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Involuntary Retrieval from Autobiographical Memory
and The Nature of Cues

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by

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Abstract

The present thesis starts by exploring the possibility of eliciting involuntary autobiographical memories (ABMs) in the laboratory, as a preliminary step in studying the retrieval process of involuntary ABMs. The main aim of the thesis is to test whether involuntary ABMs (IAMs) can be successfully elicited in the lab, to assess whether cue manipulation changes the patterns of memories reported, and to compare IAMs and voluntary ABMs. We adopted the basic experimental paradigm recently developed by Schlagman & Kvavilashvili (2008) with a slight but important modification to it. A series of seven experiments were conducted and a total of 310 participants, participated in these experiments. Results of Experiment 1 indicate that instructing participants about involuntary memories increased significantly the number of involuntary memories reported. A clear increase in memories was obtained also when the interruptions were scheduled by the experimenter. These results indicate that the amount and type of involuntary memories depends strongly on the method used to elicit these memories. Three subsequent experiments (Exp, 2, 3, 4) have been devised to examine whether it is possible that by manipulating the cues in an experimental setting, different numbers of involuntary autobiographical memories are elicited, and memories have different qualities. The results of both experiments 2 and 3 confirm that pictorial cues are less effective in triggering IAMs than the verbal cues of the same items. In Experiment 4 we tested the possibility that concrete verbal material elicits more memories than abstract verbal material. The results of this study indicated that concrete verbal cues elicited more than twice as many IAMs than abstract verbal cues, showing that a clear concreteness effect was found when retrieval is involuntary. To explore the role of additional visual details and the distinctiveness of the items in a visual cue in triggering involuntary autobiographical memories, Experiment 5 was conducted. We found that the addition of visual details did not have a significant effect on the number of reported IAMs. In Experiment 6 we examined if adding a relatively specific detail to the cue would enhance the likelihood for that cue to trigger an involuntary memory. The results of this study showed that adding specific details to a cue tends to enhance the possibility to retrieve involuntary memories for personal events, although the results

are not significant. To assess whether the effect of the concreteness/imageability of the cues observed in involuntary memory retrieval can be obtained in a parallel task in which autobiographical memories are obtained through voluntary retrieval we ran the last experiment (Exp 7) in the dissertation. The results of this experiment confirm the difference in effectiveness between concrete/high imagery and abstract/low imagery cues already found in Experiment 4. The results of Experiment 7 show that concrete cues are more effective in general, independently of the type of retrieval, whether involuntary or voluntary. Overall, these results indicate that involuntary memories can be elicited in a lab setting, that by manipulating the cues one manipulates also the number and characteristics of involuntary memories. In addition and unexpectedly, involuntary memories are about general and single events. This result is the opposite of what has been known from diary studies about IAMs, which have been reported as being more specific compared to voluntary memories. We offer a number of explanations of why IAMs are less specific than voluntary memories. However, being post-hoc explanations, work still needs to be done to assess them in a direct way.

Iram Batool

Dedicated

*To the hard times of my life which
strengthen me and enable me to achieve
my goals*

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Chapter: 1

Introduction

We interact daily with the world and daily we have various experiences. We remember some and forget some as an individual does not remember everything from his past. Probably it is those noticeable and important experiences that remain in our memory system. When we recall our past, we retrieve some experiences from our memory system and such experiences or memories are called autobiographical memories. Autobiographical memories are defined in different ways by different researchers in different periods. Some have defined these memories as a representation of one's personal experiences that may be both general and specific in nature. Some talk about autobiographical memories as the way in which a person recalls his past life and reports some personal facts.

Autobiographical memory is defined as the recollection of the past, sometimes this recollection is deliberate and sometimes it is spontaneous. Deliberate retrieval is called voluntary memory whereas spontaneous recollection is known as involuntary memories. Hermann Ebbinghaus (1885/1964) appeared to be the first memory researcher to attempt to define voluntary memory as he said:

“In the first group of cases we can call back into consciousness by an exertion of the will directed to this purpose the seemingly lost states (or, indeed, in case these consisted in immediate sense-perceptions, we can recall their true memory images): that is, we can reproduce them voluntarily. During attempts of this sort, – that is, attempts to recollect – all sorts of images toward which our aim was not directed, accompany the desired images to the light of consciousness. Often, indeed, the latter entirely miss the goal, but as a general thing, among the representations is found the

one which we sought, and it is immediately recognized as something formerly experienced". (p. 1)

According to Linton (1978), *Autobiographical memory* is defined as recollection of personal experience, memory for naturally occurring, "real-world" events. The term *autobiographical* suggests that there are memories which direct reference to the *self* (Conway, 1992; Fitzgerald, 1999) and are stored without benefit of conscious memory activity (Fitzgerald, 1986). The reference to the self in Linton's definition is crucial, as defining autobiographical memory as the memory of past experiences, his definition would completely overlap with the definition of episodic memory given by Tulving (1972). According to Tulving's definition information come from naturally occurring past events that take place outside the laboratory. Instead referring a past event to the self indicates that specific episodic recollection of the past from an individual's personal life.

The autobiographical memory system however does not consist only of episodic memory, it also contains semantic knowledge. Episodic memory consists of information regarding specific objects, persons, events and personal incidents whereas general knowledge and knowledge about facts is present in semantic memory. In the case of semantic autobiographical memory, the knowledge is about the self and the individual person's history. However, in their approach Crovitz and Schiffman (1974), said that autobiographical memory is the memory of a specific event and Tulving (1972, 1983), believed that autobiographical memory refers almost exclusively to episodic rather than semantic memory about oneself (Tulving, 1972, 1983). In other words, some scholars in the past have conceived autobiographical memory as being basically episodic.

Autobiographical memory is associated with two other major types of memory i.e. semantic memory and episodic memory. Semantic memories are memories which deal with retention of meaning and abstract information and do not have specific association with the individual's temporal-spatial existence. Sometimes autobiographical memories overlap with semantic memories. Such semantic-autobiographical memories can be seen as memory of the fact or memory of the episode where you were told about that fact. There are two main differences between the way in which semantic memory and autobiographical memory works. The first difference is the neurological area(s) related with semantic and autobiographical memories, and the second is the way of encoding in which semantic memories and autobiographical memories are encoded into memory. The exact location of semantic memory is still under debate but it is somehow clear that there is some degree of separation from autobiographical memories. The parahippocampal cortices are assumed as the first area where semantic memory resides. Vargha-Khadem et al. (1997) found out that patients whose hippocampus was damaged or removed still had some semantic memory ability whereas their episodic memory was severely impaired. Later on it was found that semantic memory is not simply confined to the medial temporal lobes. Oliver and Thompson-Schill (2003) found some hemispheric differences with certain types of semantic memory and parietal lobe activation.

As far as the second difference is concerned, models of memory (e.g. the Multi-Store Model of Memory and the Levels of Processing Model of Memory) talk about the prevalence of repetitious and elaborative ways of encoding semantic memory, which are therefore more complicated than autobiographical memory (Craik and Lockhart, 1972; Atkinson and Shiffrin, 1968). Whereas in autobiographical

memory such active processes do not occur and autobiographical memory is passive, automatic and is recorded without rehearsal or elaboration.

It is important to understand the difference between autobiographical facts and autobiographical memories. The former are basically a set of knowledge about existing personal facts, and no effort is required to recall any particular fact or episode (e.g. Mr. X was your primary school teacher), whereas the latter refers to information about personal past experiences. At times individuals put effort in trying to recall such experiences; at other time these memories spontaneously come to one's mind. The nature of retrieval is very important and on the basis of this dimension autobiographical memories have been distinguished between two major types, i.e. voluntary and involuntary memories. The deliberate effort to recall past experiences has been referred to as voluntary memories, whereas spontaneous recollections of past events were termed involuntary autobiographical memories (Ball, 2007; Berntsen, 1996, 1998; Mace, 2007; Schlagman and Kvavilashvili, 2008).

Since autobiographical memory plays a central role in human functioning, and in contributing to an individual's sense of self, its vital role is to enhance the ability to remain oriented in the world and to move towards one's goals effectively with past problem solving experiences. For interpersonal goals, such orientation is very important and autobiographical memory contributes a lot to a shared social world (Conway and Pleydell-Pearce, 2000; Nelson and Fivush, 2004).

Some approaches stress that the ability to remember in episodic memory (such as the knowledge of being born in a particular hospital or place) reflects accessing a trace for a real event (Tulving, 1972), whereas others talk about the fact that memories can be reconstructed (Brewer, 1986). Autobiographical memories are the memories which are mainly auto-noetic, and contain unnecessary, irrelevant detail and vividness.

Unconscious reconstruction of these memories can happen to achieve cohesiveness with newer information. One should also differentiate between generic autobiographical memories and specific autobiographical memories (Neisser, 1986). Memories of repeated, mundane events are generic autobiographical memories whereas specific autobiographical memories included specific and novel events of the past. The phenomenon of flashbulb memories can be thought of as a class of specific memories.

Perspective in the memory is also an important dimension of autobiographical memory. Nigro and Neisser (1983) for example found two significant types of memory perspective: the observer viewpoint (i.e. from an outside viewpoint, not the person's own) and the field viewpoint (the viewpoint of the individual whose memory it is). The difference between memories and reconstructed memories can be highlighted by using these two differences. With these differences it can also be seen how autobiographical memories alter with time (Nigro and Neisser, 1983; Robinson and Swanson, 1993). But another way, sometimes autobiographical memories are representations from an *observer* perspective and sometimes from a *field* perspective. Nigro and Neisser (1983) argued that some people remember their memories from a field perspective (i.e. original view point of the experience) and many memories were reported from an observer perspective (i.e. viewing the event from the outside). Nigro and Neisser stated that memories of recent past events were probably copy-type memories and re-experienced from original view point but the case is different for old memories and those reported from observer's viewpoint. In a replication Robinson and Swanson (1993) found more vividness in field memories, and it was possible to switch perspectives and to recall the memories in either the field or observer perspectives.

Williams, Conway and Cohen (2008) identify different dimensions of autobiographical memory:

1-Sometimes autobiographical memories may include biological facts, for example a person remembers the fact that he was born in specific city without any actual memory of living in that place. Such type of factual memory is named by Tulving as *noetic*. It is opposite the experiential type of memory which is called *autonoetic* memory. For example when one remembers any specific time he or she can relive the experience with associated sensory imagery and emotions.

2- Some personal past experiences are more vivid and contain a substantial amount of irrelevant information compared to the others. Brewer (1986) argued that memories of past experiences vary in the extent to which they are similar to or reconstructions, of that original experience. Some past experiences contain very vivid and detailed information and look like a copy of that event whereas some past memories contain inaccurate information rather than actual experiences. These latter examples are also considered reconstructed memories and they incorporate the interpretations made with hindsight of the events experienced.

3- Sometimes a memory of any particular or specific past event comes to our mind and sometimes generic events of previous life trigger it. So it seems that autobiographical memories are about specific or generic past experiences. Neisser (1986) pointed out that series of similar past experiences were representations of personal memory and named this type of blended memory “episodic”.

The Distribution of Autobiographical Memories across the Life Span

Rubin, Wetzler, and Nebes (1986) talk about the distribution of autobiographical memories across the life span. They said that an adequate model

mainly contained three components, namely (1) *Retention function*, (2) *an early childhood memory or childhood amnesia function* and (3) *the reminiscence bump*. A retention function mainly focuses on the monotonically decreasing frequency of reported memories. For this component it is said that with the passage of time, memories lose their accessibility. In the beginning of the retention period, the forgetting curve has a sudden drop whereas when the retention time increases there is slower decline in forgetting. A retention function was described mathematically by a power function. Crovitz and Schiffman (1974) used a power function in the first quantitative description of the distribution of autobiographical memories. A power function provides the best mathematical description of the curve for autobiographical memories (Crovitz and Schiffman, 1974; Rubin, 1982; Rubin and Wenzel, 1996).

Childhood amnesia is the second component and it refers to the reduction in memories coming from the earliest years of one's life. This component is also found among old people, as they judge their vivid and important memories as coming from childhood and early adulthood. Many researchers gave competing explanations for this phenomenon for which there is strong empirical support (e.g., Bruce, Dolan, and Phillips-Grant, 2000; Eacott and Crawley, 1999; Nelson, 1993; Pillemer and White, 1989; Rubin, 2000).

The third component of this model is *the reminiscence bump*. There is extensive work done on this phenomenon and evidence is well documented. It was found that over the age 40, people remember the information encoded during adolescence and early adulthood in a better way than the information encountered in the surrounding periods of life (see Rubin, Rahhal, and Poon, 1998, for an overview). Rubin, Wetzler and Nebes (1986), reanalysed several studies on word-cued autobiographical memories and drew attention to the reminiscence bump. Many

studies on word-cued memories also found the bump for example (Hyland and Ackerman, 1988; Jansari and Parkin, 1996; Rubin et al., 1986; Rubin and Schulkind, 1997a, 1997b), some asking about the most vivid memories, as well as memories of the most important past event (Cohen and Faulkner, 1988; Fitzgerald, 1988; Fitzgerald, 1996; Rubin and Schulkind, 1997a, 1997b). Some work was conducted also examining life narratives (Fromholt and Larsen, 1991, 1992) in which participants were asked about their most important events on a time line (de Vries and Watt, 1996). Rubin and Schulkind (1997b) conducted a study and compared people of different age groups (20-70 years old). They compared the same older adults, and found the bump of age being around age 10-30 for word-cued memories, but for important memories their bump was from age 20 to 30. In some other studies a bump was found for memories of factual information (i.e. knowledge of historical, political, and cultural events, Belli, Schuman, and Jackson, 1997; Rubin et al., 1998; Schuman and Rieger, 1992).

Later on Berntsen and Rubin (2002) conducted a study and they examined the distribution of emotionally charged autobiographical memories or of memories retrieved involuntarily across the life span. They examined the most important, happiest, saddest, most traumatic memories, and most recent involuntary memories of the personal past among participants of age range 20-93 years old. They also aimed to explore the patterns of retention among different kinds of emotional memories. They found a clear difference for the positive and negative memories. A clear bump was found in the 20s for the most important and happiest memories among participants over 40, whereas a monotonically decreasing retention function accounted the saddest and most traumatic memories. Berntsen and Rubin (2002) suggested a modification of the standard accounts of the bump given by Rubin et al. (1998). They further argued

that the dissociation between emotionally positive and emotionally negative memories can be explained by three different theoretical frameworks: a *cognitive* framework, a *narrative/identity* framework, and an account based on *life scripts*. The latter account was introduced Berntsen and Rubin (for details see, Berntsen and Rubin, 2002).

Researchers have stressed the “adaptive significance” of autobiographical memories (AMB) across the life span (Cohen, 1998; Tulving, 2002). Different researchers studied autobiographical memories in different dimensions and tried to explore the relationship between ABMs with different aspects of personality. Self is an important aspect and it was found that there is a strong link between ABMs and the building of one’s self. There is a strong argument that ABMs act as a reinforcer for the sense of self. It was found that one’s past experiences play a strong role in the achievement of interpersonal goals, and these past experiences which were named as autobiographical memories perform a directive function for a wide range of behaviours. It was concluded that people learn from their past experiences and modify their present behaviours in the light of their past experiences (Hyman and Faries, 1992; Pillemer, 2003a, 2003b; Williams, 2004). Before these findings there was a pervasive view that semantic memory guides one’s present and future behaviour (see Pillemer, 2003a, 2003b).

To get an understanding about the relationship between history and memory Brown et.al (2009) conducted a cross-national study. Previously it was argued that past experiences played a critical role in the construction and maintenance of group identity and was implicated in the persistence of group conflict (Bar-Tal, 2007; Cairns and Roe, 2003; Halbwachs, 1992; Pennebaker, Paez, and Rime’, 1997; Tessler, Konold, and Reif, 2004). Brown and his colleagues investigated the relation between history and memory from a new and different angle and the main focus of

investigation was around the organization of memory. They explored the significance of memories of critical events (e.g. war, terrorism, and natural disaster) of the past. They argued that such memories played a vital role in the construction of group identity and the persistence of group conflict. When there was a direct, forceful, and prolonged impact of public events, the impact of personal memory and knowledge of the collective past become less effective. In response to cue words, Bosnians mainly talked about their civil war whereas Izmit Turks frequently recalled earthquake in their country and very rarely participants belongs to different nations (Serbs, Montenegrins, Ankara Turks, Canadians, Danes, or Israelis) talked about respective public events. They concluded that historical importance of public events is not the determinant but it is personal significance of that event which played important role in organizing autobiographical memory.

Investigations of autobiographical memory have been conducted in many different contexts. Some research was done to explore its nature and function (for example, Pillemer, 1998; Rubin, 1996; Wheeler, Stuss, and Tulving, 1997) and social factors in its early development were investigated by different researchers (e.g., Nelson and Fivush, 2004; Reese, 2002). The phenomenon of encoding and its related and underlying processes were examined. It was explored that how events are encoded, retrieved, and forgotten (Castel and Craik, 2003; Hertel and Gerstle, 2003; Lancaster and Barsalou, 1997; Schacter and Slotnick, 2004; Tulving, 1983, 2002; Tulving et al., 1994). How autobiographical memory play role in organizing one's sense of self (Conway and Pleydell-Pearce, 2000) and the aspects that are affected by neurological damage (e.g., Burgess and Shallice, 1996; Conway and Fthenaki, 2000; Rugg and Wilding, 2000).

Talarico, Labar, and Rubin (2004) planned a series of experiments to investigate the interaction of emotional dimensions (i.e. valence and intensity) on the accuracy, persistence, and quality of autobiographical memories. Their main aim was to determine whether either of these patterns would emerge for autobiographical memories. They conducted four experiments in which their participants generated autobiographical memories in response to 20 distant emotional categories (i.e. amused, annoyed, calm, relieved, surprised etc). The given emotions varied in valence (positive vs. negative) and intensity (high vs. low). After reporting past experiences related to a given list of emotions, all the participants had to rate their reported memories on various perceptual, cognitive, and emotional properties. They found that intensity of emotion affects the properties of autobiographical memories more than valence. Another important feature of autobiographical memory has been explored by Williams et.al (2007). They found that autobiographical memory is closely linked with the psychopathology of emotion: overgenerality.

Williams, et.al (2007) review paper showed that when many emotionally disturbed patients recall autobiographical events, they summarize categories of events rather than retrieving a single episode. This phenomenon was named as overgenerality, and they examined the mechanisms underlying such overgeneral memory. They based their theorizing on Conway and Pleydell-Pearce's (2000) hierarchical search model of personal event retrieval. They described an elaboration of their model that focuses on three interacting mechanisms i.e. capture and rumination, functional avoidance, and executive control. They explained that in retrieval when mnemonic information is used, ruminative thinking is activated. Further they said that episodic material that threatens to cause affective disturbance and impairment in executive capacity and

control limits an individual's ability to remain focused on retrieval in the face of distraction.

Autobiographical memories and problem solving ability

A unique link was found between the specificity of autobiographical memories and problem solving ability among old and young adults. Beaman, Pushkar, Etezadi, and Conway (2007) assumed that old adults have poor social problem solving ability and have less specific ABMs than young adults. They hypothesized in their study that old adults have age-related cognitive decline and are unable to recall their specific past experiences, so they have less ability to solve their social problems as compared to young adults. They found that ABM specificity is a predictor of social problem-solving performance among young and old adults. The findings of their study supported the previous findings that autobiographical memory performs a directive function across the life-span. For example, Goddard, Dritschel and Burton (2001) assumed that retrieval of specific autobiographical memories improve social problem solving ability among depressives. They concluded that recall of past specific life events improved problem-solving ability among depressed patients. In line with previous research, age differences were found in retrieval of autobiographical memories and cognitive ability. Cognitive ability was found as a predictor of retrieval of ABMs (Bunce and Macready, 2005; Hertzog et al., 2003; Riby et al., 2004).

Maurex, et al. (2010) has conducted a study to investigate the retrieval of autobiographical memory and social problem-solving performance. They explored these phenomenon among individuals with borderline personality disorder (BPD) and a history of suicide attempts, with and without concurrent diagnoses of depression and/or post-traumatic stress disorder (PTSD) in comparison of controls. Additional

aim was to explore the relationships between autobiographical memory, social problem-solving skills and various clinical characteristics among BPD. Reduced specificity of autobiographical memory, and poor problem-solving skills, was found among the depressed BPD group. They concluded that reduced specificity of autobiographical memory is an important characteristic of BPD individuals and it is related to poor social problem-solving capacity in the BPD group.

Recently, Uzer, Lee, and Brown (2012) conducted series of experiments to address two key research questions. First question was to explore whether direct retrieval can occur when memories are deliberately recalled. Their second purpose of the study was to compare ease-of-retrieval account with a dual-strategies account. They used three converging methods, 1) concurrent verbal reports, 2) retrieval times, and 3) a measure of information use during retrieval. Each of these methods was designed to differentiate direct from generative retrievals. Experiment 2 was replicated with three differences, 1) participants were not required to provide verbal protocols when retrieving memories, 2) participants were tested in solitude and 3) retrieval strategy question was manipulated. In third Experiment, same procedure (used in experiment 2) was followed. Across three experiments, they found that autobiographical memories were recalled by two different retrieval mechanisms, one is direct retrieval route, which is fast and effortless and nonstrategic, and the other is slower generative route, in which searching memory for task-relevant information is included. They also found that direct retrieval was at least as common as generative retrieval. Their findings contradict a common belief about personal memories, that personal memories are usually generated in tasks that use the word-cueing task (Conway and Pleydell-Pearce, 2000; Haque and Conway, 2001; Rubin and Schulkind, 1997a, 1997b; Conway, 2005; Reiser et al., 1986).

Individual differences in Autobiographical memories

Individual differences were also one of the dimensions of Autobiographical memories which were addressed by different researchers at different points in time. For example Barclay and Wellman (1986) conducted a study to find out the accuracy of autobiographical memories. They asked their participants to record everyday autobiographical events over four months. After recording their past experiences participants were asked to perform a recognition task. The task consisted of original items and foil items. Original items were matched with participants own records whereas foil items were basically distracters (i.e. altered records or records of some other participants). They found that after some weeks participants were failed to identify original items as their own memories. They concluded that people were unable to recall their autobiographical memories accurately over time

Horselenberg Merckelbach, Breukelen and Wessel (2004) conducted a study to explore individual differences in accuracy of autobiographical memories. They were interested to see whether there was any effect of personality traits (i.e. fantasy proneness, dissociation, absorption, suggestibility and depression) on the retention of accurate past memories. A diary method was used for recording of memories and after six month participants were given an unexpected recognition test. They found that most participants recognized their original memories but some of them experienced difficulty in recognizing their recorded memories (i.e. original items in recognition task). They also found that individuals with “fantasy proneness” personality trait performed better on the recognition task than other personality traits which were dissociation, absorption, suggestibility and depression.

Philippot, Schaefer and Herbette (2003) conducted two studies to examine the relationship between emotional intensity and generation of autobiographical

memories. According to the authors, this is the first time in which the level of specificity vs. generality of autobiographical memories was manipulated. There were two main hypotheses in this study, (a) that there is a positive relationship between emotional intensity and specificity of personal memories, (b) that retrieving specific past experiences or personal memories requires an inhibition of emotions. The results of their study supported their first hypothesis and they concluded that specific emotional autobiographical memories increase the intensity of emotion. For the second hypothesis, results supported the strategic inhibition hypothesis.

Some other researchers compared younger and older adults and found that in comparison with young adults, older adults recall more general memories or experiences from their past and these experiences contain fewer contextual and sensory details (Anderson, Cohen, and Taylor, 2000; Levine, Svoboda, Hay, Winocur, and Moscovitch, 2002; Piolino, Desgranges, Benali, and Eustache, 2002; Piolino et al., 2006). Other studies were conducted to see whether autobiographical memories retrieved were more about recent past or older past. The findings of these studies revealed that when people were asked to recall their past experiences, they mostly talked about their recent past. In other words, most retrieved memories were voluntary because they were intentionally recalled and mostly he/she recalls recent past events (Janssen, Chessa, and Murre, 2005; Rubin, 1999, 2000).

Functions of Autobiographical memories

It is important to understand why did we have autobiographical memories and what are the functions of autobiographical memories. Functional explanations of autobiographical memory have assumed three separate functions for this memory system i.e. directive, social and self functions. Directive function guide future

behaviour, social function improves social cohesion among people and with self functions one can maintain and facilitates conceptualizations of the self (see for review, Baddeley, 1988; Conway, 1996, 2005; Bluck and Alea, 2002). Detail of these functions are given below.

Directive function

Autobiographical memory has some directive functions, for example using past experiences and getting guidance from them to shape present and future behaviour, getting help to problem solve and also to work as a tool for future predictions (Baddeley, 1987). To deal with current daily life problems, it is not always possible to rely solely on general or schematic knowledge from our past. Sometimes it is useful to get information or knowledge from autobiographical memory. To solve any current problem it is quite helpful to search a past experience which is similar to that particular situation or any specific situation where one encountered the similar problem. To know the way to behave in social and professional contexts, deal with practical problems for example changing a tyre or buy a ticket for a concert, knowledge based on past experiences of similar kind is used. The practical importance of this directive function of autobiographical memory and the evolutionary significance are emphasized by Pillemer (1998, 2003). Some example of change in behaviour referring to how Americans get direction from autobiographical memory of past specific event (September 11, 2001 event) was discussed in details. He concluded that personal past experiences direct and guide present behaviour.

Social

Neisser (1988), like others, considers the social function of autobiographical memory as a fundamental function of memory. In social interactions, information

from past experiences is used. People share their past experiences and with sharing memories and having conversations they become friends. Self-disclosure of personal experiences, with others who were not in that original experiences, increase intimacy, understanding and sympathy. It bring opportunity of “placing ourselves” in a specific context and culture. Sharing of past experiences, with those who were part of past experiences, play role in enhancing social bonding and intimacy among social groups (Bluck, 2003; Fivush, Haden, and Reese, 1996). Research work done by Robinson and Swanson (1990), highlighted the importance of autobiographical memories in building and strengthening social bonds and research also showed that when episodic remembering is impaired, social relationship can suffer. Some other researchers work in this area found some other related aspects. For example potential evolutionary adaptivity has been tied to the social functions of autobiographical memories (Neisser, 1997; Nelson,2003) conversations become more believable and persuasive if they involve sharing personal past experiences (Pillemer,1992a). Particularly in parent child interaction, sharing of past experiences is very helpful and useful in educating and informing the child (Bluck, 2003; Fivush, Berlin, Sales, Mennuti-Washburn, and Cassidy, 2003).

Self

The relationship of the self with personal past experiences is the defining characteristics of autobiographical memory. Significant personal past experiences are recollected and such events are a database for the construction of the self (Conway, 2005). Personal past experiences are very important and play a vital role in the development of personal identity. The interaction between self and memory is viewed as the most important function of autobiographical memory by memory researchers. Knowledge based on personal past experiences act to constrain what the self is, was

and will be in the future (Conway, 2005). To build coherence with the current aspects of self, memories of the past might be modified, twisted or fabricated (Conway, 2005). According to Conway (2005) central aspects of self and memory are assumed as a coherent interdependent system. In that system autobiographical memories support and confirm beliefs and knowledge about the self. In Conway's model, the working self and autobiographical memory have a reciprocal relationship within a self-memory system (SMS).

Whenever memory researchers try to explain why different types of autobiographical memories are different from other types of memory, they use the function of the memories for reference. For example it is often concluded that autobiographical memories play distinctive self related functions (see for review, Baddeley, 1988; Neisser, 1982a). Information that is crucial to our survival is contained in emotionally negative memories more than positive memories and, because of this, the two types of memories are different on other characteristics (for review see. Freud, 1920/1952; Talarico, Berntsen and Rubin, 2009; Taylor, 1991).

Robinson (1986) proposed that the self was a "resource" for autobiographical memories and these memories could be used to sustain or change aspects of the self. Different personality aspects were found to be closely related (McAdams, 1982, 1985; McAdams et al., 1997; Woike, 1995; Woike, Gershkovich, Piorkowski, and Polo, 1999). Brewer (1986) argued that autobiographical memories could be defined by their inherent self-referring nature and because of this these memories can be easily distinguished from all other types of long-term knowledge.

Singer and Salovey (1993) examined "self-defining" memories and their relationship with current goals and psychological well-being. The role of memories in building stable self-system and how they contribute to different aspects of self such as

generation identity has been investigated by many researchers (Beike and Landoll, 2000; Conway and Rubin, 1993; Conway and Tacchi, 1996; Conway, 1997a; Conway and Haque, 1999; Fitzgerald, 1988, 1996). Some other authors emphasized negative aspects of relationship between self and memory such as distortion of current beliefs and fabrication of memory have given similar priority to the connection between the self and memory but emphasized more negative aspects of this relation such as the distortion and even wholesale fabrication of memory in favour of current self-beliefs. They have highlighted influences of the self on encoding and recall of memory (Barclay, 1996; Barclay and Wellman, 1986; Conway et al., 1996; Conway and Tacchi, 1996; Greenwald, 1980; Mullen, 1994; Ramachandran, 1995; Ross, 1989; Solms, 1995, 1999; see Hastorf and Cantril, 1952,). Whereas, Skowronski et al. (1991) and Betz and Skowronski (1997) found the accuracy of autobiographical memories for events has a strong relationship with self-reference (see Larsen and Conway, 1997, for similar findings). According to some theorists, self and memory are *intrinsically related* so that autobiographical memory is a part the self or the two very closely related with each other (Conway and Tacchi, 1996; Howe and Courage, 1997; Robinson, 1986).

Functional comparisons of involuntary and voluntary memories

There are very few investigations done in this area of function for example Mace and Atkinson, 2009 argued that they may have functions which in many ways overlap with these functions. It creates a logic that both types involuntary and voluntary recall would have similar or overlapping functions. Might be involuntary memories have unique functions but it's not the case for voluntary memories.

Comparing the memories generated from involuntary and voluntary retrieval

To get the answer to the question whether involuntary and voluntary memories are similar or different in characteristics, there are two conflicting answers. According to one, both are different from each other whereas the second said that involuntary and voluntary memories are similar in characteristics as both likely to be sampling the same autobiographical memory base. However, some differences between two has been reported for example specific Vs General memory. Berntsen (1998) found more specific events in involuntary retrieval than voluntary recall in response of cue-word or cue- phrase. Mace (2010) argued that he do not still understand the reason for this difference. Further he argued that one possible explanation is that involuntary recall is mostly in naturalistic environment and it might be because of unique cuing circumstances surrounding everyday involuntary memory retrieval. When the event-cuing procedure is compared in involuntary memory chaining, another possible difference was found between two types of memories. Higher rate of general event associations (i.e. memories connected to the same general event) was found in comparison with conceptual associations (i.e. memories unconnected by a general event or the other temporal connections, but connected by common content, e.g., same people or activities), which are dominant form in involuntary memory chains (see for review, Mace, 2006; Mace 2007a). To look at the similarities between involuntary and voluntary memories, there are some conflicting results for example Berntsen, 1998; Berntsen and Hall, 2004. Same emotional valance has been found in both types (Berntsen, 2009). Same level of vividness and confidence about the details of memories has been found by Mace et al (2011). In the same study it was also found that both types of memories come with the same proportions of field (original point of

view in the event) and observer (third party view point) perspectives. The studies on memories also come across with another similarity and that is named the reminiscence bump. This bump was found in both type of reported memories among older adults (see for details, Berntsen and Rubin, 2002; Schlagman, Kvavilashvili, and Schulz, 2007). It seems that both involuntary and voluntary memories have more similarities than differences in characteristics. It might possible that both memories come from the same memory system but retrieval process might be different (see for review, Mace 2010).

Comparing Involuntary remembering to voluntary remembering

There is a clear demarcation between involuntary and voluntary memories; former type of memories is generated unintentionally by cognitive process whereas latent type of memories is self-generated. Sometime we generate a sought after memory and sometimes a memory is produced by cognitive activity produced by internal or external cues in the stream of thoughts. Mace (2010) compares two types of memories on two main lines 1) underlying retrieval processes and 2) their relationship with conscious processes, mainly volition or intentionality of retrieval.

Retrieval Processes

A top-down search or hierarchical memory search is done in voluntary remembering. Conceptually it is driven process where rememberer uses some strategies to recall or the recall process starts at a query. Strategies to recall the memory sometimes selected by rememberer and unique in nature and sometimes rememberer use more organized hierarchically driven strategy (see Conway and Pleydell-Pearce, 2000; Haque and Conway, 2001). Whereas involuntary remembering is lacking strategic search. Many cues which elicit involuntary memories in daily life are abstract cues (for review see Mace, 2004, 2005b; Schlagman, Kvavilashvili and

Schulz, 2007). Some cues are classified as perceptual in nature might have some conceptual connections to involuntary memories and they might trigger memory (see for review, Schlagman et al. 2007). It is argued that bottom-up search of memory is involved in involuntary remembering (for example spread from sensory system to the autobiographical memory system) and it's very rare that sensory cues elicit involuntary memories (see, Mace, 2004; Berntsen 2007). Mace further argued that if we broadly classify each type of remembering as top down, each type may correspond to very different type of top down processes. Top-down spreads from generic memory systems (i.e. noncontextual systems like semantic memory) to autobiographical memory may involve in involuntary remembering. Whereas, top-down processes occurring within the autobiographical memory system is always involve in voluntary remembering. In voluntary remembering different retrieval and cue elaboration strategies could be involved (see for review, Mace, 2010).

Awareness and intentionality

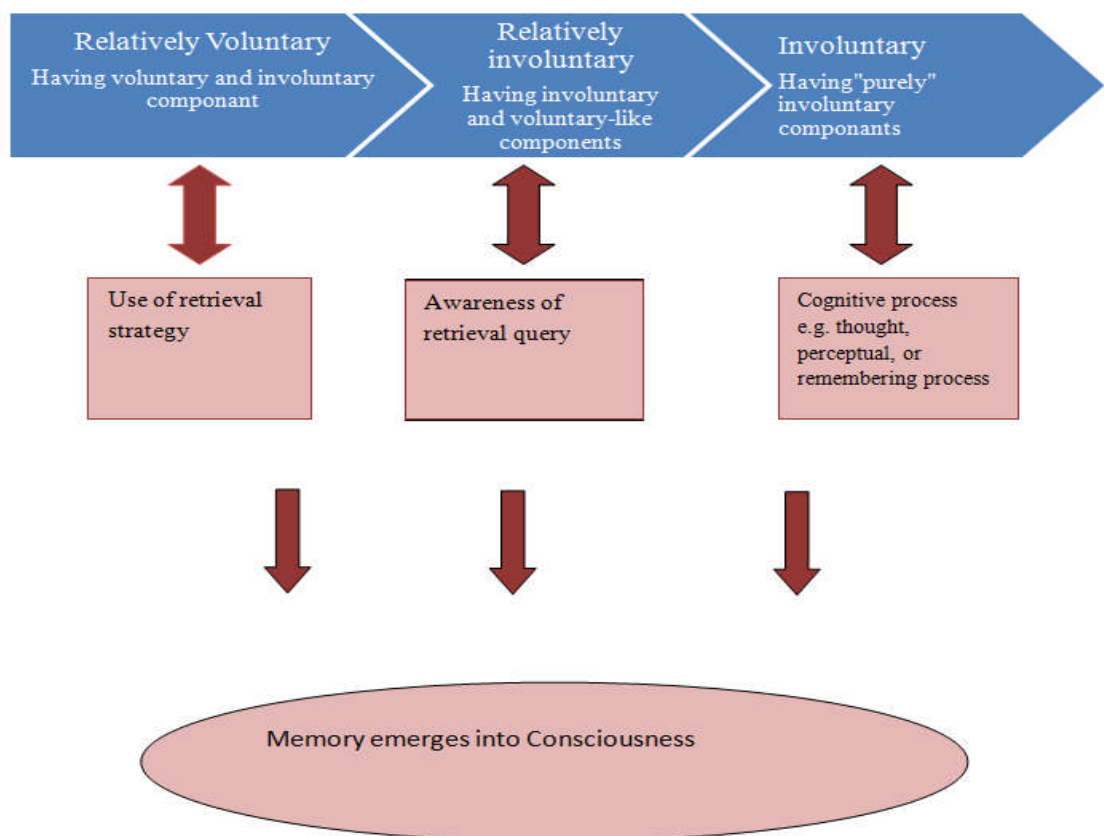
The information available at conscious level is roughly same in both involuntary and voluntary remembering. The rememberers mostly aware of the strategies used to recall the memory (Conway, 1996; Haque and Conway, 2001) and in diary studies mostly they report the cues which bring memory to mind (Ball and Little, 2006; Berntsen1996; Kvavilashvili, and Mandler, 2004; Mace, 2004; Schlagman, Schulz, and Kvavilashvili, 2006). Equal clarity has been found in both type of remembering either its involuntary or voluntary retrieval process and rememberers have the same perspectives i.e., field or observer (see for review, Mace 2010). Although these two forms of remembering have same conscious properties but both are clearly different along an intentionality continuum. Intentional and unintentional

processes are focused by cognitive researchers, but in memory system it is difficult to determine what constitutes voluntary processes and what constitutes involuntary processes. Generally there are two schools of thought: one broadly define voluntary processes and prefers narrower definition of involuntary processes, whereas the other is totally opposite to first one and come up with broader definition of involuntary processes and narrower definitions of voluntary counterpart. Mace (2010) preferred the latter school of thought and argued that there is still no sure way for empirical testing for this position. For involuntary remembering Mace believed that all processes under this term are mainly uncontrollable acts of cognition. He said that this believe is based on a common believe about cognition that cognition is largely an involuntary, automatic, and many times unconscious act (Reber, 1993; Wegner, 2002).

On the other hand, controllable and intentional acts are involved in voluntary retrieval. Mace further argued that sometimes one's introspection leads to the believe that an act is involuntary or uncontrollable even when it is voluntary. For example on simple perception of query, spontaneous and immediate recall of past experiences can happened or some specific situation or cues might start process of remembering without engaging in strategic search. Such sort of remembering might be weakly named as voluntary and more likely be moved towards involuntary remembering. For the intentional turning of attention towards the process of remembering, strong labels might be used. These labels also include specific mental strategy, maintenance of that strategy or change of that strategy until memory finally retrieved. The main important point among all these processes is deliberation or intention. Whether the processes are labelled as strong or weak with respect to will or intention, it seems that all other processes related with voluntary remembering are involuntary. So from different perspectives, one can argued that voluntary remembering is involuntary. Figure 1.1

describes a categorization schema for involuntary and voluntary remembering along an intentionality continuum. Categorical schema emphasizes on involuntary remembering processes, and narrows down intentionality, and transfers it towards unintentional end of continuum. The case where involvement of will is weak or somehow absent may be called involuntary remembering or quasi-voluntary retrieval, further down the continuum towards the involuntary end. Mace concluded that this labelling is not based on empirical evidences, but this categorical schema might be helpful for future investigation.

Figure 1.1: A categorization schema for involuntary and voluntary remembering along an intentionality continuum.



Theoretical models of Autobiographical Memories

The literature review (e.g. Conway, 2005; Conway and Pleydell-Pearce, 2000) gives us information about different explanations and perspectives about the organization and underlying mechanism of autobiographical memories. These theoretical perspectives provide different explanations about the mechanisms involved in the retrieval process of both voluntary and involuntary autobiographical experiences or memories. Here the focus is, as much as possible, on the way these models organize the representation and retrieval of involuntary autobiographical memories.

Schank (1982, 1999) in his theory talks about a dynamic autobiographical memory structure. He claims that these structures can adapt at many levels to the processing of new input information. These levels include the goals and plans of the individual (and perceived goals of others), the script that describes the situation, and the sensory characteristics of the input information being perceived. Each level of memory processing can lead to the involuntary retrieval (unconscious reminding) of previous experiences, as each level of processing leads to different expectations of what input information should be coming through the memory system. A failed expectation will lead to memory retrieval, and the actual experience that comes to awareness will be the prior experience that best matches this same failed expectation in the past. According to Schank's model, atypical features common to both the retrieved memory and the retrieval context will point to the level of memory processing where the failure occurred.

Conway's model (Conway, 2005; Conway and Pleydell-Pearce, 2000) suggests that voluntary autobiographical memories are transitory dynamic mental constructions generated from an underlying knowledge base. This knowledge base, or regions of it,

is minutely sensitive to cues, and patterns of activation constantly arise and dissipate over the indexes of autobiographical memory knowledge structures. This model further explains that the involuntary retrievals arise during the normal ongoing activation of autobiographical memories. Conway in his model argues that when we interact with the environment, an activation occurs which is automatic and for the most part unconscious. He explains the concept of autobiographical knowledge base and its structure, self and memory and memory construction. Conway claims that his model is applied to a wide range of autobiographical memory phenomena which explain the life span development of memory. According to Conway's model the knowledge of autobiographical memories is always present at different levels of specificity. He identifies three broad levels of specificity: lifetime periods, general events, and event-specific knowledge (ESK), (Anderson and Conway, 1993; Conway, 1990a, 1992, 1996b; Conway and Bekerian, 1987a; Conway and Rubin, 1993; Barsalou, 1988; Brown, Shevell, and Rips, 1986; Linton, 1986; Schooler and Herrmann, 1992; Treadway, McCloskey, Gordon, and Cohen, 1992).

Lifetime Periods refer to distinct periods of time with identifiable beginnings and endings, and also represent general knowledge of significant others, plans goals, actions, common locations, activities, characteristic of a period. But it might be fuzzy rather discrete. For example refers to generically 'when I was a child', 'when I was at school', 'when I was working for XX Company' etc. The content of a lifetime period represents common features of that period which contains *thematic* knowledge (Conway, 1992, 1996b; Linton, 1986), and *temporal* knowledge about the duration of a period. For any given chronological period there may, however, be a number of lifetime periods, and thematic knowledge of these time periods may index different parts of the autobiographical knowledge base (Barsalou, 1988; Brown et al., 1986;

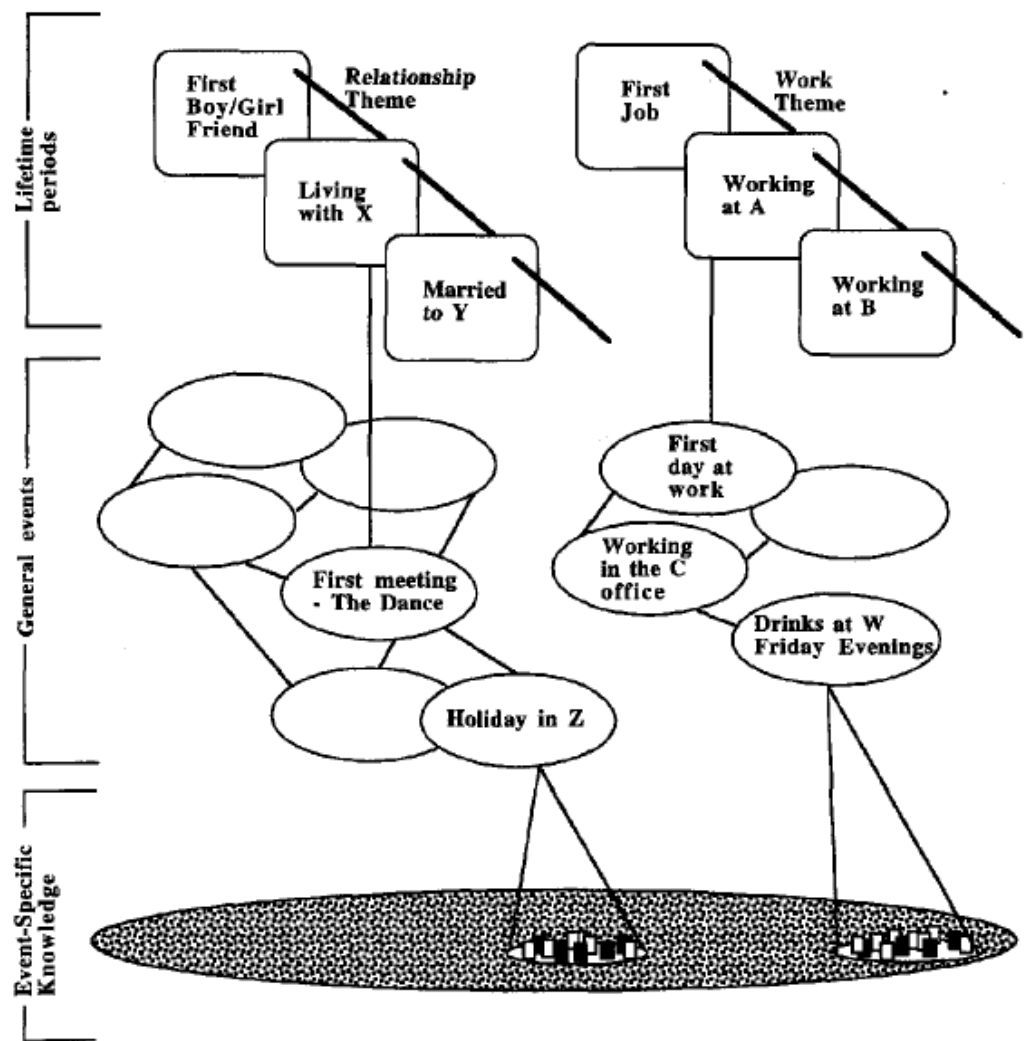
Conway and Bekerian, 1987a; Lancaster and Barsalou, 1997; Linton, 1986). Moreover, lifetime periods may themselves be thematically linked to form higher order themes such as work, relationships, and other themes (Conway, 1992; Linton, 1986). Indeed, there is some evidence that people form attitudes to periods from their life (e.g., *this was a time when things did not go well for me*) and this self-evaluative knowledge of a lifetime period may be represented at this level and be used in memory construction (e.g. Bruhn, 1990). The temporal knowledge contained in lifetime periods may take the form of personal temporal schemas (Larsen and Conway, 1997; Larsen and Thompson, 1995; Thompson et al., 1996), which, at the very least, must delimit the boundaries of the period and also contain other knowledge of landmark events from which temporal order can be further inferred or constructed (see Shum, 1998; Skowronski, Betz, Thompson, and Shannon, 1991; and Thompson et al., 1996, for further discussion of this).

General Events General events are more heterogeneous and specific than lifetime periods. Robinson (1992) found that general events have series of memories which are associated to similar events, so they can come under same theme. In the section 'Initial findings' he concluded that these are basically memories of individuals about goal-attainment knowledge, and they might be both positive and negative in nature. Memories of these events are thematically similar, more vivid and convey significant information about the self. These findings were supported by Singer and Salovey (1993) in their study of "self-defining" memories. Barsalou (1988) found that general events referred to both repeated events (e.g., *evening hikes to meadows*) and single events (e.g., *my trip to Paris*).

Event-Specific Knowledge is based on imagery information. Centrality of imagery to autobiographical memory was focus of interest by many researchers from the original

studies of Gallon (1883; see Conway, 1990a, for a review). Brewer's (1986) theoretically analysed the predominant role of imagery in autobiographical remembering (see also Brewer, 1996, for a historical review). Some recent studies concluded that imagery has a very strong relationship with the specificity of the memories (Williams, Healy, and Ellis, 1999). Figure 1.2 explain Conway's model of autobiographical memory.

Figure 1.2: The autobiographical memory knowledge



Anderson and Conway (1993) found that there are two possible ways to access the detail of event represented in any single specific memory: (a) one way is that one

first recalls the thematic or distinctive detail and the other details are accessed later; (b) the second form of access is that recall should be sequential, which means that it should start from the first-occurring activities down to the last. They further argued that additional memory details were accessed in a forward temporal order and this provides information about the organization of these memories in long-term memory (see also Butt, Mitchell, Raggatt, Jones, and Cowan, 1995). The autobiographical memory knowledge structure held at different levels and specificity of knowledge is different, and this produces different organizational patterns (Barsalou, 1988; Conway and Bekerian, 1987a; Lancaster and Barsalou, 1997; Linton, 1986). Conway (1996b) further explains that there is a hierarchical autobiographical memory knowledge structures. In these structures items of Event Specific Knowledge are part of general events that in turn are part of lifetime periods. Knowledge stored at the level of a lifetime period provides cues that can be used to index a prescribed set of general events and knowledge at the level of general events indexes.

The self and Autobiographical Memory

The relationship of self and memory has always been considered important by researchers, as reported in the first section of this report, and they try to study both in different dimensions.

Conway and Pleydell-Pearce (2000) made a connection between self and memory by introducing the term *Working self*. The main function of the working self is to make a subset of working-memory control processes, organize goals into hierarchies. This hierarchical organization controls those goals which direct and guide cognition and behaviour. The Working self is conceived as a mental model of the abstract capacities and functions of the system (Craik, 1943; Johnson-Laird, 1983). This model presents a very similar view of self-schemas core and peripheral long-term

memory representations of different conceptions of the self (Markus, 1977) — firstly proposed by Markus and Ruvolo (1989). According to Markus and Ruvolo these schemas generate possible selves and these are dynamic, but stability comes through long-term memory self schemas. According to Conway's model, autobiographical knowledge is encoded through the goal structure of the working self, which plays an important role in construction and remembering of specific memories. Discrepancies among different dimensions of the self come through negative emotional experiences, which create psychological tension and hinder the person from setting up personal goals. The model mainly argued that this goal-based working-self system affects the process of encoding and remembering of memories. The relationship between the goals structure of the working self and encoding and retrieval of autobiographical memories is critical.

Conway and Holmes (2000) conducted a study on older adults, using content analysis of free recall of memories from each of seven decades from their lives, and found that the recalled memories were predominated by the psychosocial theme of the relevant age. For example, memories recalled from the period 10 to 20 years had mainly a content of identity confusion, and from the decade 20 to 30 years reported memories were dominated by the theme of intimacy-isolation (Holmes and Conway, 1999). Conway's model also talks about the relationship of emotions and memories. In laboratory studies, it was found that emotional cues were least effective cues in eliciting autobiographical memories (Conway, 1990c; Conway and Bekerian, 1987a; Conway, Pleydell-Pearce, and Whitecross, 1999; Robinson, 1976). A general bias was found against retrieval of memories of intense and negative emotional experiences. (Conway, 1990c; Conway and Bekerian, 1987a; Conway, Pleydell-Pearce, and Whitecross, 1999; Robinson, 1976).

The Self-Memory System (SMS)

Combination of working self and autobiographical memory knowledge form the self-memory system (SMS). This system plays a very strong role in remembering autobiographical experiences because it conjoined the working self and autobiographical knowledge base, otherwise it could not occur. At the same time, this system controls independent functioning of two components, i.e. working self and autobiographical knowledge (e.g. Conway and Fthenaki, 2000). Conway and Tacchi (1996) highlighted the main function of autobiographical memories in SMS. They proposed that these memories provide a ground to the self, and a person could not sustain a goal if that conflicts with autobiographical memories. They further argued that until there is a realistic and acceptable connection between working self and knowledge base, our goals cannot implemented in our SMS. Conway used the term of superordinate memory system for SMS, and its function is to make a connection and easy access to other memory systems. The SMS also gets information from other subordinate memory systems. This system analyzes goal compatibility and then decides what kind of knowledge will or will not be included in autobiographical memory. Selection of cues for the retrieval of ABM, arrangements of pre-stored knowledge (by successively elaborating cues) are some of its main functions.

The Construction of Memories

Conway's model conceptualizes retrieval from ABM as a pattern of activation across the indexes of the autobiographical knowledge base conjoined with a subset of activated working-self goals. As a result a specific autobiographical memory is retrieved. In other words, a memory is an interlocked pattern of activation across these two components of the SMS. There are two ways for the generation of specific memories; (a) *generative retrieval*, and (b) *direct retrieval* (Conway, 1992, 1996b;

Moscovitch, 1989; Moscovitch and Mello, 1997). Memories retrieved through the former type are modulated by the control system, but in the latter type it's not so extensive.

Generative Retrieval

The concept of generative retrieval originates from the concept of “memory description” introduced by Norman and Bobrow's (1979). According to them retrieval process has three stages: *first* is elaboration and verification of a cue for memory, *second* is matching with memory record, *third is* the assessment of record against verification criteria. The retrieval of memory occurs in a way that the cue passes through these three stages and if it is accepted by verification criteria, a memory output is elicited, but in case of non acceptance after verification, the process starts its cycle again. Both Conway (1996b) and Burgess and Shallice (1996) proposed that supervisory executive processes most probably sited in networks in frontal cortex, modulate these stages. A critical component of the model is the one responsible for the formulation of the criteria, and the fact that the verification of criteria is different for different tasks and type of memories.

Conway examined the data of several unpublished studies and further elaborated about generative retrieval. He explained that when environmental cues are related to someone's current aspects of life, it causes retrieval of autobiographical memories. Physical environmental cues map directly onto autobiographical memories, as our environment has some common or related aspect to our working-self and current goals. Elaboration is the first stage in generative retrieval, but it is not necessary that on the first trial of elaboration of the cue generative retrieval occurs. Sometimes the initial elaboration stage is followed by further elaborations and as a result the person finds some vivid mental images. Sometimes there are some

“blocking” elements, by which the person has some conceptual knowledge but is unable to retrieve some memories. Earlier models argued that cues work together with original cue and first accessed record to generate a memory from long-term autobiographical knowledge, sometime with the further generation of a second cue. But the protocol studies on retrieval process of memory (Conway, 1996b, Conway and Haque, 2000) conclude that retrieval of general life events and access to life time period is easy. If the person is asked to remember something from the past, the first thought is often related to general autobiographical knowledge. The reason might be that general autobiographical event knowledge are at preferred entry level in the knowledge base, when the whole memory system is in retrieval mode for specific events (Burgess and Shallice, 1996; Conway and Haque, 1999; Schacter et al., 1998; Tulving, 1983).

Direct Retrieval

More pertinent for assessing involuntary memories is the part of the model that examines direct retrieval. The autobiographical knowledge base responds to all type of cues and at all levels from an abstract to a specific structure of the problem (Ross et al., 1990; Schank, 1982). From this Conway supposes that different patterns of activation come up and dissolve continuously in the knowledge base and sometimes they forms specific patterns which then are linked with working self goals. In this case, memory retrieval occurs. Specific cues and the way they are processed may create stable and distinct patterns. Conway (1997c) briefly discussed direct activation of Event Specific Knowledge (ESK) with the help of cues. Description of ESK is mapped onto general events and general events are mapped into lifetime period (it is possible that they further have mapping with some other lifetime periods and general events). Active ESK stimulate one general event which causes activation in lifetime

periods, and as a result some stable and focused patterns emerge which lead to memory retrieval. Many different general events are accessed by the knowledge at the level of lifetime periods, and knowledge of general events can also have access to relate other general events, lifetime periods and different recorded ESK. However, without the interacting influence of a generative retrieval mode, stable active patterns do not combine with autobiographical knowledge structure, and the possibility to have memory is very low. On the other hand, if there are focused and stable patterns of activation from ESK and there is strong connection between working memory goals, recall of spontaneous and unexpected events may suddenly occur. These are involuntary memories. There are many informal reports in the literature about these occurrences, and their findings support the fact that spontaneous memory retrieval occur in response to specific cues, with the person who recalls or retrieves the memory not being aware of these cues, and these cues interrupt current activities of person (Salaman, 1970; see Conway, 1997c.). One of the major reasons why control processes evolve to inhibit awareness of activation patterns for autobiographical knowledge is the disruptive effect of spontaneous retrieval. Some theorists found that there might be some sort of inhibitory form of control which result in us being unaware of some potential memories (Anderson, Bjork, and Bjork, 1994; Bjork, 1989; MacLeod, 1997), and its dependent on the central processing capacity (see Wegner, 1994). It was found that the reason might be stress and distracted state of the rememberer (Conway, 1997a). According to Conway, involuntary memories are memories that are not yet integrated into the hierarchical autobiographical memory system described here, but are separate, probably in a different memory store, and refer to more recent events, which is the reason why their integration within the general autobiographical memory system has not yet occurred.

Many other researchers agreed on the organization of autobiographical memories to be hieratical in a way that memories for single experiences are nested within larger cognitive structures (e.g. Anderson and Conway, 1993; Neisser, 1986; Schank and Abelson, 1977; Schooler and Herrmann 1992). There was broad consensus on the existence of the cognitive structure but the organization of events is still disputed. In 1998 Brown and Schopflocher developed an event cueing technique, which helped to explore these structures. In their study they asked the participants to generate events from their autobiographical memories, and then used those events as cue for other autobiographical memories. The same procedure was extended later by Wright and Nunn (2000). They extended Brown and Schopflocher's procedure by using events to cue other events, and then use those events to cue further events. Wright and Nunn (2000) aimed at exploring similarities of various characteristics within these structures, and named these structures as "event clusters". They concluded that memories belonging to the same cluster are similar in respect to clarity, emotion, importance, happiness, and estimated date of occurrence. Memories or events from different cluster were different from them on these characteristics.

Autobiographical knowledge or information stored in the memory system is termed as *episode* and *event*, and more recently *theme*. Conway and Pleydell-Pearce, (2000) used these terms in their model to explain the organization of autobiographical knowledge, these terms define key structures in the theory, but their psychological reality has rarely been researched. Burt, Simon and Conway (2003) examined the nature of episodes, events, and themes in autobiographical memory. They aimed to explore how these concepts refer to ways of organizing autobiographical knowledge that people actually use. Another query was to understand what an "event" is in autobiographical memory. The diary method has been used mainly for data collection

for specific on-one-day events as the dominant experimental stimuli (e.g., a visit to the beach, lunch with a colleague) and it is assumed that these are autobiographical events (e.g., Burt, 1992; Conway, Collins, Gathercole, and Anderson, 1996; Linton, 1975; Wagenaar, 1986; White, 1982). Burt, Simon and Conway conducted three experiments and they were aimed to address the fundamental issue of what defines an autobiographical event. They used both ways (diary entries in experiment 1 and photographs in experiments 2 and 3 to collect the data (stimuli). They asked the participants to classify the stimuli as events and themes that reflected their life. They concluded the findings that events and themes were mainly formed from clusters of experiences combined using content association rather than temporal sequence. Similar event- and theme-building strategies were found in their experiment 2, and even the manipulation of stimuli in experiment 3 did not influence construction strategies. They further concluded that both autobiographical events and themes frequently consist of episodes taken from more than 1 day.

The Berntsen Model of Autobiographical Memory

Although Berntsen (1996, 1998) never proposed a fully developed model to explain autobiographical memory as Conway did, she was the first person to work on involuntary autobiographical memories, and her work has led her to present a way to conceive autobiographical memory which partially overlaps with Conway's. The reason to report her conception of ABM here depends on the fact that it is important for the predictions and the interpretation of my findings. Berntsen (1996, 1998) obtained some similarities between involuntary and voluntary ABMs, like the fact that memories dealing with unusual events dominated both in voluntarily and involuntarily retrieved memories. Additionally, in both types of memories the most powerful

predictor of the frequency with which a memory was rehearsed was its emotional intensity. Finally, for both types of memories event summarization (i.e. a memory which is about a general event) was strongly predicted by the degree of usualness of the event, suggesting that mostly it is non-distinctive events that are turned into summarised representations.

However, the number of differences was much bigger, and marked differences in memory characteristics were found between autobiographical memories retrieved voluntarily in response to verbal cues in the lab and autobiographical memories coming involuntarily to mind in everyday life situations. For example, involuntary memories referred to specific events more often than voluntary memories. Second, involuntary memories were rated considerably lower in frequency of rehearsal than voluntary memories. Third, involuntary memories were rated significantly more emotionally positive than voluntarily retrieved memories. Fourth, involuntary memories tended to be more recent than the voluntary memories.

These differences, along with the even more important difference in the role of attention in eliciting the two types of memories, led Berntsen (1998) to propose that our memory system contains, separately, a large number of very specific and detailed memories, which are usually inaccessible to the voluntary retrieval system, and instead can be easily accessed when attention is diffused and strong external cues are present. In conditions in which the matching between the content of the cue and some specific content of the memory match, the cue would directly trigger the specific memories outside of the intention to remember.

This approach shares some important similarities with the approach by Conway (Conway and Pleydell-Pearce, (2000), as both consider the retrieval process

of involuntary memories to be direct and not mediated by intention, and both suggest that what can become an involuntarily retrieved memory comes from a separate pool of memories. If they are correct, then also involuntary memories elicited in the lab should be different from voluntary memories elicited in the lab, and testing this prediction is one of the aims of this dissertation.

Chapter 2

Involuntary Autobiographical Memories

And suddenly the memory returns. The taste was that of the little crumb of madeleine which on Sunday mornings at Combray . . . when I went to say good day to her in her bedroom, my aunt Leonie used to give me, dipping it first in her own cup of real lime-flower tea . . . And once I had recognized the taste of the crumb of madeleine soaked in her decoction of lime-flowers . . . immediately the old grey house, where her room was, rose up like the scenery of a theatre to attach itself to the little pavilion opening to the garden . . . and with the house the town, from morning to night and in all weathers, the Square where I was sent for luncheon, the streets along which I used to run errands, the country roads we took when the weather was fine.

– Proust, 1928, pp. 66–67

Part 1

Proust's description of how the taste of cookies comes to his mind and how unexpectedly he remembered childhood experiences is basically a description of an occurrence of involuntary memories. Involuntary autobiographical memories are those memories which come to our mind without putting any effort during recall. The concept of involuntary autobiographical memories is not new, as it started at the time of Ebbinghaus (1885/1964) when he identified three basic modes of remembering (or recollecting) the past, voluntary conscious memory, involuntary conscious memory, and involuntary unconscious memory. But during the past century cognitive psychologists gave mainly attention to the other two modes and ignored the involuntary part of remembering. Involuntary remembering is a very common everyday experience, in which autobiographical memories 'pop up' in the mind without any effort. In spite of the frequency of this involuntary experience, relatively

few studies (compared to the body of work on voluntary autobiographical memories) have addressed the issue of involuntary autobiographical memories until now. The first studies date back to the late 90s (Berntsen, 1996), even if Ebbinghaus (1885/1964, pp. 1–2) already mentioned the existence of involuntary memories when he identified those three basic kinds of memory in his book that launched the experimental study of human memory, which he studied using the method of savings. He distinguished involuntary from voluntary memories in that involuntary memories return to consciousness without any act of will. Involuntary memories, he said are

“In a second group of cases this survival is even more striking. Often, even after years, mental states once present in consciousness return to it with apparent spontaneity and without any act of the will; that is, they are reproduced involuntarily. Here, also, in the majority of cases we at once recognize the returned mental state as one that has already been experienced; that is, we remember it. (Ebbinghaus (1885/1964, p. 2).

The distinction between voluntary and involuntary memories may bear some similarity with the one between a voluntary type of retrieval initiated and controlled by the subject, and a more automatic involuntary retrieval, which manifests itself predominantly in implicit tests (see for example Richardson-Klavehn, Gardiner, and Java 1996), although such similarity can be discussed and objected to, given the aware/declarative nature of involuntary memories. It is in this respect important to understand the difference between typical involuntary memory and implicit memory, as implicit memory is known as unintentional memory that we are unaware of (see Richardson-Klavehn and Bjork, 1988; Schacter, 1987 for a review).

The distinction between voluntary and involuntary memory has been adopted in the autobiographical memory literature very recently, hence the rather scant number of studies which compare voluntary and involuntary autobiographical memories

(hereinafter called IAMs). Researchers of this modern era define IAMs more or less in the same way as defined by Ebbinghaus. For example, Berntsen (1996), who was the first to study this phenomenon, defined IAMs as memories of personal events that come to mind with no preceding attempt (Berntsen, 1996, 2001), while others referred to them variably as memories that come to mind spontaneously, unintentionally, automatically, without effort, and as unexpected retrieval of past experiences etc (e.g., Ball and Little, 2006; Conway and Pleydell-Pearce, 2000; Kvavilashvili and Mandler, 2004; Mace, 2004; Mandler, 1994; Richardson-Klavehn et al., 1996; Schacter, 1987). Similarly, different terms are used when referring to involuntary memories, among them involuntary explicit memory, involuntary conscious memory, involuntary autobiographical memory, and involuntary aware memory (e.g., Mace, 2005a; Richardson-Klavehn, Gardiner, and Java, 1994; Bowers and Schacter, 1990; Schacter, 1987; Ball and Little, 2006; Berntsen, 1996; Kvavilashvili and Mandler, 2004; Mace, 2004; Kinoshita, 2001).

Involuntary memories are spontaneous and automatically retrieved and these memories are as common in daily life as deliberately recalled memories (Rubin and Berntsen, 2009). Such findings bring a challenge for the traditional goal-oriented understanding of human memory. They also raise many interesting queries concerning the possible functions of such seemingly accidental recollections. In the beginning of modern cognitive psychology, the traditional view about remembering was that it is a goal-directed process and its start is purposeful. This point of view is still dominant and still it is assumed that we remember because we have a conscious goal to recall (or reconstruct) a particular piece of information stored in long-term memory (Berntsen, 2007).

The term involuntary does not imply that the existence or nonexistence of a 'free will' should be used to explain how we objectively remember past events (Wegner, 2002). Basically this term is used to describe the fact that memories that fit into this category are subjectively experienced as unintended. Therefore, when the rememberer has any involuntary retrieval, he wonders why that particular information comes to his mind, a question that does not occur for voluntarily retrieved autobiographical memories, because in that case the search is intentional and goal directed.

Involuntary memories: three different occurrences

Mace (2007) in his book *Involuntary Memory* he talks about three different types of occurrences of involuntary memories, a brief explanation of which is given here below. The *first* occurrence refers to situations in which memory occurs in our everyday mental life, the *second* occurrence refers to situations in which memory occurs as a by product during the process of voluntary recall or involuntary recollection of past memories. *Thirdly*, involuntary memories can occur as part of a psychiatric syndrome.

Precious fragments

The first form of occurrence represents a very common and familiar form of retrieval of involuntary memories. This type of involuntary memories occurs as a result of everyday mental functioning. Involuntary recollection of childhood memories reported by novelist Marcel Proust, in the series *Remembrance of Things Past* (as reported at the beginning of this chapter) is a very good example to understand this type of occurrence. Involuntary memories come spontaneously to our mind and the

pioneering autobiographical memory researcher, Marigold Linton, named these past experiences as “precious fragments” of the past (See Mace, 2007).

Involuntary Retrieval from Autobiographical Memory

It is very important question to get answer that how frequently involuntary memories occur in everyday life. For example cognitive therapists typically think that these memories are rare. Tulving (1983) said that recall of episodic memories is dependent on being in retrieval mode. Very rarely environmental stimuli activate conscious recollection of episodic experiences by associative mechanism outside of retrieval mode. Whereas Mandler (1985) believed that most of daily life experiences are not deliberate. According to his observation episodic information is mostly deliberate, consciously accessed and context dependant. On the other hand semantic information is context free and automatically available. In short modern cognitive psychologists believed that involuntary conscious memories are mostly treated as exception because of purely theoretical reason but not because they found them rare (Berntsen, 2009).

In a pioneering diary study, Berntsen (1996) found that on average people report 3-20 naturally occurring involuntary memories per day, with 5to 6 being the most frequent estimates. Mace (2005) mentioned that the average is 2-4 per day. Later on, Mace (2004, 2005b) reported that participants experienced 1-5 involuntary memories per day, thus keeping the number per day relatively low, in line with previous work. These findings indicate however that the idea that involuntary memories occur very rarely is a clear a misconception, given that on an everyday basis we all remember several things involuntarily.

In addition, studies (e.g. Berntsen 1998) reported that involuntary memories occur mainly when the person is in a state of non focused, diffused attention. These findings raised a number of questions about the relationship between attentional state, level of activation and the retrieval of involuntary memories. More specifically, Berntsen (1998) was the first who argued that everyday involuntary memories production interact with one's state of attention. She found two third of reported involuntary memories occurred in a non focused ("diffuse") state of attention (see also Kvavilashvili and Mandler, 2004). Mace (2007) said that "Such findings are important because they immediately beg a number of questions about attentional state and involuntary memory activation. For example, do involuntary memories occur more frequently in non focused attention because such a state enhances the processing of cues (Kvavilashvili and Mandler, 2004)? Or does attention interact with involuntary memory production because a mechanism which normally blocks memories from coming to mind during focused states of attention is relaxed during non focused states of attention (Conway and Pleydell-Pearce, 2000)?" (Mace, 2007 p.5-6). It might possible that in a non focused state, attention is relaxed and does not interact with memory and thus cannot stop memories from coming to mind (see Mace 2007).

Rubin and Berntsen (2009) planned a study to examine some of unresolved issues regarding involuntary autobiographical memories. They examined whether voluntary recall of autobiographical experiences is more common than involuntary recall. They examined memory for two different personal events. In one sample group they asked participants to think of important personal event from their recent past and the other sample group were asked to retrieved remote memory. The main aim of the study was to measure the relative frequency of voluntary recall and involuntary recall. They found striking results and concluded that both involuntary and voluntary

memories were rated as similar in frequencies. They found the same results for recent and remote experiences and consistent across the life span. Their findings challenge the idea that for the retrieval of past experiences, voluntary recall is the standard mode. It looks like voluntary and involuntary modes are basically two different ways of retrieval. Their results opposed dual system views (Brewin et al., 1996) and in agreement to the view that recollection of past events is affected similarly by mechanisms related to encoding and maintenance (Berntsen, 2009; Berntsen and Jacobsen, 2008; Rubin, Boals, and Berntsen, 2008).

Berntsen in 2009 summarized these results indicating that overall there is agreement that involuntary memory are not so rare. In one of large representative sample survey on the Danish population it was found that involuntary autobiographical memories were well known, and 58 percent of the participants replied that they were able to remember the last time they had an involuntary past experience (Berntsen and Rubin, 2002; see also Brewin, Christoulides, and Hutchinson, 1996). Another survey was conducted on 81 Danish undergraduates, 85% of the respondents reported that they had involuntary autobiographical memories for few times in a week. Diary studies also found higher frequencies of involuntary autobiographical memories. The range varies from 3–5 involuntary autobiographical memories per day (e.g., Berntsen, 1996a, 2001; Mace, 2004, 2005; Kvavilashvili and Mandler, 2004). Findings of these studies are in contrast with aesthetic theories (e.g., Epstein, 2004; Proust, 1928; Salaman, 1982), as they claim that involuntary autobiographical memories are very rare in occurrences (although involuntary memories with the characteristics observed by Proust (1928) may in fact be rare, Mace, 2005).

As by-products of other memories

Sometimes it happened that involuntary memories are triggered by another voluntarily or involuntarily recalled memory. This type of occurrence is less common. It is easy to understand the occurrence of memory by the name of this type. For example, when one memory is triggered or recalled involuntarily or voluntarily, sometimes the memory triggers another memory, which might trigger another. Memory researchers also talked about this type of involuntary memory production. For example Ebbinghaus suggested that the recall of nonsense syllables seemed to cause others syllables to come to mind automatically, suggesting that probably Ebbinghaus had this form of involuntary remembering in mind. Linton (1986) described these memories as another way in which “memories come unbidden”: she wrote about these memories as “Throughout my life I have noticed delicate memory fragments that recur year after year – coming unbidden sometimes when my ‘mind is silent’ but also as by-products of searches for other information” (p. 53). Salaman (1970) featured this type of memories in his writings and described them as resulting from other deliberate attempts to construct the past.

Chained activations

Chained activation (or memory chaining) refers to a situation in which an involuntary memory is triggered by any immediate preceding involuntary memory. This phenomenon was observed in diary studies in which people reported that memories were triggered by other related memories. Linton (1986) said that this process of chaining occurred during voluntary recall of memories. Mace (2007) agreed with this point of view and extended it to involuntary memories, saying that “involuntary memories which occur in this way appear to do so because some aspect of a preceding memory (e.g., its contents) is responsible for triggering the occurrence

of another related memory” (p.7). He further argued that it is natural expectation that the same process would occur during deliberate recall and involuntary recall, when preconditions are the same. He reviewed laboratory and other types of data and found that involuntary memory production does occur during voluntary memory production. He further suggested that involuntary memory recall probably occurs routinely when the past is being recalled deliberately. Chaining in involuntary memory was mainly examined by Mace (2005, 2006, 2007a). Mace (2010) said that diary studies focused on natural occurrence of involuntary memories. He suggested that there are two ways in which involuntary memories occurred. First way is called direct involuntary remembering in which single involuntary past experience triggered by different thoughts, percept, sensory experience or any activity. Whereas second way is known as chained involuntary remembering in this kind of remembering a series of involuntary memories occur in quick succession (Mace, 2007c). For chained remembering, it might possible that one directly cued involuntary memory triggered another involuntary memory. Chained involuntary remembering is less common than involuntary memories triggered by direct cues. Mace (2010) suggested that for involuntary chain memory associations always appeared. By understanding how these associations occur (general-event association and conceptual association) one can better understand the organization of memories in the autobiographical memory system. General-event association memories come from same general event whereas conceptually associated memories come from overlapping of content and they can come from any time period (see Mace, 2010).

On the basis of given observation Mace (2010) planned a study, in which he examined voluntary and involuntary chained memories. The main purpose was to investigate and explore main indicators of autobiographical memory organization. 82

undergraduate students participated in the study. An *Event cueing task* was used for voluntary memories and a *diary method* was used for involuntary memory. In the *Event cueing task* long and short lists of cue phrase were used. All participants were instructed to recall specific past events. After finishing the whole list they should start again and use the reported memory as a cue and try to retrieve any other related memory. They were instructed that a second memory should also be a specific memory of their past and related to the first reported memory. Participants in the diary condition were instructed to record involuntary memories for two weeks time period. They were also instructed to record chained memories separately. Analysis of event cueing data told that participants generated more information for the first memory than second memory and second memories were mostly general or summary memories. Whereas such generation process was not seen for the second memory in the chain of involuntary memories. After doing different comparisons and reanalysis of data they concluded that chain in involuntary memory provides an adequate picture of the organization of autobiographical memory.

Not so precious fragments

According to Mace (2007) to this category belong those memories which are the result of traumatic experiences. People, after coming out of traumatic experiences, often and repetitively experience involuntary recall of those events. The occurrence of this third type of involuntary memories is uncommon in everyday life and rare as compared to the other two types. In posttraumatic stress disorder (PTSD) traumatic involuntary memories are so common that they are listed as one of the key features of the syndrome (American Psychiatric Association, Diagnostic and Statistical Manual of Mental Disorders, 4th ed., 1994; DSM-IV; Berntsen and Rubin, 2008).

Traumatic Involuntary Memories

Spontaneous recollection of past traumatic event is different from ordinary involuntary recollection of the past. Traumatic recollection is repetitive and refers to the same aspects of the past. Traumatic involuntary memories are mostly experienced by people suffering from PTSD, and they rarely appear in normal individuals. Apart from their rarity, it is important to understand which traumatic involuntary memories can provide helpful information for the clinicians and which may also helpful in understanding ordinary involuntary memories (see Mace 2007 for review).

Some clinical psychology researchers believed that involuntary memories are limited to traumatic, negative and stressful experience content. For example van der Kolk and Fisler (1995) examined people who were “haunted by memories of terrible life experience” (p. 514). They concluded that non traumatic experiences were never remembered involuntarily. Thus researchers of both paradigms treated deliberate or strategic retrieval as the standard way of recall of past experience. And they consider involuntary conscious retrieval as an exception.

Berntsen and Rubin (2008) explored recurrent involuntary autobiographical memories after traumatic events. They predicted that people with recurrent involuntary memories of traumatic event report higher levels of fear and danger that they experienced at the time of that event, while currently they also have high level of PTSD symptom. They found that people with recurrent memories of traumatic experience also showed higher level of PTSD symptoms, as they had very severe exposure of trauma. They also found that recurrent memories were generally about most emotionally arousing moments during traumatic experiences. Their findings agreed with some clinical theories of PTSD (e.g., Horowitz and Reidbord, 1992;

Pitman, 1988). It was not clear whether recurrent involuntary memories, posttraumatic stress and negative affect was particular to subsets of populations only or it could be studied in the general population as well. To get the answer study 2 was designed. In Study 2, prevalence, emotion, and life span distribution of recurrent involuntary memories in general population was investigated. Expected results were found about emotional intensity of memory. It was found that there were more memories referring to emotionally intense events than less emotionally intense events. These findings seems to be in agreement with previous findings that in old age, experience of negative emotions become less frequent and less intense (e.g., Charles, Reynolds, and Gatz, 2001; Mroczek, 2001; Berntsen and Rubin, 2002, for reviews).

The role of traumatic experiences for memory has been long debated in psychology (e.g. Conway, 1997; Kihlstrom, 1997, 2006). Rubin, Boals and Berntsen (2008) studied autobiographical memory in relation to Post traumatic stress disorder (PTSD) - a disorder that may follow exposure of traumatic experiences. They designed a comprehensive series of studies to address mainly to key controversies regarding role of traumatic memories in PTSD. They contrast two views; one was named as *special mechanisms view* which talks about PTSD in terms of hypothesized memory mechanisms, and it is special to traumatic experiences. The second view is called *basic mechanisms view*, and according to this view PTSD can be reported by basic psychological mechanisms related to memory emotion and personality. In Study 1, voluntary memory about traumatic experiences was studied. They also studied “control” autobiographical memories among participants with high Vs low PTSD symptoms. In Study 2 involuntary and voluntary memories of same individuals were studied by using diaries method for involuntary memories. They summarized the findings of their studies indicating that participants who varied in symptoms of PTSD,

reported high frequency for both voluntary and involuntary retrieval, while more emotional intensity was found in all memories for stressful events, and memories of high severity PTSD symptom. They further concluded that increase in emotional intensity with increasing PTSD symptoms and emotional distress of the event is consistent with both special and basic mechanisms view. They found involuntary memories almost similar to voluntary memories but the former are stronger in emotional intensity and less centrality to the life story. These differences were consistent with the basic mechanisms view and inconsistent in special mechanisms view.

Distressing Involuntary memories of any stressful or traumatic experience are called intrusive memories. Intrusive memories are central part of Post Traumatic Stress Disorder (PTSD) symptoms. Many PTSD theories talk about role of intrusion in the development of disorder e.g., Brewin, Dalgleish, and Joseph, 1996; Ehlers and Clark, 2000. These theories mainly stressed that forcefully recalled memories should be distinguished from memories which are retrieved without any conscious retrieval effort i.e. involuntary memories. Mostly clinical theories of PTSD showed their consent that there is a discrepancy between voluntary and involuntary memories regarding the effect of emotional arousal during encoding, whereas, as we just saw, memory research and emotion did not support that prediction. Hall and Berntsen (2008) conducted a study with the purpose of exploring whether emotional stressful events at encoding has differential effects on the characteristics of both types of memories. To examine voluntary and involuntary memories under comparable conditions was another aim of the study. They also wanted to compare measures of subjective reactions at encoding and recall for negative emotional stimuli. No previous studies were done before on this topic. They used distinctive aversive pictures as

stimuli to measure subjective reactions at encoding and recall. No differences were found between voluntary and involuntary memories regarding emotions associated with the remembered picture at encoding. Voluntary memories were scored higher narrative content, imagery and vividness than involuntary memories during recall. And that involuntary memories scored higher on measures of emotion.

Recently Rubin, Dennis, and Beckham (2011) ran a study which main aim was to explore autobiographical memories for stressful events and to test a well developed theory (for review see: Rubin, Berntsen and Bohni, 2008; Rubin, Boals, and Berntsen, 2008). A 2x2x2 design was selected for the comparison of three dimensions to test their theory and other traditional theories of PTSD. In three way comparisons, *i*) most stressful memories were compared with other memories *ii*) involuntary memories were compared with voluntary counterpart and *iii*) adults with and without diagnosed PTSD were compared. Greater emotional intensity was found in involuntary autobiographical memories than voluntary memories but former were not frequently related to traumatic experiences. It was also concluded that emotional intensity, rehearsal and centrality of life story were properties of both types of autobiographical memories related to PTSD. They claimed that their results have theoretical implication for the therapeutic process.

To investigate the phenomenon of involuntary autobiographical memories among dysphoric and non-dysphoric participants Kvavilashvili and Schlagman (2011) conducted a laboratory study. The findings of this study showed that among dysphoric involuntary memories are as frequent and as quick as among non-dysphoric. But involuntary memories of dysphoric group of participants were not intrusive memories of negative or traumatic events. Content analysis of responses of all participants showed that participants of dysphoric group did not recall more memories of

objectively negative events (e.g., accidents, illnesses, deaths) than non-dysphoric group of participants. In terms of mood congruency effect a significant difference among two groups has been found. Dysphoric participants rated their memories as more negative than nondysphoric participants. It was also explored if there is any relationship between the recall of unpleasant involuntary memories during the vigilance task and participants' mood ratings at the end of the session. Partial correlations were found between the proportion of memories rated as negative by participants and their mood ratings at the end of the session. No difference was found between two groups on memory characteristics such as vividness, specificity and rates of rehearsal. Former is high in both groups and latent are low in both groups.

Involuntary memories: Retrieval

The main question, and the question of interest in this dissertation, is how IAMs are elicited.

How IAMs are elicited

The main questions refer to the representation and the retrieval of IAMs. For example, the main query refers to how memories are activated and how cues elicit IAMs. Activation is one way to distinguish involuntary memories from their voluntary counterparts (Mace, 2007). More specifically, questions about activation refer to the role of cuing sources, cuing/encoding interaction and the role of priming. Related to this, one additional question refers to the frequency of occurrence of involuntary memories and its relation with one's state of attention (Mace, 2007).

Cues

It is important to know which cues trigger involuntary memories. Many studies have been carried out on this issue and irrespective of differences in the method and analyses; all results provide information on some basic features of cues for involuntary memories. Most studies converge with the initial finding by Berntsen (1996) indicating, for example that involuntary retrieval occur by identifiable cues. Additionally, cues seem to have their basis in a variety of different experiences, including external and internal experiences. Internal experiences include mood states, thoughts, other memories, etc. External experiences refer to external objects and events. External cues seem to be more powerful (Berntsen, 1996; Mace 2004) in eliciting IAMs, but most researchers agree that the popular notion that typically involuntary memories were evoked by basic sensory/perceptual cues is incorrect (Ball, Mace, and Corona (2007); Berntsen 2007 (see also Mace 2007). In other words, the power of basic perceptual cues such as smells, colours etc, a la Proust, seems very limited. Mace (2004) ran a study on cues and showed that most of everyday life involuntary memories were evoked by abstract types of cues rather than sensory/perceptual or state cues.

Cueing/encoding interaction

Many theories talk about encoding specificity when they explain the process of activation of episodic memories (e.g., Conway, 2005; Moscovitch, 1995; see Berntsen, 2009, for a review). Encoding specificity means there is a greater probability of successful retrieval of a memory when there is an increased overlap between the information present at retrieval (e.g., the cue) and the information stored in memory (e.g., Tulving, 1979). But this point of view raised many questions as well in

researchers of involuntary memories. Berntsen et al (2012) argued that if we accept it that features from the retrieval situations match with several past events equally well why only one memory then becomes activated? She further argued that the encoding–retrieval match explanation is unable to explain involuntary episodic memories retrieval. If involuntary autobiographical memories were dependant on an encoding–retrieval match, then our daily life should be flooded with such memories (Berntsen, 2009). The cue overload principle supplemented the encoding-specificity principle to resolve these issues. According to cue overload principle “the probability of recalling an item declines with the number of items subsumed by its functional retrieval cue” (Watkins and Watkins, 1975, p. 442). It means that the extent to which this cue is uniquely associated with the target, will determine the likelihood of a cue providing access to a given target memory. The more it is related to other memories, the more its strength is decreased (see also the related notion of fan effects described by Anderson, 1983). The concept of cue–item discriminability was introduced and defined by Rubin (1995). He said defined it as “how easily a given cue isolates an item” (p. 151): “Simply put, a word is likely to be recalled if, on the basis of the cues available at the time, it can be discriminated from all else in memory” (p. 146). Berntsen argued that this concept is very important in the context of involuntary retrieval of memories, as for involuntary activation of memory a cue is needed that is sufficiently distinct to discriminate a past event from alternatives through spreading activation in an associative network. For the activation of event-relevant units, or nodes and deactivation of irrelevant units, the cue has to be able to do this. Deactivation of irrelevant units is also important, as they would interfere with the spontaneous construction of the memory and make the activation process vague (Berntsen, 2009; Rubin, 1995).

Asymmetrical cueing

To explore the relationship between the situation where retrieval of past experience occur and the remembered past event, Berntsen (1998) investigated the role played by the memory cue in the retrieval situation and in the remembered event. She found that, the cue-feature was a peripheral (non-content-addressing) part for the situation where retrieval occurs whereas it was a central (content-addressing) part for the remembered event. Morton (1990) argued that involuntary memories mostly triggered by features that were simply part of the background for the retrieved past experience. This argument contradicts the previous finding which claims that cues in the great majority of cases were content-addressing features for the memory. But Conway's (1997) suggested event specific details match with retrieval situation which trigger involuntary memories.

On the issue of cues, Berntsen (2007) concluded that generally in diary studies, respondents asked to report which cues trigger memory, led to the categorization of cues as external (present in the physical surroundings), internal (only present in thoughts), or mixed (a combination of external and internal features). Berntsen (1996a, 2001) and Berntsen and Hall (2004) explored any salient commonalities perceived by participants of their diary studies, between the memory and the retrieval situation. Whereas Mace (2004, 2005) directly asked for the description of the retrieval cue. Although they used different ways to explore but found quite similar results. For the majority of memories specific cues could be identified (see Kvavilashvili and Mandler, 2004).

In most of the studies the external cues are more common than cues present in thoughts only. Although, Mace (2004) found frequency of internal cues, but it seems

likely to reflect differences in the instructions, especially, his operationalization of internal cues. In spite of using internal, external and mixed cues, Mace (2004) used different classification for cues and that included into abstract cues (“thoughts or linguistic referents to the remembered episode,” p. 895), sensory/ perceptual cues (“all fundamental sensory/perceptual referents to the original episode,” p. 895), or state cues (“all physiological and emotional states referents to the original episode,” p. 895). He found the dominance of linguistic/thought cues (68%) over sensory/perceptual cues (30%) and internal states (2%). Berntsen (1996a, 2001) and Berntsen and Hall (2004) classify the cues into ten categories. People, activities, specific objects, or themes (unrelated to the person’s personal life, e.g., election to the European Parliament) are the most dominant cue categories. Berntsen (1996b) found auditory cues as more active to trigger memory than other types.

Cue characteristics that elicit involuntary memories

The classic Proustian view suggests that most of involuntary memories are triggered by sensory cues. And elaborating on this point one could suggest that involuntary memories might be triggered by single sensory characteristics of a cue, which may be related to sensory elements of past experiences. However, modern researchers (e.g. Ball, Mace, and Corona, 2007) totally rejected this idea, and according to their report “the contents of most involuntary memory cues, including those which have an apparent sensory or perceptual nature, relate to the central conceptual theme of a prior episode”. We agree that this might be the case. However, many different elements of a cue might relate to the central conceptual theme of a prior episode. While so far only the emotional valence of the cue has been manipulated, finding that negative cues are more likely to trigger IAMs (e.g.

Schlagman and Kvavilashvili, 2008), in this dissertation we will examine the role of pictorial information, and of concreteness, extending thus to involuntary autobiographical memories topics of investigation that have proven fruitful in the past in understanding voluntary episodic memory.

To summarize, most involuntary autobiographical memories are activated by specific cues, and typical cues are salient features of the everyday environment, such as specific people, activities, objects, locations and recurrent topics or themes. Such environmental features may elicit memories both when perceived in the physical environment and when represented in thoughts, though the former appears to be more common. Feeling states or mere sensory experiences are quite infrequent as cues for involuntary memories. Findings related to characteristics of the cues can be seen to suggest that cues for involuntary autobiographical memories reflect which types of information are salient and recurrent in our everyday environment (e.g., people, objects, locations, and activities) rather than characteristics inherent to the cues or memory *per se*. One implication of this interpretation is that what are common and less common cues for autobiographical memories will vary as a function of variations in the environment of the study population. For example, all diary studies of involuntary memories so far have involved university students or academics and thereby individuals for whom written language and abstract ideas constitute an important part of daily life. It is likely that the relative frequency of sensory/perceptual cues would be greater in different populations, such as among factory workers, fishermen, or professional football players, or in different cultures. Likewise, people who are introverted and/or tend to ruminate are likely to have more internal cues for involuntary autobiographical memories than outgoing and stimulation-seeking individuals.

Accuracy of Involuntarily Retrieved memories from Autobiographical Memory

Accuracy of involuntary autobiographical memories is the area which gets recent attention. It is very important to explore that either involuntary memories are accurate and in real involuntary or they are false memories. Mandler (2007) emphasized the need to examine the veridicality of involuntary autobiographical memories and following this hint Mace, Atkinson, Moeckel and Torres (2011) planned their work to investigate veridicality of involuntary autobiographical memories, and overall accuracy of involuntary memories. The other important part was to explore how participants perceived themselves in reported memory. Previous studies talked about perspectives taking in memory. This takes two forms, can either be *the field perspective* or *the observer perspective*. Perspectives might be changed with age (for review see Nigro and Neisser, 1983). The second question of investigation was to explore which perspective is present in involuntary memory and how its proportions can be compared with proportion of the two perspectives of voluntary memories. A diary method was used to record involuntary autobiographical memories and the phrase-cue method was used to voluntary recall from memory. Two strategies were used to check veracity and accuracy of memories. *Firstly*, every participant rated their confidence level at 5 point scale and *secondly*, friends and relatives were interviewed about each memory reported by participants. Results indicated that participants showed a high degree of confidence for their memories, when judging about the accuracy of details, and relatives and friends rating were also high about the veridicality of the same involuntary memories. No difference was found between the accuracy of involuntary and voluntary memories. It was also found that involuntary memories also experienced both perspectives (field perspective and observer perspectives) like voluntary memories. The authors concluded that although these

findings answered some important questions still more work is needed to explore accuracy of involuntary memories.

Involuntary Autobiographical Memories: the Role of Aging

Extensive work has been done on the effect of aging in a number of different areas of memory research (e.g., episodic memory, implicit memory, voluntary autobiographical memory). Researcher conducted exclusive work on aging and autobiographical memories but their main focus was voluntary autobiographical memories. However research has found that it is rather common that past experiences come spontaneously to mind, and people belonging to all age groups should experience involuntary retrieval.

Schlagman, Schulz, and Kvavilashvili (2006) conducted a study with young and old adults by using diary method. Main aim of their study was to analyse the content of memories reported by young and old participants and want to explore predominance of categories of remembered experiences among both groups. They also aimed to explore age difference on content categories and positivity effect in old age was also explored. One important point about this study was that it was fist study which systematically analysed the content of involuntary autobiographical memories. Results of the study illustrated that young and old people reported similar frequency of involuntary memories and mostly they are about positive past experiences. Old people reported some negative experiences as well but interestingly they rated negative event as neutral or even positive. Positivity effect in old age was found. No difference was found between frequencies of positive content past memories of young and old participants.

Subsequently Schlagman et al. (2007) planned a diary study to further examine the effect of aging on IAMs. They compared involuntary and voluntary memories in young and old participants. Their main aim was to expand research work on involuntary memory and look at differences and similarities among involuntary or voluntary experiences of young and old participants. It was assumed that the frequency of involuntary memories might be lower among old people than younger population. The most important finding of this study was that there was no effect of age on proportion of specific memories. Secondly, they found a clear reminiscence bump among old participants accompanied by a reduced recency effect. They further concluded that in both groups reported involuntary memories were predominantly in response to external triggers and during habitual activities. Old participants reported less involuntary memories than young adults. Older people have to concentrate more on their daily routine tasks, with the consequence that they have less cognitive capacity to experience any additional thought or mental content.

Few years later, along the same lines Schlagman, Kliegel, Schulz and Kvavilashvili (2009) conducted a study in which they compared involuntary memories with voluntary memories among young and old people. The main aim of the study was to explore whether different patterns of aging would emerge for voluntary and involuntary memories, and to assess whether there would be differences in memory characteristics e.g. specificity, pleasantness, vividness as function of age. They also investigated distribution of both types of memories across the life span and examined for this the number of both involuntary and voluntary memories. It was hypothesized that old people will report less memories than young people. Their assumptions were in the line of Schlagman et al. (2007). For voluntary memories they found age effect on retrieval time. Old participants took more time to retrieve than the younger group,

whereas for involuntary memories no difference was found for the proportion of specificity. In addition old people reported more pleasant memories than the younger group. In the young group no difference was found on distribution of voluntary and involuntary memories across life span. Mostly reported memories were from the last 5 years. Distribution of voluntary and involuntary memories was also identical. Recency effect and a clear reminiscence bump were found among old group. These results were in the line of Rubin's (1999) work and contradict the findings of Schlagman et al. (2007), as they did not find any recency effect for involuntary memories.

Part 2

Methodological issues: a review of some diary and experimental studies

Diary studies

The most common approach to study involuntary memories is the naturalistic diary method. Participants keep provided diaries and record involuntary memories in their everyday life. This method was mostly used in early studies on involuntary memories, necessarily with some variations among researchers (e.g., Berntsen, 1996, 1998; Mace, 2004; Schlagman, Schulz, and Kvavilashvili, 2006 etc). This method provided useful information about involuntary memories. Most of the studies on autobiographical memory focus on voluntary memories, where participants deliberately attempt to recall personal past experiences in response to a particular cue word or phrase provided by the experimenter (the so-called *cue-word technique*; see Conway and Bekerian, 1987; Haque and Conway, 2001; Rubin, 2005). In other studies participants are asked to recall their most vivid or most important memories (Rubin and Kozin, 1984; Rubin and Schulkind, (1997b).

In the studies addressing involuntary autobiographical memories, it was found that IAMs can come to mind spontaneously without any conscious or deliberate attempt to retrieve them. Despite their prevalence in everyday life, these involuntary autobiographical memories have received relatively little attention, compared to those on voluntary memories, with only a dozen published empirical studies on the topic (e.g., Ball, 2007; Ball and Little, 2006; Berntsen, 1996, 1998; Berntsen and Hall, 2004; Berntsen and Rubin, 2002; Hall and Berntsen, 2008; Kvavilashvili and Mandler, 2004; Mace, 2004, 2005, 2006; Schlagman, Kvavilashvili, and Schulz, 2007; Watkins, Grimm, Whitney, and Brown, 2005). From the findings of these studies using the

diary method one can conclude that there are certain optimal conditions in which involuntary memories occur in everyday life. One condition is that these memories come to mind while the person is engaged in daily routine work (Berntsen, 1998; Kvavilashvili and Mandler, 2004; Schlagman et al., 2007). The second condition is that these memories are elicited by easily identifiable cues, and these cues are very close and have central features that match the memory content (Berntsen, 1998; Berntsen and Hall, 2004; Schlagman et al., 2007). These studies also conclude that people mostly report involuntary autobiographical memories for specific events from their past.

The first diary study of involuntary autobiographical memories was conducted by Berntsen (1996). The study was conducted on 14 participants (7 females, 7 males, their average age was 23.4 years). All the participants were asked to record 50 memories with no fixed time period. Participants were further instructed that they had to record only the first two memories of the day. Subjects were instructed to record the memory and the current context promptly when an involuntary memory occurred. The recording of memory had two steps, first, immediately after an involuntary memory occurrence they had to record keyword phrases in a small notebook that they carried all the times. Second, later on the same day at a self-chosen time, they had to answer a more extensive questionnaire about each memory assisted by the keyword phrases in the notebook. The questionnaire addressed: (1) the subject's mood in the current situation (rated on a five-point scale from very negative to very positive); (2) the emotional content of the memory (rated on a five-point scale from very negative to very positive); (3) how usual the remembered event appeared (rated on a five point scale from 'very unusual' to 'very usual'); (4) the subject's age in the remembered event; (5) frequency of prior rehearsal (rated on a five-point scale from 'never' to

‘very often’); (6) the perceived impact of the memory on present mood (three possibilities were offered: current mood could become (a) better, (b) worse, or (c) uninfluenced); and (7) the subject was asked to describe in detail the current situation as well as the memory and to indicate whether there were phenomenologically clear commonalities between the two; eleven categories of commonalities were offered. Finally, subjects were asked to mark which of records referred to specific episodes (‘one-time occasions’) and which referred to event summarizations (‘a summarized representation of many occasions’). Berntsen followed a procedure similar to the one used in Barsalou’s (1988; see Williams and Dritschel, 1992, for a related distinction) study, in which the notion of ‘summarized events’ (p. 200) was originally pointed out.

The results of this study suggested that involuntary memories had identifiable cues. Access of memory was biased towards (a) mood-congruent (b) recent and (c) distinctive (unusual) events. The memories were most frequently rated as emotionally positive (for opposite results however see more recent experiments in the lab, e.g. Schlagman and Kvavilashvili, 2007), and found to influence current mood in a way that was consonant with the emotional valence of the memories. It was concluded by Berntsen that on average people experience 2-4 involuntary autobiographical memories per day, when people are engaged in their daily routine work (see Berntsen, 1996b).

Later on, Berntsen, (1998) compared recorded involuntary autobiographical memories in a diary study with voluntary autobiographical memories retrieved in the laboratory in response to verbal cues (using the cue-word method) by the same participants. She conclude that voluntary memories were different from involuntary memories in that the former are less specific, more frequently rehearsed, and less emotionally positive than the latter ones. She further concluded, after the reanalysis of

the data of the diary study, that involuntary memories were mostly triggered by the cues which were in the environment and had some common features with voluntarily retrieved memories.

Mace (2004) conducted another diary study to examine the retrieval process of involuntary autobiographical memories. Sixteen subjects in the age range of 21-51 ($M=30$) were given structured diaries for a period of two weeks. Participants were informed that the diary they were given had four entries per memory and that for each reported memory they were required to provide details that included: (1) a description of the memory, including its date; (2) a description of the retrieval cue; (3) a description of thoughts occurring prior to the memory coming to mind; (4) a description of the activity engaged in, prior to the memory coming to mind. After recording the memory they had to fill a questionnaire which asked a single question about the most frequent thought or thoughts (work, school, personal finances, family or family member, significant other [e.g., current or former spouse or fiancé], other thoughts not listed, nothing in particular) present in their mind when they had that memory. He found that participants reported an average of 35 involuntary memories over the 2 weeks. 92% of involuntary memories were elicited by identifiable cues, 30% were thought based, 31% were language based, 27% were sensory/perceptually based, and only 4% were mood based.

As already mentioned in a previous section above, the role of priming in the production of involuntary autobiographical memories was examined in two more diary studies conducted by Mace (2005). The material and instructions for recording memories were the same as used in study 1 but the difference was that on the midpoint day participants had to go to the laboratory and recall their high school time period for 30 min. After that recall session they again had to complete their diary task. The time

period before the recall session (i.e. before the visit to the lab was used as a natural baseline condition and memories about high school during that time were considered as “unprimed” memories, whereas after the recall session reported high school memories were considered as “primed” memories. In a third study, like in study 2 (Mace, 2005) participants were asked to recall different life time periods in the recall session in the laboratory (for example from the previous year or memories from age group of 13-16). They had the same procedure and material as participants of study 1 and 2. The results of study 2 and 3 concluded that priming plays a significant role in retrieval of involuntary memories (Mace, 2005).

Berntsen and Hall, (2004) conducted two more studies in which they examined whether involuntary and voluntary autobiographical memories had different characteristics. In their Study 1, they compared level of specificity and different phenomenological variables (vividness, emotional impact, remember/know judgments of the emotions associated with the event, and physical reaction to the memory, to measure the extent to which the rememberer feels that he or she is travelling back in time to re-experience the event) in involuntary and voluntary autobiographical memories. They assumed that involuntary memories would be more about the specific episodes of past experiences and more similar to reliving the original experience. The diary method was used by the participants. Participants were instructed to record 40 memories in an unlimited time period, but they were further instructed that when they recorded involuntary memory, they also had to find and report the cue which triggered that memory. After recording the memory the participants also had to fill out a questionnaire, asking questions like “ where were you when the memory come to your mind”, “what were you doing?” etc (for more details see Berntsen and Hall,2004) . The purpose was to get contextual information about the memory, for example “Did

you think of something else while you were doing this”)? In study 2 they recorded voluntary memories in two ways and then they compared these results with study 1. The two methods used were a) a *memory walk* task and b) a *cue word* task in 2 different groups. In *memory walk* task participants had to go for a walk and after every 30 steps they had to stop themselves and try to retrieve some memory related to any environmental cue encountered. And after retrieval they had to fill out a questionnaire given by the researchers. The questionnaire was the same as in the previous study. In the cue-word task participants were asked to retrieve some autobiographical memories in response to 15 cue-words, for example party, flowers, friends, snow, sports, cinema, happy etc. The authors found differences between the two types of memories. They concluded that voluntary memories were more general, mostly about common events of the past, and about negative experiences, while involuntary memories were more specific, less positive and were more about unusual events of the past(Berntsen and Hall, 2004). They further concluded, on the basis of the results of the questionnaire, that involuntary memories involved more physical reactions and had a greater impact on mood as compared to voluntary memories.

Review of results of these diary method studies shows different results. It might possible that different methodologies might be the reason for finding differences, or it might be differences in the sampling method that are responsible for the differences. There is possibility that one kind of participants (undergraduate students, e.g. Berntsen and Hall, 2004) might report one type of cue and the other (graduate students and academicians e.g. Mace, 2005) report some other type of cues (abstract cues e.g. Mace, 2004). Another pitfall of diary method is general inability to manipulate the variables; this problem limits the researcher questions that can be asked, and highlights the need to study involuntary memories in laboratory.

Laboratory Studies

The other method for studying involuntary autobiographical memories is the experimental method, based in the laboratory. Here we remind that researchers used lab setting to elicit involuntary autobiographical memories. Mazzoni et al, (2009), for example, had piloted a new priming technique to obtain involuntary autobiographical memories in the lab. In the first published study investigating under controlled laboratory conditions, factors that modulate the report of involuntary memories, Schlagman and Kvavilashvili (2008) also compared involuntary and voluntary autobiographical memory on their characteristics and on the difference in retrieval time. They designed a new and clever laboratory task of involuntary autobiographical memories that mimicked the conditions of diffused attention that diary studies (e.g. Berntsen, 1998) revealed characterize the retrieval of IAMs in everyday life. Participants were asked to complete a vigilance task that involved detecting vertical lines in a stream of stimuli which included horizontal lines. On the screen also appeared one irrelevant sentence per stimulus (e.g. “happiness is being single”). Participants were asked to record if they had any involuntary memories during the experiment. They were told what involuntary memories are and that they could interrupt the vigilance task whenever they thought they had an involuntary memory (see Schlagman and Kvavilashvili(2008) instructions in Appendix A). The authors found that people reported an average of 7 memories over a period of over one hour, and using more than 800 stimulus trials (short sentences). The majority of reported memories were triggered by the irrelevant cue phrases presented on the screen. The results of their study showed that involuntary memories were more specific and significantly faster than voluntary memories. More likely than voluntary autobiographical memories, involuntary autobiographical memories were triggered by

negative cues (see however Berntsen and Hall, 2004, that reported that more positive cues are obtained in their diary study).

In the same series of studies, Schlagman and Kvavilashvili (2008) compared laboratory involuntary memories with the memories obtained out of the laboratory, which they called ‘memories in a naturalistic context’. For this purpose they used a laboratory experiment and a diary method. They concluded that there is no difference between involuntary memories retrieved in a laboratory setting and in the natural environment. The detailed results of this study are reported later in the chapter.

Berntsen, Staugaard, and Sørensen (2012), conducted a series of experiments in which they controlled the encoding and the retrieval phase of involuntary recollections, and they predicted on the basis of manipulations done at the time of encoding, about the likelihood of memories to be involuntarily activated in the retrieval phase. They claimed that when other factors were controlled, the combined effects of an encoding–retrieval match and the principle of cue overload activate the involuntary episodic memories (Nairne, 2002; Tulving, 1979; Tulving and Thompson, 1973; Watkins and Watkins, 1975). The main aim of these series of experiments was “demonstrate that it is possible to control the activation of involuntary episodic memories by systematically varying the level of cue–item discriminability”. Berntsen and her colleagues pointed out some important points about their studies. *First* they used a paired-associate methodology because they said that the paired-associate methodology allowed them to independently manipulate the similarity between the cues as well as the similarity between the to-be-remembered targets (Crowder, 1976). *Second*, they used distinct environmental auditory cues because previous studies found that concrete external cues (e.g., objects, locations, sensory impressions) are more common as cues for involuntary memories than internal states (e.g., thoughts and emotions). *Third*,

visual images of common, everyday scenes were used as previous naturalistic studies showed that visual imagery is central for autobiographical remembering and for the sense of reliving the past events (Rubin, 2006). Fourth, they used neutral or slightly positive scenes as a cue. Fifth, in the retrieval phase of the experiments, they used an attention-demanding sound location task as a cover task for eliciting involuntary memories. They asked their participants to record task independent thoughts during a boring, but attention-demanding task. They mentioned that this task is a well-established way of studying spontaneous thought processes (e.g., Giambra, 1989; Singer, 1966; Smallwood and Schooler, 2006).

They conducted four experiments and all four experiments had an encoding phase, a retrieval phase and recognition phase. All participants had same encoding phase whereas the retrieval phase was conducted for either involuntary or voluntary (between subject) retrieval. In the encoding phase repeated (i.e., derive from the same category) or unique (i.e., derive from a non repeated category) sounds coupled with pictures of scenes that were either repeated (i.e., derive from the same category) or unique (i.e., derive from a non repeated category) were presented. Their manipulation of sound was (unique vs. repeated sounds) and picture. They did 2x2 manipulation for four systematically varied levels of cue–item discriminability for subsequent involuntary versus voluntary recall. In the recall phase auditory cues were used as memory cues and all participants had to fill questionnaire for each reported memory. All participants had to complete a recognition task after the completion of the retrieval phase. In recognition phase, one unseen and one seen pictured were presented together and they were asked to indicate the familiar picture by pressing a button and then they had to rate their self on 5 point rating scale how much they were confident that their response was correct. Their predictions for the involuntary memories follow basic

principles of association, notably the principle of cue overload. They predicted “High probability of involuntary memories in response” when unique sound cues were presented with unique scenes. For unique sound cue-repeated scenes condition they predict “Reduced probability of involuntary memories in response to the cues”, whereas in repeated sound-unique scenes condition they predict “Markedly reduced probability of involuntary memories”. Finally for repeated sound-unique scenes condition their prediction was “The repetitive cue may bring to mind a general (nonspecific) representation of the repeated target picture (a case of over general retrieval)”. They found that unique sounds elicited most involuntary memories, and these results were consistent with the notion of cue overload. Repeated sounds very rarely triggered involuntary memories. Involuntary memories showed lower retrieval time than voluntary memories which suggest that there is less executive control involved in involuntary recall. They concluded that it is possible to control the activation of involuntary episodic memories of daily life on the basis of well-known mechanisms of associative memory.

Berntsen Reviews (2009; 2010)

In her 2009 and 2010 paper, Berntsen provide a more general and theoretical review of the results of research in involuntary memories, which she claims represent a basic mode of remembering and retrieval. She mainly referred to concepts like universality, frequency, functionality and maintenance and encoding of involuntary memories in memory system. According to Berntsen, *Universality* means that involuntary memories are common and universal. Everyone experiences involuntary recall of past experiences and these memories come to mind when people are not intending to recall. Those who have intact autobiographical memory experience this

phenomenon very often. She refers to many diary studies to support the claim that involuntary memories occur regularly in daily life (e.g., Ball and Little, 2006, Berntsen and Rubin, 2002; Rubin and Berntsen, 2009, for review). The notion of *Frequency* refers to the fact that involuntary autobiographical memories are frequently experienced by everyone. Their frequency may vary from person to person and within each person over time. A frequency between two to five involuntary memories per day was found (Berntsen, 2009, for review). A study conducted on large stratified sample also supports the idea that involuntary memories occur as frequently as voluntary memories (Rubin and Berntsen 2009). The notion of *Memory System* refers to the need to establish whether the two types of memory are operated by same episodic memory system. The research has shown that the same encoding and maintenance processes seem to be involved in both types but the difference is in the way they are retrieved. Many previous studies found similarities between involuntary and voluntary memories, as for example the same forgetting function was found in both (e.g., Berntsen, 1998; Schlagman, Kliegel, Schulz, and Kvavilashvili, 2009). Some other commonalities found by different researchers for both types are the presence in both of a reminiscence bump (remember more memories from young age than middle or old age), lack of memories from the first 2-3 years of life, dominance of positive events among nondysphoric individuals (but see Schlagman and Kvavilashvili, 2007). However the retrieval process is different. Voluntary retrieval is goal directed and involuntary retrieval is associative. Both retrieval processes have different requirements for the retrieval of memory. Goal directed retrieval is monitored by an executive control while on the contrary involuntary recall is initiated by situational cues. As the retrieval process is different in the two types of memories, the retrieved memories might also differ in nature. For example mostly voluntarily recalled

memories are relevant to daily life, they are about general events, reflect turning points in people's lives or refer to normative events etc. On the contrary, involuntarily recalled memories are about emotional, surprising, peculiar, but non-consequential events. *Functionality* is another notion Berntsen discusses in her reviews (2009, 2010). She claims that involuntary memories are functional and an adaptive expression of memory. She said that it is an important function of involuntary memories that they may be stop us from "living in the present". We learn a lot from our involuntary recalled past experiences without any effort. About the intrusive memories Berntsen suggested one practical implication of research on healthy individual's involuntary autobiographical memories, and claimed that research in this area provided an alternative explanation of intrusive memories in PTSD. The traditional point of view states that voluntary and involuntary memories are different and some time it is very difficult to recall deliberately, whereas events and experiences easily come to mind in involuntary recall. ON the contrary, Berntsen supports the alternative view, believing that both types of memories work under same episodic memory system, with the same encoding and maintenance processes. She argued that emotionally stressful events are well encoded, which is the reason why they are easily accessible and spontaneously come to mind. She summarised her arguments by stating that involuntary autobiographical memories represent a basic mode of remembering and both types of memory (voluntary and involuntary) depend on same episodic memory system.

Involuntary Autobiographical memories: A basic mode of remembering

Recently, Berntsen (2009) came up with another explanation of involuntary memories and she proposed that involuntary autobiographical remembering is a basic mode of remembering. According to Berntsen associative mechanisms (mediated

mainly through the medial temporal lobes), are involved in involuntary mode, and more advanced search mechanisms (mediated primarily through the prefrontal cortex) are involved in voluntary mode of remembering, that have been added on to the involuntary mode at some point in evolution (see Moscovitch, 1995, for a similar separation of two possible modes of episodic remembering). A recent brain imaging study conducted by Hall, Gjedde, and Kupers, (2008) is in the favour of this view. According to this study, both involuntary and voluntary recollection of emotional pictures activate brain areas that are associated with retrieval success (the medial temporal lobes, the precuneus and the posterior cingulate gyrus), whereas enhanced activity was seen in areas in the prefrontal cortex that are known to be involved in strategic retrieval, when voluntary recollection was compared to involuntary recollection (Hall, Gjedde, and Kupers, 2008). Schlagman and Kvavilashvili, (2008) found shorter retrieval times for involuntary than voluntary autobiographical memories, these findings support the assumption that involuntary retrieval requires little cognitive effort. Berntsen (2009) further argued that both types of remembering were operated by same episodic memory system, and same mechanisms of encoding and maintenance were shared by both type of memories. Recency, emotional arousal and rehearsal are some important factors which enhanced the accessibility for both kinds of memories, but the retrieval mechanism of the two is different. As involuntary retrieval mode, the voluntary mode partially relies on automatic associative principles. It can be seen in context-effects in voluntary recall (Godden and Baddeley, 1975). But in the voluntary mode (unlike the involuntary mode) the search towards a particular target is a top-down, schema-guided fashion whereas involuntary retrieval occurred without any specific situational demands. Spontaneous thought processes included daydreaming (Singer, 1966), fantasy (Klinger, 1971), task-unrelated thought

(Giambra, 1989) and mind wandering (Antrobus, Singer, Goldstein, and Fortgang, 1970; Smallwood and Schooler, 2006) and involuntary memories were also included as one among several kinds of spontaneously arising mental representations. Many diary studies found occurrence of involuntary retrieval of memories and images of future events, when person's attention is defused task (e.g. Berntsen, 1998; Schlagman, Kvavilashvili, and Schultz, 2007). Many brain imaging studies reported that activity in certain brain areas increased when brain is in rest state or certainly not involved in a variety of cognitive tasks (Mason et al., 2007; Mazoyer et al., 2001). Comparison of resting state activity and a relatively simple arrow detection task suggested that activation of temporal lobe structures were especially robust. These findings further suggested that 'long-term memory processes may form the core of spontaneous thought' (Christoff et al. 2004). These findings are in the support of this idea that involuntary autobiographical memories form a basic mode of remembering. There are many implications for involuntary remembering as a basic mode of remembering.

1-Frequency of involuntary memories is the same as their voluntary counterparts. It was found by many researchers that involuntary autobiographical memories are frequent in daily life for example (Ball and Little, 2006; Berntsen 1996; Schlagman et al., 2007). The idea that involuntary memories are as frequent as voluntary memories in daily life was supported by a recent study conducted by Rubin and Berntsen, (2009). In that study a large number of participants assessed their involuntarily as well as voluntarily thoughts about self-chosen important past experiences from last week as well as an important childhood experiences. Rubin and Berntsen found that both involuntary and voluntary remembering had same frequency of occurrence. These

findings are in the support of the idea that involuntary remembering forms a basic mode.

2-Everyone experiences involuntary retrieval in their daily routine life. Berntsen, (2009) found that involuntary autobiographical memories are very common and experienced by everyone, but their frequency of occurrence may vary between individuals and within individuals over time.

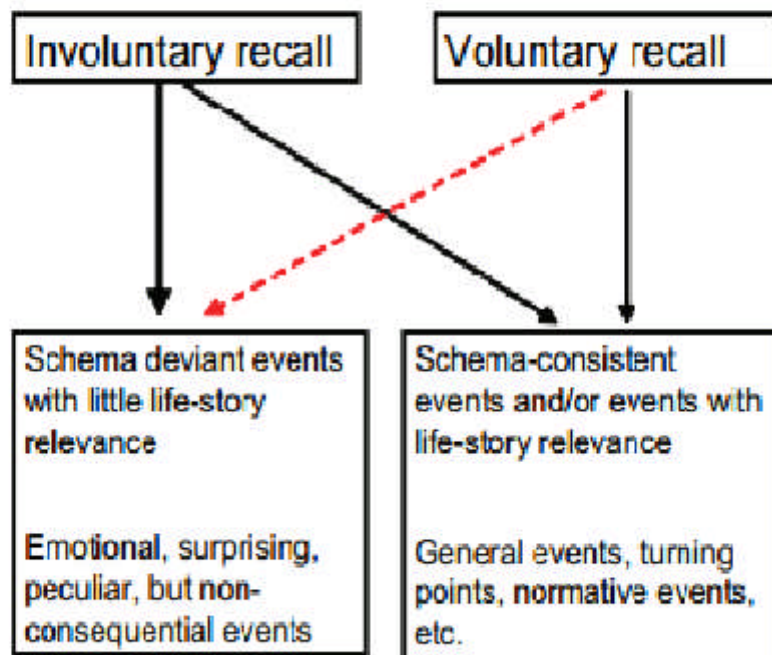
3-The third implication is about the functionality of involuntary memories. Involuntary memories are as functional as voluntary memories and they are not simply the by-product of a 'normal' voluntary memory mode. They are not a sign of mental disturbance, though in response to extremely negative events, they become dysfunctional for example in Posttraumatic Stress Disorder (American Psychiatric Association, 2000; e.g. see Krans, Na'ring, Becker, and Holmes, 2009). Special trauma-related memory mechanisms or systems explained the dysfunctional and emotionally negative aspects of involuntary remembering (e.g. Brewin, Dalgleish, and Joseph, 1996; Ehlers and Clark, 2000; Horowitz, 1975). Recollection of stressful events were also explained in terms of the same mechanisms as of everyday involuntary memories, but for extreme situations, such as traumatic events, those explanations do not hold (Berntsen, 2009; Berntsen, Rubin, and Bohni, 2008; Rubin et al., 2008).

4-Involuntary and voluntary memories are operated by the same episodic memory system but the difference between two lies in how these memories are retrieved. Both kinds (involuntary and voluntary) of memories share same basic encoding and maintenance factors. In the support of this claim there are many studies which found some important similarities between the two, for example showing that the same

standard forgetting function is followed by both (Berntsen, 1998; Schlagman, Kliegel, Schulz, and Kvavilashvili, 2009). The phenomenon of the reminiscence bump was also found in both types of memories, as middle-aged and older people reported more memories from young adulthood in both types of retrievals (Berntsen and Rubin, 2002; Schlagman et al., 2009). Involuntary and voluntary memories have found to similarly show different measures of memory characteristics (Berntsen, 1998; Rubin and Berntsen, 2009). Apart from these similarities, involuntary and voluntary memories follow different retrieval mechanisms. When there is voluntary recollection of past, the search process is monitored by executive functions and search is goal directed, on the other hand when retrieval is involuntary, there is little executive control, situational cues instigated this search and this search occurs as an associative process. Reliance on frontal lobe structures is less in involuntary than voluntary mode of remembering. In a brain imaging study involuntary and voluntary recollection of emotional pictures create activity in those brain areas which are associated with retrieval success (the medial temporal lobes, the precuneus, and the posterior cingulate gyrus), findings are in the support of the previous claim. On the other hand in the comparison to voluntary recall, in involuntary retrieval enhanced activity in areas in the prefrontal cortex areas known to be involved in strategic retrieval has been observed (Hall, Gjedde, and Kupers, 2008). Schlagman and Kvavilashvili's (2008) findings of shorter retrieval times for involuntary as compared to voluntary autobiographical memories are in support of the claim that less cognitive effort is required for involuntary recollection. And some of researchers found that high frequency of occurrence of involuntary autobiographical memories in defused attention state (e.g., Berntsen, 1998; Berntsen and Jacobsen, 2008), a finding that also

supports the idea of automatic spreading activation which may leads to the recollection of an involuntary memory.

Figure 1.3: A brief description of involuntary and voluntary recall



There is another argument regarding the differences between retrieval processes of two kinds of memories and according to that the content of the recovered material in the two modes is different. Overall schematized knowledge about ourselves plays a role in goal directed search and makes it easy to access such past experiences which are consistent with such schematized knowledge and/or plays a central role in our life story (Conway, 2005). Whereas retrieval of such past events occur in involuntary recall which had a distinctive match to features in the current situation,

and such features work as cues for the memory. So access is easier and less time taking in involuntary retrieval when recalling schema-deviant events with little life-story relevance as compared to voluntary retrieval. As in the voluntary mode of remembering search is top-down, it is hard to recall schema-deviant events with little life-story relevance. In figure 1.3 there is a brief description of both types of recall. Berntsen's (2009) findings and many other studies are also in the favour of this claim that involuntary memories are more frequent and about more specific past events than voluntary memories. In a further explanation Berntsen argued that recollection of specific past experiences which took place on particular day can be more easily accessed through involuntary recall than such events which summarized event representations of many similar occasions (i.e., a memory of a particular thunderstorm vs. a memory of thunderstorms in general). Rubin, Boals, and Berntsen, (2008) found recollection of experiences that contained distinctive contents, and are less important to the person's life story and identity, when recall is involuntary. Their findings are in the favour of the idea that spontaneous recollection mainly comes up with distinctive contents rather than events corresponding to higher-order autobiographical themes. To conclude all that, it is however important to remember that both voluntary and involuntary memories are operated by same episodic memory system, while it is their retrieval mechanism to be different (Berntsen 2010).

A model for involuntary memories

Kvavilashvili and Mandler (2004) propose a cue-priming theory to explain the retrieval processes involved in involuntary autobiographical memories (IAMs). This model assumes that the activation of a memory is primed by previous experiences but that this memory will only reach awareness when further triggered by a cue present in

the retrieval situation. Memory networks are activated to satisfy the goals and intentions of the particular situation, and this goal-based activation will spread to other associated networks (semantic and autobiographical), as well as combine with additional sources of activation elicited by peripheral contextual information (e.g. physical environment and internal states). Memories activated in this way are primed for retrieval and therefore do not require as much further activation to become a candidate for conscious awareness (and for being output). However, primed memories can only reach awareness involuntarily when triggered by a sensory cue present in the physical environment at retrieval. Mace (2005) recently provided support for the role of priming in the involuntary retrieval of autobiographical memories. He found that thinking and reminiscing about a previous life-period is enough to increase the proportion of IAMs reported from this life period and these reports could even occur days after the priming experience. Kvavilashvili and Mandler (2004) suggest that diffuse states of attention provide more opportunities to notice task irrelevant stimuli (i.e. cues) or provide faster spreading of activation (i.e. priming) through the memory networks. A comparison of the retrieval states (e.g. attention focus and mood state) reported by participants recording a goal/sensory-cued IAM versus participants recording a sensory cued IAM will provide a test of this cue priming model. Kvavilashvili and Mandler (2004) do not apply their cue-priming model to explain no-cue retrievals of IAMs, but they do apply it to explain the retrieval of involuntary semantic memories (ISMs) when no cues are identified. Kvavilashvili and Mandler (2004) suggest that ISMs and IAMs share many common features; however, they believe the involuntary retrieval of autobiographical memories must always involve a salient external cue whereas the involuntary retrieval of semantic memories does not. This theoretical conclusion is however somewhat confusing in light of the fact that

participants in their study were unable to identify a salient cue for 20% of the IAMs recorded.

Rationale of the study

This extensive review gave a detail information about the history of research in autobiographical memory and then how involuntary autobiographical memories become focus of the researchers. Distribution of deliberate memories is hierarchal in nature, whereas involuntarily recalled past experiences are directly recalled from our memory system (Conway and Pleydell-Pearce, 2000). It was assumed that these memories come from the separate pool on memory system and involuntary memories are mostly about the specific past experiences (Berntsen, 1998). The first aim of this study is to see if these memories come from the separate pool or from the same pool of memory system.

Previous researches separate voluntary and involuntary memories into two categories which are different in nature. It was found that purposeful recollection of past is mostly about the general events where as spontaneous recalled events are about the specific episodes of past. Another aim of this study is to find out the answer to this assumption, whether these memories are different or same in nature.

Mostly diary method was used to study involuntary memories. For the first time Schlagman and Kvavilashvili, 2008 used Laboratory setting to elicit involuntary memories. The method used in their study was designed on the basis of Berntsen (1996) findings that involuntary memories were elicited when the person is engaged in some other activity. The methodology used by Schlagman and Kvavilashvili, 2008, had some methodological issues which need to be modified. The aim of the present studies is to resolve those issues by introducing those modification. To summarize the

main aims of these experiments, are to explore if voluntary and involuntary memories come from same memory system or from the separate memory system. To explore if there is any difference between the two on their characteristics. The third aim is to introduce some modification to the methodology used by Schlagman and Kvavilashvili, 2008, and elicit involuntary memories in Lab settings.

Chapter 3

Eliciting Involuntary Autobiographical Memories in Lab

Experiment 1: Setting the stage

Introduction

This work starts by exploring the possibility of eliciting involuntary autobiographical memories (ABMs) in the laboratory, as a preliminary step in studying the retrieval process of involuntary ABMs. The main aim of the thesis is to test whether the prediction stemming from two ABM models (Berntsen, 1998; Conway, 2005) that involuntary ABMs are accessed directly from a separate memory system, are correct.

These predictions derive from the two models (Berntsen, Conway), that claim that ABM is composed of two separate systems, one that contains more abstract and generic information about, for example, lifetime periods (Berntsen, 1998) or a hierarchical structure of life themes and general episodes (Conway, 2005), while the other contains specific and possibly recent (Conway, 2005) life events stored as single representations.

Normal voluntary retrieval of ABMs starts from the knowledge of one's past, which is distributed across the hierarchical system (Conway and Pleydell-Pearce, 2000) in which specific "memories are transitory dynamic mental constructions" (p.

261), and are not represented by a single memory trace. These temporary dynamic mental constructions are formed by combining information from various levels of the autobiographical memory knowledge base (see also Conway, 2005). Thus, voluntary retrieval of autobiographical memories is reconstructive, and follows a top-down hierarchy with lifetime period information enabling access to general events, which in turn facilitate access to fragmentary sensory, perceptual, and affective information that come to represent the specific details of a past event. When these single elements are activated, they are interwoven using a reconstructive process that results in the retrieval of a single episode, and a voluntary specific ABM is remembered.

Involuntary memories, on the contrary, are assumed to be directly retrieved from a separate pool of recent memories that have not yet been consolidated into the long-term autobiographical memory system and are not the product of the reconstructive process that is typical of retrieving specific episodes of one's life (e.g. Conway, 2005). In a similar way, Berntsen (1998) claims that involuntary ABMs are directly accessed from the system containing information about specific events, whereas voluntary ABMs are reconstructed via a more effortful system that used information about lifetime periods. She also claims that often memories accessed involuntarily cannot be accessed voluntarily, as involuntary memories are triggered by specific cues that match exactly some elements in the memory. Thus the likelihood of activating those memories voluntarily are rather low, as the voluntary process would not use the specific cues that in other less controlled conditions would activate the memories.

However recent data (Schlagman and Kvavilashvili, 2008) have questioned these assumptions, as they found that involuntary and voluntary memories are basically not different in terms of their retrieval from memory system. They suggested

that involuntary memories are also retrieved from the same autobiographical memory knowledge base as their counterpart (voluntary memories) and their retrieval also follows the same top-down process as for voluntary memories. However in their study, in which the authors devised a methodology to elicit involuntary autobiographical memories in a lab setting, instructions to participants ask them to report memories, and it is not clear whether the memories they obtained were indeed involuntary memories. Even if the authors claim that in their study involuntary memories have shorter response time than voluntary memories, in both tasks response time measurement is far from being precise, to the point that the authors decide to take out 2-3 sec from the average response time for involuntary memories, as participants might have taken longer to report involuntary memories because of the process of realizing that it is a memory. Therefore differences in response time, as assessed in their study, do not guarantee that the memories that are called involuntary in their study are indeed involuntary. In addition, a more recent study by Berntsen (e.g. Berntsen, 2009, see also Berntsen, 2010) claims that voluntary and involuntary memories tap into the same memory pool.

When compared to a condition in which people are asked to come up with associations, a task overtly aimed at reporting IAMs can have three unwanted effects. For example, it can induce individuals to try to retrieve IBMs in a way similar to what happens with voluntary retrieval of ABMs. As retrieval of ABMs in response to cues is very productive, one expects an increase of IAMs reported compared to the condition in which there is no mentioning of IAMs in the instructions. Another possible effect is to create an overall priming of autobiographical contents, which would in general make ABMs more available. In both cases, informing participants that they have to report involuntary memories should lead to an increase in reporting

of IAMs and ABMs. In both cases what would be reported are the memories that are more accessible (i.e. those that have been previously rehearsed or reported). Furthermore, instructions focusing on involuntary memories can also activate (either intentionally or unintentionally) pre- or post-retrieval selection of ABMs, by which only a certain subset of ABMs are reported. Instructions including reference to involuntary memories might also create a report bias, and limit the report to what people naively understand involuntary memories should be (e.g. specific personal events, that are vivid and detailed).

The main point is that in all these cases, the retrieval and the nature of IAMs obtained might not be representative of all IAMs, with the consequence that the conclusions that diary studies and the Schlagman and Kvavilashvili (2008) study have reached on the nature of IAMs might be partially incorrect.

In order to obtain IAMs that are not affected by these problems, here we used a modified version of the Schlagman and Kvavilashvili (2008) paradigm, in which we asked the participants to report whatever came to their mind, including plans, generic thoughts, intentions for the future, past experiences. Crucially, participants were not instructed to focus on involuntary memories and we also avoided mentioning the word “memory” at all. Only once all mental contents had been reported, participants were asked to indicate which referred to past events, and thus were memories. These changes are supposed to ensure that the memories would be truly involuntary, as they prevented any priming of ABMs, and avoided participants voluntarily trying to retrieve memories, or selecting during the task what they considered being “a memory”. These changes made the task more similar to a typical mind-wandering task.

A second element manipulated in the present study is whether the report of mental contents is self-paced or follows a random predetermined schedule, so that the participant is told by the experimenter when to report their mental content.

In both diary and laboratory studies on involuntary memories, participants are asked to report their memories using self-paced interruptions (i.e. where participants stop their particular activity or the experiment at any time to report the memories that come to their minds). However, studies on mind-wandering have shown that individuals routinely fail (at least temporarily) to notice that their minds have wandered and they are only intermittently aware of their internal state (see for a review, Schooler et al., 2011). By contrast, when prompted by the experimenter, people can accurately report whether or not they are in a mind wandering state, and in response to queries they routinely indicate that they had been unaware of their mind wandering up until the time of the probes. Moreover, when participants classify mind-wandering episodes as unaware, their performance (Smallwood et al., 2008a) and neurocognitive activity (Christoff et al., 2009) systematically differ from when they report having known they were mind wandering (Smallwood et al., 2006).

For IAMs, it might be the case that, similarly to mind wandering, people are at times relatively unaware of the constant flux of mental contents that occurs during undemanding activities. Hence, by letting people report their mental contents only when they become aware of them, we can omit involuntary memories that, unless made aware of, would remain undetected. It might then be the case that until now studies have examined only a subset of involuntary memories that “pop up” in the individuals’ mind, a subset that might have special qualities that make them more readily pass the awareness threshold.

In the present study we then compared IAMs and their characteristics presenting two conditions, one in which participants was free to interrupt any time they became aware of a IAM or of a mental content (depending on the condition), and the second in which a predetermined schedule of interruptions was implemented, in which interruptions had the same frequency as in a prior pilot study with a self-paced interruptions condition. We reminded participants that in one condition self interruptions were to occur only when people realized that they had retrieved *an involuntary memory* whereas, in the other condition self interruptions had to occur when any mental content (plans for the future, generic thoughts and considerations) crossed the participant's mind.

Experiment 1 has been submitted to Cognitive Processing, and is currently under revision. The paper is reported here.

Submitted to Cognitive Processing, revision submitted

Modifying frequency and characteristics
of involuntary autobiographical memories

Abstract

Recent studies have shown that involuntary autobiographical memories (IAMs) can be elicited in the laboratory. Here we asked whether the specific instructions given to participants can change the nature of the IAMs reported, in terms of both their frequency and their characteristics. People were either made or not made aware that the aim of the study was to examine IAMs. They also reported mental contents either whenever they became aware of them, or following a predetermined schedule. Both making people aware of the aim of the study and following a fixed schedule of interruptions increased significantly the number of IAMs reported. When aware of the

aim of the study, participants also reported more specific memories, which also had been retrieved and rehearsed more often in the past. These findings demonstrate that retrieval of IAMs and their characteristics depend on modifications of the procedure. Explanations of these effects and their implications for the research on IAMs are discussed.

Keywords: involuntary memories, autobiographical memory, mind wandering

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, 2009; Mace, 2007). Recent studies (Ball, 2007; Berntsen, Staugaard and Sørensen, 2012; Schlagman and Kvavilashvili, 2008, Kvavilashvili and Schlagman, 2011) have shown that IAMs might be elicited and experimentally investigated in the laboratory. In the present study we ask if the instructions given to participants can change the nature of the IAMs reported. We show that changing specific details of the procedure used to elicit IAMs strongly affects their retrieval, in terms of both their frequency and their phenomenological properties. Two variables have been manipulated in the present study, whether people are made aware that the aim of the study is to examine IAMs, and whether they report their mental contents whenever they become aware of them, or when requested to do so at random times set by a predetermined schedule.

Historically, the most common approach for studying IAMs has been the naturalistic diary method (e.g. Berntsen, 1996; Berntsen and Hall, 2004; Mace, 2004), in which individuals are asked to keep a diary of IAMs they experience in everyday life. These studies have shown that people report involuntary memories frequently, with routine daily occurrences of about 3–5 per day (Berntsen, 1996; see also Mace,

2004). They usually occur when one is engaged in undemanding activities that require little attention and concentration (e.g. during relaxation and routine activities) (e.g. Berntsen and Hall, 2004; Kvavilashvili and Mandler, 2004). In most cases involuntary memories are reported to be elicited by identifiable cues that are generally related to prominent, possibly thematic, aspects of the remembered experiences (e.g. Berntsen, 1996; Berntsen and Hall, 2004; Schlagman, Kvavilashvili and Schulz, 2007).

The diary studies have also revealed that most IAMs tend to refer to specific, and mainly positive episodes (e.g. Berntsen and Rubin, 2002; but see Schlagman and Kvavilashvili, 2008). Although diary studies provide many important basic findings, there are also intrinsic limitations related to this specific methodology, the inability to manipulate variables being the most obvious pitfall, as it limits the number of questions that can be addressed.

Two novel experimental methods have been successful in eliciting and measuring IAMs in the laboratory. They have simulated the conditions that in more naturalistic diary studies have been shown to facilitate the production of IAMs, including using monotonous undemanding cognitive tasks. In a paradigm based on retrospective evaluations, participants were required to produce free associations to word cues (concrete nouns). At the end of the session, participants decided if a personal experience might have come to mind while giving these responses. Although the tendency was to provide a stream of semantic associations, participants reported autobiographical memories in 86% of the trials (Ball, 2007).

In the other laboratory task (Schlagman and Kvavilashvili, 2008, hereinafter S and K, 2008), participants were asked to perform an undemanding vigilance task while they were simultaneously exposed to irrelevant cue-phrases presented on the screen. Several involuntary memories were generated throughout the task, the majority

triggered by the cues. This procedure made it possible to compare involuntary with voluntary memories. IAMs were more likely to be about specific past episodes, to be retrieved in response to negative cues, and retrieval time was almost twice as fast as for voluntary memories.

In the word-association task developed by Ball (2007), the participants were not provided with any information about involuntary memory retrieval until after they had provided all of their free associations. Thus, one might assume that they were not voluntarily retrieving autobiographical experiences to satisfy a demand characteristic of the experiment. Conversely, in the vigilance paradigm developed in the Schlagman, and Kvavilashvili (2008) study the“ participants were informed that some unrelated thoughts could be past memories that spontaneously “pop” to mind, and the nature of involuntary autobiographical memory was explained” (p. 923).

As in diary studies, in this procedure people were informed that they had to report involuntary memories. A task overtly aimed at reporting IAMs can have three unwanted effects. For example, it can induce retrieval processes that are more similar to those of voluntary retrieval of autobiographical memories (hereinafter ABMs). In this case, as retrieval of ABMs in response to cues is very productive, one expects more IAMs reported, compared to the condition in which IAMs are not mentioned in the instructions. Another possible effect is to create an overall priming of autobiographical contents, which would in general make ABMs more available. In this case too one expects an increase in report, and mainly of memories that are more accessible (e.g. those that have been previously rehearsed or reported). Instructions focusing on involuntary memories can also activate retrieval selection, setting the focus of attention at retrieval towards ABMs, or triggering a report bias that would

limit the report to what people naively understand involuntary memories should be (e.g. specific personal events, that are vivid and detailed).

The main point is that, in all these cases, the retrieval and the nature of IAMs obtained might not be representative of all IAMs, with the consequence that the conclusions on the nature of IAMs reached with the diary method and the Schlagman, and Kvavilashvili, (2008) study might be incomplete or partially incorrect.

In order to obtain IAMs that are not affected by these problems, we used a modified version of the Schlagman, and Kvavilashvili, (2008) paradigm, in which we asked the participants to report whatever came to their mind, including plans, generic thoughts, intentions for the future, past experiences. Crucially, participants were not emphasisedly instructed to focus on involuntary memories and mentioning the word “memory” was also avoided. These changes are supposed to ensure that the memories would be truly involuntary, as they prevented any priming of ABMs, and prevented participants from voluntarily trying to retrieve memories, or selecting during the task mental contents that they considered being “memories”. These changes also made the task more similar to a typical mind-wandering task. (see Schooler et al., 2011).

In the new procedure participants were instructed to report task-unrelated mental contents when these popped into their mind, and do so by interrupting the presentation of the stimuli and writing down a very synthetic description of the mental content. The description, although synthetic, should be sufficiently detailed to allow them to later identify what the mental content was. Only at the end of the presentation of all the stimuli, participants were asked to indicate which of the mental contents they reported on paper referred to past events (i.e. memories). This method has been used extensively in structured diary studies of IAMs (e.g. Berntsen, 1996, 1998, Berntsen and Hall, 2004; Berntsen and Jacobsen, 2008), in which the two-step recording

procedure introduced by Berntsen (1996) was adopted. Immediately after the involuntary memory has occurred, participants make a preliminary record of the memory, by recording keyword phrases in answer to a fixed set of questions listed in a small notebook. Step two involves filling out a more extensive questionnaire about each memory. A second reason to have participants fill out the questionnaires at the end of the stimuli presentation was because a pilot study with the original Schlagman, and Kvavilashvili, (2008) procedure (questionnaires were filled out after each single interruption) indicated that, although participants interrupted several times during the first half of the stimuli presentation, they stopped interrupting and reporting after a while, and indicated that this was due to the need to fill out the questionnaire every single time.

Even if we believe that the procedure we used in our studies should elicit a valid sample of all IAMs, no direct comparison between the original Schlagman, and Kvavilashvili, (2008) procedure and the modified one exists. The aim of the current study is to compare the two. Participants were either informed or not informed that the aim of the study was to examine IAMs, and the effect of this manipulation was assessed on the number and characteristics of memories reported.

A second element manipulated in the present study is whether the report of mental contents is self-paced or follows a random predetermined schedule (participants are told by the experimenter when to report their mental contents). In both diary and laboratory studies on IAMs, participants are asked to report their memories using self-paced interruptions. However, studies on mind wandering have shown that individuals routinely fail (at least temporarily) to notice that their minds have wandered, as they are only intermittently aware of their internal state (see for a review, Schooler et al., 2011). By contrast, when prompted by the experimenter,

people can accurately report whether or not they are in a mind-wandering state. In response to queries about this procedure, they routinely indicate that they had been unaware of their mind wandering up until the time the probe was presented. Moreover, when participants classify mind wandering episodes as unaware, their performance (Smallwood, McSpadden, and Schooler, 2008) and neurocognitive activity (Christoff et al., 2009) systematically differ from when they report having been aware that they were mind wandering.

For IAMs, it might be the case that, similarly to mind wandering, people are at times relatively unaware of the constant flux of mental contents that occurs during undemanding activities. Hence, by letting people report their mental contents only when they become aware of them, researchers can omit involuntary memories that, unless made aware of, would remain undetected. It might then be the case that until now studies have examined only a subset of involuntary memories, a subset that might have special qualities that make them more readily pass the awareness threshold.

In the present study we then compared IAMs and their characteristics in two conditions, one in which participants were free to interrupt any time they became aware of a IAM or of a task-unrelated mental content (depending on the condition), and the second in which a predetermined schedule of interruptions was implemented, in which interruptions had the same frequency as in a prior pilot study. In the pilot study a self-paced condition was used, as explained in the procedure below.

To summarize the whole design, we compared the effect on the frequency and characteristics of IAMs of two factors, a) inserting information about the aim of the study on *involuntary memories* (2 levels, either inserted or not inserted), and b) pacing of interruptions (self *vs.* experimenter-paced interruptions).

Method

Participants

Forty eight undergraduate students from the University of Hull (29 females, age range 18-35) participated in the experiment. English was their first language and they had normal or corrected-to-normal vision. The difference in age among the four groups was not significant.

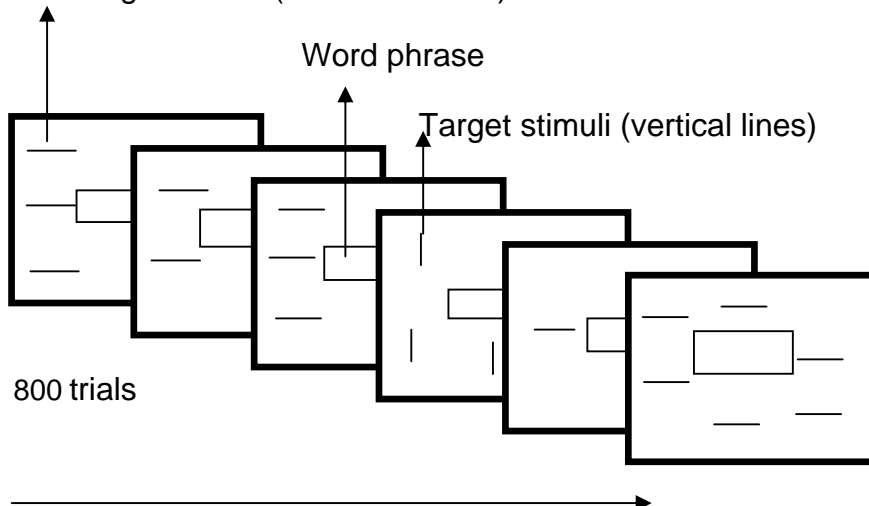
Materials

Vigilance Task. The same vigilance task was used as in Schlagman, and Kvavilashvili, (2008). The task consisted of 800 trials, presented in a continuous fixed order, each remaining on the screen for 1.5 sec. Each showed a card depicting either a pattern of black horizontal (non- target stimuli) or black vertical lines (target stimuli). Target stimuli appeared on 15 trials and were presented randomly every 60–90 sec (i.e., 40–60 trials), in order to ensure that they came at fairly long and irregular intervals. In addition to the pattern, a word phrase (e.g., relaxing on a beach, supportive friend, see appendix E), was presented in size 18 Arial and placed in the middle of each card in each trial.

Figure 3.1 *Experiment 1*

Session 1 (Involuntary retrieval)

Non-target stimuli (horizontal lines)



Questionnaire. Participants recorded details of their memories on a two-page questionnaire (Schlagman, and Kvavilashvili, 2008), where they described the memory content in detail and indicated whether the memory was triggered by their thoughts, an environmental trigger (and state what the trigger was), or whether there was no trigger. Then they rated their overall level of concentration during the vigilance task, the vividness and pleasantness of the memory, how unusual or common and how pleasant the event was, whether it was general or specific, their age when the event occurred, and how often the memory had been thought of/rehearsed before (see Appendix K).

Design. This was a 2 (Instruction type: with vs. without mentioning IAMs) x2 (Interruption type: self-interrupted vs. experimenter interrupted) design, with both factors manipulated between subjects.

Procedure

Participants individually read an information sheet explaining the vigilance task in which they had to detect randomly presented target stimuli (patterns of vertical lines) from a large number of non-target stimuli (patterns of horizontal lines). Each time a target stimulus was detected participants had to say “yes” out loud. They were also informed to ignore the words in the center of the pattern. They were also told that, due to the task being quite monotonous, they could find themselves thinking about other things, which was quite normal.

Participants with Memory instructions and Self-interruptions (SPI) had the original procedure (Schlagman and Kvavilashvili, 2008). They were told that some unrelated thoughts could be past memories that spontaneously “pop” to mind, and the nature of IAMs was explained. It was also specified that memories could be about specific or general events, from one’s recent or remote past, and so forth. Their main

task was to continue to respond by saying “yes” out loud each time they saw the target vertical lines, but that if an involuntary autobiographical memory came to mind, then they should click the mouse, which would stop the vigilance task, and in one-two lines (i.e. a relatively short sentence) record their memory. They were told that this initial brief description of the memory should however be sufficient to remind them of the content of that specific memory at a later point in time. Only when all stimuli had been presented and all memories recorded, participants were presented with their brief descriptions and asked to complete for each the two-page questionnaire (see Appendix K, for instruction see Appendix A).

Participants with No-Memory instructions and Self-interruptions (SPI) received the same instruction, but this time no overt mention of memories or past memories was made. Instead participants were asked to interrupt the presentation of the stimuli when task-unrelated mental contents (thoughts, plans, considerations, past events, images) popped up in their mind during the task. Also in this case they were asked to click the mouse when these mental contents came to mind, which would stop the vigilance task, and in one-two lines (i.e. a relatively short sentence) record their mental content. Also in this condition they were told that this initial brief description of the mental content should however be sufficient to remind them of the content of that specific mental content at a later point in time. Only when all stimuli had been presented and all mental contents recorded, participants were informed about the nature of involuntary memories, presented with their brief descriptions, asked to categorize the descriptions as involuntary memories or non-memory contents (that we called more generically thoughts), and asked to complete a two page questionnaire for each of the memories (see Appendix K, for instruction see Appendix B).

Participants with Memory instructions and Experimenter-interruption (EPI) received the same instruction as the first group but they were told that they would have been interrupted during the performance and asked to report the involuntary memories that were going through their mind at the moment or/and just before the interruption. If there were, they were asked to briefly record their memory as in the previous two conditions (see Appendix C). The number of interruptions (n= 13) was established on the basis of pilot data collected using self interruptions. In the pilot the procedure by Schlagman, and Kvavilashvili, (2008) was used on 15 participants and the average number of interruptions calculated. In the final study the interruptions were scheduled from item (cue) 37 (1st interruption) to item (cue) 763 (13th interruption), the intervals were initially selected at random but these were then kept the same for all participants of this condition.

Participants with No-Memory instructions and Experimenter-interruptions received the same instructions as the second group, but were told that they would be interrupted by the experimenter and asked to report task-unrelated mental contents (see Appendix D). The session lasted from one hour and half to more than two hours, depending on the number of mental contents or involuntary memories generated.

Results

All participants completed the vigilance task successfully. Participants generated a total of 521 IAMs with a mean of 10.86 (SD= 9.02, range 0-37) per participant. Out of 521 IAMs, the majority (76 %) were reported to have identifiable triggers. Out of these, 227(57, 3%) were triggered by environmental cues and 169(42, 6%) were triggered by internal thoughts.

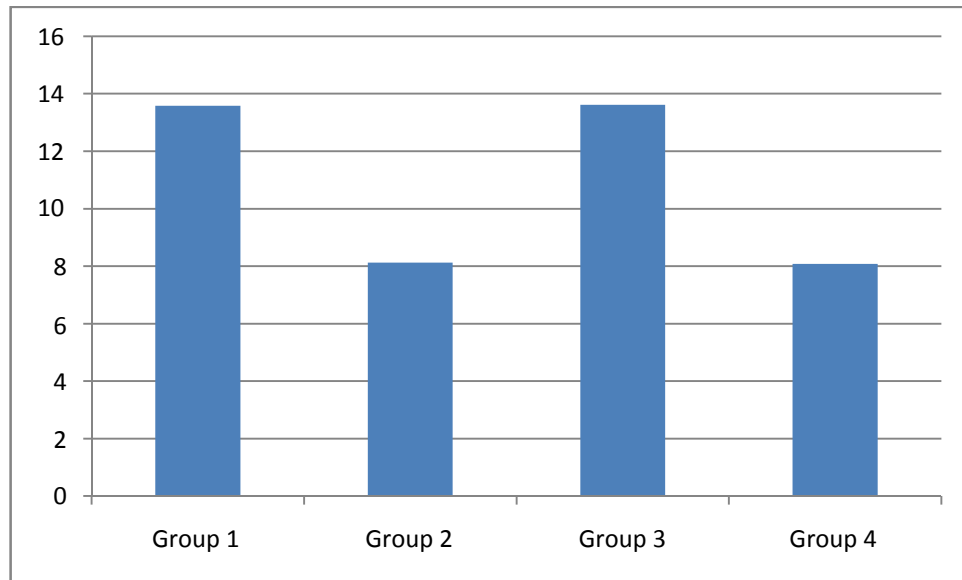
Table 3.1: Descriptive data (means and standard deviations) for all dependent measures.

	Memory		No Memory	
	SPI	EPI	SPI	EPI
Memories	9.25*	17.92*	6.92	9.33
	(6.17)	(10.47)	(6.63)	(8.94)
Non-memories	N/A	N/A	10.33	17.17
			(5.30)	(9.56)
Vividness	5.38	5.46	5.29	5.45
	(1.09)	(.68)	(1.13)	(.60)
Repeated before	3.23*	3.28	2.44	2.87
	(1.15)	(.87)	(.81)	(.91)
Specific proportion)	.74*	.75	.55	.64
Concentration	(.18)	(.20)	(.34)	(.23)
	3.75	3.33	3.13	3.33
	(.91)	(.83)	(.81)	(.59)
Unusual	2.91	3.17	3.29	3.15
	(.65)	(.61)	(.58)	(.58)
Age of event	18.08	17.50	19.95	17.64
	(3.10)	(1.49)	(5.97)	(2.70)
Pleasant event	3.27	3.51	3.53	3.44
	(.86)	(.52)	(.39)	(.46)
Pleasant memory	3.60	3.49	3.66	3.57
	(.76)	(.48)	(.49)	(.48)

Descriptive data for all dependent variables are reported in Table 3.1. To assess the effects of type of instruction and type of interruptions on the total number of memories, the average number of IAMs per person was calculated and entered into a 2 (Instruction Type) x 2 (Interruption Type) ANOVA. Participants with Instructions mentioning IAMs recalled more IAMs ($M = 13.58$) than participants in the Instructions without mentioning IAMs ($M = 8.12$) [$F(1, 44) = 5.27, p = .027$]. The main effect of type of Interruption was also significant [$F(1, 44) = 5.43, p = .024$]. More IAMs were

reported when experimenter-interrupted (EPI) ($M = 13.62$) than when self-interrupted (SPI) ($M = 8.08$). The interaction was not significant [$F(1,44) = 1.73, p > .19$].

Graph 3.1 Number of IAMs among four groups



As for the number of mental contents that were not memories, participants who were experimenter-interrupted reported on average more mental contents ($M = 17.17$) than participants in the self-interrupted condition ($M = 10.33$) [$t(22) = 2.17, p = .04$]. We remind that in the other two groups (Instructions mentioning IAMs) only memories were reported.

The results so far indicate that instructing participants about involuntary memories increased significantly the number of involuntary memories reported. A clear increase in memories was obtained also when the interruptions were scheduled by the experimenter. Having to report what they had in mind (memories or task-unrelated mental contents in general) at unexpected times helped participants become aware of, and report, their mental contents.

The next question is whether the two experimental manipulations affected the phenomenological quality of involuntary memories retrieved. The mean ratings for all

recorded memory characteristics were calculated and entered into several 2 x 2 ANOVAs with instruction type and interruption type as independent variables.

Participants who received instructions mentioning IAMs reported a higher proportion of specific memories [$F(1,42) = 4.67, p = .036$], and a higher frequency of rehearsal of the reported memory [$F(1,42) = 4.61, p = .038$], compared to participants who received instructions without mentioning IAMs. There was no difference between self and experimenter-interrupted conditions in any memory characteristics, and no significant interaction.

Discussion

The amount and type of involuntary memories depends strongly on the method used to elicit these memories. Informing participants that they had to report 'involuntary memories' (IAMs) in an involuntary memory task increased significantly the number of IAMs reported. These memories were also more specific and had been retrieved and rehearsed more than IAMs reported in the condition in which people were allowed to report any task-unrelated mental content. In addition, we also found that more IAMs were reported when participants were interrupted by the experimenter. However, the characteristics of the memories were not different when interruptions were scheduled by the experimenter compared to self interruptions. The lack of a significant interaction indicates that the influence of information about the type of task and that of type of interruption acted independently in triggering IAMs.

Several, and not mutually exclusive, explanations might be advanced for these effects.

The greater number and different characteristics of memories obtained when instructions mentioned IAMs could be due to an unaware priming effect, that might enhance the overall activation of autobiographical memories and help those already more active (e.g. more rehearsed) to pass the threshold and pop up in the person's

mind. The fact that memories reported when instructions focused on IAMs were indeed more rehearsed lends support to this interpretation. However, one can speculate that instructions focusing on involuntary memories might also activate some form of selection at retrieval. This could be reflected in a report bias, by which only mental contents are reported that reflect what people naively understand involuntary memories should be. Reported memories are usually and naively conceived as referring to specific personal events, which are indeed the type of memories we found to be more frequent in the memories reported when the instructions explicitly stated that the aim was to study IAMs. Selection at retrieval could also be reflected in more narrowly focusing attention during retrieval just on memories, leaving other mental contents unattended. Conversely, in the other self-paced group in which ‘memory’ was not mentioned attention would instead be less focused and more spread over all mental contents that pop in mind, with the consequence that possibly some IAMs would go unnoticed. This would lead to a smaller number of IAMs in the No Memory condition, as obtained here. In other words, when no memory instructions are given, people end up omitting a number of IAMs that, if they paid attention, would be reported. Although the present data do not provide a definitive answer on whether this selection occurs at a pre-retrieval or post-retrieval phase, the attentional explanation advanced for the “memory mentioning” effect receives some support also from the other result of this study, showing that a higher amount of IAMs is obtained when participants are unexpectedly interrupted by the experimenter (compared to the self-interruption condition).

As suggested by previous results obtained in mind wandering tasks, being unexpectedly interrupted and requested to report memories (in one condition) or mental contents (in the other) that have recently come to mind helps individuals

become aware of mental contents that would otherwise go unnoticed (Christoff et al., 2009; Smallwood et al., 2008). Random interruptions then would make individuals aware also of the current mental contents, thus boosting the number of items reported. In the present data, this increase occurred not only for memories, but also for other mental contents when instructions did not mention IAMs.

Recent theorizing about mind wandering suggests that meta-awareness (i.e. one's explicit knowledge of the current contents of thought), corresponds to an intermittent process whereby individuals only periodically notice the current contents of their mind. Direct comparisons between self-catching measures of the mind-wandering state (e.g. asking participants to press a response key every time they notice by themselves that they have been mind wandering) and probe-catching sampling (in which participants are intermittently queried whether or not they were mind wandering, and if they were, they are asked to indicate if they had been aware of this fact) have shown that individuals routinely mind wander without noticing it (zoning out) (see for a review and discussion, Schooler et al., 2011).

In the current study we found that when interruptions follow a predetermined schedule (although randomly sampled), more mental contents and more memories are obtained. It is possible, then, that diary studies, in which people necessarily report only involuntary memories of which they are aware, as well as studies using self-interruption procedures, have limited their investigation to involuntary memories that are sufficiently activated to pass the awareness threshold. These can be memories with special qualities, in which case the theoretical explanations proposed so far on how involuntary memories are retrieved might not extend to all involuntary memories.

In this respect it is interesting to notice that in the present study the predetermined interruptions scheduled by the experimenter (although randomly

sampled) did not change the characteristics of the memories that were assessed, even though the number of memories reported increased. This would confirm that the increase in memories in this case is not due to intentional selection or to reporting bias at retrieval. Rather, as in other forms of mind wandering tasks, this increase might be due to increased awareness of mental contents that, without those interruptions, would remain below threshold. It might also indicate that aware involuntary memories are not qualitatively different from unaware ones, and that passing the awareness threshold is a random event. However future studies should assess the effect of other characteristics of the memory, such as the degree of self-involvement in the event portrayed in the memory, or how the content is linked to self-relevant goals, which represent crucial elements in autobiographical memory (see for example the model proposed by Conway, 2005).

While all the explanations advanced so far hold for the present data, it will be the task of future studies to assess which explains them best. Future studies should also assess whether the differences obtained in the current experiment might also be due to differences in the nature of the retrieval process activated in the various conditions. It might be possible, in fact, that when instructions mention memory, retrieval processes become somewhat similar to those involved in voluntary retrieval from autobiographical memory, and proceed in a hierarchical way, from general themes, to general memories, to specific memories (Conway and Pleydell-Pearce, 2000). Response time data might help in testing this hypothesis, as involuntary retrieval should be faster than voluntary retrieval.

In the present work we found a large inter-individual variability in the number of mental contents and memories reported during the vigilance task. This finding might indicate that there are potentially important individual differences in cognitive

and meta cognitive processes between those who did report many mental contents and those who reported only a few. Future studies should investigate in a more systematic fashion the role of individual differences in metacognitive processes (monitoring and control) as well as personality variables (e.g. extroversion vs. introversion) on the tendency to report mental contents.

Despite the limits of the present work, our data clearly demonstrate, for the first time, that the procedure used to elicit IAMs strongly affects both the amount of memories obtained and their characteristics, and that modifications in the procedure might change the results obtained about involuntary memories. This suggests that what is known about involuntary memories might still be very far from the final picture and probably important components of the processes involved in the retrieval of involuntary memories are still missing.

In any case, a firm point made by our results is to show the necessity of supplementing diary studies on involuntary memories with experimental work, if we want to reach an adequate understand of how involuntary memories are retrieved. Recent experimental work in this area (e.g. Berntsen et al., 2012) suggests the same considerations.

After having compared the four methods, we are in a better position to understand what their effect is. While we believe there are pros and cons with each method, the response to the question depends also on the aim of the study. The method in which participants are not informed that the aim of the study is to collect involuntary memories is in our opinion preferable to the one in which such directions are given, as these directions seem to change not only the likelihood of obtaining memories but also their characteristics. Self paced interruptions seem to limit the output to memories that are over the awareness threshold, and thus should be used

when the aim of the study is to examine the characteristics of these specific memories, or the variables that facilitate the report of these memories. We believe, however, that the most interesting question in the retrieval of IAMs refers to understanding the factors that activate existing information in autobiographical memory, and those that bring IAMs to an aware level. Much still need to be done in this area, and the results will help understand to which extent the factors that typically modulate retrieval in voluntary memories also affect involuntary retrieval.

Experiment 1.1

Comparing involuntary with voluntary memories

Given the results showing that differences are found in IAMs depending on the procedure adopted, it was decided to compare the results on involuntary memories (Session 1) with the results on voluntary memories (session 2). To this aim, all the participants of session 1 (in all four groups) were called again to complete a voluntary memory task. This task was held between 1 and 2 weeks after the involuntary memory task. The procedure adopted for the voluntary task followed exactly the procedure used by Schlagman, and Kvavilashvili, 2008), in which a much smaller number of cues were presented, and participants were instructed to voluntarily trying to remember personal events associated with the cues.

Method:

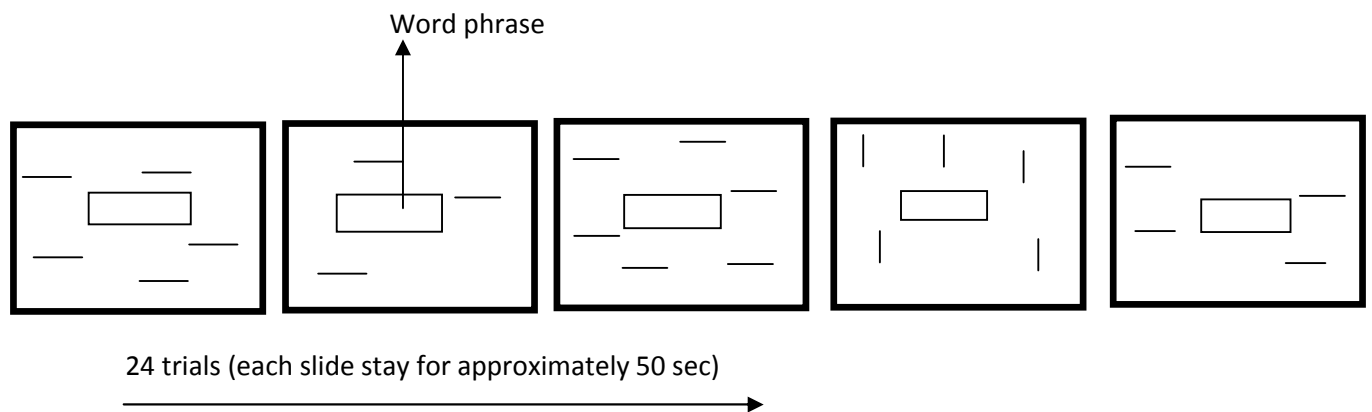
Participants: all the participants of session 1 participated in session 2.

Material and procedure: In this session 24 new phrases (8 positive, 8 neutral, 8 negative) not shown in Session 1 were presented randomly on E-prime software. The same phrases used by Schlagman, and Kvavilashvili, 2008) were used and were shown in the same way as in Experiment 1. Their font size was 18-point Arial, and were presented in the centre of the card along with the block of black horizontal lines. All

the participants were instructed that they had to concentrate on the phrases (also called cues words) shown on the screen and try to retrieve a memory (related to the phrase) from their past. It was further explained to all of them that if they were unable to retrieve any memory they had to wait for some time (50 sec approximately) and the new sentence would be displayed. For all reported memories they had to fill the two-page memory questionnaire as they did for Experiment 1.

Figure 3.2 *Experiment 1*

Session 2 (voluntary retrieval)



Results

T-tests for paired samples were run on the total number of memories obtained in the involuntary session (Exp.1) and in the voluntary session. Results showed that participants reported more memories in the voluntary session ($X=16.38$, $SD=5.18$) compared to the involuntary session ($X=12.28$, $SD=9.16$), $t(39)=2.99$, $p<.005$. Comparison of memory characteristics also revealed significant differences between involuntary and voluntary memories. The former were significantly *less* specific compared to voluntary memories, both when the number of specific memories was calculated (Involuntary, $X=8.20$, $SD=6.98$, Voluntary, $X=11.30$, $SD=4.11$), $t(39)=3.05$, $p<.004$, and when the ratio of general over specific memories was calculated,

$t(39) = 2.74, p < .01$. In addition, voluntary memories required more concentration, ($X=4.24, SD = .73$, vs $X=3.39, SD = .79$), $t(39) = 6.86, p < .001$, and referred to more experiences described by participants as “unusual”, ($X= 3.48, SD= .61$, vs $X= 3.07, SD = .57$), $t(39) = 4.93, p < .001$. No other characteristics, including age, reached significance. Events were reported to have occurred at the average age of 17 years.

In other words the results indicated the pattern of differences and it is interesting to notice that the pattern of differences depending on how IAMs were obtained. Separate t-test for paired samples was calculated for each group. The difference in specificity of memory and concentration on task between voluntary and involuntary memories found in the overall sample was no longer significant when IAMs were obtained using instructions that specified the aim of the study, independently of whether interruptions were self or experimenter paced. And when the experiment was interrupted following a predetermined schedule, and no aim was mentioned, IAMs were rated as being also more vivid and pleasant than voluntary memories (in addition of being still less specific and require more concentration).

Discussion

The comparison between involuntary and voluntary memories provides interesting results, even if we need to use caution in interpreting these results, given the different sets of words that were used for the involuntary and voluntary tasks. It seems that, differently from the agreed-upon convention that IAMs are more specific than voluntary memories, our results indicate quite the opposite, IAMs are more generic than memories that are obtained intentionally. The idea that IAMs are more specific derives from diary studies, but it has also been confirmed in a previous experiment by Schlagman, and Kvavilashvili (2008). However when we replicated the same procedure as Schlagman, and Kvavilashvili (2008) we found no significant

difference in event specificity. It is true that our sample was small, and certainly too small to draw strong conclusions. The pattern however is interesting and it suggests that more work needs to be done to examine similarities and differences between IAMs and voluntary memories using experimental procedures. This conclusion is confirmed by another of our results, that people reported more concentration during the voluntary than involuntary memory task but only when they were not told that the aim of the study was to examine involuntary memories. This result hints at the possibility that the original procedure used by Schlagman, and Kvavilashvili (2008) has likely directed participants to use also a relatively voluntary type of retrieval.

As we said, the difference in type of material and procedure between the involuntary task and the voluntary task might have created an artefact in the results. In Experiment 7 we will address this point by comparing involuntary and voluntary memories obtained using the same material (counterbalanced across participants) and the same procedure, the difference being only the instructions, that for the voluntary part are almost identical to the ones used here (taken from Schlagman, and Kvavilashvili, 2008).

Chapter 4

Eliciting Involuntary Autobiographical Memories in Lab

Experiments 2, 3: Are pictorial cues effective in eliciting IAMs?

This chapter reports three experiments that have been devised to examine whether it is possible that by manipulating the cues in an experimental setting, different number of involuntary autobiographical memories are elicited. This chapter has been written up as a paper that will be shortly submitted to *Experimental Psychology*.

Introduction

Involuntary personal episodic 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 contexts, 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 and Mandler, 2004; Schlagman and Kvavilashvili, 2008).

Interestingly, research using diaries has shown that 80% or more of cases of IAMs are elicited by easily identifiable cues (e.g. Berntsen, 1996; Berntsen and Hall, 2004; Mace, 2004, 2006; but see also Ball and Little, 2006), and that some cues seem to be more effective than others. The consistent finding across laboratories and studies

is that in diary studies external (environmental) cues are more commonly reported by participants compared to internal cues (thoughts, emotions). For example, Berntsen (1996, 2001; see also Berntsen and Hall, 2004) had participants report 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, and that the best cues were mainly auditory or visual and referred to sensory and perceptual experiences. However cues typically involved specific objects, activities, people, and themes, whereas pure raw sensory experiences (e.g., a smell, a taste) were relatively infrequent.

Seemingly different results have been obtained in subsequent diary studies using a different coding system (Ball and Little, 2006; Mace, 2004, 2006), with participants reporting that both internal thoughts and external linguistic cues (e.g. spoken and written words and phrases, all considered abstract cues, Mace, 2004, p.894) were more effective in eliciting involuntary memories (68%), compared to sensory/perceptual cues (30%) or cues related to internal states (2%). However, a study in which both coding systems have been applied (Schlagman, Kvavilashvili and Schulz, 2007) confirmed the initial internal/external distinction. The majority of IAMs with identifiable triggers were evoked by external (72%) as opposed to internal (28%) cues, with a high but similar percentage of both “abstract” and “sensory/perceptual” ones (47 percent and 44 percent, respectively). The role of emotional valence of the cues has also been examined in other studies on IAMs. For example, in an experimental study Schlagman and Kvavilashvili (2008) presented participants with cues that had either a positive, a neutral or a negative emotional valence, and found that negative cues were most often reported by the participants as those that elicited involuntary memories.

We then know that involuntary memories are elicited mainly by external and negative cues. Here we ask whether other aspects of the nature of the cue are important in determining the likelihood of eliciting involuntary memories. No studies so far have experimentally compared if pictorial cues are more effective than verbal cues, when the modality of presentation is the same (i.e. visual).

There are reasons to expect that cues presented as pictures are more powerful than the same cues presented in a verbal format. Pictorial cues are more effective than verbal stimuli in many circumstances. For example they elicit more disgust, more sexual desire, more and stronger emotional reactions (e.g. Bradley et al, 2001), and enhance search processes in attentional tasks (e.g. Knapp and Abraham, 2012).

It seems also generally accepted that pictures are better cues to episodic memory than words. Pictures should help people visualize events, and a large number of studies have shown that visualizing something helps recall (e.g. Dobson and Markham, 1993). In the realm of autobiographical memory the powerful effect of visual/pictorial cues has been evidenced in studies on intentional/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), memories for personal events (Roebbers and Elishberger, 2002), and were associated with a significant increase in correctly reported information while error rates remained constant. Importantly, the effectiveness of the cues increased with age. In other studies pictorial cues facilitated specific memory retrieval, compared to general memories, in PTSD patients (Schönfeld, and Ehlers, 2006).

Research in the 60s and 70s showed that in general people remember pictures better than words (Paivio, 1971; Paivio et al, 1968; Shepard, 1967) (picture superiority effect) an effect that has been mostly attributed to enhanced processing at encoding. Both Paivio's dual coding hypothesis (Paivio, 1971, 1983, 1986) and Nelson's sensory semantic model (Nelson, 1979, stating that pictures provided more distinctive visual representations) refer to enhanced encoding processes. Better encoding of pictorial cues would entail more links with existing memories, and hence a greater likelihood of eliciting involuntary memories. The superiority of pictures has also been attributed to the fact that pictures promote distinctive processes at encoding (Israel and Schacter, 1997), and a number of studies have shown that distinctive encoding enhances retrieval (Hanczakowski and Mazzoni, 2011).

The principle of encoding specificity has also been invoked and recent studies (e.g. Vaydia, Zhao, Desmond and Gabrieli, 2002) have shown that during retrieval there is a clear reactivation of picture processing areas in the brain. Interestingly, results of this study revealed that a subset of the brain regions involved specifically in encoding of pictures were also engaged during recognition memory for the encoded pictures, indicating that cortical areas originally involved in perception of a visual experience become part of the long-term memory trace for that experience. This result provides an interesting explanation for the effectiveness of pictorial cues in episodic (including autobiographical) memory. For the same reasons pictorial cues might be highly effective also for the retrieval of IAMS.

Current theorizing on retrieval processes involved in IAMs emphasizes the associative nature of the spreading of activation from the representation of the cue to related concepts in the autobiographical memory system (Berntsen, 2009, 2012; Mace et al, 2011; Schlagman and Kvavilashvili, 2008), and there seems to be agreement that

in the great majority of cases retrieval is due to some degree of overlap, in some identifiable features, between the cue and the content of the memory (Schlagman et al 2007; see Berntsen, 2009, for review). In agreement with the conception that retrieving information from episodic memory occurs via interactions between a retrieval cue and a memory representation (Tulving, 1983), current understanding is that IAMs are triggered when a sufficient match occurs between elements of the cue and central features or themes of the memories (e.g. Ball, Mace, and Corona, 2007; Berntsen and Hall, 2004; Berntsen, 2009, 2010), a concept that 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).

More recently, however, Berntsen et al (2012) have also proposed that the encoding specificity principle should be supplemented with an ancillary mechanism that limits the number of potential memory representations activated by a cue. They argue that this is necessary in order to explain why people are not flooded by memories, as would be predicted solely on the basis of the encoding specificity principle (encoding-retrieval match). The authors propose the principle of cue overload as a way to account for the limited number of IAMs that are usually observed in both diary and lab studies. According to this principle “the probability of recalling an item declines with the number of items subsumed by its functional retrieval cue” (Watkins and Watkins, 1975, p. 442, cited in Berntsen et al, 2012, p.2). In other words, cues that are uniquely associated with a target memory representation are more effective in eliciting that specific memory. Berntsen et al (2012) link this idea to the notion introduced by Rubin (1995) of cue–item discriminability, defined as “how

easily a given cue isolates an item” (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. The uniqueness of the link between the cue and the memory is thus necessary in explaining how IAMs are retrieved.

In the case of pictorial cues, the amount and consequent specificity of visual-perceptual details makes them rather unique and specific. Hence, according to the cue overload and the cue-item discriminability principle, one would predict these cues to be more effective than verbal cues, as they would uniquely match a specific content in memory. For example, in a picture, a glass of red wine is represented as a very specific glass with a specific hue of red, whereas the words ‘a glass of red wine’ can create a less detailed mental representation and thus potentially activate a much larger number of memories which would decrease the cue effectiveness, leading to a decrease in IAMs.

The elements above then would lead to predict a clear superiority effect for pictorial cues. However, in spite of the amount of evidence suggesting that pictorial cues should be more effective than verbal cues in eliciting IAMs, it is possible that verbal cues might be more powerful, and there is more than one reason to predict so. A first reason to expect greater effectiveness for verbal rather than pictorial cues refers to a possible backfiring effect of the very large amount of details contained in pictures. If each element acts as an independent sub-cue, hence increasing the number of potential cues contained in the picture, the success of retrieval would decrease as predicted by the fan effect (Anderson, 1983). A second reason refers to the likelihood of obtaining a sufficient overlap between the cue and the existing memory representation, which might be greater for verbal compared to pictorial cues. 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) are more powerful cues than pictures of the same scene. One explanation proposed for this result, that can be applied to memory in general and not just to false memories, is that narratives “allow and even demand that subjects generate their own details” (Garry and Wade, 2005, p.365). Generating personal details is involved not only when processing narratives, but in general when processing verbal material. Even in reading the single and simple word ‘ball’ the reader creates a mental representation of the word that contains specific details which are not imposed by the word, but that are generated by the readers, who have the freedom to create their own images and incorporate in the mental representation their own personal knowledge. Similarly to what Garry and Wade (2005) also claim, by contrast pictures impose more constraints on the mental representation that the single individual has of the item, as pictures contain specific details, people, and settings which might be different from the ones each subject would create if free to do so. If so, then verbal cues should be more effective than pictorial cues in eliciting IAMs. This could be true also in IAMs. The principles of encoding specificity and that of cue-item discriminability that have been invoked to explain how retrieval of IAMs occurs could after all be more easily met when the cues activate information that is already in the memory representation of an individual. This is more likely to occur when the information elicited by the cue is not just detailed, but contains those very details that are part of the individual’s original experience. In other terms, verbal cues can turn out to be more effective to the extent that these cues leave the subject free to incorporate into the mental representation of the cue their own personal details. In the first two studies we compared pictorial with verbal cues of the same episode (Experiment 1) or the same object (Experiment 2). To anticipate the results, pictorial cues turned out to

be significantly less effective in eliciting IAMs both with more complex events and with simple objects.

Having established that verbal cues are more effective than pictorial cues, in Experiment 3 we then tested whether verbal cues of different nature (concrete vs. abstract cues) might also differ in their effectiveness in eliciting involuntary memories. Extensive research in the 60s, 70s 80s and 90s has revealed a so-called concreteness effect, which has been observed in a variety of cognitive tasks, showing that concrete verbal material leads to greater cued and free recall, easier comprehension, faster lexical decisions (e.g., Walker and Hulme, 1999; de Groot, Dannenburg, and van Hell, 1994; Holmes and Langford, 1976; James, 1975; Paivio, 1971, 1986). Besides the dual coding theory (Paivio, 1971, 1986), the effect has been explained as due to greater context availability (Schwanenflugel, Akin, and Luh, 1992). In other words, contextual information and circumstances linked to concrete words are easier to access when processing concrete compared to abstract words (Kieras, 1978; Schwanenflugel and Shoben, 1983; Audet and Burgess, 1999; see also Altabirra, Bauer and Benvenuto, 1999), while word meaningfulness does not seem to matter (William and Jarvis, 1966). The concreteness effect has also been linked to a higher likelihood of eliciting mental images either automatically or strategically (e.g. Schwanenflugel, Akin and Luh, 1992), given that concrete items are also characterized by greater perceptual/sensory details (Bower, 1972), for which recall superiority might be due to storage of redundant information which provides alternate routes for retrieval (Kieras, 1978).

Independent of the specific explanation of the concreteness effect in memory, the fact remains that concrete verbal material has more links with existing information be it semantic, lexical or episodic. Thus, concrete verbal material can be more

effective in eliciting IAMs because of its superior connection with existing knowledge/mental representations, compared to abstract verbal material. In addition we know from previous diary studies in IAMs (e.g. Berntsen, 1996, 2001; Berntsen and Hall, 2004) that people reported the best cues to be mainly auditory or visual, referring to sensory and perceptual experiences and involving specific objects, activities, people, and themes. Concrete verbal material is high in sensory and perceptual information (Bower, 1972), and its concrete aspect refers to objects, people, specific situations, which would provide them with the potential of creating successful matches with existing elements in memory.

Our study

While most studies on IAMs have been carried out by asking individuals to keep a diary in which their spontaneous occurrence is reported, more recently several studies have adopted an experimental design to elicit IAMs in the lab (Schlagman and Kvavilashvili, 2008; Berntsen, et al 2012; for a review see Mace, 2007). In our studies we adopted the basic experimental paradigm recently developed by Schlagman and Kvavilashvili (2008; see also Kvavilashvili and Schlagman, 2011), with a slight but important modification to it. In the original paradigm, participants were asked to perform a vigilance task in which they had to detect target stimuli (patterns of vertical lines) randomly presented among a large number of non-target stimuli (patterns of horizontal lines). In the center of each pattern short phrases were presented, that participants were asked to ignore. They 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 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 mind, things about the past, plans, intentions for the future, etc, making this more akin to a mind wandering task (for a review, Schooler et al., 2011). Second, participants were asked to categorize their mental contents as memories vs. thoughts only at the end of the report. Previous work (Vannucci, Batool and Mazzoni, under revision) had shown that this method leads to clearly involuntary memories, which turned out to refer to less specific events compared to IAMs obtained with Schlagman and Kvavilashvili's (2008) original method.

This method makes it possible to simulate in the laboratory two important conditions in which involuntary memories occur in everyday life: attention is not focused (as participants had to complete vigilance task) on the current ongoing activity, and easily identifiable triggers are present (cues were presented on screen). The modification ensures that involuntary memories are indeed involuntary (as word memory was not mentioned to participants). 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.

Using this method we ran three experiments, the first two comparing IAMs elicited by cues that were either concrete/high imagery verbal material (short sentences) or pictorial representations of the same items, and the third comparing the same concrete/high imagery verbal items with abstract items.

Experiment 2

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. 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.

Materials

Cues. 150 concrete and highly imaginable verbal cues were used. These were short sentences selected from the pool of 800 cues used in previous studies (e.g. Schlagman and Kvavilashvili, 2008) by 5 independent judges asked to rate their level of concreteness on a 7-point scale (1 “low” - 7 “high”) and 5 more independent judges were asked to rate their imageability level, again on the same 7-point rating scale. 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), neutral (n=50) and negative (n=50) cues were used in each group (valence of cue was already decided by Schlagman and Kvavilashvili, 2008) and were presented in blocks with orders counterbalanced across participants.

In the picture condition more than 150 pictures were created or found to match the same 150 highly concrete/imaginable verbal cues (e.g. the phrase ‘a glass of wine’ and the picture of a glass of wine, see Appendix F). 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 level of disagreement was resolved via discussion.

Vigilance Task. We employed the vigilance task used by Schlagman and Kvavilashvili (2008), using 150 trials. In each trial a card (approximately 21.5 X 12.5 cm in size) was shown on screen depicting either a pattern of black horizontal (non-target) or vertical lines (target). Eight different target stimuli were presented. The word phrases were shown on each trial in the center of the card. Each stimulus remained on the screen for 1.5 sec.

Memory characteristics questionnaire. The questionnaire was adapted from the one used by Schlagman and Kvavilashvili (2008). Participants were asked to briefly describe the memory, rate its vividness, state whether the event was common or unusual, whether it was general or specific, if they had this memory before, if the cue was internal or external, and report the age in which the event happened (see Appendix L).

Procedure

Participants were tested individually. Instructions for the vigilance task were taken from Schlagman and 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. These changes to the original procedure were made to ensure that the memories were involuntary. After completing the informed consent form, all the participants completed the vigilance task in which they 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. They were also asked to ignore the words shown in the center of the card. Participants 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), which was normal. They were told 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. They were told 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.

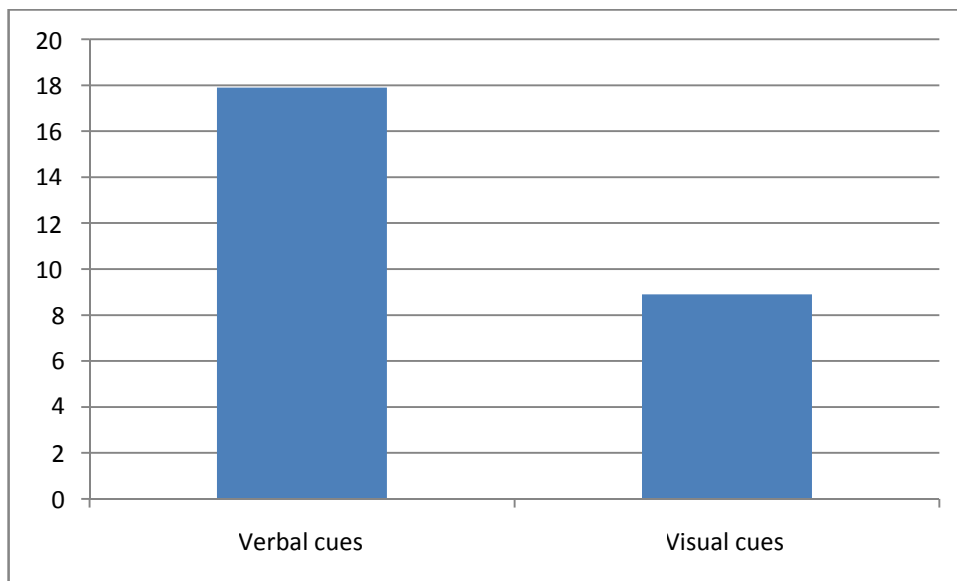
Results

All participants completed the vigilance task successfully. All participants also reported thoughts and at least one involuntary memory. Neither the number of interruptions (verbal $M=38.45$ vs. pictures $M=23.75$ [$t(38) = 1.89, p < .07$]), nor the number of thoughts (verbal $M=18$; pictures, $M=12.85$, [$t(38) = .65, p < .52$]) were significantly different in the two groups. The total number of interruptions was 1244, of which 657 were thoughts and 536 were labeled as IAMs (M per participant= 13.40) (range 1–34) and 51 were unlabelled mental events. Out of 536 IAMs, the majority ($n=527, 98.3\%$) were reported to have identifiable triggers. Of these 527 memories, 75.5 % were triggered by the cues on the screen, 2.7 % memories by other environmental cues and 21.8 % by internal thoughts.

To assess the effect of type of cue, total number of IAMs as well as the number of IAMs in the subset elicited by the cues on the screen was compared between the two groups.

Participants in the verbal cue condition reported almost twice as many IAMs ($M = 17.90$) during the vigilance task than participants in the picture condition ($M = 8.90$) [$t(38) = -3.59, p = .001$]. 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 (M per participant = 13.00) than pictures ($M = 6.90$), [$t(38) = -3.01, p = .004$].

Graph 4.1 IAMs triggered by Verbal Vs Visual cues



	Inv. Memories (total triggered memories)		Inv. Memories (subset triggered by only the cues)	
	Words	Pictures	Words	Pictures
Proportion of specific memories	78.08 (16.04)	68.42 (19.64)	82.46 (16.24)	72.99 (23.28)
Vividness	4.80 (.74)	5.34 (.88)	4.99 (.92)	5.36 (.93)
Pleasantness of the event	3.33 (.45)	3.55 (.69)	3.18 (.45)	3.33 (.92)
Pleasantness of the memory	3.49 (.56)	3.60 (.56)	3.31 (.53)	3.43 (.88)
Frequency of rehearsal	2.84 (.73)	3.28 (.76)	2.91 (.67)	3.29 (.81)
Unusualness	3.39 (.43)	3.30 (.59)	3.60 (.52)	3.53 (.64)

No differences were found on the phenomenological qualities of the memories (alpha =.01) (see *Table 4.1*).The age of the memory was not significantly different in the two groups (verbal: 15 years; pictures: 16 years).

Discussion

More involuntary memories were obtained with verbal compared to pictorial cues, a result that clearly indicates that verbal cues facilitate retrieval of involuntary memories. IAMs came from the same pool, as no memory characteristic was significantly different in the two conditions (Pictorial vs. Verbal cues). This result can be considered unexpected if one takes into account the amount of evidence that favors the prediction that pictorial items are more effective cues to voluntary retrieval. No previous studies have compared the effectiveness of pictorial and verbal cues in involuntary memory retrieval however, and it might be possible that processes differ between voluntary and involuntary retrieval. The Conway and Pleydell- Pearce (2000) model of autobiographical memory, for example, posits that voluntary retrieval follows a hierarchical path, starting from higher-level themes and general events, to move down to specific events, which are at the bottom of the hierarchy. The retrieval of specific events is cued by the themes and general events which have been activated by the cues, and not directly by the cues themselves. Retrieval is potentially different in involuntary memory, where theories (for reviews see Berntsen, 2009; Mace 2007) assume that cues directly activate memory representations of more specific events. The activation triggered by the information contained in the cue spreads through a network in memory, and activates the event with which the greatest level of match occurs. Stated in another way, the greater the match between the content of the cue and the content of the memory, the higher the likelihood for a memory to be retrieved involuntarily. If the two processes are different, it is then possible that what works best in voluntary retrieval might not be equally effective in involuntary retrieval.

The results of Experiment 2 suggest that this match is less likely to occur when cues are pictorial compared to verbal. The richer encoding of pictorial cues (e.g. the

dual encoding hypothesis, Paivio, 1971; the semantic encoding, Nelson, 1979) or the more detailed content of pictorial cues should help retrieval.

It is possible that the details of pictorial cues are too specific and unchangeable, and for this reason they limit activation of existing memories, if the retrieval is not voluntary. This second explanation is in line with previous results by Garry and Wade (2005) showing that in the creation of false autobiographical memories verbal material is more effective than pictures (photos). One of the main explanations for their results is that photos contain too many details that might not match the actual content an individual's memory. Although their reasoning is applied false memories this explanation could also apply to true memories, and nicely fits with the hypothesis of a direct involuntary activation of memory representations, and the idea of a match in content between the cue and the event representation. If details are given in the cues that are not part of the individual's experience, then the likelihood of obtaining a match is clearly reduced. When the cue is a picture of a glass of wine, the glass has a given shape and the wine a given color and hue. And these might not match with the actual experience of drinking wine that the participant had. The greater the number of specific details, then, the greater the number of potential mismatch. This explanation is rather different from the idea of cue overload. If we consider the picture as a whole, detailed pictures should be very low in cue overload, as they refer to very specific events.

It is also possible however, that pictorial cues contain many details and each detail might act as an independent cue, with the result that too many potential candidates are activated in memory to render the retrieval process effective (fan effect). While the encoding specificity principle would predict greater effectiveness of pictorial compared to verbal cues for their greater richness, the fan effect would

predict exactly the opposite, and one can speculate that when the cue is too rich and detailed the negative influence of the fan effect (or cue overloading) not only masks but reverses the positive effect of encoding specificity.

Experiment 3

In experiment 1 pictures turned out to be less effective cues than the short sentences that described the same event. This result seems to confirm that the specificity of pictorial information, instead of producing more memories, represents a hindrance in the spontaneous retrieval of IAMs, an effect that can be explained in two ways. The one refers to the possibility that the various visual/perceptual elements in the visual stimulus would act as independent cues, thus diminishing the effectiveness of the cues because of a cue overload/ fan effects. These principles state that the effectiveness of a cue is inversely proportional to the potential number of mental representations that it activates (see Berntsen et al, 2012 for a discussion of this effect in IAMs). Thus a pictorial cue of a complex element (e.g. a glass of wine) can contain several elements that could trigger a memory (e.g. besides the semantic concept of a glass of wine, the specific shape of the glass and the specific colour of the wine can be additional cues) each triggering one or more memories. This is even more true with even more complex events like going to Disneyworld, dinner with friends, just to mention two additional cues used in Experiment 1. Then we wondered if the effect (greater number of IAMs with verbal cues) could be reduced by presenting simple objects and compare them with the names of the objects represented in the figures (e.g. a picture of a ball compared with the word 'ball'). The procedure in Experiment 2 was the same as in Experiment 1, with the difference that the material this time was pictures of simple objects compared to their verbal labels.

Method

Participants

In total, 30 participants participated in this experiment. Fifteen participants were male and 15 were female (age range between 20 and 27, $M = 21.10$, $SD = 1.71$) years old. All of them were postgraduate students at the University of Hull, and fluent English speakers. The experiment was completed in one session, for an average duration of approximately 60 min. All participants were randomly assigned to two groups (15 participants in each group). All participants were tested individually and none of them were aware of the aim of the study at the onset.

Material and Procedure

One hundred and fifty simple pictures of objects (e.g. ball, cake) and their corresponding verbal labels were used as cues in a between-subjects design. Fifty cues were positive, 50 neutral and 50 negative in each subset (see Appendix G). The identical procedure and E-prime programme as in Experiment 1 was used. Participants were instructed to let their mind wander while they were participated in the experiment. Whenever anything unrelated to the task came to their mind they were instructed that they could stop the experiment by clicking the mouse, and report a short description of the mental content on a piece of paper. Participants were also informed that if something personal came to their mind which they did not wanted to share, they still needed to stop the experiment by clicking the mouse but could only write the word “personal”. By the end of the experiments all the participants were asked to categorise reported items as memories or thoughts. Then they had to fill the memory questionnaire only for each of reported memory (see Appendix L).

Results

All participants (30) successfully completed their vigilance task and almost all participants reported memories during the experiment. Twenty nine out of 30 participants reported memories, ranging from 1 to 20 memories. There was only one participant in the picture condition who did not report any memory. Total number of interruptions were 580 in both conditions.

Graph 4.2 IAMs triggered by simple Verbal Vs Simple Visual cues

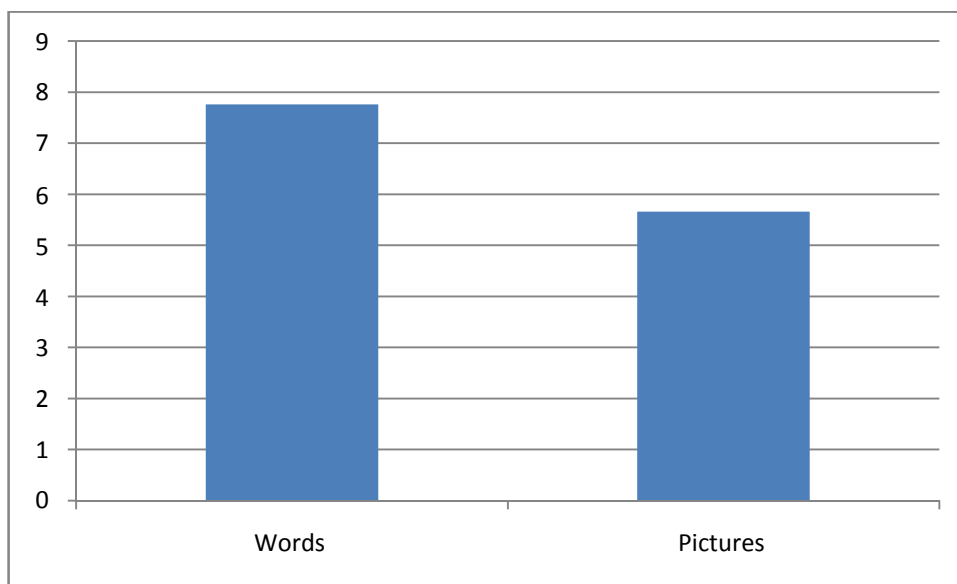


Table 4.2: *Percentage of specific memories (standard deviations in parenthesis), and mean characteristics ratings in all involuntary memories (verbal cues vs. pictures).*

	Inv. memories (total) (N=233)	
	Pictures	Words
Proportion of specific memories	97.88 (5.59)	79.34 (26.31)
Vividness	5.13 (1.61)	5.61 (.81)
Pleasantness of the event	3.52 (1.11)	3.54 (.65)
Pleasantness of the memory	3.43 (1.03)	3.77 (.71)
Frequency of rehearsal	2.67 (1.22)	2.93 (.78)
Unusualness	2.95 (1.15)	3.00 (.76)

The total number of complete memories was 233 (mean=7.76, SD= 5.67, range= 1-20). Participants identified the trigger of the memories either in thoughts, in the environment or said that there was no trigger of their reported memories. All memory characteristics were measured and mean and standard deviations for involuntary memories were computed (see table 2). The independent sample T-test computed on the number of reported involuntary autobiographical memories indicated that participants in the words condition reported more memories (M= 9.86, SE=6.05) than the participants in the pictorial condition (M=5.66, SE= 4.53). The difference was

significant $t(28) = 2.15$, $p < 0.04$. No significant differences were found on the phenomenological qualities of the memories ($\alpha = .01$) (see Table 4.2).

Discussion

The results of both experiments 2 and 3 confirm that pictorial cues are less effective in triggering IAMs than the verbal cues of the same items. This was true not only with complex cues, but also when cues were simple objects and the counterpart their simple verbal labels. Although the two experiments cannot be directly compared, it is worth noticing, however, that the number of IAMs reported when cues were more complex items was almost double (17.90 and 8.90 respectively for verbal and pictorial cues) than when more simple items were presented (9.86 and 5.66 respectively). The number of memories retrieved in response to simple verbal cues (e.g. ball, cake) was almost the same as that for memories retrieved in response to more complex visual cues (glass of red wine). This suggests that, rather than hampering retrieval, more complex events (especially verbal descriptions) were more productive cues, and suggests that the richness of the mental representation activated by the cues might matter in the processes involved in triggering involuntary personal memories.

The difference between pictorial and verbal material can simply consist in the difference of the way stimuli are presented (visual vs. verbal), and the various possible interpretations in terms of encoding specificity or cue overload be simply unsubstantiated speculations. In order to rule out the interpretation that just type of presentation matters, we ran an additional study, in which we compared two types of verbal material (i.e. modality of presentation is equated) and manipulated the type of information (i.e. the content) of the cues. One set of cues was concrete, and one set was abstract. We know that concrete and abstract verbal material is differently effective in memory, with concrete material being more easily remembered on

average. We assessed whether the same difference would be observed in the retrieval of involuntary memories.

Experiment 4

In Experiment 4 we tested the possibility that concrete verbal material elicits more IAMs than abstract verbal material. As already discussed in the introduction, the concreteness effect shows that concrete material is not only better remembered, but is also a more effective cue, and this occurs also in autobiographical memories (e.g. Roebbers and Elishberger, 2002). One ancillary element that contributes to predict better retrieval of IAMs with concrete cues is the finding that in our participants more complex and hence richer verbal material (Exp. 1) elicited more involuntary memories than more simple verbal material (Exp. 2). Concrete items are richer in their semantic and contextual connections (Schwanenflugel, Akin, and Luh, 1992), which makes them more powerful triggers of existing memory contents.

Participants

Forty undergraduates from the University of Hull (23 females; age: 18-35 years), all native English speakers, took part for credit. All had normal or corrected-to-normal vision. Half were randomly assigned to the “concrete” cue group (11 females) and the other half to the “abstract” cue group (12 females). Age did not differ between the two groups ($M=20.15$ $SD=3.71$ and $M=19.45$ $SD= 1.35$ respectively).

Materials

Cues. 150 concrete and 150 abstract short sentences were selected from the pool of 800 cues used in previous studies (e.g. Schlagman and Kvavilashvili, 2008) by 5 independent judges asked to rate their concreteness on a 7-point scale (1 “low” - 7 “high”) and by five

more judges asked to rate their imagery on a 7-point scale (1 “low” - 7 “high”). Phrases rated 1-2 were abstract and low in imagery and those rated 6-7 were concrete and high in imagery. Familiarity was rated by 5 additional raters and was not significantly different in the two sets of cues (Schlagman and Kvavilashvili, 2008 had mentioned that list of 800 cues were established for British population and it is culturally adapted). An equal number of positive (n=50), neutral (n=50) and negative (n=50) cues were used in each group and were presented in blocks in a counterbalanced order across participants (see Appendix H).

Vigilance Task. We employed the vigilance task used by Schlagman and Kvavilashvili (2008), using 150 trials. In each trial a card (approximately 21.5 X 12.5 cm in size) was shown depicting either a pattern of black horizontal (non-target) or vertical lines (target). Eight different target stimuli were presented. A word phrase either concrete (e.g., relaxing on a beach) or abstract (e.g., feeling optimistic) was shown on each trial in the center of the card. Each stimulus remained on the screen for 1.5 sec.

Memory characteristics questionnaire. The questionnaire was adapted from the one used by Schlagman and Kvavilashvili (2008). Participants were asked to briefly describe the memory, rate its vividness, state whether the event was common or unusual, whether it was general or specific, if they had this memory before, if the cue was internal or external, and report the age in which the event happened (see Appendix L).

Procedure

Participants were tested individually. Instructions for the vigilance task were taken from Schlagman and Kvavilashvili (2008), with the major difference that participants were told to stop the experiment when *any* type of mental content crossed their mind (mental contents could refer to thoughts, intentions, plans for the future, past

experiences, etc.) The procedure was as in Experiments 1 and 2. These changes were made to ensure that the memories were involuntary. 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. They were also asked to ignore the words shown in the center of the card. Participants 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. They were told 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 in a way that would make it possible for them to recognize it later. 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

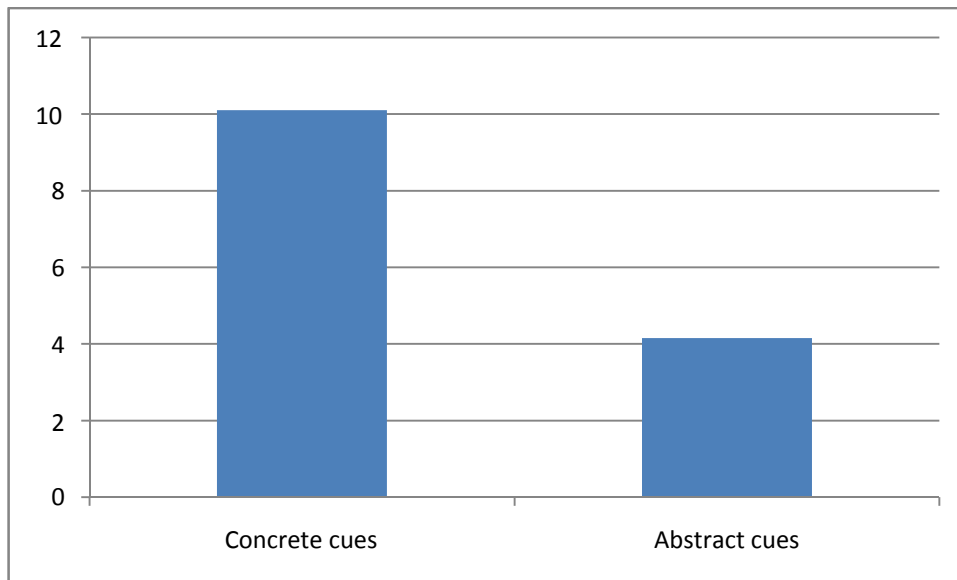
All participants completed the vigilance task successfully, and none omitted any target. Only 2 participants failed to report any IAMs throughout the session. The remaining 38 participants generated 285 IAMs, with a mean of 7.50 (SD = 7.90, range 1–38) per participant. The total number of interruptions was 795 (mean per participant 19.88, SD 37.03); the total number of thoughts 505 (mean per participant 12.63, SD = 34.36). There were only 5 mental contents that participants did not classify.

Most (263, 92.2%) of the 285 IAMs were reported to have identifiable triggers. Of these, 51.57 % were triggered by the cues on screen, while 4.73% memories were triggered by other environmental cues (e.g. lines on the screen, outside noise, etc.) and 43.7 % by internal thoughts.

Effects of Cue Concreteness

To assess the effect of the concreteness of the cues on the production of IAMs, we compared the mean number of IAMs reported in each of the two conditions (concrete vs. abstract cues). Analyses were first performed on the total number of IAMs and then on the specific subset of memories triggered by the cues on the screen. In the condition with concrete cues, IAMs were more than twice as many ($M= 10.1$) as in the abstract cue condition ($M = 4.15$) [$t(38) = 2.54, p = .015$].

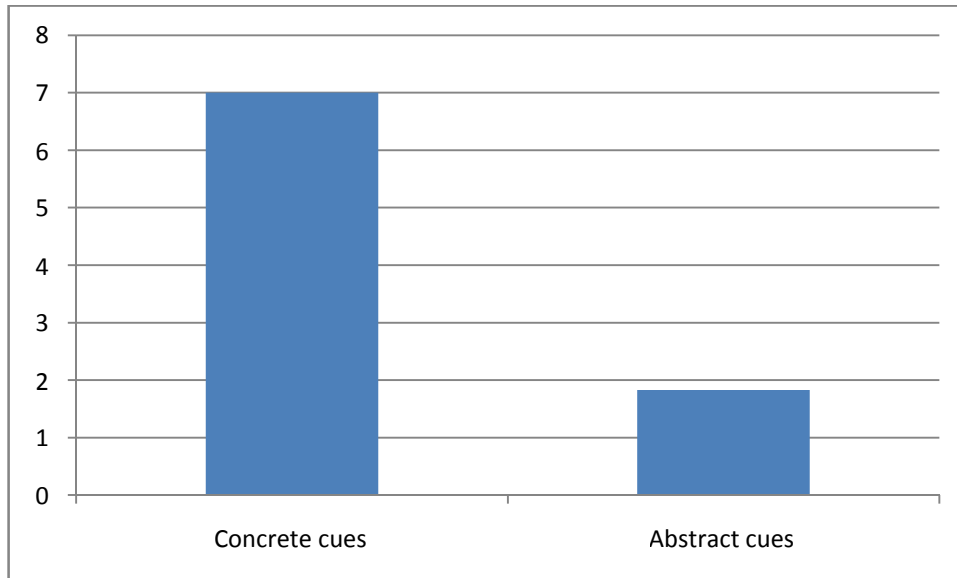
Graph 4.3 IAMs triggered by concrete Vs abstract cues (on total no.of memories)



A similar result was obtained when the analysis was limited to memories triggered by the cues (concrete cues elicited more than three times ($M= 7.00$) the memories elicited by abstract cues ($M = 1.83$) [$t(38) = 2.49, p = .017$]). Neither the

difference in total number of interruptions nor the difference in number of thoughts was significantly different between conditions.

Graph 4.4 IAMs triggered by the cues (concrete vs. abstract cues)



To examine the effect of the concreteness of the cue on the phenomenological qualities of IAMs, analyses were first performed on the total number of IAMs and then on the subset of memories triggered by the cues on the screen (see Table 4.3). No significant differences between concrete and abstract cues were observed in any memory characteristic (largest $t = 1.41$) in either case. No difference was found also for the age of the events (median for high imaginable: 17 years; for low-imaginable: 16 years).

Table 4.3: *Percentage of specific memories (standard deviations in parenthesis), and mean characteristics ratings in all involuntary memories, and in the subset triggered by the cues, as a function of cue type (concrete/high-imaginable vs. abstract/low-imaginable verbal cues).*

	Inv. memories (total triggered memories)		Inv. memories (subset triggered by the cues)	
	High	Low	High	Low
Proportion of specific memories	75.22 (20.14)	63.50 (36.26)	84.14 (19.15)	85.61 (24.98)
Vividness	5.25 (.92)	5.67 (.91)	5.06 (1.08)	5.34 (.63)
Pleasantness of the event	3.49 (.64)	3.15 (1.0)	3.28 (.81)	3.45 (.98)
Pleasantness of the memory	3.68 (.90)	3.30 (.98)	3.40 (.72)	3.67 (.86)
Frequency of rehearsal	2.88 (.70)	3.06 (1.05)	2.96* (.65)	2.25* (.90)
Unusualness	3.22 (.76)	3.13 (.95)	3.44 (.72)	3.27 (.99)

Discussion

Concrete verbal cues elicited more than twice as many IAMs as abstract verbal cues did, showing a clear concreteness effect when retrieval is involuntary. Concreteness thus seems to be a powerful element, both when it is a characteristic of

the material that needs to be remembered, as shown by innumerable studies in voluntary episodic memory, but also as cues in voluntary recall (Roebbers and Elishberger, 2002). This experiment shows that it is a powerful cue also for involuntary autobiographical memories. Before examining possible explanations for this effect, we need to stress that these results seem to rule out a simple hypothesis that can apply to explain why words are better cues than pictures for IAMs (i.e. that the way in which material is presented (visual vs. verbal) matters). These results instead show that the way cues are presented (whether visual or verbal) does not matter per se. If the effect was determined exclusively by type of presentation, then no differences should have been found in Experiment 4. The fact that a strong and significant difference was obtained then tells that presentation does not represent the whole story. It is more likely to be the nature of the cue (i.e. the information that the cue contains) and the type of processes that encoding that cues entail, that are important in determining their effectiveness in eliciting involuntary recall of personal memories.

Why are concrete items more effective cues for the retrieval of IAMs? The spreading of activation hypothesis per se does not seem to be able to explain such result, as both concrete and abstract cues contain information that can activate information in memory. However, if one assumes that concrete cues are encoded differently than abstract cues, and their encoding is richer, as predicted by the old theories on the concreteness effect, then the spreading of activation represents a potential explanation, with greater activation following items that enjoyed a richer encoding. A similar result can however be explained in terms of the two processes invoked by Berntsen et al (2012) to explain how IAMs are retrieved. Concrete items are more specific, and as such are less prone to lead to a negative effect on retrieval due to cue overloading. Conversely, abstract items are more vague and generic, and

might then tendentially activate too many competing memories, with a detrimental effect on the amount of involuntary memories retrieved. If this is the correct explanation, then concrete verbal items, with fewer specific details than pictures but more specific elements than abstract cues seem to represent the best cues for IAMs, as they seem to contain the right amount of specificity for the successful activation of involuntary autobiographical memories.

There is also a different explanation, though, which is not necessarily alternative to the one just proposed. Concrete verbal cues contain more perceptual-like/sensory-like information compared to abstract cues, and in this way they are more similar to the external cues participants in diary studies have reported to be successful in triggering IAMs in everyday life. It might thus be possible that the nature of the information in the cue matters, rather than (or in addition to) the amount of information contained in it. This might be explained if we consider that current theories assume that IAMs are retrieved via a match between the content of the cue and the content of the memory representation. If so, we can hypothesize that the sensory-like information contained in the cues facilitates the match with the content in memory. This explanation, as said before, is not necessarily in contradiction with the idea of the right amount of cues proposed as a first possible explanation of the richer retrieval produced by concrete verbal cues. Rather, it can supplement it. In other words, both the amount and nature of the cue can play a role.

General Discussion

In three studies we have experimentally manipulated the nature of the cues used to elicit involuntary memories. In Experiment 2 we found that concrete verbal cues are better than pictures of the same cues in eliciting involuntary memories. In Experiment 3 we have tested the hypothesis that the complexity of the cue was not the

only determinant of the effect, finding that the superiority of concrete verbal cues also remains when the cues were very simple pictures and their corresponding verbal labels. In addition, the comparison of the data between Experiments 2 and 3 revealed that when pictures and verbal cues referred to rather complex events the rate of retrieval was at least twice as much as when cues referred to very simple objects. These results taken together would suggest that it is not the complexity of the event in the picture condition that matters. Rather, it might be the *higher number* of *specified* details present in pictorial cues. Both words in italics in the previous sentence might be of importance. A higher number of cues might hinder successful retrieval if each acted as an independent cue, thus raising the number of active cues in the picture compared to the verbal condition. According to the cue overload principle, a higher number of cues would trigger a higher number of potential memories which would compete for retrieval, and thus reduce the likelihood for each to be actually remembered. However it still needs to be demonstrated that in a picture each detail might act as an independent cue. On the other hand, the presence of *specified* details might hinder the retrievability of memories, as the details might be too specific to correspond to the specific events that people have actually experienced, and that, as such, are represented in memory. Previous studies have proposed this as an explanation for the superiority of verbal stimuli as cues for memory, compared to pictorial stimuli (Garry and Wade, 2005). Although the first explanation is in principle possible, we tend to prefer this second explanation because of the results of the comparison between Experiment 2 and 3, which shows that a larger number of details, within the same pictorial modality, does not seem to hinder involuntary recall. Quite on the contrary, it seems to facilitate it. Hence, we believe that, rather than the amount of details per se, it is the nature of the cue and of the details in it (i.e. the information

that cues contain) that matters. Verbal cues are more effective because they lend themselves to be completed with details that are personally relevant and congruent with one's experience, rather than containing pre-specified (and potentially personally irrelevant, or that conflict with the person experience).

In Experiment 4 we compared the effectiveness of two types of verbal cues, concrete vs. abstract, testing the concreteness effect in involuntary recall of personal events. The two sets of cues also differed in terms of imageability, as expected, in line with the results of a large number of studies carried out in the 60s, 70s, 80s and 90s, on the relationship between concreteness and imageability of verbal material. Our results showed that concrete verbal cues were more effective than abstract verbal cues, confirming then the existence of a concreteness effect also in the retrieval of involuntary memories. And, more important for our aim, also confirming the idea, which stemmed from the results of the two previous experiments, that the nature of the information of the cue is crucial in modulating the involuntary retrieval of autobiographical memories.

The effect could be explained as being due to a greater (richer) encoding of concrete/high imagery cues, which would then more likely spread activation through the memory network, thus enhancing the likelihood of activating existing memory representations. But this is not the only possible explanation. This result can be attributed to the interplay of the two processes invoked by Berntsen et al (2012) to explain how IAMs are retrieved. Specifically, for concrete verbal cues encoding specificity might be facilitated, and these cues would be characterized by less overloading. The facilitation of encoding specificity could depend on concrete verbal cues contain more perceptual-like/sensory/like information compared to abstract cues, perceptual-like information that could represent a powerful trigger of existing

memories. After all, involuntary memories refer to events that have been experienced and perceptual-sensory information should be strongly represented in them. The reactivation during retrieval of the same information present during encoding reflects the principle of encoding specificity, which represents an effective enhancer in recall.

As for the cue overloading principle, concrete verbal stimuli are more specific compared to abstract items which, being more generic, might activate too many competing memories, with a detrimental effect on the amount of involuntary memories retrieved. On the other hand, however, the possibility remains that abstract cues reflect more an abstraction of an experience, rather than a specific experience, and the lack of perceptual/sensory details might hinder the match with the memory representation of an experienced event.

One important conclusion that we can draw from these whole set of results is that the way in which the cue is presented (whether visual or verbal) does not seem to be, per se, a crucial element in determining how likely IAMs are retrieved. While the results from experiments 2 and 3 could be interpreted that way (after all verbal material was found to always yield to superior performance) the effect of the way the cue is presented did not seem to matter in Experiment 4, when we compared two types of verbal material, concrete/high imagery and abstract/low imagery. If only type of presentation was responsible for the results of Experiment 2 and 3, then in Experiment 4 we should have not observed any difference between the two conditions. The fact that a strong and significant difference was obtained then tells that type of presentation does not represent the whole story. It is most likely the nature of the cue (i.e. the information that the cue contains) and the type of processes that encoding that cues entail, that determine the effectiveness of a cue, as they are responsible for the likelihood that a match occurs between the information in the cue and information in

the memory. And the likelihood of eliciting involuntary memories for personal events depends on the degree of such match between information in the cue and information in the memory.

One last point needs to be discussed about these results specifically, the reality of the memories reported in these three studies. While in principle we are not interested in whether the memories triggered by the various cues refer to real events, the theoretical considerations mentioned so far are based on the implicit assumption that the memories are true. In particular, the encoding specificity principle and the cue-memory matching hypotheses both are predicated upon the implicit assumption that cues elicit the memory representation of truly experienced events. Even if it is far from being our intention to claim that IAMs elicited in the lab are about events that did not occur to the people who remember them, the possibility remains that verbal cues, and in particular concrete verbal cues, enhance the production of memory-like reports that are not reflecting real experiences. After all, the Garry and Wade (2005) study clearly showed that verbal material is more effective in creating false memories, and invoke the level of familiarity that is conveyed by these stimuli as a partial explanation for why short narratives are more prone to lead to false memories for the events that they portray. In a large number of studies on dual-process models of retrieval (Jacoby et al., 1989; Yonelinas et al., 2010) the principle of familiarity has been invoked as one of the two main processes responsible to remembering, the other being recollection. But familiarity is prone to errors, as items that feel familiar can be considered 'old' (or experienced, i.e. real) even when they were not (Jacoby, Kelley, and Dywan, 1989; Johnson et al., 1993). Different factors can promote a feeling of familiarity, such as the ease with which information is remembered. This ease-of-remembering—or *fluency*—can be misattributed to prior experience, which in turn causes people to have memory

distortions (Jacoby et al., 1989; Whittlesea, 1993). Some studies have shown how familiarity and fluency (and unexpected fluency - also called the revelation effect) affect the accuracy of retrieval output also for autobiographical events (Bernstein and colleagues (Bernstein, Whittlesea, and Loftus, 2002; Nourkova, Bernstein, and Loftus, 2004). As Garry and Wade (2005, p.365) point out, narratives allow, and as they put it, “even demand that subjects generate their own details, narratives should give subjects freedom to generate their own images, incorporate personal knowledge, and require deeper processing”. Deeper processing and more elaboration has been found to enhance false attributions in memory. More elaborated words were more likely to be erroneously reported as being seen twice, for example (Kronlund and Whittlesea, 2005). It is then also possible that the larger number of IAMs obtained with concrete material might then just reflect only the creation of false memories that occur to a lesser extent with pictures. While this consideration can easily apply for the difference between pictorial and concrete verbal cues, it is however less likely to apply to explain the difference between concrete and abstract verbal cues. In this case the level of elaboration is most likely to be similar, or to be greater in case of abstract material.

Chapter 5

Eliciting Involuntary Autobiographical Memories in Lab

Experiments 5

Is additional information in cues helpful for eliciting Involuntary Autobiographical Memory?

In Experiments 2 and 3 we have shown that the type of cues used modulate the likelihood of retrieving involuntary memories for personal events, and experiment 4 has additionally demonstrated that it is not just the presentation modality that matters (material presented verbally, no matter what, is better than material presented visually). It is instead the information in the cue that affects how easily involuntary memories are activated and remembered, as it affects the likelihood of the match between the cue and the memory representation. However, it might have been also possible that the specificity of details mattered (i.e. the fact that the details had made each cue rather distinctive). We know that item distinctiveness as well as its relational properties affect recall (McDaniel and Einstein, 1993), and data have so far supported the idea that distinctiveness among items is especially beneficial under some circumstances (for a recent approach that stresses the role of distinctiveness and extends it to explain other domains such as the effect of expertise, see Rawson and Van Overschelde, 2008; and Hunt and Rawson, 2011).

Extensive research has established that recall is highest when both organizational and item processing occur during acquisition (Hunt and McDaniel, 1993, for a review). This has been shown to be true with word lists. Recall of categorized lists is better when during encoding the task and/or instructions direct the processing of the material to the meaning of the individual words distinctive processing. Conversely, individual words (or words belonging to more fuzzy categories) are better remembered when the task directs processing at encoding to the category they belong to (Einstein and Hunt, 1980; Hunt and Einstein, 1981). When no orienting task is present, categorized material activates the processing of similarity among items (relational processes), whereas unrelated material (e.g. unrelated word lists) facilitates the activation of distinctive processing. In this line of research it has been found that “precise memory” (Hunt and Rawson, 2011, p.391) is most likely to occur when distinctive processes (i.e. processing of differences among items) are encouraged at encoding. Although the authors of this proposal have predominantly examined the effect of distinctive encoding on word lists, when the same words that are encoded are also retrieved. However, the effect of distinctiveness at encoding could also be true also with other material and other forms of retrieval. In particular, the distinctive encoding of an item can have clear effects on the retrieval of IAMs. The reason behind this claim is that uniquely processed cues should be more effective in eliciting a memory, compared to cues that are processed in a relational way. Distinctive processing is highly diagnostic of a particular item (differences) in a particular context (similarity). Making reference to the cue overload principle, a distinctive type of processing would render cues unique and thus might help the activation of one distinct memory, rather than many different memories. However, we were hoping to observe a general ‘distinctive’ mind set during the whole process of cue-target retrieval. Although it might be possible that

the relatively small number of participants and the large variability in the outcome (this latter unfortunately inherent with the nature of the task of involuntary retrieval) might have hindered the possibility of obtaining significant results, the lack of numerical difference in total memories would speak against that possibility. We believe then that distinctive processing as we have manipulated it in the present study does not have an effect on the retrieval of autobiographical memories. A different result might be obtained if one manipulated distinctive encoding of a cue that is then reinstated at retrieval.

It might also be possible however, that if a stimulus is too specific it triggers fewer memories as compared to stimulus which carries more general information. The reason is that it can be too narrow and not trigger any potential candidate (i.e. substantially decrease the likelihood of observing a match between the cue and a target memory). Less specific stimuli are more flexible to match with information stored in the memory system of many people as compared to stimuli with additional information.

The main question of the present study was to explore role of additional visual details in a visual cue in triggering involuntary autobiographical memories. In this experiment simple pictures were used as stimuli to elicit memories. While in condition 1 the pictures were presented without a background, in condition 2 they were presented with a background. The reason for adding the background is to create an orienting task that would facilitate the use of distinctive processing during retrieval. The background represents an additional visual detail, but it is not related to the picture.

Experiment 5 followed the exact same procedure as Experiments 2, 3, 4. The same instructions were used for all participants. Each participant completed a memory questionnaire for reported memories.

Method

Participants and Design

Thirty participants were tested. They were recruited from University of Hull subject pool and received credit for their participation. Their ages ranged from 18 to 36, with mean age of 19.82 and $SD = 2.17$. All of the participants spoke English as their first language. This study was completed in one session. The task was designed to elicit involuntary autobiographical memories, in response to visual cues. Participants were randomly assigned to two conditions (15 participants in condition 1 and 15 in condition 2). Participants of condition 1 saw a set of simple pictures in the middle of a screen containing either horizontal or vertical (target) lines during a mind wondering task. Participants of condition 2 were presented with simple pictures with additional details (with backgrounds). Participants in both conditions completed the memory questionnaire for reported memories at the end of the study, as in all prior studies in this dissertation.

Material

The simple pictures were given to three independent raters who labelled them as either positive, neutral or negative. Ratings were based on raters' perception of the emotional valence of each picture. Three hundred potential backgrounds were also judged for distinctiveness (sufficiently different from each other) by the same raters, and from these 150 neutral backgrounds were selected for this study. One hundred and fifty simple pictures (50 positive, 50 neutral, 50 negative) were presented to one condition, and the same 150 simple pictures with an additional background (50 positive, 50 neutral, and 50 negative) were presented to condition 2. Addition of background made picture distinctive, the distinctiveness of pictures were done by independent raters. Counterbalancing of background across pictures was conducted to control presentation sequence. For background, 150 distinct texture patterns were obtained from the web (see appendix I).

Procedure

Following the same procedure as in the previous experiments, participants of both groups completed the vigilance task. The same instructions were given to all the participants of both groups. The experiment had only one session and took one hour to complete. All participants completed the memory questionnaire for their reported memories at the end of session.

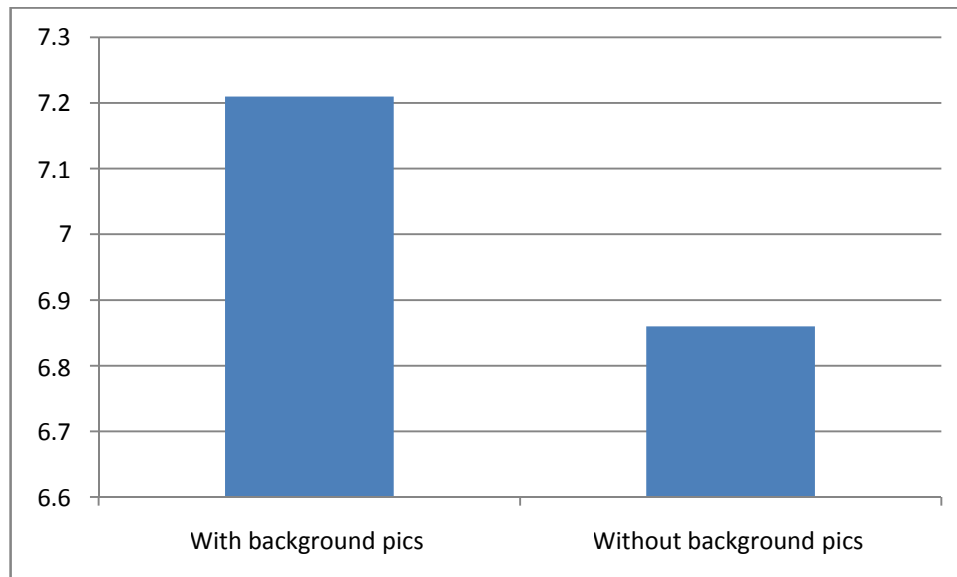
Results

All 30 participants completed their vigilance task successfully and all participants reported memories in both sessions. No participant was discarded from the data and the whole data set was analysed. The total number of reported memories (i.e. memories reported during the Vigilance task) was 282 (mean=9.40, SD= 5.22, range= 1-24), and the total number of complete memories (i.e. memories for which they complete memory questionnaire) was 211 (mean = 7.03, SD= 2.49). All memory characteristics were measured and mean and standard deviations were computed (see table 5.1). Our main interest was to assess whether the retrieval of involuntary autobiographical memories was influenced by the distinctive processing of the cues, that should be facilitated by the presentation of distinctive backgrounds. Independent sample t-test was computed on the number of all mental contents reported, on the number of involuntary memories and on each of their characteristics of the memories.

Descriptive statistics are reported in Table 5.1. Results showed that on average participants of the group presented with a cue with a background reported more memories (M=7.21, SE = 3.62) than participants seeing a cue without any background (M = 6.86, SE = 2.82). Although these results go in the expected direction, of an increase in memories when distinctive processes are in place, this difference was not significant $t(28) = 0.360, p = 0.554 > 0.05$. No significant difference was found on other memory characteristics i.e. memory

vividness $t(27) = -0.790$, $p = 0.996 > 0.05$, weather the event was rated as unusual $t(27) = -0.518$, $p = 0.875 > 0.05$ or common, and memory before $t(27) = -0.61$, $p = 0.867 > 0.05$.

Graph 5.1 IAMs triggered by pictures with and without background



Discussion

In the present study we found that the presence of a visual background, which should have activated distinctive processing during cue encoding, did not have a significant effect on the number of IAMs reported, even if the difference in memories goes in the expected direction, thus favouring the condition in which the cue was processed distinctively. The manipulation implemented in this study assesses only the effect of distinctive processing at encoding, In other words, ours was a condition in which the additional distinctive encoding of the cue would have triggered distinctive processes for cue encoding, and does not speak about a cue-target match. However, we were hoping to observe a general ‘distinctive’ mind set during the whole process of cue-target retrieval. Although it might be possible that the relatively small number of participants and the large variability in the outcome (this latter unfortunately inherent with the nature of the task of involuntary retrieval) might have hindered the possibility

of obtaining significant results, the lack of numerical difference in total memories would speak against that possibility. We believe then that distinctive processing as we have manipulated it in the present study does not have an effect on the retrieval of autobiographical memories. A different result might be obtained if one manipulated distinctive encoding of a cue that is then reinstated at retrieval.

Indeed, one of the hypotheses advanced to explain the results of Experiment 2 and 3 refers to the uniqueness of the cue-target match. This idea, that Rubin (1995) called cue-item discriminability, has been proposed more recently by Berntsen et al (2012) also as a principle to explain involuntary retrieval from autobiographical memory. This notion has been developed building upon two main principles in retrieval (i.e. encoding specificity and cue overload). The first states that an item is more likely to be retrieved if there is a stronger match between the information processed at encoding and that activated during retrieval. As reported by Berntsen et al (2012, p.427) the probability of successfully retrieving a memory increases by increasing overlap between the information present at retrieval (e.g., the cue) and the information stored in memory (e.g., Tulving, 1979).” Cue overload refers instead to the idea that the greater the number of potential memory candidates that cue triggers, the less the cue is effective. Put more elegantly the cue overload principle states that “the probability of recalling an item declines with the number of items subsumed by its functional retrieval cue” (Watkins and Watkins, 1975, p. 442). These two principles are both necessary, and need to be integrated, if we want to explain why only a specific memory is triggered, when potentially many could be. In this latter case potent competition among target memories could occur, with the result of lowering the likelihood of recall of any of them (for a different hypothesis on the effectiveness of a cue see Kompus et al, 2011). The notion of cue-item discriminability was defined by

Rubin as “how easily a given cue isolates an item” (p. 151): “Simply put, a word is likely to be recalled if, on the basis of the cues available at the time, it can be discriminated from all else in memory” (p. 146). According to Berntsen et al, this principle fits well as an explanatory principle for involuntary retrieval from autobiographical memory. Again quoting Berntsen et al (2012, p.2) “ In the present context, the notion captures the important idea that in order to spontaneously activate an episodic memory, a cue is needed that is sufficiently distinct to discriminate a past event from alternatives through spreading activation in an associative network. Thus, the cue (or cues) has to be able to activate event-relevant units, or nodes, in the network, and deactivate irrelevant units that would otherwise interfere with the spontaneous construction of the memory. If not, the activation will be too indistinct to form a memory (Berntsen, 2009; Rubin, 1995).

Given this notion of cue-target discriminability, in the following experiment we decided to use instead verbal material and add one specific element to it. Adding one element would not only render the cue more specific, it also should enhance the likelihood for the cue to discriminate more easily a specific memory from all other potential memories that share similar gist content with that target memory.

Experiment 6

In Experiment 6 we examined whether adding a relatively specific detail to the cue would enhance the likelihood for that cue to trigger an involuntary memory. For technical difficulties, this was implemented only for verbal cues, in which additional specific details were much easier to insert than in the figures used so far in the studies.

Method

Participants and design

Fifty participants recruited from a pool of psychology undergraduates took part in the experiment. Their ages ranged from 18 to 36, with a mean age of 19.92 and $SD=2.82$. All of the participants had English as their first language. All fifty participants were randomly assigned to one of two conditions (25 participants in each condition). Participants in condition one saw the list of 120 cue words without additional details whereas in condition two participants saw a list of cue words with additional details.

Material and Procedure

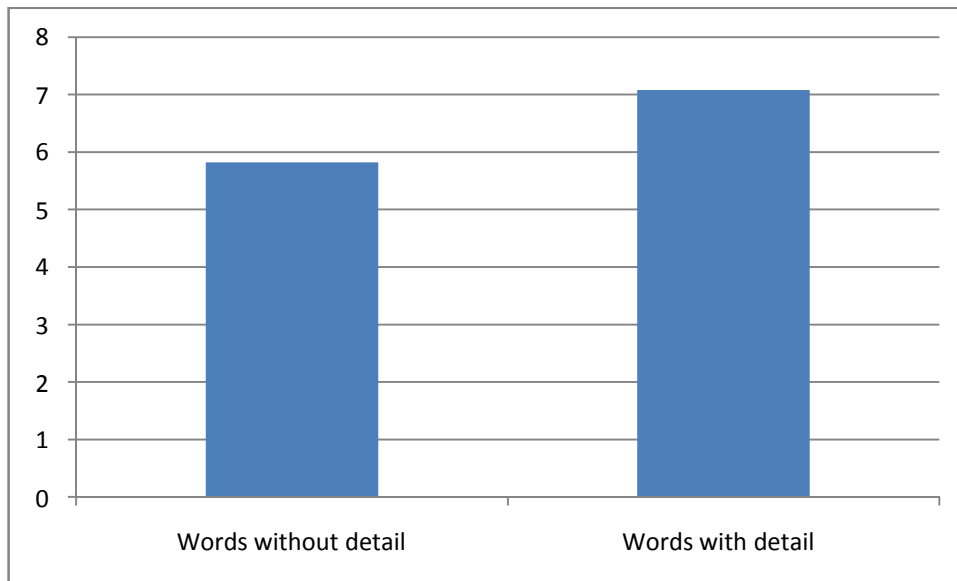
The list of 300 high imagery cue words, used in previous experiments was used to prepare a list of cue words for experiment 4. The list of words was given to two independent Judges and they were asked to add some additional highly specific information relevant to topic of the cue (see Appendix J). The purpose was explained to them, that in the present study the effect of additional specific details was to be examined. Both judges added information to each cue word according to their own thinking, keeping in mind that the additional information should be specific. The example 'Glass of wine' 'Glass of wine in Paris' was given. After getting the list from both judges, the list of cue word for condition two

of Experiment 6 was finalized. One hundred and twenty cue words were randomly selected from the list (40 positive, 40 neutral and 40 negative cues). For condition one the original cue words were used without any change, but for condition two the cues with additional information were used. Experiment 6 was designed on the same lines as of all previous Experiments. The same procedure was followed as that of Experiments 2, 3, 4, 5. All the participants of both conditions were instructed in a same way as of the participants of Experiment 2. This experiment was completed in one session and took approximately one hour. All the participants completed the memory questionnaire as participants in the previous experiments (see Appendix L).

Results

All fifty participants completed their vigilance task successfully and all participants reported at least one memory. No participant was discarded from the data and the whole data set was analysed. The total number of memories was 323 (mean=6.46, SD= 2.61, range= 1-9). Participants identified the trigger of the memories either in thoughts, in the environment (i.e. the cue phrase on computer screen) or they stated that there was no trigger for their reported memories. All memory characteristics were measured and mean and standard deviations for involuntary memories were computed (see table 5.2). As shown in table 5.2, the number of memories was numerically higher in the condition with added specific details. However the t-tests indicated that there difference between two groups in number of memories was only marginally significant (group without detail, $M= 5.82$, $SE=2.62$ and group with detail, $M=7.08$, $SE=2.50$), $t(48) = 1.71$, $p<.094$.

Graph 5.2 IAMs triggered by with detail words Vs without details words



Vividness of memory was also not significantly different between two groups $t(48) = -0.218, p = 0.194$. No significant difference between two groups was found on the characteristics of event common or unusual $t(48) = -1.168, p = .689$, and whether the memory had already been retrieved before $t(48) = 0.348, p = 0.74069$.

Table 5.2: Mean (standard deviation) of characteristics of memory for Experiment 6

	Words without details	Words with additional details
	Mean	Mean
No. of reported memories	8.70 (7.87)	9.68 (5.97)
Complete memories	5.84 (2.62)	7.08 (2.49)
Vividness	5.29 (0.70)	5.34 (0.91)
Event unusual/commonness	3.16 (0.74)	3.40 (0.73)
Memory before	2.74 (0.67)	2.68 (0.63)

Discussion

The results showed that adding specific details to a cue tends to enhance the possibility to retrieve involuntary memories for personal events. However the increase was only marginally significant, in spite of the relatively large number of participants (twenty five per group). Although adding participants to this procedure might help increase the significance of the difference, future studies should also probably change the material, and assess the effect of adding more than one specific detail. However there is a caveat. While adding more than one specific detail (e.g. glass of red wine in Paris with my mother) would definitely render the cues clearly unique and distinctive, and as such would potentially increase the likelihood of triggering personal memories in an involuntary way, we should be wary of the possibility that cues that are too specific can create a match only in a very limited number of participants, thus

producing a decrease rather than an increase in IAMs overall. In other words, only people who have been in Paris with their mother and drank red wine would have a memory representation for a similar event. It is highly likely that the specificity and distinctiveness of the cue acts as a double-edge sword, and the lack of results in both experiments 5 and 6 might depend on the fact that the two opposing effects have cancelled each other out. Different results might be obtained if the details were tailored to each specific individual and on their experiences, thus enhancing the possibility of a match between the elements in the cue and the elements in their memory representation of an experienced event. The necessity to consider the individual idiosyncratic nature of the experiences that are represented in autobiographical memory should be taken clearly into account when assessing the effectiveness of cues on the involuntary retrieval of autobiographical memories and when proposing theoretical explanations on how involuntary retrieval from autobiographical memory works.

Eliciting Involuntary Autobiographical Memories in the Lab

Experiment 7

Comparing the effect of concreteness in involuntary and voluntary retrieval from autobiographical memory.

The aim of this study was to assess whether the effect of the concreteness/imageability of the cues observed in involuntary memory retrieval can be obtained in a parallel task in which autobiographical memories are obtained through voluntary retrieval. A comparison between involuntary and voluntary memories was also obtained in Experiment 1. However, in that study the nature of the cue was not manipulated. In addition, the number of voluntary and involuntary memories could not be compared, as only approximately 40 cues were presented for the voluntary task, compared to the 800 that were presented for the involuntary task. While the decision of reducing drastically the number of cues is justified by the very instructions given for the voluntary task (to provide a voluntary memory for each cue), that would produce an overwhelming number of memories, the profound difference between the two methodologies can raise doubts about differences obtained. It is our conviction that a better way to run the comparison is to use a more limited number of cues, but use the same task in both conditions (involuntary and voluntary) while giving different sets of instructions. In Experiment 7 this was achieved by presenting participants with a much smaller number of items (50), both when the task was about involuntary memories (as in Experiment 3) and when it was about voluntary memories. While for

the involuntary memory session (Session 1) the instructions were identical to those given in Experiment 3, for the voluntary part of the experiment (Session 2) participants were instructed to try to remember as much as they could in response to the cues. However, unlike the procedure used in Experiment 1 for the voluntary session, this time the cues were not only presented in the middle of the cards with horizontal and vertical (target) lines, but participants were also told that it was a monotonous task, and that in such circumstances the mind wanders. And that we were interested in understanding how much one could remember intentionally about past experiences that are triggered by the cues. In this sense the task was to intentionally try to remember in response to a cue, but at the same time participants were not forced to remember in response to every cue. We assumed that in this case the voluntary recall of personal memories might possibly not be the result of indirect retrieval, but of direct retrieval. In other words, the memories that people would report after this form of intentional retrieval would be those that were more easily triggered by the cue. In this sense we expected no difference in response times between involuntary and voluntary recall, while, at the same time, maintaining the differences in memory qualities we observed in Experiment 1. Given the reduction in number of cues, we also expect a reduction in the number of memories obtained in the involuntary task, and certainly a drastic reduction in voluntary memories. It is our hypothesis that the differences in memory qualities will show that the memories obtained in the two sessions are not the same.

Method

Participants

Eighty participants were tested in this experiment, all recruited from a pool of psychology undergraduates. Their ages ranged from 18 to 41, with a mean age of 20 and

SD=3.31. All of the participants spoke English as their first language. All participants had to complete two sessions. The task in Session 1 was designed to elicit involuntary autobiographical memories, and was identical to that of Experiment 3 (but for the number of cues) whereas in Session 2 the task aimed at eliciting voluntary autobiographical memories. Session 1 and Session 2 were held one week apart. The eighty participants were randomly assigned to 2 conditions (40 participants in each condition), one in which only concrete/high imagery word cues were presented, and one in which only abstract/low imagery cue words were presented. Counterbalancing was done across stimuli both within and across sessions.

Materials

Cues. 50 concrete and highly imaginable verbal cues, and 50 abstract/low imaginable word cues were used. These were short sentences selected from the pool of 800 cues used in previous studies (e.g. Schlagman and Kvavilashvili, 2008) by 5 independent judges asked to rate their level of concreteness on a 7-point scale (1 “low” - 7 “high”) and 5 more independent judges who were asked to rate their imageability level, again on the same 7-point rating scale. Familiarity was rated by 5 additional raters and was not significantly different in the two sets of cues. An approximately equal number of positive, neutral and negative cues were used in each group and were presented counterbalanced across participants.

Vigilance Task. We employed the vigilance task used by Schlagman and Kvavilashvili (2008), using 50 trials. In each trial a card (approximately 21.5 X 12.5 cm in size) was shown depicting either a pattern of black horizontal (non-target) or vertical lines (target stimuli). Eight different target stimuli were presented. The word phrases were shown on each trial in the center of the card. Each stimulus remained on the screen for 1.5 sec.

Memory characteristics questionnaire. The questionnaire the same as in Study 5 and 6, and adapted from the one used by Schlagman and Kvavilashvili (2008). Participants were asked to briefly describe the memory, state whether the event was common or unusual, if they had this memory before, and report the age in which the event happened. This time the questionnaire also included additional questions related to the memorability and the subjective importance of the event (see Appendix M).

Procedure

Participants were tested individually. Instructions for the vigilance task were taken from Schlagman and Kvavilashvili (2008), with the major difference that participants, as in previous experiments 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.

Participants in both conditions also had to complete the vigilance task as of Experiment 1. 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. In the involuntary task they were also asked to ignore the words shown in the center of the card. Participants in both sessions 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), which was normal.

For the involuntary session the rest of the instructions were the same as in Experiment 3. For Session 2 the instructions were in part the same (the part that referred to the task being monotonous, and leading to mindwandering). However, instead of then stating that in these circumstances mental contents pop into mind, we stressed that during the task there were verbal cues, and that the participant's task was, in addition to respond 'yes' to vertical lines, also to try to remember past personal events in response to the cues. Instructions were given about the possibility of interrupting the presentation of the cues as soon as they were able to remember an event linked to a cue, but it was mentioned that they did not have to come up with a memory for every cue. They were told to report the memories that were triggered by the cues. If a memory came to mind during the task, they should click the mouse to interrupt the presentation and write a short sentence describing it. In both groups they were told this initial description should be sufficient for them to identify the mental content/memory at a later point in time, if necessary, and to write at the same time the element that triggered the memory. When the task was over, participants in the involuntary group 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 (and for all items in the voluntary session) they were asked to complete the two-page memory characteristics questionnaire.

Results

All eighty (80) participants completed their vigilance task successfully. In the involuntary session, two participants reported no memory, but reported 1 thought, where as all other reported a minimum of 1 and maximum 29 memories in session 1. In Session 2 the minimum number of reported memories was 2 in response to presented cues. The total number of memories in session 1 (involuntary) was 543 (mean=6.78, SD= 6.51, range= 1-29). The total number of reported memories in

session 2 (voluntary) was 622 (mean = 7.77, SD = 4.64, range = 2-24). All memory characteristics were measured and mean and standard deviations for involuntary memories were computed (see table 6.1 for involuntary memories and table 6.2 for voluntary memories).

Table 6.1: Mean (standard deviation) of characteristics of IAMs elicited in Experiment 7. Session 1

	<i>Concrete cue word</i>	<i>Abstract cue word</i>
	<i>Mean</i>	<i>Mean</i>
No. of interruptions	15.40 (11.70)	9.72 (9.49)
No. of reported memories	9.30 (7.77)	4.31 (3.56)
% Specific event	62.91 (26.94)	53.91 (32.23)
% General event	34.61 (25.52)	41.07 (31.18)
Event unusual/commonness	3.26 (0.65)	3.03 (0.84)
Single experience	1.51 (0.24)	1.57 (0.32)
Memorable/nonremarkable	3.28 (0.74)	3.52 (0.64)
Very important/trivial	2.62 (0.73)	3.09 (0.71)

A 2 (concrete vs. abstract) x 2 (involuntary vs. voluntary) mixed ANOVA was calculated on number of interruptions. The results showed that interruptions were significantly more frequent in the involuntary ($X = 12.56$) than in the voluntary

condition ($X=8.08$), $F(1,77) = 16.79$, $p<.001$, and that they were more frequent in the group with concrete cues ($X= 12.42$) than in the group with abstract cues ($X=8.22$), $F(1,77) = 7.63$, $p<.006$.

A similar ANOVA showed that there was no difference between the number of involuntary ($X=6.80$) and voluntary ($X=7.82$) memories reported $F(1,77) = 2.45$, $p>.10$, though the latter were more frequent whereas the difference was significant between concrete ($X=9.19$) and abstract ($X=5.44$) cues, $F(1,77) = 13.63$, $p<.001$, with a larger number of memories in response to concrete cues. The interaction was not significant.

In order to assess whether the memories elicited with the two methods were the same (e.g. both involuntary), similar ANOVAs were also computed on each memory characteristic. Voluntary memories were significantly more specific ($X=67.52$) than involuntary memories ($X=58.41$), $F(1,77) = 4.65$, $p<.04$. Although the difference was not significant between type of cue, the marginally significant interaction cue by type of memory, $F(1,77) = 3.86$, $p<.053$ indicates that, unexpectedly, more specific memories were obtained in the voluntary session in response to abstract cues, whereas the lowest percentage of specific memories was obtained in the involuntary session in response to abstract cues (Inv Concrete, $X= 62.91$; Inv Abstract, $X= 53.91$; Vol. Concrete, $X = 63.92$; Vol. Abstract, $X= 71.32$).

The ANOVA on the percentage of generic memories reveals a complementary pattern. The significant interaction, $F(1,77) = 5.19$, $p<.025$, indicates that involuntary memories in response to abstract cues were more general than all the others ($X=41.08$), while the voluntary memories in response to abstract cues were the least general ($X=24.82$). Voluntary memories reflected also more unusual events ($X=3.42$)

compared to involuntary memories ($X=3.14$), $F(1, 75) = 11.26$, $p < .001$. Involuntary memories referred less often to single experiences ($X=1.53$) compared to voluntary memories ($X=1.41$), $F(1, 75) = 10.81$, $p < .002$.

However there was no difference between voluntary and involuntary memories (or between concrete and abstract cues) in the evaluation of how memorable the event portrayed in the memory was, and no difference between involuntary and voluntary memories in importance attributed to the event. But memories in response to abstract cues, both in the involuntary and voluntary conditions, were considered to refer to more important events ($X=3.00$) compared to memories in response to concrete events ($X=2.64$), $F(1, 75) = 5.99$, $p < .02$. (We should notice that two participants did not report any rating about whether the event was common or unusual, if it referred to a single experience, if it was remarkable or important).

Table 6.2: Mean (standard deviation) of characteristics of voluntary memories elicited in experiment 7. Session 2.

	<i>Concrete cue word</i>	<i>Abstract cue word</i>
	<i>Mean</i>	<i>Mean</i>
No. of interruptions	9.45 (5.46)	4.31 (3.56)
No. of reported memories	9.07 (5.27)	6.56 (3.60)
% Specific event	63.72 (25.16)	71.32 (27.83)
% General event	36.27 (25.17)	24.82 (23.32)
Event unusual/commonness	3.41 (0.64)	3.43 (0.57)
Single experience	1.41 (0.26)	1.40 (0.22)
Memorable/nonremarkable	3.52 (0.62)	03.53 (0.78)
Very important/trivial	2.66 (0.64)	2.91 (0.79)

In this study we also collected response times, and we calculated N-backs from the time in which the person interrupted the experiment and reported the memory and the trigger, and the time when the cue that triggered that memory was presented. Response times were calculated multiplying the time between the onset of each cue and the next cue for the number of N-backs for that memory. For example, if the person had interrupted the experiment and reported a memory after 6 cues (between

the 6th and the 7th), but reported that the trigger was cue n 3, then the N-backs were 3, and the ISI (inter stimulus interval, which was the same for every cue) was multiplied by 3 for that memory. To that time the time between the onset of cue 6 and the time in which the interruption occurred was also added. Outliers (i.e. those with response times that were 3 or more standard deviations from the mean) were eliminated from these analyses. The 2x2 ANOVA on RTs showed that response times calculated in this way did not discriminate between voluntary and involuntary memories, $F(1,73) = 1.24, p < .27$. There was also no overall effect of type of cue, $F(1, 73) = 1.58, p < .21$, and no significant interaction, $F(1,73) = .83, p < .37$. Similarly non significant results were obtained for the total number of zero backs, and the total number for backs that were 1 or more.

A further analysis was done only on the cues after categorizing them as high and low performance cues. High performance cues (i.e. cues which triggered more memories than other cues in the list presented) were mostly concrete, but even among concrete cues one could observe a large variability in performance. The large variability tells us that concrete Vs. abstract does not explain fully why memories are retrieved and that within the concrete cues condition some seem to be more successful. The idea was to assess the characteristics of the memories, since we could not manipulate the cues, and examine if cues that were high performers would elicit memories that were in principle more accessible. Hence we ran an independent sample T-test, limited to concrete cues, and compared the characteristics of the memories between high and low performers.

Table 6.3: Mean (standard deviation) of high performance cue words on memorability and importance of event.

	<i>High performance</i>	<i>Low performance</i>
	<i>Mean</i>	<i>Mean</i>
Memorability	3.42 (0.91)	2.71 (1.31)
Importance	2.97 (0.81)	1.97 (1.31)

Results indicated that there was a significant difference between high performance concrete verbal cues and low performance concrete verbal cues on two characteristics, memorability of the event, $t(34) = 2.65, p = 0.012 < 0.05$, and importance of the event, $t(34) = 2.79, p = 0.009 < 0.05$.

Discussion

The results of this experiment confirm the difference in effectiveness between concrete/high imagery and abstract/low imagery cues already found in Experiment 4. But they add much more to the results of that study. First, they show that the effect of cue type is not significantly different (is similar) in involuntary and voluntary memories, a result that confirms results of previous studies showing that the same principles apply to voluntary and involuntary retrieval. Second, and importantly, the results show that in spite of a lack of difference in frequency of recall, involuntary and voluntary memories differ on a number of characteristics. This result is interesting, as it seems to suggest that maybe the old hypotheses by Bemtsen and by Conway, that the pool of memories that are accessed is different, might be true after all. Unexpectedly, voluntary memories collected with this method were more

specific and less general (the two measures were independently taken) than involuntary memories, reflected more unusual events and referred to more single events.

But do these results speak in favour of separate pools of memories that are accessed? Or do they refer to different retrieval activities in the two tasks? Our propensity is to agree with the second hypothesis. Voluntary retrieval is certainly more effortful than involuntary retrieval, and people might then select in this case memories that are in line with what people consider to be 'memories' (e.g. about specific events), and memories that are about unusual/unique events. Whereas in involuntary retrieval memories are not selected during retrieval, and thus they can refer to any type of event. One alternative explanation is that the type of involuntary retrieval activated by our methodology is much akin to the mental activity in mind wandering, and as such activates more vague and less specific mental contents. Some further studies would be outlined in the final discussion chapter.

An indirect confirmation that differences in retrieval are the right explanation, rather than separate pools of memories comes from the several significant interactions that were observed with type of cue. More specific voluntary memories were obtained, but in response to abstract cues, for example, whereas the lowest number of specific memories was obtained in the involuntary procedure in response to similarly abstract cues. So the nature of the cue plays a different role in voluntary and involuntary retrieval, which supports the idea that different retrieval mechanisms are at play, rather than different pools of memories. Similarly, involuntary memories referred to more general events, but only in response to abstract cues, whereas voluntary memories in response to abstract cues were the least general. To reiterate, these interactions suggest that probably, as the activation of information in memory is modulated by the cues, so it could be by the type of retrieval used. To clarify, we claim here that involuntary and voluntary memories do not come from different pools, but form the same pool, and the type of memory that is triggered from within that pool

depends on *both* the cues and the retrieval used. However, the claim that memories come from the same pool need to be specified. We do not believe that involuntary memories are more recent, for example, but it is possible that the accessibility to the memory is the key factor to be considered here.

Do concrete and abstract cues lead to the report of memories with different characteristics, besides interacting with type of retrieval? In general the fewer memories retrieved in response to abstract cues referred to more important events. Either abstract concepts (e.g. disappointments) are considered more important, or abstract cues, which are in general less effective, only trigger memories that are accessible because of the importance of the event they refer to. Put another way, the importance of the event could have the potential effect of increasing the accessibility of memories that otherwise, given the lower effectiveness of abstract cues, would have remained inaccessible.

Our results are also important in revealing that when the same basic components of the procedure are used in both involuntary and voluntary memory tasks, no difference is observed in response time, nor in N-backs defined here as the difference in cues between the cue that triggered the response and the cue where the interruption occurs. This suggests that other results showing differences in response times should be considered with caution, as they might be the outcome of the specific differences in the procedures used.

Finally, our data reveal that concrete cues, in spite of being in general more effective, still allow for a large variability in the number of involuntary memories elicited. Comparing the qualities of the memories that are elicited by high and low performers among concrete cues, we found that events that are considered more

memorable and more important are triggered more often in response to high performance cues. This implies that the likelihood of retrieving an involuntary memory does not depend on the power of the cue alone (or the match between the content of the cue and the content of the memory). It also depends on the quality of the events, as events that are more important and more memorable are retrieved more easily by the same type of cues.

Chapter 7

General Discussion

In a series of seven experiments we examined the role of the cues in eliciting involuntary autobiographical memories (IAMs). The question asked in the present dissertation was to assess whether cues that typically are more effective in voluntary memory (not necessarily autobiographical) would also be more effective in eliciting IAMs. We chose to manipulate two characteristics of the cue, the presence of pictorial information, and the concreteness of the cue, because both factors have been extensively examined in the memory literature, and both have shown to be very effective as memory cues. Previous work had already assessed whether cues with different emotional valence (positive, negative and neutral) have different effects in triggering IAMs, showing that, when an experimental manipulation was used, negative cues are more productive in eliciting IAMs compared to positive and negative ones (SandK, 2008). In the present study the role of emotional valence was not examined, and the valence of the cue was randomly interspersed in the cue list, just to control for a factor that is already known to play a role in eliciting IAMs. The results observed when pictorial cues were compared to verbal cues were rather unexpected, as they showed that pictorial cues are significantly less effective in eliciting IAMs. Subsequent experiments confirmed that the effect was not due to the complexity of the cues, nor to their distinctiveness. Even if it was not possible to statistically compare the experiments with complex and more simple pictorial cues the number of memories with complex cues was almost twice as big as that obtained with simple cues,

suggesting that, if anything, the complexity of the picture might help eliciting more IAMs during retrieval. As we discuss at the end of Chapter 4, one possible explanation for this unexpected result refers to the fan effect (or cue overload principle). According to the cue overload principle, the fact that a cue triggers many potential memories decreases its efficacy, as the memories compete for retrieval, leading to a lower likelihood of recalling each specific one. In the discussion of chapter 4 we say that it is possible that, compared to verbal cues, pictorial cues activate too many potential memories because each element in the cue could act independently as a ‘sub-cue’, thus multiplying the potential memories that the pictorial cue as a whole could activate. However, no studies have assessed so far whether the greater effect of pictorial information in memory could be due to the presence of individual ‘sub-cues’, and this line of investigation was also not pursued in this dissertation, because we believed that a better explanation is available for these results. The effect could be due to the fact that these details are, as we said in Chapter 4, *highly specified*. Highly specified details might hinder the retrieval of memories for a very simple reason. Specified details (e.g. in the pictorial cue ‘A glass of red wine’ the shape of the glass is clearly specified, as is the hue of the wine) might be too specific to correspond to the specific events that people have actually experienced. Although this effect should be less strong for simple outlines of objects (used in Experiment 3), it might still be true that even more simple visual outlines of objects can specify characteristics that might not correspond to the personal experience with objects of that category. I might have encoded a memory for a glass of red wine, but the glass was different from the one I am presented now, and the colour of the wine too. Hence there is limited match between the cue and the memory in terms of sensory details. Previous diary studies have shown that the most common active cues in triggering IAMs are those that

contain information that presents sufficient overlap with the content of a memory. This type of explanation is in line with the results (and explanation proposed for them) of previous studies, in which verbal stimuli were found to be more effective cues for memory, compared to pictorial stimuli (Garry and Wade, 2005). Although that study (and hence the results) dealt with the creation of false memories, it has often been claimed that false memories and true memories are created via the same processes and mechanisms (e.g. the Fuzzy-Trace theory, Brainerd and Reyna, 2005; the Source monitoring framework, Johnson, Hastroudy and Lindsay, 1993; the Activation-Monitoring hypothesis, Roediger et al, 2001; Roediger et al, 1998; the metacognitive model proposed by Mazzoni and Kirsch, 2002). Hence an explanation that applies to the retrieval of false memories can also apply to the retrieval of other types of memory as well. Thus the explanation proposed by Garry and Wade (2005) to the retrieval of false memories can be applied also to the retrieval of involuntary memories. Although attributing this effect to cue overloading and the fan effect is in principle possible, we prefer this second explanation, because the data show that numerically (although not statistically comparable) the number of memories obtained with complex pictures is higher than the number obtained with simple pictures. According to the cue overload hypothesis, competition among memories should be higher in complex than simple pictures, if pictorial sub-cues are to be considered as an important factor, whereas the results seem to go in the opposite direction. A larger number of details, within the same pictorial modality, does not seem to hinder involuntary recall but rather facilitate it. This leads to hypothesize that, rather than the amount of details per se, it is the nature of the cue (i.e. the nature of the information that cues contain) that matters. The greater the likelihood of the match between that information and the content of personal memories, the greater the likelihood of retrieving IAMs. According to this

hypothesis, verbal cues are more effective because they lend themselves to be completed (via the elaboration of the cue) with details that are personally relevant and congruent with one's experience, rather than containing pre-specified (and potentially personally irrelevant) details, or details that conflict with the personal experience. Elaboration of the cue that adds details that are part of the personal experience then would enhance successful matches between the content of the cue and the content of the memory and consequently elicit more IAMs.

This hypothesis was tested in Experiment 6, in which we compared the verbal cues used in Experiment 4 (e.g. a glass of wine) with the same verbal cues to which more details was added (e.g. a glass of red wine in Paris). The results however did not suggest that the hypothesis was correct, as, even if not significantly different; the number of memories was somewhat larger in the condition with more specific information. In the discussion of Experiment 6 we suggest that the lack of a significant difference might indicate that details in the cue have two opposing effects. On one hand they decrease the likelihood of a match because the cues might be too specific. On the other hand, they might increase the likelihood of a match as the added details might represent a good match for some people. To clarify, in the 'glass of red wine in Paris' example, adding the location (Paris) might represent a negative feature and decrease the likelihood of finding a match for those people who have not been in Paris, but increase the likelihood of a positive match for the people who have been in Paris, or have some experience related to Paris. A third possibility, however, is that adding details does not matter, which would suggest that the hypothesis that single elements in a cue function as partially independent 'sub-cues' might be incorrect, and what matters is the match between the gist of the cue and the gist of the experience. Further studies will explore this topic.

An indirect confirmation of the potential correctness of the hypothesis according to which personal elaboration of the cue is important in enhancing the likelihood of a match comes from Experiment 4, in which we compared verbal cues that were either concrete/highly imaginable or abstract/poorly imaginable. We hypothesized that concrete/highly imaginable cues would be more successful in producing IAMs. The results confirmed that concrete cues were more productive for IAMs, an effect that could be due to the fact that concrete cues can be more easily elaborated, for example, via mental imagery. This additional elaboration (elaboration that would make the cue more ‘personal’) could be then responsible for the increased number of IAMs retrieved with these cues. These results also indicate that at least in this case the same principles governing voluntary retrieval also govern involuntary retrieval. This suggestion is also supported by the finding of Experiment 7, in which concrete and abstract cues were compared again, but this time both in involuntary and voluntary retrieval. The results of Experiment 7 show that concrete cues are more effective in general, independently of the type of retrieval, whether involuntary or voluntary. A result that however mitigates this claim (that concrete and abstract cues work in the same way in involuntary as in voluntary memories) is that in Experiment 7 several characteristics were significantly different between involuntary and voluntary memories, and in a very unexpected direction. Overall voluntary memories were more specific, less general (the two were measured independently), referred more to single and more unusual events. This result suggests that the nature of the memories accessed when voluntarily attempting to retrieve the memories, or while letting the memories spontaneously pop up is quite different. We also need to stress that this set of results is in clear contradiction with the results from diary studies, in which involuntary memories are typically rated as more specific, and referring to more

uncommon events. In spite of this contradiction, there are good reasons to believe that our results make good sense. It is possible, for example, that in voluntary retrieval, when the retrieval is not forced, but is free, as in our case (participants were not supposed to *try* find a memory in response to each cue), the process of retrieval is more likely to be less indirect and less hierarchical, and more direct, which would more likely open the access to more specific events, rather than general/generic ones, which are more likely to be obtained in response to forced recall tasks. The fact that free and forced recall produces significant and important differences in the output is an accepted result in the memory literature (see for example Koriat and Goldsmith 1996). Although nobody has examined whether memory is more or less specific when using forced vs. free recall, it is known that in forced recognition (which is the typical way of performing a recognition task) the output reflects to a greater extent a sense of familiarity, rather than recollection, whereas in free recognition (when people are left free to opt out and not respond to some of the items) the output seems to be more often characterized by recollection. It might thus be the case that also the voluntary retrieval from autobiographical memory is similarly affected by this manipulation. When people are explicitly or implicitly requested to try to remember an event in response to all the cues, then they probably use top-down hierarchical processes (as hypothesized in the model by Conway and Pleydell-Pearce, 2000). This would lead to memories that are rather generic. When recall is free, then they can output only events that elicit a strong sense of recollection. These tendentially are events that are specific. Even if this speculation is interesting, the current set of studies were not aimed at specifically addressing this point, and strong conclusions cannot be drawn, Future studies will have to manipulate retrieval in a more rigorous way.

It might also be the case that, instead of being due to different types of recall processes (indirect for generic and direct for specific memories), during voluntary retrieval a number of metacognitive processes are at play, that can modify the output of the retrieval process. Decades of research in metacognition have shown that retrieval involves monitoring and control processes, with important interplays between the two. Monitoring would then help select for the output the memories that are typically considered to correspond to what people consider memories, i.e. episodic, about specific events. In this case, we propose, in free voluntary retrieval from autobiographical memory the content that is finally output is the result not only of purely memories processes at retrieval, but also of the metamemorial processes that play a major role during this phase (see for example Hanczakowski and Mazzoni, under review). Metacognitive processes might not be at play (at least not to the same extent) during involuntary retrieval, where memories do not undergo an aware and intentional evaluation, and thus are less filtered after they are retrieved.

This interpretation finds some indirect confirmation in part of the results of Experiment 1, in which we compared four allegedly involuntary conditions. Crossed with each other we manipulated the information given to participants (informed about the aim of the study on IAMs, or not; and self-interrupted or interrupted following a predetermined schedule). We found that during the two factors led to different numbers of involuntary memories. More memories were obtained when the instructions mentioned the aim of the study; and when interruptions followed a predetermined schedule. And when instructions mentioned the aim of the study, IAMs had also different characteristics, as they were more specific and had been rehearsed more. This is the result that indirectly confirms what obtained in Experiment 7 on the difference between voluntary and involuntary retrieval in autobiographical memory.

When people know that the task refers to memory, then it might be that monitoring processes are automatically activated and selection occurs by which only memories that are considered to correspond to more typical memories are then reported. Hence the more specific memories, which were also memories that had come more often to mind previously.

Future studies

The experimental work in this dissertation has raised a number of interesting possibilities for future studies. Assuming that the hypothesis that has subsumed this whole work, that involuntary memories occur when there is a sufficient match (activation) between the content of a cue and the content of a memory representation, is correct, future studies should examine which part of the cue is important. In other words, it might be that it is just the gist of the cue that matters, or, as the results of previous diary studies suggest, single elements in the cue can act in a partial independent way in the form of what we called here 'sub-cues'. It might be the case, as we claimed that the power of a cue relies on the number of potential sub-cues each contains. It also might be that both single independent cues and the central gist of the cue potentially activate memory representations. In any case, one way to assess this will be by manipulating the number of additional details that are added to the central gist of the cue. Future studies can also manipulate the additional details by modifying the congruency of the additional details with the central gist of the original cue (adding congruent details, that add to the strength of the gist, or adding incongruent details).

A second area that we hypothesize could be of importance in enhancing or diminishing the power of a cue is the extent to which the elaboration of a cue increases the likelihood of triggering IAMs. As we stated above, elaboration might add to the

gist of the cue elements that are personally relevant for the individual who is remembering, and hence increase the likelihood of a match with existing mental representations of past personal events.

A third area that deserves more investigation is the role of cue overload, and the linked fan effect. Their role in IAMs retrieval was first proposed by Berntsen et al (2012) as a way to explain why we are not flooded by IAMs during our waking state. We referred to this notion as a potential way to interpret a number of our results. However a direct test of the cue overload effect that is not limited to very simple material might be necessary to define the role of this principle in involuntary retrieval.

A fourth area for future studies will be to better understand (and exploit) the similarity between typical mind wandering tasks and the vigilance task adopted in these seven experiments, and to assess the extent to which involuntary retrieval is automatically activated in typical mind wandering tasks. A study is now underway to examine this point.

And, as a final major point, an important question is raised by the unexpected and consistent finding that voluntary memories are actually more specific and more unique than involuntary memories, a result that contradicts what found in previous diary studies. Do these opposite results depend on the specific method adopted here? A recent unpublished study in our laboratory has used a different approach to trigger IAMs, and the quality of those memories is now being assessed.

While all the new areas of investigation listed above will help understand the boundary conditions that trigger involuntary recall of past personal events, it seems then that this dissertation has raised more questions than it has answered. And, importantly, the main question remains open, which refers to the possibility that when

studying spontaneous involuntary memories in everyday life using a diary method, and when investigating involuntary retrieval in the laboratory, we might actually examine different processes and different memory outputs. Which would lead to the question: Can genuine IAMs be really elicited in the Lab? This is the main point future studies will need to examine.

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Appendices

Appendix A

Study 1 Instruction (Group 1)

Welcome!

The aim of this task is to study people's ability to concentrate on a relatively monotonous and repetitive task. In order to study your concentration you will be shown a large number of cards on a computer screen one by one. The cards will show patterned lines. Most of the time a pattern of horizontal lines will be shown and you should ignore these. Occasionally you will see a pattern of vertical lines, these are the targets which you should detect. Each time you detect vertical lines on a card presented on the screen you should respond by saying "yes" out loud and the computer will automatically record your response and time taken to respond to this target.

In addition to seeing horizontal and occasionally vertical lines you will also see some words in the middle of the cards. You do not need to do anything with these words as we are looking at your ability to keep track of patterns, just continue to react to the target lines when they appear. In another condition, participants will have to concentrate on the words and ignore the lines. Therefore, the overall aim of the study is to investigate which stimuli are better for concentration (the words or patterns).

Although this seems like a simple task it is sometimes quite difficult to concentrate on a monotonous task and your thoughts may drift away from the task. We are interested in mind-wondering. In mind-wondering people let their mind free. In this state, different thoughts, irrelevant to the person's current situation, come to mind. During this time you may find yourself thinking about various things that are unrelated to the task, for example, you may begin to think about your plans for this evening, your current situation, daydreams or events that have happened to you in the past. It is very normal to have such thoughts, and in addition to your concentration abilities we are also interested in some of these unrelated thoughts that you may experience. You may

find that memories from your past come into your mind spontaneously without any deliberate attempt to retrieve them. In other words, a memory that simply 'pops' into your head without you trying to consciously remember anything and it is these involuntary memories that we are also interested in.

Involuntary memories may vary in detail some may be specific and refer to a single episode that you experienced on a particular day (e.g., 'the day you moved into a new house' or 'how you passed your driving test'). Other memories may be more general and refer to events that lasted longer than one day. General memories can be of a single event that you experienced repeatedly over an extended period (i.e., 'visits to the dentist' or 'going to seaside every summer during your childhood') or they can be of an extended event that lasted for more than a day (for example, 'a trip to Paris') and the memory is of the whole trip, not a specific day. The only criterion we have is that your past memory came to mind spontaneously without you trying to consciously remember anything.

If a memory from your past does 'pop' into your mind without you deliberately trying to remember anything then you should press the mouse. This will stop the presentation on the computer and you will then be asked to write the title of your memory. You will then press the button again to return to the vigilance task and you should repeat this procedure if another memory comes to mind spontaneously. Finally, if a memory comes to mind that you feel is too personal and you do not wish to give the details then this is fine, you will still press the mouse but you will not need to describe the content of your memory, it can be recorded as 'personal'.

All the information you give us will remain strictly confidential and anonymous as you are encouraged not to write your name on anything. Your documents will be identified by a code number (this is simply to ensure your documents are not mixed up with any other participants) and will not be seen by anyone outside a small research team.

Appendix B

Study 1 Instruction (Group 2)

Welcome!

The aim of this task is to study people's ability to concentrate on a relatively monotonous and repetitive task. In order to study your concentration you will be shown a large number of cards on a computer screen one by one. The cards will show patterned lines. Most of the time a pattern of horizontal lines will be shown and you should ignore these. Occasionally you will see a pattern of vertical lines, these are the targets which you should detect. Each time you detect vertical lines on a card presented on the screen you should respond by saying "yes" out loud and the computer will automatically record your response and time taken to respond to this target.

In addition to seeing horizontal and occasionally vertical lines you will also see some words in the middle of the cards. You do not need to do anything with these words as we are looking at your ability to keep track of patterns, just continue to react to the target lines when they appear. In another condition, participants will have to concentrate on the words and ignore the lines. Therefore, the overall aim of the study is to investigate which stimuli are better for concentration (the words or patterns).

Although this seems like a simple task it is sometimes quite difficult to concentrate on a monotonous task and your thoughts may drift away from the task. We are interested in mind-wondering. In mind-wondering people let their mind free. In this state, different thoughts, irrelevant to the person's current situation, come to mind. During this time you may find yourself thinking about other things that are unrelated to the task, for example, you may begin to think about your plans for this evening, your current situation, daydreams or events that have happened to you in the past. It is very normal to have such thoughts, and in addition to your concentration abilities we are also interested in some of these unrelated thoughts that you may experience.

When a thought comes to your mind, stop thinking and write the title of what you are thinking about. We are interested in the thoughts that you might experience. Each time a thought comes to your mind, then you should press the mouse button. This will stop the presentation on the computer and you will then be asked to write your thought. You will then press the mouse again to return to the vigilance task and you should repeat this procedure if another thought comes to mind spontaneously. Finally,

if a thought comes to mind that you feel is too personal and you do not wish to give the details then this is fine, you will still press the button but you will not need to describe the content of your thought, it can be recorded as 'personal'.

To summarise, when you have a thought, you can interrupt your thinking and write your thought (only the title of it).

All the information you give us will remain strictly confidential and anonymous as you are encouraged not to write your name on anything. Your documents will be identified by a code number (this is simply to ensure your documents are not mixed up with any other participants) and will not be seen by anyone outside a small research team.

Appendix C

Study 1 Instruction (Group 3)

Welcome!

The aim of this task is to study people's ability to concentrate on a relatively monotonous and repetitive task. In order to study your concentration you will be shown a large number of cards on a computer screen one by one. The cards will show patterned lines. Most of the time a pattern of horizontal lines will be shown and you should ignore these. Occasionally you will see a pattern of vertical lines, these are the targets which you should detect. Each time you detect vertical lines on a card presented on the screen you should respond by saying "yes" out loud and the computer will automatically record your response and time taken to respond to this target.

In addition to seeing horizontal and occasionally vertical lines you will also see some words in the middle of the cards. You do not need to do anything with these words as we are looking at your ability to keep track of patterns, just continue to react to the target lines when they appear. In another condition, participants will have to concentrate on the words and ignore the lines. Therefore, the overall aim of the study is to investigate which stimuli are better for concentration (the words or patterns).

Although this seems like a simple task it is sometimes quite difficult to concentrate on a monotonous task and your thoughts may drift away from the task. We are interested in mind-wondering. In mind-wondering people let their mind free. In this state, different thoughts, irrelevant to the person's current situation, come to mind. During this time you may find yourself thinking about various things that are unrelated to the task, for example, you may begin to think about your plans for this evening, your current situation, daydreams or events that have happened to you in the past. It is very normal to have such thoughts, and in addition to your concentration abilities we are also interested in some of these unrelated thoughts that you may experience. You may find that memories from your past come into your mind spontaneously without any deliberate attempt to retrieve them. In other words, a memory that simply 'pops' into your head without you trying to consciously remember anything and it is these involuntary memories that we are also interested in.

Involuntary memories may vary in detail some may be specific and refer to a single episode that you experienced on a particular day (e.g., 'the day you moved into a new house' or 'how you passed your driving test'). Other memories may be more general and refer to events that lasted longer than one day. General memories can be of a single event that you experienced repeatedly over an extended period (i.e., 'visits to the

dentist' or 'going to seaside every summer during your childhood') or they can be of an extended event that lasted for more than a day (for example, 'a trip to Paris') and the memory is of the whole trip, not a specific day. The only criterion we have is that your past memory came to mind spontaneously without you trying to consciously remember anything.

The vigilance task will be interrupted at random intervals during the experiment. During these interruptions you can record memories from your past that have "popped" into your mind without you deliberately trying to remember anything. At this point you will have to

Write the title of your memory/memories. You will then press the mouse-button to return to the vigilance task. Finally, if a memory comes to mind that you feel is too personal and you do not wish to give the details then this is fine, you will not need to describe the content of your memory, it can be recorded as 'personal'.

All the information you give us will remain strictly confidential and anonymous as you are encouraged not to write your name on anything. Your documents will be identified by a code number (this is simply to ensure your documents are not mixed up with any other participants) and will not be seen by anyone outside a small research team.

Appendix D

Study 1 Instruction (Group4)

Group 4

Welcome!

The aim of this task is to study people's ability to concentrate on a relatively monotonous and repetitive task. In order to study your concentration you will be shown a large number of cards on a computer screen one by one. The cards will show patterned lines. Most of the time a pattern of horizontal lines will be shown and you should ignore these. Occasionally you will see a pattern of vertical lines, these are the targets which you should detect. Each time you detect vertical lines on a card presented on the screen you should respond by saying "yes" out loud and the computer will automatically record your response and time taken to respond to this target.

In addition to seeing horizontal and occasionally vertical lines you will also see some words in the middle of the cards. You do not need to do anything with these words as we are looking at your ability to keep track of patterns, just continue to react to the target lines when they appear. In another condition, participants will have to concentrate on the words and ignore the lines. Therefore, the overall aim of the study is to investigate which stimuli are better for concentration (the words or patterns).

Although this seems like a simple task it is sometimes quite difficult to concentrate on a monotonous task and your thoughts may drift away from the task. We are interested in mind-wondering. In mind-wondering people let their mind free. In this state, different thoughts, irrelevant to the person's current situation, come to mind. During this time you may find yourself thinking about other things that are unrelated to the task, for example, you may begin to think about your plans for this evening, your current situation, daydreams or events that have happened to you in the past. It is very normal to have such thoughts, and in addition to your concentration abilities we are also interested in some of these unrelated thoughts that you may experience.

The vigilance task will be interrupted at random intervals during the experiment. During these interruptions you can record thoughts also from your past that have "popped" into your mind. We are interested in the thoughts that you might experience. At this point you will have to write the title of your thought/thoughts. You will then press the mouse-button to return to the vigilance task. Finally, if a thought comes to

mind that you feel is too personal and you do not wish to give the details then this is fine, you will not need to describe the content of your thought, it can be recorded as 'personal'.

To summarise, during the interruptions you can write down your thoughts (only the title of it).

All the information you give us will remain strictly confidential and anonymous as you are encouraged not to write your name on anything. Your documents will be identified by a code number (this is simply to ensure your documents are not mixed up with any other participants) and will not be seen by anyone outside a small research team.

Thank you very much for participating.

Appendix E

Cues Experiment 1

S.No.	Cue words	Valence of cue
1	Ecstatic Crowd	Positive
2	Coffee Jar	Neutral
3	Young free and single	Positive
4	Going to a party	Positive
5	Gaining insight	Positive
6	Pushing a trolley	Neutral
7	Learning disability	Negative
8	Disney World	Positive
9	Good business	Positive
10	Terrible nightmare	Negative

Appendix F

Cues Experiment 2

Concrete cues

S.No.	Cue words	Valence of cue
1	Dinner in restaurant	Positive
2	A glass of wine	Positive
3	Refreshing drink	Positive
4	Hot water bottle	Neutral
5	Small scissors	Neutral
6	Coffee jar	Neutral
7	Paint Brush	Neutral
8	Skiing accident	Negative
9	Falling off a horse	Negative
10	Tooth extraction	Negative

Cues Experiment 2

Picture cues (Complex pictures)

A glass of wine



Coffee jar



Falling off a horse



Appendix G

Cues Experiment 3

Simple words

S.No.	Cue words	Valence of cue
1	Birthday cake	Positive
2	Bright Star	Positive
3	Juicy Apple	Positive
4	Tie	Neutral
5	Spoon	Neutral
6	Iron	Neutral
7	Alarm clock	Neutral
8	Sharp Saw	Negative
9	Hairy Spider	Negative
10	Loaded Gun	Negative

Cues Experiment 3

Simple pictures

Birthday cake



Alarm clock



Hairy Spider



Appendix H

Cues Experiment 4

Concrete cues

S.No.	Cue words	Valence of cue
1	Christmas presents	Positive
2	Disney World	Positive
3	Family pet	Positive
4	Bookmark	Neutral
5	Red pen	Neutral
6	Hospital porter	Neutral
7	Local Newspaper	Neutral
8	Deliberate harm	Negative
9	Falling off a horse	Negative
10	Skiing accident	Negative

Cues Experiment 4

Abstract cues

S.No.	Cue words	Valence of cue
1	Sense of humour	Positive
2	Exciting goal	Positive
3	Life time achievement	Positive
4	Filing a complaint	Neutral
5	Drawing the curtains	Neutral
6	Setting alarm	Neutral
7	Middle of the week	Neutral
8	Missed opportunity	Negative
9	Sprained ankle	Negative
10	Disappointment	Negative

Appendix I

Cues Experiment 5

Simple pictures (Pictures without background)

Birthday cake



Alarm clock



Hairy Spider



Simple pictures Cues with additional Back ground



Appendix J

Cues Experiment 6

High imagery cues (without additional details)

S.No.	Cue words	Valence of cue
1	Dinner in restaurant	Positive
2	A glass of wine	Positive
3	Refreshing drink	Positive
4	Hot water bottle	Neutral
5	Small scissors	Neutral
6	Bedside lamp	Neutral
7	Paint Brush	Neutral
8	Skiing accident	Negative
9	Falling off a horse	Negative
10	Tooth extraction	Negative

Cues Experiment 6

High imagery cues (with additional details)

S.No.	Cue words	Valence of cue
1	Dinner in Asian restaurant	Positive
2	A glass of Red wine	Positive
3	Refreshing drink on the boat	Positive
4	Brown hot water bottle	Neutral
5	Mom's small scissors	Neutral
6	Dad's bedside lamp	Neutral
7	New paint brush	Neutral
8	Skiing accident in childhood	Negative
9	Falling off a horse as a teenager	Negative
10	Tooth extraction last year	Negative

Appendix K

Anonymity Number: _____ Memory Number: _____

1. Briefly describe the content of your memory i.e., what is your memory about?

2. How vivid is your memory (circle)?

Very vague 1 ____ 2 ____ 3 ____ 4 ____ 5 ____ 6 ____ 7 ____ Very vivid

almost no image at all
vision

almost like normal

3. Was the memory triggered by something (circle)?

(a) in your thoughts

(b) in your environment

(c) there was no trigger

4. What was the trigger?

5. How much were you concentrating on the activity you were involved in (circle)?

Not at all __1____ 2____ 3____ 4____ 5__ Fully concentrating

6. Was the memory about an unusual or common event in your life (circle)?

Very common 1____ 2____ 3____ 4____ 5 Very Unusual

7. How pleasant or unpleasant was your memory (circle)?

Very Unpleasant 1 _____ 2 _____ 3 _____ 4 _____ 5 Very Pleasant

8. How pleasant or unpleasant was the original event at the time you experienced it (circle)?

Very Unpleasant 1 _____ 2 _____ 3 _____ 4 _____ 5 Very Pleasant

9. Is the memory of a general or specific event (circle)?

General / Specific

10. Approximately, how old were you in the memory? _____ years

11. Have you ever had this memory before (circle)?

1 _____ 2 _____ 3 _____ 4 _____ 5 _____

Never Once or twice A few times Several times Many times

Appendix L

Participant Number: _____ Memory Number: _____

1. Briefly describe the content of your memory i.e., what is your memory about?

2. How vivid is your memory (circle)?

Very vague __1__ 2__ 3__ 4__ 5__ 6__ 7__ Very vivid

almost no image at all

almost like normal vision

3. What was the trigger (please write the exact word)?

4. Was the memory about an unusual or common event in your life (circle)?

Very common __1__ 2__ 3__ 4__ 5__ Very Unusual

5. Approximately, how old the memory is? _____ years

6. Have you ever had this memory before (circle)?

1 _____ 2 _____ 3 _____ 4 _____ 5 _____

Never Once or twice A few times Several times Many
times

Appendix M

Anonymity Number: _____ Memory Number:

1. Briefly describe the content of your memory i.e., what is your memory about?

2. What was the cue that triggered the memory? If it is one of the word/ sentences presented, please report here which one.

3. Was the memory about an unusual or common event in your life (circle)?

Very common __1____2____3____4____5__ Very Unusual

4. Is the memory of a general or specific event (circle)?

General / Specific

5. Was the memory about a single experience (event occurred only once in your life)?

Yes/No

6. Was the memory about a memorable event of your life?

Very non ___1___2___3___4___5___ Very memorable
remarkable

7. What is the importance of the event in your life?

Totally trivial ___1___2___3___4___5___ Very Important

Appendix N

INFORMED CONSENT FORM –“Mind wondering”, The University of Hull]

You are invited to voluntarily participate in a research study on Mind wondering. This research is being conducted by Iram Batool at the psychology department. In total, we will have approximately 80 participants in this study.

Procedure

It will take approximately _____ minutes to participate in this study and the procedure will be completed in _____ session.

In this study, you will be sitting in a chair in front of a computer screen and you will be asked to perform vigilance tasks.

Voluntary Participation

You are free to choose whether or not to complete the study. You may stop the procedure at any time without loss of any benefits of participation.

Anonymity/Confidentiality

No personal information except for age (for statistical purposes) will be collected in this procedure.

Risks and Benefits

No risk for participants arises in this procedure.

You may benefit from this study by learning more about memory research in psychology. The debriefing will be held on _____, 10.00 in room AS250.

Compensation/Costs

The study will take approximately _____ minutes of your time and you will receive credits for your participation.

Contacts

The researcher will be happy to answer any questions that you might have about taking part in this study. If complaints or problems concerning this research project should arise, they should be reported to Iram Batool.

Thank you for your effort and honesty in completing the study today.

WRITTEN CONSENT

By signing here I consent to voluntary participation in this research study. I understand the procedures to be followed and the guarantees and limits of confidentiality. I understand that I will also receive a signed copy of this consent form.

Name _____ Signature _____

Date _____ Experimenter _____

