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How intention and monitoring your thoughts influence characteristics of autobiographical memories

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How intention and monitoring your thoughts influence characteristics of autobiographical memories

Abstract

Involuntary autobiographical memories come to mind effortlessly and unintended, but the mechanisms of their retrieval are not fully understood. We hypothesize that involuntary retrieval depends on memories that are highly accessible (e.g., intense, unusual, recent, rehearsed), while the elaborate search that characterizes voluntary retrieval also produces memories that are mundane, repeated or distant - memories with low accessibility. Previous research provides some evidence for this “threshold hypothesis”. However, in almost every prior study, participants have been instructed to report only memories while ignoring other thoughts. It is possible that such an instruction can modify the phenomenological characteristics of involuntary memories. The present study aimed to investigate the effects of retrieval intentionality (i.e., wanting to retrieve a memory) and selective monitoring (i.e., instructions to report only memories) on the phenomenology of autobiographical memories. Participants were instructed to 1) intentionally retrieve autobiographical memories, 2) intentionally retrieve any type of thought, 3) wait for an autobiographical memory to spontaneously appear, or 4) wait for any type of thought to spontaneously appear. They rated the mental content on a number of phenomenological characteristics both during retrieval and retrospectively following retrieval. The results support the prediction that highly accessible memories mostly enter awareness unintended and without selective monitoring, while memories with low accessibility rely on intention and selective monitoring. We discuss the implications of these effects.

Key words: involuntary memories; voluntary memories; retrieval mode; retrieval intentionality; intention; attentional factors; autobiographical memory; autobiographical memories; consciousness; monitoring processes

1. Introduction

Autobiographical memory is the ability to remember events in our personal past (Conway & Pleydell-Pearce, 2000). We use this ability intentionally, when trying to recall where we left the keys or the last time we had tiramisu, which is known as voluntary memory. However, memories may also pop into our mind unintended, for example when the taste of tiramisu suddenly brings back a memory of a previous trip to Italy, which is known as involuntary memory (Berntsen, 1996, 2010). The last two decades has seen a shift in the literature on involuntary autobiographical memories from being a rare and relatively inconsequential phenomenon (e.g. Davachi & Dobbins, 2008) to being a central aspect of daily life, mental health, and well-being (e.g., Berntsen, 2010, 2015; Brewin, Gregory, Lipton, & Burgess, 2010; Clark, Mackay, & Holmes, 2013; Moulds & Krans, 2015). Yet, many aspects of involuntary memory are currently debated, particularly how these memories come to mind and how they differ from their voluntary counterparts, which is especially important in relation to posttraumatic stress disorder (e.g., Brewin, 2014; Berntsen & Rubin, 2014).

Research has shown that voluntary and involuntary memories have different phenomenological properties (e.g., Barzykowski & Staugaard, 2016; Cole, Staugaard, & Berntsen, 2016; Johannessen & Berntsen, 2010; Schlagman & Kvavilashvili, 2008). However, it's not clear how these differences can be explained. Berntsen (2009) suggested that involuntary retrieval favors memories that are highly accessible (e.g., novel and emotional). Building on this idea, a *threshold hypothesis* was recently suggested to account for the phenomenological differences between voluntary and involuntary memories (Barzykowski & Staugaard, 2016). According to this hypothesis, a memory has to pass an awareness threshold in order to reach consciousness. The ease with which this happens is

known as the memory's accessibility. Accessibility is increased by factors such as emotional intensity, importance, unusualness, vividness, recency, and rehearsal (Ritchie, Skowronski, Walker, & Wood, 2006). Consequently, memories low in accessibility are mundane, repeated, unclear, distant, and unrehearsed. The main prediction of the threshold hypothesis is that highly accessible memories pass the awareness threshold easily and are therefore able to enter consciousness without intention or effort (i.e., involuntarily), while low-accessible memories rarely enter consciousness unless the awareness threshold is lowered. Barzykowski and Staugaard (2016) predicted that intentional and effortful retrieval (i.e., voluntary retrieval) could lower the threshold.

1.1. Intention

Findings from earlier studies comparing voluntary and involuntary retrieval support the idea that voluntary retrieval leads to a higher frequency of low-accessible memories. In these studies, participants are informed about the nature of involuntary memories and asked to record them in a diary during normal daily living. For the voluntary comparison, participants record memories in response to cues selected by the experimenter. A robust finding across these studies is that involuntary memories often refer to a specific event (*the one time when my partner forgot my birthday*), whereas voluntary memories are more likely to refer to a general event (*my childhood birthdays*; Berntsen, 1998; Berntsen & Hall, 2004; Berntsen & Jacobsen, 2008; Finnbogadottir & Berntsen, 2011; Johannessen & Berntsen, 2010; Mace, 2006; Mace, Atkinson, Moeckel & Torres, 2011; Rasmussen, Johannessen & Berntsen, 2014; Schlagman, Kliegel, Schulz, & Kvavilashvili, 2009; Watson, Berntsen, Kuyken, & Watkins, 2013). The decreased specificity of voluntary memories can be interpreted to reflect the retrieval of summarized or repeated events that would not have reached consciousness unless participants intentionally made the effort of looking for them.

One problem with the diary method described above is that the two retrieval

conditions may not be directly comparable, since the cues in the involuntary condition are self-selected, whereas the cues in the voluntary condition are selected by the experimenter. Schlagman and Kvavilashvili (2008) reported the first study on involuntary autobiographical memories with experimental control of the retrieval phase. Their original design was made specifically to simulate the circumstances in which involuntary autobiographical memories are most frequently observed in daily life, namely while participants are engaged in routine or mundane tasks (e.g. ironing, washing the dishes, driving along the highway; see Berntsen, 2009, for a review). Therefore, Schlagman and Kvavilashvili (2008) asked participants to perform a boring attention task while watching short cue phrases on a computer screen. In addition, they were asked to indicate if autobiographical memories unexpectedly came to mind during the task. Participants in the voluntary condition were shown a subset of the same cue phrases and had to retrieve a memory to each one. This laboratory method confirmed the difference in specificity found in diary studies (Cole et al., 2016; Schlagman & Kvavilashvili, 2008; Vannucci, Pelagatti, Chiorri, & Mazzoni, 2016).

Three studies did not support the decreased specificity of voluntary memories. In a diary study, Rubin, Boals, and Berntsen (2008) found that involuntary memories had significantly lower specificity than voluntary memories. The authors argued that this unexpected finding could be due to an atypical cuing procedure in the voluntary condition, where participants were asked to retrieve memories from a specific time period instead of in response to cue words. Two other studies found no significant differences between the specificity of involuntary and voluntary memories. Rubin, Dennis, and Beckham (2011) used the same cuing technique as Rubin et al. (2008), which could explain this null-result. Barzykowski and Staugaard (2016) instructed participants to report all thoughts rather than just memories, which might have influenced the specificity of the resulting memories.

Other findings support the threshold hypothesis in that involuntary memories

have been found to be more recent and more impactful on current mood compared with voluntary memories (Cole et al., 2016; Johannessen & Berntsen, 2010; Rubin et al., 2011). At the same time, involuntary memories appear to be less related to a person's life story or identity (Johannessen & Berntsen, 2010; Rasmussen et al., 2014; Rubin, et al., 2008), which could reflect that they depend more on the present moment and less on schematic knowledge compared with voluntary memories (Berntsen, 2010). Finally, involuntary memories are retrieved much faster than voluntary memories (Berntsen, Staugaard, & Sørensen, 2013; Cole et al., 2016; Schlagman & Kvavilashvili, 2008), which likely reflects that their retrieval is effortless.

1.2. Monitoring

Taken together, there is evidence to suggest that involuntary memories, on average, have higher accessibility than voluntary memories. However, a second process has been proposed to influence retrieval of involuntary memory, and to potentially bias the results of earlier studies (e.g., Vannucci, Batool, Pelagatti, & Mazzoni, 2014). When instructing participants, the nature of involuntary memory is carefully described and participants are required to report only memories, while ignoring other types of thoughts that might appear (e.g., associations, task-unrelated thoughts). This entails that participants must monitor their stream of consciousness during the task and look specifically for mental content that meets the previous description. This *selective monitoring* could place participants in retrieval mode (Tulving, 1983), in which 'the cognitive system is prepared for or expects memory construction and recollection' (Conway, 2001, p. 1379). According to the threshold hypothesis, monitoring your thoughts in search of a memory should lower the awareness threshold, thereby increasing the number of low accessible memories that can reach consciousness. These instructions would then have the side effect of making involuntary memories appear more similar to voluntary memories.

An alternative hypothesis regarding the possible confounding effects of selective monitoring comes from Hintzman (2011) and Vannucci et al. (2014). According to them, instructing participants to limit their reporting to autobiographical memories can increase, rather than decrease, the awareness threshold, creating what Hintzman (2011) termed a “formidable bottleneck”. This bottleneck prevents the majority of involuntary memories from being reported, either because they do not fit the participant's understanding of what an autobiographical memory should be, or because their accessibility is too low. This would lead participants to report memories that are more rehearsed, specific, vivid, and detailed (Vannucci et al., 2014), potentially accentuating differences between involuntary and voluntary memories.

Recently, two studies investigated the effect of selective monitoring on the phenomenology of involuntary memories. Using a modified version of Schlagman and Kvavilashvili's (2008) original experimental design described above, Vannucci et al. (2014) had participants retrieve involuntary memories under two conditions: In one condition, they were asked to report only autobiographical memories (the standard instruction in prior research), while in the other condition, they were asked to report all thoughts that entered their mind involuntarily. By manipulating the type of instructions, Vannucci et al. (2014) found that selective monitoring increased the frequency, specificity, and rehearsal of involuntary memories. There were no effects of selective monitoring on vividness, unusualness, valence, the age of the event, or the pleasantness of the event. These findings appear to go against the threshold hypothesis, since selective monitoring increased specificity and rehearsal, while having no significant impact on other indicators of accessibility. However, one issue with Vannucci et al.'s (2014) design is that all memories were rated retrospectively in a separate phase, rather than “online” during retrieval. The problem with retrospective ratings is that participants are asked to rate their memories in an intentional and

effortful manner, consistent with being in retrieval mode (Barzykowski & Staugaard, 2016; see also Hintzman, 2011, for a similar argument). Put differently, while the experimental manipulation leads participants to use different retrieval strategies during the online procedure, they all presumably use the same strategy during the post-task rating procedure, namely voluntary retrieval. Retrospective ratings should therefore be supplemented with online ratings.

Barzykowski and Niedźwieńska (2016) replicated Vannucci et al.'s (2014) design using both online and retrospective ratings. They found that selective monitoring lead to involuntary memories with reduced clarity, detail, vividness, and physical reaction. Importantly, these characteristics were all rated online during retrieval. At the same time, the retrospective ratings reported after the completion of the retrieval phase showed that memories retrieved while monitoring were more unusual and more personal. Finally, there were no effects of selective monitoring on rehearsal, valence or specificity.

1.3. The present study

In summary, previous research shows that intention has effects on memory consistent with the threshold hypothesis. Memories retrieved unintentionally (i.e., involuntary memories) show a range of indicators suggesting increased accessibility, including higher specificity, greater mood impact, and increased recency, vividness, clarity, and detail. Research on selective monitoring, however, shows mixed findings. While Barzykowski and Niedźwieńska (2016) found support for the threshold hypothesis using online ratings, the retrospective ratings both in their study and in the study by Vannucci et al. (2014) seem to support an alternative hypothesis, which predicts that the effects of selective monitoring increase, rather than decrease, the frequency of highly accessible memories retrieved. Also, no prior study has included a voluntary retrieval condition as a comparison, which makes any conclusions concerning intentionality difficult.

In the present study, we attempted to overcome the limitations of previous research. First, we used a modified version of Schlagman and Kvavilashvili's (2008) experimental design in order to control the retrieval phase. Second, we used both online and retrospective ratings of memories, since participants are likely to be in retrieval mode during the retrospective ratings regardless of their experimental condition. Third, we included a voluntary retrieval condition, which is essential to investigate the predictions of the threshold hypothesis. We predicted that involuntary memories should be more specific, clear, vivid, unusual, emotionally intense, relevant to the current life situation, and less effortful compared with voluntary memories. In relation to selective monitoring, we tentatively expected instructions to report only memories to lower the threshold, thereby increasing the frequency of memories with low accessibility. However, this result may only be apparent for the online ratings.

2. Method

The Research Ethics Committee approved this study. Written consent for participation was obtained prior to data collection.

2.1. Design

In order to investigate the effects of intention and selective monitoring, we divided participants into four groups, using the same terminology as Barzykowski and Niedźwieńska (2016). One group was instructed to intentionally retrieve only autobiographical memories (the *voluntary restricted* condition). A second group was instructed to intentionally retrieve any type of thought (the *voluntary unrestricted* condition). A third group was instructed to report autobiographical memories that came to mind unintended (the *involuntary restricted* condition). Finally, a fourth group was instructed to report any type of thought that came to mind unintended (the *involuntary unrestricted* condition). The study was therefore a 2 (intention: involuntary vs. voluntary) x 2 (monitoring: restricted vs. unrestricted) between-

subjects design.

An overview of all experimental conditions is presented in Figure 1. Across conditions, participants were encouraged to write down their thought as soon as they became aware of it, regardless of what it was. We operationalized intention to be the conscious decision to retrieve a thought, while selective monitoring was operationalized as the process of deciding whether the thought belonged to the category “autobiographical memory”.

2.2. Participants

A total of 132 undergraduate students (96 females, $M_{age} = 23.52$, $SD = 3.15$, range 19-37 years) participated in this study in return for a gift card worth 20 PLN (*ca.* 5\$). They were randomly assigned to one of the four experimental conditions (see Figure 1). Three participants in the involuntary unrestricted condition guessed the true goal of the study and were excluded from the sample. Due to technical difficulties, three additional participants did not finish the experiment. Therefore, the final sample consisted of 32 participants in the involuntary restricted condition (24 females, $M_{age} = 23.26$, $SD = 2.74$, range 20-32 years), 28 participants in the involuntary unrestricted condition (21 females, $M_{age} = 24.27$, $SD = 3.83$, range 20-37 years), 33 participants in the voluntary restricted condition (24 females, $M_{age} = 23.68$, $SD = 3.42$, range 19-34 years), and 33 participants in the voluntary unrestricted condition (25 females, $M_{age} = 23.01$, $SD = 2.54$, range 20-32 years).

2.3. Materials

2.3.1. The Involuntary Memories Program (IMP)

We employed a modified and fully computerized task based on Schlagman and

Kvavilashvili's design (2008). The Involuntary Memories Program (IMP) is described elsewhere in detail (e.g. Barzykowski & Niedźwieńska, 2016, pp. 5-6; Barzykowski & Staugaard, 2016, p. 524). Participants in the two involuntary conditions performed a monotonous vigilance task where they were required to detect 15 slides featuring vertical lines in a stream of 785 slides featuring horizontal lines. Each slide was presented for 2 seconds. In addition, short verbal phrases (e.g. *riding a horse*, *listening to the concert*) displayed in the centre of each slide acted as potential cues for involuntary memories (restricted condition) or involuntary thoughts (unrestricted condition). The order of cues was fixed and counterbalanced between participants in each experimental group.

The pool of 800 phrases used in the two involuntary conditions consisted of approximately equal numbers of carefully selected neutral ($N = 267$), positive ($N = 267$) and negative ($N = 266$) phrases (e.g. *visiting my friends*, *missed opportunity*, *swimming in the sea*, *riding a bike*). From this pool, 48 word phrases (16 positive, 16 negative and 16 neutral) were randomly selected to be used as cues in the voluntary unrestricted condition. From this pool, we randomly selected 24 verbal phrases (8 positive, 8 negative and 8 neutral) to be used as cues in the voluntary restricted condition. Importantly, the random selection of word phrases from the pool was exactly the same for all participants. Put differently, in the two involuntary conditions, and in the restricted voluntary condition, we used the same amount of verbal cues as in previous studies, that is 800 and 24, respectively (Barzykowski & Staugaard, 2016; Schlagman & Kvavilashvili, 2008). However, due to the fact that participants' responses in the voluntary unrestricted condition were not limited to autobiographical memories, we expected that the number of memories would be significantly lower in this condition. Therefore, we doubled the number of verbal phrases to 48 cues to ensure an adequate number of memories.

Equivalence of cues. To investigate the comparability of cues used in the four

conditions, 10 independent judges rated each of the 800 phrases for imagery, concreteness, and typicality on 7-point scales (1 = low to 7 = high). Then we calculated the mean ratings for each phrase as a function of cue type (involuntary, voluntary restricted, and voluntary unrestricted) and entered them into three separate between-subject ANOVAs with concreteness, imagery, and typicality as dependent variables. There were no significant main effects ($F < 1$, $p < .05$) of the cue type for any of the characteristics. We therefore feel confident that any differences in the phenomenological characteristics of reported memories found in the present study were not explained by differences in concreteness, imagery or typicality of the verbal phrases.

2.4. Procedure

Participants were tested in groups of 2 to 6. They were informed that they were free to withdraw from the study at any time. The experimenter also assured them that their responses would be anonymous, and informed them that they could refrain from reporting particularly sensitive thoughts by typing "X" as an answer, or (if possible) by providing a general description of their thoughts rather than a detailed account.

2.4.1. Involuntary conditions

Unrestricted condition. Participants were informed that they might experience different kinds of thoughts during the vigilance task. We provided them with examples of such thoughts, including personal goals, words, current concerns, plans, and memories, without emphasizing a particular type of thought. It was pointed out that thoughts can be diverse (specific or general). The participants were instructed to write down any spontaneous thoughts that occurred during the 800 vigilance trials, by pressing the spacebar as soon as they became aware of them. Immediately after pressing the spacebar, they provided a brief description of the content of their thoughts and rated the following characteristics on 7-point

scales¹ (on all scales, 1 corresponded to not endorsing the item at all, while 7 corresponded to endorsing the item highly; 4 was undecided or neutral): the extent to which they had deliberately tried bringing the thought to mind, the vividness of the thought, the emotional valence of the thought, and the intensity of emotions experienced in response to the thought. After completing these questions, participants clicked 'continue' to return to the vigilance task.

After completing the vigilance task, participants answered open-ended questions concerning the true goal of the study. Then they were given written and verbal information describing the nature of autobiographical memory (see Schlagman, Kliegel, Schulz, & Kvavilashvili, 2009, p. 410) and were informed about the post-task procedure. During the post-task, participants reviewed all the thoughts they had recorded during the vigilance task, and were asked to decide whether each thought was an autobiographical memory or not. Participants then described each memory more thoroughly and rated its clarity, how personally significant it was, the relevance of the memory to the participant's current life situation, the perceived importance of the original event, how often the participant had recalled the memory in the past by talking about it (i.e. rehearsal), how unusual the remembered event was, and their own age at the time of the event. In addition, participants judged whether the memory was general or specific by classifying the event as: (1) extended in time (e.g., last summer), (2) repeated in the past (e.g., regular meetings), or (3) referring to a particular situation happening within 1 day (e.g., *the day I met Nina for the first time*). Both 1 and 2 were then classified as general events, while 3 was classified as a specific event.

Restricted procedure. The only difference between the restricted condition and the unrestricted condition was that participants were instructed to report only autobiographical memories that spontaneously came to mind during the vigilance task.

¹ Please note that like in the previous studies (e.g. Barzykowski & Staugaard, 2016; Barzykowski & Niedźwieńska, 2016) all points along the scale were clearly labelled during the task.

2.4.2. Voluntary conditions²

Unrestricted procedure. Participants were instructed to produce free associations as quickly as possible to the 48 verbal phrases displayed on the screen. Similar to the unrestricted involuntary condition, they were also provided with examples of associations such as: personal goals, words, current concerns, plans, and memories, without emphasizing any particular type, and it was pointed out that thoughts can be specific or general. As soon as participants retrieved an association, they should press the spacebar. If participants did not press the spacebar within 60 s, the program automatically proceeded to the next phrase. After pressing the spacebar, participants provided a brief description of the association and answered a series of questions, which were identical to the ones posed in the involuntary condition. After completing the 48 trials, the post-task procedure began, which was also identical to the post-task procedure in the involuntary condition.

Restricted procedure. The only difference between the restricted condition and the unrestricted condition was that participants were instructed to recall an autobiographical memory as quickly as possible to the 24 verbal phrases displayed on the screen. Similar to the involuntary restricted condition, they were also provided with verbal and written instructions concerning the nature of autobiographical memories. It was explained that memories could be specific or general as well as recent or remote.

3. Results

3.1. Strategy for analysing data

Only entries that participants designated as autobiographical memories were included in the analyses. Examples of excluded non-autobiographical entries were future plans (*having an appointment tomorrow at 8 AM*), memories unrelated to the personal past (*migrants and*

² Please note that participants in the voluntary conditions were not instructed to perform the vigilance task and that the verbal phrases were displayed on the screen without additional task.

refugees marching through the fields), semantic thoughts (word rhymes, song lyrics), task related thoughts (e.g. *I need to remember about the vertical lines*) or task-related interference (e.g. *how boring is the task*)³. All entries identified by the participants as autobiographical memories were also scored as either memories or non-memories by independent judges. The agreement between participants and judges was perfect for all four groups. For each participant, we calculated mean ratings, because subjects provided dependent multiple observations (for a detailed description see also Berntsen & Hall, 2004; Schlagman & Kvavilashvili, 2008)⁴. We excluded outliers with a value of 2.5 SD or more above or below the mean of the group⁵.

We calculated retrieval latencies (RT) for all involuntary autobiographical memories reported by participants as triggered by a cue phrase. The RTs were calculated by adding up the time that had passed between the memory and the onset of the cue phrase indicated by the participant to be the trigger of that memory.

We analyzed differences between the four conditions in separate factorial ANOVAs with each memory characteristic as an outcome variable and intention (involuntary vs. voluntary) and monitoring (restricted vs. unrestricted) as between-subject factors. To control for multiple comparisons, we corrected the alpha level for the post hoc tests using the False Discovery Rate correction (Benjamini & Hochberg, 1995). With $\alpha = .05$, the critical value q for post hoc tests was .027.

³ The majority of non-autobiographical thoughts recorded in the unrestricted voluntary condition were related to the cue, indicating that participants followed instructions (i.e., "produce an association in response to the cue presented on the screen"). We inspected the data in the unrestricted involuntary condition and found that around 45% of all recorded non-autobiographical thoughts were triggered by presented cues.

⁴ Unlike similar previous studies (e.g. Vannucci et al. 2014; Barzykowski & Niedźwieńska, 2016), we compared the mean memory characteristics per participant instead of the mean ratings for each recorded memory. While this reduces statistical power, it also substantially reduces the risk of type I errors. However, for this reason it may be difficult to compare results between these studies directly.

⁵ Since we were excluding ratings below/above 2.5 SD we did such an exclusion on a rare occasions. The mean percentage of excluded ratings was 1.47%.

3.2. Frequency of involuntary and voluntary memories

One participant in the involuntary restricted condition did not experience any autobiographical memories, which left 31 participants in this condition. These remaining participants recalled 315 memories, which corresponds to 39% of the 800 cues ($M = 10.50$, $SD = 7.24$, range 1–31), while participants in the involuntary unrestricted condition recalled 105 memories (13% of 800 cues, $M = 4.04$, $SD = 2.37$, range 1–10). Participants in the voluntary restricted condition recalled 676 memories in response to 744 cues (90%, $M = 21.29$, $SD = 2.43$, range 14–24), while participants in the voluntary unrestricted condition recalled 600 memories in response to 1536 cues (39%, $M = 9.38^6$, $SD = 4.11$, range 2.50–17.50). As can be seen in Table 1, participants in the two voluntary conditions retrieved significantly more memories compared with participants in the two involuntary conditions (main effect of intention). Participants in the two restricted conditions retrieved more memories than participants in the two unrestricted conditions (main effect of monitoring). The increase in frequency as an effect of selective monitoring was greater in the voluntary condition compared with the involuntary condition (interaction between intention and monitoring).

3.3. Retrieval latencies of memories

Involuntary memories were retrieved significantly faster ($M = 3.52$, $SD = 2.28$, range 0.43–10.21) than voluntary memories, $M = 5.56$, $SD = 2.30$, range 1.65–11.58). The main effect of selective monitoring was not significant, but we found a significant interaction between intention and monitoring. Post hoc tests showed that unrestricted voluntary memories were retrieved faster than restricted voluntary memories (see Table 1). The effect of monitoring on retrieval times for involuntary memories was not statistically significant.

⁶ Since there were twice as many cues in the unrestricted voluntary condition (48) compared with the restricted one (24), we normalized the number of memories in the unrestricted procedure by dividing it by 2. This allowed us to compare the mean number of memories relative to the number of cues.

3.4. Phenomenological characteristics of memories

3.4.1. Characteristics recorded online

During the retrieval task, participants rated effort, vividness, valence, and emotional intensity associated with each thought. Here we report only characteristics for thoughts identified as autobiographical memories. As seen in Table 1, voluntary memories were rated as more effortful than involuntary memories (main effect of intention). In addition, when instructed to report all thoughts, participants rated the memories as more effortful compared with reporting only memories (main effect of monitoring). There were no effects of selective monitoring or intention on valence or vividness. However, we found a main effect of monitoring for emotional intensity and an interaction for vividness. The instruction to report all thoughts resulted in memories with significantly higher emotional intensity compared with reporting only memories (see Table 1). Furthermore, post hoc tests showed that unrestricted voluntary memories were more vivid than restricted voluntary memories, while the effect of monitoring on involuntary memories was not statistically significant.

3.4.2. Characteristics recorded offline during the post-task procedure

Having completed the main vigilance task, participants rated their memories on a number of additional phenomenological characteristics. As can be seen in Table 1, involuntary memories were rated as clearer, more important, more personal, more frequently rehearsed in the past, more unusual, more recent, and more relevant to the current life situation, compared with voluntary memories (main effects of intention). At the same time, participants instructed to report only memories rated their memories as more specific and less important compared with participants instructed to report all thoughts (main effects of monitoring). There was also an interaction for the participant's age at the time of the remembered event. Post hoc tests showed that unrestricted involuntary memories were more recent than restricted involuntary memories, while there was no effect of monitoring on

voluntary memories. We did not find any difference between the four groups in terms of retrospective valence.

4. Discussion

We investigated the effects of intention and selective monitoring on the phenomenological characteristics of autobiographical memories. Participants were randomized into four conditions: involuntary retrieval with or without selective monitoring, and voluntary retrieval with or without selective monitoring. This allowed us to test our main hypothesis that selective monitoring can increase the frequency of memories with low accessibility by lowering the awareness threshold. Such a threshold effect can be observed as an average decline in ratings related to memory accessibility such as specificity, emotional intensity, clarity, unusualness, recency, rehearsal, and importance (e.g., Barzykowski & Staugaard, 2016). An alternative hypothesis is that selective monitoring adds a decision stage to the retrieval process, which might raise the awareness threshold by limiting the range of mental content judged to be relevant to the task at hand (e.g., Hintzman, 2011; Vannucci et al., 2014). This should lead to an average increase in specificity, recency, rehearsal, and possibly other indicators of accessibility. In the present study, both intention and selective monitoring influenced memory characteristics to some extent. We discuss the main effects of intention first, followed by the main effects of selective monitoring. Then we discuss interactions between intention and monitoring.

4.1. Effects of intention

The effect of intention was operationalized as the difference between the memory characteristics reported in the voluntary and involuntary retrieval conditions. Involuntary

memories were retrieved much faster than voluntary memories. The retrieval latencies for the voluntary restricted (5-6 s) and involuntary restricted conditions (about 3 s) correspond very closely to the latencies reported in earlier studies using different experimental procedures and paradigms, which supports the validity and reliability of our design (Berntsen et al., 2013; Schlagman & Kvavilashvili, 2008; Staugaard & Berntsen, 2014). It additionally supports the hypothesis that involuntary memories are more accessible, since they are retrieved more easily than voluntary memories. This is also reflected in the finding that involuntary memories were retrieved with less effort (Table 1). Contrary to our expectations, involuntary memories did not have higher ratings of valence or vividness during the online procedure. While the lack of an effect on valence was unexpected, it has been found that emotional intensity is a better predictor of reliving than valence (Talarico, LaBar, & Rubin, 2004), which could explain why we failed to find an effect. In terms of vividness, we did find an interaction between intention and monitoring, which we discuss in the relevant section below. After the online procedure, involuntary memories were rated as clearer, more important, more personally significant, more recent, more frequently rehearsed, more relevant to the current life situation, and more unusual than voluntary memories. This consistent pattern of findings clearly shows that the intention to retrieve an autobiographical event influences many aspects of the resulting memory. It supports the prediction that involuntary memories are more accessible than voluntary memories on average. As we argued above, this could be an important determinant for why they enter consciousness unintended, while other – less accessible – memories require effort, time, and strategic search in order to be retrieved (Barzykowski & Staugaard, 2016). Naturally, highly accessible memories are available to both voluntary and involuntary retrieval in this view. We suggest that the differences in phenomenology occur when voluntary retrieval uncovers repeated, summarized, or mundane events that lower the average ratings of voluntary memories

relative to the average ratings of involuntary memories.

We expected involuntary memories to also be more specific than voluntary memories. While we found a numerical difference in the predicted direction, this result was not statistically significant. Specificity was rated retrospectively, which could confound this result as argued in the introduction, since all participants are expected to be retrieving the characteristics of the events in a similar way during the post-task procedure. The elaboration of the event required in order to judge its specificity (e.g., estimating the event's extension in time and its uniqueness) could make judgments more alike regardless of whether the memory came to mind unintended or not. Ideally, a measure of specificity that does not rely on metacognitive judgments and elaboration should be included during the online procedure, possibly in the form of estimating a point along a continuum rather than making a categorical judgment.

Finally, it's also worth noting that voluntary memories were much more frequent than involuntary memories despite much fewer cues. On the one hand, this difference reflects the nature of the instructions and replicates previous studies (e.g. Barzykowski & Staugaard, 2016; Berntsen, Staugaard, & Sørensen, 2013; Schlagman & Kvavilashvili, 2008). Participants in the voluntary conditions were required to report memories and thoughts, whereas participants in the involuntary conditions waited for memories and thoughts to spontaneously arise. On the other hand, the difference in frequency could also be taken to support the threshold hypothesis in that intention should make more memories available, even if their accessibility is low.

4.2. Effects of selective monitoring

Selective monitoring was operationalized as the difference between the restricted procedure (reporting only memories) and the unrestricted procedure (reporting all thoughts). We expected selective monitoring to increase the likelihood that memories with low

accessibility were retrieved independent of intention. First, and consistent with previous studies (Vannucci et al., 2014; Barzykowski & Niedźwieńska, 2016), selective monitoring increased the frequency of memories (main effect of monitoring), and this increase was particularly pronounced in the voluntary condition (interaction between intention and monitoring). We therefore replicated a previous finding in the literature on involuntary memories and showed that this also holds true for voluntary memories. While it is not surprising that participants asked to selectively report autobiographical memories do this to a greater extent than participants asked to report any type of thought, it is still interesting that this effect is stronger in the voluntary condition. It is possible that the interaction reflects a cumulative effect of intention and selective monitoring, which would be evident if the additional memories reported in the restricted conditions were primarily memories with low accessibility. The higher frequency also supports the threshold hypothesis as selective monitoring can be interpreted to reflect a lowered awareness threshold. The results therefore does not appear to support the prediction that monitoring should raise the awareness threshold (Hintzman, 2011; Vannucci et al., 2014).

Second, we found selective monitoring led to a decrease in retrieval effort. This appears to also go against the prediction by Hintzman (2011) that adding a decision stage to the process of reporting involuntary memories should introduce a “bottleneck”. All else being equal, a metacognitive judgment should be more effortful than simply reporting whatever is in your mind. Another interpretation of this finding is that reporting all thoughts might require a continuous monitoring process, especially in the voluntary condition, where participants are asked to make an association of every trial. The difference in effort between the two voluntary conditions might therefore reflect the difference in the number of trials. Future studies should control for this possible limitation, by having equal numbers of trials across conditions.

Third, selective monitoring led to memories that were less emotionally intense. This supports the prediction that emotional intensity plays an important role in the process of becoming aware of having a memory, even when a person is not actively searching for it. The finding is also in accordance with results from previous research showing that emotional intensity is a strong predictor of various aspects of reliving (Talarico et al., 2004). As predicted by the threshold hypothesis, when engaged in an undemanding cognitive activity, an emotionally intense memory is more likely to cross the awareness threshold compared with an emotionally neutral memory. The reduced emotional intensity as a result of selective monitoring is hypothesized to be a result of an increased frequency of emotionally neutral memories.

Finally, selective monitoring led to memories that were rated as less important, which again supports the threshold hypothesis.

4.3. Interplay between intention and selective monitoring

A significant interaction between intention and monitoring for retrieval time partially supported the threshold hypothesis. Voluntary memories retrieved while monitoring were significantly slower than memories retrieved without monitoring. We can interpret this to reflect that memories with low accessibility requires more time to retrieve, simply because they rely much more on cue-elaboration and generative retrieval (Conway, 2005). The effect was not significant for involuntary memories, and in fact numerically opposite of what we expected (selective monitoring appeared to decrease retrieval times). This null-result could reflect that the unrestricted condition was considered slightly more effortful.

We also found a significant interaction for age of the memory, which again partially supported the threshold hypothesis. While selective monitoring did not significantly influence the age of voluntary memories, involuntary memories retrieved while monitoring were older than involuntary memories retrieved without monitoring. We can interpret this finding to

reflect more recent memories being more accessible.

Finally, a significant interaction for vividness partially supported the threshold hypothesis. Voluntary memories retrieved while monitoring had lower vividness than voluntary memories retrieved without monitoring, while there was no statistically significant effect on involuntary memories. The null-result for involuntary memories could be related to the increased specificity of involuntary memories retrieved while monitoring, since previous research has argued that vividness and specificity are related (Berntsen & Hall, 2004).

In summary, we found some support for our main hypothesis that intentional retrieval and selective monitoring leads to an increase in low-accessible memories, which is evident in an average decrease of many phenomenological aspects of the memory experience. Some aspects of the memory experience appeared to be unaffected by selective monitoring, namely clarity, rehearsal, unusualness, and the memory's personal nature and overlap with the current life situation. Finally, a result was unexpected: selective monitoring appeared to decrease the level of effort experienced, which might reflect the nature of the task rather than ease of retrieval. We did not find support for the alternative prediction that selective monitoring should lead to a "bottleneck" and thereby decrease the frequency of memories reported. We also did not find support for the alternative prediction that selective monitoring should increase phenomenological characteristics of the memory experience such as specificity, rehearsal, vividness, and level of detail.

4.4. Theoretical implications

An ongoing debate in the literature on involuntary memory can be summarized as a dual-system vs. a single-system approach (Brewin, 2014; Berntsen & Rubin, 2014). In a dual-system view, some highly intense and traumatic memories can only be accessed in an involuntary, cue-driven manner, while less intense, un-traumatic memories can be accessed in a voluntary manner (Brewin et al., 2010). In a single-system view, all memories belong to

the same “pool” and differences between them are due to factors operating during retrieval, such as active emotion regulation (Berntsen & Rubin, 2014). The question is then whether phenomenological characteristics of memories are determined primarily by encoding factors or retrieval processes. While our results and experimental design do not allow us to investigate these two opposing views, we take a moderate stance: high-accessible and low-accessible memories can be retrieved either involuntarily or voluntarily from a single pool of memories. However, retrieval processes influence the frequency of either type of memory by lowering the awareness threshold. Two of these processes are intention and monitoring. Within the threshold hypothesis, a memory's accessibility is therefore not determined only by retrieval or encoding processes, but by a complex interplay between factors during encoding (e.g., the intensity of the event and attention processes), factors during consolidation (e.g., rehearsal and recency) and factors during retrieval (e.g., emotion regulation). In this view, intention and monitoring are simply tools that enable access to otherwise inaccessible memories.

4.5. Methodological implications

Probably one of the biggest challenges of studying involuntary memories is minimizing the intention and expectations that participants may have. This raises the question of what is the best way to study involuntary memories. While it may be tempting to conclude that a condition that reduces selective monitoring as much as possible is more valid, we should be very careful before making such a recommendation. For example, as our findings demonstrate, participants instructed to report any thought appeared to find the task effortful even though they were not required to make online judgments. This implies that the unrestricted procedure has its own set of restrictions, but maybe at another level of processing. Following Hintzman (2011), at least two stages of decision is involved in the reporting of involuntary memories: first, one should notice that there is a memory (this is

where memory accessibility is highly relevant); second, one should make a conscious decision to report the memory (which may depend less on accessibility and more on expectations about memories). While the unrestricted instructions circumvent the second stage of decision making, it may increase the attentional resources required at the first stage, when the relevant amount of mental content is potentially infinite. In summary, none of these two conditions (i.e. restricted or unrestricted) is inherently superior to the other, but each can be used to address different questions about the retrieval process. For example, the retrospective judgments involved in the unrestricted procedure can be problematic, but also allow investigation of the relationship between involuntary memories and other types of involuntary thoughts (see for example Plimpton, Patel, & Kvavilashvili, 2015).

4.6. Possible limitations

When evaluating the present results, we should consider some limitations. First, it can be argued that participants' retrospection in deciding whether a thought was a memory or not may be inaccurate. This also pertains to previous studies (Barzykowski & Niedźwieńska, 2016; Barzykowski & Staugaard, 2016; Vannucci et al. 2014). However, participants did not report any difficulties with this judgment and made it relatively quickly. In addition, as described above, independent judges re-evaluated all entries identified as memories.

Second, since we used a self-interrupted task, it can be argued that all memories reported are a product of some form of selective monitoring. Other studies have used a probe-caught method to circumvent this issue (e.g. Plimpton et al., 2015; Vannucci et al. 2014). For example, studies on mind-wandering has shown that participants are not always aware of their internal state and stream of thoughts (Schooler et al., 2011). It's possible that selective monitoring can be considered as a continuum with restricted and self-interrupted reporting in one end, and unrestricted and probe-caught reporting in the other. This idea could be addressed in future studies.

4.7. Final conclusions

We investigated the role of retrieval intention and monitoring processes in autobiographical memory. First of all, our results demonstrate that retrieval intentionality and monitoring influence the characteristics and frequency of autobiographical memories. Involuntary memories show several indicators of increased accessibility compared with voluntary memories. We argue that this is a result of intentional retrieval leading to a greater proportion of memories that refer to events that are mundane, summarized, repeated, or distant. Much less is known about the influence of monitoring on memory characteristics. Consistent with our predictions, we found that selective monitoring led to retrieval of memories with low emotional intensity and low importance, regardless of intention. Monitoring also led to voluntary memories with low vividness and increased the retrieval time of voluntary memories. Finally, monitoring led to more distant involuntary memories. Some characteristics did not show effects of selective monitoring, suggesting that this process is more subtle than intentionality. This may pertain to a broader question; namely, how do we become aware of a memory? We theorize that memory accessibility is important in determining whether a memory passes the threshold of awareness or not. The present findings show that the intention to retrieve a memory and the selective monitoring for memories can lower this threshold.

References

- Ball, C. T., & Little, J. C. (2006). A comparison of involuntary autobiographical memory retrievals. *Applied Cognitive Psychology*, 20(9), 1167–1179. doi:10.1002/acp.1264
- Barzykowski, K., & Niedźwieńska, A. (2016). The effects of instruction on the frequency and characteristics of involuntary autobiographical memories. *PLoS ONE*, 11(6). doi:10.1371/journal.pone.0157121
- Barzykowski, K., & Staugaard, S.R. (2016). Does retrieval intentionality really matter? Similarities and differences between involuntary memories and directly and generatively retrieved voluntary memories. *British Journal of Psychology*, 107(3), 519–536. doi: 10.1111/bjop.12160
- Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society, Series B: Methodological*, 57(1), 289–300.
- Berntsen, D. (1996). Involuntary autobiographical memories. *Applied Cognitive Psychology*, 10, 435–454. Doi: 10.1002/(SICI)1099-0720(199610)10:5<435::AID-ACP408>3.0.CO;2-L
- Berntsen, D. (1998). Voluntary and involuntary access to autobiographical memory. *Memory*, 6, 113–141.
- Berntsen, D. (2009). *Involuntary autobiographical memories: An introduction to the unbidden past*. Cambridge, UK: Cambridge University Press.
- Berntsen, D. (2010). The unbidden past: involuntary autobiographical memories as a basic mode of remembering. *Current Directions in Psychological Science*, 19(3), 138–142.
- Berntsen, D. (2015). From everyday life to trauma: research on everyday involuntary memories advances our understanding of intrusive memories of trauma. In L. Watson, D. Bernstein (Eds.), *Clinical perspectives on autobiographical memory* (pp. 172–196). New York, NY, US: Cambridge University Press.
- Berntsen, D., & Hall, N. M. (2004). The episodic nature of involuntary autobiographical memories. *Memory and Cognition*, 32(5), 789–803. doi:10.3758/BF03195869
- Berntsen, D., & Jacobsen, A. S. (2008). Involuntary (spontaneous) mental time travel into the past and future. *Consciousness and Cognition*, 17(4), 1093–1104. <https://doi.org/10.1016/j.concog.2008.03.001>
- Berntsen, D., & Rubin, D. C. (2014). Involuntary memories and dissociative amnesia: Assessing key assumptions in posttraumatic stress disorder research. *Clinical Psychological Science*. doi:10.1177/2167702613496241.
- Berntsen, D., Staugaard, S. R., & Sørensen, L. M. T. (2013). Why am I remembering this now? Predicting the occurrence of involuntary (spontaneous) episodic memories. *Journal of Experimental Psychology: General*, 142, 426–444. doi:10.1037/a0029128
- Brewin, C. R. (2014). Episodic memory, perceptual memory, and their interaction: Foundations for a theory of posttraumatic stress disorder. *Psychological Bulletin*, 140(1), 69–97. doi:10.1037/a0033722.
- Brewin, C. R., Gregory, J. D., Lipton, M., & Burgess, N. (2010). Intrusive images in psychological disorders: Characteristics, neural mechanisms, and treatment implications. *Psychological Review*, 117, 210–232. doi:10.1037/a0018113
- Clark, I. A., Mackay, C. E., & Holmes, E. A. (2013). Positive involuntary autobiographical memories: you first have to live them. *Consciousness and Cognition*, 22(2), 402–6. doi:10.1016/j.concog.2013.01.008.
- Cole, S. N., Staugaard, S. R., & Berntsen, D. (2016). Inducing involuntary and voluntary mental time travel using a laboratory paradigm. *Memory and Cognition*, 44(3), 376–389. <https://doi.org/10.3758/s13421-015-0564-9>
- Conway, M. A. (2001). Sensory-perceptual episodic memory and its context:

Autobiographical memory. *Philosophical Transactions of the Royal Society of London, Series B: Biological Sciences*, 356, 1375–1384. doi:10.1098/rstb.2001.0940

Conway, M. A. (2005). Memory and the self. *Journal of Memory and Language*, 53, 594–628. doi:10.1016/j.jml.2005.08.005

Conway, M. A., & Pleydell-Pearce, C. W. (2000). The construction of autobiographical memories in the self-memory system. *Psychological Review*, 107, 261–288. doi:10.1037/0033-295X.107.2.261

Davachi, L. & Dobbins, I. G. (2008). Declarative Memory. *Current Directions in Psychological Science*, 17(2), 112–118. doi:10.1111/j.1467-8721.2008.00559.x.

Finnbogadottir, H., & Berntsen, D. (2011). Involuntary and voluntary mental time travel in high and low worriers. *Memory*, 19, 625–640.

Gross, J. J. (2001). Emotion regulation in adulthood: Timing is everything. *Current Directions in Psychological Science*, 10, 214–219. doi:10.1111/1467-8721.00152

Hintzman, D.L. (2011). Research strategy in the study of memory: fads, fallacies, and the search for the “coordinates of truth.” *Perspectives on Psychological Science*, 6, 253–271.

Johannessen, K. B., & Berntsen, D. (2010). Current concerns in involuntary and voluntary autobiographical memories. *Consciousness and Cognition*, 19(4), 847–60, doi: 10.1016/j.concog.2010.01.009.

Kvavilashvili, L., & Mandler, G. (2004). Out of one's mind: A study of involuntary semantic memories. *Cognitive Psychology*, 48, 47–94.

Kvavilashvili, L., & Schlagman, S. (2011). Involuntary autobiographical memories in dysphoric mood. *Memory*, 19, 331–345. doi:10.1080/09658211.2011.568495

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

Mace, J. H., Atkinson, E., Moeckel, C. H., & Torres, V. (2011). Accuracy and perspective in involuntary autobiographical memory. *Applied Cognitive Psychology*, 25(1), 20–28. doi:10.1002/acp.1634

Michael, R. B., Garry, M., & Kirsch, I. (2012). Suggestion, Cognition, and Behavior. *Current Directions in Psychological Science*, 21, 151–156. <https://doi.org/10.1177/0963721412446369>

Moulds, M. L., & Krans, J. (2015). Intrusive, involuntary memories in depression. In L. Watson, D. Bernstein (Eds.), *Clinical perspectives on autobiographical memory* (pp. 154–171). New York, NY, US: Cambridge University Press.

Plimpton, B., Patel, P., & Kvavilashvili, L. (2015). Role of triggers and dysphoria in mind-wandering about past, present and future: A laboratory study. *Consciousness and Cognition*, 33, 261–276.

Rasmussen, A. S., Berntsen, D. (2009). The Possible Functions of Involuntary Autobiographical Memories. *Applied Cognitive Psychology* 1152, 1137–1152.

Rasmussen, A. S., Johannessen, K. B., & Berntsen, D. (2014). Ways of sampling voluntary and involuntary autobiographical memories in daily life. *Consciousness and Cognition*, 30, 156–168. <https://doi.org/10.1016/j.concog.2014.09.008>

Ritchie, T. D., Skowronski, J. J., Wood, S. E., Walker, W. R., Vogl, R. J., & Gibbons, J. A. (2006). Event self-importance, event rehearsal, and the fading affect bias in autobiographical memory. *Self & Identity*, 5, 172–195

Rubin, D. C., Boals, A., & Berntsen, D. (2008). Memory in posttraumatic stress disorder: properties of voluntary and involuntary, traumatic and nontraumatic autobiographical memories in people with and without posttraumatic stress disorder symptoms. *Journal of Experimental Psychology. General*, 137(4), 591–614. <https://doi.org/10.1037/a0013165>

Rubin, D. C., Dennis, M. F., & Beckham, J. C. (2011). Autobiographical memory for stressful events: The role of autobiographical memory in posttraumatic stress disorder. *Consciousness & Cognition*, 20, 840–856.

Schlagman, S., & Kvavilashvili, L. (2008). Involuntary autobiographical memories in

and outside the laboratory: How different are they from voluntary autobiographical memories? *Memory and Cognition*, 36, 920–932. doi:10.3758/MC.36.5.920

Schlagman, S., Kliegel, M., Schulz, J., & Kvavilashvili, L. (2009). Differential effects of age on involuntary and voluntary autobiographical memory. *Psychology and Aging*, 24(2), 397–411. doi: 10.1037/a0015785 PMID: 19485657

Schooler, J. W., Smallwood, J., Christoff, K., Handy, T. C., Reichle, E. D., & Sayette, M. A. (2011). Meta-awareness, perceptual decoupling and the wandering mind. *Trends in Cognitive Science*, 15, 319–326. doi:10.1016/j.tics.2011.05.006.

Staugaard, S. R., & Berntsen, D. (2014). Involuntary memories of emotional scenes: The effects of cue discriminability and emotion over time. *Journal of Experimental Psychology: General*, 143(5), 1939–1957. <https://doi.org/http://dx.doi.org.ez.statsbiblioteket.dk:2048/10.1037/a0037185>

Talarico, J. M., LaBar, K. S., & Rubin, D. C. (2004). Emotional intensity predicts autobiographical memory experience. *Memory & Cognition*, 32, 1118–1132. doi:10.3758/BF03196886

Tulving, E. (1983). *Elements of episodic memory*. New York: Oxford University Press.

Vannucci, M., Batool, I., Pelagatti, C., & Mazzoni, G. (2014). Modifying the frequency and characteristics of involuntary autobiographical memories. *PLoS ONE*, 9(4). doi:10.1371/journal.pone.0089582

Vannucci, M., Pelagatti, C., Chiorri, C., & Mazzoni, G. (2016). Visual object imagery and autobiographical memory: Object Imagers are better at remembering their personal past. *Memory*, 24(4), 455–470. <https://doi.org/10.1080/09658211.2015.1018277> [doi]

Watson, L. A., Berntsen, D., Kuyken, W., & Watkins, E. R. (2013). Involuntary and voluntary autobiographical memory specificity as a function of depression. *Journal of Behavior Therapy and Experimental Psychiatry*, 44(1), 7–13. doi:10.1016/j.jbtep.2012.06.00

Table 1. The overall mean ratings for characteristics of memories as a function of group.

	Involuntary memories				Voluntary memories				Voluntary vs. Involuntary	Restricted vs. Unrestricted	Interaction
	Restricted procedure:		Unrestricted procedure:		Restricted procedure:		Unrestricted procedure:				
	Involuntary & monitoring only for memories		Involuntary & monitoring for any thoughts		Voluntary & monitoring only for memories		Voluntary & monitoring for any thoughts				
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		<i>Test</i>	
Normalized number of memories	10.50	7.23	4.04	2.37	21.29	2.43	9.38	4.11	$F(1, 115) = 93.73^*$ $\eta^2 = 0.45$	$F(1, 115) = 121.71^*$ $\eta^2 = 0.51$	$F(1, 115) = 10.72^*$ $\eta^2 = 0.09$
Retrieval latencies	2.96	1.65	4.15	2.73	6.43	2.45	4.68	1.79	$F(1, 112) = 24.02^*$ $\eta^2 = 0.18$	$F(1, 112) = 0.47$ $\eta^2 < 0.01$	$F(1, 112) = 13.01^*$ $\eta^2 = 0.10$
Online ratings											
Effort	2.01	.61	2.41	1.07	2.76	.79	3.59	1.64	$F(1, 120) = 23.10^*$ $\eta^2 = 0.16$	$F(1, 120) = 9.53^*$ $\eta^2 = 0.07$	$F(1, 120) = 1.16$ $\eta^2 = 0.01$
Vividness	4.84	.93	4.48	1.17	4.65	.42	5.04	.93	$F(1, 120) = 1.25$ $\eta^2 = 0.01$	$F(1, 120) = .01$ $\eta^2 < 0.01$	$F(1, 120) = 5.36^*$ $\eta^2 = 0.04$
Valence of the memory	4.42	.71	4.54	1.07	4.24	.45	4.45	.63	$F(1, 118) = 1.05$ $\eta^2 = 0.01$	$F(1, 118) = 1.55$ $\eta^2 = 0.01$	$F(1, 118) = .12$ $\eta^2 < 0.01$
Intensity of emotions	4.26	.96	4.49	.84	4.16	.59	4.55	.78	$F(1, 120) = .02$ $\eta^2 = < 0.01$	$F(1, 120) = 4.85^*$ $\eta^2 = 0.04$	$F(1, 120) = .31$ $\eta^2 < 0.01$
Offline ratings recorded during the post-task procedure											
Specific memories (proportion)	.67	.19	.53	.29	.60	.15	.54	.23	$F(1, 119) = .55$ $\eta^2 = 0.01$	$F(1, 119) = 6.10^*$ $\eta^2 = .05$	$F(1, 119) = 1.00$ $\eta^2 = 0.01$

Clarity	5.34	.85	5.34	1.03	4.92	.51	5.09	.65	$F(1, 122) = 5.79^*$ $\eta^2 = 0.05$	$F(1, 122) = .39$ $\eta^2 < 0.01$	$F(1, 122) = .33$ $\eta^2 < 0.01$
Personal nature	4.40	.95	4.39	1.44	3.70	.95	3.90	.98	$F(1, 122) = 9.39^*$ $\eta^2 = 0.07$	$F(1, 122) = .28$ $\eta^2 < 0.01$	$F(1, 122) = .29$ $\eta^2 < 0.01$
Current life situation	3.56	1.18	3.67	1.59	3.12	.93	3.04	1.06	$F(1, 122) = 6.39^*$ $\eta^2 = 0.05$	$F(1, 122) = < 0.01$ $\eta^2 < 0.01$	$F(1, 122) = .20$ $\eta^2 < 0.01$
Importance of the event	3.91	.91	4.35	1.26	3.45	.70	3.65	.73	$F(1, 122) = 12.76^*$ $\eta^2 = 0.09$	$F(1, 122) = 3.92^*$ $\eta^2 = 0.03$	$F(1, 122) = .54$ $\eta^2 = < 0.01$
Rehearsal: recalling in the past	3.45	.89	3.79	1.22	2.98	.63	3.04	.83	$F(1, 122) = 14.09^*$ $\eta^2 = 0.10$	$F(1, 122) = 1.53$ $\eta^2 = 0.01$	$F(1, 122) = .73$ $\eta^2 = 0.01$
The age of the memory	18.80	3.66	21.02	3.47	17.91	2.38	17.19	2.58	$F(1, 117) = 17.88^*$ $\eta^2 = 0.13$	$F(1, 117) = 1.80$ $\eta^2 = 0.02$	$F(1, 117) = 6.94^*$ $\eta^2 = 0.06$
Unusualness	4.19	.89	4.44	.87	3.93	.84	3.79	.80	$F(1, 122) = 9.20^*$ $\eta^2 = 0.07$	$F(1, 122) = .14$ $\eta^2 < 0.01$	$F(1, 122) = 1.67$ $\eta^2 = 0.01$

* $p < .05$. The online and offline phenomenological characteristics were rated on 7-point scales (1 = low to 7 = high). In the case of the age of the memory, participants indicated how old they were when the event in memory took place. The specificity of memories was the proportion of specific relative to general memories.

Figure 1. An overview of the experimental groups.

		Intention	
		+	-
		Voluntary condition	Involuntary condition
Monitoring for memories	<p>+</p> <p>Restricted procedure:</p> <p><u>Focus only</u> on memories</p> <p>Report <u>only</u> memories</p>	<p>1</p> <p><u>Recall a memory</u> in response to a verbal phrase</p>	<p>3</p> <p><u>Report</u> any spontaneously occurring <u>memory</u></p>
	<p>-</p> <p>Unrestricted procedure:</p> <p><u>Focus</u> on thoughts</p> <p>Report <u>any</u> thought</p>	<p>2</p> <p><u>Report</u> any <u>thought</u> in response to a verbal phrase</p>	<p>4</p> <p><u>Report</u> any spontaneously occurring <u>thought</u></p>