Published in final edited form as:
Mem Cognit. 2009 July 1; 37(5): 679–688. doi:10.3758/37.5.679.

The Frequency of Voluntary and Involuntary Autobiographical Memories across the Lifespan

David C. Rubin and
Duke University, Durham North Carolina

Dorthe Berntsen
Aarhus University, Aarhus, Denmark

Abstract

Ratings of the memory of an important event from the last week on the frequency of voluntary and involuntary retrieval, belief in its accuracy, visual imagery, auditory imagery, setting, emotional intensity, valence, narrative coherence, and centrality to the life story were obtained from 988 adults whose age ranged from 15 to over 90. Another 992 adults provided the same ratings for a memory from their confirmation day when they were about age 14. The frequencies of involuntary and voluntary retrieval were similar. Both frequencies were predicted by emotional intensity and centrality to the life story. The results from this study, which is the first to measure the frequency of voluntary and involuntary retrieval for the same events, are counter to both cognitive and clinical theories, which consistently claim that involuntary memories are infrequent compared to voluntary memories. Age and gender differences are noted.

Involuntary autobiographical memories are explicit memories of personal events that come to mind with no preceding attempt at retrieval (Berntsen, 1996, 2009). Their counterpart is voluntary autobiographical memories – that is, personal memories that follow a controlled, strategic retrieval process. Memory studies have concentrated on the latter. Only recently have involuntary memories been a focus of systematic research (e.g., Ball & Little, 2006; Berntsen, 1996, 2009; Berntsen & Hall, 2004; Berntsen & Rubin, 2002, [2008]; Kvavilashvili & Mandler, 2004; Mace, 2007; Rubin, Boals, & Berntsen, 2008; Schlagman, Kvavilashvili, & Schulz, 2007). Here we examine a number of unresolved issues related to involuntary autobiographical memories.

Cognitive theorists have considered involuntary autobiographical memories as rare. For example, a scientist wanting to study them "can only sit and wait, hoping for the improbable" (Miller, 1962, p. 161). Tulving (1983) argued that successful recall from the episodic memory system was contingent upon being in a retrieval mode. Only rarely would stimuli in the environment activate conscious episodic recollections through purely associative mechanisms outside retrieval mode. "Access to, or actualization of, information in the episodic system tends to be deliberate and usually requires conscious effort" (p. 46). "Few things that we perceive make us think of previous happenings in our own lives … many stimuli that could potentially serve as reminders or cues, even if prominently displayed to person, will have no such effect" (p. 169). Although Mandler (1989) acknowledged that "much of everyday memory experiences are in fact non-deliberate" (pp. 102–103) he also observed that autobiographical, episodic knowledge is generally

Send Correspondence to: David C. Rubin, Department of Psychology and Neuroscience, Box 90086 Duke University, Durham, NC 27708-0086 U.S.A., david.rubin@duke.edu.

"deliberate, and consciously accessed, context dependent and 'remembered'" whereas semantic knowledge "is often automatically available, context free and 'known'" (p. 94).

Ebbinghaus (1885/1964. pp. 1–2) identified three basic kinds of memory in the book that launched the experimental study of human memory: voluntary conscious memory, involuntary conscious memories, and the involuntary unconscious memory, which he studied using the method of savings. In contrast, most research on implicit memory has equated the distinction between conscious and unconscious memory with a distinction between intentional and unintentional retrieval (e.g., Schacter, Bowers & Booker, 1987; but see Kinoshita, 2001; Schacter, 1987, for discussions). As a consequence, the category of involuntary – but nonetheless conscious – memories is overlooked (but see Richardson-Klavehn, Gardiner, & Java, 1994). In research on consciousness, spontaneous thought processes have been studied under a variety of labels, such as daydreaming (Singer, 1966) fantasy (Klinger, 1971), task-unrelated thought (Giambra, 1989), stimulus independent mentation (Singer, 1970), mind wandering (Antrobus, Singer, Goldstein & Fortgang, 1970; Smallwood & Schooler, 2006), and mind popping (Mandler, 1993). However, all of these notions are very loosely described in terms of contents. None of them are limited to involuntary episodic memories. Therefore, research on spontaneous thought processes has not challenged the dominant view among memory researchers that episodic/autobiographical remembering is typically a controlled and deliberate process. In short, in modern cognitive psychology, involuntary conscious memories are generally treated as an exception or rarity, not because they have found to be rare empirically, but for purely theoretical reasons (Berntsen, 2009).

In a similar vein, some researchers in clinical psychology have argued that involuntary conscious memories are limited to events with a traumatic and/or negatively stressful content. For example, van der Kolk and Fisler (1995) studied individuals that were "haunted by memories of terrible life experiences" (p. 514). The participants were interviewed about both their involuntary trauma memories and memories of non-traumatic events, such as graduations, birthdays, and weddings. According to van der Kolk and Fisler, the non-traumatic events were never remembered involuntarily. However, systematic studies with less biased samples have found that involuntary conscious memories are indeed common for non-traumatic experiences. In fact, diary studies with online recording as well as retrospective reports have shown that involuntary autobiographical memories are more frequently about positive than negative experiences, thus replicating the positivity bias that is found generally in autobiographical memory (see Berntsen, 2009, for a review). Nonetheless, it is still a widespread idea among clinical researchers that involuntary memories are more common for negative and traumatic events than for mundane events and that the opposite is true for voluntary autobiographical memories (e.g., Halligan, Clark, & Ehlers, 2002).

Thus, both cognitive and clinical psychologists have treated strategic (voluntary) retrieval as the standard way of recalling the personal past and involuntary conscious memories as an exception. It is against the background of this long history of speculation in major theories of memory, that we examine our main question of whether voluntary recall of autobiographical events is more common than involuntary recall. We do so here by asking our participants to estimate the frequency of prior involuntary and voluntary recall of two specific autobiographical events. The use of the same specific event for frequency judgments of both involuntary and voluntary recall has several advantages. The first advantage is related to the use of retrospective judgments of frequency. Retrospective judgments in general are not as accurate as online judgments (Ericsson, & Simon, 1993). However, frequency information tends to be encoded automatically and retrospective judgments of frequency for specific remembered events are in general quite good (Hasher &

Zacks, 1979; Hintzman, 2001). The second is that the task of reporting on specific events is easier and more directed and should lead to more reliable and valid results. The term *event* and *recall* have to be clear to the participant to ask questions about how many times did you involuntarily or voluntarily recall any event during the last week,. However, if we have each participant first think about one specific event, then the task is much clearer and the same criteria are likely to be applied to both the involuntary and voluntary memory. Thus, the frequency judgments are more likely to be directly comparable within each respondent. The third advantage is that the same events are rated on the frequency of involuntary and voluntary recall. Thus, we avoid any possible confounding of the frequency judgments with the type of event that people recall involuntarily and voluntarily. The corresponding disadvantage is that what we test here may only hold for the kind of events we sample, which are important events.

We use a large stratified sample covering the entire adult life span allowing us to consider the additional questions of whether age and gender interact with the reported frequencies of the two modes of recall. Studies on the relation between age and spontaneous thought processes have yielded mixed results with some studies demonstrating an age-related decline in frequency of task-unrelated thought (e.g., Giambra, 1989, 1993) and other studies showing that frequency of automatic thought operations generally increases with age, due to reduced inhibition (Hasher & Zacks, 1979; Healey, Campbell, Hasher, 2008; Rubin, 1999). Although involuntary autobiographical memories may be viewed as a subclass of such spontaneous thought processes, it is beyond the scope of the present article to discuss possible reasons for these conflicting findings regarding spontaneous/automatic thought in general. We limit ourselves to age differences in the frequency of involuntary autobiographical memories. Only two studies exist. Both suggest that the frequency of involuntary autobiographical memories declines in old age (Berntsen & Rubin, 2002; Schlagman, et al., 2007). These studies have obtained frequency estimates either through retrospective reports for involuntary memories in general (Berntsen & Rubin, 2002) or through online recording of involuntary memories in diary studies (Schlagman, et al., 2007). Neither of the studies has therefore examined the frequency of involuntary and voluntary recall for the same events, as we do in the present study. Further, the present method is likely to be less cognitively demanding, minimizing the possibility that some of the age effects seen in the previous studies may reflect that older participants have more difficulties with the task itself rather than them having fewer involuntary memories.

In addition to differences in the frequency of involuntary and voluntary retrieval, we also wish to examine differences in underlying mechanisms. Some theories developed from clinical observations have accounted for involuntary versus voluntary memories in terms of two separate memory systems – each with its own dedicated functions and type of information (e.g., Brewin, Dalgleish & Joseph, 1996; Ehlers & Clark, 2000). In spite of some differences, these dual systems theories agree on a distinction between a sensory-perceptual processing system associated with involuntary recall and a verbal-conceptual processing system associated with voluntary recall (Holmes & Bourne, 2008). Because the sensory-perceptual system is assumed to dominate in response to highly emotional events, involuntary memories are argued to often deal with such events and to be especially focused on the sensory-perceptual details (e.g., visual impressions) of the events. In contrast, events (or parts of events) that have been processed largely through the verbal-conceptual system are more accessible for voluntary recall. Because this system often fails to function during highly emotional events, such events will be harder to access voluntarily. In addition, voluntary recall will be less sensory detailed and less emotional than involuntary recall.

In contrast to this view, it has been argued that involuntary and voluntary autobiographical memories reflect the operations of the same underlying episodic memory system (Berntsen,

2009; Berntsen & Jacobsen, 2008; Berntsen & Rubin, 2008, Hall & Berntsen, 2008; Rubin, Boals, & Berntsen, 2008). In this view, the two types of memories differ only with regard to the mechanisms that bring them to mind at a particular moment, whereas their encoding and long-term maintenance is expected to be supported by the same mechanisms. For example, emotion at the time of encoding is expected to enhance the likelihood of subsequent recall, irrespective of whether retrieval is involuntary or voluntary. We examine these contrasting views here by measuring which properties of autobiographical memories predict their likelihood of voluntary and involuntary recall, respectively. According to the dual systems theories, we should expect involuntary recall to be predicted by the sensory-perceptual and emotional qualities of the memories whereas voluntary recall would be predicted by the verbal-conceptual properties, such as amount of verbal details. According to the single system account, on the other hand, following what we know about factors increasing the accessibility of autobiographical memories, the two types of recall would in general have the same predictors, for which life story relevance and emotion would be the most likely candidates.

We use the basic-systems model of autobiographical memory (Rubin, 2005, 2006; Rubin, Schrauf, & Greenberg, 2003) and the autobiographical memory questionnaire (AMQ) which follows from it to measure the basic properties of autobiographical memories in a comprehensive fashion. According to the basic-systems model, the mind and brain are divided into basic systems, including vision, audition, olfaction, other senses, spatial imagery, language, emotion, narrative, motor output, and explicit memory. Each system has a substantial intellectual history including studies involving neuroanatomy, neuropsychology, neuroimaging, cognitive-experimental psychology, and individual differences research (see Rubin, 2006, for a review). In the present context, the model is especially relevant for disentangling the verbal-conceptual (e.g., language and narrative) versus emotion and sensory-perceptual properties (e.g., visual and spatial imagery) of autobiographical memories and their differential effects as predictors for involuntary versus voluntary recall, thereby assessing the validity of the theoretical claims reviewed earlier.

In addition, because the present study involves a large stratified sample, it also allows us to examine how characteristics of autobiographical memory other than the frequency of involuntary and voluntary retrieval, as measured by the AMQ, change over the adult life span. We do this for several reasons. As ratings of the properties of autobiographical memories are commonly used in lifespan studies, it is important to know whether any age differences found are due to the particular issues involved in an experiment, or rather, are due to general age trends in the way various scales are used. In addition, if developmental changes occur in some, but not all scales, it can give clues into how various processes change over the lifespan. In studies with undergraduates, meta-cognitive judgments of reliving and belief in autobiographical memories have been predicted by different memory properties (Rubin, Schrauf, & Greenberg, 2003; Rubin, Schrauf, Gulgoz, & Naka, 2007; Rubin & Siegler, 2004). Because the present study involves a large representative sample covering the entire adult life span, it allows us to examine the generalizability of these findings. At the same time, the validity of the present survey findings will be supported to the extent they replicate such results obtained through laboratory studies.

Experiment 1: A Survey

Method

Design—We examined memory for two different personal events. In one sample, we asked respondents for an important personal event from the week before the recall. This question uses a fixed, short retention interval, purposely confounding the age of the respondent at encoding and retrieval. From this question, we have reports of recent autobiographical

memories that were encoded and retrieved by people who varied in age. A second sample of respondents retrieved a remote autobiographical memory encoded in early adolescence, at about age 14. This question provides data on how an event in youth is remembered over a lifetime by unavoidably confounding age at retrieval with retention interval. When compared to the first question, this question allows an initial attempt at separating age differences in encoding and retrieval.

In order to find an event that would be experienced by most respondents and still recalled to some extent, we took advantage of the existence of a personal landmark event in Danish culture, confirmation day. Confirmation day occurs on a religious holiday in the spring. It is preceded by one year of weekly confirmation preparation classes that take place during ordinary public school classes as well as obligatory attendance of church service once or twice a month. Following the church service there is a party for the extended family and friends with speeches and songs composed in honor of the confirmed youth. The following Monday is an official school holiday in which groups of confirmed youths go to a city or amusement park to spend their confirmation presents on their own as ‘adults.’ It is the major rite of passage in Danish culture. Young people with a different religious or cultural background who do not have a confirmation often have a ‘nonfirmation’ party, in order not to feel too socially isolated from their peers. Confirmation normally takes place when the person is between 13 and 14 years old. In the state church of Denmark, to which 89% of the population of Denmark belonged in 1990, when our youngest respondents were born (http://www.km.dk), it marks entry into adulthood. Thus, it is an important day, even for those who observe it with their peers, but not as a religious event. We exclude through an initial screening question respondents who reported they had not had a confirmation day or similar ‘nonfirmation’ celebration. We therefore expected and found this event still to be recalled at long retention intervals.

The main goal of this study is to measure the relative frequency of voluntary and involuntary memories. To make the task as easy as possible for a general population, we asked each person about only one event. For half of our participants, it was an important event from last week; for the other half, it was confirmation day. Based on the theoretical speculation we reviewed, we choose important events to increase the frequency of what was expected to be a rare occurrence so that we could avoid floor effects. Reports about confirmation day are more difficult because they ask participants to average over their entire adult life spans rather than a period of days, and so they might be considered less reliable. However, having two very different events allows us to begin to check and generalize our results, as well as to begin to examine differences in the age of the participants at the time of encoding. Because the events are so different, if they provide similar results, we are in a good position to generalize to other important events. However, if we obtain differences, it will be difficult to say exactly why they occurred, and so we limit our theoretically relevant comparisons between the two events to noting where differences occur that limit our ability to generalize.

We use a fixed order of questions, as we have done in all our other studies using similar questions (e.g., Berntsen, & Rubin, 2008; Rubin, Boals, & Berntsen, 2008; Rubin, Schrauf, & Greenberg, 2003) to obtain an order that minimizes the possible interactions among the questions and avoids introducing random variance across respondents caused by changes in order. This decision, which is also made in all standardized questionnaires, means that some of our results may be due to the particular order we used. Because we were using a general population, we asked a series of questions to have participants define, focus on, and elaborate a single event, before turning to our key questions about frequency of involuntary and voluntary recall. Because we wanted to ensure that we did not get reports of voluntary recalls in our involuntary question, we asked about the frequency of voluntary recall first in a manner that stressed the willful recall of the participant. Next, we asked about the

frequency of involuntary recall, clearly contrasting it from voluntary recall and using a more passive construction in which the memory comes to the participant instead of the participant searching for the memory.

Participants—A representative sample of 2020 Danes between 15 and 96 years participated. Forty respondents who did not provide answers to three or more questions were excluded from the analyses. Table 1 shows the number and gender of remaining respondents sorted into seven age groups for each of the two events we used. Respondents were selected from all geographic areas of Denmark except Greenland and the Faroe Islands. All respondents were able to speak and understand Danish. In each household, one or two respondents were randomly selected via a combined criterion based on number of household members above age 14 and their birthdays. In Denmark, for research not involving sensitive topics, 15 year olds providing anonymous data can give consent and participate in survey research and are routinely sampled. Permission to include the data of the younger respondents was approved by the Duke University Institutional Review Board for the Protection of Human Subjects in Non-Medical Research.

Procedure—Data were collected as part of a telephone survey by TNS Gallup, Denmark. The response rate for the entire survey was 58%. The questions of relevance for the present study were preceded only by demographic questions in the survey. The respondents were informed that the purpose of the present study was to obtain information about memories and that no financial or political interests were involved. Only respondents who reported they had had a confirmation day or similar celebration to an initial screening question were included in the procedure that follows. All questions also included a “do not know” option, which was not read to the respondents, but was used only if the respondent stated to the interviewer that he or she did not know the answer to the question. Do not know responses were coded as missing data.

Respondents were read the following introductory instructions. Depending on whether the respondent was in the recent or remote condition, they received one of the two options shown in square brackets. “The following questions are part of research on how memory works. I will ask you some questions on how you remember. I will not ask about what you remember. Thus, I will not ask you to describe the contents of your memories. I will ask you to think back upon an important event that you can remember from [your confirmation day / or/ last week]. It has to be an event that you personally experienced [on your confirmation day. /or/ on a particular day. If you do not think that you have had an important event within the last week, please choose a somewhat important event from the last week.] It has to be an event that you personally have experienced. Try to remember the event as well as you can. When you have brought the memory to mind, we will continue (here the interviewer paused for a few seconds).” The Danish term for memory used roughly corresponds to the English term recollection.

Following the instruction, all respondents were asked the same 11 questions about their memories in the order that follows. Each question had five labeled responses, which we coded with the numbers 1 to 5 in our data analysis. The keyword, which we use to refer to the question, is presented here in italics. When I recollect the event, it is as if I am *reliving* it: not at all / vaguely / somewhat / clearly / as clearly as if it were happening now. (This scale was used for the next three questions.) When I think of the event, I can see with my mind’s eye what took place (*visual*). When I think of the event, I can remember the sounds that are connected with the memory (*auditory*). When I think of the event, I can remember the surroundings where it took place (*setting*). The emotions I have when I recall the event are intense (*intensity*): not at all intense / vaguely intense / somewhat intense / intense /very intense. The emotions I have when I recall the event are (*valence*): extremely negative /

negative / neutral-mixed / positive / extremely positively. When I think about the event, I remember it as a coherent, connected event, not as a collection of isolated, disconnected fragments (*coherence*): totally disconnected / somewhat disconnected / somewhat connected / connected / totally connected. The remembered event could be a part of my *life story*: not at all / as a very minor detail / as a detail / as an important part / as a very important part. I believe that the event really took place the way I remember it, and that I did not imagine anything or invent anything that did not take place (*belief*): my memory may be completely wrong / may be partly wrong / may be wrong regarding certain details / is almost completely correct / is completely correct. Since it happened, I have willfully thought back to the event in my mind and thought about it or talked about it (*voluntary*): never / seldom / sometimes / often / very often. Has the memory of the event suddenly popped up in your thoughts by itself – that is, without your having attempted to remember it (*involuntary*)?: never / seldom / sometimes / often / very often. In contrast to this last question on involuntary memory rehearsal, the voluntary rehearsal question was formulated clearly to refer to only voluntary retrieval.

Results

We begin the results section with our analysis of the key issue: the relative frequency of involuntary and voluntary memories. We next turn to other questions that are more peripheral to our research goals, but which our data nonetheless can help to clarify. We use multiple regressions to ask which of our other variables predict the frequency of involuntary and voluntary memories in order to see if the frequency measures are similar in ways other than their mean levels. We here specifically want to examine predictions from dual systems theories (Brewin et al., 1996; Dalgleish, 2004), according to which emotion, sensory imagery, coherence and life story would be differentially related to voluntary and involuntary recall. We then predict our belief and reliving measures to compare the current data to that collected in a laboratory setting to ensure that the results obtained here are comparable. In the next section, we briefly examine the effects of the respondents' age, gender, and our two different events. Data collected in a laboratory setting comparing younger to older adults show that older adults tend to rate properties of their memories, such as those measured here, more highly. Here we can investigate that finding using a continuous range of ages and a more representative sample of people. Similarly, there is literature on gender differences in autobiographical memory that our data can address (Bauer, Stennes, & Haight, 2003; Davis, 1999; Seidlitz & Diener, 1998). Because our two events differ in ways that make them hard to compare, we include events as a factor in ANOVAs to ensure our results hold over both events and to allow us to combined data from in analyses where events do not produce interactions, but we can draw limited conclusions from any differences.

The Frequency of Voluntary and Involuntary Memories—The overall distribution of frequency responses to involuntary and voluntary recall of the two events are shown in Figure 1. As illustrated by this figure, the frequency estimates of the two types of recall are strikingly similar. To provide more detailed analyses, the lifespan pattern of the means of the frequencies is presented in Figure 2. The seven age groups in Table 1 that were used to describe our respondents were used to plot data in Figure 2. We did an ANOVA with the type of event (recent versus remote), age group, and gender as between subject variables and the type of rehearsal (involuntary versus voluntary) as a within subject variable. With nearly 2,000 respondents, the main effects of frequency of involuntary versus voluntary rehearsal (2.72 versus 2.86 or 0.14 units on 5-point scale, $F(1,1944) = 33.76$, $\eta 51;^2 = .00$), recent versus remote event (3.25 versus 2.33, $F(1,1944) = 345.32$, $\eta 51;^2 = .12$), and gender (2.64 versus 2.91, $F(1,1944) = 35.99$, $\eta 51;^2 = .01$) were all significant at the .0001 level. The effect of age group was not significant at the .05 level (2.80, 2.78, 2.79, 2.85, 2.77, 2.86, and

2.59, $F(6,1944) = 0.72$, η51;^{2} = .00). There was one significant interaction: involuntary versus voluntary recall by recent versus remote event ($F(1,1944) = 9.18$, $p < .01$, η51;^{2} = .00). As seen in Figure 2, this is caused by a larger difference in the recent events.

A surprising and noteworthy finding is that the frequency and lifespan patterns of the involuntary and voluntary rehearsal are very similar for both events. Involuntary memories are slightly less frequent than voluntary memories, but not much rarer as would be expected from the literature. Several points follow from these observations. First, although involuntary memories tend to be viewed as rare occurrences, here they are not and are roughly as common as voluntary rehearsal. Second, the frequency of involuntary memories does not decrease over the lifespan. From Figure 2, it appears that for the oldest participants there is a drop in involuntary and voluntary memories for the recent event and for involuntary memories for the remote events. However, there is no main effect or interactions with the age of the respondents, and if the frequencies of involuntary and involuntary recall of the oldest participants are compared with that of the previous two age groups, none of the differences are significant (the largest F was $F(1,283) = 1.92$, $p = 0.17$). Third, both the involuntary and voluntary rehearsals were to an event that was recalled voluntarily before any ratings took place. In the case of the recent event, it was selected voluntarily by our respondents from among all events of the preceding week as being important. Thus, if voluntary and involuntary retrieval worked on qualitatively different mechanisms, the estimates of the frequency of involuntary recall would be lowered by our procedure because the events were selected either by the respondents (for the recent event) or the researchers (for the remote event) to be easily recalled voluntarily.

Predictors of the Frequency of Involuntary and Voluntary Memories, Belief, and Reliving—Table 2 presents multiple regressions. To investigate the frequency of *involuntary* retrieval, we compared it to willful *voluntary* retrieval of the event using the independent variables of *visual, auditory, setting, intensity, valence, coherence, life story, age, gender,* though only variables that entered at the $p < .05$ level are shown. The frequencies of involuntary and voluntary rehearsal are similar in their mean values and in the distribution of responses. They are also the most highly correlated among all our correlations (.64 for the recent and .59 for the remote event). We therefore wanted to see if the same variables would predict them. Initially, for *involuntary* we removed *voluntary* and for *voluntary* we removed *involuntary*. The best predictors of *involuntary* and *voluntary* were remarkably similar. Therefore, we tried a stronger test in which we included *voluntary* as a predictor of *involuntary* and *involuntary* as a predictor of *voluntary* to ensure that the similarity was not just caused by the high correlation between *involuntary* and *voluntary*. The results remained the same, with a decrease in the weights of the other predictors. The main finding from this analysis is that either with or without the measures of frequency predicting each other, emotional *intensity* and *life story* are consistent predictors of both *involuntary* and *voluntary*. Thus, the same measures predict the frequencies of voluntary and involuntary memories, suggesting that similar mechanisms underlie the frequency of recall, contrary to dual systems theories.

Reliving and *belief* can be seen as meta-cognitive judgments based on the processes measured by the variables used to predict *voluntary* and *involuntary* (Rubin, 2005, 2006). We have therefore chosen *reliving* and *belief* as the dependent variables for multiple regressions in earlier laboratory studies. This allows us to test the generality of those results here using a wider range of participants and to ensure that the method of using a survey with only one memory per respondent does not produce fundamentally different results than laboratory studies. The results here replicate findings from undergraduate samples (Rubin, Schrauf, & Greenberg, 2003; Rubin & Siegler, 2004) including those from Japan and Turkey (Rubin, Schrauf, Gulgoz, & Naka, 2007). In general, the independent variables differ

for the dependent variable of *reliving* and *belief*, but there are similar independent variables and weighting for the two events. In particular, reliving is predicted best by *visual* imagery, other sensory variables, here *auditory*, and emotional *intensity*; whereas belief is predicted less well by cognitive variables in general, and depends most on *setting* and narrative *coherence*. Thus, these findings provide converging evidence for the laboratory studies with undergraduates and give us more confidence in the analysis of the novel questions asked here.

General Effects of Age, Event, and Gender on Other Properties of Autobiographical Memory

Changes over the lifespan: Table 3 presents correlations with the age of the respondent. The correlations are mostly positive, not large, and tend to be larger for the recent event. In fact, all of the significant correlations, with the exception of *valence* for the remote memory, are positive, suggesting that as the respondents increase in age, the ratings increase consistent with Rubin and Schulkind (1997). In studies of cognitive aging that sample only a younger and an older age group near the extremes of our range, this small correlation can lead to moderate differences in the overall ratings.

Difference between the two events: The results of the two (recent versus remote event) by two (gender) ANOVAs on all measures are presented in Table 4. We contrasted an important, culturally sanctioned event from youth with whatever event in the last week was most important to the respondent and so comparisons are limited because of the major differences in the events. There are often substantial differences between the memories of the two events, with the recent event memories being rated higher, except for *valence*. The biggest differences, in terms of $\eta 51;^2$ are in the frequency of *voluntary* and *involuntary* rehearsal and *auditory* imagery.

Gender: Table 4 also provides a quantitative measure of the gender differences from the same two by two ANOVAs. The interaction of event and gender is small. It is statistically significant for only three measures, even at the uncorrected $p < .05$, with over 1,900 observations; none of these interactions had an $\eta 51;^2$ as large as .01. Thus, in this study, we can examine gender independently of the particular event being measured. The largest effects of gender are on emotional *intensity*, *coherence*, *life story*, the frequency of *voluntary* retrieval, and frequency of *involuntary* retrieval. The *coherence*, *life story*, and frequency of *voluntary* rehearsal measures can be seen as part of the narrative organization of the memory and thus can be seen as consistent with previous studies showing gender differences in narratives of autobiographical events (Pillemer, Theresa, & Sanborn, 2003). Higher emotional *intensity* is consistent with previous work showing a tendency of women to focus more on emotional aspects of the past and to be more expressive about them than are men (Bauer, Stennes, & Haight, 2003;Davis, 1999;Seidlitz & Diener, 1998). The greater frequency of *involuntary* memories in females is a novel finding.

Experiment 2: Order Effects

In order to check that our use of only one order for the questions about the frequencies of voluntary and involuntary memories did not affect our conclusions, we did a small study using both orders. Half of the participants answered the frequency question in the order involuntary – voluntary, the other half in the order voluntary – involuntary.

Method

Based on the procedure for Experiment 1, 60 Duke University Undergraduates between the ages of 18 and 22 read the same instructions as were given earlier for the recent event and answered the same questions about the frequency of involuntary and voluntary retrieval.

Results and Discussion

The mean ratings for the involuntary and voluntary memory frequency questions were 3.07 (*SD* = 0.98) and 3.30 (*SD* = 0.88) in the participants who answered the involuntary question first. The mean ratings for involuntary and voluntary were 2.87 (*SD* = 1.14) and 3.17 (*SD* = 0.79) in the participants who answered the voluntary question first. Using a two by two mixed design ANOVA with involuntary versus voluntary memory as a within factor and order as a between factor, there was a main effect of involuntary versus voluntary ($F(1,58) = 4.98$, $p = .03$) caused by involuntary memories having a lower mean rating (2.97 versus 3.23). There was no effect of order ($F(1,58) = 0.60$, $p = .44$) or their interaction ($F(1,58) = 0.08$, $p = .78$).

The observation that the difference between the ratings of the frequency of involuntary and voluntary memories do not significantly differ in the two orders and is similar to the difference for the recent event for younger age groups shown in Figure 1, provides converging evidence for Experiment 1.

General Discussion

The most striking findings in the present study are the frequencies of involuntary versus voluntary autobiographical memories. We have shown that when measured retrospectively for the same events, involuntary and voluntary memories are rated as having highly similar frequencies. Moreover, this pattern is consistent across the lifespan and occurs when measured for a recent and a remote event. This finding challenges the idea that voluntary recall is the standard mode of recalling the personal past. Instead it seems that the involuntary and voluntary mode are two different ways of reviewing past events that may be equally frequent in daily life. Importantly, the present study also showed that the frequency of these two modes of recalling past events are predicted by the same memory characteristics (especially, emotional intensity and relevance to the life story). This disagrees with dual systems views (e.g., Brewin et al., 1996; Dalgleish, 2004) and agrees with the view that the two modes of recall are affected similarly by mechanisms related to encoding and maintenance (Berntsen, 2009; Berntsen & Jacobsen, 2008; Rubin, Boals, & Berntsen, 2008). The findings are consistent with the view that differences between involuntary and voluntary autobiographical memories on phenomenological qualities shown in previous studies (e.g., Berntsen & Hall, 2004) are most likely to be explained in terms of their dissimilar retrieval mechanisms – that is, associative versus strategic recall – rather than encoding and maintenance factors (Berntsen, 2009; Berntsen & Jacobsen, 2008).

The present study did not replicate previous work showing a decline in involuntary memory with age (Berntsen & Rubin, 2002; Schlagman et al., 2007). The lack of a decline in involuntary memory frequency with increasing age may reflect that the questions used in the present study to measure involuntary memory were easier to answer than the ones used in previous surveys (e.g., Berntsen & Rubin, 2002) in that the present questions asked about the frequencies of such memories in relation to a particular event and not for events in general. Following this explanation, the lower frequencies among older participants observed in previous work may have reflected that they had greater difficulties at remembering prior incidences of having involuntary memories when answering retrospective, open-ended questions, rather than them having less involuntary memories as

compared to younger participants. Differences with diary studies (Schlagman, et al., 2007), may be due to age changes in the ability to do the dual task of keeping diaries of involuntary memories during ongoing daily activities. The present findings can be seen to agree with research showing no differences between young and old subjects with regard to automatic retrieval processes leading to increased interference effects in priming studies (Ikier, Yang, & Hasher, 2008).

In addition to the main findings on the frequency of involuntary memories, we replicated past laboratory results using a survey method requesting ratings in response to one specific memory in a more representative and diverse population. These include the increase of ratings of the phenomenological properties of autobiographical memories with age (Rubin & Schulkind, 1997) and the prediction of the meta-cognitive judgments of reliving and belief (Rubin et al., 2003; Rubin et al., 2007; Rubin & Siegler, 2004). We also replicated and extended findings on gender including that females have slightly easier access to emotional events and are slightly more inclined than males to voluntarily rehearse and narrate their personal past (Bauer et al., 2003; Davis, 1999; Pillemer et al., 2003; Seidlitz & Diener, 1998). In addition, we showed a similar gender effect for the likelihood of recalling experiences through involuntary recollections. This novel finding may reveal one contributing factor that may help to explain why females more frequently than males develop Posttraumatic Stress Disorder even for similar events, since highly emotional intrusive involuntary recollections are an important characteristic of this disorder (American Psychiatric Association. 2000; Rubin, Berntsen, & Bohni, 2008; Tolin & Foa, 2006).

Finally, the use of both a recent and a remote event helps us isolate age effects of encoding and retrieval. We obtained similar effects with both events. The one exception is that there is more of an increase with the age of the respondent in many rating scales for the recent than the remote event, which can be reasonably attributed to the offsetting effects of the increased retention interval for the remote event. From these results, it is improbable that the effects we report here are due mainly to lifespan changes in encoding because for one event encoding was always from youth and for the other it changed with the age of the respondent.

In summary, a large representative sample of respondents estimated the frequency of involuntary and voluntary autobiographical memories for the same event. Independent of whether the event was recent or remote and independent of the age and gender of the respondent, they estimated involuntary memories to be about as frequent as voluntary memories. Thus, in order to get anything approximating a complete picture of the workings of episodic memory, of how often events are rehearsed, and about how they are cued, we need to study both forms of retrieval.

Acknowledgments

This work was supported by grant R01 MH066079 from the National Institute of Mental Health and by the Danish Research Council for the Humanities. We wish to thank Lynn Hasher for her comments and TNS Gallup, Denmark for their assistance.

References

American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4. Washington, DC: American Psychiatric Association; 2000. Text Revision

Antrobus JS, Singer JL, Greenberg S. Studies in the stream of consciousness. Experimental enhancement and suppression of spontaneous cognitive processes. Perceptual and Motor Skills 1966;23:399–515.

Ball CT, Little JC. A comparison of involuntary autobiographical memory retrievals. Applied Cognitive Psychology 2006;20:1167–1179.

Bauer PJ, Stennes L, Haight JC. Representation of the inner self in autobiography: Women's and men's use of internal states language in personal narratives. Memory 2003;11:27–42. [PubMed: 12653487]

Berntsen D. Involuntary autobiographical memories. Applied Cognitive Psychology 1996;10:435–454.

Berntsen, D. An introduction to the unbidden *past*. Cambridge University Press; 2009. Involuntary autobiographical memories.

Berntsen D, Hall NM. The episodic nature of involuntary autobiographical memories. Memory & Cognition 2004;32:789–803.

Berntsen D, Jacobsen AS. Involuntary and Voluntary Mental Time Travel into the Past and Future. Consciousness and Cognition 2008;17:1093–1104. [PubMed: 18424178]

Berntsen D, Rubin DC. Emotionally charged autobiographical memories across the lifespan: The recall of happy, sad, traumatic, and involuntary memories. Psychology and Aging 2002;17:636–652. [PubMed: 12507360]

Berntsen D, Rubin DC. The reappearance hypothesis revisited: Recurrent involuntary memories after traumatic events and in everyday life. Memory & Cognition 2008;36:449–460.

Brewin CR, Dalgleish T, Joseph S. A dual representation theory of posttraumatic stress disorder. Psychological Review 1996;103:670–686. [PubMed: 8888651]

Dalgleish T. Cognitive approaches to posttraumatic stress disorder: The evolution of multirepresentational theorizing. Psychological Bulletin 2004;130:228–260. [PubMed: 14979771]

Davis PJ. Gender differences in autobiographical memory for childhood emotional experiences. Journal of Personality and Social Psychology 1999;76:498–510. [PubMed: 10101879]

Ebbinghaus, H. Memory. A contribution to experimental psychology. New York: Dover Publications; 1885/1964.

Ehlers A, Clark DM. A cognitive model of posttraumatic stress disorder. Behaviour Research and Therapy 2000;38:319–345. [PubMed: 10761279]

Ericsson, KA.; Simon, HA. Protocol analysis: Verbal reports as data (Rev.). Cambridge, MA: MIT (Bradford Books); 1993.

Giambra LM. Task-unrelated-thought frequency as a function of age: A laboratory study. Psychology and Aging 1989;4:136–143. [PubMed: 2789741]

Giambra LM. The influence of aging on spontaneous shifts of attention from external stimuli to the contents of consciousness. Experimental Gerontology 1992;28:485–492. [PubMed: 8224044]

Hall NM, Berntsen D. The effect of Emotional Stress on Involuntary and Voluntary Conscious Memories. Memory 2008;16:48–57. [PubMed: 17852728]

Halligan SL, Clark DM, Ehlers A. Cognitive processing, memory, and the development of PTSD symptoms: two experimental analogue studies. Journal of Behavior Therapy and Experimental Psychiatry 2002;33:73–89. [PubMed: 12472172]

Hasher L, Zacks RT. Automatic and effortful processing in memory. Journal of Experimental Psychology: General 1979;108:356–388.

Healey, MK.; Campbell, KL.; Hasher, L. Cognitive Aging and Increased Distractibility: Costs and Potential Benefits. In: Sossin, WS.; Lacaille, JC.; Castellucci, VF.; Belleville, S., editors. Progress in Brain Research. Vol. 169. Amsterdam: Elsevier; 2008. p. 353-363.

Hintzman DL. Judgments of frequency and recency: How they relate to reports of subjective awareness. Journal of Experimental Psychology: Learning, Memory, and Cognition 2001;27:1347–1358.

Holmes EA, Bourne C. Inducing and modulating intrusive emotional memories: A review of the trauma film paradigm. Acta Psychologica 2008;127:553–556. [PubMed: 18234153]

Ikier S, Yang L, Hasher L. Implicit, proactive interference, age, and automatic versus controlled retrieval strategies. Psychological Science 2008;19:456–461. [PubMed: 18466406]

Kinoshita S. The role of involuntary aware memory in the implicit stem and fragment completion task: A selective review. Psychonomic Bulletin & Review 2001;8:58–69. [PubMed: 11340867]

Klinger, E. Structure and functions of fantasy. New York: Wiley; 1971.

Kvavilashvili L, Mandler G. Out of one's mind: A study of involuntary semantic memories. Cognitive Psychology 2004;48:47–94. [PubMed: 14654036]

Mace, JH. Involuntary memory. Malden, MA: Blackwell; 2007.

Mandler, G. Hypermnesia, incubation, and mind-popping: On remembering without really trying. In: Umilta, C.; Moscovitch, M., editors. Attention and performance. Conscious and unconscious information processing. Cambridge, MA: MIT Press; 1994. p. 3-33.

Miller, GA. The science of mental life. London: Penguin Books; 1962. Psychology.

Pillemer DB, Theresa ED, Sanborn RL. Gender differences in autobiographical memory styles of older adults. Memory 2003;11:525–532. [PubMed: 14982120]

Richardson-Klavehn A, Gardiner JM, Java RI. Involuntary, conscious memory and the method of opposition. Memory 1994;2:1–29. [PubMed: 7584283]

Rubin DC. Frontal-striatal circuits in cognitive aging: Evidence for caudate involvement. Aging, Neuropsychology, and Cognition 1999;6:241–259.

Rubin DC. A basic-systems approach to autobiographical memory. Current Directions in Psychological Science 2005;14:79–83.

Rubin DC. The basic-systems model of episodic memory. Perspectives on Psychological Science 2006;1:277–311.

Rubin DC, Berntsen D, Bohni MK. A memory-based model of posttraumatic stress disorder: Evaluating basic assumptions underlying the PTSD diagnosis. Psychological Review 2008;115:985–1011. [PubMed: 18954211]

Rubin DC, Boals A, Berntsen D. Memory in posttraumatic stress disorder: Properties of voluntary and involuntary, traumatic and non-traumatic autobiographical memories in people with and without PTSD symptoms. Journal of Experimental Psychology: General 2008;137:591–614. [PubMed: 18999355]

Rubin DC, Schrauf RW, Greenberg DL. Belief and recollection of autobiographical memories. Memory & Cognition 2003;31:887–901.

Rubin DC, Schrauf RW, Gulgoz S, Naka M. On the cross-cultural variability of component processes in autobiographical remembering: Japan, Turkey, and the U.S.A. Memory 2007;15:536–547. [PubMed: 17613796]

Rubin DC, Schulkind MD. Distribution of important and word-cued autobiographical memories in 20-, 35-, and 70 year-old adults. Psychology and Aging 1997;12:524–535. [PubMed: 9308099]

Rubin DC, Siegler IC. Facets of personality and the phenomenology of autobiographical memory. Applied Cognitive Psychology 2004;18:913–930.

Schacter DL. Implicit memory: History and current status. Journal of Experimental Psychology: Learning, Memory and Cognition 1987;13:501–518.

Schacter, DL.; Bowers, J.; Booker, J. Intention, awareness and implicit memory: The retrieval intentionality criterion. In: Lewandowsky, S.; Dunn, JC.; Kirsner, K., editors. Implicit memory. Theoretical issues. Hillsdale, NJ: Lawrence Erlbaum; 1989. p. 47-65.

Schlagman, S.; Kvavilashvili, L.; Schulz, J. Effects of age on involuntary autobiographical memories. In: Mace, John H., editor. Involuntary Memory. Malden: Blackwell; 2007. p. 87-112.

Seidlitz L, Diener E. Sex differences in the recall of affective experiences. Journal of Personality and Social Psychology 1998;74:262–271. [PubMed: 9457787]

Singer, JL. Daydreaming. An introduction to the experimental study if inner experience. New York: Random House; 1966.

Singer, JL. Drives, affects, and daydreams: The adaptive role of spontaneous imagery on stimulus-independent mentation. In: Antrobus, JS., editor. Cognition and affect. Boston: Little, Brown and Company; 1970. p. 131-157.

Smallwood J, Schooler JW. The restless mind. Psychological Bulletin 2006;132:946–958. [PubMed: 17073528]

Tolin DF, Foa EB. Sex differences in truama and postruamatic stress disorder: A quantitiative review of 25 years of research. Psychological Bulletin 2006;132:959–992. [PubMed: 17073529]

Tulving, E. Elements of episodic memory. New York: Oxfrod University Press; 1983.

Van der Kolk BA, Fisler R. Dissociation and the fragmentary nature of traumatic memories: Overview and exploratory study. Journal of Traumatic Stress 1995;8:505–525. [PubMed: 8564271]

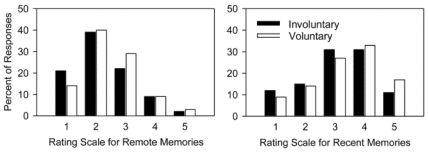

Figure 1.
Histograms of the frequency of involuntary and voluntary rehearsal. The left column is for confirmation, the right for an important event from the last week: 1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = very often.

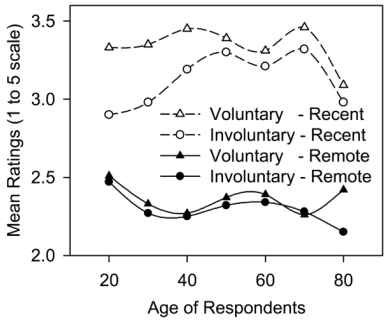

Figure 2.

Mean responses on five-point rating scales for the frequency of voluntary and involuntary recall of the remote event of confirmation and a recent important event from the last week: 1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = very often.

Table 1

Demographics

Age Group	Remote Memory			Recent Memory		
		Mean %			Mean %	
	n	Age	Female	n	Age	Female
15–24	132	19	52	132	19	60
25–34	185	30	54	148	30	53
35–44	201	39	53	204	40	53
45–54	186	49	54	177	50	59
55–64	147	59	59	174	59	59
65–74	88	69	56	95	69	58
75–96	65	79	75	46	81	57

Mem Cognit. Author manuscript; available in PMC 2011 February 25.

Table 2

Multiple Regression Analyses for Reliving, Belief, and Frequency of the Involuntary Memory

Dependent Variable		Beta Weights for Independent Variable									R^2
		visual	auditory	setting	intensity	valence	coherence	life story	voluntary*	age	
Involuntarys	recent				.10			.14	.56	.06	.44
Involuntary	remote		.05	.05	.09	.05		.12	.46		.40
Voluntary	recent				.14		.07	.12	.51	−.10	.45
Voluntary	remote	.07			.09			.15	.45		.41
Reliving	recent	.41	.19		.13				.12	.06	.37
Reliving	remote	.32	.12		.25		.08		.15	.06	.43
Belief	recent			.11			.27		.07	.08	.12
Belief	remote			.15			.20			.10	.18

Note: There are between 942 and 953 observations in each regression equation.

**Voluntary* was replaced by *involuntary* for predictions of *voluntary*.

Table 3

Correlations with age at recall

Measure	Event	
	remote	**recent**
Involuntary	−.04	.08*
Voluntary	−.02	−.02
Reliving	.09**	.19***
Belief	.13***	.13***
Visual	.02	.14***
Auditory	.02	.23***
Setting	−.01	.08**
Intensity	.04	.22***
Valence	−.14***	.08**
Coherence	.06*	.16***
Life story	.00	.08**

Notes: all corellations have between 972 and 990 degrees of freedom.

* $p < .05$,

** $p < .01$

*** $p < .0001$.

Table 4

Mean differences in autobiographical memories with gender and type of memory

Measure	Gender				Event				Interaction
	male	female	F	η^2	remote	recent	F	η^2	F .
Involuntary	2.57	2.84	37.65***	.02	2.31	3.14	295.59***	.13	5.27*
Voluntary	2.71	2.98	39.78***	.02	2.36	3.37	431.38***	.18	2.93
Reliving	3.58	3.69	6.70*	.00	3.38	3.90	119.10***	.06	0.80
Belief	4.32	4.34	0.45	.00	4.22	4.44	40.43***	.00	0.38
Visual	3.91	3.98	3.96*	.00	3.69	4.21	174.05***	.08	3.64
Auditory	2.96	3.04	3.31	.00	2.46	3.55	327.84***	.14	0.01
Setting	4.25	4.30	2.95	.00	4.17	4.40	44.73***	.02	0.58
Intensity	3.19	3.53	45.46***	.02	3.08	3.69	139.36***	.06	0.11
Valence	3.77	3.88	5.00*	.00	3.90	3.77	8.73**	.00	4.60*
Coherence	3.75	3.96	25.38***	.01	3.60	4.13	146.98***	.07	0.21
Life story	2.65	3.03	48.68***	.02	2.79	2.93	6.46**	.00	4.00*

Notes: all F have 1 df in the numerator and between 1949 and 1972 in the denominator.

* p < .05,

** p < .01

*** p < .0001.

η51;2 for all interactions were .00