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Recent Advances in Understanding the Reminiscence Bump: The Importance of Cues in Guiding Recall From Autobiographical Memory

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Abstract
The *reminiscence bump* is the increased proportion of autobiographical memories from youth and early adulthood observed in adults over 40. It is one of the most robust findings in autobiographical-memory research. Although described as a single period from which there are more memories, a recent meta-analysis that reported the beginning and ending ages of the bump from individual studies found that different classes of cues produce distinct bumps that vary in size and temporal location. The bump obtained in response to cue words is both smaller and located earlier in the life span than the bump obtained when important memories are requested. The bump obtained in response to odor cues is even earlier. This variation in the size and temporal location of the reminiscence bump argues for theories based primarily on retrieval rather than encoding and retention, which most current theories stress. Furthermore, it points to the need to develop theories of autobiographical memory that account for this flexibility in the memories retrieved.

Keywords
autobiographical memory, cuing, important memories, olfaction, reminiscence bump, word-cued memories

The *reminiscence bump* refers to the disproportionate number of autobiographical memories, in adults over 40, dating from youth and early adulthood. Since Rubin, Wetzler, and Nebes (1986) first demonstrated the bump, it has been considered a hallmark of autobiographical memory and, as such, is typically featured in introductory cognitive textbooks (e.g., Eysenck & Keane, 2010; Goldstein, 2015; Rathbone, Moulin, Conway, & Holmes, 2012). Researchers generally cite a single age range—from approximately 10 or 15 to 30 years of age—as representing a single bump period (e.g., Dickson, Pillemer, & Bruehl, 2011; Habermas, 2007; Koppel & Berntsen, 2014). The widespread interest in the bump stems in part from the consideration that it provides a quantitative description that allows reminiscence and nostalgia to be probed in more detail, and in part from the fact that the bump does not conform to standard monotonically decreasing retention functions (e.g., Ebbinghaus, 1885/1964; Rubin & Wenzel, 1996).

However, recent evidence and some isolated early observations have suggested that the bump has been widely misunderstood, in that it is often treated as a unitary phenomenon when, in fact, both the size and the temporal location of the bump are sensitive to the cuing method used to elicit memories. We review this evidence before discussing its theoretical implications.

The Life-Span Distribution of Autobiographical Memories

Three phenomena are observed when adults are asked to retrieve autobiographical memories in response to

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words not selected for special content. The first is retention, which can be described as a power function (i.e., a linear function of the logarithm of the number of memories recalled per hour plotted as a function of the logarithm of the time since the event). It has an excellent fit to a precise quantitative function with identical slopes across participants of different ages (Rubin & Schulkind, 1997; Rubin & Wenzel, 1996; Rubin et al., 1986). The second phenomenon is childhood amnesia, which can be described as a monotonically increasing function of age from 0 to about age 8 (Rubin, 2000). The third phenomenon is the bump. Empirically, the first two phenomena can be described much more precisely than the third. None of the three has a single preferred theoretical mechanism. However, because both childhood amnesia and the bump depend on age at the time of the remembered event rather than the age at retrieval or the retention interval, explanations of the bump have emphasized heightened encoding during the ages for which the bump occurs rather than differences in cuing, which occurs much later at retrieval.

Word-Cued Memories Versus Important Memories

Two methods have been dominant in studying the bump (Koppel & Berntsen, 2015). The first method, with which the bump was first identified (Rubin et al., 1986), requires participants to retrieve autobiographical memories in association to cue words. It is intended to provide a neutral sample of the entire contents of memory (Crovitz & Schiffman, 1974; Galton, 1879). The second method requires participants to report important autobiographical memories, such as the most important memories of their lives (e.g., Rubin & Schulkind, 1997) or memories they would include in a book about their life (Fitzgerald, 1996).

Koppel and Berntsen (2015) argued that the key distinction between these two cuing methods concerns the contrasting retrieval strategies triggered in each. The word-cue method allows any association between the cue and the memory, whereas the request for an important memory requires an event with a specific role in the participant's life story and so tends to produce a narrative-based search. Initial empirical observations indicated that neither the bump nor the broader distribution of autobiographical memories are identical across these two methods. Specifically, compared to the bump for important memories, the bump for word-cued memories contains a smaller proportion of the memories and is located earlier in the life span (Rubin & Schulkind, 1997). The word-cue method also produces many more recent memories (Rubin & Schulkind, 1997; Rubin et al., 1986). In a meta-analysis examining more than 50 studies that used either word cues or requests for important memories to study the bump, Koppel and Berntsen (2015) found that the beginning and ending ages reported for the bump for word-cued memories had means of 9 and 23 years of age compared to 15 and 28 years for important memories, a difference of about 5 years. Thus, there are effectively at least two different bumps. Figure 1 presents a temporal distribution for both word-cued and important memories taken from the same study and for odor-cued memories estimated from three published studies.

The bump in word-cued memories may begin even earlier than is indicated by Koppel and Berntsen's (2015) estimate. Researchers have most often used either 5-year intervals (e.g., 0–5 years, 6–10 years; Koppel & Berntsen, 2016) or 10-year intervals (e.g., 0–10 years, 11–20 years; Rubin & Schulkind, 1997) in plotting the distribution of word-cued memories. However, both Rubin and Schulkind (1997) and Janssen, Rubin, and St. Jacques (2011) demonstrated that the location of the bump for word-cued memories can shift depending on which age bin researchers employ. For instance, Janssen et al. (2011) found that plotting their word-cued memory data in 5-year bins produced a peak from 6 to 10 years of age, whereas 10-year bins produced a peak from 11 to 20. This suggests that using 10-year bins for word-cued memories may obscure the beginning of the bump in the 6- to 10-year age range. Therefore, the bump in word-cued memories may peak soon after childhood amnesia, which generally ends around the age of 8 (Rubin, 2000).

Olfactory Cues

In terms of the temporal location of the bump, odors provide the most striking comparison to word cues and requests for important memories. Three studies testing older adults compared odor and word cues with the same referent (Chu & Downes, 2000; Willander & Larsson, 2006, 2007). Koppel and Berntsen (2015) included the word-cued data from these studies, which, using 10-year bins, produced bumps with most memories in the 11-to-20 decade, consistent with other word-cued studies. There were not enough studies using odor cues to include for the criteria of Koppel and Berntsen's (2015) meta-analysis, but when they were examined qualitatively by Rubin (2015), a consistent and much earlier bump was found in the 0-to-10 age bin, as is shown in Figure 1. The agreement among the three studies was striking and was replicated even when older adults were asked to imagine the odor given the corresponding word cue (Willander & Larsson, 2008).

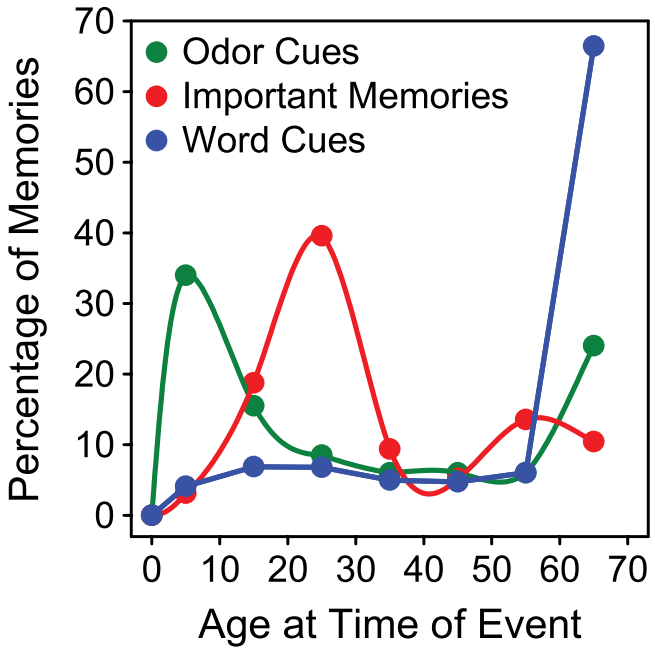

Fig. 1. Three curves showing memory bumps elicited using different methods. The data for the word-cued and important memories are from Rubin and Schulkind (1997) and are used to illustrate the basic findings of the Koppel and Berntsen (2015) review using a single study. The olfactory plot is an approximation based on articles by Chu and Downes (2000) and Willander and Larsson (2006, 2007), with the 60- to 70-year-old decade approximated from information in Chu and Downes (2000).

Other Changes in Cuing

As reviewed, changing the cues from odors to words to requests for important events produces dramatic changes in the temporal location and proportion of memories in the bump. But even within these kinds of cuing, large differences are possible. For instance, for three word cues given to 212 undergraduates, the time between the recall and the reported dates of the memories were 10 days for *paper*, 61 days for *hospital*, and 334 days for *fire* (Rubin, 1982). In another word-cued study (Rubin & Schulkind, 1997), 20 adults aged 73 were given instructions that included the words in the first of each pair in parentheses; 20 other adults received instructions that included the words in the second:

> The (memory) / (event) you think of. . . can come from any point in time in your life, (even from as far back as you can remember) / (even as recently as this morning). The (memory) / (event) does need to be very specific. . . For example, if I were to use the word *store*, you might (remember having gone to a little country store with your grandfather when you were five) / (think of having gone to the hardware store yesterday).

The instructions using the words in the first of each pair in parentheses produced a bump that peaked in the 10-to-20 age bin and contained 35% of the memories; the instructions using the words in the second produced a bump that peaked in the 20-to-30 age bin and contained 23% of the memories.

Even within word-cued memories, there are large differences that involve retrieval as well as encoding. Within the realm of important and retrospectively reported involuntary memories, memories that participants considered positive produced a bump, and those they considered negative did not (Berntsen & Rubin, 2002; Rubin & Berntsen, 2003). Memories cued by words for specific positive emotions, such as *extremely happy*, produced a bump, but those cued by words for negative emotions, such as *extremely sad*, did not. One exception was *extremely jealous*, a negative emotion that often requires the positive emotion of love. The two other exceptions in this Danish sample were *extremely afraid* and *most traumatic*, but the bump occurred only in the oldest participants, whose bump period coincided with the occupation of Denmark in World War 2, an exception that proves the rule. Moreover, there were differences in when the bump occurred across positive emotions: The cue *extremely in love* produced a bump that peaked in the teens; *extremely proud* peaked in the 20s.

Theoretical Implications

Theoretical accounts of the bump were developed to account for a single increase in memories for events occurring between the ages of 10 or 15 to 30, and thus most were based on encoding differences during that period (see Koppel & Berntsen, 2015, for a review). For instance, the *identity-formation account* postulates that this period contains a clustering of events that are related to identity formation (Conway & Holmes, 2004; Conway & Pleydell-Pearce, 2000; Fitzgerald, 1988, 1996; Rubin, Rahhal, & Poon, 1998). Such events receive increased encoding and retention because they are involved in solving basic life issues, are more central to related networks of events, and have their availability maintained through increased rehearsal. The *cognitive account* postulates that the increased availability of memories from the bump period in later adulthood is caused by the increased effort at encoding needed by the many novel events during that period (including many first-time experiences; Robinson, 1992) and the increased and continued rehearsal of those events, because they are

more relevant to later life than childhood events (Rubin et al., 1998). The *cognitive-abilities account* postulates that the optimal encoding efficiency of many cognitive and neural functions during the bump period causes the bump (Janssen, Kristo, Rouw, & Murre, 2015; Rubin et al., 1998).

In contrast, the *life-script account* was devised specifically to explain the bump observed when important events were requested or were reported as having occurred involuntarily—that is, as coming unbidden without an attempt at recall (Berntsen & Rubin, 2004). The life script includes culture-based general knowledge about categories of important events in a typical life and when they are expected to occur, such as marriage at age 27. Based on empirical observations used to formulate the life script, such categories of events are predominantly emotionally positive and are dated as occurring during the bump period in important memories. As an explanation of the bump, the life-script account differs from the other theories in that it stresses processes at retrieval rather than encoding, cultural semantic knowledge common to a group rather than episodic information from an individual life, and autobiographical memories that are personally important rather than autobiographical memories in general. Nonetheless, the importance of past and future life-script events in an individual's life should lead to their being especially well encoded and rehearsed, adding to the effectiveness of later searches. The finding of three different bumps suggests different explanations for each; the life-script account represents a starting point for such differentiated accounts, as it is intended for only the bump for important events.

The life-script account allows more specific hypotheses to be made about the search processes for important memories, and thereby the location of the bump, than do the accounts of word- and odor-cued memories. It is likely that word cues trigger a search that involves looking for an event with a language-based and thus often a narrative-based context, through a cyclical process of refining the search by providing more specific cues until a memory is obtained (Conway & Rubin, 1993). For instance, the word cue *apple* may lead to an image of apples on a recent shopping trip or a time in one's life when one ate a lot of apples. Odor cues can bypass the neural structures supporting language that word cues require and possess a direct, preconscious link with one's emotions (Rubin, 2006). Odor cues are therefore more likely to invoke isolated events lacking a linguistic and thus narrative context and may therefore avoid interference from memories that are more verbally accessible, which could account for their earlier bump (e.g., Lawless & Engen, 1977). Similar effects could hold for linguistic instructions to imagine odor cues, though they would not bypass the initial processes using language-based neural structures.

The bump is a robust phenomenon, an observation that was not a prediction or test of psychological theories. As such, it tests existing theories of autobiographical memory and memory more generally. Theories devised and tested in the laboratory have provided much of our scientific understanding of memory, but those theories have been based on and tested using a restricted range of events that does not span trivial to extremely relevant events, or encoding, retention, and retrieval times from minutes to decades, or processes that change with development over the course of a person's life span. The bump therefore provides a test case for using our existing theories to understand human memory as it functions in the wild, so that we can begin to find the aspects of our theories that will be most useful in this endeavor.

Although the bump has been investigated for 30 years, recent work has forced a reconceptualization of its underlying processes. In particular, although factors that can affect the bump cannot be easily manipulated while holding all other factors constant, the demonstration of three distinct bumps allows the well-studied cognitive manipulation of changing retrieval cues to provide a way to distinguish among theories and suggest further tests. If autobiographical memory is to be adaptive over the life span, it must be flexible and able to produce relevant information as it is needed or desired, something a focus on encoding does not allow for. The existence of changes in the word-cued reminiscence bump with changes in the word cues and instructions used and the existence of different reminiscence bumps for odor cues, word cues, and requests for important events illustrate this flexibility and point to existing methods that can study it.

Recommended Reading

Berntsen, D., & Rubin, D. C. (2002). (See References). Represents the initial elaboration of the cultural life-script account of the bump.

Conway, M. A., & Pleydell-Pearce, C. W. (2000). (See References). Presents the most elaborated description of what is currently the most influential iteration of the identity-formation account of the bump, in the context of an overarching model of autobiographical memory.

Koppel, J., & Berntsen, D. (2015). (See References). Provides a systematic illustration of the differential locations of the bump across word-cued versus important memories and discusses the theoretical implications thereof in greater detail than we have been able to provide here.

Rubin, D. C., & Schulkind, M. D. (1997). (See References). Represents the first within-subjects demonstration of the differences in the bump across word-cued versus important memories.

Rubin, D. C., Wetzler, S. E., & Nebes, R. D. (1986). (See References). Provides the first empirical demonstration of

the bump through a combination of a reanalysis of prior work and the presentation of new data.

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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