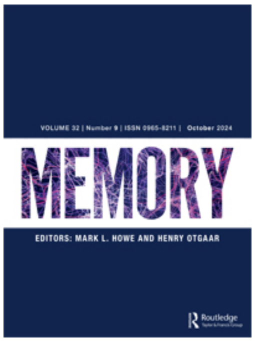

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The influence of event similarity on the detailed recall of autobiographical memories

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ABSTRACT

Memories for life events are thought to be organised based on their relationships with one another, affecting the order in which events are recalled such that similar events tend to be recalled together. However, less is known about how detailed recall for a given event is affected by its associations to other events. Here, we used a cued autobiographical memory recall task where participants verbally recalled events corresponding to personal photographs. Importantly, we characterised the temporal, spatial, and semantic associations between each event to assess how similarity between adjacently cued events affected detailed recall. We found that participants provided more non-episodic details for cued events when the preceding event was both semantically similar and either temporally or spatially dissimilar. However, similarity along time, space, or semantics between adjacent events did not affect the episodic details recalled. We interpret this by considering organisation at the level of a life narrative, rather than individual events. When recalling a stream of personal events, we may feel obligated to justify seeming discrepancies between adjacent events that are semantically similar, yet simultaneously temporally or spatially dissimilar – to do so, we provide additional supplementary detail to help maintain global coherence across the events in our lives.

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When we have the rich recollection of a personal event, we can vividly conjure back the happenings at the specific time and place that they had originally occurred (Tulving, 1972, 2002). This recollection is oftentimes accompanied by the experience of related memories flooding back to mind. For example, recalling a memory of "moving into my apartment" may prompt the recall of memories that share similar temporal (e.g., "unpacking the next day"), spatial (e.g., "a party at my apartment") or semantic (e.g., "helping a friend move") features (de Sousa et al., 2021; Morton et al., 2017). This process of activation between related events is thought to occur automatically, and emphasises the associative nature of memory (Mace & Clevinger, 2019).

These associations are thought to be critical for guiding memory search, as described by retrieved context models of episodic memory search (Howard & Kahana, 2002a; Kahana, 2020; Polyn et al., 2009a; Polyn & Cutler, 2017). These models, including the Temporal Context Model and the Context Maintenance and Retrieval Model, purport that the contents of memory are encoded alongside a slowly drifting representation of context – when a given item is recalled from memory, its accompanying context is also activated and can serve as a retrieval cue for subsequent memory search. According to retrieved context models, the gradually changing nature of contextual representations means that items that occur close together in time will be encoded with more similar contexts, resulting in phenomenon such as the temporal contiguity effect, a tendency to recall items in an order that is similar to how they were initially encoded (Healey et al., 2018; Kahana, 1996).

Temporal contiguity effects have typically been studied using word list learning tasks with relatively short durations between items, on the scale of seconds (Kahana, 1996; Sederberg et al., 2010). However, this property of memory search also extends to longer timescales. Even within studies using word list learning tasks, participants tend to show temporal contiguity effects across lists when making inter-list intrusions or when asked to recall words across an entire experiment, providing evidence for temporal clustering on the scale of minutes (Howard et al., 2008; Lohnas et al., 2015; Unsworth, 2008; Zaromb et al., 2006). These temporal contiguity effects have also been demonstrated beyond the timescales of those studied in more traditional laboratory-based studies, with

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temporal clustering seen during the free recall of word lists learned over the course of a day on smartphones (Cortis Mack et al., 2017), news events over a period of several months (Uitvlugt & Healey, 2018), and autobiographical events across several years (Moreton & Ward, 2010).

Despite initially being proposed to explain temporal associations in memory, retrieved context models have been expanded over time to accommodate other types of associations that can be used to guide memory search, such as spatial and semantic associations. For example, memory organisation along a spatial dimension has been previously demonstrated in studies where participants learned a list of words at different locations in a virtual environment under the guise of a delivery task (Herweg et al., 2020; Miller et al., 2013). During these tasks, the spatial relationships between encoded items can be used to help organise recall, and accordingly, participants showed a spatial clustering effect at recall akin to the temporal contiguity effect. Memory organisation along a semantic dimension has also been observed during the free recall of word lists. Semantic clustering at recall is observed for coarse-level category membership in lists made up of items from distinct semantic categories (Bousfield, 1953; Polyn et al., 2005; Shuell, 1969). Semantic clustering is also observed for more nuanced semantic associations in lists made up of items without an inherent semantic structure (Howard & Kahana, 2002b; Romney et al., 1993; Sederberg et al., 2010), as quantified using word embedding models that capture the subtle semantic relationships between words (e.g., Landauer & Dumais, 1997; Le & Mikolov, 2014; Mikolov et al., 2013; Pennington et al., 2014; Steyvers et al., 2004). These patterns in semantic clustering are thought to arise due to repeatedly encountering semantic associates in similar contexts over the course of one's lifetime (Howard et al., 2011; Lohnas et al., 2015; Polyn et al., 2009a).

The temporal, spatial, and semantic clustering described by retrieved context models parallel findings investigating the order in which autobiographical memories activate and cue one another. For example, studies using event-cueing paradigms probe the organisation of autobiographical memory by examining sequences of recalled events (Brown, 2005; Brown & Schopflocher, 1998a, 1998b; Wright & Nunn, 2000). Specifically, participants first recall a personal event, and subsequently, this recalled event is used to cue the recall of a second personal event. These event-cueing paradigms reveal that events tend to be recalled in event clusters, groups of events which share similar temporal, spatial, and semantic features. This is corroborated by evidence looking at the recall of involuntary memory chains, the spontaneous retrieval of a sequence of events without the prior intention of retrieval (Berntsen, 2010; Mace et al., 2013). Memory diary studies show that the events recalled in involuntary memory chains also typically share temporal, spatial, and semantic associations (Mace et al., 2010, 2013).

Previous work has demonstrated that the associations between items in memory can be used to help facilitate later recall. This idea underlies many mnemonic techniques, such as the method of loci or the peg method, which capitalise on the temporal and spatial associations between items in memory to scaffold the recall of other items (Bouffard et al., 2018; Caplan et al., 2019; Roediger, 1980; Yates, 1966). This also aligns with studies finding a relationship between memory organisation at retrieval and memory performance. For example, better recognition memory is observed when items are tested in an order that matches how they were initially encoded (Averell et al., 2016; Schwartz et al., 2005). Furthermore, positive relationships between the degree of temporal organisation and the amount of episodic detail at recall has been observed for memory of naturally occurring (Pathman et al., 2023) and staged naturalistic events (Diamond & Levine, 2020).

Despite the evidence underscoring the importance of temporal, spatial, and semantic associations in memory, relatively little is known about how facilitating their reinstantiation at retrieval affects detailed recall for real-world, personal events. To address this, we investigated whether the similarity between adjacently recalled events affected the details with which they were recalled. In the current study, participants were first asked to provide a set of digital photographs corresponding to events from their own personal lives. Here, we opted to use personal photographs because this allowed us to provide an evocative cue to selectively probe memory for real-world events from a specific time and place, while also imposing criteria to collect a relatively uniform temporal distribution of events within the time period of a year (Gilboa et al., 2004). Participants then completed a cued autobiographical memory recall task where they were presented with a series of their personal photographs and asked to verbally recount their memory for the corresponding events. We then assessed the pairwise similarities across tested events along their temporal, spatial, and semantic associations. To categorise the types of information used when recalling an event, responses from the cued autobiographical memory recall task were transcribed and scored according to the Autobiographical Interview, which quantifies the episodic and semantic contributions to memory recall (Levine et al., 2002; Renoult et al., 2020). We hypothesised that higher similarity between events at recall would facilitate the retrieval of episodic information – for example, recall for "the summer beach day in San Diego" was predicted to have more episodic detail when preceded by the recall for "the summer road trip going to California" (similar in time, space, and semantics) compared to "the winter cottage in Quebec City" (dissimilar in time, space, and semantics). We did not have strong predictions regarding how the similarity between events at recall would affect the semantic information provided. Assuming a positive relationship between event similarity and episodic information recalled, one potential hypothesis is that higher similarity between adjacent events at recall could facilitate the recall of semantic information, suggesting that episodic and semantic information support one another at retrieval (Irish & Piguet, 2013). In contrast, higher similarity between adjacent events at recall could impede the recall of semantic information, suggesting a potential trade-off between the amount of episodic and semantic details at recall (Devitt et al., 2017). Alternatively, higher similarity between adjacent events at recall could have no effect on semantic information, with higher event similarity having selective benefits to episodic memory.

Methods

Participants

28 participants were recruited from the University of Toronto community. All participants had normal or corrected-to-normal vision, and no reported history of psychological or neurological disorders, or brain damage (i.e., stroke or surgery). Experimental data from 9 of these participants was not collected either because of drop out after the first session ($n = 6$) or an insufficient number of provided photographs (n = 3). The final sample comprised 19 participants ($M_{Age} = 23.37$ years, $SD_{Age} = 4.17$ years, $Range_{Age} = 18\text{-}35$ years, 4 men/15 women). This sample size is comparable to group sizes reported in other studies using the Autobiographical Interview (Simpson et al., 2023). All participants provided written informed consent prior to the study and received monetary compensation for their participation. The study was approved by the Research Ethics Board at the University of Toronto (Protocol 38,856).

Study design

The study took place across two sessions (Figure 1). During the first session, participants were given instructions for stimuli collection. Participants then returned three to four weeks later for a second session, where they completed a cued autobiographical memory recall task and an event characterisation task. The first session took approximately 30 min to complete, and the second session took approximately 90–120 min to complete.

Session 1: stimuli collection

During the first session, participants were given instructions to select a set of 40–50 personal digital photographs from the previous year, with each photograph corresponding to a unique event that they personally experienced. Participants were asked to avoid selecting routine or recurring events, unless there was something unique about that particular event. Additionally, participants were asked to limit themselves to select only 1 event per day and up to 2 events per week. Participants were told that they would be asked to describe these events at a later session, so they should refrain from selecting events that they would not be comfortable discussing with others. After receiving instructions at this session, participants sent these photographs to a member on the research team in one of two ways: (1) using a flash USB drive or (2) using a secure, password-protected Google Drive or Dropbox folder. On average, participants sent 41.71 photographs ($SD = 5.05$) – these were received 5.94 days ($SD = 5.36$ days) after the first session. Participants were then scheduled to return approximately 3–4 weeks after sending in their photographs for a second session ($M = 25.41$ days, $SD = 8.61$ days). This was done to mitigate any effects of reactivation that may have occurred during the stimuli collection process. Participants were asked to not review their photographs prior to coming in for their second session.

After receiving a set of photographs from each participant, we determined the trial order for their cued autobiographical memory task to vary the temporal similarity between adjacently cued events. To determine the temporal similarity between events, the date information from each event was obtained using the metadata of each image file to establish when the event took place. If this metadata was not available, we asked participants to provide the date of each of their photographs prior to the second session. Participants were asked to provide this information for all of their photographs to avoid having some events be reviewed more than others. Photographs where the date could not be identified were excluded from selection for the cued autobiographical memory recall task. Thirty events were randomly selected to be tested on the cued autobiographical memory task. Two participants described 24 and 29 events because they did not provide a sufficient number of photographs that met the above criteria.

Events were sorted from oldest to newest (i.e., Event 1 is the oldest event, Event 2 is the next oldest event, etc.), and this ordinal position was used to derive the trial order for the cued autobiographical memory recall task. Specifically, events were pseudorandomized so that no more than three adjacent trials had an absolute difference that exceeded nine ordinal positions (e.g., there would be a difference of 11 positions if Event 3 was cued on Trial 1 and Event 14 was cued on Trial 2). This systematic selection procedure allowed us to obtain a relatively normal distribution of date lags between adjacent events centred around a date lag of 0 days in a standardised fashion across participants. Given the evidence for the logarithmic compression of our representation of time (Gallistel & Gibbon, 2000; Howard et al., 2015; Nielson et al., 2015), this distribution of date lags allowed us to prioritise investigation for the effects of shorter date lags compared to longer date lags. Although events were sorted from oldest to newest for the purposes of generating the trial order, this forward temporal order was not maintained

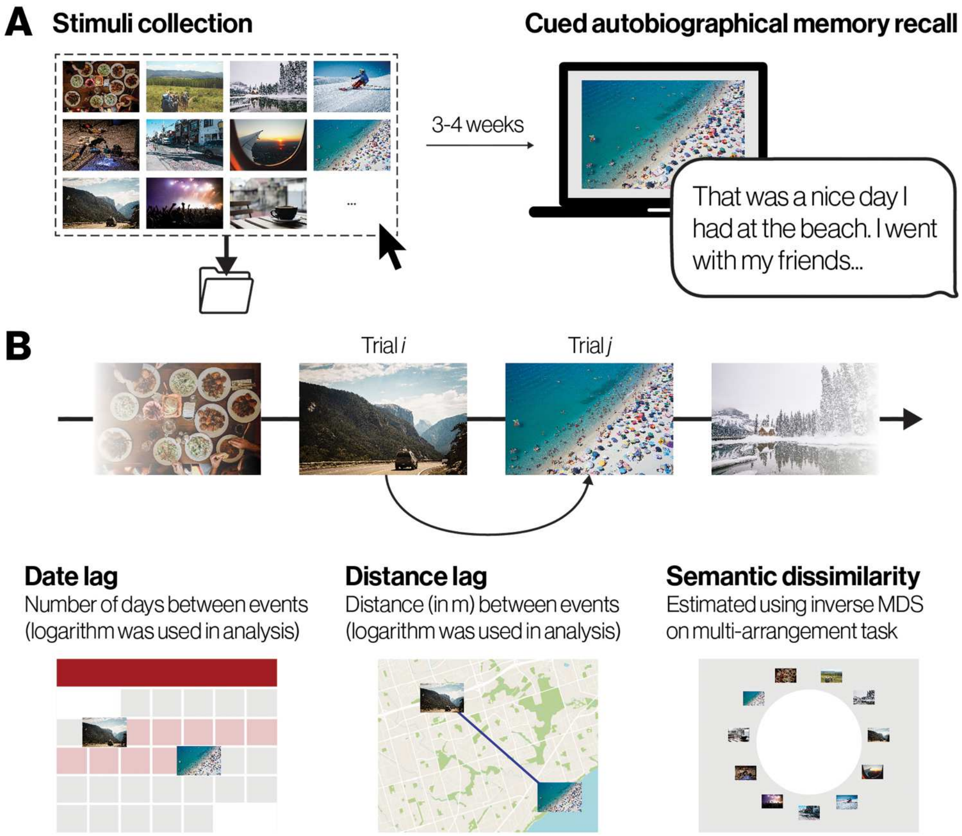

Figure 1. Schematic overview of study paradigm. (A) The study took place across two sessions. During the first session, participants were given instructions to compile a set of personal digital photographs, with each photograph corresponding to a unique, autobiographical event. After sending these photographs to the research team, participants were scheduled to return 3–4 weeks later for a second session. During the second session, participants were cued with the photographs sequentially and freely described the corresponding event in as much detail as possible. (B) The temporal, spatial, and semantic associations between events were characterised to assess whether the similarity between the previously recalled event and the cued event (i.e., between Trial *i* and Trial *j*) predicted recall for the cued event (i.e., Trial *j*).

during the cued autobiographical memory task (i.e., a preceding event could be either before or after the cued event in time).

Session 2a: cued autobiographical memory recall task

During the second session, participants first completed a cued autobiographical memory recall task where they were asked to describe the events corresponding to their provided photographs. For each trial, a photograph was presented on screen for one second. A fixation cross was also presented on screen for one second before and after the photograph. Afterwards, a row of asterisks was presented on screen alongside an auditory beep, prompting them to begin verbally describing the corresponding event in as much detail as possible. Participants were not given a time limit on their recall and indicated that they were finished recalling with a key press. Participants were then asked to rate the vividness of their recollection on a scale from 1 to 5, with 1 corresponding to "Not very vivid" and 5 corresponding to "Very vivid". Participants were also asked to identify the absolute date of the event as accurately as possible – they were given the option to indicate if they were completely unsure of the date of the event.

Session 2b: event characterisation

After the cued autobiographical memory recall task, participants were asked to characterise each of their tested events. This was done to determine the spatial and semantic relationships between each event – the temporal relationships between each event were determined prior by using the identified date from each photograph.

We first identified the location of each event to characterise the spatial relationships between events. Participants were presented with their photographs one at a time and asked to indicate the location of the event as accurately as possible, ideally to the level of the nearest intersection. To most accurately characterise the spatial relationships between events, participants were permitted to use other resources (e.g., social media, personal calendars, etc.) when specifying the location of a given event. The latitude and longitude of each location was then later identified using Google Maps. This was used to calculate the distance between adjacently tested events using the Vincenty formula for ellipsoids (Vincenty, 1975), as implemented in the *geosphere* package in R (Hijmans et al., 2019).

We then used inverse multidimensional scaling (MDS) to determine the pairwise similarities between events to characterise the semantic relationships between events (Charest et al., 2014; Kriegeskorte & Mur, 2012; Mur et al., 2013). Participants completed a multi-arrangement task where they were iteratively asked to drag and drop sets of up to 30 photographs, drawn from the photographs used in the cued autobiographical memory recall task, into a 2D circular arena. Specifically, they were instructed to arrange the photographs so that similar events were close together and dissimilar events were far apart. To avoid biasing responses, participants were purposefully not given criteria to guide their assessments of event similarity – although this does not probe for semantic relationships directly, we predict that the residual variance after controlling for temporal and spatial distance will likely pick up on more high-level conceptual associations. Participants continued the multi-arrangement task until the minimum evidence weight (i.e., 0.5) was reached or a time limit of 15 min had elapsed. On average, participants completed 11.50 trials ($SD = 5.74$) of the task. Data from one participant on the multi-arrangement task was excluded due to computer failure but was otherwise included in all other analyses.

Lastly, participants were asked to rate how personally important each event was on a scale from 1 to 5, with 1 corresponding to "Not very important" and 5 corresponding to "Very important".

Detail scoring protocol

Verbal descriptions were manually transcribed and scored to characterise their memory for each event. Specifically, we used the Autobiographical Interview scoring protocol (Levine et al., 2002) to quantify the number of (1) internal details, that capture the episodic information that is specific to the cued event (e.g., recollecting the experience of swimming in the ocean during a beach trip to California), and (2) external details, that capture more general semantic knowledge or other information that is not specific to the cued event (e.g., knowledge for what typically happens during a day at the beach). Internal details were further subcategorised to identify the event, time, place, perceptual, and thought/emotion details, as described in the standard Autobiographical Interview (Levine et al., 2002). We adapted this scoring protocol so that internal details for an event were omitted from analyses if they were present in the photograph used during the cued autobiographical memory recall task. External details were subcategorised to parse apart general semantic and personal semantic information, as described in Renoult et al. (2020). A more detailed description of each detail type, along with participant-level summary statistics, can be found in Table S1.

Two authors independently scored the transcripts for internal and external details, with the primary scorer (B.A.R.) scoring all transcripts, and the secondary scorer (B.H.) scoring a subset of the transcripts (~37% of the data; based on recommendations in Wardell et al. (2021)). Interrater reliability was assessed using single-score two-way intraclass correlations (*ICC*) based on a consistency (McGraw & Wong, 1996), calculated using the *irr* package (Gamer et al., 2012) in R 4.1.0 (R Core Team, 2021). Agreement was high across both internal ($ICC = .945$) and external ($ICC = .816$) details. Both scorers completed the training procedure for the standard Autobiographical Interview, provided by B. Levine, and achieved the benchmarks described therein to determine reliability with four experienced scorers from the original Autobiographical Interview scoring protocol.

Statistical analyses

To assess whether the number of internal or external details recalled for a cued event was affected by its similarity to the last recalled event, we analyzed the data using 2-level multilevel generalised Poisson models nesting individual trials within participants – Poisson models were used to help account for the count-based nature of the number of details recollected at recall (Bolker et al., 2009). Separate models were specified for each detail type (i.e., internal and external). All models were fit using the maximal random effects structure (Barr et al., 2013). Specifically, we estimated both fixed effects and random slopes for the date lag, distance lag, semantic dissimilarity, and their interactions, and a random intercept for each participant. A covariate to control for the personal importance of the cued event was also estimated. The logarithm of both date lag and distance lag was used based on previous evidence suggesting a scale-invariant representation of both time and space (Gallistel & Gibbon, 2000; Howard et al., 2015; Nielson et al., 2015). All predictors were grand-mean centred and standardised.

To better grasp how event similarity at recall affects the episodic and semantic information generated, we also investigated the relationship between the two types of details during recall (Devitt et al., 2017). A 2-level multilevel generalised Poisson model nesting individual trials within participants was used to predict the number of external details recalled. We estimated a fixed effect and random slope for the number of internal details recalled, and a random intercept for each participant. The number of internal details was group-mean centred and standardised.

All models were fit using the *lme4* package (Bates et al., 2015) in R 4.1.0 (R Core Team, 2021). All models were estimated using an unstructured covariance matrix. We used a backward-selection heuristic, outlined in Matuschek et al. (2017), to reduce the random effect structure in the situation that the maximal model failed to converge due to overparameterization. Conditional and marginal coefficients of determination (R^2_C and R^2_M, respectively), calculated with the *performance* package (Lüdecke et al., 2021), was used to assess model fit (Nakagawa et al., 2017). Significant interactions were probed by comparing simple slopes at one standard deviation above and below the mean (Aiken et al., 1991) using the *emmeans* package (Lenth et al., 2021). The best fitting models described using Wilkinson notation, and their corresponding model fit and fixed-effect statistics are summarised in Table S2.

Results

Internal details

We found that there was no main effect of date lag ($b = -0.00542$, $SE = 0.0333$, $z = -0.163$, $p = .871$), distance lag ($b = 0.0278$, $SE = 0.0220$, $z = 1.264$, $p = .206$), or semantic dissimilarity ($b = -0.0520$, $SE = 0.0313$, $z = -1.661$, $p = .0966$) on the number of internal details provided during the cued autobiographical memory recall task (Figure 2). We also found no significant interactions between any predictors (all p's > .05).

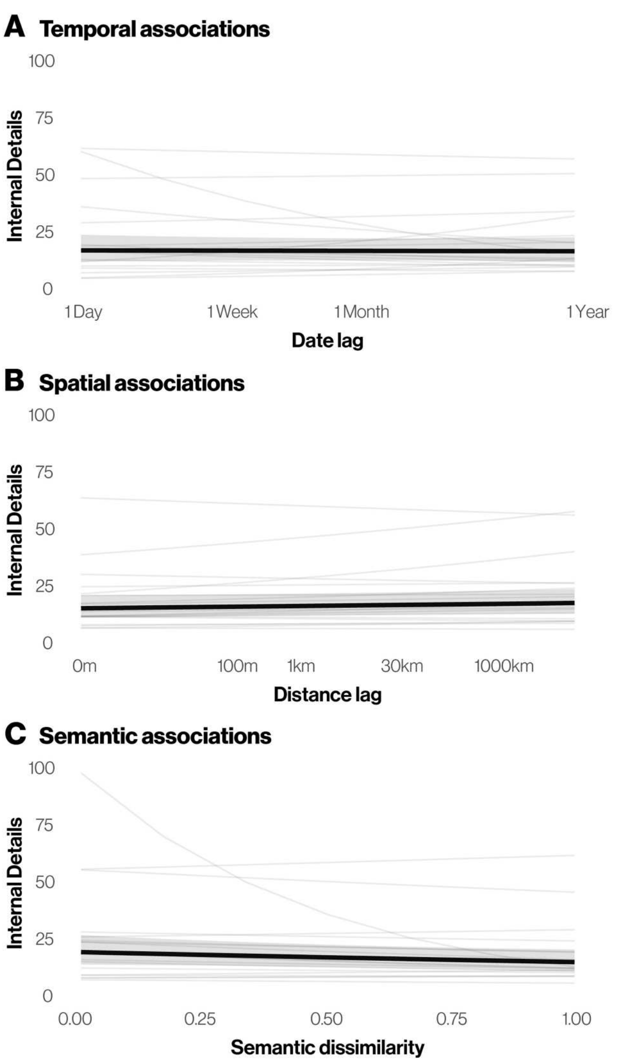

Figure 2. Estimated marginal means of the trends between the number of internal details recalled and (A) date lag, (B) distance lag, and (C) semantic dissimilarity (estimated using inverse MDS). The thick black line denotes the average relationship for a given fixed effect, with the ribbon around the line denoting the 95% confidence interval. The thin grey lines denote the random effect estimated for each participant.

External details

Turning to external details, we found a significant main effect of semantic dissimilarity, with participants recalling more external details for events that were more semantically similar (i.e., less semantic dissimilarity) to the preceding event ($b = -0.110$, $SE = 0.0414$, $z = -2.650$, $p = .00805$). Additionally, there was a significant interaction between semantic dissimilarity and both date lag ($b = -0.00501$, $SE = 0.0236$, $z = -2.122$, $p = .0338$), and distance lag ($b = -0.0873$, $SE = 0.0223$, $z = -3.866$, $p = .00011$) (Figure 3). This pattern of results was driven by an increase in the number of external details recalled when consecutive events were both semantically similar and either

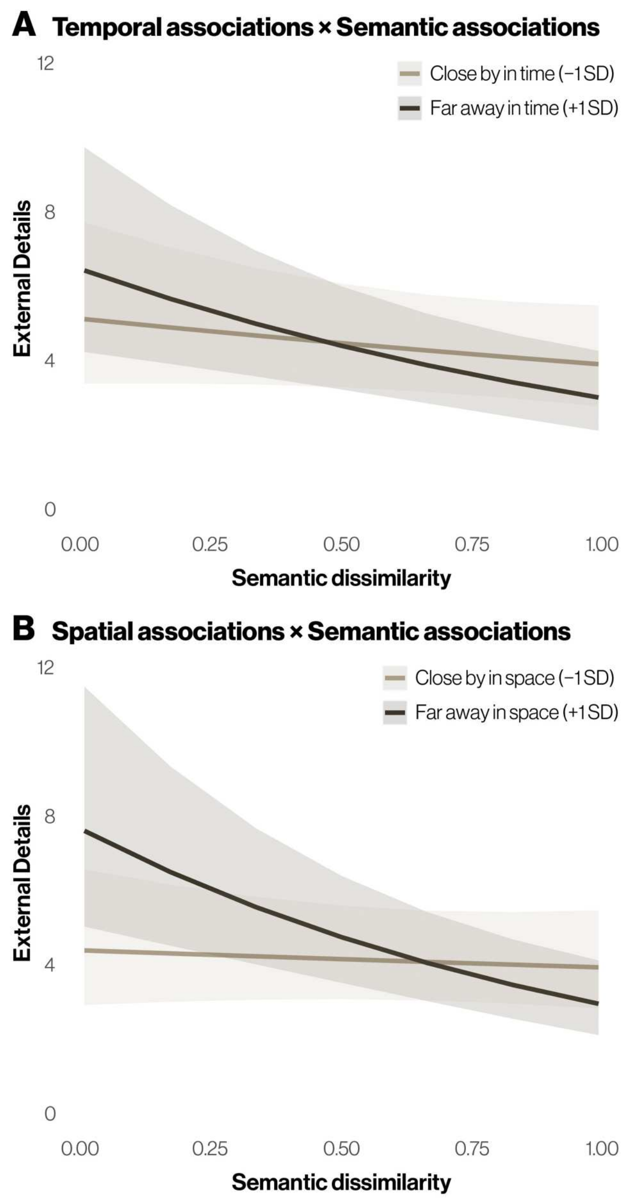

Figure 3. Estimated marginal means of the trends between the number of external details recalled and semantic dissimilarity across high and low (mean ± 1 standard deviation) levels of (A) date lag, and (B) distance lag. Each line denotes the average relationship for a given fixed effect, with the ribbon around the line denoting the 95% confidence interval.

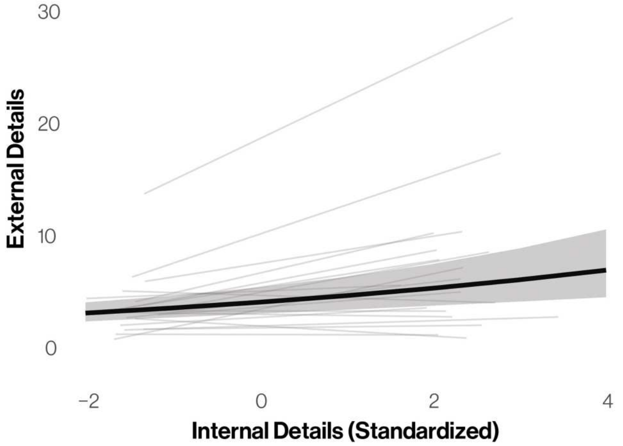

Figure 4. Estimated marginal mean of the trend between the number of external details recalled and the number of internal details recalled (standardised within each participant). The thick black line denotes the average relationship for the fixed effect, with the ribbon around the line denoting the 95% confidence interval. The thin grey lines denote individual regression lines for each participant.

temporally or spatially distant. For temporal distance, we found that participants provided more external details for events that were more semantically similar to the preceding event when the preceding event was far away in time ($b = -0.158$, $SE = 0.0483$, 95% CI [−0.253, −0.0634]), but not when it was close by in time ($b = -0.0563$, $SE = 0.0468$, 95% CI [−0.148, 0.0355]). We found the same pattern for spatial distance – participants provided more external details for events that were more semantically similar to the preceding event when the preceding event was far away in space ($b = -0.197$, $SE = 0.0483$, 95% CI [−0.292, −0.103]), but not when it was close by in space ($b = -0.0227$, $SE = 0.0460$, 95% CI [−0.113, 0.0675]). We did not find a main effect of either date lag ($b = -0.0219$, $SE = 0.0469$, $z = -0.466$, $p = .641$), or distance lag ($b = 0.0430$, $SE = 0.0230$, $z = 1.871$, $p = .0613$). We did not find any other significant interactions (all p's > .05).

Relationship between internal and external details

We found a significant main effect of the number of internal details provided ($b = 0.128$, $SE = 0.0288$, $z = 4.442$, $p < .001$) on the number of external details provided when recalling a given event, with participants providing more external details when more internal details were provided (Figure 4).

Discussion

The present study aimed to assess whether the detailed recollection of an autobiographical event was affected by its associations to the event recalled just prior. Participants were first asked to compile a set of personal photographs corresponding to autobiographical events from the previous year. These photographs were then used in a cued autobiographical memory recall task where participants were asked to sequentially describe the events corresponding to a given photograph. Importantly, these events were characterised to assess their pairwise temporal, spatial, and semantic similarity. We then evaluated the quality of memory recall by transcribing and scoring recall responses using the Autobiographical Interview to quantify the amount of internal or external details provided (Levine et al., 2002; Renoult et al., 2020). Contrary to our predictions, we did not find a significant effect for event similarity between adjacent events at recall along any of the measured associations on the number of internal details recalled. However, we did find that participants provided more external details for an event as the semantic similarity to the previously recalled event increased, with this effect being exacerbated with increasing temporal or spatial distance between the two events. Furthermore, we observed a positive relationship between the number of internal and external details recalled, suggesting that the external details recalled were likely not reflecting a compensatory function for poor episodic recollection. As an illustrative example, a participant would provide more external details when recalling the event "going to a punk show in July" if they had just recalled "learning a new song on the guitar in December" (i.e., high semantic similarity and far away in time) than if they had just recalled "going on a hike in July" (i.e., low semantic similarity and close by in time) – these associations would have no bearing on the number of internal details recalled. Altogether, these results suggest that event similarity between adjacent events at recall does not affect the recall of episodic information for a given event, but rather the recall of more extraneous information.

The retrieval of events from autobiographical memory can be conceptualised to take place across two discrete phases, namely an early "access" (or "construction") phase and a later "elaboration" phase (Addis et al., 2007; Cabeza & St Jacques, 2007; Conway, 2005; Daselaar et al., 2007). The access phase involves an active and controlled search process that occurs when first cued to retrieve a given event from one's personal past. The elaboration phase can then ensue, where the recollection of the given event is maintained and expanded upon with specific details (Conway & Pleydell-Pearce, 2000). Many of the previous studies investigating the associative nature of autobiographical events, such as those using event-cueing or memory diary paradigms, have demonstrated how access to a given event can be facilitated by its associations to other events (Brown, 2005; Mace et al., 2013). However, our findings suggest that these associations between events may not carry an added benefit to the recollection of episodic detail.

The observed pattern of results may be explained by considering the organisational structure of autobiographical memory at different levels. Namely, our initial hypotheses were informed by studies investigating the organisation of autobiographical memory by probing associations between individual life events (Brown & Schopflocher, 1998b; Mace et al., 2010, 2019). For example, in event-cueing paradigms, participants are first asked to recall a personal event – this event is then used to cue for the recall of a second personal event. These paradigms have helped to elucidate the associations that underlie the activation of related events that come to mind and have provided strong evidence for temporal, spatial, and semantic associations between events. In contrast to those paradigms, our current study design had participants recall a continuous stream of self-selected autobiographical events, which may encourage organisation at a coarser level than the event-to-event associations described previously. Specifically, the cued autobiographical memory recall task used may encourage recall of a more overarching narrative that captures organisational coherence across all recalled events (Bluck & Habermas, 2000; Nusser et al., 2022). This retrieval process may be facilitated by life story schemas, which provide an organisational scaffold to link together different autobiographical events into a coherent personal narrative (Bluck & Habermas, 2000). The activation of a life story schema is congruent with the pattern of results observed for external details, with participants providing more supplementary detail beyond the scope of the cued event for adjacent events that are semantically similar, yet simultaneously distant in either time or space. We may feel compelled to provide details beyond the cued event to help maintain a coherent narrative between the different events within a given period in our lives.

This interpretation is consistent with work demonstrating how our motivations and goals at retrieval can alter how we recall events from memory (Murty & Adcock, 2017). In addition to serving as a means to act in the future and understand our own selves, autobiographical memory plays a critical social function, allowing us to communicate our personal experiences to develop and maintain connections with others (Alea & Bluck, 2003; Bluck et al., 2005; Hirst & Echterhoff, 2012; Mahr & Csibra, 2018). Previous work has shown that when participants are tasked with recalling an event with the goal of sharing a story, they tend to provide more extraneous and general information than when asked to recall an event with the goal of accuracy (Dudukovic et al., 2004; Dutemple & Sheldon, 2022; Eckardt et al., 2023; Marsh, 2007). In the current task, participants are tasked with recalling a series of provided personal events, which may prompt them to weave them together into a cohesive story – this underlying retrieval goal may in turn explain the recall of external details in the current study. Further, this may be exacerbated given that participants are recalling their personal events to an unfamiliar researcher, with familiarity between communication partners having been shown to affect how autobiographical memories are shared (Alea & Bluck, 2003). Future work can further explore this question by explicitly manipulating instructions to shift retrieval goals during autobiographical memory recall (Melega et al., 2024).

Recalling autobiographical events in the context of a life story schema may explain the positive correlation between the number of internal and external details observed in the current study. Previous work has found a robust negative correlation between the number of internal and external details when recalling autobiographical events, with the recall of external details being thought to make up for a deficit in internal details (Devitt et al., 2017). However, this negative relationship has been demonstrated in studies investigating recall for a relatively small number of autobiographical events within a given life period – in contrast, the cued autobiographical memory recall task in the current study has participants recall a relatively large number of events from within the last year. Here, the retrieval of semantic details to connect different events may lay the groundwork to support the retrieval of additional episodic information (Irish & Piguet, 2013).

Additionally, the subjective perception of the different associations between individual events may be influenced by how they fit within general events that are extended across time. According to the Self-Memory System framework, autobiographical knowledge is arranged in a hierarchical structure (Conway, 2005). Under this framework, specific episodes (e.g., "going to the Musée des beaux-arts") can be contained within temporally extended events (e.g., "a week-long trip to Montreal"). This nested structure of autobiographical events has been proposed as a potential mechanism that gives rise to the temporal and spatial associations in memory (Mace & Clevinger, 2019; Thomsen, 2015). This may have downstream effects on the perception of these associations so that the same objective difference in time or space across specific episodes is perceived as subjectively different if they occur within or across temporally extended events. For example, a temporal distance of two days may be perceived as being more temporally proximal for specific episodes occurring within the same temporally extended event (e.g., between "going to the Jardin botanique" and "going to the Musée des beaux-arts", both on a trip to Montreal) compared to across different temporally extended events (e.g., between "going to the Musée des beaux-arts" and "giving an important presentation at work", occurring across the trip and returning home). Capturing how individual events fit in relation to a broader autobiographical memory hierarchy may help elucidate the subjective perception of associations in memory and how this subsequently affects detailed recall.

This proposed explanation parallels findings from laboratory-based studies showing the disruption of contextual associations between items at event boundaries (Brunec et al., 2018; Clewett et al., 2019; DuBrow et al., 2017). According to retrieved context models, the associative chaining in memory arises from a slowly drifting representation of context encoded alongside items in memory – the gradual change in this representation is thought to capture changes in space and time, with an event's spatiotemporal context being reinstated when it is subsequently retrieved (Kahana, 2020). However, evidence suggests that these contextual representations can abruptly shift at event boundaries, which segment our ongoing experience into discrete events (Zacks, 2020). For example, items that are learned within the same event tend to have better associated temporal order memory and are perceived as being closer in time than items that are learned across different events (DuBrow & Davachi, 2013; Ezzyat & Davachi, 2014; Heusser et al., 2018). Given the analogous hierarchical structure of event segmentation (Kurby & Zacks, 2011; Zacks et al., 2001) and autobiographical memory (Conway, 2005), the properties of contextual representations within and across event boundaries may inform the nature of associations between specific episodes within and across temporally extended autobiographical events.

Furthermore, quantifying the emotional associations between different events could help capture an important property on which memories are organised and subsequently recalled. A robust body of literature has demonstrated that the emotions evoked during a given event affects how it is remembered – this includes what aspects of experience are attended to at encoding, how readily it comes to mind from storage, how it is reconstructed at recall, and how robust it is to forgetting (Holland & Kensinger, 2010; Simpson & Sheldon, 2020). Recent evidence characterising the similarity of autobiographical events across various dimensions of experience suggests that these emotional characteristics may also be a predominant characteristic on which overall event similarity is assessed (Tomita et al., 2021). Specifically, the evoked emotions of a given event may facilitate the retrieval other events with similar emotional properties (Cohen & Kahana, 2022; Nusser & Zimprich, 2021; Talmi, 2013). These emotional associations may affect the detailed recall of an event, both in terms of the type of information provided and the emotional quality of recall. For example, memory for a "convocation day" (assuming that this evokes positive emotions) is predicted to be recalled with more episodic detail and more positive language following recall of a "birthday party" (i.e., mood congruent) compared to a "funeral" (i.e., mood incongruent).

These predictions align with work extending retrieved context models to capture the role of emotion in the organisation of memory. Here, the emotions experienced during a given event are thought to be imbued during the encoding of an event, forming an emotional context analogous to a spatiotemporal context (Palombo & Cocquyt, 2020; Tambini et al., 2017; Yonelinas & Ritchey, 2015). The reactivation of this emotional context at retrieval is proposed to cue memories with similar emotional properties (Cohen & Kahana, 2022; Long et al., 2015; Talmi et al., 2019). This emotional context may also selectively enhance or diminish associations across other aspects of experience, such as time and space (Palombo et al., 2021). Characterising the emotional properties of the events in the current study may help reveal both the contributions of emotional associations themselves and their interactions with other types of associations to the detailed recall of autobiographical events.

Future work could investigate whether the findings from this study differ in an older adult population. The ability to both re-experience the details of a given event, and bind these details to a given context has been shown to be dependent on the function of the hippocampus (Moscovitch et al., 2006; Ranganath, 2010), and age-related changes in episodic memory have been attributed to both structural and functional changes in the hippocampus (Gorbach et al., 2017). Accordingly, declines in episodic memory with age have been demonstrated to manifest in both reduced recall of event-specific detail for autobiographical memories and weaker temporal organisation at recall (Howard et al., 2006; Levine et al., 2002; Wingfield & Kahana, 2002). Thus, although the current study did not find evidence for an effect of increased event similarity and episodic detail in young adults, facilitating associations between events may be more effective at triggering episodic recollection for older adults, where the retrieval mechanisms that guide search may be affected by the aging process.

One aspect of our study methodology to note is the use of self-selected, personal digital photographs to cue for memory of specific events. We view this as a feature of our study given our interest in investigating detailed recall for naturally-occurring, real-world, and personally relevant events (Virk et al., 2024). Personal photographs also provide a benefit in serving as particularly evocative and specific cues that likely facilitate more direct access to a given event, which may in turn heighten the salience of similarities between consecutively cued events (Addis et al., 2012; King et al., 2024). Further, by setting criteria for participants during our stimuli collection phase, we were able to obtain cues to probe for events with a relatively uniform temporal distribution within a year (Gilboa et al., 2004). This allowed us to manipulate the trial order to vary event similarity between adjacent events on our cued autobiographical memory recall task, which may have otherwise been difficult using more generic experimenter-generated cues. This stimuli collection procedure may be relevant for other studies investigating autobiographical memory across the lifespan. For example, asking participants to collect stimuli in advance of recall may help to avoid confounds that may otherwise occur when probing for personal events at the time of recall, such as those stemming from the reminiscence bump, which may lead to an oversampling of events from late adolescence to early adulthood (Rubin, 2002). Extending the findings from the current study for events across the lifespan, rather than a year, would also be of theoretical interest given work demonstrating the scale-invariant nature of our internal representation of time (Howard et al., 2015; Shankar & Howard, 2012).

However, it is crucial to note that the self-selected nature of the stimuli may result in a bias towards events that are highly memorable or well-rehearsed. Although we have attempted to mitigate this by introducing a delay period prior to the recall task and by controlling for event importance in our statistical analyses, this self-selection bias may result in a ceiling effect that makes it more difficult to detect potential differences in recall. Contrasting our findings with paradigms that use other forms of stimuli capture, such as those using wearable cameras (Chow & Rissman, 2017) or smartphones (Martin et al., 2022), may allow us to investigate how differences in event memorability may moderate some of the effects in the current study.

Moreover, an important consideration when interpreting the conclusions of the current study is the low sample size. Although our sample size is similar to other studies using the Autobiographical Interview, the relatively low number of participants makes it more difficult to detect any significant differences (Simpson et al., 2023). However, the current study also involves collecting a larger number of trials (up to 30) within each participant than the typical five trials assessed in a standard Autobiographical Interview (Levine et al., 2002). This larger number of trials better allows us to capture the within-participant variance and can help to compensate for the smaller number of participants (Smith & Little, 2018). Nevertheless, the current study suggests that additional work with a larger sample size is warranted to better characterise the relationship between event similarity and detailed recall.

In conclusion, the current study used the cued recall of autobiographical events to investigate whether the associations between adjacent events at retrieval would affect their detailed recall. We found that the similarity between events at recall did not affect the episodic richness of recall. However, more detail from outside a cued event was provided when the preceding event was both semantically similar and distant in either time or space. These results help further our understanding of the link between detail and organisation in the recall of autobiographical memories and furthermore, points to the importance of considering memory organisation at different levels of coarseness.

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Data availability

Data from this work is available as an open-access dataset: https://osf.io/um45c/

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