Manipulating Cues in Involuntary Autobiographical Memory:

Are Pictorial Cues More Effective?

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Abstract

In two experiments pictorial cues were compared with their verbal labels to assess their effectiveness in eliciting involuntary autobiographical memories. Cues were relatively complex in Experiment 1 (e.g. relaxing on a beach), and simple objects in Experiment 2 (e.g. a ball). In both experiments participants went through a vigilance task in which they were presented with frequent non target and rare target visual stimuli. Pictures or their corresponding verbal labels were also displayed on both target and non-target stimuli, but participants were told these were irrelevant to the task. They were asked to interrupt the vigilance task whenever they became aware of task-unrelated mental contents and to report them. In both experiments more involuntary memories were elicited in the verbal cue condition rather than in the pictorial cue condition. This result is discussed in relation to previous work that highlighted the greater effectiveness of verbal cues in memory tasks.

Introduction

Involuntary autobiographical memories (IAMs) are spontaneously arising memories of personal events that come to mind with no deliberate attempt directed at their retrieval (Berntsen, 1996, 2009; Mace, 2007). Although IAMs might occur in a wide variety of conditions, they are more likely to occur when one is engaged in undemanding activities that require little attention and concentration (e.g. relaxation, routine or automatic activities) (Berntsen, 1998; Kvavilashvili & Mandler, 2004; Schlagman & Kvavilashvili, 2008).

Research on involuntary personal memories using diaries has shown that in 80% or more of cases IAMs are elicited by easily identifiable cues (e.g. Berntsen, 1996; Berntsen & Hall, 2004; Mace, 2004, 2006; but see also Ball & Little, 2006), and that some cues seem to

be more effective than others. The consistent finding in diary studies is that external (environmental) cues are more commonly reported by participants compared to internal cues (thoughts, emotions). For example, Berntsen (1996, 2001; see also Berntsen & Hall, 2004) had participants mention which cues had triggered the daily involuntary memories that they were reporting in their diaries. Most involuntary memories were triggered by external rather than internal cues. The best cues were mainly auditory or visual and referred to sensory and perceptual experiences. They typically involved specific objects, activities, people, and themes, whereas pure raw sensory experiences (e.g., a smell, a taste) were relatively infrequent. The prevalence of external cues (72%), with an equal proportion of abstract (i.e. verbal 47%) and "sensory/perceptual" (44%) cues was also found in a study (Schlagman, Kvavilashvili & Schulz, 2007) in which two different cue coding systems were used.

While the superior effectiveness of external cues has been demonstrated, no studies so far have examined if other characteristics of the cue modulate the likelihood of eliciting involuntary memories. Here we assess whether pictorial cues, which are external and sensory/perceptual, are more effective than their verbal labels, when the modality of presentation is the same (i.e. visual).

There are reasons to expect that cues presented as pictures would be more powerful than the same cues presented in a verbal format. At the same time there are reasons to predict that verbal cues might be more effective in eliciting memories. Here for the first time these two predictions are compared. While the literature supporting the hypothesis of a pictorial superiority is quite strong, the results of previous studies indicating a verbal superiority should not be dismissed.

Why pictorial cues might lead to more IAMs.

The powerful effect of visual/pictorial cues has been evidenced in studies on voluntary recall in children and adults. For example, in both kindergartners and second

graders, pictorial cues facilitated recall of a short video seen one week before (cues were designed to cue memory for persons involved in the event, the setting, actions, and conversations/dialogues in the film), and specifically increased memory accuracy (Roebers & Elischberger, 2002). In studies on PTSD patients, pictorial cues facilitated specific memory retrieval (Schönfeld & Ehlers, 2006). Predictions that stem from the autobiographical memory model proposed by Conway & Pleydell-Pearce (2000) suggest that pictorial cues, which have highly specific information, may provide a direct access to the event-specific knowledge (ESK) base (Conway, 1992), and hence might be more effective in eliciting memories. These results are consistent with the picture superiority effect observed in the 60s and 70s, showing that pictures are remembered better than words (Erdelyi & Becker, 1974; Madigan, 1974; Nelson, Reed, & Walling, 1976; Paivio, 1971; Paivio, 1991;Shepard, 1967; Standing, 1973; Standing, Conezio, & Haber, 1970). Studied pictures can also be easily discriminated from a large number of semantically similar foils (Brady et al, 2008), indicating that subjects must have encoded and retained visual details of the stimulus such as colour, shape, texture, etc. These elements make pictures more perceptually rich than words, and this visual distinctiveness lends them an advantage in memory, as distinctive processes at encoding (Israel & Schacter, 1997) enhance retrieval (Hanczakowski & Mazzoni, 2011; see also Nelson, 1979, stating that pictures provide more distinctive visual representations).

Pictures can vary in their complexity and in how strongly they are similar to a person's prior experience, ranging from detailed colour photos of first-person-point-of-view of personal experiences, to black-and-white line drawings of objects. The visual distinctiveness of different types of pictures varies accordingly and should represent an important variable in determining how powerful these cues are for the retrieval of involuntary memories (IAMs). For example, cue effectiveness for IAMs may be quite different if the cue is a detailed first-person point-of-view colour photograph of a person's specific previous

experience, or if it is a black-and-white line drawing of an object from that same experience. In order to understand this prediction, one needs to consider that retrieval of IAMs is currently conceived as due to spreading of activation within an associative network, from the representation of the cue to related concepts in the autobiographical memory system (Berntsen, 2009; Mace, 2007; Schlagman & Kvavilashvili, 2008). It is commonly agreed that in the large majority of cases retrieval of IAMs is due to some degree of overlap, for some identifiable features, between the cue and the content of the memory (see Berntsen, 2009; Schlagman et al, 2007, for a review). In agreement with the hypothesis that retrieval from episodic memory occurs via interactions between a retrieval cue and a memory representation (e.g. Tulving, 1979), involuntary retrieval occurs when a sufficient match occurs between elements of the cue and central features or themes of the memories (e.g. Ball, Mace, & Corona, 2007; Berntsen & Hall, 2004; Berntsen, 2009, 2010). This 'matching' hypothesis refers to the principle of encoding specificity (Conway, 2005; Moscovitch, 1995; see also Berntsen, 2009, for a review on IAMs), according to which the likelihood of retrieval is a function of the degree of overlap between the information present at retrieval (e.g., the cue) and the information stored in memory (Tulving, 1979). Hence, the greater the potential overlap, the greater the number of IAMs retrieved. The greater and more specific amount of distinctive information they contain should enhance the activation of memory representations and hence increase the likelihood of eliciting memory retrieval. In the case of pictorial cues, the richness of the visual cue and thus the number of visual-perceptual details (e.g., the picture of a man riding a horse contains multiple details about the horse and the rider) should increase the likelihood of a match between the cue and a memory representation. Hence, one would predict these cues to be more effective than verbal cues in eliciting IAMs.

There is a second reason, which is linked to the richness of the cue, for predicting a superiority for pictorial cues in eliciting IAMs. It refers to the principle of cue-item

discriminability (Rubin, 1995; see Berntsen, Staugaard, &Sørensen, 2013). Cue effectiveness is defined as "how easily a given cue isolates an item" (Berntsen et al, 2013, p. 151) when activation from the cue spreads through an associative network. Thus a cue activates a personal episodic memory if it is sufficiently distinct to discriminate one specific past event from others that are also activated via spreading of activation. In order to be effective, a cue has to activate event-relevant units in the memory network and to deactivate irrelevant ones that would otherwise interfere with memory retrieval. In a recent study, Berntsen et al (2013) have consistently shown, across four studies, that involuntary memories were more frequent when the cues were uniquely associated with the memory target. In their study they used auditory cues (sounds) to involuntarily evoke memories of pictures which in earlier learning trials were paired with the sounds. In the case of pictorial cues (e.g. the photo of a man riding a horse) greater specificity of a cue should increase cue-item discriminability, leading to a greater likelihood of retrieval of IAMs. Conversely, the verbal description (a man riding a horse) can create a less detailed mental representation, with a negative effect on the effectiveness of the cue. A clear pictorial superiority effect should then be obtained in the retrieval of IAMs.

Why verbal cues might lead to more IAMs.

There are reasons, however, that would favor the opposite prediction (i.e., a superiority effect for verbal cues). One reason refers to a possible backfiring effect of the very large number of details contained in complex pictures (e.g. photos), if each detail in the picture acts as an independent sub-cue. Increasing the number of potential cues contained in the picture would decrease the success of retrieval, as predicted by the cue overload hypothesis (Watkins & Watkins, 1975) stating that "the probability of recalling an item declines with the number of items subsumed by its functional retrieval cue" (Watkins & Watkins, 1975 p. 442; see also the fan effect, Anderson, 1983). According to this principle,

the likelihood of a cue providing access to a given target memory depends on the extent to which the cue is uniquely associated with a specific memory target, while its strength declines to the extent it is associated with other memories as well. Rich and highly detailed pictorial information would increase the number of items subsumed by a retrieval cue rich in details, thus reducing the likelihood of retrieving a memory.

A second reason refers to the likelihood of obtaining an adequate overlap between the cue and the existing memory representation. In a study on the creation of false memories, Garry and Wade (2005) have shown that verbal cues (in their study in the form of narratives) were more powerful than pictures of the same scene. One explanation proposed for this result is that narratives "allow and even demand that subjects generate their own details" (Garry &Wade, 2005, p. 360). This reasoning can be applied to involuntary memories as well. Cues that facilitate the generation of personally-relevant details might produce a better overlap between the cue and existing memory representations also in an involuntary task such as retrieval of IAMs. Consider again the example of a 'man riding a horse'. In its verbal form, it is vague enough to leave room for personal interpretations and the creation of mental images that refer to personal experiences (one can imagine a known rider, a specific attire, the horse of a friend, etc, with information and mental images that are different from person to person). Even in reading the single and simple word 'ball' the reader can create a mental representation that contains specific details likely generated by previous experiences with a specific ball, which might then be a better fit with existing memory representations. Hence cue-item discriminability might actually be greater for verbal rather than pictorial cues, increasing the likelihood of retrieval of IAMs. As Garry and Wade (2005) noted, pictures might impose too many constraints on the mental representation that the single individual has of the event, as pictures contain specific details which might not be part of any experience (and hence any memory) for a given individual. Thus, verbal cues can turn out to be more

effective to the extent that these cues leave the subject free to incorporate their own personal details into their mental representation of the cue.

Our study

To assess whether pictorial or verbal cues are more effective in eliciting IAMs, we compared pictorial with verbal labels about of the same rather complex episode (e.g. relaxing on a beach, Experiment 1) or the same simple object (e.g. ball, Experiment 2). In both Experiments we employed a slight but important modification of a paradigm recently developed by Schlagman & Kvavilashvili (2008; see also Kvavilashvili & Schlagman, 2011). In the original paradigm, participants were asked to perform a vigilance task in which they were to detect target stimuli (patterns of vertical lines) randomly presented among a large number of non-target stimuli (patterns of horizontal lines). Short phrases that participants were told were not important were displayed in the center of each pattern. Participants were informed that the monotonous task could trigger thoughts and memories and were told that the experimenters were also interested in recording involuntary memories. The nature of involuntary memories was explained. Our modification (see Batool & Mazzoni, 2011; Vannucci, Batool, Pelagatti & Mazzoni, in press) consists of two elements. First we avoided informing participants that one of the aims was to study involuntary memories. Instead, participants were asked to report whatever came to their minds, things about the past, plans, intentions for the future, etc, as long as they were not task-related, making this more akin to a mind wandering task (Schooler et al., 2011). Second, participants were asked to categorize their mental contents as memories vs. non memories (generically called thoughts) only at the end of the report.

This paradigm makes it possible to simulate in the laboratory two important conditions in which involuntary memories occur in everyday life: attention is not focused on the current ongoing activity, and easily identifiable triggers are present (e.g. Berntsen, 1996;

Berntsen & Hall, 2004; Kvavilashvili & Mandler, 2004, Schlagman, Kvavilashvili & Schulz, 2007). The modification ensures that involuntary memories are indeed involuntary. Both quantitative (number of involuntary memories and number of involuntary memories triggered by the cues) and qualitative (phenomenological characteristics) aspects of the retrieval of IAMs were analyzed.

Experiment 1

Method

Participants

Forty undergraduates students from the University of Hull (21 females; age range: 18-37 years, all native English speakers with normal or corrected-to-normal vision) participated in the experiment which was run on a computer using E-Prime. Half were randomly assigned to the verbal cue condition (10 females) and the other half to the picture cue condition (11 females). Groups did not significantly differ in age (overall average age 20.6).

Materials

Cues. 150 highly imaginable and concrete verbal cues were used. These were short sentences selected from the standardized pool of 800 cues developed by Schlagman and Kvavilashvili (2008), and already used in clinical (e.g. Schlagman & Kvavilashvili, 2011) and non clinical (e.g. Schlagman & Kvavilashvili, 2008) studies on English samples. Five independent judges rated level of imagery and concreteness of the cues on a 7-point scale (1 “low” - 7 “high”). Phrases rated 6-7 were high-imaginable and concrete cues. Familiarity was rated by 5 additional raters and was not significantly different in the two sets of cues. An equal number of positive (n=50) (e.g. relaxing on a beach), neutral (n=50) (e.g. washing hands) and negative (n=50) (e.g. armed robbery) cues

were used in each group and were presented with order counterbalanced across participants [1].

In the picture condition more than 150 high-resolution colour photos were created or found on the internet to match the same 150 highly imaginable verbal cues (e.g. the phrase 'a glass of wine' and the picture of a glass of wine). The photos were actual representations of real scenes or complex objects, very similar to percepts and were not abstract. Five judges were then asked to name each picture, and the 150 pictures that were named in a way that was very similar or identical to the cue phrase were selected to be part of the final set of pictures. Agreement among judges was very high, and the minimal disagreement was resolved via discussion.

Vigilance Task. We employed the vigilance task used by Schlagman and Kvavilashvili (2008), using 150 trials, which was run on a computer using E-Prime. In each trial, on the computer screen an image (approximately 21.5 X 12.5 cm in size) was shown depicting either a pattern of black horizontal (non-target) or vertical lines (target) presented on the periphery of the image. Eight different target stimuli were presented. Each stimulus remained on the screen for 1.5 sec. The word-phrases and the pictures were presented in the middle of the image, without obscuring any of the lines. Words were presented in 18-point Arial font, **while pictures were approx 12cmx6cm in size.**

Memory characteristics questionnaire. The questionnaire was adapted from the one

[1] As reported in Schlagman & Kvavilashvili (2008), in the development of the set, emotional valence was independently rated by 8 coders. Only phrases with an agreement of 75% or above were included. An approximately equal numbers of negative (n 267), neutral (n 266), and positive (n 267) phrases were used" (Schlagman & Kvavilashvili, 2008, p. 922). In our study 50 cues were taken from the positive subset, 50 from the neutral subset and 50 from the negative subset.

used by Schlagman and Kvavilashvili 2008). Participants recorded details of each memory on a two-page questionnaire (Schlagman & Kvavilashvili, 2008). On the first page participants wrote a brief description of the memory, and rated the vividness of the memory (7-point scale: 1 = very vague, almost no image at all; 7 = very vivid, almost like normal vision), indicated the trigger of the memory (their thoughts, an external trigger - in which case they had to mention which - or no trigger). On page 2, they rated on a 5-point scale their overall level of concentration during the vigilance task (1 = not at all concentrating; 5 = fully concentrating), how unusual or common the remembered event was (1 = very common; 5 = very unusual), how often the memory had been thought of/rehearsed before (1 = never; 2 = once or twice; 3 = a few times; 4 = several times; 5 = many times), how pleasant or unpleasant the memory event was (1 = very unpleasant; 3 = neutral; 5 = very unpleasant), how pleasant or unpleasant the original event was (1 = very unpleasant; 3 = neutral; 5 = very pleasant). They were also asked whether the remembered event was general or specific, and indicated their age when the event occurred.

Design

The study conforms to a between subjects design comparing the effect of type of cue (verbal cues vs. their pictorial representations) on number of IAMs and the rating of their phenomenological characteristics.

Procedure

Participants were tested individually. Instructions for the vigilance task were taken from Schlagman & Kvavilashvili (2008), with the major difference that participants were told to stop the experiment when any type of mental content (unrelated to the task) crossed their mind. It was specified that mental contents could refer to thoughts, intentions, plans for the future, past experiences, etc. These changes to the original procedure were made to ensure

that the memories were involuntary (Batool & Mazzoni, 2011; for exact instructions see Appendix A in Vannucci et al., in press). After completing the informed consent form, in the vigilance task participants were asked to detect target stimuli (vertical lines) among a large number of non target stimuli (horizontal lines). Stimuli were randomly organized within each block and blocks presented in a fixed order. Participants were asked to say ‘‘yes’’ out loud each time they detected a target stimulus, and told that the words shown in the center of the image were not important. They were also informed that the task was quite monotonous and they could find themselves thinking about other things (thoughts, plans about the future, past experiences, etc), which was normal. The instruction also mentioned that if something came to mind during the task, they should click the mouse to interrupt the presentation and write a short sentence describing their mental content. This initial description should be sufficient for them to identify the mental content at a later point in time, if necessary. When the task was over, they were presented with the list of what they had written and asked to rate which were thoughts and which were memories. Finally, for the items marked as memories, they were asked to complete the two-page memory characteristics questionnaire. The session lasted approximately 60 to 90 min.

Results

All participants completed the vigilance task successfully. All participants also reported thoughts and at least one involuntary memory. The total number of interruptions was 1244, of which 657 were thoughts and 536 were labeled as IAMs (M per participant=13.40, SD= 9.05) (range 1–34). There were only 51 items that participants did not label. Out of 536 IAMs, the majority (n= 527, 98.3%) were reported to have identifiable triggers. Of these 527 memories, 75.5 % were reported to be triggered by the cues on the screen, 2.7 % by other environmental cues and 21.8 % by internal thoughts.

No significant differences between the two groups (pictorial vs. verbal condition) was observed in the number of interruptions [t (38) = -1.89, p =.07, Cohen's d =- 0.60], and in the number of thoughts (non-memories) [t (38) =- .65, p =.52, Cohen's d = -0.21]. Comparing the total number of IAMs between the two groups showed that in the verbal cue condition almost twice as many IAMs were elicited during the vigilance task than in the picture condition [t (38) = -3.59, p = .001, Cohen's d = -1.135]. Descriptive data are reported in Table 1. A similar result was obtained for the subset of memories reported as being triggered by specific cues on the screen: verbal cues produced almost twice as many IAMs than pictures[t (38) = -3.10, p =.004, Cohen's d = -0.98).

No differences were found on the phenomenological qualities of IAMs with an alpha =.01. Only memory vividness was significantly higher when cues were pictures compared to words (alpha .05). The age of the memory was not significantly different in the two groups. In both cases, the memories date back to when participants were approximately 15-16 years old.

Table 1. Descriptive data (means and standard deviations) for all dependent measures.

	Cues		
	Pictures	**Words**	**p**
Number of Non-Memories	14.85 (12.94)	18 (17.20)	ns
Number of Memories (IAMs)	8.9 (5.14)	17.9 (9.96)	<.001
Vividness	5.34 (.88)	4.80 (.74)	<.05
Repeated before	3.28 (.75)	2.84 (.72)	ns
Specific (proportion)	.68 (.19)	.78 (.16)	ns
Concentration	3.54 (.50)	3.68 (.59)	ns

Unusual	3.30 (.59)	3.39 (.43)	ns
Age of event	16.11 (2.47)	15.93 (2.13)	ns
Pleasant. Event	3.55 (.69)	3.33 (.45)	ns
Pleasant. Memory	3.60 (.56)	3.49 (.56)	ns

Discussion

This is the first study in which the effectiveness of pictorial and verbal cues is compared in the retrieval of involuntary memories. More involuntary memories were obtained with verbal compared than with pictorial cues. This result is in contrast with the evidence showing the superiority of pictorial cues in voluntary retrieval of episodic autobiographical memories (Roebers & Elishberger, 2002). However retrieval processes are thought to be different in involuntary memory, where theories (for reviews see Berntsen, 2009; Mace 2007) assume that cues directly activate memory representations of events via spreading of activation within an associative network. The results of Experiment 1 suggest that this match is less likely to occur when cues are pictorial.

However, before concluding that pictorial cues in general are less effective, we need to rule out the possibility that this effect is due to the specific cues used in Experiment 1, which were relatively complex scenes (e.g. relaxing on a beach), and show that the effect occurs when simple pictorial cues are used. Complex pictorial cues might contain details that can act as independent sub-cues, each potentially and independently activating some memory representation. Since multiple activations are detrimental for involuntary retrieval (Berntsen et al., 2013), as they would create a ‘cue overload’ effect (Watkins & Watkins, 1975) and a decrease in cue-item discriminability (Rubin, 1995), fewer IAMs would be activated in

response to complex cues. In Experiment 2 very simple pictures were compared with the single words that described the pictures (e.g. the picture of a ball and the word 'ball').If pictorial cues turn out to be less effective than verbal cues also in this case, one can conclude that pictorial cues, no matter their complexity, are in general less effective than verbal cues in eliciting IAMs.

Experiment 2

The procedure in Experiment 2 was the same as in Experiment 1, with the difference that cues were pictures of simple objects which were compared to their verbal labels.

Method

Participants

Thirty undergraduates students from the University of Hull (15 females; age range: 20-27years, mean = 21.10, all native English speakers with normal or corrected-to-normal vision) participated in the experiment. Half were randomly assigned to the verbal cue condition (9 females) and the other half to the picture cue condition (6 females). Groups did not significantly differ in age.

Materials

Cues. One hundred and fifty simple pictures of objects (e.g. ball, cake) and their corresponding 150 verbal labels were used as cues in a between-subjects design. Fifty cues were positive, 50 neutral and 50 negative in each subset. The pictures were taken from a standardized set of coloured high-resolution (300 dpi) photographs of real objects (without background) (Viggiano, Vannucci & Righi, 2004), most of them taken by the authors of the

set. For each picture normative data for English speakers on familiarity, visual complexity and between-subjects agreement on naming are available (Viggiano et al, 2004). The in-plane orientation and the directionality (leftward or rightward) of each object were chosen according to normative data obtained in right-handed subjects in a previous work (Viggiano and Vannucci, 2002). Objects in the pictures were all presented in canonical position (Viggiano &Vannucci, 2002).

Design

The study conformed to a between-subject design comparing the effect of type of cue (simple pictures of objects vs. their verbal labels) on the number of involuntary memories reported and the rating of their phenomenological characteristics.

Procedure

The identical procedure and E-prime software as in Experiment 1 was used. Participants were instructed to let their mind wander while they participated in the experiment. Whenever anything unrelated to the task would come to their mind they should stop the experiment by clicking the mouse, and report a short description of the mental content on a piece of paper provided at the beginning of experiment. Participants were also informed that if something personal came to their mind which they did not want to share, they still needed to stop the experiment by clicking the mouse but could write the word "personal". By the end of the experiment all participants were asked to categorize reported items as memories or thoughts. Then they had to fill the memory questionnaire for each reported memory.

Results

All participants completed the vigilance task successfully. Only 1 out of 30 participants (in the picture condition) did not report any involuntary memories throughout the task.

The total number of interruptions was 580, of which 341 were thoughts and 233 were labeled as IAMs (M per participant = 7.76) (range 1–20). Unlabelled mental events were 6. The majority of IAMs (n= 230, 98.7%) were reported to have identifiable triggers. Of these 220 (95.6 %) were reported to be triggered by the cues on the screen, and 10 (4.4%) by internal thoughts.

No significant differences between the two groups (pictorial vs verbal condition) was observed in the number of interruptions [t (28) = -1.69, p =.10, Cohen's d = -0.62] and in the number of thoughts, [t(28) = -0.79. p =.44, Cohen's d = -0.288]. Comparing the total number of IAMs between the two groups showed that participants in the verbal cue condition recalled significantly more IAMs than participants in the picture condition [t (28) = -2.15, p = .04, Cohen's d = -0.785]. Descriptive data are reported in Table 2. A similar result was obtained for the subset of memories that participants stated were triggered by a specific cue presented on the screen, where verbal cues produced more IAMs than pictures [t (28) = -2.00, p =.05, Cohen's d = -0.73].

No differences were also found on the phenomenological qualities of the memories (alpha =.01). Only concentration was significantly higher with word cues compared to pictures (alpha .05). The age of the memory was not significantly different in the two groups. In both groups the memories dated back to when participants were approximately 15 years old.

Table 2. Descriptive data (means and standard deviations) for all dependent measures.

	Cues		
	Pictures	**Words**	**p**
Number of Non-Memories	10.07 (7.65)	12.67 (10.21)	ns
Number of Memories (IAMs)	5.67 (4.53)	9.87 (6.06)	<.04
Vividness	5.13 (1.62)	5.61 (.82)	ns
Repeated before	2.68 (1.22)	2.94 (.78)	ns
Specific (proportion)	.93 (.15)	.79 (.26)	ns
Concentration	3.70 (1.20)	4.56 (.64)	<.05
Unusual	2.95 (1.15)	3.01 (.77)	ns
Age of event	14.92 (5.26)	15.11 (3.69)	ns
Pleasant. Event	3.52 (1.11)	3.54 (.66)	ns
Pleasant. Memory	3.43 (1.04)	3.77 (.71)	ns

General Discussion

In two experiments, we have experimentally manipulated for the first time the nature of the cues used to elicit involuntary memories, by comparing pictorial cues with their verbal label (presented in a visual modality). Pictorial cues were found to be significantly less effective in eliciting IAMs not only when the cues represented relatively more complex situations (e.g. relaxing on a beach, Experiment 1) but also when they were pictorial representations of very simple objects (e.g. a ball, Experiment 2). There was no significant difference between the effect of verbal and pictorial cues on the recency of the event. With both cues, memories dated back a few years (at age 15-16, i.e., 3-4 years before the test).

This recency effect is consistent with what has been previously reported in the literature (see Berntsen , 1996, 1998; Berntsen & Hall, 2004).

There was only one significant difference in the qualities of the memories accessed by the two types of cues. Memories elicited with pictorial cues were rated as more vivid than those elicited by verbal cues, but only when the cues were complex (i.e., in Experiment 1). Taken together, these data suggest that, compared to verbal cues, pictorial cues hinder memory retrieval. The two types of cues provide access to the same pool of memories, with more complex pictorial cues seemingly enhancing the visual quality of the memories.

The inferiority of pictorial cues is a rather surprising result if one considers the extensive evidence showing that pictorial information facilitates memory (e.g. Erdelyi & Becker, 1974; Madigan, 1974; Nelson, Reed, & Walling, 1976; Paivio, 1971; Paivio, 1991;Shepard, 1967; Standing, Conezio, & Haber, 1970; Standing, 1973). Our data also seem surprising in light of the results of a recent study in which verbal, visual and odour cues were used to elicit autobiographical memories (Miles & Berntsen, 2011) and no difference was found between verbal and visual cues. However in that study participants were requested to voluntarily recall personal memories, and only a small set of 12 cues were presented, exclusively referring to objects with clearly defined odours (e.g. mint, chlorine, mustard). According to current models of retrieval from autobiographical memory (e.g. Conway & Pleydell-Perce, 2000), cues in voluntary retrieval most likely set in motion a top-down hierarchical search through autobiographical memory, from life themes, to general events, to specific event knowledge; while in involuntary memory cue activate existing memories via spreading of activation plus selective match (see Berntsen et al, 2013). Given the differences in retrieval processes, it is not surprising to find different results in voluntary and involuntary retrieval tasks.

The inferiority of pictorial cues is also inconsistent with the idea that pictorial cues should facilitate autobiographical voluntary retrieval because of an enhanced direct access to the event-specific knowledge base in autobiographical memory (Conway, 1992). According to our results, pictorial cues not only do not seem to facilitate, they seem to hinder retrieval from autobiographical memory, which suggests that either it is not true that pictorial cues enjoy an enhanced direct access to autobiographical memory representations, as suggested by Conway (1992), or indicate that such enhanced access might work against successful retrieval in IAMs. We will discuss below how the inferiority of pictorial cues can be explained.

Our data, however, are in agreement with the results of a diary study showing that abstract cues, including verbal cues, were reported to be more effective in the retrieval of IAMs compared to sensory/perceptual cues (Mace, 2004). In that study, sixty-eight percent of IAMs were reported to be triggered by abstract cues, a result interpreted as suggesting that direct involuntary retrieval seems to be more likely to occur with cues that 'are more cognitively elaborate' (Mace, 2004, p. 898). Although this explanation might apply in principle to our results, there is no reason to assume that our verbal cues were more cognitively elaborate than the corresponding pictures. Rather than being less cognitively elaborate than verbal cues, we believe that the disadvantage of pictorial cues lies in the nature, more than in the amount, of cognitive elaboration triggered by the cue.

Consistent with the idea that the differences in the way (rather than the amount) pictorial and verbal cues are elaborated is the key reason for their different effectiveness in eliciting memories are results reported by Gary and Wade (2005) who compared the effectiveness of pictorial cues (photos of scenes) with that of narrative describing the same event in producing personal memories. The focus of their study was on the creation of false memories. For this reason they presented narratives about non-existing events, and compared them to seeing photos of the same events. As in our study, in that study too pictorial cues

resulted to be *less* effective than verbal cues in eliciting (false) autobiographical memories. We think that the inferiority of verbal over of pictorial cues in the activation of IAMs is due to processes similar to those hypothesized by Garry and Wade (2005) to explain the superiority of narratives (and the –in comparison- inferiority of pictures) for false memory creation (for a clear effect of personally-relevant information on false memory creation see Scoboria, Mazzoni, Jarry, Bernstein, 2012). Specifically, we believe that the claim that verbal cues are superior because they "allow and even demand that subjects generate their own details" and that pictorial cues block this possibility (Garry &Wade, 2005) could be adapted to explain our results in involuntary retrieval. In other words, cues that are likely to elicit personally-relevant details might produce better overlap between the cue and the memory representation even in an involuntary task.

Successful retrieval in IAMs is due to an initial spreading of activation stemming from the cue, followed by a match with an existing memory representation (Ball, Mace, & Corona, 2007; Berntsen & Hall, 2004; Berntsen, 2009, 2010). Adapting Garry and Wade explanation to our results, verbal cues do not hinder the match with an existing personal memory while pictorial cues do. One major difference between the picture of a ball (for example) and the word 'ball' is the presence in the picture of specific details that are missing in the word. The ball is a very specific object that has a specific color and shape. These additional details might hinder, rather than facilitate, the activation of episodic information in memory, because they may be inconsistent with the potentially remembered event. According to this explanation, verbal cues allow the creation of mental representations that are consistent with the individual's personal knowledge and experiences, thereby facilitating a match between the cue and existing memory representations. We emphasize here the potential crucial role of activating personally-relevant information in the retrieval of IAMs. Personally-relevant mental contents activated by the cue enhance the likelihood of having a

successful unique match with existing memory representations, which in turn boosts memory reports. This mechanism is consistent with the principle of cue-item discriminability (Rubin, 1995) which refers to the ability of a given cue to evoke in memory one specific item among many when the cue activates an associative network. Personally relevant information is in most cases sufficiently distinct to discriminate one specific past event from others that are also activated via spreading of activation. According to this interpretation, the distinctive information provided by the presence of details in a pictorial cue is not, per se, the element that would enhance item discriminability. Rather, in IAMs, cue-item discriminability would be maximized when the cue and its details activate mental representations that are part of the individual's existing personal experiences.

The same rationale explains the ineffectiveness of pictorial cues. The presence of specified details in pictorial cues might hinder the likelihood of obtaining ad adequate match. Details in pictorial cues might be too specific to correspond to the very elements that characterize each individual personal experience. Specific pictures chosen by an experimenter (or occurring naturally in the social environment) are likely to contain details that are inconsistent with those memory representations. For example, suppose that a person has had a golden retriever as a pet. The word 'dog' might activate an image of that particular breed of dog, which is part of the personal experience of that individual, and trigger a memory for it. Conversely, if the pictorial cue is a picture of a collie, it is less likely to activate the image of a retriever and, hence, less likely to elicit an involuntary autobiographical memory in that person. Thus, in the retrieval of IAMs, specific elements in a cue might hinder the activation of an existing memory if these elements are different from those in the memory.

An alternative explanation for pictorial cues to be less effective than their corresponding verbal labels refers to cue overload principle. A higher number of details

might hinder successful retrieval if each acts as an independent cue, thus raising the number of possible links between the cue and memory and creating a cue overload (Watkins & Watkins, 1975; see also Berntsen et al, 2013 for the effect in IAMs). However, a comparison of the data between Experiments 1 and 2 suggests that this explanation does not hold, as we found that the rate of retrieval was almost double when pictorial and verbal cues referred to complex events (Experiment 1) than when they referred to simple objects (Experiment 2). Although comparisons of the results of separate experiments need to be interpreted cautiously, these data suggest that the mere number of details in a pictorial cue is not the factor responsible for the lower effectiveness of pictorial cues.

Although specified details in pictures might not act as independent sub-cues, it is still possible that pictorial cues trigger less memories because of interference at retrieval. According to some authors (e.g. Conway, 1992), pictorial cues have easier direct access to specific memory representations. If it is true that pictorial cues have facilitated access, this might imply spreading activation across a larger number of memory representations compared to verbal cues, producing similar levels of activation in a number of memory candidates, thus creating competition at retrieval in a way that mirrors retrieval induced forgetting mechanisms in episodic memory tasks (e.g., Anderson, Bjork & Bjork, 2000; Saunders & MacLeod, 2006). Retrieval induced forgetting has not only been observed in memory for simple episodic information, it has also been shown to occur in autobiographical memory (Barnier, Hung & Conway, 2004). Involuntary retrieval necessarily implies two mechanisms, one that makes activation of existing memories possible, and the other that enhances cue-item discriminability (see also Berntsen et al, 2013). We believe that personally-relevant information in the cue serves the function of enhancing cue-item discriminability more than interference mechanisms at retrieval. It is however the task of future studies to understand the contribution of each mechanism in explaining the observed

inferiority of pictorial cues. These processes do not have to occur at an aware level. In the retrieval of IAMs, the accessibility to personally relevant information facilitated by the cue can enhance the activation and retrieval of personal memories outside of awareness, as spreading of activation is not a process of which people are aware. Similarly, both the cue overload effect and retrieval-induced forgetting are mechanisms that occur outside of awareness.

This is the first study in which the nature of the cue for the retrieval of involuntary memories has been experimentally manipulated. While in Mace (2004) abstract cues were reported to be more effective than sensory/perceptual cues, the 'abstract' category was rather over-inclusive, including both thoughts and words/phrases, with no distinction between verbal cues and thoughts that referred to concrete objects/actions/persons and cues that were indeed abstract. Our verbal cues referred to concrete/perceptual experiences, a characteristic that might turn out to be important in eliciting IAMs. Future studies should examine whether this type of verbal cues is more effective for involuntary retrieval compared to both abstract verbal and pictorial cues. Compared to abstract verbal cues, concrete/perceptual verbal cues might more easily refer to life experiences and thus increase the likelihood to create a positive match with existing memory representations.

Finally, we have shown here that different methodological approaches to the study of involuntary memory seem to lead to similar results, our data confirming for example the superiority of verbal cues found in a previous diary study (Mace, 2004). However, we believe that a better understanding of involuntary retrieval processes requires complementing data obtained via diary methods with experimental data in which variables can be reliably manipulated.

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Authors' note: The paper reports two studies run in partial fulfillment of Iram Batool doctoral dissertation at the University of Hull.