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Involuntary and Voluntary Memory Sequencing Phenomena

An Interesting Puzzle for the Study of Autobiographical Memory Organization and Retrieval

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Introduction

One of the most enduring questions about long-term memory is how such a vast quantity of information is organized for efficient and reliable retrieval. Within semantic memory, the clustering of items in category generation tasks informs our understanding of organization. Bousefield (1953) defined a cluster as "a sequence of associates having an essential relationship between its members ... [with the] assumption that clustering is a consequence of organization in thinking and recall" (p. 229). Similarly, clustering in the recall of personal experiences can inform our understanding of autobiographical memory organization. There are two sources of clustering in the autobiographical memory literature. One is a laboratory technique known as event cueing, where subjects voluntarily generate sequences of autobiographical memories. The other is a naturally occurring phenomenon known as involuntary memory chaining, where subjects spontaneously generate sequences of autobiographical memories. While both of these clustering sources have produced internally consistent sets of results, the findings between the sources are contradictory, with the former indicating dominance for temporal associations, the latter dominance for conceptual associations among autobiographical memories.

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In this chapter, we review the findings from these two different paradigms. While we attempt to reconcile the discrepant sets of data, as will become clear as the chapter progresses, a complete resolution to the problem is not at hand. However, we believe that the possible solutions present some interesting and potentially important implications for understanding autobiographical memory retrieval and organization. The chapter is divided into three main sections: (1) a review of the laboratory-based data, (2) a review of the involuntary memory data, and (3) a review of some of the ideas that may explain the differences between these two sets of data.

Laboratory Techniques Used to Study Autobiographical Memory Organization

The primary technique for examining the organization of autobiographical memory is the event-cueing procedure. Based on the Galton/Crovitz word-cue procedure (Crovitz & Shiffman, 1974), one autobiographical memory is used to cue another autobiographical memory. The generated event (cued-memory) is assumed to share key characteristics with the cueing memory provided. The candidate characteristics include those based on memory content (e.g., activity, participants, or location) and remembering process (e.g., vividness or emotional response). The prevalence of each relationship type is thought to be indicative of the organizing principles of autobiographical memory retrieval.

Autobiographical memory clusters are defined as groups of memories that are causally related, hierarchically related, or are part of the same larger story (Brown & Schopflocher, 1998a). In addition to shared theme, participants, and setting, Brown and Schopflocher's (1998a) participants also generated memory pairs that shared common activities. Furthermore, most events in the cueing-memory and cued-memory pairs were temporally proximate.

Brown and Schopflocher (1998b) demonstrated that participants' cued memories were systematically drawn from two different populations based on age. The first is a store of recent, mostly mundane, autobiographical events. The second is a store of long-lasting, more important, autobiographical events. This is consistent with the distribution of freely recalled autobiographical memories from across the lifespan (Rubin, Wetzlel, & Nebes, 1986; Rubin & Schulkind, 1997a, 1997b), but also suggests that each store may have its own organizational features.

To test the extent of this temporal structure within autobiographical memory, Brown (2005) asked first- and second-year undergraduate participants to generate autobiographical memories from either the past week, their high school years, or their grade school years in response to cue words. Subsequently, these memories were presented in a random order as cues for

participants to generate personal events that were "somehow related to the cueing event" (p. 41). Events from the recent past (high school years) were most likely to elicit memories from the same cluster, significantly more so than grade school memories, with past-week memories resulting in moderately frequent recall of clustermates (not significantly different from high school or grade school). Memories within clusters from each time period were also more likely to share people and location than nonclustered memory pairs.

In addition to this temporal-cueing manipulation, Brown (2005) manipulated the instructions given to participants when recalling the event-cued memories. The first group was required to recall an event from the "same story" as the cueing event, whereas the second group was required to recall an event that was related to the cueing event in any way *except* that it was part of the same story. The final group was given standard instructions to think of the first memory that came to mind that was related in any way to the cueing event. All three instructions resulted in a replication of standard findings that within-cluster memories included the same people and location more often than nonclustered memories. "Same story" instructions lead to more frequent clustered memories and faster reaction times for clustered memories, suggesting that event clusters may be more prevalent than standard retrieval instructions indicate. Furthermore, nonclustered memories were retrieved faster with standard instructions than with "not-same story" instructions, indicating that retrieval of clustermates with standard instructions is unlikely to be due to biased search for narratively related memories in the standard design.

Fitzgerald (1980) examined the development of autobiographical memory organization by asking participants to generate memories in response to cue words and then shuffling and re-presenting those memories as cues to generate an additional autobiographical memory. He found that the most common relationships between memories were a continuation of the same ongoing event and a common theme or element shared between different events. Furthermore, younger participants (aged 13) were more likely to continue describing the ongoing event when prompted with a memory, whereas older participants (aged 19) were more likely to generate new events related in theme, participants, or setting.

Wright and Nunn (2000) expanded the original event-cueing procedures which had been limited to linking one (typically word-cued) autobiographical memory to one subsequently generated autobiographical memory to include larger groups of memories. They also examined more noncontent memory characteristics that might serve to relate autobiographical memories. Participants were presented with seven cue words to generate the initial autobiographical memory of each cluster. Those memories were then presented in series as cues for additional autobiographical memories. The procedure was

repeated until clusters of six memories apiece were generated, with the restriction that the cued memory could not be from the same day as the cueing event. Subsequent to the memory generation task, participants rated the emotionality, clarity, and importance of each memory as well as providing a date for each. Emotionality predicted importance which predicted memory clarity within event clusters, and each characteristic was more similar among events within a cluster than among events between clusters. Furthermore, their data replicated the temporal proximity findings of Brown and Schoplocher (1998b), even with the same-day restriction in place.

Instead of directly examining the relationships between memories, Odegard, Lampinen, and Wirth-Beaumont (2004) investigated the reliability of event clusters. They asked participants to generate four-memory clusters, each initiated by a word-cued memory. After a six-week delay, participants sorted their previously generated memories into event clusters. One's own memories were more reliably sorted than were other participants', but performance on both tasks was well above chance. Furthermore, the likelihood of correctly sorting an event decreased with an increasing distance between memories within the cluster. In other words, sequential memories within a cluster were more likely to be reliably sorted than were more distantly related events. When they repeated this procedure and added an additional memory generation task at the three-week mark, they replicated these findings. However, the advantage of sorting one's own memories was eliminated when participants were asked to sort into supraclusters (i.e., all memories generated in response to an initial cueing memory, regardless of if they were generated at time 1 or time 2) instead of sorting each event cluster separately, even though performance on the sorting tasks remained well above chance. Also noteworthy was the finding that cueing memories resulted in few of the same cued memories at time 1 and at time 2.

Procedurally, event-cueing paradigms offer many advantages. The cueing- and cued-memory pairs are easy to generate and the resulting data involve straightforward analysis. Cueing memories can be generated by a variety of means to explore secondary questions of memory organization (as demonstrated by Brown's [2005] time period restrictions) or the reliability of cueing-memory/cued-memory pairs (as demonstrated by Odegard, Lampinen, and Wirth-Beaumont, 2004). The procedure could also be adapted to examine the variability of cued memories that can be generated in response to the same cueing-memories, for example.

These laboratory-based memory-cued-memory procedures demonstrate that content features (e.g., people, location, event age, and event importance) are quite commonly shared among event clusters. However, the decreasing likelihood of accurate event-cluster identification with increasing distance between the to-be-sorted memory and the cluster-initiating memory found

by Odegard, Lampinen, and Wirth-Beaumont (2004) could mean that the event-cueing procedure overestimates the content similarity of memories within event clusters. The ability of participants to sort other participants' memories more reliably than would be predicted by chance alone (Odegard, Lampinen, & Wirth-Beaumont, 2004) indicates that, not surprisingly, there are some inherent constraints on memory content and the relationships among memories. However, there is still room for other organizing principles. There is some indication of higher-order relationships (causal or hierarchical links) predicting recall in these data. However, when trying to examine the organizational structure of autobiographical memory, limiting stimuli to memory pairs may be too restrictive, especially given the near infinite capacity in long-term memory. The lack of recalling the same memories when provided with the same cueing event (Odegard, Lampinen, & Wirth-Beaumont, 2004) underscores the quantity of information available in autobiographical memory and the necessity of a retrieval strategy that is both reliable and flexible. The functional demands of any given retrieval situation require organizational principles that can accommodate these needs.

Involuntary Memory Chains

Naturally Occurring Indicators of Autobiographical Memory Organization?

Diary studies of naturally occurring involuntary memories have shown that these memories sometimes occur in a series (e.g., Mace, 2005). Known as involuntary memory chains, subjects in these studies report that their involuntary memories sometimes occur in a rapid stream or succession of spontaneously generated memories (i.e., one memory quickly followed by one or more memories, hence the term *memory chains*). The chains typically contain two to three memories (longer chains appear to be very rare), and it appears that some 15–20 percent of all naturally occurring involuntary memories result in a chain of memories (see Mace, 2007). Other work on the chaining phenomenon has shown that it also occurs when subjects are intentionally recalling autobiographical memories, or words from a previously studied list (Mace, 2006; Mace & Martin, 2009, see review in Mace, 2007). The only difference in the case of voluntary remembering is that the precipitating memory (i.e., the first in the chain) is produced intentionally while the rest of the chain occurs spontaneously, thus mimicking the phenomenon as it is observed to occur in diary studies (for more details, see Mace, 2007).

Whether they have been observed to occur on laboratory tasks of autobiographical memory or in everyday involuntary remembering, memories in these chains uniformly exhibit a relationship to one another (see Mace, 2007). Similar to event-cueing procedures, these relationships are either temporally related event clusters or they are conceptually (but nontemporally) related clusters. However, the distribution of these associations appears in stark contrast to the distributions produced by event-cueing procedures, with conceptually related clusters dramatically outstripping temporally related clusters (typically, 80 percent versus 20 percent; see Mace, 2006, and Mace, 2007, for a review of distributions found in various studies).

This dissociation between voluntary memory laboratory procedures and involuntary memory chains brings us to the obvious question: What is the cause of this difference? Although we have no definitive answers, as stated at the outset, we believe that the possible solutions could have important implications for the study of autobiographical memory organization and retrieval. We devote the rest of this chapter to the possibilities.

Explaining the Dissociation

We argue that there are two competing sets of explanations for the causes of the dissociation between the voluntary event clusters and involuntary memory chaining: (1) methodological, and (2) theoretical. The methodological account works under the assumption that the differences are merely an artifact of measurement that is produced by laboratory procedures. That is, the dissociation in question is produced by two very different sets of data, one occurring spontaneously, the other deliberately, and thus inconstancy of conditions may be in some way responsible for the differences. One logical assumption may be that involuntary memory chains represent naturally occurring, automatic spreading activation in the autobiographical memory system (see Mace, 2007, chapter 8, this volume). And, as such, one might argue that they flow along more settled lines of organization within the system, similar to the idea that semantic priming follows the organization of semantic memory. Another methodological problem to consider is that voluntary recall procedures are relatively unnatural laboratory procedures, which leaves them open to the influences of subject biases (e.g., subjects thinking that temporal associations are the best examples of related memories, or that such memories are what the experimenter is asking for). In stark contrast to these explanations, theoretical accounts work under the assumption that the dissociation represents a real difference, perhaps the function of retrieval differences or retrieval/organization interactions. As these possibilities are more complicated, we introduce them after we review data that relate to the methodological explanations.

Methodological accounts

The event-cueing paradigms described above randomize presentation of the cues within each trial. The consequence of this is that each cued memory is the result of a novel search process. The potential problem with this technique is that it may encourage more deliberative search based (i.e., top-down strategic recall) on content features than would more naturalistic retrieval of related memories in sequence which may be more open to the influence of unconscious retrieval processes and therefore better reveal the emergent structure of autobiographical memory. The traditional memory-cued memory tasks are more similar to paired-associate retrieval tasks than to the free-recall tasks in category generation used to assess the structure of semantic memory.

Another difficulty in comparing data generated by the event-cueing procedure to data generated by involuntary memory chains is that the memories from each of these occur at very different time intervals. In event-cueing, subjects first go through a list of cues, recalling a single memory in response to each. Once they finish this task, they return to the generated memories, with the instructions to recall related ones, but this is obviously occurring some minutes (or longer) after the initial memories had been generated. This is not the case in involuntary memory chains, where memories are retrieved sequentially, within seconds of one another.

Memory chaining involves the sequential generation of related memories. In an attempt to bridge the laboratory-based event-cueing paradigm with the naturalistic diary recording of involuntary memory chains, Talarico (2005) gave participants a word-cue to generate an initial autobiographical memory, and then subsequently presented each cued memory as an immediate cue for a further memory in the chain. These memory chains are more naturalistic in that they are meant to model the kind of mind-wandering reminiscence that occurs outside the laboratory when individuals recall personally experienced events, but they still occur in a controlled laboratory session that allows for the discrimination of one memory from another and for the probing of relationships among memory-cued-memory pairs.

Talarico (2005) found that memory chains generated via this technique were recalled with significantly less effort than were memory clusters generated by the same participants via a traditional event-cueing technique. However, memory chains replicated the temporal proximity overlap found in event clusters. Also, memories within both chains and clusters had significant overlap in participant, activity, and location content and were not different in the frequency of higher-order relationships (e.g., "part of the same story" and/or "causally related") found among those memories.

Mace (2006) similarly instructed subjects in the event-cueing procedure to recall memories and then immediately recall related memories, such that a memory was recalled in response to a cue and then a related memory was

recalled immediately after this, making it very similar in time to involuntary memory chaining. The results generated from this approach, however, still dissociated from the involuntary memory chaining data, with the former showing significantly more event clustering than the latter.

However, it is not entirely clear what role subject bias might be playing in event cueing. In Mace's lab, different patterns of results have been observed for somewhat different subject populations. That is, relatively more mature subjects (i.e., roughly between the ages of 25 to 35) tend to show less event clustering than younger subjects (i.e., roughly 18 to 19 years of age, the typical subject pool age; Mace & Martin, 2009). This observation suggests that these different age groups may have different ideas about what constituted related memories. Another (not necessarily mutually exclusive) possibility is that younger subject populations may perceive the task of generating related memories as onerous and may therefore look for short cuts, such as recalling event clusters instead of conceptual clusters, whereas older subjects may be somewhat less inclined to approach the task in this manner.

To test the possibility that perceived task difficulty might influence outcomes, Mace and Martin (2009) set up two event-cueing conditions: one long list containing 18 cues, representing the typical event-cueing condition which might be perceived as laborious, and one short-list condition containing four cues, representing an atypical testing condition which might be perceived as relatively easy. The results showed that subjects given the long list showed a high proportion of event clusters, comparable to other event-cueing findings. However, short-list subjects dissociated from long-list subjects, in that they showed a significantly lower proportion of event clusters, comparable to involuntary memory chains. Furthermore, an inspection of the first four pairs of memories in the long-list group did not reveal any differences from the pairs generated in the rest of the list, thus ruling out the possibility that non-event or conceptual clustering was a function of the initial memories generated on a list of any length.

In sum, it appears that inconsistencies with the methods of measurement have been ruled out as alternative explanations, although there still may be a few avenues to explore here. On the other hand, the list-length findings show that subject biases can play a large role in the data generated from the event-cueing procedure. However, there are problems with accepting this conclusion and simply dismissing the dissociation between event cueing and involuntary memory chaining as a mere methodological artifact. For example, if subjects find it easier to retrieve event-related memories, then this suggests that there is something special about them, such as there may be more of them available, or they may be more readily available or easier to produce. Consistent with an ease of production view, Brown (2005) demonstrated that retrieval time for event-related memories was faster than retrieval time for conceptually related memories. Further, it is also possible that biases work in

the other direction. That is, when the task is not perceived as burdensome, subjects might feel that they have more time to look for conceptually related memories, which might be considered the better model for related memories. All of this, then, makes the prevalence of event clustering in event cueing seem like a real phenomenon, which of course implies that the dissociation between event cueing and involuntary memory chaining is still open to theoretical interpretation.

Theoretical accounts

The dissociation between event cueing and involuntary memory chaining might be based on two different factors. The main factor concerns the distribution of event-related and conceptually related memories over time. More recent memories may be more likely to be connected to other temporal events than to conceptually related events. One reason for this might be that newer memories may not have yet had the opportunity to connect to other conceptually related memories in autobiographical memory through the process of rehearsal and consolidation. However, as time goes by, these connections are made and simultaneously some of the temporal connections may be lost through the normal process of forgetting, though this part could be a small or negligible component. The result, then, is increasing conceptual connections with the passage of time (a point which seems to be supported by increased conceptual clustering in the event-cueing data generated from remote periods; Brown, 2005).

The second factor is a subject characteristic which combines with the first to produce event-clustering dominance. Younger subjects (i.e., 18 to 19) may be more inclined to recall recent memories rather than more remote memories. Thus, when these subjects use recent memories to generate related memories, they recall more temporally related memories because more of them are available, according to the theory put forth above. Hence, event clusters dominate their data, and given that most of the event-cueing data are based on subject populations from this age range, the results are skewed towards event clusters. Further support for this idea comes from the fact that the youngest subjects tested, aged 13, were the most likely to rely on temporal continuation when generating events in response to event cues (Fitzgerald, 1980).

However, this account alone probably does not entirely explain the differences between event-cueing and involuntary memory chaining, because it appears that irrespective of all of the preceding arguments, one process has a tendency to produce a set of temporal connections while the other has a tendency to produce a set of conceptual connections. If these differences are truly a function of inherent differences in the two retrieval processes, then the questions that quite logically follow are how and why. Functionally,

voluntary remembering might be better served if it naturally followed temporal pathways, as temporal information frequently is a central aspect of a retrieval problem. This could be accomplished by directing the search along the targeted temporal lines, while other temporal periods are simultaneously inhibited. So, for example, when a subject first recalls a memory in response to a cue, a temporal period is selected and set and a memory from the period is produced. If the subject then uses that memory as a cue to recall a related memory, the temporal parameter remains intact (or is reinstated) and the second search produces a memory that is closely related temporally (i.e., another memory from the event cluster). If the goal is to produce a single memory, without a second search (as in the case of typical voluntary remembering), or if a memory occurs spontaneously (as in the case of everyday involuntary remembering), then additional spontaneous activations can flow along any set of connections, though it appears that conceptual flows are more likely, as indicated by the involuntary memory chaining data (Mace, 2006, 2007; Mace & Martin, 2009).

How are Memories Organized in the Autobiographical Memory System?

As is evident from this review, studies using event-cueing methods have suggested that event clusters are the dominant form of organization in autobiographical memory (e.g., Brown, 2005). The involuntary memory chaining data, however, suggest just the opposite (e.g., Mace, 2007). We have suggested that the two sets of data may indicate that organizational dominance depends on the way that memories are retrieved (or organization conforms to retrieval function). And we have also reviewed a way in which event age may interact with organization. While we would like to argue that these points reconcile the two sets of data such that one might reasonably conclude that conceptual and temporal connections are equal (or nearly equal) in autobiographical memory, there appear to be too many open questions and conflicting possibilities to allow for such a conclusion at this time.

Summary

We have presented paradoxical data from two different memory sequencing retrieval phenomena (one voluntary, the other involuntary), both of which rely on the assumption that cued memories easily brought to mind by cueing memories are our best representatives of naturalistic organization of autobiographical memory. The voluntary retrieval data reveal a temporal

organization to autobiographical memory with event clusters formed by sequences of individual events. This kind of relationship dictates that content features of the memories will be similar and likely to include substantial thematic overlap as well. However, these seem to be a consequence of their temporal relationship in these data, not an organizing principle. The involuntary retrieval data reveal a conceptual organization of event clusters including thematically related events than may have occurred at temporally distant time points. The dissociation between these two phenomena may be indicative of different underlying retrieval processes, which has the potential of enhancing our understanding of these processes and their functions.

References

Bousefield, W. A. (1953). The occurrence of clustering in the recall of randomly arranged associates. *Journal of General Psychology*, *49*, 229–240.

Brown, N. R. (2005). On the prevalence of event clusters in autobiographical memory. *Social Cognition 23*, 35–69.

Brown, N. R., & Schopflocher, D. (1998a). Event clusters: An organization of personal events in autobiographical memory. *Psychological Science*, *9*, 470–475.

Brown, N. R., & Schopflocher, D. (1998b). Event cueing, event clusters, and the temporal distribution of autobiographical memories. *Applied Cognitive Psychology*, *12*, 305–319.

Crovitz, H. F., & Shiffman, H. (1974). Frequency of episodic memories as a function of their age. *Bulletin of the Psychonomic Society*, *4*, 517–518.

Fitzgerald, J. M. (1980). Sampling autobiographical memory reports in adolescents. *Developmental Psychology*, *16*, 675–676.

Mace, J. H. (2005). Priming involuntary autobiographical memories. *Memory*, *13*, 874–884.

Mace, J. H. (2006). Episodic remembering creates access to involuntary conscious memory: Demonstrating involuntary recall on a voluntary recall task. *Memory*, *14*, 917–924.

Mace, J. H. (2007). Does involuntary remembering occur during voluntary remembering? In J. H. Mace (Ed.), *Involuntary memory* (pp. 50–67) Oxford: Blackwell.

Mace, J. H., & Martin, C. (2009). *Involuntary memory chaining versus event cuing: Which is a better indicator of autobiographical memory organization?* Manuscript submitted for publication.

Odegard, T. N, Lampinen, J. M., & Wirth-Beaumont, E. T. (2004). Organisation and retrieval: The generation of event clusters. *Memory*, *12*, 685–695.

Rubin, D. C., & Schulkind, M. D. (1997a). The distribution of autobiographical memories across the lifespan. *Memory and Cognition 25*, 859–866.

Rubin, D. C., & Schulkind, M. D. (1997b). The distribution of important and word-cued autobiographical memories in 20, 35, and 70 year-old adults. *Psychology and Aging*, *12*, 524–535.

Rubin, D. C., Wetzlel, S. E., & Nebes, R. D. (1986). Autobiographical memory across the adult lifespan. In D. C. Rubin (Ed.), *Autobiographical memory* (pp. 202–221). Cambridge: Cambridge University Press.

Talarico, J. M. (2005, November). *Event clustering and event chaining: Associations in autobiographical memory*. Poster presented at the annual meeting of the Psychonomic Society, Toronto, Canada.

Wright, D. B., & Nunn, J. A. (2000). Similarities within event clusters in autobiographical memory. *Applied Cognitive Psychology*, *14*, 479–489.