found for the control group with the AI, $F(1, 26) = 39.06$, $p \leq .001$, $\eta_p^2 = .60$, but not the AMI. On the AI, the controls recalled more internal details from recent periods than from remote periods. We also included educational level as a covariate in the above analyses, but found no significant contribution.

Varying the number of events to be recalled

We examined whether the use of one (the first recalled memory) instead of two memories per life period would obscure a temporal gradient. The mean scores and standard deviations when only using one memory per life period are presented in Table 3. A marginally significant interaction was found for semantic details of the AI, $F(4, 42) = 2.49$, $p = .058$, $\eta_p^2 = .19$. No significant trends were observed in either group. Significant group by life period interactions were found for AI internal details, $F(4, 42) = 5.39$, $p < .001$ $\eta_p^2 = .14$, and the AMI episodic incident schedule, $F(4, 42) = 4.50$, $p = .004$, $\eta_p^2 = .30$, with a significant decreasing linear trends in the Korsakoff group ($p \leq .048$). A significant trend for the control group was only observed with the AI internal details, $F(1, 26) = 20.49$, $p \leq .001$, $\eta_p^2 = .44$, indicating an increase in internal details across time-periods. In sum, examining one memory per life period was still enough to obtain significant interaction effects in the Korsakoff group for episodic memory on both the AI and the AMI, reflecting the presence of a temporal gradient.

Table 3. AMI and AI personal semantic and episodic autobiographical memory scores when scoring one memory.

Interview scores	Childhood	Adolescence	Early adulthood	Middle age	Recent period
AMI—Episodic (range 0–3)					
Korsakoff	2.00 (0.86)	1.65 (0.67)	1.93 (0.61)	1.55 (1.10)	1.00 (1.08)
Control	2.52 (0.51)	2.32 (0.85)	2.70 (0.47)	2.59 (0.50)	2.70 (0.47)
AI—Semantic (range 0—∞)					
Korsakoff	10.55 (8.40)	13.65 (11.18)	13.65 (9.05)	9.10 (6.53)	6.50 (7.96)
Control	10.22 (9.66)	10.26 (8.31)	13.96 (12.40)	15.52 (12.99)	14.41 (15.31)
AI—Episodic (range 0—∞)					
Korsakoff	9.50 (8.75)	6.85 (4.28)	9.20 (5.21)	7.25 (8.40)	3.90 (5.95)
Control	13.93 (8.02)	12.93 (8.97)	19.59 (10.29)	20.48 (10.28)	23.07 (9.71)

Note. Means, with standard deviations in parentheses. AMI = autobiographical memory interview. AI = autobiographical interview.

Table 4. Mean "Buchanan" rating scores.

Group	Pleasantness	Emotional intensity	Vividness	Rehearsal	Significance	Confidence
Korsakoff	3.36 (0.82)	2.71 (1.06)	3.91 (0.67)	2.21 (0.75)	3.27 (1.03)	4.79 (0.36)
Control	3.59 (0.55)	3.28 (0.69)	4.07 (0.54)	2.51 (0.57)	3.56 (0.64)	4.68 (0.36)

Note. Standard deviations in parentheses.

Subjective experience

Table 4 displays the means and standard deviations for the subjective ratings. Only five out of 20 Korsakoff patients recalled a full set of 10 life events. Five patients recalled nine events, three patients recalled eight events, two patients recalled seven events, two patients recalled six events, two patients recalled five events, and one patient recalled only three events. One-way ANOVAs, instead of repeated measures ANOVAs, were run to examine differences in subjective experience by Korsakoff patients, where a memory was successfully retrieved, compared with controls. ANOVAs showed a significant effect of group only on the emotional intensity rating, $F(1, 45) = 4.85$, $p = .033$. The controls rated their memories as more "emotionally intense" ($M = 3.28$) than the patients ($M = 2.71$). There were no significant differences between the groups on the other five ratings.

Discussion

The aim of this study was to examine whether there was a temporal gradient in Korsakoff patients, and whether differences between the AMI and AI procedures influenced the findings in semantic and episodic autobiographical memory in Korsakoff patients. There was a temporal gradient in Korsakoff patients across both aspects of autobiographical memory, and the findings were generally consistent across the AMI and AI, as Barnabe et al. (2012) had found in MCI and Alzheimer patients. Varying the number of events did not affect the pattern of the gradient. In accordance with previous studies, we found temporal gradients for personal semantic and episodic autobiographical memories in this patient group (Albert et al., 1981; Kopelman, 1989; Kopelman et al., 1999; Zola-Morgan et al., 1983).

We found that patients with Korsakoff's syndrome consistently demonstrated remote memory impairments in semantic autobiographical memory across all tested periods compared with healthy controls on both the AMI and the AI. Moreover, both interview methods revealed a significant group by life period interaction effect for personal semantic memory, indicating a robust temporal gradient in personal semantic memory in Korsakoff patients. These results are in line with previous studies using the AMI in patients with Korsakoff's syndrome (Kopelman, 1989; Kopelman et al., 1999). It should be noted that, whereas the AMI personal semantic schedule was designed for assessing semantic autobiographical memory independently of episodic recall, the AI "semantic details score" was not. The AI assumes that semantic and episodic details are not independent of each other, as they are given in the context of the same interview. The scoring of the AI is based on the notion that the recall of episodic events can contain semantic information. Despite this, the results of this study show that the AMI personal semantic schedule and AI semantic details scores are equally likely to detect a temporal gradient in patients with Korsakoff's syndrome.

Although the findings were largely comparable between the AMI and AI, some differences must be addressed. First, the effect sizes for the main effect of group and the group by time period interaction for semantic autobiographical memory were considerably higher for the AMI than for the AI. It is not clear what caused these differences in effect sizes. A possibility might be that participants were not asked to provide semantic memories according to the AI instructions. The AI semantic details score shows how much semantic information is incorporated in the context of episodic events, and it does not directly reflect memory for personal facts. Future studies should consider adjusting the AI method, and include semantic probing for a fairer comparison between the AMI and AI personal semantic scores. Second, the AI is a fine-grained method with an extended scoring system. Although the inter-rater reliability of the internal details was good, the scoring system appears to be more difficult (even for trained raters in this study) than the scoring of the AMI, which has excellent inter-rater reliability. Finally, across all life periods controls scored consistently high on the AMI's personal semantic schedule, likely reflecting a ceiling effect. This was also pointed out by Levine et al. (2002). However, it must be noted that the AMI was designed to examine autobiographical memory in patient groups, not healthy participants.

Only a few studies examined the pattern of episodic autobiographical memory loss in patients with Korsakoff's syndrome. Moreover, the AI does not appear to have been administered in this patient group before. We found that Korsakoff patients were impaired in episodic autobiographical memory compared with healthy controls across all time periods, and that there was a significant group by life period interaction effect for episodic autobiographical memory using both the AMI and the AI. These results are consistent with previous findings in Korsakoff patients using the AMI and Crovitz procedures (Kopelman, 1989; Kopelman et al., 1999, 2009; Zola-Morgan et al., 1983). The results from the present study indicate that the AMI and AI were equally able to detect a temporally graded pattern of retrograde amnesia in personal semantic and episodic autobiographical memory when assessing Korsakoff patients. Hence, the temporal gradient in Korsakoff patients would not appear to be an artifact of either the AMI or the AI method.

We also examined the effect of asking for only one memory to be recalled from each life period, as is commonly done using the AI. Barnabe et al. (2012) found that requesting one memory per life-period obscured the presence of a temporal gradient in episodic autobiographical memory in Alzheimer patients, presumably because participants recalled only their best "embedded" and most richly rehearsed episode. The present study shows that in Korsakoff patients, by contrast, a temporal gradient for episodic and personal semantic autobiographical memory was present even when only the first recalled memory was scored on both the AMI and the AI. Kopelman (1989) reported that Korsakoff patients show a "steeper" gradient than patients with Alzheimer's disease, and this may have contributed to the greater robustness of the temporal gradient in the Korsakoff group on testing for a single memory per life-period.

We also examined whether the recollection of episodic or internal details by Korsakoff patients showed enhanced, similar, or diminished emotional valence, compared with controls' episodic recall. However, only five Korsakoff patients were able to produce a full set of 10 life-events, and the other patients recalled a lower number of life-events. Overall, the controls indicated that they experienced their memories as more "emotionally intense" than the Korsakoff patients. No significant differences on other ratings were found between the groups, indicating that, where successful retrieval had occurred, the subjective experience of the events was comparable across the groups. In other words, if Korsakoff patients could recall autobiographical memories, they did not differ from controls in subjective experience, except on ratings of "emotional intensity" itself. It has been demonstrated that patients with Korsakoff's syndrome are likely to remember highly emotional events (Candel et al., 2003). It is possible that the reversed effect might also be true: Autobiographical memories that are rated as less emotionally intense are more prone to be forgotten. Future studies should examine the topic of emotionality and autobiographical memory in Korsakoff patients in greater depth.

Various theories exist regarding the nature and appearance of temporal gradients in amnesic disorders (Alvarez & Squire, 1994; Cermak, 1984; Nadel & Moscovitch, 1997; Squire, 2006; Winocur & Moscovitch, 2011). These theories have focused mainly on the role of MTL, and in particular the hippocampus. According to consolidation theory (Alvarez & Squire, 1994), recent memories are in the process of consolidation, and will therefore be more vulnerable to disruption in brain damage than older memories, giving rise to a temporal gradient for both semantic and episodic memories. In contrast, multiple trace theory (Nadel & Moscovitch, 1997) suggested that the loss of memories depends on the number of traces laid down, and that there is a steeper gradient for semantic facts than for episodic memoires. As Korsakoff patients' primary damage is in the diencephalon rather than the MTL (Pitel et al., 2012; but see Sullivan & Pfefferbaum, 2009), no specific claims about MTL functioning can be made in the present study. However, our results are highly relevant for understanding the nature of temporally graded retrograde amnesia in patient groups with lesions in brain areas other than the MTL. The findings showed a temporal gradient in the Korsakoff patients for personal semantic and episodic autobiographical memories. We suggest that future studies might focus on the collection of similar data in other patient groups with autobiographical memory impairments resulting from brain lesions outside the MTL.

Some limitations of this study must be addressed. The procedure used in the present study combined the AMI and AI into one interview. The rationale for modifying the procedure was to apply the scoring procedures for both interviews to the same set of answers, and to prevent interference between the two tasks. These modifications were also used in Barnabe et al. (2012). However, by modifying the procedures, some important changes were made to both protocols. For example, we omitted the specific probe condition of the AI interview, which could have affected our results.

In summary, there was a temporal gradient in Korsakoff patients for both personal semantic and episodic autobiographical memory, detectable on both the AMI and the AI. Both tasks appeared sensitive to picking up differences between a control group and Korsakoff patients, and the slope of the temporal gradient appeared similar across the two tasks.

Autobiographical memory is difficult to assess, and available methods have been criticized. Moreover, it has been suggested that the presence of a temporal gradient is related to the technique used. The results of this study show that the temporal gradient for autobiographical memory is a robust and reliable finding in amnesic patients, not an artifact of a particular method. These results indicate that a temporally graded retrograde amnesia is also present in patients with lesions in brain areas other than the MTL. Moreover, the results of this study demonstrate that the AMI and AI are both appropriate interview methods to clinically and empirically assess important phenomena associated with the amnesiac syndrome: retrograde amnesia and the temporal gradient.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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