Ways of Sampling Voluntary and Involuntary Autobiographical Memories in Daily Life

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Abstract

Cognitive psychologists have often equaled retrieval of personal events with voluntary recall from autobiographical memory, but more recent research shows that autobiographical memories often come to mind involuntarily—that is, with no retrieval effort. Voluntary memories have been studied in numerous laboratory experiments in response to word-prompts, whereas involuntary memories primarily have been examined in an everyday living context, using a structured diary procedure. However, it remains unclear how voluntary memories sampled in the laboratory map onto self-prompted voluntary memories in daily life. Here, we used a structured diary procedure to compare different types of voluntary autobiographical memories to their involuntary counterparts. The results replicated previous findings with regard to differences between word-prompted voluntary and involuntary memories, whereas there were fewer differences between self-prompted voluntary and involuntary memories. The findings raise the question as to what is the best way of sampling voluntary memories and the best comparison for involuntary memories.

Ways of Sampling Voluntary and Involuntary Autobiographical Memories in Daily Life

1. Introduction

Cognitive psychologists have often equated retrieval of personal events with voluntary recall from autobiographical memory (e.g., Miller, 1962/1974; Robinson, 1976; Tulving, 1983), but over the last 15 years evidence has accumulated that autobiographical memories can come to mind both involuntarily and voluntarily (see Berntsen, 2009; 2010, for reviews). Whereas the first line of research typically has studied voluntary memories in response to word-prompts in a controlled laboratory setting, the latter tradition have examined involuntary memories primarily via the structured diary procedure, where participants report their naturally occurring involuntary memories in their everyday living contexts. Here, we examine how voluntary memories prompted by word-stimuli map onto voluntary memories in daily life, and we utilize the structured diary procedure to examine such self-prompted voluntary memories as well as to compare them with involuntary and word-prompted voluntary memories

Almost 40 years ago, John Robinson published an article on different ways of sampling autobiographical memory, in which he defined autobiographical memory as "... the ability for voluntary recall of one's past life... (1976, p. 578)". The article described a study, where three sets of words (i.e, words for objects, activities and feelings respectively) were used as prompts for free recall of discrete experiences. Robinson was inspired by Galton's (1907) and Crovitz's and Schiffman's (1974) pioneering works on the efficiency of word-prompts to evoke associations to a wide variety of autobiographical memories. Since then, the word-prompt paradigm has been used in numerous laboratory studies, and has generally been considered as a method for eliciting a

representative sample of autobiographical memories (e.g., Rubin, 1980; Rubin & Schulkind, 1997a; Rubin & Siegler, 2004; Rubin Schrauf & Greenberg, 2003). However, although the robustness and effectiveness of this method are unquestionable, very little is known about how word-prompted voluntary memories may map onto voluntary remembering in everyday life.

While the study of word-prompted voluntary memories was crucial in the start-up of autobiographical memory research, studies from the last fifteen years have repeatedly demonstrated that autobiographical memories can come to mind not only voluntarily through strategic or goal-directed retrieval, but also involuntarily – that is spontaneously without any preceding conscious attempts at retrieval (e.g., Ball & Little, 2006; Berntsen, 1996, 2001; Berntsen & Hall, 2004; Kvavilashvili & Mandler, 2004; Mace, 2004; Rubin, Boals & Berntsen, 2008; Schlagman & Kvavilashvili, 2008; for reviews, see Mace, 2007; Berntsen, 2009, 2010). In contrast to word-prompted memories, involuntary autobiographical memories typically have been assessed in the participant's everyday living context using a structured diary procedure in which the participants make records of the memory and the retrieval context on-line, that is immediately after a memory has come to mind (e.g., Ball & Little, 2006; Berntsen, 1996; Berntsen & Hall, 2004; Berntsen & Jacobsen, 2008; Finnbogadottir & Berntsen, 2011; Johannessen & Berntsen, 2010; Mace 2004; 2005; Rubin Boals & Berntsen, 2008; Schlagman, Kliegel, Schultz & Kvavilashvili, 2009; Schlagman, Schultz & Kvavilashvili, 2006). This method has the advantage of being more naturalistic, albeit less controlled. Surprisingly, this type of diary method never has been used to sample voluntary autobiographical remembering as they are retrieved in everyday life.

In the following, we will examine how different ways of sampling voluntary versus involuntary memories will influence their content, perceived function and other characteristics. We compare three types of voluntary memories to involuntary memories in four consecutive, but separate, diary studies. We first describe different paradigms for investigating voluntary and

involuntary memories. We then review studies on differences and similarities between the two types of remembering.

1.1. Voluntary and Involuntary Remembering: Two Standard Research Paradigms

The word-prompt method was introduced by Sir Francis Galton (1907) and later revised by Crovitz and Schiffman (1974) in order to specifically prompt voluntary autobiographical memories. Galton (1907) examined his own thoughts while walking around in a familiar environment, using objects in the environment as prompts for the deliberate retrieval of thought associations and mental images, of which he then took mental note. This method has since been coined as the *memory walk procedure* (Berntsen & Hall, 2004), and was a precursor for the more convenient *word-prompt method*, which Galton also developed. Here, he would sit at his desk and take note of his own thought associations in response to self-chosen word-prompts. In case the thought association turned out to be an autobiographical memory, Galton would also date that memory. The word-prompt method was reintroduced and systematized by Crovitz and Schiffman (1974), who asked participants to retrieve discrete autobiographical events in response to word-prompts chosen by the experimenter and also to date each remembered event. They found that the frequency of the memories decreased systematically as a function of the age of the memories, following the standard forgetting curve (Ebbinghaus, 1985). The word-prompt method generally is regarded as a random way of sampling a wide variety of autobiographical memories spanning over a large proportion of the participants' lives (e.g., Robinson, 1976).

Since then, the word-prompt method has been used and manipulated in a large number of laboratory experiments. For instance, Robinson (1976) showed how different types of word-prompts would yield systematic differences on memory properties such as latencies, age of memory and type of experience. Likewise, Rubin and Schulkind (1997a) found that word-prompts varying

with respect to their level of imagery, concreteness, meaningfulness, goodness, emotionality and frequency elicited memories that differed systematically on age as well as retrieval latencies. Rubin and colleagues also have used word-prompts to examine the relationships between a representative sample of participants' autobiographical memories and measures of individual differences, such as differences related to personality traits, depression symptoms, dissociation and posttraumatic stress disorder symptoms (e.g., Rubin, Boals & Berntsen, 2008; Rubin, Scauf & Greenberg, 2003; Rubin & Siegler, 2004, see also Rasmussen & Berntsen, 2010). In addition to word-prompts, more elaborate descriptions, such as an instruction to retrieve important memories (e.g., Fitzgerald, 1988; Pillemer, 1998; Rubin & Schulkind, 1997b), emotionally positive or negative memories (e.g., Berntsen & Rubin, 2002; Rasmussen & Berntsen, 2009a; 2013; Talarico, LaBar & Rubin, 2004; Walker, Rodney, & Thompson, 1997) as well as instructions to elicit memories with specific functions (e.g., Harris, Rasmussen & Berntsen, 2013; McLean & Lilgendahl, 2008; Rasmussen & Berntsen, 2009a) have been used as prompts for deliberate recall in various studies. In spite of their differences, these types of prompts all have been used to initiate a voluntary search for an autobiographical memory, but - as we will discuss in the following - not necessarily a voluntary search as we would expect it to occur in daily life.

In contrast to most studies on voluntary memories, involuntary autobiographical memories typically have been examined outside a laboratory context (but see for example Ball, 2007; Berntsen, Staugaard & Sørensen, 2013; Mace, 2006; Schlagman & Kvavilashvili, 2008). Some of these studies have used retrospective assessments, which is a method often used in clinical research on intrusive involuntary memories. For instance, Brewin, Christodoulides and Hutchinson (2008) asked participants to list the five most frequent involuntary intrusive memories from the last two weeks. For similar uses of retrospective assessments, see for example Berntsen and Rubin (2002) and Rasmussen and Berntsen (2009a). However, the most common method for sampling

involuntary autobiographical memories in naturalistic settings is *the structured diary method* (see Berntsen, 2009, for a review), where participants are instructed to carry a small booklet in their everyday living context and to make a brief record of their naturally occurring involuntary memories in the booklet. The advantage of this method compared with methods that ask for the most frequent involuntary memories is that the involuntary memories are sampled on-line, immediately after retrieval, thereby diminishing retrospection (Ericsson & Simon, 1980; Nisbett & Wilson, 1977).

In some diary studies, the involuntary memories have been compared to a voluntary memory for instance by having participants retrieve memories in response to word-prompts in a laboratory context (Berntsen, 1998; Mace, 2005), or by offering the participants a word-prompt for a voluntary memory each time an involuntary memory is recorded (e.g., Berntsen & Hall, 2004; Johannessen & Berntsen, 2010; Finnbogadottir & Berntsen, 2011), or by asking the participant to retrieve a voluntary memory from the same time period as the involuntary memory (Rubin, Boals & Berntsen, 2008; Rubin, Dennis & Beckham, 2011). The two latter types of studies have the advantage that the voluntary memory is sampled in a naturalistic setting with a self-paced procedure, albeit still controlled by the experimenter. In another diary study, the voluntary memories have been sampled with the Galton memory walk procedure, which uses environmental and non-verbal prompts to activate a voluntary memory search (Berntsen & Hall, 2004). Again this method has the advantage of providing a more naturalistic setting for sampling voluntary memories than what is the case for traditional laboratory experiments. However, although diary studies have attempted to approach a more ecologically valid way of prompting voluntary memories, they have not examined involuntary autobiographical memories in comparison with self-initiated or self-prompted voluntary memories, sampled on-line in everyday life immediately after retrieval.

1.2. Differences and Similarities between Voluntary and Involuntary Memories

Studies comparing involuntary and voluntary (word prompted) memories generally have shown that involuntary as compared to voluntary retrieval more frequently refers to specific episodes – that is experiences that have taken place at a particular time and place in the person's past, in contrast to summarized events of many similar occasions (e.g., Williams, 1996). In addition, involuntary memories often are rated as less central to the person's identity and life story, but tend to come with more mood impact and physical reaction (e.g., see Berntsen, 2009 for review), and involuntary as compared to voluntary memories have markedly shorter retrieval times when studied experimentally (Berntsen, Staugaard & Sørensen, 2013; Schlagman & Kvavilashvili, 2008). At the same time, the two types of memories also show a number of important similarities. For instance, they both show a standard forgetting function including childhood amnesia, a reminiscence bump and a recency effect (e.g., Berntsen, 1998; Berntsen & Rubin, 2002; Schlagman, Kliegel, Schultz & Kvavilashvili, 2009). They both show a marked dominance of positive events in healthy individuals (e.g., Berntsen, 1998; Walker, Skowronski & Thompson, 1996), and emotional arousal affects the two types of remembering in similar ways (e.g., Hall & Berntsen, 2008). Both voluntary and involuntary recall show increased activation in brain areas known to be associated with retrieval success, but voluntary as compared to involuntary recall additionally shows increased activation in prefrontal areas known to be involved in strategic retrieval (Addis, Knapp, Roberts, & Schacter, 2012; Hall, Gjedde & Kupers, 2008; Hall, Rubin, Miles, Davis, Wing, Cabeza & Berntsen, 2014; Kompus, Eichele, Hugdahl, & Nyberg, 2011).

The similarities between voluntary (word-prompted) and involuntary memories are consistent with the assumption that the two types of remembering rely on the same underlying episodic memory system - that is, they share the same basic encoding and maintenance factors. The differences – on the other hand – support the idea that voluntary and involuntary retrieval differ

with regard to factors that affect the retrieval process (e.g., Berntsen, 2009; 2010). More specifically, involuntary remembering is an associative, context-dependent process that occurs with no strategic search, whereas voluntary retrieval is more elaborate and involves more executive control to initiate and monitor the retrieval process. This agrees with findings from brain imaging research showing little frontal involvement in the retrieval of involuntary memories (Hall et al., 2014) as well as with the shorter retrieval times for involuntary memories. Because the automatic and fast retrieval leaves little time for efficient emotional regulation, this may help to explain why involuntary retrieval more frequently is associated with mood impact and physical reaction in response to the memory. Conversely, the higher ratings for centrality to identity and life story and lower levels of specificity for voluntary remembering agree with the idea that voluntary as compared to involuntary retrieval, because it is based on a top-down, strategic and goal-directed search, relies more on generalized and schematized knowledge. Involuntary as compared to voluntary memories are more specific and less relevant to identity and life story, probably because their activation relies on environmental cues and favor events with a distinct feature match to the current situation (e.g., Berntsen, 2009, Berntsen et al., 2013; Rasmussen & Berntsen, 2009b). However, since diary studies have never compared involuntary retrieval to a self-prompted voluntary counterpart, it remains unclear how different voluntary and involuntary memories are in everyday life, if sampled using the same on-line recording method (i.e., the diary method).

Only one study has compared involuntary and self-prompted voluntary memories of autobiographical events as recorded on-line as part of daily life (Rasmussen & Berntsen, 2011). Here, participants were instructed to assess the frequency of one of the two types of remembering in their everyday living context using a mechanical counter to help them keep track of the number of voluntary or involuntary memories. Furthermore, by the end of the day, they were instructed to complete a short questionnaire addressing their state of attention at the time of retrieval and the

perceived function and emotional valence of the memories. The results showed that involuntary memories were roughly three times as frequent as their voluntary counterparts, but voluntary as compared to involuntary memories were more associated with problem solving and social sharing, whereas involuntary memories were more associated with day dreaming, periods of boredom, and 'no reasons for remembering'. Also, compared with the voluntary memories, the involuntary memories more frequently came to mind when attention was unfocused, consistent with the finding that involuntary remembering was more associated with daydreaming, whereas voluntary retrieval was more associated with problem solving. One potential limitation of this study was that perceived function, emotional valence and attentional focus were measured retrospectively at the end of the day and not for each memory at the time of retrieval. The goal of the present study is to assess these variables immediately after retrieval and to compare involuntary autobiographical memories with different types of voluntary memories.

1.3. The study

In the present study, we compare three types of voluntary memories (i.e., self-prompted, word-prompted and SMS-prompted) with involuntary (i.e., un-prompted) memories. Self-prompted memories are self-initiated voluntary autobiographical memories, which are prompted or initiated by the person retrieving the memory. Like involuntary memories, they are retrieved in the person's everyday living context (see Rasmussen & Berntsen, 2011), but they come to mind voluntarily preceded by a strategic search. Word-prompted memories are voluntary memories that are prompted by word-stimuli in line with the standard laboratory paradigm, with the exception that the current prompting takes place in the participants' own everyday environment, consistent with previous diary studies (e.g., Berntsen & Hall, 2004, Finnbogadottir & Berntsen, 2011; Johannessen & Berntsen, 2010). SMS-prompted memories are voluntary memories that the participants are

instructed to retrieve in response to the current situation whenever they receive a text-message (i.e., SMS; Short Message Service) from the experimenter. This condition may be viewed as a variant of Francis Galton's memory walk procedure (Galton, 1907; Berntsen & Hall, 2004). This was done in order to include a condition, where retrieval was initiated by the participant's current situation as in the self-prompted condition, but at the same time, the retrieval was prompted and controlled by the experimenter as well as being randomly distributed over time and contexts.

We examine these different types of retrieval by comparing them on different memory characteristics and perceived functions. In order to examine the "here and now" context of retrieval in the participant's everyday life situation, we used questions that previously have been used in studies employing the standard diary procedure (e.g., Berntsen, 1996; 2001; Berntsen & Hall, 2004; Johannessen & Berntsen, 2010) as well as a set of new questions that were constructed for the purpose of the present study in order to measure the immediate behavioral and social reaction to the memories. We examined the phenomenological characteristics of the memories by including theoretically derived phenomenological measurements of autobiographical memory (e.g., Brewer, 1996; Conway & Pleydell-Pearce, 2000; Rubin, 2006). In order to probe global functionalities we used questions addressing three theoretically and empirically derived functions of autobiographical memory (i.e., the directing behavior, self defining and social bonding functions; e.g., Bluck, Alea, Habermas & Rubin, 2005; Cohen, 1998; Pillemer, 1992). These questions were developed and validated in previous work on autobiographical memory function (Rasmussen & Berntsen, 2009a; 2013). An additional question, concerning the subjective sense of feeling energized by the memory at time of retrieval, was included in order to explore motivational aspects of remembering (e.g., Bargh, Gollwitzer & Oettingen, 2010; Oettingen, Pak & Schnetter, 2001).

Consistent with previous work (Rasmussen & Berntsen, 2009b; 2011), we expected self-prompted voluntary as compared to involuntary memories to be rated higher on directive and social

function at the time of retrieval as well as to occur in situations in which the person is more concentrated. We expected to replicate earlier diary studies, showing that involuntary memories are more specific and come with more physical reaction and mood impact than word-prompted memories, whereas word-prompted memories are rated as more central to the person's identity and life story (see Berntsen, 2009; Rasmussen & Berntsen, 2009b for reviews). We did not have any specific a priori hypotheses with regard to the SMS-prompted memories, since this is a new way of prompting voluntary autobiographical memories.

2. Method

2.1. Participants

Twenty-eight psychology undergraduates recorded 15 self-prompted, 15 word-prompted and 15 involuntary memories in three diaries. Twenty-six of those participants (25 females; 1 male; mean age = 23.31 years, SD = 4.60 years; range 20-45 years) agreed to record an additional 15 SMS-prompted memories in a fourth diary. Since the scores of the one male participant (who also was the outlier with regard to age) were within the range of the female participants, we based the analyses on all 26 participants. Each participant had signed a written consent form, and they were compensated with gift cards with a total value on approximately \$170 (i.e., approximately \$42 after completing each diary study).

2.2. Procedure

The participants were first instructed to record 15 self-prompted, 15 word-prompted and 15 involuntary memories in three separate but consecutive diaries in randomized order over an open-ended time period. Since initial analyses showed that there were no order effects between these

three conditions, we added the SMS-prompted condition roughly 4 months after the participants had finished the third diary. The method for all four conditions was a variant of the structured diary procedure introduced by Berntsen and colleagues (e.g., Berntsen, 1996; 2001; Berntsen & Hall, 2004; Johannessen & Berntsen, 2010). The participants were asked to record the first two memories per day in each condition. (For the SMS-prompted condition, we texted the participants twice each day at randomly distributed time slots, until they had reached the final number of 15 memories). This was done in order to avoid that the participants purposely generated and/or selected particular kinds of memories, and it also ensured that the recorded memories in each person's diary were distributed over time and contexts. In order to prevent carry-over effects, there was always at least two weeks between the completion of one diary and the beginning of the next. The recording of the self-prompted voluntary, the SMS-prompted voluntary and the involuntarily retrieved memories had two steps. First, immediately after a self-prompted, SMS-prompted or involuntary memory had been noticed, the participant recorded keyword phrases and ratings in response to a subset of questions listed in a small booklet, which the participants were instructed to carry with them at all times. The recording in the booklet enabled the participant to describe and rate the self-prompted, SMS-prompted or involuntary memories as well as the retrieval context "here and now", immediately after retrieval, thereby diminishing the influence of retrospection (Ericsson & Simon, 1980; Nisbett & Wilson, 1977). The recording in the booklet took little time and thus interfered little with the participant's everyday activities. Second, at a self-chosen time the same day the participant filled out a more comprehensive questionnaire, supported by the notes in the booklet. The participant transferred the ratings from the booklet to the questionnaire, and used the keyword phrases as the basis for providing a more elaborated description of the memories as well as answering a number of additional questions.

The word-prompted memories were recorded in a one-step procedure. At a self-chosen time each day, the participants would open a sealed envelope containing a questionnaire with a word-prompt hidden under a post-it. They were asked to remove the post-it and to retrieve a memory in response to the word-prompt. As with the self-prompted, SMS-prompted and involuntarily retrieved memories, they were instructed to retrieve a maximum of two memories for each day until they had reached the final number of 15 memories. The 15 word-prompts used in the present study were generated from environmental prompts found to elicit involuntary memories in previous work (see Berntsen, 1998; Berntsen & Hall, 2004, for more details). They were selected on the basis of the distribution of word-prompts per thematic category as well as according to how often they had been reported in Berntsen and Hall (2004). The 15 word-prompts (according to thematic category) were: Party, working, travelling (activity), book shirt, telephone (object), mum, dad (relationship), view, rain (sensory experience), sports, chance (theme), school (location), happy and sad (emotion).

Both verbal and written instructions were given. The verbal instructions clarified and elaborated the written instructions. The instructions were given separately for each diary study and immediately before its initiation. At each of these four different meetings (introducing the self-prompted, SMS-prompted, the word-prompted or the involuntary condition, respectively), only the first author or an assistant and the participant were present. A self-prompted voluntary memory was defined as a memory retrieved in a goal-directed and controlled fashion. It was emphasized that the memory did not simply pop up by itself. Its retrieval had to be initiated in an intentional fashion in order for it to be considered a self-prompted memory. At the same time, it also was stressed that the memory had to be a naturally occurring voluntary memory. This was done in order to reduce the potential temptation to “make up” memories for the sake of participating in the study. A SMS-prompted memory was defined as a memory retrieved in response to the current situation (using both internal and external cues) when receiving a text-message from the experimenter. A word-

prompted voluntary memory was defined as a memory that is retrieved in response to a word-prompt. An involuntary memory was defined as a memory about a past event that is brought to consciousness with no preceding conscious attempts at retrieval. Involuntary memories could be cued by the present surroundings or by aspects of current thought as long as the association in question had been established without intentional attempts. The four types of memories were illustrated by similar examples and it was emphasized that the memories could deal with many different kinds of personal experiences, regarding age, emotional valence, amount of rehearsal or level of importance. Each question in the questionnaire was explained carefully and neutral examples were given if necessary.

2.3. Questionnaire

The questionnaire answered for each memory is presented in Table 1. The questions were derived or adapted from Berntsen and Hall (2004), Rasmussen and Berntsen (2009a; 2013) and Johannessen and Berntsen (2010), or generated for the purpose of the present study. Because questions 1-6 were not meaningful for the word-prompted memories, they were not included for this condition. The questions in the booklet corresponded to Questions 1-12 in the questionnaire (see Table 1), addressing the immediate reaction to and function of the memory. The questionnaire contained a set of additional questions (see Questions 13-25 in Table 1) that were answered at a later point on the same day. These questions addressed global qualities associated with the memories (such as their age), which could be assessed retrospectively. As shown in Table 1, most of the questions were rated on 5-point scales except for Questions 1-2 and 4-6, addressing the situation in which the memory was retrieved, the content of the memory and the overlap between situational cues and memory content, as well as Question 16 addressing the specificity of the memory and Question 25 addressing the age of the memory. Questions 3 addressed the level of

concentration at time of retrieval. Questions 7-12 addressed a set of memory characteristics perceived immediately (“here and now”) at the time of retrieval, including reaction to, function of, and immediate changes caused by the memory. Questions 13-15 addressed the perceived global function of the memories or whether the memory had previously served a function. The “global directive” and “global social” function questions are thus different from the “directive now” and “social now” questions, which address the functions of the memories as perceived “here and now” at the time of retrieval. Questions 17 and 19-20 addressed the amount and type of subjective re-experiencing associated with the event. Question 18 addressed different kinds of rehearsal. Question 21 addressed perceived consequences of the event. Questions 22-24 addressed the perceived relevance of the memory to the person’s identity, life story and expectations for the future.

3. Results

We first compare all four memories on the dependent variables listed in Table 2. We then compare the self-prompted and SMS-prompted voluntary and the involuntary memories with regard to the context and state of concentration at time of retrieval and the cueing of the memories (conceived of as the perceived feature overlap between the retrieval context and the memory content). Because this analysis is not meaningful for the word-prompted voluntary memories, they are not included in this analysis.

3.1. Comparisons of voluntary self-prompted, word-prompted, SMS-prompted and involuntary memories

Since data from the diary consisted of multiple observations from each of the 26 participants, we calculated an average score across the 15 memories for each variable within each subject. Table 2 shows the means and standard deviations. We conducted a series of repeated measures ANOVAs

to compare the ratings for the four memories as well as a series of repeated measures ANOVAs to compare the ratings of the three types of voluntary memories (i.e., self-prompted, word-prompted and SMS-prompted) alone. The results are also shown in Table 3. With the exception of vividness, all main effects were significant for both sets of analyses. In order to analyze this pattern more carefully, we conducted a series of Bonferroni adjusted pairwise comparisons comparing all memory types to each other as well as a smaller number of planned comparisons for the variables involving our specific a priori hypotheses. The resulting *p*-values are presented in Table 3 – planned comparisons are highlighted in bold.

As shown in Table 3, when comparing the three types of voluntary memories with involuntary memories, the differences between word-prompted voluntary and involuntary memories were most pronounced. Consistent with previous diary studies (see Berntsen, 2009 for a review) and the a priori stated hypotheses, word-prompted memories were rated as being more central to identity and life story, whereas involuntary memories were rated as being more specific. Furthermore, involuntary as compared to word-prompted voluntary memories were rated higher on action reaction, “directive now” and “social now”, whereas word-prompted memories were rated higher on global self-function. Contrary to our predictions, there were no differences between involuntary and word-prompted memories with regard to physical reaction and mood impact, but this was most likely because earlier diary studies have treated both physical reaction and mood impact as categorical variables, whereas they were treated as continuous variables in the present study (see Table 1). In particular, this may have made a difference with regard to mood impact, because this variable was rated on a valence scale (from -2 to 2). Table 4 illustrates the distribution of the mood impact ratings for all memories. The four types of memories were all rated as having a predominantly positive mood impact, but the number of involuntary memories with negative mood impact ratings (i.e., -2 and -1) was considerably higher than the corresponding number for word-

prompted voluntary memories (68 versus 0; Fishers test, $p < .0001$), suggesting that involuntary as compared to word-prompted voluntary memories have more negative mood impact, consistent with some previous work (Berntsen & Jacobsen, 2008; Johannessen & Berntsen, 2010). In contrast to the word-prompted voluntary memories, self-prompted voluntary memories were the least different from involuntary memories. As shown in Table 3, they differed only on two variables: Consistent with our a priori predictions, self-prompted as compared to involuntary memories were rated higher on “directive now” and “social now”. Finally, involuntary as compared to SMS-prompted voluntary memories were rated higher on centrality of event to identity, whereas SMS-prompted memories were dated as being closer to the present than involuntary memories.

We also compared the three types of voluntary memories against each other. The analyses showed that self-prompted as compared to word-prompted voluntary memories were rated higher on action reaction, directive now and social now, whereas word-prompted voluntary memories were rated higher on global self-function, rehearsal, consequences, identity and life story. Compared to the corresponding analyses between word-prompted voluntary and involuntary memories, few differences were observed (i.e., rehearsal and consequences, see Table 3), suggesting that self-prompted voluntary memories have more in common with involuntary relative to word-prompted voluntary memories. The comparison between self-prompted and SMS-prompted voluntary memories also showed few differences: Self-prompted as compared to SMS-prompted memories were rated higher on “directive now” and “social now”, energized and emotional valence. The comparison between word-prompted and SMS-prompted voluntary memories showed that these two memories were the most different among the four memory types. Word-prompted as compared to SMS-prompted memories were rated higher on “global self” and “global social” function, centrality of event to identity and life story, consequences and intensity, whereas SMS-prompted memories were rated as being more recent and more specific as well as higher on action reaction

and “directive now”. Thus, even the SMS-prompted memories, which were prompted to be randomly distributed across contexts, were more functional in terms of how they affected present behavior compared with the word-prompted voluntary memories.

Finally, because inspection of the mean-ages of the four memories showed that the SMS-prompted memories were more recent than the other three types of memories (although not significantly more recent than the self-prompted voluntary memories); we plotted the frequency distribution for each memory type as a function of their temporal distance from the present. As shown by Figure 1, all four memories were characterized by a dominance of memories for recent events, but the decline in number of memories as a function of retention interval seemed steeper for the SMS-prompted memories than for the other memories.

3.2. Retrieval context

Because the word prompted memories always were retrieved in response to an experimenter-generated cue word, they were not included in the following analyses of retrieval cues. The distribution of external, internal and mixed cues eliciting self-prompted, SMS-prompted and involuntary memories is shown in Table 5. Consistent with previous work (e.g., Berntsen, 2009), involuntary memories were predominantly elicited in response to external cues ($\chi^2(2) = 8.75, p < .05$). Self-prompted and SMS-prompted memories were predominantly elicited in response to external and mixed cues, whereas internal cues were the least frequent cue type for both of these memory conditions ($\chi^2(2) = 15.02, p < .0005$ and $\chi^2(2) = 31.90, p < .0001$, respectively). Table 6 shows the frequencies by which each cue type was identified as a salient commonality between a memory and its retrieval context. We ran a series of Spearman rank correlations between the cue type commonalities for each memory. The results showed significant relationships between the three types of memories ($.793 < \rho < .909, ps < .0005$), suggesting that quite similar types of feature

overlaps between retrieval context and memory content are involved in the activation of all three types of memories.

There were no significant differences between the three types of memories with respect to whether the participants were alone or together with other people when a memory occurred (Mean proportions: $M = .50$, $SD = .25$ for the self-prompted memories; $M = .56$, $SD = .19$ for the SMS-prompted memories and $M = .53$, $SD = .16$ for the involuntary memories; $F(2,50) = .64$, $p = .53$, $\eta_p^2 = .025$). There were no differences between the three types of memories ($M = 2.65$, $SD = .66$ for self-prompted memories; $M = 2.55$, $SD = .41$ for SMS prompted memories; $M = 2.47$, $SD = .46$ for involuntary memories) with regard to level of concentration at time of retrieval ($F(2,50) = 1.07$, $p = .35$, $\eta_p^2 = .041$), and contrary to previous work (see Rasmussen & Berntsen, 2011), planned comparisons showed no differences in concentration between self-prompted voluntary and involuntary memories ($p = .193$).

4. Discussion

How different were the three types of voluntary memories from involuntary memories? Perhaps not surprisingly, the self-prompted memories were the voluntary condition which was the least different from the involuntary memories. Consistent with previous work (Rasmussen & Berntsen, 2011), self-prompted voluntary memories were rated higher on “directive now” and “social now”, whereas involuntary memories were dated as referring to older events. These findings may suggest that naturally occurring voluntary memories differ from their involuntary counterparts mainly by having a more specific function (serving a clearer purpose) to the individual. In contrast to Rasmussen and Berntsen (2011), we found no difference between self-prompted voluntary and involuntary memories with respect to the state of concentration at time of retrieval, but this was

most likely because earlier work have measured this variable retrospectively, whereas the present work measured state of concentration immediately after each individual memory instance.

The results largely replicated previous diary studies with respect to the differences between involuntary and word-prompted voluntary memories. Involuntary memories more frequently referred to specific events and more frequently involved a negative mood impact as compared to their word-prompted voluntary counterparts, whereas word-prompted voluntary as compared to involuntary memories were rated higher on centrality to identity and life story. In contrast to previous work, we found no significant differences with respect to physical reaction. Furthermore, involuntary as compared to word-prompted voluntary memories were rated higher on action reaction, such as deciding to act immediately on the memory, as well as on the directive and social 'here and now' functions. This is likely to reflect that the word-prompted memories were generated without a natural association or distinct feature overlap with the participant's immediate context. Thus, they were less dependent on the present context and probably therefore less likely to motivate immediate behavioral change. On the other hand, word-prompted voluntary as compared to involuntary memories were rated higher on the global (and thus not situation-specific) self-function as well as on centrality to identity and life story, which may reflect a more schema-driven, top down retrieval strategy for word-prompted memories.

The SMS-prompted memories were included as a condition, where retrieval was initiated by the participant's current situation as in the self-prompted condition, but at the same time, the retrieval was also prompted and controlled by the experimenter as in the word-prompted condition. The SMS-prompted voluntary memories were dated as more recent than the involuntary and word cued memories, but not significantly more recent than the self-prompted memories (see Table 3). Furthermore, the SMS-prompted condition may be seen as a variant of the Galton memory walk procedure, which has been shown to produce voluntary memories with property ratings similar to

that of word-prompted memories (Berntsen & Hall, 2004). However, unlike the previously employed memory walk procedure, where the participants are aware of the fact that they soon will have to use the environment to retrieve a voluntary memory, and therefore may be monitoring their surroundings more closely, participants in the current study were completely unprepared. They did not know when they would receive a text message, for which reason they may have picked more random cues for the memory search. Also, in the current study, the participants were informed that they could use both internal and external cues, whereas previous studies with the memory walk procedure utilizes only environmental cues. Finally, the comparisons of the three types of voluntary memories against each other showed that self-prompted voluntary memories differed from word-prompted voluntary memories in ways that were very similar to involuntary memories, whereas word-prompted and SMS-prompted memories were the most atypical among the four memory types.

Since the rated properties of self-prompted voluntary and involuntary memories in the present study were so similar, how can we be sure that the participants really understood the instructions and not occasionally recorded involuntary memories in the self-prompted voluntary condition? The higher ratings on the “directive now” and “social now” functions, which has also been found in previous work (Rasmussen & Berntsen, 2011), suggests that this may not be the case. The findings on the “here and now” functions suggest that participants were more conscious of their retrieval strategy when generating self-prompted voluntary as compared to involuntary memories, although the ratings on other memory properties were largely similar for the two retrieval conditions. What these findings may suggest is that the deliberate search for voluntary memories in daily life as compared to the laboratory has a more associative character. Consistent with this idea, Uzer and colleagues (Uzer, Lee & Brown, 2012) found that when participants are asked to voluntarily retrieve autobiographical memories in response to a word-prompt (i.e., object or

emotion word), some memories come to mind immediately with little or no effort (i.e., direct retrieval), whereas other memories have to be actively searched for (i.e., generative retrieval). Importantly, the latter has longer response times (Uzer et al., 2012). To the extent that we can generalize these findings to a real-life setting, they suggest that voluntary retrieval may be seen as laying on a continuum of retrieval effort.

How well did word-prompted voluntary memories map onto real-life self-prompted voluntary memories? The present findings show that self-prompted as compared to word prompted voluntary memories serve more “here and now” functional relevance to the individual, whereas word-prompted memories are assessed to be functional in terms of “global” self-relevance. This suggests that the two types of voluntary retrieval tap into two very different functionalities of autobiographical remembering, and that researchers should be careful not to draw conclusions about everyday voluntary remembering solely based on the properties of word-prompted voluntary memories. Although, the robustness and efficiency of the cue word method to generate a wide variety of autobiographical memories has been demonstrated in numerous studies (e.g., Crovitz & Schiffmann, 1974; Robinson, 1976; Rubin & Schulkind, 1997a; Rubin, Scauf & Greenberg, 2003), using word-stimuli as prompts may not be the most typical way that people would initiate a voluntary memory search in their day-to-day lives. Earlier diary studies have primarily compared involuntary memories with word-prompted voluntary memories and have found consistent differences between the two types of memories, but the present study shows that voluntary and involuntary memories sampled via the same diary procedure are not that different. The present study also shows that different types of voluntary memories differ from one another dependent on how they are prompted. This consequently raises the question as to what is the best way of sampling voluntary autobiographical memories in general and what is the best comparison for involuntary memories.

The frequency of both self-prompted and word-prompted voluntary memories varied systematically and similarly as a function of time since the event, whereas SMS-prompted voluntary memories were more recent and therefore may not be as reliable a method for sampling a random set of voluntary memories from an individual's past (see Figure 1). At the same time, word-prompted voluntary memories were the most unique among the four memory types with respect to their ratings on "here and now" function, self-relevance and other phenomenological properties, which is likely to reflect their separation from a real-world context. Hence, it is possible that some of the claims made by researchers on the basis of the word-prompt paradigm may have led to false conclusions regarding the real-life properties and functions of autobiographical memories, for which reason they also may not be the most optimal way of sampling voluntary autobiographical memories. However, there are also reasons why researchers should continue to choose word-prompted as well as self-prompted voluntary memories as comparisons for involuntary memories and for the study of autobiographical memory in general: First, there is sound theoretical reasoning for using word-prompted voluntary memories as comparisons to involuntary memories, because the word prompt method has shown very systematic findings, such as concerning the retention function for autobiographical remembering as well as the typical dominance of positive events (Walker et al., 2003), which suggests that it is a sampling technique that yields a reliable measure of the accessibility of past events and their forgetting rate. Second, it has by large been the most common way of eliciting voluntary autobiographical memories, whereas the self-prompt method has been used only in few studies. It makes sense to compare involuntary remembering with the "prototypical" voluntary form of retrieval task used in research. Third, diary studies using alternative voluntary control conditions such as non-verbally prompted voluntary memories (Berntsen & Hall, 2004) or voluntary memories from the same time period as the involuntary memories (Rubin, Boals & Berntsen, 2008; Rubin, Dennis & Beckham, 2011) have found

differences between involuntary and voluntary memories that are similar to differences identified in diary studies comparing involuntary and word-prompted voluntary memories. Fourth, findings from studies using more experimental approaches comparing voluntary and involuntary autobiographical memories in the laboratory (e.g., Schlagman & Kvavilashvili, 2008) are consistent with findings from diary studies. Fifth, as shown by the work from Uzer et al. (2012), voluntary remembering can be effortful as well as effortless even in the laboratory. Thus, although word-prompted voluntary as compared to self-prompted voluntary and involuntary memories clearly are divorced from a real-world context as indicated by their ratings on functions and importance to self, they also represent a reliable sample of autobiographical memories with regard to other central variables and hence forms a meaningful comparison to involuntary memories. Nonetheless, the present findings suggest that word-prompted voluntary memories are different from voluntary self-prompted memories in daily life at least on some dimensions, and future research should take this into account.

The present study has a number of limitations. Given that gender differences have been found in autobiographical memory research (e.g., Grysman & Hudson, 2013; Pillemer, Wink, DiDonato & Sanborn, 2003), one potential limitation of the present study is that the sample primarily consists of females. Another potential limitation is the contextual variability of the task, which may differ among participants in that some participants might have more interesting personal environments than others. This raises an interesting question of how exactly a natural environment should be defined (see Berntsen & Hall, 2004, for a similar discussion). In the present study, we have attempted to control for some of this variability via the SMS-prompted condition, where participants are texted at random time slots during the day and hence the memory retrievals are distributed over time and context. We found only minor differences between the cue-types involved in the retrieval of self-prompted and SMS-prompted voluntary memories as well as involuntary memories (see Tables 5-6).

The present study has broader implications for how we understand autobiographical memory. The fact that the two naturalistically retrieved memory types (i.e., self-prompted voluntary and involuntary) were perceived as being more functionally relevant to the situations in which they were retrieved, suggests that context is an important factor in prompting meaningful autobiographical memory material, which is reminiscent of earlier research on context effects in memory retrieval (e.g., Davies & Thomson, 1988). In particular, the re-instatement of context may be relevant when attempting to reactive eyewitness memories (e.g., Geiselman, 1988) or to prompt long lost memories among cognitively disadvantaged populations such as patients with brain damage or dementia, consistent with some research (e.g., Miles, Fischer-Mogensen, Nielsen, Hermansen & Berntsen, 2013).

4.1. Conclusion

The present findings show that voluntary self-prompted autobiographical memories differ from their involuntary counterparts primarily with respect to the perceived function at the time of retrieval. This suggests that the self-prompted voluntary memories have a lot in common with involuntary autobiographical memories. To some extent they both may reflect an associative and context-dependent retrieval form. If so, involuntary memories as studied in naturalistic settings may be more representative for how we generally access our personal past, through both strategic and non-strategic retrieval, than are word-cued memories studied in the laboratory. Future research should aim at examining these possibilities as well as different ways of sampling autobiographical memories both in real life and in the laboratory.

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Table 1

Questions and Answering Options in the Diaries (translated from Danish)

Questions in the booklet answered only for the self-prompted, SMS-prompted and involuntary memories

1. Describe in your own words the situation when you retrieved the memory. (Where were you, what were you doing, what were you thinking?)
2. Were you alone or together with others when you retrieved the memory? (yes/no)
3. Was your attention focused on specific thoughts or activities? (1 = very unfocused; 5 = very focused)
4. Describe the memory
5. Compare the content of the memory with what had taken place in your thoughts and surroundings right before you retrieved the memory. Did anything in your surroundings, thoughts or activities repeat itself in the memory? Check the most salient commonalities. (person(s)/place/sensoryexperience/object/feeling/lifetheme/theme/activity/wording/other/no commonalities)
6. Were the commonality/ies present in your external/physical surroundings or only present in thought? (external/internal/mixed)

Questions in the booklet answered for all four memories

7. Physical: The memory triggered a physical reaction - e.g., palpitations, feeling restless, tense, fear, laughter. (1 = not at all; 5 = to a very high degree)
8. Action: The memory triggered an action - e.g., deciding to do the dishes, buying a special present for another person, listening to a certain song from my collection. (1 = not at all; 5 = to a very high degree)
9. Directive now: Did the memory help you handle the current situation? (1 = not at all; 5 = to a very high degree)
10. Social now: Did you share the memory with others? (1 = not at all; 3 = I may share it later; 5 = I shared it right away)
11. Mood impact: This memory affected my mood. (-2 = extremely negative; 2 = extremely positive)
12. Energized: Did you feel energized by the memory (1 = not at all; 5 = to a very high degree)

Additional questions in the more comprehensive questionnaire answered for all four memories

13. Global directive: I think of this memory in order to handle present or future situations. (1 = not at all; 5 = to a very high degree)
14. Global self: This memory tells me something about my identity. (1 = not at all; 5 = to a very high degree)
15. Global social: I have often shared this memory with other people. (1 = not at all; 5 = to a very high degree)
16. Specificity proportion: The memory deals with (1 = a concrete event that happened on a specific day; 0 = a mixture of similar events that happened on more than one day)
17. Vividness: How vivid was the memory? (1 = cloudy and imageless; 5 = vivid and clear)
18. Rehearsal: I have previously thought and talked about the event. (1 = almost never; 5 = extremely often)
19. Valence: The feelings I experience as I recall the event are (-2 = extremely negative; 2 = extremely positive)
20. Intensity: The feelings I experience as I recall the event are intense. (1 = not at all; 5 = to a very high degree)
21. Consequences: The event had consequences. (1 = not at all; 5 = to a very high degree)
22. Identity: I feel that this event has become part of my identity (1 = totally disagree; 5 = totally agree)
23. Life story: I feel that this event has become a central part of my life story (1 = totally disagree; 5 = totally agree)
24. Future: I often think about the effects that this event will have on my future (1 = totally disagree; 5 = totally agree)
25. Age at event: How old were you when the remembered event took place? (age estimated in years)

Note: The questions in the booklet were answered right after the memory came to mind. The questions in the more comprehensive questionnaire were answered at a self-chosen time later on the same day

Table 2

Mean and Standard Deviations for Self-prompted, Word-prompted, SMS-prompted, and Involuntary memories

Variable	Voluntary						Involuntary	
	Self-prompted		Word-prompted		SMS-prompted		Un-prompted	
	M	SD	M	SD	M	SD	M	SD
Physical reaction	2.33	.76	2.55	.87	2.11	.58	2.40	.87
Action reaction	2.06	.75	1.45	.58	1.87	.56	1.81	.76
Directive now	2.19	.69	1.35	.46	1.81	.58	1.75	.48
Social now	2.10	.79	1.24	.41	1.50	.40	1.66	.59
Mood impact	.56	.31	.53	.27	.34	.37	.50	.38
Energized	2.39	.68	2.20	.69	1.95	.59	2.20	.66
Global directive	1.84	.54	1.88	.64	1.58	.50	1.71	.63
Global self	2.24	.78	2.60	.68	2.14	.64	2.30	.58
Global social	2.57	.70	2.95	.81	2.41	.74	2.66	.80
Specificity	.79	.13	.74	.16	.85	.18	.84	.12
Vividness	3.27	.56	3.48	.55	3.35	.51	3.45	.57
Rehearsal	2.81	.65	3.23	.73	2.73	.67	2.97	.73
Valence	.61	.28	.58	.34	.35	.45	.48	.42
Intensity	2.38	.64	2.69	.66	2.19	.69	2.43	.65
Consequences	1.73	.50	2.04	.53	1.58	.52	1.87	.62
Identity	1.66	.51	2.06	.59	1.53	.46	1.76	.60
Life story	1.63	.44	2.11	.60	1.55	.49	1.72	.62
Future	1.47	.44	1.64	.50	1.39	.41	1.54	.50
Age of memory in years	3.03	2.57	4.23	3.35	2.01	1.38	3.82	2.58

Note: Values for specificity refer to mean proportions.

Table 3

Results from Repeated Measures ANOVAs and Pairwise Comparisons of the Different Types of Memories

Variable	F	η_p^2	F	η_p^2	Pairwise Comparisons, p values					
	Self/Word/SMS/Inv		Self/Word/SMS		Self/Inv	Word/Inv	SMS/Inv	Self/Word	Self/SMS	Word/SMS
Physical reaction	3.15*	.11	4.65*	.16	1.000	.170	.637	1.000	.320	.063
Action reaction	7.98***	.24	11.27***	.31	.540	.006	1.000	.004	.958	.002
Directive now	18.05****	.42	22.95****	.48	.000	.000	1.000	.000	.010	.012
Social now	18.24****	.42	25.26****	.50	.002	.004	.942	.000	.002	.056
Mood impact	3.23*	.11	5.27**	.17	1.000	.576	.399	1.000	.058	.082
Energized	6.28**	.20	7.74**	.24	.281	1.000	.074	.664	.002	.227
Global directive	2.83*	.10	3.87*	.13	1.000	1.000	1.000	1.000	.080	.307
Global self	6.50**	.21	9.31***	.27	1.000	.028	.861	.032	1.000	.001
Global social	5.58**	.18	8.29**	.25	1.000	.073	.784	.061	1.000	.008
Specificity	3.68*	.13	4.34*	.15	.681	.020	1.000	.906	.660	.088
Vividness	2.45	.09	2.90	.10	.481	1.000	1.000	.117	1.000	.947
Rehearsal	6.54**	.21	9.30***	.27	1.000	.129	.406	.013	1.000	.005
Valence	3.58*	.13	5.22**	.17	.614	1.000	.697	1.000	.017	.241
Intensity	6.95***	.22	11.04***	.31	1.000	.125	.365	.055	.631	.000
Consequences	6.81***	.21	9.21***	.27	.765	.945	.058	.031	1.000	.002
Identity	11.97****	.32	16.22****	.40	1.000	.004	.039	.004	.947	.000
Life story	14.84****	.37	20.34****	.45	1.000	.001	.225	.000	1.000	.000
Future	3.23*	.12	4.52*	.15	1.000	1.000	.334	.350	1.000	.117
Age of memory in years	9.88***	.28	12.66***	.34	.225	1.000	.002	.140	.128	.000

Note: * $p < .05$; ** $p < .01$; *** $p < .0005$; **** $p < .00001$; $p = .000$ denotes $p < .001$. Post hoc tests were conducted with Bonferroni adjustments for multiple comparisons, with the exception of comparisons involving a priori hypotheses, which were conducted as planned comparisons (p -values highlighted in bold).

Table 4

Distribution of Mood Impact Ratings for all Four Types of Memories

	Highly negative			Highly positive	
	-2	-1	0	1	2
Self-prompted	7	50	124	137	72
Word-prompted	0	0	122	189	77
SMS-prompted	7	55	169	118	41
Involuntary	13	55	116	138	68

Table 5
*Frequencies of Self-prompted, SMS-prompted and Involuntary
Memories Across Internal, External, Mixed and no Identifiable Cues*

Cue Type	Self-Prompted		SMS-Prompted		Involuntary	
	No.	Percentage	No.	Percentage	No.	Percentage
External	138	35.4	153	39.2	148	37.7
Internal	90	23.1	74	19.0	105	26.9
Mixed	147	37.7	150	38.5	112	28.7
No Iden.	15	3.8	13	3.3	25	6.4

Total	390	100.0	390	100.0	390	100.0

Note: $\chi^2(4) = 12.56$, $p < .05$, not including memories with no identifiable cue

Table 6
Frequencies by Which Each Cue Category Was Identified as a Salient Commonality Between a Memory and Its Retrieval Context

Cue category	Self-Prompted		SMS-Prompted		Involuntary	
	No.	Percentage	No.	Percentage	No.	Percentage
Person	120	16.8	93	12.2	86	13.1
Location	99	13.9	135	17.7	70	10.6
Sensory	51	7.1	55	7.2	53	8.1
Object	106	14.8	97	12.7	97	14.7
Feeling	69	9.7	95	12.5	69	10.5
Life theme	12	1.7	13	1.7	24	3.6
Theme	114	16.0	123	16.2	95	14.4
Activity	108	15.1	118	15.5	89	13.5
Wording	8	1.1	8	1.1	13	2.0
Other	10	1.4	12	1.6	28	4.3
No common.	17	2.4	12	1.6	34	5.2
Total	714	100.0	761	100.0	658	100.0

Note: $\chi^2(18) = 50.25, p < .0001$

Figure 1.

Frequency Distribution of the Self-Prompted, SMS-Prompted, Word-Prompted and Involuntary Memories as a Function of the Age of the Memories in Years.