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Self-centered memories: The reminiscence bump and the self

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The self–memory relationship is thought to be bidirectional, in such a way that memories provide context for the self, and equally, the self exercises control over retrieval (Conway, 2005). Autobiographical memories are not distributed equally across the life span; instead, memories peak between ages 10 and 30. This reminiscence bump has been suggested to support the emergence of a stable and enduring self. In the present study, the relationship between memory accessibility and self was explored with a novel methodology that used generation of self images in the form of *I am* statements. Memories generated from *I am* cues clustered around the time of emergence for that particular self image. We argue that, when a new self-image is formed, it is associated with the encoding of memories that are relevant to that self and that remain highly accessible to the rememberer later in life. This study offers a new methodology for academics and clinicians interested in the relationship between memory and identity.

In the field of memory research, there has been a recent upsurge of interest in narrative accounts of personality and identity. Such approaches (e.g., McAdams et al., 2006) suggest that personality is supported by the construction of life stories based on autobiographical memory (AM). AM is memory for events that occur in one's life (Conway & Rubin, 1993) and is closely linked to our life goals, our emotions, and our personal meanings. Our very sense of identity depends on being able to recall personal history (self-defining memories; Moffitt & Singer, 1994); in order to explore self and identity, it is necessary to understand the encoding and retrieval of event-specific temporal knowledge (see, e.g., Skowronski et al., 2007). For a review of the complex relationship between self and memory, see Conway (2005). One well-established finding of AM research is that memories are not distributed equally across the life span, but instead parallel changes in the self and in goals over time. Undoubtedly, the self changes over the course of childhood and perhaps stabilizes into an enduring form only in late adolescence and early adulthood (Erikson, 1950; Schwartz, 2006; Waterman, 1999).

A prominent theory is that these periods of development of the self and of personality are reflected in the life span retrieval curve, which is observed when adults (aged about 35 and older) recall autobiographical memories (e.g., Rubin, Wetzler, & Nebes, 1986). The life span retrieval curve consists of three components: the period of childhood amnesia (from birth to approximately 5 years), the period of the reminiscence bump (10–30 years), and the period of recency (from the present declining back to the period of the reminiscence bump). For those studying the relationship between the self and memory, the reminiscence bump is of particular interest, because it is the period from which, in a free recall task, people produce the most memories. Crucially, the reminiscence bump is based robustly on the age of the rememberer at the time of encoding and not on the age of the memories, so that artifactual, retrieval-based accounts of this finding can be rejected (Rubin et al., 1986).

There are several plausible explanations for the high level of memories from the reminiscence bump period. One broadly cognitive theory is that this period is permeated by novel experiences and that it is this novelty, preserved in memory in some way, that ensures their enduring memorability. In support of this theory, Cohen and Faulkner (1988) found that 93% of vivid life memories were of either first-time experiences or of unique events. Similarly, Pillemer, Goldsmith, Panter, and White (1988) observed high memorability of first-time experiences, with 41% of participants' memories for their first year at college coming from their first month of coursework.

Somewhat counter to this proposal is the finding that, of the experiences recalled from the period of the reminiscence bump, only a small proportion are of novel events. Fitzgerald (1988) found little evidence that experiences recalled in the period of the reminiscence bump were novel events, the majority being events distinctive to the participants' life circumstances and personal interests. For example, the memories tend to focus upon events concerning relationships, family, work, and education (Elnick, Margrett, Fitzgerald, & Labouvie-Vief, 1999). Such inconsistencies in research based on the novelty account have led to the development of alternative explanations, such as the life script hypothesis. Berntsen and Rubin

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(2002) proposed that AM is organized by culturally shared life scripts. A *life script* is defined as a form of semantic knowledge, outlining the typical, culturally expected events that occur at given times in the life span (Berntsen & Rubin, 2002, 2004; Rubin & Berntsen, 2003). Across a range of studies, Berntsen and Rubin found that people do not show reminiscence bumps for sad and traumatic memories, but only for positive, important life events (see also Collins, Pillemer, Ivcevic, & Gooze, 2007). Berntsen and Rubin (2002) suggested that sad or traumatic events are not expected culturally and contradict rudimentary beliefs about the self (Janoff-Bulman, 1988); thus, the life script account explains the preference for a life narrative of positive memories, linked with normative "happy" events, such as marriage and childbirth. Although this account views normative life scripts as the central organizational factor in autobiographical recall, an alternative account of the bump posits the self as the key component. Rather than placing the emphasis on an internal cultural script, this view suggests that the high accessibility of memories from the reminiscence bump period may be related to their enduring relation to the self.

Erikson (1950) proposed that one's adult identity emerges during late adolescence and early adulthood. Possibly, many memories from this period are of "self defining" experiences (Singer & Salovey, 1993) and have a powerful effect in binding the self to a specific reality. This alternative view suggests that a self account (Conway & Haque, 1999) of the reminiscence bump might explain why most memories are generated from this period. Thus, the reminiscence bump relates to a time in an individual's life that is critical for the formation and maintenance of a stable self (e.g., Erikson, 1950; Rubin, Rahaal, & Poon, 1998). In support of this idea, Conway and Haque showed similar accessibility of autobiographical memories from a period outside the reminiscence bump, a product of the "privileged encoding" of experiences that are particularly relevant to the self. A group of older Bangladeshi participants showed a second reminiscence bump between the ages of 35 and 55, coinciding with a period of national conflict in Bangladesh. These data suggest that the formation of a collection of new self images (as a result of circumstances that involve major changes to personal identity) can result in the heightened retrieval of memories from that time, further demonstrating the relation between high accessibility of memories and AM's enduring link with the self (Conway & Pleydell-Pearce, 2000).

In the same vein, Schrauf and Rubin (1998) found that reminiscence bumps in a group of immigrants corresponded with their age at time of immigration. For those who immigrated in their early 20s, the reminiscence bump was in the usual range of 10–30 years. However, within the group that immigrated in their mid-30s, a greater proportion of memories came from slightly later, reflecting the period of immigration, with fewer memories generated from the standard reminiscence bump range. By using a narrative interview methodology, Schrauf and Rubin (2001) found similar patterns of retrieval for times of immigration. These studies further suggest that times of change, and resulting development of new identities, are linked with heightened memory retrieval.

In addition, reminiscence bumps have been found for age of encountering favorite films (Sehulster, 1996), songs (Holbrook & Schindler, 1989), and books (Larsen, 1996). Janssen, Chessa, and Murre (2007) directly compared distributions of first encounters with favorite books, films, and records and found reminiscence bumps for all three. Results were proposed to partially reflect increased rehearsal of favorite items. Furthermore, the authors suggested that their findings could indicate privileged encoding of items during adolescence, because this could be when memories most linked with self formation are laid down. A further avenue of support for viewing the self as central to the reminiscence bump comes from the study of temporal references in dreams. Grenier et al. (2005) found that dreams demonstrated a peaking of events temporally associated with adolescence and young adulthood, in effect producing a reminiscence bump. Furthermore, content analysis of dreams temporally linked with the bump revealed a prominence of themes associated with identity and life goals (Cappeliez, 2008) that were regarded as reflecting the importance of reminiscence bump memories for the construction of a meaningful self.

The self is not envisaged as a unitary structure; rather, it is the combination of many self schemata, including cognitive representations developed from specific autobiographical events, as well as general representations, such as "I am a mother" (Markus, 1977). Among these many types of self-schemata are the selves that are activated at a given moment, depending on certain contextual cues present. Context has been shown to have a marked effect on the types of self-concepts generated (e.g., a female in an all-male room is more likely to use the frame of gender in a self description; see McGuire & Padawer-Singer, 1976). Markus and Kunda (1986) defined this active identity as the *working self-concept*. More recently, this term has been developed by Conway and Pleydell-Pearce (2000) as the *working self*, a control structure that combines episodic memories with autobiographical knowledge in AM formation. The working self consists of self concepts, goal hierarchies, and other forms of self knowledge and may function to exercise inhibitory control over the knowledge base (Conway, Singer, & Tagini, 2004). The working self and its link to AM change over childhood, but, it has been suggested, stabilizes in late adolescence and early adulthood, which would be supported by the presence of a reminiscence bump in memory age distributions. It is therefore possible that the key to the reminiscence bump lies in the theory that memories from this time are of "self-defining" experiences (Fitzgerald, 1988; Singer & Salovey, 1993).

Self-defining memories are a specific type of AM with the characteristics of being linked to other memories, vivid, high in emotionality, repeated regularly, and associated with an enduring theme or unresolved conflict. According to Conway and Pleydell-Pearce (2000), when goal pursuit is smooth, the working self's relationship to the episodic memory system and autobiographical memories from the long-term self is inhibitory. However, when

the status of a goal changes, the working self becomes excitatory, there is affective arousal, and a retrieval mode functions to cue elaboration and activate autobiographical memories. We suggest that within this framework, a self-defining memory is activated if the affective arousal is sufficient, the goal change presents a cue match, and the goal is developmentally relevant. The activated self-defining memory creates a type of mental stimulation that combines motivational, cognitive, and affective information, and it forms a personal script that contains goal–affect–outcome sequences (see also Conway et al., 2004).

Recent research, then, suggests that an explanation of the reminiscence bump is the grounding of an individual's self; and that this part of the retrieval curve is involved in storing memories germane to identity formation and highly self-relevant experiences (Conway & Haque, 1999). According to this view, as observed with the Bangladeshi participants, at any time when there is material relevant for self goals and self identity, there should be heightened accessibility of AM accompanying the formation of a self defining memory. The present article examines this relationship between emergent selves and memory formation. Thus, the primary purpose of our studies was to examine the distribution of autobiographical memories around those times of identity formation.

STUDY 1

Although some research has measured self knowledge and memory (see Gramzow, Gaertner, & Sedikides, 2001), to our knowledge, Addis and Tippett (2004) were the first to use measures of memory function alongside the Twenty Statements Test (TST), an emperical measure of the self (Kuhn & McPartland, 1954). This task rests on the long sociological literature on the self and is based on the facts that each individual has numerous and multifarious selves and that these "self images" can be collected through self reporting (e.g., Madson & Trafimow, 2001). The TST requires participants to generate 20 self concepts that begin "I am . . . ." This empirical tool enables the collection of a number of concepts and roles that are important to the definition of self.

The novel focus of this article, however, was to collect memories associated with these self-concepts and roles, referred to as *self images.* In particular, we argued that each self image (e.g., *I am quick tempered*) should be associated with a set of accessible and relevant memories—for example, upsetting a colleague at a former institution or throwing yogurt over a schoolmate in a dispute. In essence, each self image, regardless of age of onset, should have an associated reminiscence bump. This is not unlike the finding that patients with dissociative identity disorder have separate sets of autobiographical memories for each personality (Bryant, 1995). The role of the working self, therefore, would be to activate these sets of defining memories within each self-concept. We argue that, because the self images gathered in the TST reflect enduring and important aspects of the self, there should be a set of memories supporting those ideas, formed at the time the individual judges that that self emerged.

Method

Participants. There were 16 participants (11 female, 5 male) of mean age 54.6 years (range, 47–66). All were community dwelling and reported themselves to be in good health and without memory impairment.

Materials and Procedure. Participants were sent a test booklet, which they completed individually at a time of their choosing over a 2-week period. The booklet had three sections. In Section 1, participants were asked for their date of birth, age in years and months, and gender. In Section 2, they were asked to write down 10 enduring *I am* statements that they felt "defined their identity," a variant of the TST (Cousins, 1989; Gordon, 1968; Kuhn & McPartland, 1954). In Section 3, the participants selected 3 of these statements as the "most personally significant to [their] sense of identity" for which they could recall memories. These statements (labeled A, B, and C) were then used to each generate 10 memories (A1–A10, B1–B10, and C1–C10), as the participant recalled times for each statement (e.g., "I am a wife") when they felt it was a significant part of their identity (e.g., "my wedding day"). Participants were asked to give a title, a brief description, and their age at the time that the remembered event occurred. They also reported the age at which they felt each of the 3 statements became a "defining part of their identity." This question was placed at the end of each of the sections A, B, and C, so as not to affect the participants' recall for the 10 memories described in each section.

Results and Discussion

In total, 480 detailed memories were collected, with all 16 participants providing 10 memories for each of their three identity statements. The *I am* statements had a mean age at acquisition (referred to here as the *critical age*) of 22.9 years ($SD = 13.2$). Participants dated each memory by indicating their age at the time of the event. Figure 1 (upper panel) shows the distribution of all memories across the life span. Although Figure 1 shows the typical period of childhood amnesia, it does not show the normal reminiscence bump of increased memory generation between the ages of 10 and 30. This might have been a result of our methodology (most methods used for identifying the bump do not use multiple memories per cue), and Study 2 addressed this issue in more detail. In order to explore the effect of critical age on memory distribution more closely, each dated memory was converted to an age relative to the participant-selected critical age for each *I am* statement. Thus, each of the 480 memories was dated as positive (occurring after the critical age for the relevant identity statement), negative (occurring before the critical age), or 0 (occurring in the same year as the critical age). Thus, for Participant 10's identity statement "I am adventurous," which had a critical age of 15, his or her memory of traveling around Australia at age 22 would be reformulated as 7. Figure 2 (upper panel) shows these data for all 480 memories. These memories are distributed normally around zero (mean = 6.97, mode = 0, median = 4.5, skew = −0.10, kurtosis = 0.75).

Figure 2 shows a clear centering of memories around the critical age of self image formation, with 0 (the year of critical age) having the highest number of memories (10% of all memories), and with 18% of all memories generated for the period between 0 and 2 years after the formation of that self. More memories were generated after the emergence of the self than before it (66% vs. 24%).

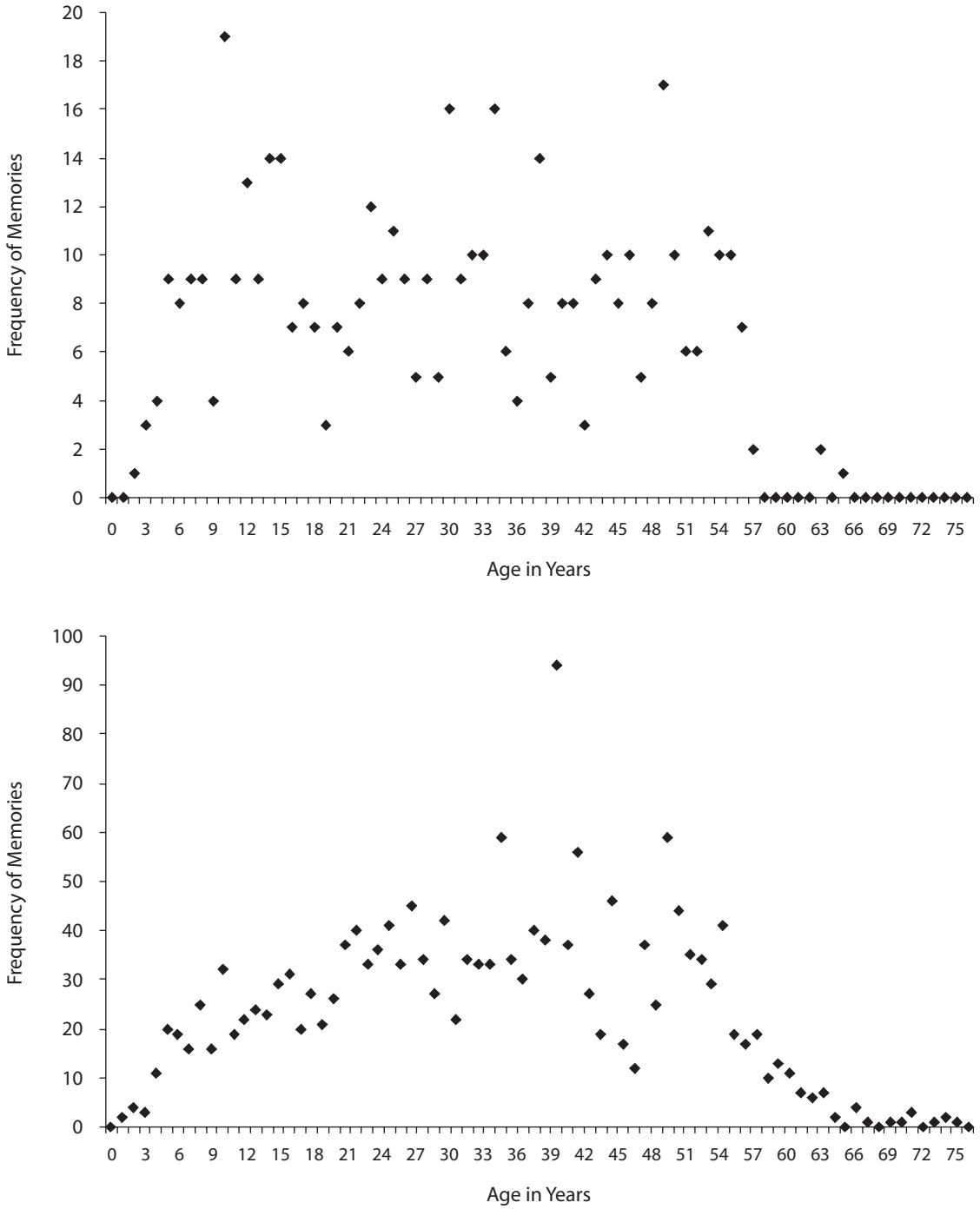

Figure 1. Studies 1 (upper panel) and 2 (lower panel): Graph to show distribution of memories across the life span.

Person-by-person analysis. For analysis, we split these data into 12 epochs: −64 to −55, −54 to −45, −44 to −35, −34 to −25, −24 to −15, −14 to −5, −4 to 5, 6 to 15, 16 to 25, 26 to 35, 36 to 45, 46 to 54. The data for each participant were then recoded as the proportion of memories that fell into each epoch. Table 1 (left columns) shows these data.

A repeated measures ANOVA showed a significant effect of epoch [$F(11,165) = 35.74$, $MS_e = .006$, $p < .001$]. This result indicates that people generated significantly more memories for some epochs than for others. Tests of between-subjects factors revealed no significant effects of age or gender ($F < 1$). Pairwise comparisons were made by using Bonferroni-corrected t tests to compare the 12 epochs with each other. Crucially, in the central epoch (−4 to 5 years, on either side of the emergence of the particular self image), participants generated significantly more memories (mean number of memories recalled = 12) than for 10 of the other epochs ($p < .05$, corrected).

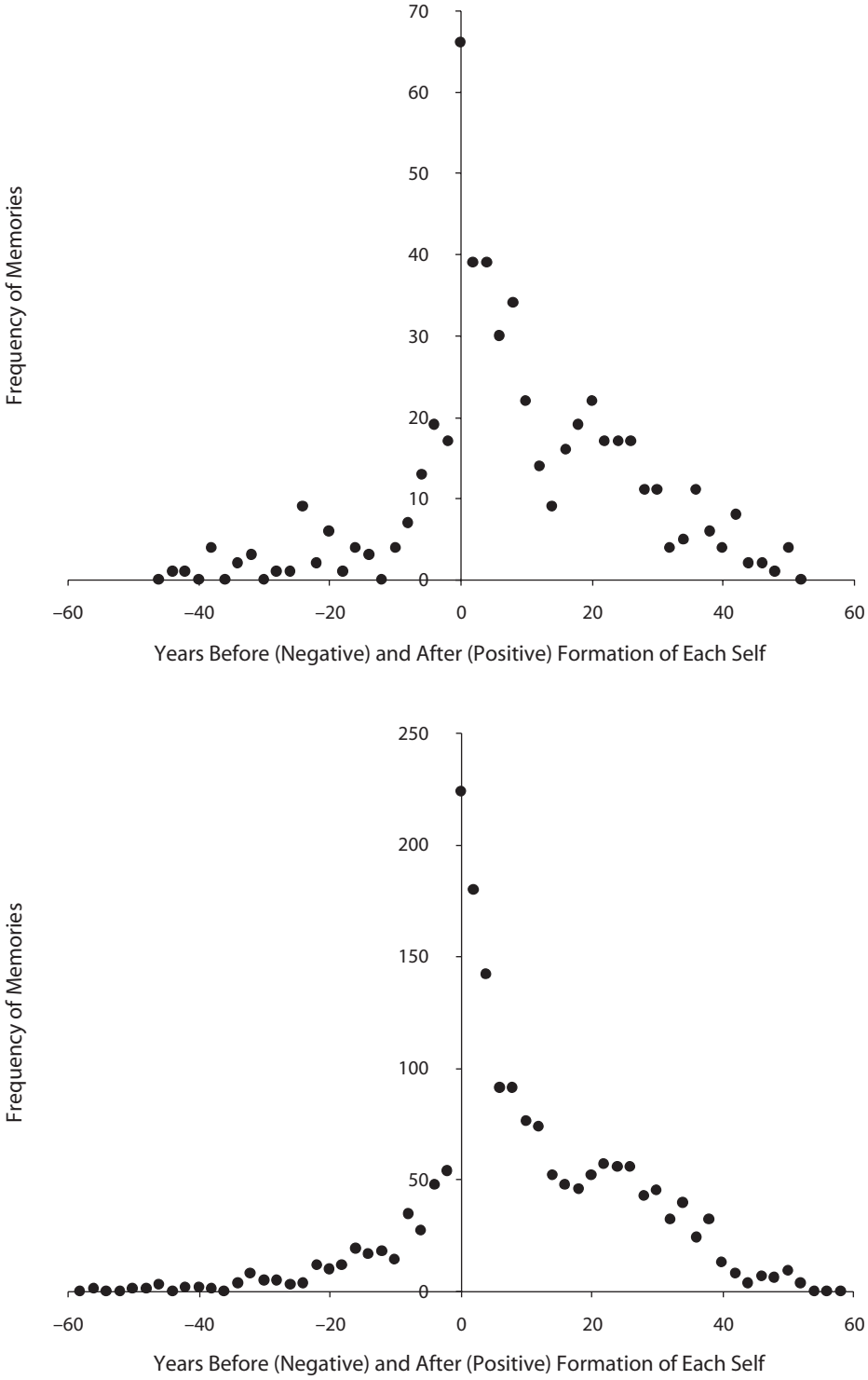

Figure 2. Studies 1 (upper panel) and 2 (lower panel): Graph to show number of memories generated by age of self image.

Table 1
Studies 1 and 2: Proportion of Memories in Each Epoch

	Study 1			Study 2		
Epoch	*M*	*SD*	*N*	*M*	*SD*	*N*
−64 to −55	0	0	0	.001	.004	0.031
−54 to −45	.002	.008	0.033	.003	.016	0.167
−44 to −35	.010	.029	0.167	.004	.015	0.254
−34 to −25	.023	.048	0.367	.014	.038	0.813
−24 to −15	.042	.060	0.667	.033	.052	1.947
−14 to −5	.073	.067	1.167	.070	.082	4.103
−4 to 5	.383	.136	6.133	.363	.177	21.419
6 to 15	.183	.115	2.933	.207	.120	12.219
16 to 25	.169	.105	2.700	.146	.117	8.592
26 to 35	.063	.054	1.000	.110	.123	6.505
36 to 45	.050	.074	0.800	.039	.063	2.293
46 to 55	.002	.008	0.033	.011	.025	0.657

Thus far, the data show that when generating autobiographical memories to a self image, people are far more likely to sample from an epoch close to the time at which they judge that that self emerged. People are generating memories to their own idiosyncratic selves—selves that they feel best define themselves.

We were further motivated to consider the nature of the selves generated in order to examine whether that had any bearing on the number of memories generated by critical age. It is standard to split these *I am* statements into abstract (subconsensual) and concrete (consensual) roles, on the basis of the coding system used by Kuhn and McPartland (1954). Thus, the participant's three identity statements were coded dichotomously either as abstract, denoting a statement without consensual group meaning such as an attribute or trait (e.g., "I am ambitious," "I am lacking in self confidence," "I am outspoken"), or concrete, denoting a nonambiguous statement whose conditions of membership are common knowledge (e.g., "I am a Christian," "I am a wife," "I am an only child"). We were interested in whether the self-centered distribution of memories held for both sets of selves. In particular, we envisaged that memories of concrete of selves would center on the formation of that self—for example, on memories of the wedding for "I am a husband." However, a more stringent test of our theory would be whether even abstract self-cued memories would center on the formation of that self, where there is no concrete start point, assumption of role, or public event.

Thus, all *I am* statements were divided into abstract (producing 28 statements) or concrete (producing 20 statements). The mean age was 25.9 years for memories generated from concrete identity statements and 19.7 for abstract identity statements. Figure 3 (upper panel) shows these data. This graph shows that the two sets of selves have overlapping functions and that both produce the highest number of memories for the zero-centered epoch. Because half of the sample elected to generate memories from three selves that were either all concrete or all abstract, it was not possible to analyze this formally by using a person-by-person approach.

Finally, we checked that the age of the memories was not distributed purely according to temporal associations between adjacent memories. When participants are given a free rein to generate memories in AM tasks, it is known that, all else being equal, participants tend to prime themselves, such that any two memories generated sequentially are very likely to come from the same period. To ensure that participants were not self-priming subsequent memories in this manner, an analysis was carried out on the distribution of ages for adjacent memories. Results showed that only 36% of memory

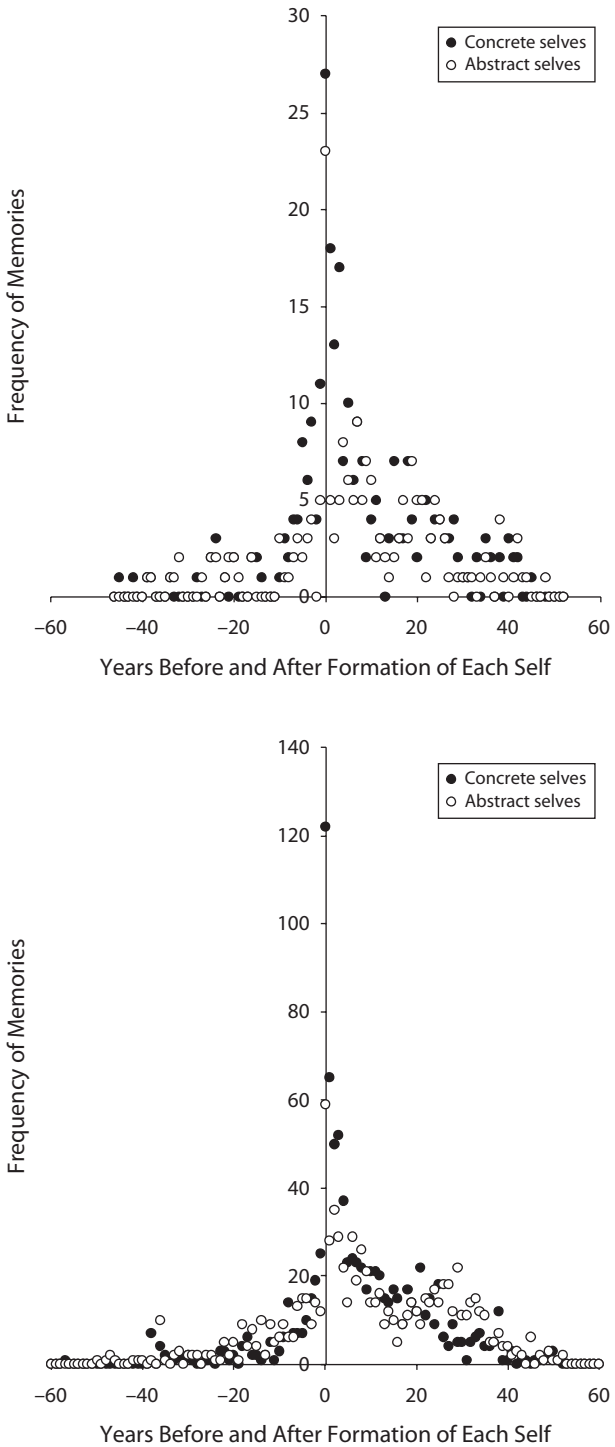

Figure 3. Studies 1 (upper panel) and 2 (lower panel): Graph to show number of memories generated by age of self image for concrete and abstract selves.

ages were from within 2 years of the previous memory. As mentioned above, at the end of the questionnaire, we asked for the critical age for each identity, which ensured that no priming occurred from the stated age of self image formation. Thus, the distribution of memories seems to be driven by self and personality constructs, not mere temporal groupings based on cognitive concepts such as priming.

The methods of analysis used above reflect a traditional person-by-person approach to analyzing memory distributions. However, an alternative method is to carry out an item-by-item analysis, comparing all dated memories across participants. In this manner, a more thorough investigation of the differences between abstract- and concrete-cued memories can be achieved.

Item-by-item analysis. There were 280 memories cued by concrete selves and 200 cued by abstract selves. Table 2 (upper panel) shows the data on the distributions of these memories. The higher kurtosis value reflects the more tightly clustered distribution of concrete-cued memories. A 12-epoch analysis of the item-by-item memories showed that 44% of all concrete memories came from the central epoch (−4 to 5), compared with 31% of abstract-cued memories.

For each group, we conducted two *t* tests to determine whether differences between the skew and kurtosis values for abstract- and concrete-cued memories were statistically significant. In essence, this analysis is the same as considering the difference in means between two samples on the basis of the distribution, but instead of the mean and the standard error of the mean, this analysis considers the value and standard error of skew and kurtosis, in turn.[1] Neither of these differences was significant (skew, $t = 0.72, p > .05$; kurtosis, $t = -1.45, p > .05$). Analysis of frequency of memories in each epoch by concrete and abstract cue revealed no significant differences [$\chi^2(10) = 15.464, p = .116$]. Figure 3 (upper panel) shows overlapping distributions for abstract and concrete selves, supported by this nonsignificant difference in distributions.

To summarize, Study 1 showed that autobiographical memories tend to cluster around the time of self formation. The motivation for Study 2 was to replicate this finding and to address several methodological and theoretical issues. When given the opportunity to generate self-concepts and identities that are reflective of the self, people tend to generate memories from when that self identity was formed. This tendency suggests that each self-concept is supported by a distribution of distinct memories and that those memories are most accessible for the period at which the self emerged. This finding is novel, because it demonstrates separate "reminiscence bumps" centered on particular aspects of self, and it represents a new means of generating memories that are related to important concepts and traits. Given its novelty and the small sample size, it seemed important to replicate these findings in a separate, larger sample.

Table 2
Studies 1 and 2: Memories Cued by Concrete and Abstract Selves

	Type of Self Cue	
	Abstract	Concrete
	Study 1	
Mean (*SD*)	7.81 (16.660)	6.37 (14.969)
Skew (*SE*)	−0.195 (0.172)	−0.033 (0.146)
Kurtosis (*SE*)	0.443 (0.342)	1.093 (0.290)
SD of skew ($SE \times \sqrt{N}$)	2.432	2.443
SD of kurtosis ($SE \times \sqrt{N}$)	4.837	4.853
N	200	280
	Study 2	
Mean (*SD*)	9.18 (17.942)	7.11 (14.228)
Skew (*SE*)	−0.280 (0.083)	−0.009 (0.080)
Kurtosis (*SE*)	0.179 (0.165)	1.658 (0.159)
SD of skew ($SE \times \sqrt{N}$)	2.455	2.457
SD of kurtosis ($SE \times \sqrt{N}$)	4.881	4.883
N	875	943

STUDY 2

The approach for Study 2 is similar to that described above, but in order to replicate the study with a larger sample size, the questionnaire was converted into an online study.

Method

Participants. There were 59 participants (16 male, 43 female) of mean age 53.95 years (range, 39–76). All were accessed either via e-mail or through psychology questionnaire Web sites.[2]

Materials and Procedure. Participants completed the online questionnaire, which was very similar in format to that used in Study 1. In Study 2, retrospective dating of all memories was carried out, instead of the concurrent dating used in Study 1. The dating of memories occurred after all four sections of memory-title generation had been completed, so as to avoid potential cuing of future memories by the dating process. Similarly, participants were asked to report their age at which each *I am* statement became self-defining only after all memory titles and dates had been generated (rather than after each "I am" section, as in Study 1).

In order to examine potential clustering across a wider range of selves per participant and to facilitate the analysis of concrete and abstract selves, we asked participants to generate eight memories for four separate "I am" statements.

Results and Discussion

A total of 1,818 memories were collected, with each participant giving an average of 31. Figure 1 (lower panel) shows the distribution of these memories across the life span and replicates our previous finding. Memories cued by identity statements do not produce the typical life span retrieval curve reminiscence bump. It was surprising that a reminiscence bump was still not produced with this larger sample, considering that the bump is a robust phenomenon and has been found using a wide variety of methods (Rubin et al., 1998). Furthermore, the combination of finding that memories cluster around selves and that mean age of self formation was between 22.9 (Study 1) and 25.1 (Study 2) years would imply that a reminiscence bump should be shown in the raw data. Thus, an additional analysis was carried out to determine whether using just the first 3 memories per self would reveal a more distinct bump. Figure 4 shows a clear retrieval peak during ages 20–40, with nearly 50% of all first 3 memories coming from these years. The continued peaking of memories during participants' 30s, despite the drop in self formation in

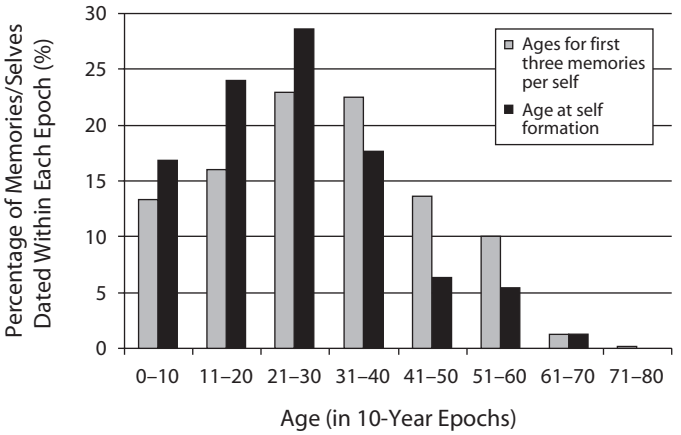

Figure 4. Study 2: Graph to show distribution of first three memories per self and age of self formation across the life span.

this decade, reflects the fact that many memories cluster in the 20 years following self formation (see Figure 2). This result is much more in accordance with previous findings, and our suggestions for its appearance when only initial memories are used shall be raised within this article.[3]

Figure 4 also shows the percentage of selves emerging in each decade, using the dates that participants gave for when each self was formed. As expected, most selves are formed in participants' teens and 20s, and self formation shows a neat reminiscence bump of its own. The following analyses use all eight memories per self.

Person-by-person analysis. Following the procedure, all participants gave a critical age for each *I am* statement. The mean critical age was 25.1 years ($SD = 14.8$), slightly later than that of the first sample, and as shown in Figure 4, the spread of critical ages followed the pattern of the reminiscence bump. An independent samples t test carried out on the distributions of critical ages in Studies 1 and 2 revealed no significant differences [$t(282) = -0.94$, $p = .35$]. To investigate whether the collected memories clustered around times of identity formation, all memories were again recoded as the number of years before or after their associated identity statement. The overall mean for these data was 8.85 (mode = 0, median = 6, skew = 0.002, kurtosis = 0.68). The recoded memories were divided into the same 12 epochs described previously. Figure 2 (lower panel) demonstrates that more memories (36% of all memories) are recalled from the central epoch (−4 to 5 years) than from any other single epoch, and 12% of all memories reported came from the critical age (the year 0). Figure 2 shows a clustering pattern identical to that found in the previous study, with memory numbers decreasing as years from the critical age increase. Again, excluding those given at year 0, more memories are recalled from years after formation of self than before (1,288 vs. 344).

A repeated measures ANOVA was carried out on the 12 epochs. Again, the memories were recoded as proportional epoch data for each participant. Table 1 (right columns) shows the mean proportion of memories in each epoch. There was a significant effect of epoch [$F(3.57, 206.96) = 86.29$, $MS_e = .008$, $p < .001$]. Pairwise comparisons showed the most central epoch (−4 to 5) to have a significantly higher mean proportion of memories, as compared with all other epochs ($p < .001$, corrected). In order to examine the frequencies of concrete- and abstract-cued memories around time of self formation, memories were plotted as years before and after the critical age. Figure 3 (lower panel) shows that, again, concrete and abstract selves cue similar patterns of retrieval. However, the larger sample size in Study 2 allows a more in-depth analysis of concrete and abstract distributions using an item-by-item approach.

Thus far, the results in Study 2 replicate the pattern found in Study 1; people have a strong tendency to selectively sample memories about aspects of their identity from around the time in their lives when that identity was formed. The spread of memories, as in the previous study, does not show the traditional reminiscence bump shape, but this bump does become apparent when only the first three memories per self are used. Once again, results reveal a tight clustering of autobiographical memories around emergence of selves.

Item-by-item analysis. Following the analysis of memories cued by abstract and concrete selves in Study 1, this larger sample was used to carry out an item-by-item analysis of each of the 1,818 individual memories. Memories were coded as number of years before or after emergence of their associated self, and were marked as concrete or abstract in accordance with that self. Table 2 (lower panel) illustrates the descriptive details of the abstract- and concrete-cued memories.

Although the means are similar for both types of identity, the differences in skew and kurtosis statistics were of interest because they reflect differences in the shapes of distributions of memories cued by different selves. As before, two t tests were conducted to assess whether kurtosis and skew differences were of statistical significance between groups. In this study, the differences in skew were significant at the .05 level [$t(1816) = 2.35$, $p < .05$]. However, although the skews of the two distributions differ, both are very small, with values less than one (see Table 2). The pattern is such that the abstract selves seem

to have a slightly longer tail. The differences between the kurtosis scores were also shown to be significant at the .05 level [$t(1816) = -6.45, p < .05$], such that concrete-cued memories produce a significantly more peaked distribution than those that are abstract cued. Interestingly, whereas differences reached significance in Study 2, the mean values are in the same range as in Study 1. On the whole, concrete selves produce a more peaked normal distribution, with more memories in the central range, and a shorter, less negative skew. Although skew values differ significantly, it should be noted that the actual values are not substantially different from zero. A standard normal distribution has a kurtosis of zero, and any value greater than this indicates a greater central tendency, represented as a high clustering around the mean. Thus, all memories seem to cluster around the central point—the critical age of self formation—and interestingly, if anything, this clustering is more pronounced with the concrete selves. These slight differences in distribution are supported by a chi-squared test, which revealed significant differences in frequencies of memories in each epoch between concrete and abstract selves [$\chi^2(11) = 224.85, p < .001$].

It is possible that this is due to the types of events that are recalled in association with concrete selves. For example, "I am a mother" or "I am a husband" are both very likely to cue memories of significant events around the time of identity formation (e.g., childbirth, weddings). Conversely, it is less likely that abstract identities (often personality traits) would be linked to such defined events, and may be grounded by more temporally dispersed examples of being "happy" or "intelligent."

Overall, however, despite the apparent differences in retrieval distributions for concrete and abstract selves, the basic pattern of results remains the same. Regardless of the type of identity used as a cue, memories tend to cluster tightly around times of identity formation. The standard person-by-person approach to analyzing memory distributions has been used in conjunction with a new method of analysis. The item-by-item approach enables the use of novel methods of analysis, such as statistical comparisons of kurtosis and skew statistics. These methods allow a closer examination of the nature of autobiographical retrieval related to different aspects of identity, and we recommend their continued use in the field of AM. Ultimately, evidence from the two means of analysis (by participants or by memories) converge on the same finding: Memories cluster around times of identity formation.

FOLLOW-UP

It was possible to examine the *I am* statements from Study 1 after an extremely long interval of 4 years. Because the age of self emergence was generated after memory retrieval, participants were not simply dating their memories according to the age of identity emergence. It is possible that their generated age of self formation was influenced partly by the memories given in the study. The ability to consider the *I am* statements after a long interval enabled us to explore the permanence of age of self formation and to ask people to date *I am* statements in a separate session when presumably they could not be cued by the answers in the memory part of the task. Of the 16 participants from Study 1, 13 took part in this follow-up, which took place over 4 years after their participation in Study 1. Participants were asked to generate an age of self image formation for the three *I am* statements they had used as memory cues in Study 1. The difference between ages of self formation for each *I am* at Time 1 and Time 2 was calculated as a difference score (mean = −.51, $SD = 12.76$, mode = 0.00, median = 0.00). A one-sample t test found that this difference score did not differ significantly from zero [$t(38) = -0.25, p = .80$]. This result indicates that the ages of identity formation did not differ at the two time points, which suggests that memories did not influence reported age of self formation in Study 1 and that these ages are relatively stable over time. To account for possible regression toward the mean, additional calculations were made on the absolute (unsigned) error of the difference scores (mean = 7.28, $SD = 10.43$, mode = 0.00, median = 0.00). Interestingly, preliminary analysis revealed that 56% of concrete selves remained stable (with a difference of 0), whereas only 6% of abstract selves were given the same year of formation at follow-up. This was expected, because concrete identities are often marked by fixed events, such as weddings and births, whereas memories linked with abstract traits are more susceptible to change. Given that there was so little difference in the dates generated initially and at follow-up, the clustering of memories around ages identified at follow-up was not calculated.

Participants were also reshown the remaining 7 of their initial 10 *I am* statements, which were mixed randomly with 7 *I am* statements from a yoked, gender-matched participant. Participants were asked to indicate which identities they had given 4 years earlier. The responses were analyzed using a calculation of hits minus false positives (mean = 3.92, $SD = 2.66$). A one-sample t test showed that participants were significantly better than chance at recognizing their identity statements from 4 years before [$t(12) = 5.32, p < .0001$], providing further indication of the enduring nature of the *I am* statements used in this methodological approach.

GENERAL DISCUSSION

In these studies, we asked participants to produce *I am* statements that were reflective of their self images (after Kuhn & McPartland, 1954). We found that participants were able to generate memories from their own lives that were related to these self-images and that these memories were mostly normally distributed around the age at which participants felt that self emerged. Results suggest that each self image might serve an organizational function within AM and that activation of a particular self image leads to the activation of a network of memories for specific events associated with that self.

Our methodology, which examines how memories are temporally organized with regard to separate self images, suggests that autobiographical memories cluster around times of self image formation. Our data support the the-

ory that image formation occurs most frequently during adolescence and early adulthood (Erikson, 1950; Fitzgerald, 1988; McAdams et al., 2006), and we argue that the standard reminiscence bump is most plausibly due to the clustering of memories around several self images that are crucial to the self. Initial raw results showed little evidence of a reminiscence bump. However, use of only the first three memories representing each self revealed a much clearer picture, and showed a marked peaking of memories between the ages of 20 and 40. It is suggested that perhaps the first few memories generated in the task are self-defining memories (Singer & Salovey, 1993) and are used to mark key events in our personal life story (Glück & Bluck, 2007) or match with cultural life scripts (Berntsen & Rubin, 2002). As results show, these initial task memories map quite neatly with the formation of selves across the life span. Memories given after the first three per self may reflect a recency effect, as participants draw on more current concerns to aid generation.

Previous research has explored the cognitive processes by which people date their memories (e.g., Betz & Skowronski, 1997; Skowronski et al., 2007). Because AM is largely viewed as a reconstructive process rather than a precise retelling of an event (e.g., Conway, 2005), it is unsurprising that there is a degree of error when people attempt to date episodes in the past. Although we cannot be entirely sure that the dates given in this study are accurate, research has shown that dating of *self-events* is more accurate than for *other-events* (Betz & Skowronski, 1997), and, because our participants were not cued by a specific marker in time, memories are likely to be spread equally, regardless of potential effects of telescoping. *Backward telescoping* or *forward telescoping* occurs when events are dated too early or too recently, respectively. Loftus and Marburger (1983) found that using personal dated landmarks reduced effects of forward telescoping, but the present study used selves as cues, rather than specific landmarks in time. By design, the ages of self formation were asked for only after all memories had been given and dated. Because participants were allowed to generate and date memories freely (as long as events were over 2 years old) for a cue such as being "a sister," there might have been some telescoping, but there seems to have been no reason for people to have misdated memories as consistently too early or consistently too recent. Clearly, dating errors might have occurred, but given the consistent pattern across the data reported here, we think that the dates given correspond to underlying self-concepts and memories.

Further support for the hypothesis that identity formation organizes retrieval of AM was found in the comparison between proportions of memories from concrete and abstract identity statements. Both concrete and abstract selves affected AM generation in a similar fashion, although item-by-item analysis in the larger sample revealed subtle differences in the natures of the memory distributions. This is very interesting, because abstract identities (e.g., "I am popular") tie in more closely with Singer's self defining memory research (Singer & Blagov, 2001) concerning times of formation of personality traits and other more abstract self-concepts, whereas concrete identities are more linked with specific life events, such as marriage ("I am a wife") and starting a job ("I am a pilot"). Further research should address the accessibility of concrete and abstract selves in a design in which all participants generate memories for both.

Although the present study enabled participants to choose selves freely from across the life span, it would be interesting to investigate how memories are used to support selves that emerge at a very young age. Although many concrete selves are formed during young adulthood (as a result of marriage, parenthood, and career path), other concrete selves may emerge much earlier. Concrete identities, such as gender and ethnicity, are not as likely to be marked by key events, and yet have been highlighted as particularly salient identities in schoolchildren (McGuire, McGuire, Child, & Fujioka, 1978; McGuire & Padawer-Singer, 1976). Investigation of the ways that memories are used to support these selves, which are likely to emerge during the period of childhood amnesia, when fewer autobiographical memories are encoded, would be an interesting area for development of this research.

Because the concept of self-defining memories is important in neurological and psychiatric populations, we also suggest that this method might be appropriate for generating personally relevant memories and memories of critical periods in life-span development. Furthermore, because both self and AM are implicated in clinical depression (Barry, Naus, & Rehm, 2006; Lemogne et al., 2006), research could focus on the distributions of memories cued by positive and negative statements. Rubin and Berntsen (2003) found that reminiscence bumps were generated only for highly positive events, not for negative events. Preliminary analysis of the data in this study revealed too few negative statements to carry out a formal analysis; however, tasks in which participants are asked to generate memories for positive and negative selves warrant further investigation. Future studies that ask participants for more detailed memory descriptions than were generated in the present study could also employ memory-coding analysis, enabling observation of distributions of positive and negative memories around self formation.

This research converges on a few critical ideas in the AM literature. First, we have demonstrated the nature of the relations between self and memory: Memories of one's life seem to converge on periods of new self image formation (e.g., Conway, 2005). Further, it seems that the reminiscence bump occurs as a result of the formation of adult identity (Conway, 1996), the novelty of events that follow, and ultimately the period of stability that results from adult identity formation (Rubin et al., 1998). Here we suggest that a reminiscence bump is formed at any point where one generates a new self image, as supported by the results of Conway and Haque's (1999) study, in which Bangladeshi participants generated a second reminiscence bump at the time of great national upheaval. Finally, as suggested by Fitzgerald (1988) and Singer and Salovey (1993), it seems that the key to the reminiscence bump could be that memories from this time are concerned with self-defining experiences. Conway et al. (2004) proposed

a cognitive model incorporating self-defining memories into Conway's model of AM (Conway & Pleydell-Pearce, 2000), and it appears the results obtained in the present study would support such a combined model.

We suggest that the underlying processes responsible for the pattern of results shown are broadly sociocognitive. As Rubin et al. (1998) pointed out, basic cognitive changes across the life span cannot be solely responsible for shaping retrieval, but social or self accounts can be seen to function through cognitive mechanisms. For example, we know that primacy is a particularly strong mental process that forms a robust memory phenomenon in retrieval for word lists (Hockey, 1973). Perhaps the formation of a new self triggers preferential encoding via similar mechanisms. The formation of particular identities across the life span is important at the personal and cultural levels (Berntsen & Rubin, 2002; Glück & Bluck, 2007). Because autobiographical memories are used to ground the self (Conway, 2005), it seems likely that, as Rubin et al. (1998) suggested, the importance of identity formation promotes the use of cognitive mechanisms. Further, we suggest that the self images produced by *I am* statements could be those socially constructed categories and "self structures" that Conway et al. (2004) suggest form the conceptual self—an aspect of the self memory system that is both constrained by, and is capable of altering, the autobiographical knowledge base. The selves that our participants generated reflect only a few of the many self images that together help form a person's identity. Naturally, these selves might have been chosen as a result of particular current concerns and motivations, but the follow-up data suggest that these identities are clearly recognizable after several years and that the age at which they are judged to emerge is stable. This emerging idea warrants further investigation to elucidate the memory mechanisms that support narrative accounts of identity. We suggest that the novel methodology adopted here would be ideal for this purpose, insofar as we can probe aspects of self and personality directly within a well-constrained memory task.

Finally, although this article proposes a model in which autobiographical memories are closely associated with, and organized by, semantic self knowledge, it is noted that other theorists have proposed a dissociation between these concepts. Neuropsychological evidence from a case of amnesia, in which semantic self knowledge was accessed in the absence of episodic memory, suggests that the self can be known without a supporting network of associated memories (Klein, Cosmides, Costabile, & Mei, 2002). However, the same authors report a case of autism in which the participant had verifiable knowledge of his own identity traits, but had severely impaired semantic knowledge of other, nonself semantic facts (e.g., animals). Klein et al. concluded that the self has a special structural role in memory, and we propose that, even if semantic trait knowledge and AM are dissociable, our data suggest that, in most cases, these two function in mutually supportive roles.

Because the critical ages of self image formation used in this study are closely related in conception to Singer's self-defining memories, the clustering of memories around these times of self image formation shows support of Fitzgerald's (1988) and Singer and Salovey's (1993) suggestion. It would appear that times of identity formation are central to reminiscence bump formation. We suggest that this methodology is likely to be informative for examining the relationship between cognitive dysfunction and personality change, as seen, for example, in Alzheimer's disease (Addis & Tippett, 2004); future work should examine this emerging field.

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NOTES

1. We are grateful for the help of Dan Wright in developing and interpreting these statistics.

2. Thanks to www.socialpsychology.org/expts.htm, psych.hanover.edu/research/exponnet.html, and genpsylab-wexlist.unizh.ch for hosting the questionnaire.

3. We carried out the standard recoding of these first three memories (as a difference score from their associated age of self formation) to check that the clustering pattern still emerged. As predicted, results showed a particularly prominent clustering of memories around ages of self formation.

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