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Please cite the final published version:

Marie Kirk, Katrine Willemoes Rasmussen, Susanne Bollerup Overgaard & Dorthe Berntsen (2019) Five weeks of immersive reminiscence therapy improves autobiographical memory in Alzheimer's disease, *Memory*, 27:4, 441-454, DOI: [10.1080/09658211.2018.1515960](https://doi.org/10.1080/09658211.2018.1515960)

Publication metadata

Title:	Five weeks of immersive reminiscence therapy improves autobiographical memory in Alzheimer's disease
Author(s):	Marie Kirk, Katrine Willemoes Rasmussen, Susanne Bollerup Overgaard & Dorthe Berntsen
Journal:	Memory
DOI/Link:	https://doi.org/10.1080/09658211.2018.1515960
Document version:	Accepted manuscript (post-print)

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Five Weeks of Immersive Reminiscence Therapy Improves Autobiographical Memory in
Alzheimer's Disease

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Abstract

We examined the effects of a new Immersive Reminiscence Therapy (IRT) programme on cognitive function, including autobiographical memory, in a sample Alzheimer's disease (AD) patients. A total of 43 AD patients with mild to moderate disease severity were randomly assigned to either an intervention group (n = 22, MMMSE = 20.77), or a control group (n = 21, MMMSE = 19.24). The intervention group received one weekly group-based session of IRT for five weeks in an authentic 1950s style museum environment, matching the time of the participants' youth. IRT included semi-structured conversations about the past. The control group received standard care. We assessed performance on cognitive function and autobiographical memory at baseline and post-intervention. Five weeks of IRT enhanced subsequent autobiographical memory performance, when participants were cued by concrete objects dated to their youth. Object-cued memories reported post intervention included a significantly higher degree of episodic details and higher word counts. The intervention showed no effect on the Autobiographical Memory Interview or word-cued recall. Global cognitive function and semantic autobiographical memory performance increased across time for both groups. Our findings demonstrate that immersion into a setting, rich on concrete cues dated to the participants' youth can improve autobiographical remembering.

Keywords: autobiographical memory; episodic memory; immersive reminiscence therapy; cognitive stimulation; Alzheimer's disease; object-cueing

Five Weeks of Immersive Reminiscence Therapy Improves Autobiographical Memory in Alzheimer's Disease

Reminiscence therapy is a popular psychosocial intervention in dementia that aims to stimulate autobiographical memory and increase subjective well-being by means of different activities directed at activating the participants' memories. The notion of reminiscence was introduced by Butler (1963) and broadly refers to reviewing the personal past, which, according to Butler, was a means to attaining integrity in old age. There is no golden standard as to what constitutes reminiscence therapy and no shared definition of the term (Dempsey et al., 2014), which may explain the wide range of methods used in the field.

One popular approach is individual-based reminiscence therapy, where participants typically develop a biography, or life story book, reviewing significant events from their past (e.g. Haight, Gibson & Michel, 2006; Morgan & Woods, 2010). Another approach involves group-based interventions, stimulating autobiographical memory recall during group conversation with the aid of memory triggers, such as objects, music and photographs dated to the participants' youth (e.g. Lai, Chi & Kayser-Jones, 2004; Akanuma et al., 2011; Haslam et al., 2010). The inclusion of external memory aids serves various mnemonic functions that are thought to facilitate remembering (Habermas & Paha, 2002; Kirk & Berntsen, 2018a). Common to these approaches is the emphasis on autobiographical memory stimulation by specifically targeting memories from the participants' younger years. This strategy is based on the finding that memory impairments in dementia affect remote memories less than memories for recent events and that individuals with dementia, similarly to healthy, older adults, show increased recollection of memories from their younger years, clustering around adolescence and young adulthood, that is, the time of the reminiscence bump (Fromholt & Larsen, 1991; Greene, Hodges & Baddeley, 1995; Graham and Hodges, 1997; Kirk &

Berntsen, 2018b; Kopelman, 1989, 1992; Piolino et al., 2003; Thomas-Antérion, Jacquin & Laurent, 2000).

The effect of reminiscence therapy

Despite its great popularity in dementia care, it has proved difficult to provide conclusive evidence with respect to the potential benefits of reminiscence therapy. A recent Cochrane review (Woods, O'Philbin, Farrell, Spector & Orrell, 2018), based on twenty-two randomized controlled studies that included both individual- and group-based interventions, concluded that there is some evidence that reminiscence therapy has positive effects on quality of life, cognition, communication and possibly mood in individuals with dementia. Subramaniam and Woods (2012) specifically reviewed the effect of individual-based reminiscence therapy in dementia. Their review included five randomized controlled trials and concluded that individual-based reminiscence therapy shows some immediate benefits on mood, well-being and cognition.

Despite such promising findings overall, studies often yield mixed results with regards to specific measures. For example, in order to assess cognitive functions pre- and post-intervention, several studies used the Mini Mental State Examination (MMSE; Folstein, Folstein & McHugh, 1975) and the Addenbrooke's Cognitive Examination (ACE; Mathuranath, Nestor, Berrios, Rakowicz & Hodges, 2000). Some studies find that performance on the MMSE (e.g. Haight et al., 2006; Wang, 2007; Van Bogaert et al., 2013) and the ACE (Haslam et al., 2010) improves as a function of reminiscence therapy, whereas others find no effect on these measures (e.g. Akanuma et al., 2011; Goldwasser, Auerbach & Harkins, 1987; Ito, Meguro, Akanuma, Ishii & Mori, 2007; Lai et al., 2004; Nakamae, Yotsumoto, Tatsumi & Hashimoto, 2014; Thorgrimsen, Schweitzer & Orrell, 2002).

Surprisingly few studies have specifically examined the effects of reminiscence therapy on autobiographical remembering. Such studies have typically assessed autobiographical memory

performance using the Autobiographical Memory Interview (AMI; Kopelman, Wilson & Baddeley, 1990), which is a semi-structured interview that assesses autobiographical memory and personal semantic memory across three broad time periods ranging from childhood to recent life. Such studies have reported mixed results.

Morgan and Woods (2010) found that twelve individual life review sessions, where participants with dementia created a life story book, significantly improved personal semantic memory, but not episodic autobiographical memory, as measured by the AMI post-intervention. The improvement on personal semantic memory was maintained at a six-week follow-up. Subramaniam, Woods and Whitaker (2014) applied a similar design with 12 individual life review sessions, including the creation of a life story book. Significant improvements were observed on the AMI, for both personal semantic memory and episodic autobiographical memory. However, no effect was observed at a six-week follow-up. In contrast to such studies involving individual-based reminiscence therapy, Woods, Bruce et al., (2012) examined the effects of 12 weeks of group-based reminiscence therapy involving 488 participants with mild to moderate dementia (Woods, Bruce et al., 2012). They found no significant improvements on personal semantic or episodic autobiographical memory as indexed by the AMI at the end the intervention, or seven months later at follow-up.

Taking a slightly different approach, Lalanne, Gallarda and Piolino (2015) used a cognitive training programme for autobiographical memory, where older adults diagnosed with AD individually were presented with autobiographical information related to, for instance, their personal work- and family life, habits, as well as visual and music cues, in a weekly one-hour session over six weeks. The control group was trained on general semantic memory related to famous public figures. The outcome measure used was the test épisodique de mémoire du passé autobiographique (TEMPau; Piolino et al., 2009), based on the AMI. As in the AMI, the test

consists of a semi-structured questionnaire with personal semantic memory and episodic autobiographical memory subscales. AD patients in the autobiographical cognitive training programme showed significant improvements of their episodic and personal semantic memory, compared with the control participants, who showed a decrease. The improvement was maintained two weeks after the post-treatment evaluation.

The present study

The aim of the present study was to examine the effects of a unique Immersive Reminiscence Therapy (IRT) programme on subsequent cognitive and autobiographical memory performance in a sample of AD patients. We use the term IRT in order to emphasize the immersive nature of the intervention, which is different from more standard forms of reminiscence therapy.

The IRT intervention is set out in a museum apartment that recreates the material and cultural contexts of the 1950s, and is designed to closely resemble a typical looking home from the 1950s; that is, from around the time when the participants were young. The apartment is located in Den Gamle By [The Old Town], the National Open Air Museum of Urban History and Culture in Aarhus, Denmark. The setting is decorated with furniture and decor from the 1950s, which means that participants are immersed in a unique and authentic environment that stimulates all modalities (i.e., vision, olfaction, audition, somatic sensation). Hands-on access to everything in the apartment furthermore allows for active exploration, which encourages re-enactment of activities in a style the participants will recognize from their youth (Kristiansen, 2013). A key aspect of the intervention involves semi-structured conversations about the past, based on different themes related to the participants' younger years. Objects relevant to the 1950s and the theme of the session are passed around to stimulate remembering. The main focus of the study is to assess whether IRT brings about change in autobiographical memory performance compared with a group of control participants, who receive standard care.

It has been suggested that the mixed and weak effects in previous studies may reflect the use of outcome measures that are not sufficiently sensitive to capture the potential effects of reminiscence therapy (e.g., Dempsey et al., 2014; Kirk & Berntsen, 2017; Moniz-Cook et al., 2011; Subramaniam & Woods, 2012). In order to address this issue, we include two qualitatively different measures to assess autobiographical memory. First, we include the AMI (Kopelman et al., 1990), which has been used in other reminiscence therapy studies (Morgan and Woods, 2010; Subramaniam et al., 2014; Woods, Bruce et al., 2012). Second, we include an adapted version of the Galton-Crovitz method (Crovitz & Schiffman, 1974; Galton, 1879) with two different conditions, that is, word- and object-cueing (Kirk & Berntsen, 2018a). The Galton-Crovitz method has, to the best of our knowledge, not been used before to index change as a function of reminiscence interventions. We expect retrieval in response to the object-cueing condition of the Galton-Crovitz task to be less dependent on executive functioning compared with more conventional memory tests, because the former provides highly concrete and easily recognisable memory cues dated to the time period of the participants' younger years (Kirk & Berntsen, 2018a). This may be beneficial to AD patients, who demonstrate executive dysfunction (Grober et al., 2008). Importantly, the object-cueing condition corresponds to a key aspect of the intervention - - that is, handling of, and exposure to, concrete objects. As a result, it may be more suitable to successfully index change. In line with previous studies examining the effect of reminiscence therapy, we furthermore include a battery of tests that tap global cognitive ability and executive functioning.

Relative to an AD control group, who receives standard care, we expect an improvement on overall autobiographical memory performance in the intervention group. More specifically, we expect recall of episodic events from childhood and early adult life as measured by the AMI to show improvement post-intervention relative to baseline. We expect that the intervention will have a positive effect on both the word- and object-cued recall conditions of the Galton-Crovitz task. We

also predict that the improvement is larger in the object-cueing condition with memories being more elaborate and containing a higher degree of episodic details after the intervention compared with baseline assessment. Given that earlier work overall reports mixed outcomes with respect to cognitive function, we have no clear predictions for these variables. However, from a theoretical point of view, autobiographical remembering involves multiple components that are also involved in other processes than memory (Rubin, 2006). We thus expect that the effects of IRT, albeit designed to stimulate autobiographical remembering, might generalize beyond autobiographical memory measures and improve overall performance on cognitive function, as indexed by the ACE and MMSE.

Method

Sample and Participant Selection

In the first step of the recruitment phase, eligible participants were identified and recruited through the assistance of regional dementia care workers, who established the initial contact to AD patients and their primary caretakers. Participants were considered for participation if they (a) had received a formal AD diagnosis at a specialized dementia unit¹ (b) were 60 years of age or older, (c) had no history of substance abuse, (d) had no history of severe head injury, or any other major psychiatric disorders, (e) demonstrated no substantial auditory or visual impairments, and (f) were native Danish speakers. Use of antidepressants and medication used to treat AD was not an exclusion criterion. During the second phase of recruitment (see Figure 1), three psychologists screened eligible participants on measures of cognitive ability (the Mini Mental State Examination (MMSE); Folstein et al., 1975) and level of dementia (the Global Deterioration Scale (GDS); Reisberg, Ferris, de Leon & Crook, 1982), and collected background information that provided a

¹ According to the international guidelines outlined by the National Institute on Aging and Alzheimer's Association clinical criteria (McKhann et al. 2011)

brief overview of the participants' life story.

A sample size of 50 participants was deemed sufficient to achieve enough statistical power, based on previous trials that examined the effects of reminiscence therapy on cognition, and which employed similar sample sizes (Akanuma et al., 2011; Goldwasser, Auerbach & Harkins, 1987; Haight et al., 2006; Morgan & Woods, 2010). Thus, a total of 50 participants² were included in the study. They were allocated to ten groups with five participants in each. For logistic reasons, participants living in the same care facilities, or geographical vicinity, were grouped together. Groups were then randomly assigned to the intervention or the control group. Due to the nature of the intervention, it was not possible to blind participants or IRT facilitators to group allocation.

Of the 50 participants initially included in the study, six participants only completed parts of the baseline testing and did not continue participation in the study due to withdrawal or too impaired hearing or vision. Consequently, a total of 44 AD participants completed testing at baseline and post-intervention, see Figure 1. One participant was excluded from the final analyses due to excessive confabulation, see Figure 1, resulting in 22 participants (16 female, 6 male) in the intervention group, and 21 participants (14 female, 7 male) in the control group.

The two groups did not differ with regards to age, years of formal education, depressive symptoms, or global cognitive ability (Table 1). The groups were comparable in terms of gender distribution, living situation, use of anti-dementia medication and anti-depressants, and marital status (Table 2). Participants demonstrated mild to moderate dementia as assessed by the Global Deterioration Scale (GDS; Reisberg et al., 1982), where scores from 1 – 3 are indicative of the pre-dementia stages, and scores from 4 - 7 indicate mild to severe dementia.

² These participants also took part in a study reported elsewhere, assessing object- and word-cued autobiographical memories in individuals with AD and healthy controls (Kirk & Berntsen, 2018a) and a study examining the life span distribution of autobiographical memories in individuals with AD and healthy controls (Kirk & Berntsen, 2018b). These data derived from the baseline measures and thus did not affect the intervention.

Procedure

Ethical approval was obtained from The Central Denmark Region Committees on Health Research Ethics. Each participant gave informed consent in the presence of their primary caretaker. Participants in the control group received an organized museum trip upon completion of the study in return for their participation.

The study employed a randomized controlled trial comparing five weeks of IRT in an intervention group with five weeks of standard care in the matched control group. Both groups completed an identical battery of cognitive tests and an autobiographical memory interview at baseline and again at post-intervention. One to two days after baseline testing, participants in the intervention group commenced the IRT sessions in Den Gamle By [The Old Town]. Post-testing was conducted one to two days upon completion of the intervention. Participants in the control group received usual care and were tested with equal time intervals to the intervention group.

All testing was conducted at the home of the participants by trained psychologists or advanced research assistants. In order to prevent fatigue, testing was structured so that the participants were presented with the more cognitively demanding tasks at the beginning of each session. Rest breaks were provided through the session when necessary, and in a few incidences, assessment was carried out on two separate, but consecutive, days in order to avoid exhaustion with some of the more fragile participants.

Intervention: Immersive Reminiscence Therapy. The IRT sessions were conducted in the Den Gamle By [The Old Town], National Open Air Museum of Urban History and Culture in Denmark, which hosts an apartment that recreates the material and cultural contexts of the 1950s. The apartment consists of a hall, kitchen, bedroom and two adjacent living rooms all decorated with wallpaper, lacquering, furniture and decor that originate from the 1950s. The apartment is unique in the sense that it allows participants to explore the interior including drawers, cupboards and shelves,

all of which contain typical household items, garments and objects from the 1950s. As such, the apartment stimulates access to autobiographical memory through different senses, such as vision, olfaction, audition, and somatic sensation. It also encourages the re-enactment of past activities that the participants likely will recognize from their youth.

Participants attended one weekly session (approximately 90 minutes, including settling in and getting ready to leave) for five weeks (i.e., five sessions in total) in groups of 4-5 participants. Each session was led by 2-3 hostesses with extensive knowledge of the 1950s, who had been instructed in the principles of IRT and were knowledgeable of the cognitive impairment associated with AD. Prior to meeting the participants, and in order to stimulate conversation during the sessions, the hostesses were provided with background information that provided a brief overview of the participants' life story, including information related to family, social relationship, occupation, hobbies and interests.

In accordance with work showing that memories from the younger years are more easily accessed than recent memories in older adults with dementia (e.g., Fromholt & Larsen, 1991; Fromholt, Mortensen, Torpdahl, Bender, Larsen & Rubin, 2003; Graham and Hodges, 1997; Kirk & Berntsen, 2018b, Kopelman, 1989, 1992), each of the five sessions was themed according to different life time periods, spanning from early childhood to young adulthood; 1 = The 1950s in general (e.g., the post-war period, gender roles), 2 = Childhood (e.g., toys, games, play, school), 3 = Youth (e.g., leisure time activities, sport, fashion, music, dance), 4 = Adulthood (e.g., first job, meeting future spouse, starting a family), and, 5 = Celebrations (e.g., birthdays, weddings, christenings).

Each session was organized to allow an easily recognisable structure for the participants. At the beginning of each session, participants and their caretakers were welcomed by the hostesses and shown around the apartment, familiarizing themselves with the surroundings before the sessions

commenced. Caretakers were located in an adjacent room during all sessions. The hostesses would then invite participants to sit down and join them for coffee and cake whilst facilitating a semi-structured and themed talk about a specific life time era. Consistent with the theme of the session, relevant objects, such as dolls, cartoons, tin soldiers in the childhood session, would be passed around in order to aid the memory along. In order to facilitate associative remembering with a minimum of demand on top-down control processes, participants were never required to recall events from their life that specifically pertained to the theme of the session, but were encouraged to share any memory or story that came to mind.

Each session always involved a planned activity, such as setting up the coffee table, whisking cream for the cakes, handling tools, operating the record player that allowed participants to re-enact activities most likely performed during their younger years. At the end of each session, the hostesses would play music originating from the participants' youth, and engage willing participants in community singing. Importantly, participation in the conversations and activities was completely voluntary.

Materials and Outcome Measures

A battery of questionnaires and tests³ were administered at both baseline and post-intervention to assess overall level of cognitive functioning, executive functioning and autobiographical memory.

Global cognitive performance. The Addenbrooke's Cognitive Examination (ACE; Mathuranath et al., 2000), which includes the MMSE (Folstein et al., 1975) was used to assess cognitive ability. Both measures are validated and extensively used in both clinical practice and research to index changes in cognitive status. Maximum scores for the ACE and the MMSE are 100

³ The test battery included other tests and questionnaires that were unrelated to cognitive abilities. These will be reported elsewhere.

and 30, respectively, with higher scores indicating better cognitive ability.

Executive functioning. Executive functioning was assessed on the Frontal Assessment Battery (FAB; Dubois, Slachevsky, Litvan & Pill, 2000), which includes six subdomain tests that tap conceptualization, mental flexibility, motor programming, sensitivity to interference, inhibitory control, and environmental autonomy. The maximum score for the full battery is 18 points (max 3 point per subdomain) with higher scores indicating better executive abilities.

The Autobiographical Memory Interview. The autobiographical memory interview (AMI; Kopelman et al., 1990) is a semi-structured interview that assesses autobiographical memory (recall of specific incidents) and personal semantic memory (recall of personal semantic facts) across three broad time periods that spans from childhood, early adult life to the recent past. The interview generates two separate composite scores; one for autobiographical incidents (range 0-27), and a second one for personal semantic memory (range 0-63), as well as subdomain scores for the three different time periods (range 0-9 for autobiographical incidents; range 0-21 for personal semantic memory). Higher scores on both scales index better recall function.

The Galton-Crovitz Cueing technique. In the present study, the Galton-Crovitz task (Crovitz & Schiffman, 1974; Galton, 1879) included two conditions; a word-cueing condition and an object-cueing condition⁴. As in the standard Galton-Crovitz cue word task for autobiographical memory retrieval, participants are presented with a cue and asked to report the first memory that comes to mind. Besides presenting participants with concrete nouns, the present task includes an additional condition where participants are presented with concrete object cues (Kirk & Berntsen, 2018a).

In the object-cued recall condition, participants are presented with concrete objects, such as

⁴ This test has been described in detail in Kirk and Berntsen (2018a)

a skipping rope, a bottle of perfume, a package of cigarettes (see Appendix 1 for a list of stimuli). All object cues had been carefully selected to match the time period from the participants' younger years, that is, childhood to early adult life. The objects were sampled and selected with the help of two experts (i.e., a historian and a social anthropologist and museum curator) with extensive knowledge of everyday life in the 20th century. In order to ensure that the stimuli were recognizable and relevant to a broad range of participants varying in age, gender, geographical, and socio-economic backgrounds, all stimuli were evaluated in a pilot study.

Participants were presented with a total of 20 cues, 10 cues at baseline testing (five concrete object cues and five verbal cues) and 10 cues (five concrete object cues and five verbal cues) at post-intervention testing. Cues were presented in blocks (words versus objects), and counterbalanced and matched across participants and conditions to avoid order effects and repetition of stimuli. The latter also reduced the risk of practice effects from baseline to post-intervention testing. Importantly, none of the object stimuli used for baseline and post-intervention testing were presented during the IRT sessions.

In the word-cueing condition, participants were presented with the verbal equivalent of the object cues such as the word "skipping rope". All word cues were presented in black font, size 36, on a 210 x 297 mm (8.3 x 11.7 in) on a white card. In the object-cueing condition, participants were presented with the concrete object cue and asked to hold it during recall. In both conditions, cues were presented one at a time, and was always overtly named by the interviewer.

Upon presentation of each cue, the participant was encouraged to report the first memory that came to mind, if any, and were told that the remembered event did not need to be specifically related to the cue. If the cue elicited no memory, the interviewer would simply proceed to the next cue. All interviewers followed standardized interview protocols in order to ensure a minimum of flexibility in the wording of questions or prompting during the tasks. Prompts included asking the

participants to elaborate on the recalled information by providing additional details, as well as naming the specific time of incident. The latter prompt was mandatory if the participant did not provide a specific event by themselves. There was no time limit on the recall task.

Coding of Autobiographical Memory Measures

The Autobiographical Memory Interview. The autobiographical memory interviews were audio recorded for subsequent transcription and coding of autobiographical episodes. Two raters, blind to assessment time and group assignment, coded the autobiographical content according to the AMI scoring protocol. Interrater reliability analyses using Kappa statistics demonstrated high consensus between raters for both baseline, $k = .77, p < .001$, and post-intervention, $k = .77, p < .001$.

Object and word cued recall. Participants' answers in response to word and object-cued recall were also audio recorded and transcribed. The transcriptions were coded for frequency of memories, episodic content, and description length. Two trained raters, blind to assessment time and group assignment, segmented the content into a total of 621 units. Each unit was defined as an independent narrative with no thematic overlap between other units, and with an identifiable beginning and end. The total number of memories generated in response to the five cues in each condition was included for subsequent statistical analysis when examining frequency (i.e., total number of memories recalled). Frequency scores ranged from 0 to 13 units in response to words, and 0 to 11 for objects, across both groups and times of testing.

In order to assess the episodic content of the reported memories, all separate units were coded according to a rating scale developed by Piolino, Desgranges, Benali and Eustache (2002) that assesses the vividness and the degree of details of the memories. The scale consists of seven different scores that range from an absence of an answer to providing a specific event with a high degree of detail; 0 = Absence of an answer or general information, 0.5 = Vague personal

impression, 1 = Vague event /repeated or continuous with little details of time and space, 1.5 = Generic event (repeated or continuous situated in time and space, 2 = Detailed generic event (repeated or continuous, situated in time and space), 2.5 = Specific event (isolated, situated in time and space) without details, and 3 = Specific event (isolated in time and space) with details (thoughts, emotions, images etc.). Thus, high scores index recall with a high degree of episodic content, whereas low scores index more overgeneral and decontextualized information. Data were scored by two raters blind to condition and group. Interrater reliability analyses using Kappa statistics yielded high agreement for both baseline, $k = .83, p < .001$, and post-intervention, $k = .70, p < .001$.

In order to examine the description length of the recalled memories, word counts were calculated for the verbatim transcripts generated in response to each cue. Description length was not calculated for each unit, but for the total amount of words generated in response to a cue.

Results

Data from the outcome measures assessing global cognitive ability (ACE), executive functioning (FAB) and autobiographical memory (AMI, word and object- cued recall) were analysed using 2×2 (Group [intervention, controls] \times Time [baseline, post-intervention]) repeated measures analyses of variance (ANOVA) with group as a between-subjects factor, and time as a within-subjects factor.

Global cognitive performance. Results demonstrated a significant main effect for time, $F(1, 39) = 11.40, p = .002, \eta^2 = .22$, revealing that performance on the ACE significantly increased by approximately 3 points from baseline to post-intervention in both groups as a function of time. There were no significant main effects for group, $F(1, 39) = .32, p = .578, \eta^2 = .01$, and no significant interaction between group \times time, suggesting that five weeks of IRT did not improve global cognitive function in the intervention group, relative to the control group, $F(1, 39) = .02, p =$

.898, $\eta^2 = .00$.

Executive functioning performance. Examining the effects of IRT on executive functioning performance yielded no significant main effects for group, $F(1, 39) = .04, p = .837, \eta^2 = .00$, or time, $F(1, 39) = 1.63, p = .209, \eta^2 = .04$. The interaction between group \times time was also non-significant for the FAB, $F(1, 39) = 1.32, p = .257, \eta^2 = .00$, indicating no change in the intervention group with respect to performance on executive functioning relative to the control group.

The Autobiographical Memory Interview.

Autobiographical episodic memory. Examining the effects of IRT versus usual care on episodic autobiographical recall, as indexed by the AMI composite score for all three time periods (childhood, early adult life, the recent past), yielded non-significant main effects for group and time reflecting similar performances between groups and across time, (see Table 3 for descriptive and inferential statistics). The interaction between group \times time was also non-significant, suggesting that IRT did not improve episodic autobiographical recall as indexed by the AMI. Three separate ANOVAs were conducted for the three different life time periods covered by the AMI. In each case, results replicated the results of the episodic composite score, yielding no significant main or interaction effects for childhood, early adult life or the recent past (see Table 3).

Personal semantic memory. A different pattern was observed for performance on the personal semantic memory schedule of the AMI. Whereas the main effect for group was non-significant (see Table 3), the main effect for time was significant, suggesting that all participants, irrespective of experimental manipulation, improved their performance on recall of personal semantic memory from baseline to post-intervention. A non-significant interaction between group \times time indicated no change in the intervention group relative to the control group, suggesting that five weeks of IRT did not affect personal semantic memory.

Separate ANOVAs were conducted for childhood, early adult life and the recent past in order to examine whether semantic recall improved equally across the three different time spans. Only recall of personal semantic memory from childhood significantly increased from baseline to post-intervention in both groups regardless of experimental manipulation, whereas performance scores remained stable across time for the two remaining time periods. All other main effects and interactions were non-significant (see Table 3).

Autobiographical memory: word-cued recall. Main effects for group and time were all non-significant for the frequency, episodic content and word count measures for the word-cueing condition. Results furthermore yielded non-significant interactions between group \times time on all three measures, indicating that five weeks of IRT did not enhance word-cued recall (see Table 4).

Autobiographical memory: object-cued recall. The main effect for group on the frequency measure in the object-cueing condition was non-significant, whereas the main effect for time was significant (see Table 4). As shown by the average number of memories recalled in response to object cues, both groups recalled a higher frequency of memories at post-intervention relative to baseline. Calculating the percentagewise increase in frequency, showed that recall in the intervention group on average increased by 31 % relative to 9 % in the control group, indicating a numerically larger increase in the intervention group, see also Figure 2A. However, the interaction between group \times time was non-significant, indicating no significant change in the intervention group relative to the control group.

As shown in Table 4, results from the episodic content measure yielded non-significant main effects for both group and time, but a significant interaction between group \times time, suggesting differences between the two groups across time. Post hoc t-tests demonstrated that object-cued memories significantly increased in episodic content (e.g., degree of details, images, thought, emotions) from baseline to post-intervention in the intervention group, $t(21) = 2.61, p = .016, d =$

.66, whereas no change was observed in the control group, $t(19) = -0.77$, $p = .453$, $d = .18$, see also Figure 2B.

Results from the word count data yielded non-significant main effects for group and time. However, a borderline significant interaction emerged between group \times time, $p = .050$. Post hoc t -tests were conducted in order to examine this further, and demonstrated a significant increase in word counts in the intervention group, $t(21) = 3.50$, $p = .002$, $d = .97$, relative to a small decrease in the control group, $t(19) = -0.24$, $p = .814$, $d = .05$, suggesting more elaborate memory descriptions post intervention. Calculating the percentagewise increase showed that description length increased from baseline to post-intervention by 29 % in the intervention group, relative to a decrease of 3 % in the control group, see also Figure 2C.

Discussion

We examined the effects of one weekly session of IRT over a five-week period on older adults diagnosed with AD. During the IRT sessions the participants were immersed into an authentic 1950s style environment that corresponded to the time period of the participants' youth, where they participated in conversations structured by two hostesses. A control group received normal care. The intervention improved autobiographical memory performance, when participants were cued by nonverbal stimuli in terms of concrete objects dated to the 1950s. Memories recalled in response to object cues were more specific, included a higher degree of details (e.g., thoughts, emotions, images), and were more elaborate, relative to memories reported prior to the intervention. A similar effect was not observed in the control group.

In contrast, autobiographical memory performance on the word-cued recall task remained stable across time for both groups. The same applied to the episodic subscale of the AMI. The latter finding is somewhat surprising, as the IRT intervention was themed around many of the life time periods covered by the AMI. Therefore, an increase in recall of personal incidents was expected on

this measure. However, another study (Woods, Bruce et al., 2012) examining the effects of group-based reminiscence therapy on autobiographical memory also found no significant improvement on the AMI. In contrast, two studies using an individual based methodology (Morgan & Woods, 2010; Subramaniam et al., 2014), found that twelve individual life review sessions improved performance on both the episodic and semantic subscales of the AMI post intervention.

The key to understanding these mixed findings may be a distinction between group- and individual-based therapy. Woods, Bruce et al., (2012) found no effect of reminiscence therapy when using a semi-structured group-based approach, whereas the paradigm used by Morgan and Woods (2010) and Subramaniam et al. (2014) involved a highly personalized life review approach that resembled the format of the AMI. During the sessions, participants were guided chronologically through their individual life stages, spanning from early childhood to adulthood. Thus, rather than covering general themes relevant to a broader group, a highly personal and individualized life story book was completed over the course of twelve weeks in the studies that identified an effect (Morgan and Woods, 2010; Subramaniam et al., 2014). As the AMI may be viewed as a structured biography that lists key incidents and hallmarks of one's life, the outcome measure closely matched the intervention in these studies. This may partially explain their results.

In the present study, both the intervention- and control groups showed an improvement on recall of personal semantic facts, probed by the AMI. More detailed analyses showed the effect to be specifically pronounced for personal semantic facts related to the childhood period, whereas no significant effects were observed for the other two life time periods on the AMI. Similarly, performance on the ACE improved across time for both groups. Improved performance on the personal semantic subscale of the AMI and the ACE may reflect practice effects, although we find it hard to explain why this should pertain only to these specific tests. It is possible that thinking and

talking about one's personal life at baseline testing in itself had a beneficial effect. More research is needed to replicate and attain a deeper understanding of these unexpected effects.

Five weeks of IRT did not bring about change in overall cognitive ability or executive functioning. Overall, there is some evidence to suggest that people with dementia demonstrate the ability to learn and retain some skills, as long as the training is targeting the specific cognitive domains in which change is desired (see Bahar-Fuchs, Clare & Woods, 2013, for a review on cognitive training and cognitive rehabilitation in dementia). Considering the fact that the intervention was specifically aimed at stimulating autobiographical remembering, it makes sense that effects of the intervention were limited to autobiographical memory and did not generalize to other cognitive abilities.

How should we explain the finding that the five weeks of IRT specifically enhanced memory performance on object-cued recall in the present study, while there was no effect of the intervention on any of the other two autobiographical memory measures? It seems plausible that the improvement observed on object-cued recall may reflect skills, such as retrieval practice, gained during the five weeks of IRT that transferred beyond the sessions. Although the intervention did not directly involve training specific skills, participants were nonetheless repeatedly exposed to stimuli that stimulated retrieval, which may have strengthened and fostered retrieval strategies that could be utilized post intervention, when exposed to similar cueing (i.e., cueing with concrete objects).

It has been suggested that the sparseness of significant effects of cognitive interventions in dementia populations may be due to outcome measures that are not sufficiently sensitive to index changes in performance and behaviour (Bahar-Fuchs, Clare & Woods, 2013; Cotelli et al., 2012; Kirk & Berntsen, 2017; Subramaniam & Woods, 2012; Woods et al., 2005, Woods, Aguirre et al., 2012). In the present study, recalling memories in response to objects dated to the 1950s in the object-cueing task closely resembled key aspects of the intervention (retrieval in response to

nonverbal stimuli), which may explain why this particular autobiographical memory task was sufficiently sensitive to capture change from baseline to post intervention. In addition, the object-cueing paradigm involves a retrieval task that is cognitively easier and may appear intuitively more meaningful and stimulating than tasks requiring memory retrieval in response to verbal cues. This suggestion is supported by Kirk and Berntsen (2018a), who found that AD patients benefit reliably from cueing by objects, relative to cueing by verbal stimuli. The authors proposed two reasons for this effect. Concrete object cues scaffold and constrain the retrieval search, hereby minimizing demands on top-down control, and hence strategic processing, facilitating easier and more direct access to autobiographical memories. Moreover, the object cues were specifically chosen to correspond to the earlier parts of the participants' lives by deriving from everyday life of the 1950s.

In contrast, the AMI relies on verbal cueing, and requires that participants strategically retrieve a specific event from, for instance, the primary school years or one's first job in response to a verbal request. As AD is associated with severe executive functioning deficits from the early onset of the disease (Grober et al., 2008), which hamper voluntary, strategic recall, specific questions posed by the AMI may be hard for this population. Similarly, conducting a voluntary search for a memory in response to a relatively generic word, such as *skipping rope* or *cigarettes* in the word-cued recall condition, places great demands on top-down control. Thus, as both tasks rely on verbal cues and on a high degree of voluntary, strategic retrieval, they may not have been sufficiently sensitive to capture potential effects on overall AM performance in the intervention group. In comparison, the object-cued task provides more external retrieval support and thus places less demands on executive processes, for which reason it may provide a more sensitive test.

The process of stimulating access to one's personal memories is transferable to more practical everyday living skills, as autobiographical remembering allows us to establish and maintain social relationships and engage in meaningful interactions with others (e.g., Bluck, Alea, Habermas &

Rubin, 2005; Pillemer, 2003; Alea & Bluck, 2007; Harris, Keil, Sutton, Barnier, & McIlwain, 2011; Harris, Rasmussen & Berntsen, 2014). There is also evidence that remembering past events support a sense of self and identity (see e.g., El Haj, Antoine, Nandrino & Kapogiannis, 2015; Prebble, Addis & Tippett, 2013). Thus, immersing individuals with AD into a setting rich on environmental cues dated to the time best preserved in the participants' memory does not only stimulate access to autobiographical memories, but may also indirectly strengthen interpersonal relationships between, for instance, the patient and a professional caregiver. Many residential homes and activity centres have designated reminiscence areas available, and findings from the present study suggest that the use of these areas may indeed be beneficial to AD patients.

Limitations and Future Directions

The study suffers from a number of limitations. The relatively small sample size, and hence limited statistical power, may have led to a Type II error on some of the included variables. This appears especially likely for the frequency measure for object-cued recall. Although both groups recalled a higher frequency of autobiographical memories at the end of the study, the numerical difference was larger in the intervention group, indicating that results from the frequency measure may have reached significance had the study included larger groups. In the light of the relatively small sample sizes and the novelty of our task and intervention method, it is important that the present findings are replicated before firm conclusions are drawn. Similarly, the lack of robust positive findings in the reminiscence field has been attributed to insufficient outcome measures not able to adequately index changes in performance. The presents study demonstrates that using a measure that matches key aspects of the intervention may more easily capture the subtle changes occurring. Although this remains to be tested, it is possible that the use of a more sensitive task such as the object-cueing task, would be able to detect improvements in autobiographical memory after a less extensive, and even non-object based intervention.

Similar to the majority of studies examining the effects of reminiscence therapy, we did not include outcome measures that assessed performance during the sessions. Assessing participants' performance during the sessions would allow examination of progress over the course of time and, in addition, provide observations on the participants' memory performance during IRT. Miles et al., (2013) examined the social interactions among older adults with dementia, when they were situated in either an everyday setting (control condition) or a museum-setting furnished in early twentieth century style (experimental condition) while being presented with condition matched cues. Conversations were audio-recorded and coded for memory content. More autobiographical memories were recalled in the museum-setting, and these memories were more elaborated, more spontaneous and included more episodic details compared with memories in the control condition. Although this study was conducted with just 12 participants and in a less optimal museum environment, the findings suggest that IRT sessions do stimulate autobiographical remembering.

Studies examining the long-term effects of reminiscence therapy on autobiographical memory have yielded mixed results (Lalanne et al., 2015; Morgan and Woods, 2010; Subramaniam et al., 2012; Woods and Whitaker, 2014; Woods et al., 2018). As the present study did not include a follow-up measurement, it remains unknown whether the observed positive effects would persist over time. However, as we found an effect only on the one measure, which closely matched key aspects of the intervention (i.e., object-cueing), long-term effects may be less likely, although this remains to be examined.

In order to rule out that the observed effects were not due to, for instance, social interaction or overall stimulation, a future study should also include a control setting comprising a different kind of social activity (see for example Haslam et al., 2010). That said, improvement in the intervention group was observed exclusively on the object-cueing measures, which matched key aspects of the intervention, and not on any of the other measures. If the positive outcomes were caused by factors

not specifically related to the IRT method, we might have expected to see enhancement on other measures as well.

The participants in the intervention group ranged in age from 64 to 94 years (four participants were ≤ 69 years of age). Thus, they were children and young adults at different time periods. The youngest were born in the early 1950s and the oldest in the late 1920s. It might therefore be argued that the 1950s environment would not appeal to the oldest and youngest participants. However, although the environment historically was dated to the 1950s in a museum context, in a real-life context and in people's actual homes, many of its elements would also be found in the 1960s and even later. Also, some of the elements would be present earlier than in the actual 1950s. This agrees with observations from the sessions indicating that all participants were engaged and were successfully cued by the themes of the sessions and overall design and decoration of the reminiscence environment. Nonetheless, a future study should aim to include participants with a minimum age of 70 years.

Last, participants in the present study all presented with mild to moderate symptoms of dementia. A future study should address whether IRT is also beneficial to more severely impaired AD patients. As we employed a group-based approach, a future study may also examine whether a more individualized IRT intervention delivered one-to-one with more personalized cues would have more positive effects on memory performance post intervention.

Conclusion

The present study demonstrated that five weeks of IRT in a unique and authentic 1950s style environment associated with the youth of the participants was advantageous to a sample of AD patients, relative to matched controls, who received standard care. More specifically, IRT successfully enhanced subsequent autobiographical memory recall when participants were cued with concrete object cues, whereas performance on more standardized autobiographical outcome

measures remained stable across time. The results have important clinical and practical implications. First, they suggest that immersion into a setting -- rich on relevant and specific cues -- that reconstructs the time best preserved in the participants' memory is able to improve autobiographical remembering beyond that setting. Second, the findings suggest that cognitive interventions in dementia should aim to include outcome measures that match key aspects of the intervention and target relatively well-preserved abilities in AD.

Acknowledgements

This work was supported by Velux Fonden [grant 13481] and the Danish National Research Foundation [grant DNRF89]. We thank Ove Dahl, Martin Djupdræt, Tine Bennedsen Gehrt, Lotte Kofoed, Anne Marie Toftegaard Kuhr, Henning Lindberg, Tove Engelhardt Mathiassen, Niels Peter Nielsen for their contributions to the project. A special thank you to Den Gamle By [The Old Town], National Open Air Museum of Urban History and Culture in Aarhus, Denmark, the participants and their caretakers, and the dementia coordinators and residential care workers who participated or assisted during the project.

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Appendix 1.

List of Stimulus Materials used in the Word and Object-Cued Recall Task

	Objects/ verbal referents	Danish	Additional information
1	Cigarettes	Cigaretter	
2	Skipping rope	Sjippetov	
3	Grade book	Karakterbog	
4	Milk bottle	Mælkeflaske	
5	Account book	Rengskabshæfte	
6	Food coupons	Rationeringsmærker	
7	Perfume	Parfume	
8	Paper scraps	Glansbilleder	
9	Hopscotch	Hinkesten	
10	Nickel	Enøre	
11	Marbles	Lerkugler	
12	Liquorice root	Lakridsrod	
13	Exercise book	Skolehæfte	
14	Coffee substitute	Kaffeerstatning	
15	Weekly magazine	Ugeblad	
16	Girdle	Rollon	
17	Children's book	Børnebog	
18	Marking ring	Hønseringe	Small plastic rings used as toys
19	Confirmation celebratory card	Konfirmationstelegram	
20	Lotion	Fugtighedscreme	

Table 1

Independent t-test Results for Age, Education, Level of Dementia, Depression, and Cognitive Ability at Baseline

	Intervention		Control		<i>t</i> (df)	<i>p</i>
	<i>M</i> (<i>SD</i>)	Range	<i>M</i> (<i>SD</i>)	Range		
Age (years)	80.18 (7.77)	64-94	79.86 (7.30)	60-93	<i>t</i> (41) = 0.14	.889
Education (years)	9.95 (3.40)	4-17	9.10 (2.74)	7-16	<i>t</i> (41) = -0.91	.368
Global Deterioration Scale	3.86 (0.47)	3-5	4.00 (0.55)	3-5	<i>t</i> (41) = -0.88	.384
Geriatric Depression Scale/ 15	2.80 (1.88)	0-7	3.25 (2.34)	0-8	<i>t</i> (38) = -0.67	.508
MMSE/ 30	20.77 (4.52)	13-26	19.24 (3.52)	13-25	<i>t</i> (41) = 1.24	.223
ACE/ 100	60.55 (12.58)	38-87	58.10 (8.78)	42-77	<i>t</i> (40) = 0.72	.474
FAB/ 18	10.24 (2.49)	5-14	10.52 (3.17)	4-17	<i>t</i> (40) = -0.33	.747

Note. MMSE = Mini Mental State Assessment; ACE = Addenbrooke's Cognitive Examination.; FAB = Frontal Assessment Battery

Table 2

Descriptive Statistics for Gender, Living Situation, Use of Anti-Dementia Medication and Antidepressants, and Marital Status

	Intervention	Control
	<i>n</i>	<i>n</i>
Female/ male	16/ 6	14/ 7
Residential home/ living at home	15/ 7	10/ 11
Anti-dementia medication (yes/ no)	19/ 2	17/ 2
Antidepressants (yes/ no)	8/ 12	7/ 10
Married or cohabit/ widowed	12/ 10	8/ 10

Note. Information for living situation, use of medication, and marital status was not available for all participants.

Table 3

Descriptive Statistics and ANOVAs for the Autobiographical Memory Interview at Baseline and Post-intervention

	Intervention		Control		df	Time			Group			Time × Group		
	Baseline	Post	Baseline	Post		F	p	η^2	F	p	η^2	F	p	η^2
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)										
AMI Episodic Part														
Total Score	10.68 (6.28)	10.06 (6.22)	9.65 (4.99)	9.33 (5.72)	1, 40	0.62	.435	.02	0.27	.609	.01	0.07	.800	.00
Childhood	4.11 (4.45)	4.45 (2.44)	4.08 (2.37)	4.70 (2.43)	1, 40	1.90	.176	.05	0.02	.882	.00	0.16	.687	.00
Adulthood	4.20 (2.70)	3.61 (2.69)	3.18 (2.07)	2.65 (2.54)	1, 40	3.00	.091	.07	1.97	.168	.05	0.01	.919	.00
Recent Past	2.36 (2.37)	1.98 (1.97)	2.40 (2.25)	1.98 (2.05)	1, 40	2.15	.151	.05	0.00	.978	.00	0.01	.945	.00
AMI Semantic Part														
Total Score	38.25 (10.37)	41.76 (10.04)	35.03 (10.32)	37.60 (9.91)	1, 40	14.60	.000	.27	1.46	.233	.04	0.32	.572	.01
Childhood	14.66 (4.41)	16.14 (3.76)	14.33 (4.20)	15.40 (3.96)	1, 40	6.82	.013	.15	0.21	.649	.01	0.17	.683	.00
Adulthood	13.59 (3.70)	14.36 (3.44)	11.93 (4.18)	11.75 (4.38)	1, 40	0.81	.374	.02	3.37	.074	.08	2.03	.162	.05
Recent Past	11.27 (5.42)	11.23 (5.54)	9.78 (4.73)	10.45 (3.98)	1, 40	0.60	.443	.02	0.59	.448	.01	0.79	.380	.02

Note. AMI = The Autobiographical Memory Interview

Table 4

Descriptive Statistics and ANOVAs for Word- and Object-cued Recall at Baseline and Post-intervention

	Intervention		Control		df	Time			Group			Time × Group		
	Baseline	Post	Baseline	Post		F	p	η^2	F	p	η^2	F	p	η^2
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)										
Word-cued recall														
Frequency	3.00 (1.95)	3.64 (2.19)	2.50 (2.06)	3.00 (1.89)	1, 40	3.22	.080	.07	1.10	.301	.03	0.46	.831	.01
Episodic	0.78 (0.70)	0.90 (0.69)	0.61 (0.74)	0.74 (0.59)	1, 40	1.36	.251	.03	0.80	.376	.02	0.00	.947	.00
Word Count	147.69 (90.40)	154.81 (90.98)	126.58 (139.60)	137.68 (87.67)	1, 40	0.61	.438	.02	0.41	.526	.01	0.03	.865	.00
Object-cued recall														
Frequency	4.05 (2.01)	5.32 (3.18)	3.80 (2.38)	4.15 (2.25)	1, 40	4.86	.033	.11	1.08	.305	.03	1.57	.217	.04
Episodic	0.96 (0.72)	1.42 (1.22)	1.14 (1.10)	0.99 (0.81)	1, 40	1.47	.232	.04	0.22	.643	.01	5.47	.024	.12
Word Count	159.25 (75.26)	206.21 (116.94)	181.78 (140.06)	176.34 (137.80)	1, 40	2.57	.116	.06	0.01	.916	.00	4.10	.050	.09

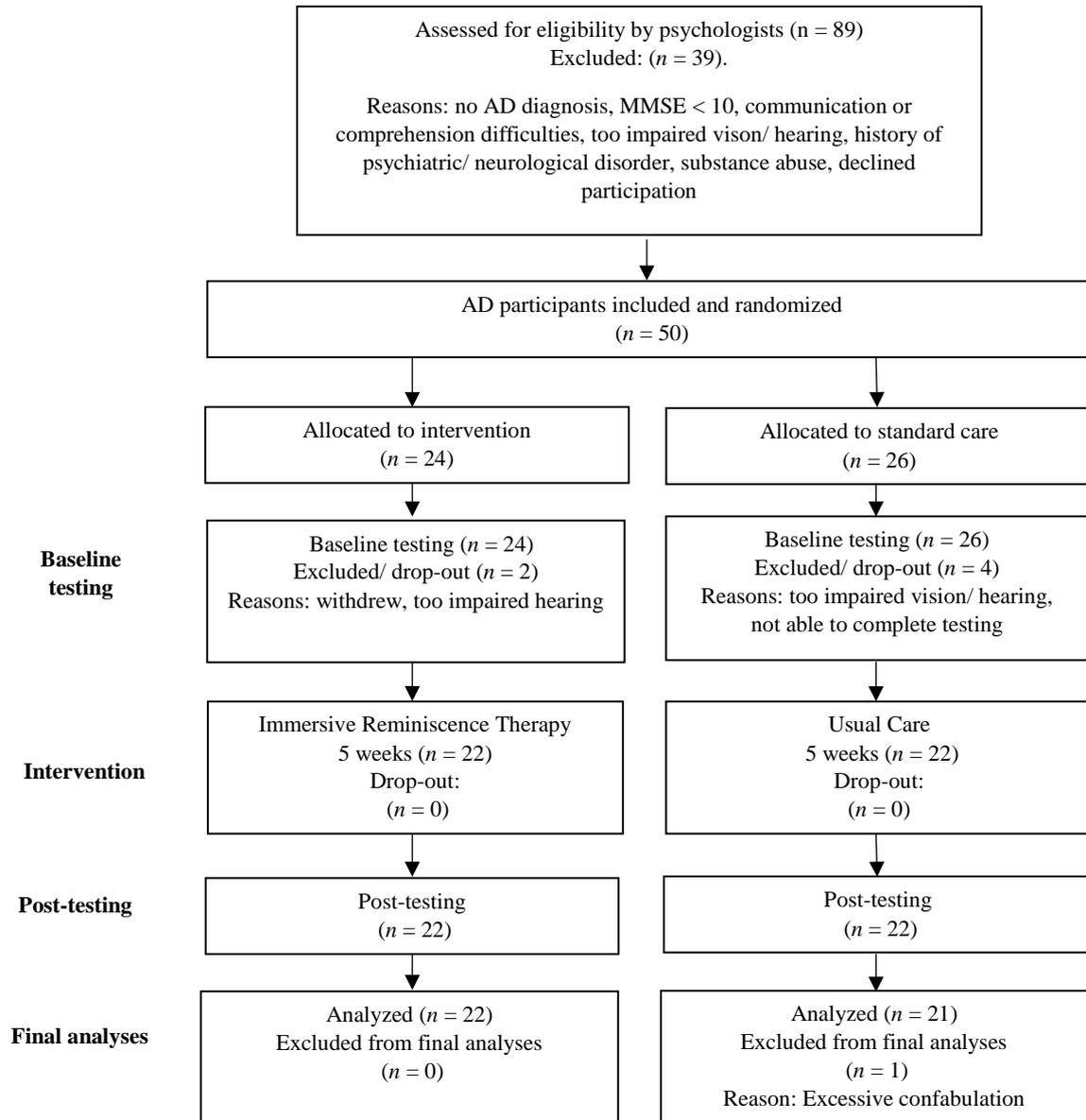


Figure 1. Flowchart showing attrition of the intervention and the control group.
 Note. AD = Alzheimer's disease; MMSE = Mini Mental State Examination

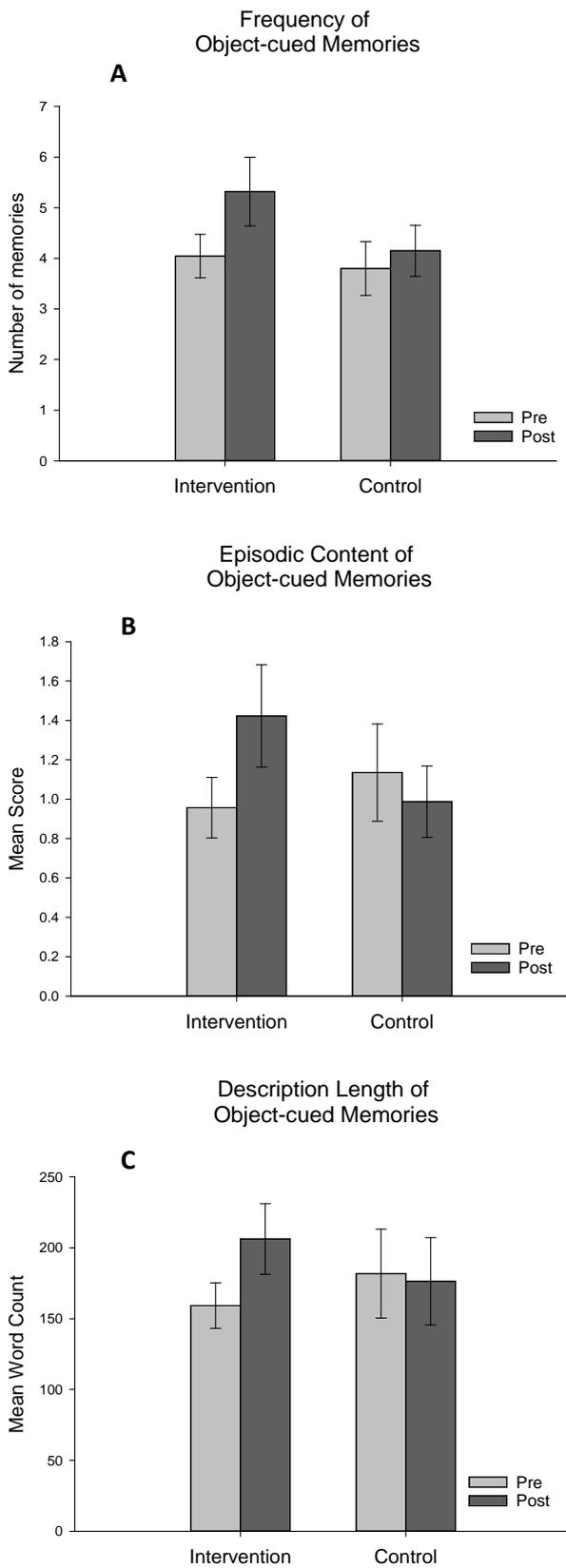


Figure 2. Mean scores with standard errors from baseline and post-intervention testing for frequency (2A), episodic content (2B) and description length (2C) in response to object-cued recall