

Individual differences in autobiographical memory: The Autobiographical Recollection Test predicts ratings of specific memories across cueing conditions

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Abstract

The Autobiographical Recollection Test (ART; Berntsen, Hoyle & Rubin, 2019) measures individual differences in autobiographical memory. We here examined whether the ART correlates with characteristics of people's specific autobiographical memories. Participants ($Ns \geq 475$) completed the ART and rated recollective qualities of autobiographical memories cued by words (Study 1), by positive and negative emotional valence (Study 2), and by future and past temporal direction (Study 3). Scores on the ART consistently correlated with recollective qualities of specific memories and future thoughts, both immediately and after a 1-week delay. The magnitude of these correlations was at the same level as the correlations between individual memory items, underscoring the ability of the ART, as a trait measure, to predict ratings of individual memories. The findings support the construct validity of the ART and demonstrate that people's evaluation of their autobiographical memory in general is reliably related to how they remember specific events.

Keywords: Autobiographical memory; Individual differences; Recollective experience; Autobiographical Recollection Test

General audience summary

Autobiographical memory is the kind of memory that allows us to remember events in our personal past. People often claim their memory for their past is better or worse than the one of others. Some seem to remember their past vividly and as coherent stories, while for others, memories of their personal past may seem vague and fragmented. Until recently, the field was lacking a viable and easily administered tool for studying such individual differences. To meet this need, the Autobiographical Recollection Test (ART) was introduced as a test of individual differences in the subjective experience of autobiographical memory. The ART has been shown to have good psychometric properties and thus is a reliable test of how people generally remember their past – for example, whether they generally consider their memories to be vivid and detailed. However, it remained to be tested if scores on the ART predict how people remember specific events from their past. In three studies, we examined this question by having participants complete the ART and rate characteristics of several specific memories from their past. We found a consistent association between scores on the ART and characteristics of specific memories, even after a 1-week delay. The findings establish the validity of the ART and demonstrate the scale as a reliable indicator of how people experience their autobiographical memories. Because the ART is a valid, robust and easily administered test of individual differences in autobiographical memory, it can help to integrate autobiographical memory research with fields generally concerned with measuring stable tendencies and preferences, such as personality, educational, and clinical psychology.

Individual Differences in Autobiographical Memory: The Autobiographical Recollection Test predicts Ratings of Specific Memories across Cueing Conditions

Introduction

Autobiographical memory enables individuals to remember and consciously reexperience events from their past. It consists of several cognitive and emotional components, such as sensory information, imagery, narrative and spatial knowledge, that shape the subjective experience of remembering past events, which has been key in understanding autobiographical memory (e.g., Brewer, 1986; Rubin, 2006; Tulving, 2002).

The recollective qualities of autobiographical memory are often examined in individual memories of events (e.g., Berntsen & Hall, 2004; Ford et al., 2012) or theoretically motivated categories of memories such as negative or recent events (e.g., D'Argembeau et al., 2003; Walker & Skowronski, 2009). Studies typically focus on differences between categories of memories, averaged across individuals, such as positive memories generally being recalled more vividly than negative memories (e.g., Rasmussen & Berntsen, 2013; Schaefer & Philippot, 2005). Few studies have examined individual differences in the recollective experience across different memories. Rubin et al. (2003) reported three studies in which undergraduates rated 15 or 30 word-cued autobiographical memories on a range of recollective qualities. Individuals who generally rated memories highly on one recollective quality also tended to give high ratings of other recollective qualities, suggesting a trait-like tendency (for similar findings, see Rubin & Siegler, 2004). Rubin et al. (2004) and Rubin (2021) had participants rate autobiographical memories on a variety of recollective qualities twice, separated by a delay. The recollective qualities were highly correlated even when compared for different memories assessed after delays. The stability of these ratings suggests stable individual differences in the experience of autobiographical memories. Rubin (2020a) showed that ratings of the ability to remember the scene of personal events strongly predicted ratings of reliving, vividness, belief, and emotional intensity on different sets of memories, indicating stable tendencies for individuals. Scene ratings also showed high test-retest correlations measured at periods of up to one month. These results add to other studies showing individual differences in the recollection of autobiographical memories (e.g., Ford et al., 2012; Greenberg & Knowlton, 2014; Rubin et al., 2019).

While earlier research indicates that examining individual differences in the recollective experience of autobiographical memory is viable and fruitful, the reviewed studies rely on ratings of specific memories, which can introduce bias. The memories are often cued (by event categories, words, sounds etc.), and the cues themselves will introduce selection bias, but could also bring cultural and gender biases into play. Even when the cues are considered neutral, they might not be perceived as so by all individuals (for similar arguments, see Rubin, 2020b). Another option is to have participants self-select a number of memories, but this allows great variation in the selected events and could introduce variance attributable to other factors (e.g., properties of the events, demand characteristics) than individual differences in the recollective experience of autobiographical memory. Furthermore, having participants retrieve, describe, and rate several

memories is time consuming and could make the integration of individual differences in the recollective experience of autobiographical memory less feasible within fields usually concerned with individual differences.

To gain further insights into individual differences in the subjective experience of remembering past events, tests overcoming the reviewed shortcomings are needed. Recently, the Autobiographical Recollection Test (ART; Berntsen et al., 2019), a psychometric test of individual differences in the recollective experience of autobiographical memory, was introduced to serve this purpose. The ART measures how well people think they remember events in their past. The higher individuals score on the ART, the more inclined they are to think they remember their past well. The focus of the ART is the recollective experience associated with memories in general, not how accurately people remember their past. The ART probes features of recollection that previous research has found important for individual memories, such as the amount of reliving or vividness accompanying the autobiographical memories. The key assumption underlying the test is that these characteristics generalize across memories within people, and vary reliably between people (e.g., some people generally experience their autobiographical memories more vividly than other people).

The ART does not require retrieval of specific memories, is easy to administer, and considers seven theoretically and empirically motivated recollective qualities: vividness, narrative coherence, reliving, rehearsal, scene, visual imagery, and life story relevance. Factor analyses of the ART demonstrated these recollective qualities to be separate but highly correlated components that were primarily attributable to one underlying second-order factor; that is, they form one unique underlying dimension of recollective experience varying between people (Berntsen et al., 2019).

Berntsen et al. (2019) thus provided evidence that different components of recollective qualities measured by the ART were highly correlated, and associated with one underlying second-order factor and that this factor showed reliable between-person variability and thus could be conceived as an individual differences dimension. However, Berntsen et al. (2019) did not provide evidence for the claim that a person's score on the ART would reliably predict how this person actually remembers individual autobiographical events, such as the level of vividness and detail associated with individual memories. In short, the construct validity of the ART remains to be tested. This is the aim of the present series of studies.

The present studies

We examine correlations between individual differences in the recollective experience of autobiographical memory measured by the ART (Berntsen et al., 2019) and ratings of specific autobiographical memories and future events, either measured in the same session as the ART or after a delay. To ensure generalizability, the events are varied according to cueing method. In Study 1, different sets of eight word cues were used. In Study 2, four categories of events with a request for positive and four for negative emotional valence were used. In Study 3, four categories of events with a request for past and four with a request for future were used. We chose these categories of autobiographical memories and cueing methods because they are some of the most frequently used strategies for studying autobiographical memories and the related field of future thoughts (e.g., Crovitz & Shiffman, 1974; D'Argembeau, 2012; Rasmussen & Berntsen, 2013). The studies were preregistered with the Open Science Framework (<https://osf.io/z67cy/>). In the final sample of each study, we aimed for 450-500 participants, randomly assigned to retrieving and rating memories

either in the same session as the ART was administered or after a delay. Settings in the online recruitment platform prevented participants from taking part in more than one of these studies.

Hypotheses

We expected the ART (and the shorter Brief ART) to correlate positively with ratings of individual memories (or future events) on the seven autobiographical memory components captured by the ART: vividness, coherence, reliving, rehearsal, scene, visual imagery, and life story relevance of individual memories. In addition, we expected positive correlations with ratings of emotional intensity and belief in occurrence of the autobiographical events. We expected these correlations for all categories of events, both when they were rated in the same session as the ART and when they were retrieved and rated after a delay, although we expected reduced correlations in the latter case due to state-related variability (i.e., situational influences at the time of measurement affects the ratings, thereby producing a stronger association between variables measured at the same time compared to variables measured at different points in time; e.g., Steyer et al., 1999).

Study 1: Word Cued Memories

The use of word cues is a standard method to elicit a representative sample of an individual's autobiographical memories (e.g., Crovitz & Shiffman, 1974; for a review see Congleton & Berntsen, 2018). In order to compare individual differences in how people think they remember past events against a broad sample of personal autobiographical memories, we examined correlations between the ART and ratings of autobiographical memories cued by words, retrieved either in the same session as the ART was administered or after a 1-week delay.

Methods

Participants

Participants recruited from Amazon Mechanical Turk (MTurk) using Cloud Research (Litman et al., 2017) were paid 2.00 USD for completing the study (participants completing the study with a delay were paid an additional 0.25 USD). Participants were automatically excluded from the study if they did not accept the informed consent form, indicated not being native English speakers, or failed either of the two attention checks.

Participants completing all study measures (irrespective of delay) were excluded from the final sample if they 1) straight-lined responses to the ART items, 2) straight-lined ratings of four¹ or more autobiographical memories, 3) completed the full study (i.e., all study measures, irrespective of delay) in 7 minutes or less or 4) did not provide meaningful answers to open-ended questions. The fourth criterion was applied to the written descriptions of the autobiographical memories and included *consistently* giving answers suggesting automated form-fillers, survey bots or the like (e.g., “very nice,” “good,” or copy-pasting text from the Internet), or *clearly* having misunderstood the task (e.g., describing the meaning of a cue word, providing personal semantics), or providing written descriptions in such poor English that the meaning was not clear.

The final sample (for exclusion of participants, see Table 1) consisted of 475 participants (236 female, 3 other; mean age = 39.41, SD = 12.90, range: 18 to 76; mean years of education = 15.88, SD = 2.63, range: 4 to 25). Of these, 259 participants completed the study in one session, and

¹ We changed this criterion from the preregistered criterion of two or more autobiographical memories as the preregistered criterion proved to be too strict, leading to the exclusion of otherwise good responses.

216 first completed the ART in one session and then retrieved autobiographical memories after a delay.

Materials

Individual differences in the recollective experience of personal memories were measured with the ART (Berntsen et al., 2019), which consists of 21 items. The ART measures seven recollective qualities: vividness, narrative coherence, reliving, rehearsal, scene, visual imagery and life story relevance. The Brief ART is an aggregate of the first seven items (one per recollective quality) of the ART. Items are scored from 1 (*strongly disagree*) to 7 (*strongly agree*). The sum scores of the ART and Brief ART are divided by the number of items, giving each scale an aggregate score from 1-7. See Table 2 for internal consistencies (Cronbach's Alpha).

Autobiographical memories were retrieved in relation to one of three sets of cue words, each consisting of eight words presented in a fixed order (Set 1: Pencil, Seat, Custom, Salad, Green, Ship, Plant, Street; Set 2: Hammer, Book, Month, Butter, Paper, Power, Window, Bowl; Set 3: Table, Person, Moment, Chair, Door, City, Engine, Dress). The cue word sets did not differ ($ps > .394$) on word length or ratings of goodness, emotionality, emotional goodness, imagery, associative frequency and familiarity (based on ratings in Rubin, 1980; Rubin & Friendly, 1986).

Characteristics of the autobiographical memories were measured with single items from the Autobiographical Memory Questionnaire (AMQ; Rubin et al., 2003) as adapted in previous studies (e.g., Finnbogadóttir & Berntsen, 2014; Rasmussen & Berntsen, 2013). Seven of the AMQ items corresponded to the seven recollective qualities measured by the ART. The items of the AMQ are to be considered separately, and not summed for a total score. For the adapted AMQ items and the verbal endpoints of their seven-point scales, see Table 3.

Procedure

The study was administered through the survey platform Qualtrics and was presented in the following order 1) informed consent, 2) demographics, 3) ART, 4) a filler task consisting of 15 pictures from the Nencki Affective Picture System (Marchewka et al., 2014) that participants had to describe with one or two words, and 5) retrieval and rating of eight autobiographical memories. Participants were randomly assigned to retrieve memories in relation to one of three sets of cue words. Approximately half of the participants had a 1-week delay before retrieving autobiographical memories. The study was introduced to participants as a memory writing task and they were instructed that the retrieved memories had to be specific (i.e., have happened at a particular place and point in time) and were asked to provide one sentence describing each autobiographical memory (instructions adapted from Rubin & Schulkind, 1997). Participants had to complete two attention checks. The first attention check was a question with several response options that participants could only pass if choosing the correct answer, which was provided to them in the instructions. The second attention check consisted of two questions testing the participants' understanding of the instructions for the retrieval of autobiographical memories.

Data Analysis

We created aggregate scores across the eight cue words and collapsed data from the three cue word sets in the final analyses. Data were analyzed using SPSS version 26 (IBM Corp., 2019). Correlations (Pearson's r) were compared using the web application of cocor (<http://comparingcorrelations.org/>) using Steiger's Z for dependent groups and Fisher's Z for independent

groups (Diedenhofen & Musch, 2015). All p -values are two-tailed and interpreted as statistically significant if $< .05$.

Results

Descriptive statistics for the ART and Brief ART are reported in Table 2. The ART and Brief ART were highly correlated ($r = .948, p < .001$), therefore only results for the full ART are reported in the correlational analyses (Tables 4 and 6). Means for the characteristics of the autobiographical memories are provided in Supplemental Material.

Manipulation Check

The written descriptions indicated that participants did retrieve autobiographical memories matching the presented cue words, and inspection of mean ratings of specificity indicated that participants did retrieve specific memories as requested. In line with previous studies, the word cued autobiographical memories were mildly positive (e.g., Rubin et al., 2011; Berntsen & Hall, 2004), and a relatively high percentage were memories of recent events (e.g., Crovitz & Shiffman, 1974; Rubin & Schulkind, 1997), with 38% of the retrieved memories having taken place within the past 12 months (range: 0 to 320 days ago).

Correlations with Characteristics of Individual Memories

The ART correlated positively and significantly with ratings of memory characteristics corresponding to the seven components of the ART: vividness, coherence, reliving, rehearsal, scene, visual imagery and life story relevance. Furthermore, the ART correlated positively with ratings of emotional intensity and belief in occurrence (Table 4).

The ART correlated more highly with ratings of memories retrieved in the same session as the ART compared to ratings of memories retrieved after a delay (Table 4). When statistically comparing these numerical differences, the ART correlated significantly higher with ratings of vividness, coherence, reliving, rehearsal, scene, and visual details (p range: .002 to .036) of memories retrieved in the same session as the ART compared to memories retrieved after a delay.

Summary and Discussion

The ART correlated positively with ratings of the characteristics of autobiographical memories retrieved in response to cue words. As expected, the ART correlated more highly with ratings of autobiographical memories retrieved in the same session as the ART than after a delay. Nonetheless, robust correlations were seen even over a 1-week delay. The findings demonstrate a consistent relationship between an individual's general experience of their autobiographical memory and the recollective qualities of a random sample of autobiographical memories.

Study 2: Positive and Negative Memories

In Study 1, the word cued autobiographical memories were mildly positive and relatively mundane, as would be expected from the literature (e.g., Rubin & Schulkind, 1997; Berntsen & Hall, 2004). However, emotional valence is a factor known to impact the recollective qualities of autobiographical memories (for a review see Holland & Kensinger, 2010). Therefore, in Study 2, we examine correlations between the ART and participants' ratings for highly positive and highly negative autobiographical memories. We predict that the ART will correlate in similar ways with ratings of both negative and positive autobiographical memories.

Methods

Participants

Participants recruited from MTurk using Cloud Research (Litman et al., 2017) were paid 2.00 USD for completing the study (2.25 USD with a delay). Participants had to agree to the informed consent form, indicate being native English speakers, and pass two attention checks (equivalent to those of Study 1, but with response options adapted to Study 2). The sample had the same criteria for exclusion as Study 1 (for exclusion of participants, see Table 1). The final sample consisted of 486 participants (292 female, 1 other; mean age = 39.43, SD = 12.53, range: 16 to 84; mean years of education = 16.09, SD = 2.91, range: 4 to 29). Of these 245 completed the study in one session and 241 had a 1-week delay between the ART and retrieving autobiographical memories.

Materials

The ART (Berntsen et al., 2019) and single AMQ items (Rubin et al., 2003) were identical to Study 1. See Table 2 for internal consistencies of the ART and Brief ART.

Procedure

The procedure was identical to Study 1 except for the memory task, for which participants retrieved four negative and four positive autobiographical memories. Participants were instructed to “Please think of a highly negative [positive] event in your past related to” 1) “school” 2) “work,” 3) “a relationship with a family member” and 4) “a relationship with someone you know well but who is not a family member” (instructions adapted from Rubin et al., 2019). Negative and positive autobiographical memories alternated, always starting each event category with a negative memory and ending with a positive memory. Participants were instructed to retrieve specific autobiographical memories (i.e., events that have happened at a particular place and point in time) and asked to provide one sentence describing each autobiographical memory. Approximately half of the participants had a 1-week delay before retrieving autobiographical memories.

Data Analysis

The analysis follows Study 1 except that aggregate scores across event categories for negative and positive autobiographical memories were analyzed separately. Cohen’s *d* reported for paired samples *t*-tests was controlled for the correlation between the two variables (e.g., Lakens, 2013). Data were analyzed using SPSS version 27 (IBM Corp., 2020).

Results

Descriptive statistics of the ART and Brief ART are reported in Table 2, and means of the characteristics of the positive and negative memories are reported in Table 5 (and Supplemental Material). Because the ART and Brief ART were highly correlated ($r = .958, p < .001$) we only report correlations between memory characteristics and the full ART.

Manipulation Check

Inspection of the mean valence, specificity and written descriptions of the memories indicated that participants retrieved specific and highly positive and negative autobiographical memories as requested, and the two sets of memories differed significantly on subjective valence. A series of paired-samples *t*-tests demonstrated that, in line with findings from previous studies comparing positive and negative autobiographical memories (e.g., D’Argembeau et al., 2003; Schaefer & Philippot, 2005; Talarico et al., 2004), the positive memories were more vivid and

involved more reliving, rehearsal, visual imagery and belief in occurrence than the negative memories (Table 5).

Correlations with Characteristics of Individual Memories

The ART correlated positively with characteristics of the negative and positive autobiographical memories corresponding to the seven components of the ART: vividness, coherence, reliving, rehearsal, scene, visual imagery and life story relevance. All correlations were statistically significant, except for ratings of life story relevance for negative memories retrieved after a delay. Ratings of emotional intensity and belief in occurrence of the positive and negative memories were also positively correlated with the ART (Table 4).

The ART correlated more highly with ratings of memories retrieved in the same session as the ART than with memories retrieved after a delay (see Table 4). However, these differences were significant only with ratings of vividness (positive memories only), rehearsal, scene (positive memories only) and life story relevance (p range: .002 to .049) of memories retrieved in the same session as the ART compared to ratings of memories retrieved after a delay.

We had no hypotheses about differences in correlations between negative and positive memories. The ART correlated more highly with ratings for positive than negative memories, except for ratings of vividness (see Table 4). However, when statistically comparing these differences, only ratings of coherence and rehearsal showed a significant difference ($ps = .021$ and $.024$) between positive and negative memories.

Summary and Discussion

In line with our hypotheses and findings from Study 1, the ART correlated robustly with ratings of the characteristics of positive and negative memories. These correlations were statistically significant except for life story relevance for negative memories rated after a delay. This exception may be due to a strong association between the life story relevance (centrality) of negative events and emotional distress and psychopathology (Gehrt et al., 2018), which introduces an additional individual differences dimension of negative events. In addition, autobiographical memory is normally biased towards positive events (for a review see Walker et al., 2003), and the ART measures individuals' general experience of their autobiographical memory, therefore it might be more closely associated with recollective qualities of positive as opposed to negative memories. However, the ART correlated significantly higher with ratings of positive compared to negative memories for only two of seven memory qualities. The pattern of correlations was stable across the delay, although the effect sizes tended to be larger when the ART and the memory task were answered in the same session rather than separated by a delay.

Overall, we replicate the findings from Study 1, by demonstrating a consistent relationship between an individual's general experience of their autobiographical memory as measured by the ART and recollective qualities of specific autobiographical memories. Similar patterns of results were observed for negative and positive memories, although the results for positive memories most closely matched the findings from Study 1.

Study 3: Memories and Future Thoughts

In Studies 1 and 2, we have compared scores on the ART against a broad range of autobiographical memories. However, the neurocognitive components that contribute to the

construction of memories for past events also play a key role in generating representations of possible events in the personal future (for reviews see D'Argembeau, 2012; Szpunar, 2010). In Study 3, we therefore compare how the ART correlates with characteristics of episodic future thoughts and autobiographical memories. We expected the ART to correlate positively with ratings of both autobiographical memories and future thoughts, but to correlate more highly with ratings of memories than with the corresponding variables for future thoughts, consistent with the latter being more strongly associated with recollective experience (e.g., Berntsen & Bohn, 2010; D'Argembeau & Van der Linden, 2004).

Methods

Participants

Participants recruited from MTurk using Cloud Research (Litman et al., 2017) were paid 2.00 USD for completing the study (2.25 USD with a delay). Participants had to indicate their informed consent, be native English speakers, and pass two attention checks (equivalent to those of Studies 1 and 2, but with response options adapted to Study 3) to complete the study. The sample was subject to the same criteria for exclusion as Study 1 (for exclusion of participants, see Table 1). The final sample consisted of 494 participants (260 female, 1 other; mean age = 40.36, SD = 13.54, range: 18 to 77; mean years of education = 15.93, SD = 2.66, range: 4 to 30), of which 236 participants completed the study in one session and 258 participants first answered the ART and then retrieved autobiographical memories and imagined future events after a 1-week delay.

Materials

The ART (Berntsen et al., 2019) and single AMQ items (Rubin et al., 2003) were identical to Study 1². For episodic future thoughts, the wording of the AMQ items were adjusted to indicate the future. See Table 2 for internal consistencies of the ART and Brief ART.

Procedure

The procedure was identical to Study 1 except for the memory task, in which participants retrieved four autobiographical memories and imagined four episodic future thoughts cued by different timeframes. Participants were instructed to “Please think of an autobiographical memory that occurred” 1) “within the last week, but not today,” 2) “between a week and a month ago,” 3) “between a month and a year ago” and 4) “more than one year ago”. The future events were cued by using the phrase “Please think of an event that might occur” followed by the same timeframes as the memories adjusted to indicate the future (procedure identical to Rubin et al., 2019). Participants were randomly assigned to retrieving either autobiographical memories or future thoughts first, and were instructed that the retrieved memories and future thoughts had to be specific (i.e., have happened / will happen at a particular place and point in time). Participants provided one sentence describing each autobiographical memory and future thought. Approximately half of the participants had a 1-week delay between answering the ART and retrieving autobiographical memories and imagining future events.

Data Analysis

² Except questions addressing temporal distance to the events, because the participants were asked to generate events with a specified distance to the present.

We created aggregate scores across the timeframes for autobiographical memories and episodic future thoughts separately. Data were analyzed using SPSS version 26 (IBM Corp., 2019). All other aspects of data analysis were identical to Study 2.

Results

For descriptive statistics of the ART and Brief ART, see Table 2. Because they were highly correlated ($r = .951, p < .001$), again we only report correlations between the full ART and ratings of individual events. Means for characteristics of the autobiographical memories and future thoughts are reported in Table 5 (and Supplemental Material).

Manipulation Check

The mean rating of specificity and the written descriptions indicated that participants did retrieve specific autobiographical memories and imagined specific future events as requested. Paired-samples *t*-tests demonstrated that, in line with previous studies comparing memories and future thoughts (e.g., Berntsen & Bohn, 2010; D'Argembeau & Van der Linden, 2004; for reviews, see D'Argembeau, 2012; Szpunar, 2010), the autobiographical memories were more vivid and involved more visual imagery, reliving, sensory details and sense of scene than future thoughts, and future thoughts were more emotionally positive than memories (Table 5).

Correlations with Characteristics of Individual Memories and Future Thoughts

The ART correlated positively and significantly with characteristics of the autobiographical memories and future thoughts with respect to vividness, coherence, reliving, rehearsal, scene, visual imagery and life story relevance. Ratings of emotional intensity and belief in occurrence were also positively correlated with the ART, but only the correlations with emotional intensity were consistently significant (Table 4).

The ART correlated more highly with ratings for memories and future thoughts retrieved and rated in the same session as the ART than those retrieved and rated after a delay, except for ratings of visual imagery for future thoughts (see Table 4). However, when statistically comparing these numerical differences, the ART correlated more highly only with ratings of vividness and rehearsal ($ps = .012$ and $.042$) of memories retrieved in the same session as the ART compared to ratings of memories retrieved after a delay. There were no statistically significant differences in correlations for future thoughts.

As expected, the ART tended to correlate more strongly with ratings of memories compared to future thoughts, except for ratings of vividness (Table 4). When statistically comparing these numerical difference, the ART correlated more strongly with ratings of rehearsal ($p = .035$) and life story relevance ($p < .001$) of memories compared to future thoughts.

Summary and Discussion

Characteristics of both memories and future thoughts correlated positively with the ART in line with our hypotheses. Few significant differences were observed for correlations between the ART and memories retrieved with and without a delay. No such differences were found for future thoughts generated with versus without a delay. This demonstrates that the delay had negligible impact on the correlations. Likewise, only few significant differences were found for correlations between the ART and memories compared to future thoughts, indicating that temporal direction had little impact on the pattern of results.

Overall, Study 3 replicated the findings from Studies 1 and 2 by demonstrating a consistent relationship between an individual's general experience of their autobiographical memory and ratings of specific autobiographical memories, and further extends these findings by demonstrating a consistent relationship between the ART and ratings of episodic future thoughts.

Analyses of Combined Data from Studies 1, 2, and 3

Studies 1 to 3 demonstrated that the ART correlated positively with subjective ratings of memory characteristics cued with different methods (see Table 4). Analyses of the combined data from the three studies were performed to examine whether these correlations are at the same level as the correlations between ratings of individual memory items. If so, this would provide further evidence of a trait like measure of autobiographical memory characteristics predicting ratings of individual memories.

Methods

We calculated Pearson's r for each memory characteristic correlated with itself using the same categories as in Table 4, for example, ratings of vividness correlated across the four positive memories retrieved in the same session as the ART in Study 2 (i.e., six correlations). For each category of events, a mean correlation was calculated using a Fisher Z-transformation before averaging. This mean was compared to the corresponding correlation in Table 4 (e.g., mean correlation for vividness x vividness compared to ART x vividness). All calculations were performed in online calculators (Lenhard & Lenhard, 2014). A positive value of Fisher Z indicates that the memory characteristic correlates more highly with the ART than with itself, and a negative value indicates that the memory characteristic correlates more highly with itself than with the ART (Table 6). For the sake of consistency, we limited these comparisons to autobiographical events retrieved and rated during the same session as the ART. This was to make sure that we compared correlations between variables assessed at the same time, as situational influences present at the time of measurement affects ratings of tests and questionnaires (Steyer et al., 1999).

Results

The correlations between the ART and the memory characteristics corresponding to the seven components of the ART were generally comparable to how highly each memory characteristic correlated with itself. The vast majority of the comparisons (85.7%) reflected either that the correlations with the ART did not differ from how highly the memory characteristics correlated with themselves or that the memory characteristics correlated more highly with the ART than with themselves (Table 6). This indicates that the ART did correlate *highly* with ratings of these memory characteristics.

General discussion

In a series of studies, we tested the construct validity of the recently introduced Autobiographical Recollection Test (ART; Berntsen et al., 2019), which measures individual differences in the recollective experience of autobiographical memory along the dimensions of vividness, coherence, reliving, rehearsal, scene, visual imagery, and life story relevance. We examined correlations between the ART and ratings of specific autobiographical memories cued by words (Study 1), positive and negative emotional valence (Study 2), and past and future temporal

direction (Study 3), that were retrieved either in the same session as the ART or after a 1-week delay.

We demonstrated that an individual's general experience of how they think they remember past events is reliably related to their recollection of specific autobiographical memories and how they imagine episodic future events. Several observations make us confident in the results. Across three studies, we report 70 correlations between the ART and characteristics of individual memories and future thoughts corresponding to the theoretical dimensions of the ART. These correlations were all positive, only one was non-significant, only five had $r_s < .20$ and $p_s > .001$, and they were relatively equal across different categories of events and different recollective qualities; thus, the findings were remarkably consistent. A 1-week delay and different cueing methods did not change the pattern of results, and additional analyses of the combined data confirmed that the correlations can be considered strong. More than 1400 participants in total took part in this series of studies, and the number of participants retrieving memories with and without a delay in each study, respectively, matches the approximate sample size needed for finding reasonably stable estimates for correlations (Schönbrodt & Perugini, 2013), adding to the reliability of the findings.

In addition to measuring characteristics of individual memories and future thoughts corresponding to the ART dimensions, we also measured and made hypotheses about two dimensions not in the ART: emotional intensity and belief in occurrence of the events. As hypothesized, correlations between the ART and emotional intensity of individual memories and future thoughts were consistently positive and statistically significant, thus following the same pattern as the memory characteristics corresponding to the seven components of the ART.

As hypothesized, we also found evidence of a positive association between the ART and ratings of belief in occurrence for individual autobiographical memories and episodic future thoughts. Although belief in occurrence is a meta-cognitive judgment, like the feeling of reliving the event (e.g., Rubin & Siegler, 2004; Scoboria et al., 2014), it is better predicted by different variables (e.g., depression, personality traits) than other recollective qualities (e.g., Rubin et al., 2003; Rubin & Siegler, 2004). In the present study, correlations between belief in occurrence and the recollective qualities of specific memories and future thoughts were lower and more varied across studies (r_s ranging from $-.16$ to $.51$), than how the seven recollective qualities correlated with each other (r_s ranging from $.27$ to $.87$). However, belief in occurrence was generally more strongly associated with the recollective qualities of specific memories and future thoughts than with the ART.

We did not formulate specific hypotheses regarding the association between (positive) emotional valence and the ART, but found some evidence of a positive association. This means that participants who scored higher on the ART also tended to rate their memories as more positive (or less negative). The fact that the relationship between the ART and emotional intensity was consistent, while the relationship between the ART and emotional valence was more inconsistent across studies, is in line with previous research indicating that emotional intensity is more strongly associated with other recollective qualities of personal past events than emotional valence (e.g., Rubin et al., 2011; Talarico et al., 2004; for a review see Holland & Kensinger, 2010).

In addition to their many strengths, the present studies have some limitations. Participants were recruited online, which might be viewed as a limitation. However, MTurk workers are shown

to produce reliable results, not differing from student samples (e.g., Briones & Benham, 2017; Casler et al., 2013). Moreover, several measures were taken to ensure data quality, such as enforcing attention checks and excluding participants according to preregistered criteria. A further advantage is that MTurk gives access to more socio-economically and racially diverse study populations than student samples (e.g., Buhrmester et al., 2011; Casler et al., 2013), making the results more generalizable. Furthermore, we chose to limit the number of recollective qualities measured for each individual memory and future thought to avoid participants becoming tired or bored, as they had to retrieve, describe and rate eight events. The chosen items are theoretically motivated, cover a broad range of qualities, and are similar to what is typically measured in studies on the recollective experience of autobiographical memories (e.g., Berntsen & Bohn, 2010; Ford et al., 2012; Talarico et al., 2004).

Having supported the reliability and construct validity of the ART, we recommend it as a tool for future lines of research on autobiographical memory features and processes. Two lines will be considered. First, the focus of the ART is the recollective experience, not the accuracy, of autobiographical memory (Berntsen et al., 2019). Future studies should therefore examine the relationship between the ART, how accurately people believe they remember past events (subjective accuracy), and how accurately they actually remember past events (objective accuracy). Second, as it is often not possible to check the objective accuracy of past events, ratings of memory confidence are often used as a way of evaluating the credibility of witnesses in legal settings. As demonstrated by the ART, there are individual differences in the recollective experience of autobiographical memory, and findings suggest that also ratings of memory confidence are somewhat stable across conditions, indicative of a trait-like characteristic (e.g., Saraiva et al., 2020). Future studies should examine how scores on the ART are related to ratings of memory confidence. Answering these questions could have important implications and potential applications, for example in legal settings.

Conclusions

Findings from three studies demonstrate that people's general experience of their autobiographical memory, measured by the ART (Berntsen et al., 2019), is reliably related to how specific autobiographical memories are recollected and future events imagined. Correlations with the ART were quite consistent across memories and future thoughts, different recollective qualities, memories cued in various ways, and events retrieved with and without a delay. The findings lend support to the construct validity of the ART. Demonstrating the ART as a reliable indicator of how individuals experience their autobiographical memory could help integrate autobiographical memory into research fields generally concerned with individual differences.

Author contributions

DB acquired funding and conceived the original idea, with contributions from DCR and RHH. DB, TBG and NPN designed the studies. TBG and NPN collected the data. TBG analyzed the data, and TBG, NPN and DB interpreted the data. TBG wrote the first draft for the manuscript, with contributions from NPN and DB. All authors commented on the manuscript and approved the final version.

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Conflicts of interest

The authors declare no conflicts of interest.

Author note

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Table 1

Exclusion of Participants from the Final Sample in Studies 1, 2 and 3.

| | Study 1 | Study 2 | Study 3 |
|---|---------|---------|---------|
| Completed the study | 763 | 515 | 667 |
| Straight-lined the items of the ART | 19 | 12 | 19 |
| Straight-lined ratings ≥ 4 autobiographical events | 17 | 8 | 26 |
| Answers characteristic of malicious programs | 104 | 2 | 77 |
| Misunderstood the task | 105 | 3 | 36 |
| Written descriptions in very poor English | 31 | 2 | 11 |
| Completed the full study in 7 minutes or less | 3 | 2 | 3 |
| Duplicate responses removed (<i>identical worker ID's or written descriptions</i>) | 9 | 0 | 1 |
| Final sample | 475 | 486 | 494 |

Table 2

Descriptive Statistics and Internal Consistency of the ART and Brief ART.

| | N | ART | | | | | Brief ART | | | | |
|---------|-----|----------|------|------|------|------|-----------|------|------|------|------|
| | | α | M | SD | Min. | Max. | α | M | SD | Min. | Max. |
| Study 1 | 475 | .96 | 4.78 | 1.06 | 1.57 | 6.95 | .89 | 4.85 | 1.11 | 1.57 | 7.00 |
| Study 2 | 486 | .96 | 4.82 | 1.08 | 1.05 | 6.95 | .88 | 4.92 | 1.10 | 1.00 | 7.00 |
| Study 3 | 494 | .96 | 4.81 | 1.08 | 1.71 | 6.95 | .87 | 4.91 | 1.06 | 1.71 | 7.00 |

Note. ART = Autobiographical Recollection Test, α = Cronbach's alpha.

Table 3

Items measuring Characteristics of Autobiographical Memories and their Verbal Endpoints.

| Characteristic | Item | Endpoints of rating scale |
|--------------------------------|---|---|
| Vividness | My memory of this event has lots of details. | 1 = Strongly disagree 7 = Strongly agree |
| Coherence | My memory of this event comes to me as a good story or description. | 1 = Strongly disagree 7 = Strongly agree |
| Reliving | While remembering the event, it is as if I am reliving it. | 1 = Strongly disagree 7 = Strongly agree |
| Rehearsal | I often think back to this event in my mind and think or talk about it. | 1 = Strongly disagree 7 = Strongly agree |
| Scene | While remembering the event, I recall where the actions, objects, and people are located. | 1 = Strongly disagree 7 = Strongly agree |
| Visual imagery | While remembering the event, I can see it in my mind. | 1 = Strongly disagree 7 = Strongly agree |
| Life story | My memory of this event is a central part of my life story. | 1 = Strongly disagree 7 = Strongly agree |
| Emotional valence | The feelings I experience as I recall the event are | -3 = extremely negative 3 = extremely positive |
| Emotional intensity | The feelings I experience as I recall the event are intense. | 1 = not at all 7 = to a very high degree |
| Specificity | The remembered event is specific in the sense that it happened at a specific time and place, and its duration did not exceed a full day - 24 hours. | 1 = not at all 7 = very specific |
| Belief | I believe that the remembered event really took place the way I remember it, and that I did not imagine anything or invent anything that did not take place | 1 = 100% fantasy 7 = 100% real |
| Distance in years ^a | Approximately how many years ago did the remembered event take place? | Age estimated in years |

| | | |
|---------------------------------|--|---------------------------|
| Distance in days ^{a,b} | If you have answered 0 years ago, approximately how many days from today did the event take place? | Time estimated in days |
|---------------------------------|--|---------------------------|

^a Studies 1 and 2 only.

^b Please note, this question was only answered by participants indicating that their memory was for an event that had happened within the last year.

Table 4

Correlations between the ART and ratings of the Autobiographical Memories and Future Thoughts.

| | Study 1 | | Study 2 | | | | Study 3 | | | |
|--|-------------------------|------------------------|-----------------|--------------|--------------|--------------|--------------|----------------------------|--------------|----------------------------|
| | Sam e sessi on | Wit h delat y | Same session | | With delay | | Same session | | With delay | |
| | | | Nega tive | Posit ive | Nega tive | Posit ive | Mem ories | Futur e thou ghts | Memo ries | Futur e thoug hts |
| <i>Memory characteristics corresponding to the seven components of the ART</i> | | | | | | | | | | |
| Vividness | .49* ** | .25* ** | .51** * | .52* ** | .39** * | .36* ** | .45** * | .39* ** | .25** * | .30** * |
| Coherence | .46* ** | .28* ** | .31** * | .42* ** | .17** | .31* ** | .41** * | .38* ** | .26** * | .24** * |
| Reliving | .58* ** | .37* ** | .48** * | .49* ** | .34** * | .34* ** | .44** * | .38* ** | .36** * | .33** * |
| Rehearsal | .50* ** | .29* ** | .32** * | .41* ** | .15* | .23* ** | .47** * | .36* ** | .32** * | .27** * |
| Scene | .48* ** | .25* ** | .50** * | .53* ** | .38** * | .36* ** | .49** * | .40* ** | .35** * | .34** * |
| Visual | .51* ** | .31* ** | .49** * | .55* ** | .43** * | .42* ** | .45** * | .38* ** | .35** * | .38** * |
| Life story | .42* ** | .30* ** | .35** * | .39* ** | .08 | .15* | .40** * | .27* ** | .31** * | .16* ** |

Other memory characteristics

| | | | | | | | | | | |
|------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Emotional valence | .32* ** | .13 | -.08 | .17* * | -.10 | .23* ** | .24** * | .22* ** | .12 | .16** |
| Emotional intensity | .41* ** | .33* ** | .24** * | .36* ** | .21** | .18* * | .40** * | .34* ** | .31** * | .32** * |
| Specificity | .01 | .00 | .09 | .04 | .10 | .12 | .13* | .13 | .05 | .16** |
| Belief | .09 | .12 | .10 | .13* * | .27** * | .20* * | .15* | .20* | .09 | .27** * |
| Distance in years | .03 | .07 | -.09 | -.05 | .07 | .05 | n/a | n/a | n/a | n/a |

Note. ART = Autobiographical Recollection Test, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 5

Paired samples t-tests for Memory Characteristics in Study 2 (N = 486) and Study 3 (N = 494).

| | Mean | SD | Mean | SD | <i>t</i> | <i>p</i> | <i>d</i> |
|---------------------|----------|------|-----------------|------|----------|----------|----------|
| <i>Study 2</i> | Negative | | Positive | | | | |
| Vividness | 5.47 | 1.02 | 5.66 | 0.97 | 5.44 | <.001 | 0.19 |
| Coherence | 4.19 | 1.61 | 5.67 | 1.06 | 19.26 | <.001 | 1.07 |
| Reliving | 5.17 | 1.19 | 5.46 | 1.10 | 6.78 | <.001 | 0.26 |
| Rehearsal | 3.92 | 1.41 | 4.59 | 1.39 | 12.14 | <.001 | 0.48 |
| Scene | 5.38 | 1.05 | 5.64 | 0.98 | 6.80 | <.001 | 0.25 |
| Visual | 5.64 | 0.96 | 5.88 | 0.87 | 7.09 | <.001 | 0.26 |
| Life Story | 3.67 | 1.34 | 4.44 | 1.38 | 13.88 | <.001 | 0.57 |
| Emotional valence | -2.26 | 0.59 | 2.53 | 0.48 | 118.54 | <.001 | 8.94 |
| Emotional intensity | 4.96 | 1.14 | 4.91 | 1.18 | -0.94 | .348 | -0.04 |
| Specificity | 5.96 | 1.18 | 6.15 | 1.02 | 5.63 | <.001 | 0.17 |
| Belief | 6.29 | 0.85 | 6.44 | 0.75 | 6.25 | <.001 | 0.18 |
| Distance in years | 13.54 | 8.61 | 11.01 | 7.80 | 11.42 | <.001 | 0.30 |
| <i>Study 3</i> | Memories | | Future thoughts | | | | |
| Vividness | 5.88 | 0.88 | 5.00 | 1.25 | 17.08 | <.001 | 0.79 |
| Coherence | 5.49 | 1.05 | 5.03 | 1.22 | 8.88 | <.001 | 0.40 |
| Reliving | 5.57 | 1.14 | 4.99 | 1.29 | 12.54 | <.001 | 0.47 |
| Rehearsal | 4.76 | 1.30 | 4.91 | 1.27 | -2.85 | .005 | -0.12 |
| Scene | 5.81 | 0.91 | 5.04 | 1.20 | 15.73 | <.001 | 0.71 |
| Visual | 6.01 | 0.92 | 5.42 | 1.13 | 13.49 | <.001 | 0.56 |
| Life Story | 4.49 | 1.33 | 4.46 | 1.29 | 0.70 | .482 | 0.03 |
| Emotional valence | 1.30 | 1.12 | 1.69 | 0.94 | -7.30 | <.001 | -0.38 |
| Emotional intensity | 4.90 | 1.21 | 4.63 | 1.25 | 6.01 | <.001 | 0.22 |
| Specificity | 6.09 | 1.08 | 5.65 | 1.22 | 8.85 | <.001 | 0.38 |
| Belief | 6.40 | 0.79 | 5.49 | 1.24 | 17.69 | <.001 | 0.84 |

Note. SD = standard deviation; *t* = t-statistic; *d* = Cohen's *d*.

Table 6

Correlations between Memory Characteristics and Comparison with their Correlation with the ART (same session data only).

| | Study 1 | | | Study 2 | | | | | | Study 3 | | | | | |
|------------------|----------|----------------------|----------|----------|----------------------|----------|----------|----------------------|----------|----------|----------------------|----------|-----------------|----------------------|----------|
| | | | | Negative | | | Positive | | | Memories | | | Future thoughts | | |
| | <i>r</i> | <i>Z_F</i> | <i>p</i> | <i>r</i> | <i>Z_F</i> | <i>p</i> | <i>r</i> | <i>Z_F</i> | <i>p</i> | <i>r</i> | <i>Z_F</i> | <i>p</i> | <i>r</i> | <i>Z_F</i> | <i>p</i> |
| <i>Vividness</i> | | | | | | | | | | | | | | | |
| x | .4 | | | .38 | | | .41 | | | .36 | | | .47 | | |
| vividness | 33 | 1.1 | .1 | 6 | 2.4 | .00 | 8 | 2.0 | .0 | 5 | 1.5 | .0 | 8 | -1. | .0 |
| x ART | .4 | 5 | 26 | .50 | 1 | 8 | .52 | 3 | 21 | .44 | 5 | 61 | .38 | 67 | 47 |
| | 88 | | | 6 | | | 3 | | | 8 | | | 8 | | |
| <i>Coherence</i> | | | | | | | | | | | | | | | |
| x | .4 | | | .59 | | | .42 | | | .31 | | | .46 | | |
| coherence | 43 | | | 0 | | | 6 | | | 3 | | | 0 | | |
| | | 0.3 | .3 | | -5. | <.0 | | -0. | .4 | | 1.7 | .0 | | -1. | .0 |
| | | 3 | 71 | | 57 | 01 | | 13 | 49 | | 0 | 45 | | 50 | 67 |
| x ART | .4 | | | .31 | | | .41 | | | .41 | | | .37 | | |
| | 62 | | | 3 | | | 7 | | | 1 | | | 7 | | |
| <i>Reliving</i> | | | | | | | | | | | | | | | |
| x | .4 | | | .50 | | | .51 | | | .57 | | | .50 | | |
| reliving | 34 | 3.1 | .0 | 8 | -0. | .27 | 9 | -0. | .2 | 3 | -2. | .0 | 5 | -2. | .0 |
| | | 5 | 01 | | 59 | 7 | | 52 | 67 | | 76 | 03 | | 40 | 08 |
| x ART | .5 | | | .48 | | | .48 | | | .43 | | | .37 | | |
| | 84 | | | 0 | | | 8 | | | 9 | | | 9 | | |
| <i>Rehearsal</i> | | | | | | | | | | | | | | | |
| x | .5 | | | .41 | | | .44 | | | .46 | | | .44 | | |
| rehearsal | 08 | -0.1 | .4 | 2 | -1. | .04 | 6 | -0. | .2 | 9 | 0.0 | .4 | 3 | -1. | .0 |
| | | 9 | 26 | | 67 | 8 | | 70 | 42 | | 0 | 98 | | 53 | 63 |
| x ART | .4 | | | .32 | | | .41 | | | .47 | | | .35 | | |
| | 95 | | | 1 | | | 4 | | | 0 | | | 9 | | |
| <i>Scene</i> | | | | | | | | | | | | | | | |
| x | .3 | | | .37 | | | .40 | | | .37 | | | .41 | | |
| scene | 76 | 2.0 | .0 | 1 | 2.4 | .00 | 1 | 2.5 | .0 | 9 | 2.0 | .0 | 5 | -0. | .3 |
| | | 3 | 21 | | 7 | 7 | | 6 | 05 | | 8 | 19 | | 29 | 87 |
| x ART | .4 | | | .49 | | | .53 | | | .48 | | | .39 | | |
| | 76 | | | 5 | | | 1 | | | 7 | | | 5 | | |

Visual

| | | | | | | | | | | | | | | |
|----------|------|------|-----|-----|------|-----|-----|-----|------|-----|------|-----|------|-----|
| x visual | .385 | 2.50 | .01 | .41 | 1.53 | .06 | .41 | 0 | 2.84 | .04 | -.02 | .25 | -1.1 | .1 |
| x ART | .514 | 0.06 | .49 | .33 | .543 | .02 | .44 | .68 | 3.02 | .44 | .48 | .38 | .21 | .13 |

Life story

| | | | | | | | | | | | | | | |
|--------------|------|-------|-----|-----|-------|-----|-----|-----|-------|-----|------|-----|------|-----|
| x life story | .497 | -1.50 | .04 | .39 | -0.81 | .21 | .40 | 2 | -0.46 | .06 | 0.24 | .2 | -1.0 | .0 |
| x ART | .418 | .857 | .34 | .39 | .81 | .0 | .38 | .23 | .07 | .40 | .405 | .27 | .57 | .58 |

Note. ART = Autobiographical Recollection Test; Z_F = Fisher's Z.