University of Alberta

THE EFFECTS OF CUE CONTENT AND CUE REPETITION ON RETRIEVAL FROM AUTOBIOGRAPHICAL MEMORY

by

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To my baby girl, Elif Yildiz, who will join us soon.

Abstract

Autobiographical memories can be recalled through effortful memory search (i.e., generative retrieval). They can also come to mind spontaneously (i.e., direct retrieval). It has long been argued that personal memories are usually generated in word-cueing studies. However, recent research (Uzer, Lee & N. R. Brown, 2012) shows that direct retrieval of autobiographical memories, in response to word cues, is common. This encourages further investigation of the conditions which increase or decrease direct retrieval. In this thesis, I explore the ways different cueing conditions (i.e., specific versus generic cues, cue repetition) influence the frequency of directly retrieved autobiographical memories. In Experiment 1, participants retrieved memories in response to cues from their own life (e.g., the names of friends) and object terms (e.g., chair). In Experiment 2, participants provided their personal cues two or three months prior to coming to the lab. In Experiment 3 only person, location, activity and possession cues from the more distant past (i.e., from high school years) were elicited. Experiment 4 investigated how cue repetition impacts the prevalence of direct retrieval. Participants retrieved memories in response to each personal cue once, twice or three times. In all experiments, RT was measured and participants reported whether memories were directly retrieved or generated on each trial. The first three experiments showed that personal cues elicited a high rate of direct retrieval. Personal cues were more likely to elicit direct retrieval than object terms, and as a consequence, participants responded faster, on average, to the former than to the latter. Experiment 4 indicated that direct retrieval decreased as the number of cue repetitions increased. Cue repetition slowed down the memory search/generation process. In contrast, cue repetition did not affect direct retrieval. These results challenge the constructive view of autobiographical memory and suggest that autobiographical memories consist of pre-stored event representations, which are largely governed by associative mechanisms. A substantial reduction in direct retrieval with cue repetition implies that inhibitory processes also influence retrieval. These demonstrations offer theoretically interesting research directions such as exploring the role of interference versus inhibition in accessing memories. Finally, implications for selective use of memory are discussed.

Keywords: autobiographical memory, direct retrieval, retrieval processes, cue repetition, inhibition

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INTRODUCTION

> Remembering past events is a universally familiar experience. It is also a uniquely human one. As far as we know, members of no other species possess quite the same ability to experience again now, in a different situation and perhaps in a different form, happenings from the past, and know that the experience refers to an event that occurred in another time and in another place. (Tulving, 1983, p.1)

Remembering the name of Mexico's capital city is different from remembering one's first trip to Mexico City. This distinction was first proposed by Endel Tulving. Tulving (1983) termed the former *semantic* (i.e., the memory for the general facts about the world and objects) and the latter *episodic memory* (i.e., recollecting the what, when and where aspects of an event). Tulving (1983) also emphasized *autonoetic awareness* associated with episodic recall, which allows people to represent past experiences in a subjective manner (Tulving, 1983). More recently, *autobiographical memory* (AM) has been introduced as a subtype of episodic memory, referring to memories a person has pertaining to his/her life experiences (Rubin, 1986; 2005; Tulving, 2001; J. M. G. Williams & Broadbent, 1986). Although the term "autobiographical memory" has sometimes been used interchangeably with episodic memory, autobiographical memories generally refer to memories of specific events from one's past (Baddeley, 1990; Brewer, 1996; Fivush, Haden & Reese, 1996). The autobiographical memory system includes *specific memories* (e.g., the first time I met my husband), *general events* (e.g., going to movie), *life-time periods* (e.g., university years) and *memory of autobiographical facts* (e.g., knowing your birthday) (Brewer, 1986; Conway, 1996; Conway, 2005; Conway & Pleydell-Pearce, 2000; Conway & Rubin, 1993). This thesis will focus on retrieval processes in autobiographical memory. First, I will investigate the prevalence of direct retrieval when participants are presented with generic (e.g., object terms) and personal (e.g., names of friends) cues. Next, how cue repetition influences retrieval from autobiographical memory will be studied.

If someone asked why autobiographical memories are important, the basic answer would be that living a normal life is unthinkable without using or remembering past experiences. This idea becomes more obvious when we consider the disturbances (e.g., amnesia) which cause people to lose their ability to remember their memories. Autobiographical memories provide an extensive database for one’s past experiences. In that sense, autobiographical memories are important for people to understand themselves, other people, and the world, and to develop and maintain a coherent life story and identity (Rybash, 1999). The autobiographical memory system enables us to mentally relive past experiences. Therefore, we know that a current mental state represents an episode of a previously experienced event (e.g., Klein, 2001; Tulving, 1993, 2002). We also remember past events as belonging to our present self. This is how the self is represented as a coherent entity (e.g., Howe & Courage, 1997; Klein, 2001; Klein, J. Loftus, & Kihlstrom, 2002; Nelson, 1997). Research specifically concerned with identifying the functions of autobiographical memory also demonstrated that autobiographical memory is essential to one’s sense of self (Bluck & Levine, 1998; Brewer, 1986; Rybash, 1999). In addition, it appears that these memories are used to guide present and future behaviors (Pillemer, 1998; Rybash, 1999) and to develop, maintain, and foster our social relationships (Cohen, 1998; Nelson, 1993, Pillemer, 1998; Rybash, 1999).

Autobiographical memory is also important in many aspects of daily life (Reiser, Black & Abelson, 1985) because remembering personal experiences is one of the fundamentals of many cognitive processes such as learning, comprehending, planning, and problem solving (Kolodner, 1983; Mace, 2010; B. H. Ross, 1984; Schank, 1982). For example, in order to make sense of a conversation with a friend we often need to access our past experiences. Many other cognitive processes (e.g. problem solving) may involve the same or similar mental activities as when we try to retrieve a past experience (Kolodner, 1983; Mace, 2010; B. H. Ross, 1984; Schank, 1982). Therefore, understanding autobiographical memory is also important in understanding cognition in general.

Memory processes involves three stages: encoding, storage, and retrieval (Melton, 1963; Roediger & Guynn, 1996). Autobiographical memory processes also follow these steps. We encode our life experiences, and encoded information creates memory traces that persist over time (i.e., storage). Finally, we access these memory traces via retrieval processes. Encoding, storage, and retrieval influence each other and are all important in understanding memory. However, as pointed out by many researchers, retrieval is the essential process of memory because without retrieval processes memories cannot be brought to consciousness, and remembering cannot take place (Bartlett, 1932; Köhler, 1947; E. F. Loftus & G. R. Loftus, 1980; Mace, 2010; Melton, 1963; Neisser, 1967; Roediger, 2000; Roediger & Guynn, 1996; Tulving, 1991). Furthermore, autobiographical memories cannot be understood and identified in the absence of retrieval processes (e.g., see Roediger, 2000; Tulving, 1991 for similar arguments).

Studying retrieval processes in autobiographical memories is important because the act of retrieval may tell us how memories are represented and structured. The debate about the nature of memory representation and corresponding retrieval processes has a long history in psychology (Berntsen & Rubin, 2008). One argument in the ongoing debate about the nature of memory representation and retrieval processes is that retrieving an autobiographical memory is a reconstruction of events from fragments of personal knowledge (e.g., Bartlett, 1932; Conway & Pleydell-Pearce, 2000; M. Ross & Conway, 1986; M. Ross, McFarland, & Fletcher, 1981). The opposite view suggests that retrieval is an associative reactivation of pre-stored memory traces (e.g., Bertnsen, 2010; Neisser, 1967). This reconstructive/associative process distinction has certain implications, both for theories of how memories are represented and organized and for those aspects of everyday life in which memory is used. To take a real-life associative recall example, when we experience an event, an earlier event that has been processed in a similar way may, sometimes, come to our mind (i.e., reminding) (B. H. Ross, 1984; Schank, 1982). For instance, the site of a red Toyota at an intersection reminds you of a Toyota seller you met earlier the same morning. Based on diary studies, Bertnsen (2007) states that involuntary memories (i.e., autobiographical memories that come to mind without a conscious retrieval attempt) occur three to five times in a day. Occurrences of involuntary recollections and remindings suggest existence of pre-stored event representations and emphasize associative mechanisms in retrieval. Associative mechanisms are also of considerable interest in understanding dysfunctional side-effects of memory such as rumination (i.e., repetitive thoughts about bad feelings and experiences from the past such as consequences associated with failure, correction of mistakes) and intrusive memories (i.e., unbidden mental images of a traumatic event including sights, sounds, feelings and bodily sensations associated with the event such as an image of a brother's face before a car crash) observed in post-traumatic stress disorder (PTSD). The effects of rumination on negative mood have been, for example, explained by associative processes (Bower, 1981, 1991; Clark & Isen, 1981; Ingram, 1984; Lang, 1984; Teasdale, 1983). Emotions are assumed to be basic organizational units that connect causally related information. When an emotion node is activated, past events associated with that emotion are also activated (Bower, 1981, 1991). Rumination, therefore, is thought to intensify emotions and enhance the activation spreading to the associated experiences. Berntsen (2010) also argues that associative recall is the basic mode of remembering and intrusive memories are produced by the same associative mechanisms that create involuntary memories in daily life. In other words, associative recall manifests its dysfunctional side effects and produces involuntary traumatic memories (i.e., intrusive memories) when applied to extremely negative situations such as PTSD.

In contrast, some other memory phenomena emphasize reconstructive retrieval processes and the erroneous nature of memories (e.g., Roediger, 1996; Schacter, 1995). A number of studies in the field of false memories (E. F. Loftus, 1996; 2005; E. F. Loftus & Ketcham, 1994; Zaragoza, Belli & Payment, 2007) showed that what an individual recalls from the past can be misguided by a variety of factors. In the misinformation paradigm, for example, participants get suggestive information about an experienced event. Some participants integrate the suggestive information into their memories and develop some false details (e.g., Bruck, Ceci, & Hembrooke, 2002; E. F. Loftus, 2005; Sutherland & Hayne, 2001). In some child sexual abuse cases, misleading interview techniques led the children to incorrectly remember that they were sexually abused (e.g., Garven, Wood, Malpass, & Shaw, 1998). As noted above, the main theoretical framework of false memory research is the notion of reconstructive memory (e.g., Bartlett, 1932). This framework suggests that our memories are reconstructed from different parts of information retrieved based on available cues. The false memory effect occurs because suggestive information is incorporated into the memory for the event during a reconstructive process. The idea that autobiographical memory is reconstructed from fragments of personal knowledge is proposed by some other researchers (Bluck, Alea, & Demiray, 2010; Bluck & Habermas, 2000; Burgess & Shallice, 1996; Conway & Pleydell-Pearce, 2000; J. M. G. Williams et al., 2007).

Involuntary traumatic/non-traumatic memories and remindings in real life reflect associative processes and pre-stored memory traces. An alternative view of memory as a reconstructive process is also supported by the literature. Then the issue becomes when retrieval is reconstructive and when it is not, and how retrieval processes operate in each case. I believe that studying retrieval processes is important in elucidating the distinct characteristics of the associative and reconstructive memory processes and in accounting for how personal memories are represented, structured, and organized.

When studying retrieval processes, it is also essential to consider the properties of the retrieval cues. An important principle of retrieval is that to access a memory there should be some type of information in the retrieval process that matches information in the target memory (Norman & Bobrow, 1979; Tulving & Thompson, 1973). This is referred to as a *cue*. The effect of a cue is to cause activation in the autobiographical memory knowledge-base. This activation or its spread to other units mostly determines the contents of the retrieval process and which memory is accessed (Collins & E. F. Loftus, 1975). Thus, studying the relationship between cues and the retrieval process (e.g., which factors influence cue-activation patterns) is important to understand how incoming environmental information is integrated with the memory traces and is used to access stored information (Tulving & Thompson, 1973).

Exploring the relationship between cue properties and retrieval effectiveness was also emphasized in several studies conducted with patients with frontal lobe impairments (see Baddeley & Wilson, 1986; Crovitz, 1986) and patients with emotional problems such as depression (see J. M. G. Williams & Scott, 1988) or post-traumatic stress disorder (McNally, Litz, Prassas, Shin, & Weathers, 1994). These studies indicated that these patients have difficulty in accessing specific memories. This research also showed that these patients' deficiency in accessing specific memories is associated with impaired problem-solving skills and impaired ability to imagine the future (Evans, J. M. G.

Williams, O'Loughlin, & Howells, 1992; Goddard, Dritschel, & Burton, 1996; J. M. G. Williams, Ellis, Tyers, Healy, Rose, & MacLeod, 1996). These researchers acknowledge that investigating the role of cues in retrieving autobiographical memories is important to figure out how this deficit in accessing specific memories comes about and how it is related to other cognitive functions such as problem-solving.

As noted above, autobiographical memories enable people to orient themselves in time and space, form their identities, and learn from their experiences. While doing all this, memory works adaptively. For example, human cognitive system selectively uses memories in situations when they are relevant and it inhibits them in situations when they become irrelevant (M. C. Anderson, 2003; Bäuml & Samenieh, 2012; Levy & M. C. Anderson, 2002; Rasmussen & Bertnsen, 2009). Studying the conditions under which retrieval is facilitated or inhibited is important in understanding how memory operates effectively in real life. This type of research has also implications for remembering unpleasant experiences such as traumatic memories.

In sum, characterizing the ways in which autobiographical memories are retrieved and how different cueing conditions influence these processes is important in understanding how autobiographical memories are represented, structured, and organized, how people utilize or fail to utilize cues to access their past experiences, and how cues sometimes remind people of things they would not want to remember. Finally, studying the conditions under which memory access is limited or facilitated helps us to understand the selective and adaptive nature of memory retrieval in life. The primary objective of this thesis is to understand the retrieval characteristics of autobiographical memory. More specifically, I want to investigate how different cueing conditions (i.e., word cues versus real-life cues, cue repetition) influence retrieval from autobiographical memory.

First, I will provide a brief review of the literature on retrieval processes in autobiographical memory. Next, Uzer et al.'s (2012) research[1], which was conducted to empirically demonstrate the prevalence of directly retrieved autobiographical memories on a word-cue task (see Uzer et al., 2012 for further details regarding those studies), and its implications will be discussed. This will be followed by an outline of the dissertation and a set of assertions sketching the importance of its contributions.

The traditional view suggests that remembering a specific experience always requires a search activity and that people employ some retrieval strategies to guide their search. Most memory models have also attempted to identify these search strategies used in memory retrieval (Reiser, Black & Kalamarides, 1986; Norman & Bobrow, 1979; Whitten & Leonard, 1981; M. D. Williams & Hollan, 1981). According to this dominant view, retrieval begins by describing the target information and determining some verification criteria. Next, candidate memory representations are selected. In the third phase, the selected memories are evaluated against the verification criteria. The search is terminated when a memory that satisfies the criteria has been found. Following this account, Conway (1996, 2005) also argues that autobiographical memories are temporary mental representations which are reconstructed through an effortful search process. He suggests that voluntary retrieval demands executive functions (e.g., *working-self*) that control the memory reconstruction process and inhibit irrelevant information.

Generative retrieval is also emphasized by word-cueing laboratory studies (S. J. Anderson & Conway, 1993; Conway, 1990; Conway & Bekerian, 1987; Haque & Conway, 2001; Larsen & Plunkett, 1987; Robinson, 1976). In these studies, each participant is presented with one cue word (e.g., pencil) at a time and instructed to recall a specific autobiographical memory related to the cue word (Conway, 2005; Conway & Loveday, 2010; Haque & Conway, 2001). For example, Haque and Conway (2001) paused the retrieval process by displaying the word "REPORT" at different times (2 sec, 5 sec and 30 sec) while the participant was recalling a memory in response to a cue word. They then asked the participant to indicate what was in his/her mind at that time. They also measured how long it took to recall a memory. They found that on rare occasions (8%) participants reported specific autobiographical memories in a very short duration (~ 2 sec). The authors regarded these instances as *direct retrievals* and argued that such fast retrieval times exemplify instances of direct recollections, where a cue (internal or external) directly activates episodic memories and related conceptual knowledge. Based on these data, they asserted that generative retrieval occurs more than 90% of the time when people are cued with single words.

In contrast, psychologists who study involuntary recall focus on direct retrieval, which occurs when there is a direct access to the event memory. Involuntary memories are spontaneous recollections of the past without any conscious effort to recall. Berntsen (1996,1998), who first explored involuntary memories systematically, introduced a structured-diary method. This method requires each participant to carry a small notebook at all times during the study period and to record information about involuntary memories when they occur. Although deliberate journaling raises questions about the validity of the involuntary nature of those recollections, results produced by this method are surprisingly consistent. For example, Berntsen (1996) reported that all subjects (14 Danish students) experienced more than two involuntary memories on a normal day. She noted that all recorded memories had identifiable cues and that most were memories of recent, distinctive, emotionally positive events. She also asked participants whether the involuntary memories that they reported had occurred to them before. Frequency of prior occurrence was generally low. For instance, 73% of memories were rated as “never” or “seldom”.

Another noteworthy involuntary memory study was conducted in a laboratory test by Schlagman and Kvavilashvili (2008). In this task, a participant was supposed to detect vertical lines among horizontal lines and spontaneously record involuntary memories if any occurred to them. The authors found that only four out of 37 participants did not report any involuntary memories during the task. Most of the memories that were elicited in this undemanding vigilance task were also memories of specific instances, and their retrieval times were quite fast (M = 5.06 sec; SD = 3.86 sec).

In sum, work on involuntary memories has shown that internal and external cues can sometimes generate the spontaneous and effortless retrieval of specific autobiographical memories, and these involuntary recollections are present in people's everyday lives (Berntsen, 1996, 1998, 2007, 2009; Berntsen & Hall, 2004; Berntsen & Rubin, 2002; Mace, 2006; Schlagman & Kvavilashvili, 2008).

Although both direct and generative retrieval forms[2] are specified in the AM literature, the question of the extent to which these two retrievals are prevalent in recalling autobiographical memories is still an empirical one. Frequency of direct and generative retrievals is an important issue because it affects our understanding of autobiographical memory structures. For example, if direct retrieval occurs frequently when recalling autobiographical memories, this implies more stable event representations and close associations between these representations and underlines horizontal-base structures and associative processes in autobiographical memory.

Word-cueing experiments have commonly used retrieval times (RT) to study retrieval processes. The prevalence of directly retrieved and generated autobiographical memories also affects the way RTs in these experiments are interpreted. For example, the literature includes several experiments that compared object terms (e.g., BOOK) to emotion terms (e.g., HAPPY; Conway & Bekerian, 1987; Fitzgerald, 1980; Larsen & Plunkett, 1987; Robinson, 1976; Uzer et al., 2012). In each case, memories were retrieved more quickly in response to the former than the latter. There are also experiments demonstrating that retrieval is faster when memories are cued by personal periods (e.g., FIRST WEEK OF PRIMARY SCHOOL) compared with day-to-day activities (e.g., GOING TO

THE CINEMA; Conway & Bekerian, 1987), and faster when cued with day-to-day activities than general action cues (e.g., FINDING A SEAT; Reiser et al., 1985). These researchers generally use retrieval times to select between competing representational schemes. For example, Conway and Bekerian (1987), and Larsen and Plunkett (1987) concluded that emotions are unlikely to structure memory because it takes more time for people to retrieve personal memories when they are cued by emotion terms than when they are cued by object terms. This claim is based on the notion that memory generation is the only retrieval process and it is easier and faster when a cue provides access to associative links that lead to a related memory than when the cue must be reformulated or embellished before the relevant links can be accessed.

Although it is conventional to interpret retrieval times as an index of the effort required to generate a set of effective retrieval cues, there is another way to approach these data. This alternative approach, the *dual-strategies* theory, accepts that a generation process is sometimes required to retrieve autobiographical memories. However, it recognizes that autobiographical memories can also be directly retrieved when people respond to experimenter-provided retrieval cues. In this view, mean RT reflects a frequency-weighted blend of two types of responses: fast responses, which occur when a memory is directly recalled; and slow responses, which occur when generation or reconstruction is required.

The possibility that participants use both retrieval strategies complicates the interpretation of the RT differences obtained in cued-retrieval studies (Lee & N. R. Brown, 2004; Siegler, 1987, 1988). It could be that the standard interpretation is correct and that RT differences occur because generation is more difficult under some conditions. However, for this to hold true, it would also have to be true that (a) generation is equally common in both conditions and that (b) direct retrieval, when it does occur, is no faster in one condition than the other.

Of course, if the dual-strategies position is correct, this is only one of several possibilities. For example, it could be that the proportion of (fast) direct responses and (slow) generative responses differs across conditions. Or it could be that the generation speed (and/or direct-retrieval speed) and strategy mix differ between conditions. The only way to select between these possibilities is to determine, for each condition of interest, the percentage of directly retrieved memories and generated memories and assess the time associated with the two retrieval strategies in different cueing conditions.

Uzer et al. (2012) conducted three experiments to (a) assess the frequency of direct and generative retrieval in a word-cue task, (b) determine if there is a relationship between cue type and the frequency of direct retrieval, and (c) link RT differences between cue-types to differences in the prevalence of direct and generative retrieval. In each experiment, RTs were collected and information obtained about the prevalence of direct and generative retrievals from participants as they recalled autobiographical memories in response to object and emotion terms.

In Experiment 1, three process-based measures were collected: retrieval times, concurrent verbal protocols, and post-retrieval strategy reports. Specifically, in each trial, each participant (25 females, median age = 20; 15

males, median age = 21) was presented with a cue word, either an object term (e.g., BAG) or an emotion term (e.g., HAPPY), and was required to think aloud (i.e., to provide a concurrent verbal protocol) as he or she attempted to recall a related autobiographical memory. RT was measured from the onset of the cue word until the participant signaled that s/he had a suitable memory in mind. A strategy report was obtained by asking the participant, at the end of each trial, whether the recalled memory had come “immediately to mind.”

Experiment 2 was conducted to eliminate potential task demands and reactive effects sometimes associated with the protocol method. In this experiment, RTs (but not verbal protocols) were collected and a modified strategy menu was used. More specifically, participants (151 females, median age = 18; 149 males, median age = 18) assigned to the *direct-only* condition were asked to decide whether the recalled memory had come immediately to mind or not. Participants in the *generation-only* condition were required to decide whether they had to search to find the memory or not. Finally, participants assigned to the *direct-and-generative* condition were presented with direct and generative retrieval alternatives and additionally with the “other” option to cover alternative possibilities. Then they were asked to choose which one represented the most appropriate alternative for them.

In Experiment 3, descriptions implying time and effort to identify retrieval strategies were avoided. Specifically, in this experiment, memory retrieval was classified as generative if the cue word itself had not elicited the memory and the participant had to use additional information to retrieve the target memory. In contrast, memory retrieval was characterized as direct if the cue word alone had triggered the memory without using any additional information. Therefore, in Experiment 3 (112 females, median age = 18; 90 males, median age = 19), participants in the *direct-menu* condition were presented with the following statement: “This memory was triggered by the cue word so I did not have to use information about my life to help me recall this memory.” Participants were supposed to press the “Y” key to indicate that the memory was evoked by the cue word alone without using additional information, implying direct retrieval, or the “N” key to indicate that they had to use additional information to recall the memory, implying generative retrieval. Participants assigned to the *generation-menu* condition were presented with the reversed statement: “This memory wasn’t triggered by the cue word so I had to use information about my life to help me recall this memory.” In this group, “Y” responses would imply generative retrieval, and “N” responses would indicate direct retrieval.

The Uzer et al. (2012) study made it possible to determine whether the cue-type effect observed in prior studies (Conway & Bekerian, 1987; Fitzgerald, 1980; Larsen & Plunkett, 1987; Robinson, 1976) was caused by differences in retrieval strategies. For instance, if generation dominates retrieval, as is commonly assumed, then an analysis of strategy usage should indicate that participants used a generative strategy on almost all trials. And if this experiment replicates the standard cue-type effect, then participants should respond more slowly when they generate memories in response to emotion terms than when they respond to object terms. In contrast, if the dual-strategies position is correct, the strategy-usage analysis should indicate that direct retrieval is at least fairly common. In other words, the dual-strategies position predicts that participants would make use of both direct retrieval and generation strategies. As noted above, this position is capable of accounting for the cue-type effect in several different ways (i.e., direct retrieval is more common when the cues are objects; generation is slower when the cues are emotion terms; etc).

Across three word-cueing experiments, Uzer et al. (2012) found that autobiographical memories were recalled by two different retrieval mechanisms. The fast and direct retrieval route seems effortless, associative, and non-strategic. The slower, generative route includes searching memory for task-relevant information (Fig 1, Fig 2). Importantly, Uzer et al. (2012) also found that direct retrieval (57%) was at least as common as generative retrieval (43%). This finding argues against the commonly held belief that personal memories are usually generated in studies that use the Crovitz word-cueing task (Conway & Pleydell-Pearce, 2000; Haque & Conway, 2001; Rubin, 1998; Rubin & Schulkind, 1997a, 1997b; cf. Conway, 2005, Reiser et al., 1986). Across these experiments, Uzer et al. (2012) also replicated the classic cue-type effect (Fig 3): on average, participants were slower at retrieving autobiographical memories when they were cued with emotion rather than object (Conway & Bekerian, 1987; Fitzgerald, 1980; Larsen & Plunkett, 1987; Robinson, 1976). Uzer et al. (2012) were able to decompose this effect. Participants were more likely to use the direct-retrieval strategy when they were cued with objects than with emotions (Fig 4).

Figure 1. *Median reaction times by retrieval strategy*

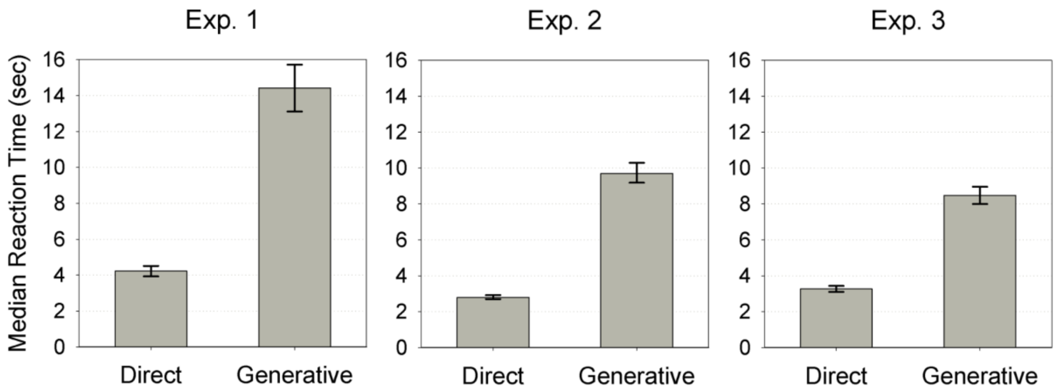


Figure 2. *Reaction time frequency distributions (top) and cumulative distributions (bottom)*

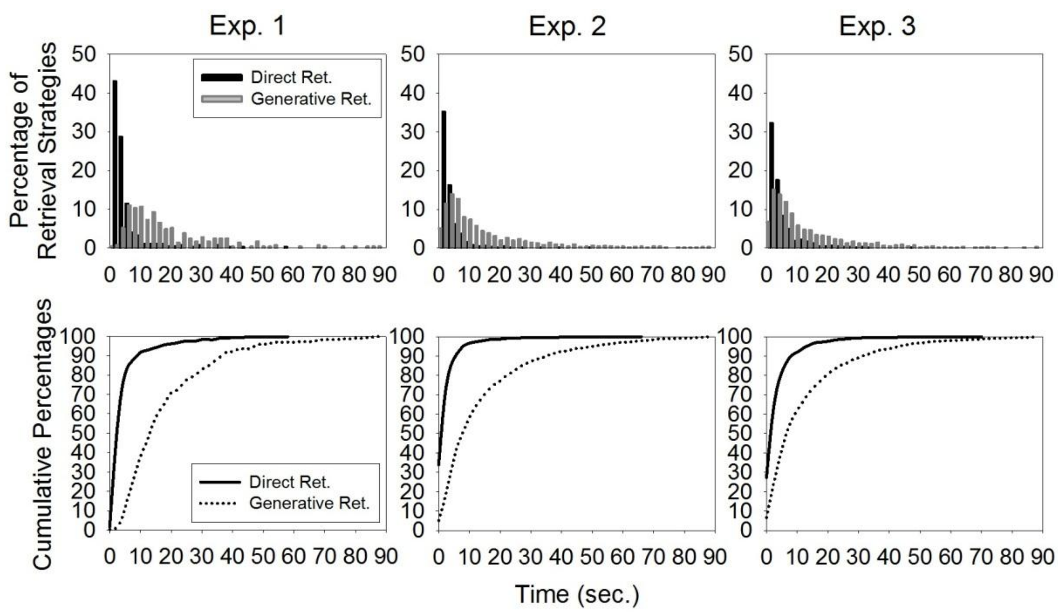


Figure 3. *Median reaction times by cue type*

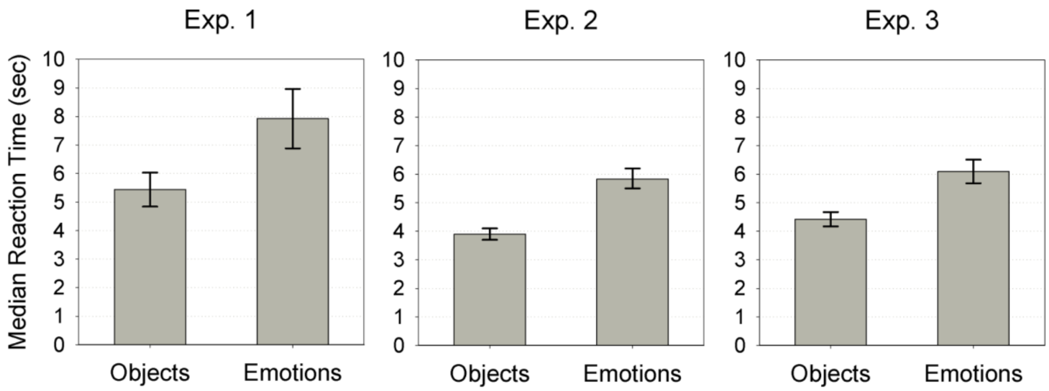
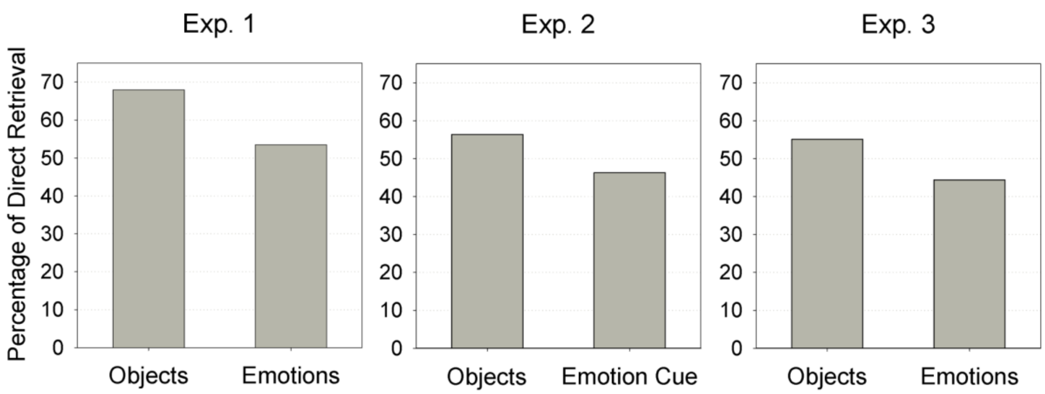


Figure 4. *Percentage of direct retrieval by cue type*



Verbal protocol data in Experiment 1 were also consistent with these results. These data were analyzed in two ways. First, a team of coders, who were blind to participants' strategy responses, listened to each verbal report and judged whether memories had been directly retrieved or generated. Then these judgments and participants' own reports were compared. The result indicated that participants were capable of answering the response strategy questions reliably, and that their verbal protocols accurately reflected their strategy reports (*Kappa* = .82). Next, the protocols were examined to define how the content of the verbal reports differed as a function of the participant's self-reported retrieval strategy

(Table 1). Verbal protocol data supported the contention that direct retrieval typically occurs with an absence of overt thinking. Conversely, generative retrieval is very likely to involve vocalizations associated with memory search, cue elaboration, and/or the use of additional task-relevant information (Table 2).

Table 1. *Examples of Categorized Protocol Responses*

Vocalizations Indicating Search

Verbalization of search process (cue: FRUSTRATED)

"I'm just thinking about anything that I did in school passed a little while with regards my grades…umm, I'm thinking about work…umm thinking about trips that I want but didn't go on, thinking about things that I wasn't able to attend that I said I would..hmm." (participant then presses the spacebar).

Task-Related Verbalization (cue: SURPRISED)

"Hmm I am not…usually I am not very surprised at things. I am usually prepared for most of the things that happen. Probably at movies but not in real life, so I think" (participant then presses the spacebar).

Utterances (cue: CHAIR)

"Ummm…Hmm…Aaaammm…Ummm, chair, Ok." (participant then presses the spacebar).

Silent/Vocalizations Without Search

Non-verbalization (cue: BORED)

--- (almost immediately after reading the cue word, the participant presses the spacebar).

Verbalization of the reported memory (cue: PILL)

"The last time I took a pill (at this moment the participant presses the spacebar) was last Monday because I had an headache so I took a pill before going to bed".

Stay Silent (cue: FRUSTRATED)

--- (after being silent for a short period of time the participant presses spacebar

Table 2. *Distribution of Experimenter Rated Retrieval Strategies by Participant's Self-Reported Strategies: Omnibus and by Cue Type*

Omnibus	Direct		Generative	
Silent/Vocalizations Without Search	361	(52%)	12	(2%)
Vocalizations Indicating Search	49	(7%)	266	(39%)
Total	410		278	
Object Cues				
Silent/Vocalizations Without Search	202	(58%)	8	(2%)
Vocalizations Indicating Search	28	(8%)	110	(32%)
Total Object Cues	230		118	
Emotion Cues				
Silent/Vocalizations Without Search	159	(47%)	4	(1%)
Vocalizations Indicating Search	21	(6%)	156	(46%)
Total Emotion Cues	180		160	

Uzer et al. (2012) concluded that direct retrieval in a voluntary retrieval task takes place only when a cue (or set of cues) is closely associated with a particular event memory and that the goal of generation is to identify potential useful cues (i.e., cues that might be directly linked to an event memory) when the current cue (or set of cues) fails to directly access an appropriate memory. The prevalence of direct retrieval implies the existence of relatively stable event representations and enduring associations, linking these representations to concepts that ground them in meaning and index them for retrieval. In addition, the cue-type differences in direct-retrieval rates imply that event memories are more likely to be indexed by concrete information than by abstract concepts such as feelings.

The research conducted by Uzer et al. (2012) narrows the theoretical distance between voluntary and involuntary memory and indicates that both are also often accessed directly. On this view, what distinguishes voluntary from involuntary memories is that in the former, generation process is engaged if the initial cue fails to evoke an accessible response, whereas in the latter, memories are only directly retrieved.

On the other hand, these finding appear to be inconsistent with the strong reconstructive assumptions that underpin Conway's SMS model (Conway & Pleydell-Pearce, 2000; Haque & Conway, 2001). The SMS theory assumes that event retrieval requires a top-down search through an autobiographical knowledge-base and that event memories are assembled (in response to task demands) from active retrieval indices and fragments of associated event-specific knowledge. Instead, this study provides evidence that supports Barsalou's contention that "an event [memory] can be retrieved directly with a wide variety of cues" (1988, p. 229). Likewise, these data are in line with Berntsen and Rubin's (2004) observation that "memories cued by neutral words … [can be] brought to mind via an associative, nonstrategic search process" (p. 430).

In summary, Uzer et al.'s (2012) research provides strong support for the existence of pre-stored event representations and suggests that these representations are very common. The current view of autobiographical memory emphasizes hierarchical organization and some type of top-down search activity among these hierarchical units (Conway, 2005; Conway & Pleydell-Pearce, 2000). Other views emphasize horizontal structures within an autobiographical memory organization (Barsalou, 1988; Belli; 1998; N. R. Brown & Schopflocher, 1998a, 1998b; Neisser, 1981) as well. Nevertheless, most of these pro-hierarchical and pro-horizontal views agree that autobiographical memories are grouped together and represented under some type of organizational units. For instance, Barsalou (1988) uses an "extended-event time line," Reiser et al. (1986) use "era," and Conway (2005) uses "lifetime periods" to explain the organization of event groups that share the same time period. Thomsen & Berntsen (2008) combine temporal and thematic co-occurrence among events and term this organizational unit as *life chapter*. Several researchers have also noted that repeated event sequences are represented together in autobiographical memory as "summarized events" (Barsalou, 1988), "repisodes" (Neisser, 1981) or "general events" (Conway, 2005). In my opinion, the prevalence of direct retrievals found in the research of Uzer et al. (2012) underlines horizontal-base structures and associative processes in autobiographical memory.

The prevalence of directly retrieved autobiographical memories in a word-cueing experiment invites the question of whether direct retrieval phenomenon is generalizable beyond the standard laboratory paradigm. It is important to extend this cue-word study with personally relevant cues, because outside of the lab we retrieve autobiographical memories in response to real-life stimuli (e.g., people and objects) found in our surroundings rather than in response to random words (Berntsen, 1996, 1998, 2007; Hintzman, 2011; Mace, 2007; Neisser, 1985). Hence, the first thing I do in the current project is to assess the prevalence of direct retrieval given personally relevant cues. In part, the purpose of this effort is to contribute to the development of a new approach to autobiographical memory organization, *Transition Theory* (N. R. Brown, Hansen, Lee, Vanderveen, & Conrad, 2012), and to link this approach with retrieval processes that associate event memories with their constituents.

According to Transition Theory, people, places, activities, and objects are the main features of an individual's experience. These components provide the content and context for personal memories. Therefore, these event components form the building blocks of autobiographical memory structure, and can be regarded as one form of basic organizational unit in the autobiographical knowledge base. As a basic unit, each component is linked to a rich set of specific memories, generic memories, factual knowledge about people, places, activities and objects, and temporal knowledge. These event components, specific experiences, generic memories, temporal knowledge, and other pieces of information are associated with each other so that episodic memories, life-time periods, and general events are formed and conceptually represented in the autobiographical knowledge-base. They also have counterparts in the literature:

Linton (1986) labels them as "elements" and Barsalou (1988) calls them "exemplars."

How might such a representational schema stated above be related to direct retrieval? If direct retrieval implies a close connection between the cue and the retrieved event, and if the event components, which define the content of every autobiographical event, are the basic units of autobiographical memory, then we would expect a substantial amount of directly retrieved memories in response to those personal event components. Furthermore, we would expect an increase in the proportion of direct retrievals among memories cued by some idiosyncratic component cues (e.g., MY COFFEE MUG) as compared to those cued by generic concept cues (e.g., CUP).

Chapter II presents three studies comparing the proportions of direct retrievals among real-life cues and word cues. These studies provide evidence that direct retrieval is even more common when people are tested with personally-relevant cues than when they are tested with object terms. The prevalence of directly retrieved autobiographical memories in the present study together with the previous research of Uzer et al. (2012) raises questions about why direct retrieval has been previously unrecognized or underestimated. The results also suggest that theories on the organization of autobiographical memories that emphasize hierarchical structures (e.g., SMS model) need to be re-considered. In contrast, the results support autobiographical memory approaches, which identify event components as central event units and emphasize associative retrieval processes (e.g., Barsalou, 1988; Belli, 1998; N. R. Brown et al., 2012; Neisser, 1981).

The frequent occurrence of directly retrieved memories in response to real-life cues also raises interesting questions. For example, how does the human memory system react to repeated presence of the cues that define our familiar surroundings? Results show that direct retrieval is very common in response to real-life cues when each cue is presented one at a time to recall a related personal memory. However, in life, there is a rich and continuous stimulation coming from our environment, and yet our awareness is not flooded by directly retrieved memories. How is that? How does repeated exposure to personally-meaningful cues interact with the human memory so that we are not inundated by directly retrieved memories? Among the responses to this question proposed by the literature are inhibitory mechanisms driven by central executive operators (Conway, 2005), a cue's inability to isolate a particular memory (i.e., insufficient cue-item discriminability) (Berntsen, 2009; Rasmussen & Berntsen, 2009), and not being constantly in a *retrieval mode* (i.e., a mental state that enables the person to perceive the stimulus as a cue to retrieve a past experience) (Tulving, 1983).

Although this issue has been raised before (Berntsen 2009, Conway, 2005; Tulving 1983), to our knowledge, the experiment reported in Chapter 3 represents the first instance of an empirical investigation into how repeated exposure to the same cues impacts the prevalence of direct retrieval. In addition to accounts mentioned above, we also consider the possibility that interference plays an important role in reducing the impact of repeated cues on the direct retrieval of personal memories. For example, it could be that cue repetition decreases direct retrieval because of increased response competition between events associated with the same cue. The results show that the prevalence of direct retrievals falls swiftly as the number of cue repetitions increases. This suggests that interference theory partly explains why human memory is not incapacitated by the flood of memories cued by everyday surroundings.

As a conclusion, this project investigates retrieval characteristics of autobiographical memories under different cueing conditions. First, the cue-word study conducted by Uzer et al. (2012) is extended with personally relevant cues. The results challenge the dominant view in the literature that autobiographical memory retrieval mostly relies on a generation process. Next, how cue repetition affects access to autobiographical memories is demonstrated. This research shows that prompting memories with the same stimuli repeatedly impairs retrieval. This suggests that some type of inhibitory processes (i.e., a passive interference mechanism or an active suppression system) also play a role in determining the accessibility of autobiographical memories. The present cue repetition study raises fruitful research questions related to retrieval blocks in autobiographical memory.

In sum, this thesis research indicates that associative and inhibitory processes work in a complementary manner when people retrieve autobiographical memories. Retrieval from autobiographical memory is, much of the time, a non-strategic and effortless process largely governed by associative mechanisms. If these associative mechanisms worked in a rough fashion, memories would be nonstop and uncontrollable. To avoid a constant flow of memories and maintain cognitive efficiency, inhibitory processes (i.e., interference or active suppression mechanisms) are operating to stop unwanted recollections. This thesis research provided robust evidence for these two processes: (a) autobiographical memories are much of the time directly retrieved in response to word cues and personally relevant cues, and (b) direct retrieval is sharply decreased when autobiographical memories are prompted with the same cue multiple times.

I begin Chapter II by elaborating on two competing approaches (i.e., the SMS theory and Transition Theory) to understand the relationship between the characteristics of autobiographical memory retrieval and cue content. I then test the assumption that real-life cues will prompt a lot of directly retrieved autobiographical memories, and the amount of direct retrievals obtained with those cues will be higher than those obtained with concrete object cues. Chapter III presents the cue repetition study and discusses its implications. Finally, Chapter IV provides an overview of the findings, points out some of the current project’s limitations, and delineates new areas of investigation for future direction.

Chapter II

In the previous chapter, I proposed that direct retrieval is the most common strategy for retrieving personal memories in tasks that employ the Crovitz word-cue method (Crovitz & Shiffman, 1974). For example, an autobiographical memory of getting one's first car springs effortlessly to mind via the cue word "automobile." I also argued that the prevalence of directly retrieved autobiographical memories cued by object terms implies close associations between personal event memories (i.e., autobiographical memory) and concepts that represent objects (i.e., semantic memory).

In the autobiographical memory representation, events typically include participant, activity, location, object, and temporal information (Barsalou, 1988; Lancaster & Barsalou, 1997). These *event components* are the basic features of an autobiographical event, and each component (i.e., the people that we know, the places we frequent, the activities we engage in, and the objects that we use) is likely to be associated with a variety of personal memories. With so many possible events and so many kinds of associated information, a number of questions remain. Is it still easy to access an event memory via these event components? Are event components more efficient at evoking autobiographical memories than generic concepts? Do differences exist among event components in their efficacy to cue autobiographical memories? Chapter II aims to address these questions. Specifically, it presents three studies that examine the frequency of directly retrieved autobiographical memories cued by event components.

Furthermore, Experiment 1 and Experiment 2 compare the proportions of directly retrieved memories cued by event components to those cued by concepts.

As noted in the previous chapter, the prevalence of direct retrieval provides an empirical challenge to the SMS model in its current form and other strongly reconstructive accounts of autobiographical memory (Bluck et al., 2010; Bluck & Habermas, 2000; Botzung, Denkova, Ciuciu, Scheiber, & Manning, 2008; Burgess & Shallice, 1996; Conway, 1990, 2005; Conway & Bekerian, 1987; Conway & Loveday, 2010; Conway & Pleydell-Pearce, 2000; Conway, Singer, & Tagini, 2004; Grysman & Hudson, 2011; Mace, 2007, 2010; Sumner, Griffith, & Mineka, 2011; J. M. G. Williams et al., 2007; cf. N. R. Brown et al., 2012). The present research will also assess the predictions of the current autobiographical memory models (i.e., the SMS theory and Transition Theory) about the relationship between the retrieval process and the cue content.

Understanding the relation between retrieval characteristics and cue content is important because it affects our understanding of how personal events are represented and structured in memory. For example, are memories reconstructed from hierarchically structured knowledge units (e.g., life-time periods, general events) as the SMS model suggests? Or alternatively, are memories directly retrieved from basic components such as people, locations or activities? First, I will review how the SMS theory and Transition Theory, explain how each conceives of the relationship between autobiographical retrieval and cue content, and develop predictions that follow from each theory.

The SMS theory (Conway & Pleydell-Pearce, 2000) does not refer to event components as basic organizational units in autobiographical memory representation. Rather, it proposes that events are represented in an autobiographical knowledge-base at three levels of specificity. At the most abstract level, life-time periods contain information about the goals, locations, evaluations, and activities that were common to that period (e.g., high school years, university period). General event representations include repeated or categorical events (e.g., daily breakfasts) and extended events (e.g., vacations). *Event-specific knowledge* (ESK) is the most specific level of event representation in the autobiographical knowledge-base, which includes all sensory and perceptual properties of the event. The model assumes that retrieval of an autobiographical memory requires a top-down search through the lifetime period, the general event, and ESK levels of the knowledge-base. Thus, for example, to retrieve the episodic memory of “Taking part in a psychology experiment related to estimating the population of some countries,” first, the lifetime period “At University X” might be accessed. Next, “At University X” might access the general event “Taking first year Psychology classes,” which then will bring to mind all images related to the specific experience of “Taking part in a psychology experiment related to estimating the population of some countries.” Recently, Conway (2005) has argued that general event representations are the most common point of entry into the autobiographical knowledge base.

Contrary to in the SMS model, event components are considered central elements of an autobiographical event in Transition Theory (N. R. Brown et al., 2012). The theory proposes that event components (i.e., the who, what, and where of an event) define the content and organization of autobiographical memories. There are two important characteristics of these event components. First, Transition Theory assumes that we know a lot about each component, and that our knowledge of these components is gained through massively repeated exposure. Each event component is linked to a rich mix of specific memories, generic memories, and event-independent facts. For instance, knowledge of a reoccurring activity such as one's daily work routine (e.g., teaching at college) includes information about the layout of the building, the person's regular job duties and responsibilities, information about the person's colleagues, some script-like knowledge of actions related to the profession, and specific memories of some distinctive work experiences.

The theory also assumes that each event component is linked to temporal knowledge. Temporal information is the second important aspect of event components in Transition Theory. Because knowledge for event components incorporates temporal knowledge, these components are termed as *Temporally-Delineated Event Components*, or *T-DEC*s. Temporal knowledge about an event component may include when the event component entered the person's life (e.g., buying a new car), when it terminated (e.g., the car is sold), or whether it is still present.

In addition to identifying T-DECs as central units of autobiographical memory, Transition Theory proposes that autobiographical memory is organized by transitional events. Transitional events refer to occurrences that cause or mark changes in the fabric of daily lives (e.g., people from their lives, the things that they possess and use, the places that they frequent, and activities that they engage in). One important aspect of transitions is that they are graded depending on how extensively they change the fabric of a person's daily life. Some transitions drastically change the fabric of daily life. Consider, for example, the experience of a person who has moved from one region (e.g., Istanbul, Turkey) to a very distant region (e.g., Edmonton, Canada). Clearly a move of this sort can be understood as a major transition because it changes so many things in a person's life. When a person relocates, s/he leaves behind a house, workplace, friends, neighbors, coworkers, shops, restaurants, malls, and other products in the local country, as well as recurring activities related to work and home life.

In contrast to major life transitions, some events bring about some changes but leave many aspects of a person's life unchanged. Becoming a parent, for instance, can be regarded as a minor transition because it brings certain responsibilities and changes into the person's life (e.g., all new activities related to baby care) but leaves many parts of life intact (see N. R. Brown et al., 2012, for a detailed examination of different transition types).

Transition Theory also assumes that transitional events structure life-time periods in autobiographical memory organization. In Transition Theory's terminology, a major lifetime period (e.g., My Canada Period) represents the span of time that falls between major transitions. Each major life-time period consists of a fairly stable set of T-DECs. T-DECs are identified with the period to which they belong, and each major life-time period has largely different T-DECs. Minor transitions, which affect a single or a few aspects of a person's life, also create *themed periods* (e.g., when I was with K.) (see N. R. Brown et al., 2012, for a detailed discussion of life-time periods). In summary, T-DECs are considered as basic units in autobiographical memory. Autobiographical memory is organized by transitions, which mark the end of one life-time period characterized by a fairly stable set of T-DECs, and the beginning of a new lifetime period characterized by a gradual build-up of a new set of T-DECs. I will refer to event component cues as T-DECs in the remainder of this project.

Now I return to the predictions of the two theories about the relationship between retrieval strategies and T-DECs. The SMS theory proposes that generation is the default strategy for retrieving autobiographical memories. On this view, direct retrieval is considered to be exceptional, occurring only when cues directly activate episodic memories (i.e., ESK) (Conway, 2005). The SMS theory predicts that, regardless of cue type (i.e., T-DECs or object terms), generative retrieval should be more common than direct retrieval. SMS theory also argues that regardless of the cue content, generation starts from the life-time period or general event level, with general events assumed to be the preferred level of access into the memory system. After a general event is activated, activation spreads from that general event to its associated ESK. In the SMS model's point of view, neither a T-DEC nor an object term has an initial advantage over the other to access this hierarchy. Therefore, generating memories in response to both T-DECs and object terms should take approximately the same amount of time. Therefore, the SMS theory predicts no difference in RT for T-DECs and object terms.

From Transition Theory's viewpoint, T-DECs are cues that should access personal memories in cueing experiments and in daily life. This claim is also consistent with how involuntary memories are usually retrieved. Involuntary memory studies (Berntsen, 1996, 1998, 2009) indicate that many of the cues that trigger such memories are concrete objects that match particular parts of the memory content (e.g., the sight of a Bon Jovi CD on the desk reminds the person of a memory of a romantic dance accompanied by Bon Jovi's song "Always"). Because T-DECs define the content of autobiographical events, cueing people with their own T-DECs should provide the closest association between cues and the memories they might evoke (Barsalou, 1988). If direct retrieval takes place when a cue is closely associated with a particular event memory, then direct retrieval should be more common when people are cued by T-DECs (e.g., my coffee mug) than when they are cued by object terms (e.g., cup).

Transition Theory also agrees with the *dual-strategies* theory that the goal of generation is to find potentially useful cues (i.e., cues that are closely associated with event memories) when a cue fails to directly access an appropriate memory. From this perspective, the generation process involves transforming generic cues (e.g., CUP) into memory-relevant T-DECs (e.g., MY COFFEE MUG). Thus, presenting an object cue (CUP) should require more generative retrieval than content-specific T-DEC cues (MY COFEE MUG). Transition Theory also predicts that, on average, T-DEC-cued memories should be retrieved faster than object-cued memories because T-DECs elicit more direct retrievals than object terms.

In the following experiments, I first assessed the prevalence of directly retrieved memories with personally relevant cues. Next, I compared the proportions of directly retrieved memories cued by T-DECs to those cued by object terms. Finally, the predictions that follow from the SMS model and Transition Theory were compared. In Experiment 1 and Experiment 2, participants were cued to retrieve autobiographical memories in response to T-DECs and object terms. In Experiment 3, only T-DECs were used to cue autobiographical memories. In each experiment, RTs were measured and information about how memoires were retrieved (direct versus generative retrieval) was collected. The retrieval strategy was assessed by requiring participants on each trial to decide if memories had been directly retrieved or generated.

Experiment 1

First, T-DECs (i.e., people that s/he met frequently, activities that s/he engaged in, and locations that s/he visited regularly) were collected from each participant. Then, on each trial, the participant was shown either an object term (e.g., AUTOMOBILE) or a T-DEC cue (e.g., MY FRIEND JAMES) and required to recall a related autobiographical memory. RT was measured from the beginning of the cue presentation until the participant indicated that s/he had an appropriate memory in mind. At the end of each trial, the participant was asked “How did you retrieve this memory?” and was required to provide an answer by selecting one of two options: "The memory came almost immediately into mind" or "I had to actively search to find the memory."

If the memory is directly retrieved, then RT should be fast, and the participant should confirm that the recalled memory came immediately to mind. Yet if the memory is generated, RT should be slow, and the participant should affirm that s/he had to actively search to recall the memory.

If generation is the dominant form for retrieving autobiographical memories, as commonly assumed by the SMS model, participants should use a generative strategy on most trials. There should be no difference of RTs between T-DECs and object cues because the memory search should take the same amount of time for both cue types.

In contrast, if strategy-usage analyses replicate the findings of Uzer et al. (2012) then direct retrieval should be fairly common. Consistent with Transition Theory's argument, T-DECs should yield a higher proportion of direct retrieval, although the actual prevalence is an empirical question. T-DEC-cued memories should, therefore, be retrieved faster, on average, than object-cued memories.

Method

Participants. Eighty-three undergraduates from the University of Alberta (59 females, *median age* = 18; 24 males, *median age* = 19) participated to receive course credit. Participants were tested individually in a procedure that took 30 minutes.

Procedure. In Phase 1, twelve T-DECs were collected from each participant (i.e., four people that s/he met frequently, four activities that s/he engaged in regularly, and four locations s/he had visited frequently since the beginning of the term). On each trial, the participant was randomly asked to name a person, activity, or location. Participants were instructed to report uniquely identifiable T-DECs (e.g., first and last name of person, a specific activity, or a specific place) and not answer with broad responses such as groups of people, ambiguous descriptions ("e.g., my friend"), vague activities (e.g., "reading"), or vague locations (e.g., "on campus"). Participants were also required to avoid providing their home addresses, and naming immediate family members, university classrooms or labs, and activities related to university such as "attending class." Participants typed their responses into an input field using no more than 15 or 16 words.

In Phase 2, participants were presented with 12 T-DECs and 12 neutral object terms (bag, ball, box, bread, car, cup, dog, pencil, pill, radio, street, and window), one at a time in a random order. Their task was to recall the first specific autobiographical memory that had the following qualities: the memory must be related to the cue; it must involve the participant; the event should have lasted at least a few minutes but no more than a day; it should have occurred at a specific time and place; the event should not describe things that happen on a recurring basis; and the event should be at least one week old. Respondents were asked to recall memories as quickly as possible, and to press the SPACEBAR (stopping the RT timer) as soon as an appropriate memory came to mind.

Immediately afterwards, the participant was presented with the question asking, "How did you retrieve this memory?" and was required to provide an answer by selecting one of two options: "The memory came almost immediately into mind" or "I had to actively search to find the memory" (using counterbalanced keyboard inputs between participants). The former option implies direct retrieval. The latter option, in which retrieval requires conscious effort before memory can be brought to mind, implies generative retrieval. Afterwards, participants typed a brief description of the event at their keyboards. If no memory had come to mind 90 seconds after the cue was presented, the computer terminated the trial automatically and requested that the participant initiate a new trial.

During Phase 3, on each trial, participants were presented with a randomly selected event memory from Phase 2 and were required to date each one as accurately as possible. After initiating a trial, the event description was presented along with two response fields for month and year estimates. For month, participants were asked to type the first three letters of the month, while year responses were reported using a four-digit numerical format. If the participant was satisfied with their answer, they logged their estimate by pressing the ENTER key. Non-responses were not permitted.

Results

First, the frequency of direct and generative retrieval as a function of cue type was computed. By doing this, I wanted to determine whether these data replicated those reported in Uzer et al. (2012). I also aimed to see whether direct retrieval was common for autobiographical memories cued by T-DECs. Next, RT as a function of cue type is examined to determine whether the RT difference between object cues and T-DEC cues was obtained. Then, an RT by retrieval strategy analysis will be reported to compare the retrieval speeds of direct versus generative retrieval. The final section contains an analysis of the content of the memories as a function of their retrieval type.

A coding framework was developed to distinguish between specific and non-specific event descriptions (Table 3). The first category, “Specific events,” includes particular autobiographical events which involved the participant, were less than a day in duration, took place at a specific time and in a specific location, and happened at least a week before the experiment day. The second category is called “Non-specific events.” This category includes extended events (i.e., events that happen over an extended period of time), summarized events (i.e., two or more events of a particular kind such as many occasions of going to movies), and descriptions of life-time periods (e.g., expressions such as “I was in the university,” “That song reminds me my childhood”). The third category “other” includes responses that do not meet any of the two criteria above. A team of coders, who were blind to participants’ retrieval strategy responses and RTs, coded the memories’ content. The degree of concordance between the coders’ judgments was compared. The result was a high level of inter-rater agreement (85%). A consensus decision was reached on disagreed memories after a period of joint discussion. I then removed the responses belonging to the “other” category based on the coders’ final judgments and conducted RT and frequency analyses on specific and non-specific memories.

Table 3. *Examples of Memory Contents*

Specific Memories

(cue: DOG)
" When I got scratched by a dog. "

(cue: CAMERON LIBRARY)
" When I warned the girl who was listening to music very loudly in the study room."

Non-Specific Memories

Extended Events (cue: CAR)
"Learning to drive with my dad."

Summarized Events (cue: BALL)
" Soccer practice every day till the end of my high school career. "

Life-Time Periods (cue: GEORGE)
" My preschool years with George. "

Unacceptable Responses (Other)

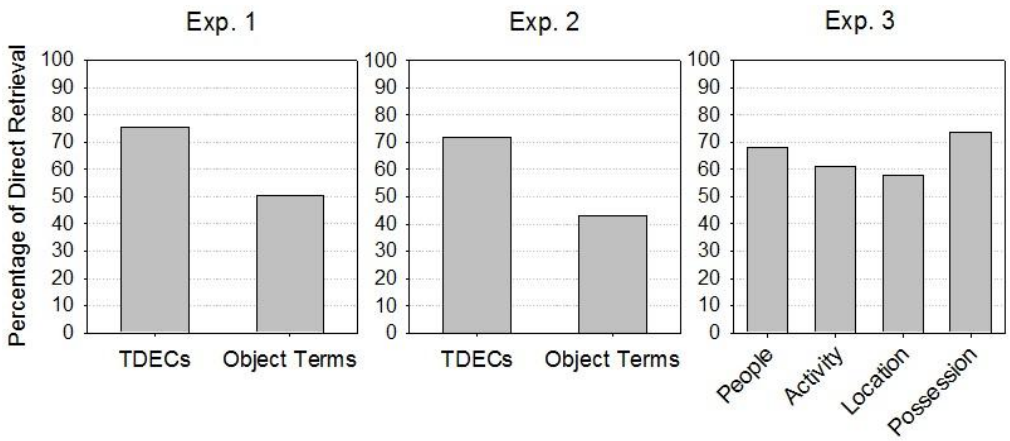
(cue: ROSE)
" My friend from Lister Center. "

(cue: RADIO)
" Alarm clock "

Thirty-seven trials failed to elicit memories within the 90-second time limit. Removal of unacceptable responses (*N* = 201) resulted in 1791 useable trials (1489 specific and 302 non-specific memories). To eliminate extreme outliers, RT values more than 2.5 standard deviations above or below the mean were also removed, leaving a total of 1657 (1407 specific and 250 non-specific memories) analyzable trials. The graphs report median RTs, and 95% confidence intervals around the medians[3] calculated based on Bonett and Price's (2002) centrality estimator. However, to draw statistical inferences from the data, RT values were log-transformed to deal with positively skewed distributions. I then fitted linear mixed-effects models (LME) using cue type (i.e., T-DEC and cue word), memory content (i.e., specific and non-specific), and retrieval strategy (i.e., direct and generative) as fixed factors, and participants and cues as random factors. Because inferences based on t or F-distributions (and their associated degrees of freedom) do not apply to LME models, only the relevant beta weights and probability values will be reported throughout this paper. P-values were bootstrapped using Markov Chain Monte Carlo (MCMC) simulations (*n* = 10,000). All main effects, and two-way and three-way interactions were examined using a stepwise variable elimination method. Taking this approach allowed the variation in random effects to be disambiguated from variation in the fixed effects. This meant that a particular T-DEC, a cue word, or a participant eliciting more direct retrieval than others have been controlled for. Using an LME model fitting also permitted to make legitimate comparisons across all three experiments.

Strategy Prevalence and Cue Types. Consistent with the findings of Uzer et al. (2012), memories cued by objects were directly retrieved most of the time (Figure 5). This argues against the traditional view that generation is a default strategy for recalling autobiographical memories in word cueing experiments.

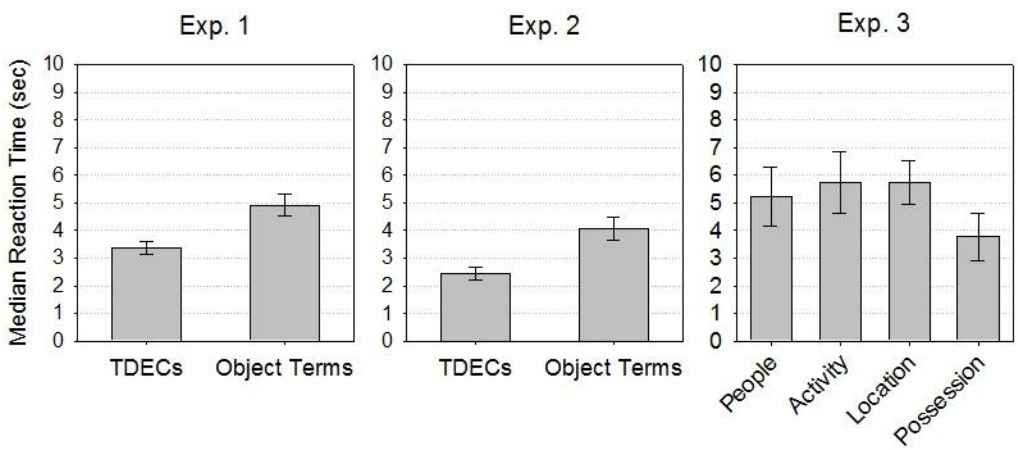
Figure 5. *Percentage of direct retrieval by cue type*



I also analyzed whether memories cued by T-DECs were more likely to be directly retrieved than those cued by objects. As can be seen in Figure 5, T-DECs (76%) elicited more direct retrieval than object cues (50%). A main effect of cue type was confirmed using a mixed-effects logistic regression ($b = 1.246$, $z = 6.23$, $p < .001$). Post-hoc comparisons also indicated that there was no difference among directly retrieved autobiographical memories cued by people -(79%), location- (77%), and activity- (71%) type T-DECs ($p > .05$). These results extend the findings of Uzer et al. (2012) with personally relevant cues. They also support the Transition Theory's argument that T-DECs determine the content of autobiographical events and are consistent with the notion that these cues should be particularly effective.

Cue Types, Retrieval Strategy, and RT. Memories cued by T-DECs (*MD* = 3.38s) were recalled 1.5 times faster than those cued by objects (*MD* = 4.92s; Figure 6). The result of the LME analysis indicated a main effect of cue type on RT ($b = 0.13$, $p < .001$). This is consistent with Transition Theory's predictions and inconsistent with the SMS model. Memories cued by people (*MD* = 2.95s) were retrieved significantly faster than those cued by activities (*MD* = 3.77s; $b = 0.14$, $p < .01$). However, RT for memories cued by locations (*MD* = 3.44s) did not differ from RTs for memories cued by people and activities ($p > .05$).

Figure 6. *Median reaction times by cue type*



Analysis of the strategy reports showed that direct retrieval (*MD* = 3.00s) was 2.5 times faster than generative retrieval (*MD* = 7.66s; $b = 0.88$, $p < .001$), as illustrated in Figure 7. Figure 8 shows the frequency distributions and cumulative distributions for RTs as a function of retrieval strategy. These data indicate that the speed of directly retrieved and generated memories is characterized by two different distributions, albeit with some degree of overlap. This in turn suggests that the participants were able to distinguish memories that spring immediately to mind from those for which they had to actively search.

Figure 7. *Median reaction times by retrieval strategy*

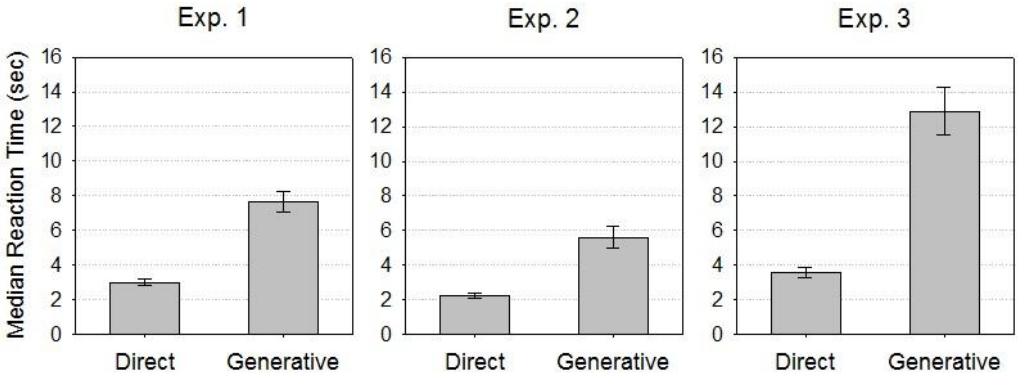
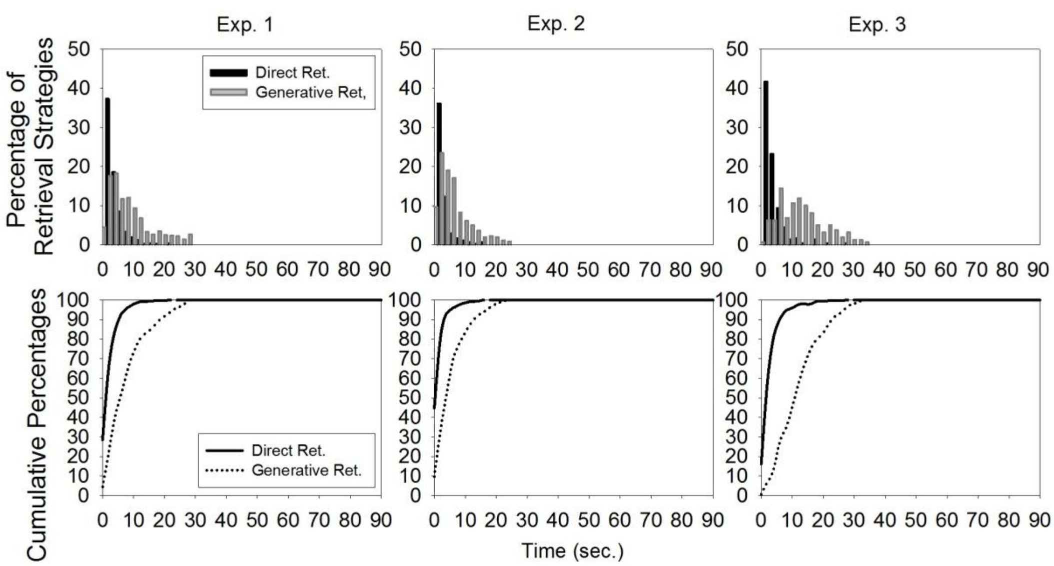
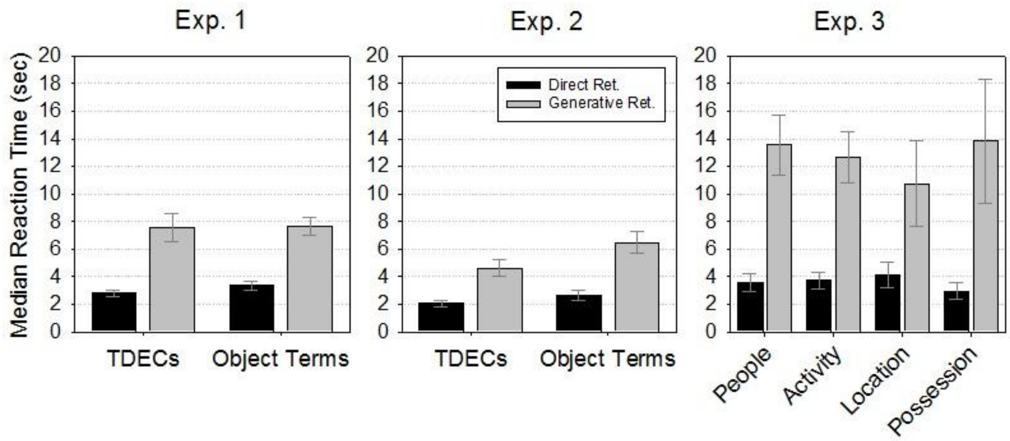


Figure 8. *Reaction time frequency distributions (top) and cumulative distributions (bottom)*



According to Transition Theory, a higher rate of directly retrieved memories cued in the T-DEC condition than the word cue condition accounts for the RT difference between T-DECs and object terms. The LME analyses indicated that there was no significant interaction between cue type and retrieval strategy (p >.05). Direct retrieval, when it occurred, was equally fast for both T-DECs and object cues. Likewise, generated memories were equally slow under each cueing condition. The absence of a difference in the speed-of-generation implies that generation is no more difficult when memories are cued by objects than T-DECs (Figure 9).

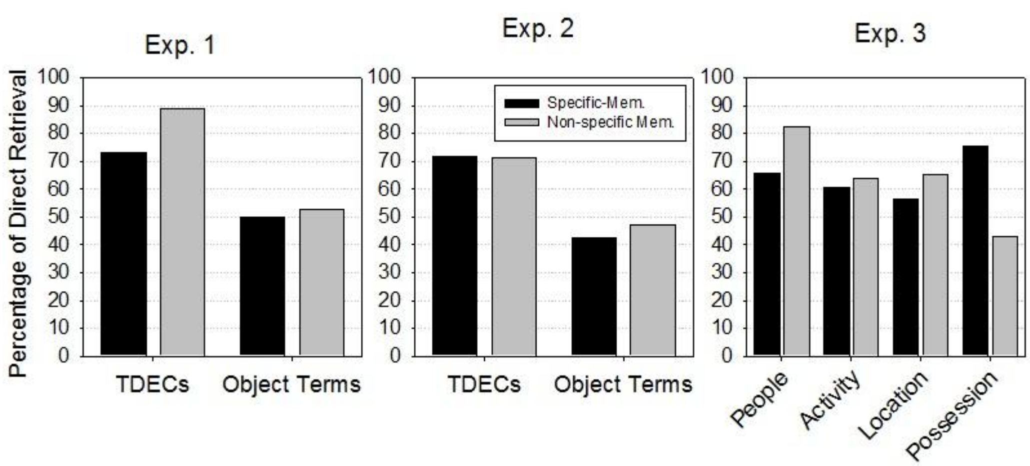
Figure 9. *Median reaction times by cue type and retrieval strategy*



Memory Content, Retrieval Strategy, and RT. Conway (1996) suggested that the general event level is "the preferred level of access to autobiographical memory" (p.7). He argued that the general event level is the optimal level to access an event (Conway, 1996, 2005) as basic level categories offer the optimal balance between informativeness and distinctiveness for concepts (Rosch, 1978). Easier access to general events, as compared to specific events, was also observed in the over-general memory retrieval phenomenon among emotionally disturbed patients (J. M. G. Williams et al., 2007). These considerations suggest that it might be interesting to determine whether there is a relation between retrieval strategy and memory type. In other words, it might be that general events are directly retrieved more often than specific events. To understand whether a relationship of this sort is present, I also used memory content as a factor in the analysis.

Eighty-five percent of memories were of single episodes (*N* = 1407). This implies that participants understood and mostly complied with the instructions. Memory content analyses showed that 71% of non-specific memories were directly retrieved as were 62% of the specific memories. LME analysis indicated that non-specific memories were more likely associated with direct retrieval than specific memories ($b = -1.01$, $p < .001$). However, interaction between cue type and memory content indicated that this pattern only held for T-DECs, as shown in Figure 10 ($b = 0.86$, $p < .05$). Consistent with previous literature, general events are more likely associated with direct retrieval than specific instances. However, most of the memories reported in this experiment were specific events, and direct retrieval was still very common when participants were able to access specific memories. Therefore, we can argue that the prevalence of direct retrieval obtained from this study does not arise from the frequent retrieval of general events.

Figure 10. *Percentage of direct retrieval by cue type and memory content*



Non-specific events (*MD* = 3.62s) and specific events (*MD* = 4.08s) did not differ for their overall retrieval speed ($p > .05$). Direct retrieval was also equally fast (*MD* = 3.03s for specific; 2.64s for non-specific) and generative retrieval was equally slow for specific (*MD* = 7.79s) and non-specific memories (*MD* = 5.99s; $p > .05$).

Discussion

Direct retrieval is considerably more common in recalling autobiographical memories than has previously been considered. General events are more likely associated with direct retrieval than specific events. However, the prevalence of direct retrieval obtained in this study cannot be attributed to retrieving generic memories.

Transition Theory correctly accounts for the differences in RTs between T-DECs and objects - because T-DEC cues elicit more directly retrieved memories than objects cues. On the other hand, the SMS theory incorrectly predicts that direct retrieval should have been uncommon and that the speed of retrieval should not differ as a function of cue type.

In sum, this experiment has provided additional data in support of the claim that direct retrieval is a default strategy to recall autobiographical memories. Moreover, consistent with Transition Theory, memories cued by T-DECs were retrieved faster than those cued by object terms because T-DECs elicit more direct retrieval than object cues.

Experiment 2

The main difference between Experiment 1 and 2 was related to how T-DECs were obtained. T-DECs were collected in the first phase of Experiment 1; in Experiment 2, participants provided their T-DECs two to three month months before coming to the lab (i.e., during mass testing). In Experiment 1, when participants were searching for elements from their lives during Phase 1, they might have remembered experiences related to these components as well. Or accessing these T-DECs during the search process might have activated autobiographical memories connected to the T-DECs. Consequently, in Phase 2, participants could easily recall autobiographical memories related to the T-DECs that they had produced a few minutes earlier. Therefore, asking participants for T-DECs in Phase 1 could potentially prime T-DEC-related memories and increase the rate of directly retrieved autobiographical memories related to T-DEC cues.

If generating T-DECs in the lab primes autobiographical memories, then the rate of direct retrieval should be higher in Experiment 1 than in Experiment 2. Otherwise, direct retrieval should be equally common in both experiments.

Method

Participants. Forty-six undergraduates from University of Alberta (30 females, *median age* = 18; 16 males, *median age* = 19) participated to receive course credit. Participants were tested individually in a procedure that took 20 minutes.

Procedure. The procedure and materials were the same as used in Experiment 1, with one important exception. In this experiment, 12 T-DECs (i.e., four people that s/he met frequently, four activities that s/he engaged in regularly, and four locations s/he frequently visited since the beginning of the term) were collected from each participant during mass testing. The University of Alberta Mass Testing is an-online survey available to Introductory Psychology students at the beginning of Fall and Winter terms. Students answer questions related to their background, attitudes, feelings, experiences, and other psychological characteristics depending on the variables of interest to the researchers. Mass testing allows researchers to pre-test materials for their future research and to identify students who are eligible to participate in their research projects. Participation to mass testing is voluntary, and students receive one course credit for their participation. As with any research study conducted in the Department of Psychology, all ethical requirements (e.g., withdrawing from the survey at any time, confidentiality of the responses, etc.) about research participation are met. Response restrictions for T-DECs (e.g., exclusion of immediate family members) were also identical to those used in Experiment 1.

Results

Fifteen cues failed to produce memories within the 90-second time limit. Unacceptable responses (N = 185) were eliminated from further analyses leaving 904 potential trials (777 specific and 127 non-specific memories). An additional 45 observations with RTs equal to or greater than the 2.5 standard deviations away from their strategy type group means were also excluded, leaving 859 (N = 741 specific memories; N = 118 non-specific memories) analyzable trials.

The analyses used here were the same as in Experiment 1. I fitted an LME regression model using log RT as the dependent variable, with cue type, memory content, and retrieval strategy as fixed factors, and individual participants and cues as random factors. Similar to Experiment 1, all main effects and two-way and three-way interactions were investigated using a stepwise variable elimination method. Predictors that did not turn out to be significant were therefore removed from the model fit.

Strategy Prevalence and Cue Types. The percentage of directly retrieved memories was much higher than is typically assumed (58%). It was also greater when memories were cued by T-DECs (72%) than when they were cued by object terms (43%; Figure 5). I fitted a Logistic Mixed-Effects Model using frequency of direct retrievals as a dependent variable, cue type and memory content as fixed, and subjects and cues as random factors. This analysis showed a significant main effect of cue type on the prevalence of strategy type ($b = 1.46$, $z = 6.28$, $p < .01$), indicating that the prevalence of direct retrieval in Experiment 1 was not biased by same-session T-DEC production. Post-hoc comparisons showed that the prevalence of direct retrieval did not differ among people- (73%), activity- (71%), and location- (71%) type T-DECs ($p > .05$).

Cue Types, Retrieval Strategy, and RT. Once again, T-DEC-cued memories (*MD* = 2.44s) were retrieved faster than those cued by objects (*MD* = 4.06s) with a difference of 1.62s between the median RTs for each cue type ($b = 0.17$, $p < .01$, Figure 6). No difference was observed between person-cues (*MD* = 2.17s), activity-cues (*MD* = 2.62s), and location-cues (MD = 2.54s) ($p > .05$). In terms of retrieval strategies, a similar two-and-one-half-fold difference in RTs between direct and generative retrieval was observed ($b = 0.70$, $p < .01$). As Figure 7 indicates, there was a substantial main effect of retrieval strategy on RTs. The frequency and cumulative frequency distributions described in Figure 8 also indicated that these data were drawn from two different strategy populations.

The LME analysis in this experiment yielded a significant interaction between cue type and retrieval strategy ($b = 0.23$, $p < .01$). Simple affect analyses showed that direct retrieval was equally fast for T-DECs and object cues. However, generation was more difficult when memories were cued by objects than when they were cued by T-DECs (Figure 9).

Note, overall RT was lower in Experiment 2 than in Experiment 1. Interestingly, the largest between-experiment difference was between T-DEC-related generated memories in Experiment 1 and T-DEC- related generated memories in Experiment 2. One possibility is that producing T-DECs at the outset of the session in Experiment 1 interfered with the memory search for T-DEC-related autobiographical memories. For example, when participants were searching for the names of their friends or frequently visited locations, they might also have remembered memories, images, or any other details related to these T-DECs. Previous activation of these memories, images, or other details could increase the response competition (see M. C. Anderson & R. A. Bjork, 1994; M. C. Anderson & Spellman, 1995) among candidate memories during memory search in Phase 2 and thereby slow the generation process of T-DEC-related memories. Alternatively, producing T-DECs in the laboratory increased the cognitive load and influenced the retrieval process in a way that inflated the overall RT in Experiment 1. However, the effect appears biased with respect to T-DEC-related generated memories, which strengthens the interference possibility.

Memory Content, Retrieval Strategy, and RT. Most (86%) of the reported memories were specific events as demanded by the instructions in this experiment. Direct retrieval was again very common among both non-specific (60%) and specific memories (58%). Unlike in Experiment 1, LME analysis indicated that non-specific memories and specific memories were equally likely associated with direct retrieval (*p* > .05). Lack of interaction between cue type and memory content indicated that this pattern held for both T-DECs and object terms (*p* > .05; Figure 10).

Similar to Experiment 1, the overall retrieval speed of non-specific events (MD = 2.73s) was not different from that of specific events (*MD* = 3.28s; *p* > .05). LME analysis indicated that direct retrieval (*MD* = 2.29s for specific; 1.99s for non-specific) was equally fast, and generative retrieval was equally slow for specific (*MD* = 5.65s) and non-specific events (*MD* = 5.04s; p > .05).

Discussion

In Experiment 2, T-DECs were collected some time before the experiment to eliminate potential problems associated with the within-session T-DEC generation task. Results indicated that direct retrieval was still very common, even when T-DECs were collected months earlier. Furthermore, RTs were comparable to those found in Experiment 1. These data suggest that the prevalence of direct retrieval cannot be attributed to the priming of autobiographical memories during the T-DEC production processes.

For the most part, results reported above replicate those obtained in Experiment 1. As before, direct retrieval was more common with real-life cues than object cues and T-DEC-cued memories were recalled faster than object-cued memories. This experiment also showed that this RT difference occurred because T-DEC-cued memories are faster to generate than object-cued memories. There are two possible explanations for the interaction. It could be that generating T-

DEC-cued memories is easier than generating object-cued memories. Alternatively this interaction might imply that T-DEC production in Experiment 1 impeded the search process for T-DEC-related autobiographical memories – an interference explanation. A lack of interaction between the retrieval strategy and cue type in Experiment 1 strengthens the latter possibility.

Experiment 3

The present experiment differed from the previous ones in three ways. First, word cues were excluded, and only T-DECs were used. Second, instead of recent T-DECs, T-DECs from the more distant past (i.e., from high school years) were elicited. Third, I included object T-DECs in addition to persons, locations, and activities.

One rationale for these modifications was to determine whether direct retrieval is still very common with older T-DECs. A second reason for executing this experiment was to directly compare the retrieval efficacy of the various types of T-DECs. In autobiographical memory, an event also includes object information. Therefore, in the present study, items or objects people have or use were also collected from participants. More specifically, in the present study participants were required to recall four people they saw a lot, four activities they engaged in frequently, four locations that they attended often, and four possessions (e.g., vehicle, article of clothing, electronics, etc.) that they had when they were in high school.

Method

Participants. Forty-one University of Alberta undergraduates participated for course credit (25 females, *median age* = 18; 16 males, *median age* = 19.5). Participants were tested individually, with each session lasting approximately 30 minutes.

Procedure. The procedure and materials were the same as in Experiment 1. One exception was that possession T-DECs were included and cue words were excluded. Another difference was that T-DECs in this study were supposed to come from the participant's high school years regardless of whether or not they were currently present in the person's life. There were four practice trials in Phase 2. In the first trial, a person T-DEC was presented to the participant. An activity T-DEC was displayed in the next trial. Location and possession T-DECs were shown in the third and fourth trials, respectively. The remaining T-DECs were presented in random order.

Results

Nine of the cues failed to elicit memories in the allotted time. Removal of practice trials resulted in 507 potential trials. 34 unacceptable memories were removed from the data leaving 473 memories (416 specific memories; 57 non-specific memories). A further 15 outlying values were also removed, leaving 458 analyzable trials (403 specific memories; 55 non-specific memories). In other respects the analysis is equivalent to the one conducted in Experiment 2.

Strategy Prevalence and T-DEC Types. The frequency of direct retrieval replicated the pattern of results obtained in previous experiments with T-DEC cues producing directly retrieved memories on 65% of the trials (Figure 5).

It seems that with older T-DECs the rate of direct retrieval dropped but direct retrieval was still very common when people were asked to recall autobiographical memories in response to more distant personal cues.

Figure 5 presents percentage of direct retrieval for the four different cue types. Consistent with the previous two studies, person cues (68%) elicited more direct retrievals than activity (61%) and location (58%) cues. Interestingly, possession cues (74%) produced the highest rate of direct retrievals. A Logistic Mixed-Effects Model analysis confirmed that possession cues ($b = 0.65$, $z = 2.07$; $p < .01$) and person cues ($b = 0.77$; $z = 2.56$; $p < .01$) were more likely than location cues to produce direct retrieval. No other differences were obtained among T-DECs ($p > .05$).

T-DEC Types, Retrieval Strategy, and RT. Possession-cued (MD = 3.77s) memories had the shortest retrieval speed followed by person-cued memories (MD = 5.23s; Figure 6). Location- (MD = 5.74s) and activity- (MD = 5.74s) cued memories were retrieved relatively slowly. Consistent with strategy prevalence data, possession-cued memories ($b = 0.19$; $p < .01$) and people-cued ($b = 0.14$; $p < .05$) memories were retrieved faster than location-cued memories. No other RT difference was observed among T-DEC types ($p > .05$).

The pattern of RTs for direct (MD = 3.58s) and generative (MD = 12.86s) retrievals replicates the pattern obtained in Experiments 1 and 2 (b =1.11, $p < .01$; Figure 7). As shown in Figure 8, frequency distributions for RTs as a function of retrieval strategy once again suggest that these data are drawn from different populations. Similar to Experiment 1, when T-DECs were produced in the lab there was no effect of T-DEC type on the generative RTs that would indicate any differences in ease of retrieval (Figure 9; $p > .05$).

Memory Content, Retrieval Strategy, and RT. Once again, most of the memories (88%) were specific events consistent with the instructions. Both non-specific memories (67%) and specific memories (65%) were directly retrieved most of the time. LME analysis showed that direct retrieval was equally common in non-specific and specific memories ($p > .05$) in this experiment. Lack of interaction between cue type and memory content showed that specific and non-specific memories cued by people-, activity-, location- and possession-T-DECs were equally likely to be directly retrieved (Figure 10; $p > .05$).

Similar to Experiments 1 and 2, non-specific events (*MD* = 4.89s) and specific events (*MD* = 5.23s) did not differ in overall retrieval speed ($p > .05$). Direct retrieval (*MD* = 3.67s for specific; 3.21s for non-specific) was equally fast, and generative retrieval was equally slow for specific (*MD* = 12.87s) and non-specific memories (*MD* = 12.12s; $p > .05$).

Discussion

Experiments 1 and 2 were extended by requiring participants to produce more distant personal cues. Results show that direct retrieval is very common when people are cued by T-DECs. Memory content analyses also support that the prevalence of direct retrieval cannot be attributed to non-specific memories.

Possessions and people were more likely than locations to allow direct access to specific autobiographical memories. Consistent with this finding, RT data showed that possessions and people provided faster retrieval than locations.

These results suggest that possessions, people, locations, and activities are all efficient cues to access autobiographical memories. Given the complex nature of connections among autobiographical memories, which memory is accessed more easily with which cue(s) will also depend on other factors such as the number of connections and strength of those connections.

Conclusions

These three experiments were conducted in part to assess the prevalence of direct retrieval of autobiographical memory with real-life cues. A second goal was to compare retrieval times and proportions of direct and generative retrievals of memories cued by T-DECs and object terms. Finally, predictions of different autobiographical memory models were compared. Across the three experiments, it was found that direct retrieval was very common when people were deliberately asked for autobiographical memories related to people, places, activities, or possessions in their lives. Comparisons among T-DECs also showed that people, object, and location cues were as efficient as activity cues to access autobiographical memories.

In Experiments 1 and 2, it was also indicated that, on average, participants were slower at retrieving autobiographical memories when they were cued with object terms than when they were cued with T-DECs. This effect was accounted for by showing that participants were more likely to use direct retrieval when they were cued with T-DECs than when they were cued with object terms. This finding suggests that when more specific and more contextualized cues such as T-DECs are provided, autobiographical memories are more likely accessed than when more generic cues such as object terms are used. This is also consistent with previous research showing that involuntary memories are mostly triggered by specific cues in the environment (Berntsen, 1996, 1998, 2009).

No RT differences were found for either directly retrieved or generated memories as a function of cue type in Experiment 1. However, Experiment 2 data showed that T-DEC-related memories were easier to generate than object-cued memories. This suggests that the T-DEC search process that was required at the outset of the session in Experiment 1 (but not Experiment 2) might have interfered with the memory search for T-DEC-related autobiographical memories. This issue is considered in greater detail in the next chapter.

In the present project, participants were instructed to recall memories of specific episodes. As discussed before, some researchers have suggested that general events are likely to be accessed before specific memories during the retrieval process (e.g., Conway, 2005; J. M. G. Williams et al., 2007). Content analyses were conducted on the responses obtained to understand whether such a relationship exists between memory content and direct retrieval, and to see whether the prevalence of direct retrieval in the three studies is due to the frequent retrieval of non-specific memories. The data produced by these three experiments make it clear that the prevalence of direct retrieval cannot be attributed to non-specific events. First, most of the memories reported were specific autobiographical memories. Second, direct retrieval was very common for both specific and non-specific memories. Third, there was not strong evidence showing that general events were more likely to be directly retrieved than specific events.

Only Experiment 1 data indicated that non-specific events produced more direct retrieval than specific events. Since this project was not conducted to study memory specificity phenomenon directly, I do not currently have an explanation for why only Experiment 1 showed evidence for the relation between direct retrieval and memory specificity. It seems the relationship between memory specificity and direct retrieval is a potential fruitful direction for future research.

The prevalence of directly retrieved autobiographical memories cued by T-DECs is consistent with Transition Theory's notion that T-DECs are the basic features of an event and that they define the content and organization of autobiographical memories. At the same time, the results presented here are inconsistent with the strong hierarchical search assumptions that underlie the SMS model (Conway, 2005; Conway & Pleydell-Pearce, 2000; Haque & Conway, 2001). In contrast, the present study provides evidence that event memories are indexed by T-DECs which structure other event units (e.g., life-time periods) and have important roles in organizing autobiographical memory.

In sum, the present research emphasizes pre-stored event representations indexed by T-DECs and supports associative retrieval processes in autobiographical memory (e.g., Barsalou, 1988; N. R. Brown et al., 2012). The results also show that hierarchical retrieval models (e.g., SMS model) need to be reconsidered.

After demonstrating the prevalence of directly retrieved autobiographical memories, the next step is to investigate factors that impact direct retrieval. More specifically, the following chapter presents a cue repetition experiment which investigates how the successive presentation of the same cue impacts the prevalence of directly retrieved memories cued by T-DECs.

CHAPTER III

Selection is the very keel on which our mental ship is built. And in this case of memory its utility is obvious. If we remembered everything, we should on most occasions be as ill as if we remembered nothing. (W. James, 1890, p. 680)

Recent autobiographical memory studies have shown that spontaneous recollections of the past can occur when people involuntarily (Ball & Little, 2006; Berntsen, 1996, 1998, 2009, 2010; Kvavilashvili & Mandler, 2004; Mace, 2005, 2007, 2009, 2010; Schlagman & Kvavilashvili, 2008; Schlagman, Kvavilashvili, & Schulz, 2007) as well as voluntarily (Uzer et al., 2012) remember their own memories. Diary studies (Ball & Little, 2006; Bertnsen, 1996, 1998) and laboratory studies (Mace, 2005, 2006, 2009, 2010; Schlagman & Kvavilashvili, 2008; Schlagman et al., 2007; Uzer et al., 2012) report that this phenomenon is quite common. One core issue in relation to the prevalence of spontaneously retrieved memories is why they do not occur all the time. In other words, given that our everyday environment is filled with familiar coffee mugs, clothes, houses, streets, and bridges, why do these not constantly trigger memories of prior events?

As indicated by James (1890), selectivity in remembering is essential for normal functioning in daily life. Take, for example, a situation in which two friends –I'll call them Joe and Sam – are talking. If an ordinary word in this conversation, such as "pencil," constantly reminded the person of all pencil-related past experiences, he would not be able to focus on any of the conversation. Therefore, when considering the use of memory, not having access to unwanted items allow us to use memory effectively. In other words, the failure of external and internal cues to trigger the retrieval of memories may be an adaptive mechanism, serving to reduce the negative impact of irrelevant information on the current activity (R. A. Bjork, 1989). But how does the human memory system accomplish this?

Some accounts in the literature suggest how this selectivity might be achieved. One interpretation is that there are inhibitory mechanisms that suppress unwanted memories. For instance, according to Conway (2005), there is a continuous pattern of activation in the autobiographical knowledge base; however, these activations are prevented from entering into consciousness by a *central executive system* (i.e., the *self*). Here, Conway (2005) argues that the self inhibits the activation of the memories to avoid their interference with the current goals of the self. Berntsen (2009) claims involuntary memories are not solely caused by available cues in the environment. Rather she argues that in order to spontaneously trigger a past event, a cue should be distinct enough to differentiate some event memories from all other interfering memories. Tulving (1983), on the other hand, argues that people should be in a cognitive state (i.e., retrieval mode) that enables them to process the stimuli in the environment as potential cues to recall past experiences. Although previous autobiographical memory researchers have suggested the alternatives mentioned above, no empirical study has investigated how cue repetition influences retrieval from autobiographical memory.

In the previous chapter, I demonstrated that once-presented personal cues often evoke directly retrieved autobiographical memories. The present study, on the other hand, investigates how repeated cuing impacts the prevalence of direct retrieval. There are two possible ways that cue repetition might work. One possibility is that repeating a cue might increase direct retrieval. Alternatively, repeating a cue might decrease the amount of direct retrieval and/or slow the generation process. If cue repetition has a negative effect on the ease with which personal memories are recall, it would suggest that some form of inhibition might play in reducing unwanted memory intrusions. The following paragraphs review the literature related to these two possibilities. Then, the predictions that follow from these two alternatives will be introduced, along with the present study's rationale.

Previous literature indicates that priming can facilitate or inhibit processing of related memory information (Mayr & Buchner, 2007; Neely, 1991; Neely, Keefe, & K. L. Ross, 1989; Ortells, Fox, Noguera, & Abad, 2003; Ortells & Tudella, 1996; Reisberg, 2007; Tipper, 1985; Tulving, Schacter, & Stark, 1982). Positive priming was demonstrated by shorter response times to name a word if it is preceded by a related word than if it is preceded by an unrelated word (Jacobson, 1973; Warren, 1977), and to retrieve a category member (e.g., eagle) if it is preceded by the retrieval another member of the same category (e.g., hawk) than if it is preceded by the retrieval of an item (e.g., chair) from a different category (E. F. Loftus, 1973; G. R. Loftus & E. F. Loftus, 1974). All of these experiments postulate that an associatively-related item presented prior to a critical item increases the activation level of the critical item, and facilitates its accessibility. This assumption is based on the spreading activation model, which (Collins & E. F. Loftus, 1975; McNamara, 2005) asserts that memory storage consists of a network of associated nodes. Each node contains information about experiences or concepts. According to the spreading activation model, positive priming occurs when the memory node's activation level is increased. This causes the memory to be processed more quickly and increases the probability that it will be recalled. Conversely, negative priming occurs when the memory node's activation level declines. This causes the memory information to be processed more slowly, decreasing the possibility that it will be retrieved.

Positive priming effects have also been found in autobiographical memories. For example, Conway and Bekerian (1987) found that people recalled autobiographical memories faster in response to general events (e.g., holiday in Italy) when these cues were primed by life-time periods (e.g., school days) than when they were unprimed. These researchers also used other semantic categories (e.g., emotions, sports), and these categories failed to prime autobiographical memories. For instance, participants were cued with some emotion words (e.g., happy, sad) and they did not recall their memories faster when emotion words were presented after their category name (i.e., emotion) than when these cues were presented after the word "ready." Conway (1990) demonstrated positive priming effect with goal-derived categories (i.e., categories representing schema variables used to achieve goals such as things to eat on a diet and birthday presents). Participants were required to retrieve autobiographical memories to cues from goal-derived and taxonomic categories (i.e., categories used to classify objects and activities in the environment such as furniture and birds). Cues (e.g., strawberry) were primed with the names of related goal-derived categories (e.g., things to eat in summer), taxonomic categories (e.g., fruit), or a neutral word (e.g., ready). Memories were retrieved faster when the cue word (e.g., jewelry) was primed by a goal-derived category (e.g., birthday present) than when the cue was followed by the word “ready.” In contrast, retrieval speed of memories did not change when the cue (e.g., chair) was primed by a taxonomic category (e.g., furniture) or by a neutral prime (e.g., ready).

Reiser et al. (1985) also examined the influence of primes on the speed of autobiographical memory retrieval. Participants in one study were presented with an action cue (i.e., a general behavior that is common to more than one activity) followed by an activity prime (i.e., sequence of actions performed to achieve one or more goals) or they were presented with an activity cue (e.g., eating in restaurants) followed by an action prime (e.g., making reservations) to recall a specific autobiographical memory. Each prime was displayed for 5 seconds. These researchers found that autobiographical memories were retrieved faster when an activity prime was followed by a general action cue than when an action prime was followed by an activity cue. Event cueing studies also showed that when a target event was cued by another event from the same cluster (e.g., a cueing event sharing a common causal and/or thematic relationship with the target memory), it was recalled faster than when the target event was cued by another event from a different cluster (e.g., a cueing event that does not share a common causal and/or thematic relationship with the target memory; N. R. Brown; 2005; N. R. Brown & Schopflocher, 1998a, 1998b).

Mace (2005, 2006, 2007, 2009, 2010) investigated the possibility that positive priming has a role in involuntary memory production. Mace (2005) demonstrated that when participants were asked to retrieve autobiographical memories in response to cues, these memories also triggered involuntary autobiographical memories. These involuntary memories then elicited additional involuntary memories. Mace labeled this form of remembering as *involuntary memory chaining (IMC)*. Mace (2005) reported that 15% of involuntary autobiographical memories were chained involuntary memories. Mace (2006, 2009) also reported that involuntary memory chaining occurred when participants were intentionally recalling autobiographical memories, or were asked to recall words from a previously studied list. According to Mace (2010), IMC occurs because the initial memory is performing as a cue to retrieve another memory spontaneously, or because it causes a spreading activation-type processing.

As noted above, retrieval is considered to follow through associative links when activation in one node spreads to others (J. R. Anderson, 1972, 1976; Collins & E. F. Loftus, 1975). Therefore, it makes sense to argue that priming a person with semantically related information should facilitate retrieving the target item. However, researchers also reported that under some conditions retrieval or task performance is impaired by prior presentation or retrieval of semantically related information. For example, studies of semantic recall indicate that semantically related primes slowed retrieval from semantic memory. In these studies, participants were presented with definitions of the target words. Each definition was preceded by a prime word. The prime was either semantically related or unrelated to the target word. Subjects were supposed to retrieve the target word. Results demonstrated that participants retrieved the target word more slowly when the definition followed a related prime than when it followed an unrelated prime (A. S. Brown, 1979, 1981; Roediger, Neely & Blaxton, 1983). Category recall studies also found that when participants repeatedly retrieved words from the same category their response times increased (Bousfield & Sedgewick, 1944; Freedman & E. F. Loftus, 1971; G. R. Loftus & E. F. Loftus, 1974). Negative priming effects were also observed in perceptual tasks. For example, when participants were presented with two letters (e.g., BG) and were asked to report one of them (e.g., G), they performed better if two different letters (e.g., BG) were displayed to them than if the same letter (e.g., GG) was shown (E. L. Bjork & Murray, 1977; Egeth & Santee, 1981; Neill 1979).

Another example of negative priming effect was observed with Stroop tasks. For instance, participants are presented with two successive stimuli – the prime (e.g., a circle with different colors) and the probe (e.g., a STROOP stimulus) – in a word naming task. The probe stimulus (e.g., the word “RED” written in green) requires paying attention to one dimension (e.g., word meaning) while ignoring the distracting dimension (e.g., word color). In critical trials, the probe (e.g., the word “RED” written in green) is related to the prime (e.g., a green circle) stimulus. In contrast, the probe (e.g., the word “RED” written in green) is unrelated to the prime (e.g., a blue circle) stimulus in control trials. The negative priming is defined as the delayed response (i.e., slower RT) to probe stimulus (i.e., naming it as red) in critical trials than in control trials (Chao & Yeh, 2008;

Frings & Wentura, 2005; Milliken, Joordens, Merikle, & Seiffert, 1998; Milliken, Lupianez, Debner, & Abello, 1999; Neill & Kahan, 1999).

The part-list cuing effect is also one of the most popularly studied cases of inhibitory effects in retrieval. In a typical part-list cueing experiment, participants study a list of words and are given part of the list and asked to use these words as cues to recall the remaining of the list. Recall of target words (i.e., those that are not used as cues) were less in the group who received part-list cues than in the free recall control group (Crowder, 1976; Mueller & Watkins, 1977; Raaijmakers & Shiffrin, 1981; Roediger, 1973,1974; Rundus, 1973; Slamecka, 1969; Watkins, 1975). More recently, part-list cueing effect was observed when subset items were produced during a group discussion (i.e., collaborative inhibition effect in group recall; Barber & Rajaram, 2011; Weldon & Bellinger, 1997). A-B, A-D interference experiments also showed that retrieval of one response impairs recall of other. In the A-B, A-D experiments, participants are presented list A and asked to recall a related item from the first or second list. Their recall performance is impaired compared to a single list control group. This occurs because of the competition between the B and D responses (M. C. Anderson & Neely, 1996; Barnes & Underwood, 1959; McGeoch, 1942; Postman, 1971; Roediger & Neely, 1982).

Another line of evidence for the role of negative priming in memory retrieval has come from research on the *retrieval-induced forgetting* (RIF) effect (M. C. Anderson, R. A. Bjork & E. L. Bjork, 1994; M. C. Anderson & Spellman, 1995). A typical RIF procedure consists of four phases: (1) a study phase, (2) a retrieval-practice phase, (3) a retention interval phase, and (4) a final test phase. In the study phase, participants study some category-exemplar pairs (e.g., Furniture-Chair, Furniture-Sofa, Fruit-Orange and Fruit-Apple). In the retrieval-practice phase, participants are asked to retrieve half of the exemplars from half of the categories with a category stem-cued recall (e.g., Furniture-Ch____) task. These practiced items are considered Rp+ items, because they receive additional activation during the practice phase. Unpracticed items from practiced categories (e.g., Sofa) are considered Rp- items. It is assumed that Rp- items interfere with practiced items (i.e., Chair interferes with Sofa) and/or that retrieval practiced items are inhibited in the long-term memory. Unpracticed items, such as Orange and Apple, from unpracticed categories, are considered Nrp items. Nrp items provide a baseline measure of recall performance. In the retention interval phase, participants complete an unrelated activity for approximately 20 minutes (e.g., solving some reasoning problems). In the final phase, participants are presented once again with entire category of cues and required to recall all of the exemplars associated with each category cue.

Results show that participants' final recall for practiced items (Rp+) is higher than their recall for unpracticed items from unpracticed categories (Nrp). Their recall for unpracticed items from practiced categories (Rp-) is lower than their recall for unpracticed items from unpracticed categories (Nrp). Here, the RIF effect refers to the former finding (Rp- < Nrp). In other words, it has been demonstrated that repeatedly retrieving an item (Rp+) brings about the loss of access to other items (Rp-) that interfere with the target item. The RIF effect has also been demonstrated by other studies using more complex stimuli (see M. C. Anderson, 2003, for a review), such as performed actions (Koutstaal, Schacter, Johnson, & Galluccio, 1999), imagined actions (Macrea & Roseveare, 2002), crime scene details (MacLeod, 2002; Shaw, R. A. Bjork, & Handal, 1995), event information (Saunders & MacLeod, 2002), personality traits (Dunn & Spellman, 2003; Macrae & MacLeod, 1999), and false memories (Starns & Hicks, 2004).

Barnier, Hung, and Conway (2004) adapted M. C. Anderson et al.'s (1994) RIF procedure for emotional and unemotional autobiographical memories. Participants were asked to retrieve 30 specific memories from their past in response to negative, positive, and neutral category cues. In addition, participants were required to provide a "personal word" for each memory. In the study phase, participants were presented with the category cue, personal memory, and associated autobiographical memory one at a time, and were asked to form a connection between the cue word, personal word, and their memory. In the retrieval practice task, participants were presented with some cue word-personal word pairs and were instructed to retrieve the appropriate memory. Each pair was presented three times during the retrieval-practice task and each time participants were asked to provide additional details about the event. In this retrieval-practice task, participants were asked to recall half of their associated memories for half of the categories. Results showed that recall of practiced memories from practiced categories (Rp+) was higher than recall of unpracticed memories from unpracticed categories (Nrp). Results also showed that recall of unpracticed memories from practiced categories (Rp-) was lower than unpracticed memories from unpracticed categories (Nrp).

In sum, positive priming research indicates that priming an item with a related item facilitates retrieval processes due to spreading activation. However, some research also report that this is not always the case. For example, A-B, A-D interference paradigm provides evidence of retrieval blocking caused by competing information. Counter to predictions of associative memory theories, some items from a list impair retrieval of remaining material as shown in part-list cuing, RIF, and collaborative inhibition effects. These two lines of research imply that two distinct processes might be operating in priming processes. One of these processes is an excitatory, spreading-activation-type, and strategy free process. If only spreading activation-type process operates then activation can also continue to spread among other associated and unrelated items. These items create competition and impair the retrieval process. Therefore, there should be a second mechanism to limit the spreading of activation. The second process is an inhibitory, selective, and more strategic process (e.g., see A. S. Brown, 1979; Posner & Synder, 1975; Saunders & McLeod, 2006 for similar arguments).

This idea is consistent to how memory performs functionally in our complex social world when goals and demands are changing. Under some circumstances, inhibiting memories may be required, whereas under other circumstances facilitation of related memories may become necessary. The conditions under which facilitative and inhibitory processes operate have not been systematically investigated (but see A. S. Brown, 1979, 1981; Bäuml &

Samenieh, 2010; Ortells & Tudela, 1996; Ortells et al., 2003). However, priming studies described above exemplify some conditions that distinguish when positive or negative priming will occur. Positive priming generally occurs when the semantically related prime does not cause a competition between the target response and alternative responses and when responding does not require ignoring distracting information coming from the prime (e.g., lexical decision tasks). In such situations, activation of the previously shown prime spreads to the target response and facilitates the later processing of the target response. In contrast, negative priming generally occurs when there is a strong response competition and when responding requires overcoming of the competition (e.g. A-B, A-D tasks, RIF) or ignoring distracting information (e.g., Stroop task). In such situations, either an active inhibitory mechanism or an interference mechanism caused by response competition causes impaired recall or delayed responding.

As discussed in the previous chapters, both generic and personal cues frequently elicit the directly retrieval of autobiographical memories. Thus one might argue that retrieving a cue-related autobiographical event facilitates accessibility to other memories related to the same cue. In other words, consistent to positive priming research, repeating cues might increase the frequency of direct retrieval. Considering the cue paradox and evidence from negative priming literature, however, repeating cues might obstruct accessibility to other memories associated with the same cue (i.e., by means of interference or inhibitory processes) and reduce the probability of recall after each repetition. Given the cue paradox, I consider the negative priming alternative with a higher probability and expect that cue repetition should decrease direct retrieval.

The present study was conducted to assess how repeating cues affects a person's ability to directly retrieve autobiographical memories. Participants provided uniquely identifiable cues from their own lives (e.g., the names of people they know) and then attempted to retrieve memories in response to each cue once, twice, or three times. On each trial, RT was measured, and participants reported whether or not the memories were directly retrieved. If spreading-activation-type processing is occurring, and positive priming is at work, then the direct retrieval should become increasingly common as the number of cue presentations increases from 1 to 3 and average RT and, perhaps, RT for generative retrievals should decrease. In contrast, if negative priming is in effect, then the prevalence of direct retrieval should decrease as the number of cue repetitions increases, and average RT and, perhaps, RT for generative retrievals should increase.

Both accounts predict that the RT for direct retrieval should remain constant as a function of cue repetition. If repeated exposure to the same cue decreases direct retrieval, this suggests that in real life memories associated with the same cues might compete with other memories, thus preventing constant recall of past experiences. However, further testing would be required to determine whether the reduction in directly retrieved memories is caused by active inhibitory processing or passive interference. In the Discussion section, I will also return to the difference between interference and inhibitory processes in negative priming and its implications.

Experiment 4

In Phase 1, T-DECs (i.e., people that the participant met frequently, and locations that s/he visited regularly) were collected from each participant. In Phase 2, on each trial, the participant was shown a T-DEC cue and was required to recall a related autobiographical memory. Some of the T-DECs were presented once, some were presented on two successive trials, and some were presented on three consecutive trials. RT was measured, and at the end of each trial, participants were asked to report their retrieval strategy.

In addition, the nature of the retrieval report format was manipulated between subjects. In the previous experiments, the response memories described direct retrieval as a situation that occurs when a memory came immediately to mind, and generative retrieval was described as a process involving an effortful search. However, these definitions imply time (e.g., the word "immediately") and effort. The concepts of time and effort in these definitions might have influenced participants' judgments about their retrieval strategy. Consequently, participants' responses to the strategy question could not reflect the actual retrieval process, but could reveal how fast the memory came to their mind or how difficult it was to recall the memory. For example, participants could base their answers on perceived retrieval times rather than the phenomenological characteristics of their subjective retrieval experience. So if memories came to mind relatively quickly, participants may have then judged the retrieval process as immediate, which I have taken to mean direct retrieval. Conversely, when retrieval was perceived as relatively slow, participants may have treated the retrieval process as effortful by comparison, irrespective of how the memories were actually recalled. Therefore, asking people about the retrieval processes in a straightforward way could potentially confound time and effort with self-reported retrieval strategies.

To avoid implying time and effort in strategy questions, Uzer et al. (2012) asked participants in one group to report *information* use during retrieval. The rationale was to measure a different, yet defining, characteristic of autobiographical memory retrieval that would still make it possible to distinguish between retrieval types. This characteristic is definitive because there is a long-standing consensus that generative retrieval involves searching for and using information from one's own life (Burt, 1992; Conway & Pleydell-Pearce, 2000, Conway et al., 1999; Reiser et al., 1985). For example, recalling the people we know, activities we have engaged in, familiar objects, or places that we frequent can often provide specific contexts to access specific events. These specific contexts form the basis of memory generation (Barsalou, 1988; Burt, 1992; Lancaster & Barsalou, 1997; Wagenaar, 1986). In contrast, the literature concerning involuntary memory indicates that direct retrieval does not involve recollecting supporting information because the event comes directly to mind.

The Uzer et al. (2012) study found that the two question formats (i.e., the one that implies time and effort and the one that implies information use) produced identical results in terms of retrieval proportions and RT differences. In the present study, participants in one group were asked to decide if they had accessed additional information during recall, which implies generative retrieval, and participants in a second group were asked to decide whether the memory was retrieved without recalling additional information, which implies direct retrieval. Based on these earlier findings, I expected that the proportions of direct and generative retrievals and corresponding RT values would be equal for the two question formats. If the proportions of direct and generative retrievals in response to first presentations are comparable to those reported in Experiments 1, 2, and 3, and if the same RT differences are observed, I could conclude that our participants were not confounding time and effort with memory retrieval during Experiments 1, 2, and 3. Moreover, I would conclude that we have made a valid distinction between the direct and generative retrieval of autobiographical memories.

As indicated previously, positive and negative priming accounts lead to competing predictions. The positive priming account predicts that as the number of cue repetitions increases (a) the prevalence of direct retrieval should increase, (b) average RT should decrease, and (c) RT for generative retrieval should decrease. In contrast, the negative priming account predicts that as the number of cue repetitions increases, (a) the prevalence of direct retrieval should decrease, (b) the average RT should increase, and (c) RT for generative retrieval should increase. Both accounts agree that RT for direct retrieval should remain constant as the number of cue repetition increases.

Method

Participants. Four hundred and seventy-three undergraduates from the University of Alberta (321 females, *median age* = 19; 152 males, *median age* = 19) participated to receive course credit. Participants were tested individually in a procedure that took approximately 30 minutes.

Procedure. In Phase-1, 14 T-DECs were collected from each participant (i.e., seven people that s/he met frequently and seven locations s/he had visited frequently during the past five years). On each trial, the participant was randomly asked to name a person or location. Response restrictions for T-DECs (e.g., uniquely identifiable response, exclusion of immediate family members, avoiding vague location) were identical to those used in the previous chapter. Participants typed their responses into an input field using no more than 16 words.

In Phase 2, participants were presented with their T-DECs and were asked to recall a T-DEC-related autobiographical memory. Autobiographical memory criteria were identical to those used in the previous studies (e.g., the event should have occurred at a specific time and location, the event should have involved the participant). Some of the T-DECs (four people and four locations) were presented only once. Some (one person and one location) were presented on two successive trials. Some (two people and two locations) were shown repeatedly on three consecutive trials. Therefore, there were 24 trials consisting of eight single presentations, two double and four triple presentations in Phase 2. Repetition orders were randomized among participants with the restriction that same repetition type (e.g., two double presentations) could not follow each other.

Participants pressed the SPACEBAR (stopping the RT timer) as soon as an appropriate memory came to mind. Afterwards, in a *direct-menu* condition, participants were presented with the statement, “This memory was triggered by the cue word, so I did not have to use information about my life to help me recall this memory.” Participants pressed either the “Y” key, which implied a directly retrieved memory or the “N” key, which implied a generative retrieval. Participants in a *generative-menu* condition were presented with the statement, “This memory wasn’t triggered by the cue word so I had to use information about my life to help me recall this memory.” They pressed either the “Y” key to indicate that they had used additional information to recall the memory (generative retrieval), or the “N” key, implying direct retrieval. Afterwards, respondents provided a brief 15-16 word description of the event. Similar to previous studies, a maximum of 90 seconds was enabled to recall a memory.

Results

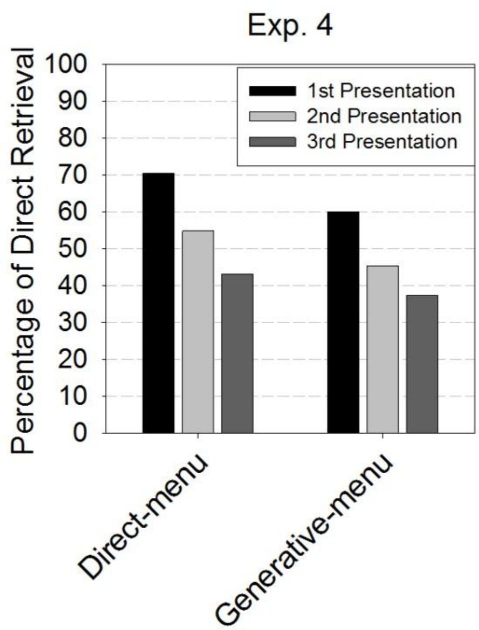
Thirty-nine cues failed to produce memories within the 90-second time limit. Unacceptable responses (N = 472) were eliminated from further analyses, leaving 10,840 potential trials (N = 10,127 specific memories; N = 713 non-specific memories). An additional 451 observations with RTs equal to or greater than the 2.5 standard deviations away from their group means were also excluded, leaving 10,389 (N = 9690 specific memories; N = 699 non-specific memories) analyzable trials.

The analyses used were the same as in the previous chapter. I fitted an LME regression model using the log RT as the dependent variable, with cue type, memory content, repetition type, retrieval strategy, and strategy format as fixed factors; and individual participants, cues, and the order in which T-DECs were reported by the participant (i.e., T-DEC order) as random factors. All main effects, two-way, three-way, four-way, and five-way interactions were investigated using a stepwise variable elimination method. Predictors that turned out to be non-significant were removed from the model fit. Bonferroni post-hoc tests were conducted where necessary.

Strategy Prevalence, Repetition Type, and Cue Types. Strategy prevalence data indicated that direct retrieval substantially declined with cue repetition. First presentations elicited a 65% direct retrieval, second presentations elicited a 50% direct retrieval, and third presentations elicited a 40% direct retrieval. A Logistic Mixed-Effects Model analysis confirmed that first presentations elicited more direct retrieval than second ($b = 0.82$, $z = 15.12$, $p < .001$) and third presentations ($b = 1.35$, $z = 20.85$, $p < .001$). Second presentations also elicited significantly less direct retrieval than third presentations ($b = 0.54$, $z = 7.46$, $p < .001$). These findings support the negative priming account.

Another analysis was whether frequency of direct retrieval was similar across the two forms of the strategy question (*direct-menu/generative-menu*). The direct-menu group (62%) resulted in more directly retrieved autobiographical memories than the generative-menu group (53%; $b = 0.54$, $z = 4.05$, $p < .001$). This difference suggests the presence of a modest affirmation bias. Nevertheless, the proportion of direct retrieval was high in the two strategy question groups. Furthermore, direct retrieval decreased with cue repetition in both strategy questions. Namely, in both direct-menu and generative-menu conditions, first presentations produced the highest rate of direct retrieval (71% *direct-menu*, 60% *generative-menu*), followed by second presentations (55% *direct-menu*, 45% *generative-menu*), and third presentations (43% *direct-menu*, 37% *generative-menu*; Figure 11). This was also supported by a non-significant interaction between the question format and repetition type on strategy frequencies ($p > .05$).

Figure 11. *Percentage of direct retrieval by question format and repetition type*



When cue types were taken into account, there was no difference between directly retrieved autobiographical memories cued by people - (58%) and location- (57%) type T-DECs ($p > .05$). This finding is consistent with the previous findings. Cue type and repetition type did not interact on strategy frequencies ($p > .05$).

Overall, these results imply that repeated exposure to the same cue decreases direct retrieval, which favors the negative priming account.

Repetition Type, Retrieval Strategy, Strategy Question, Cue Types, and RT. Memories were retrieved more slowly with the number of cue repetitions as predicted by the negative priming account (*MD* = 2.88s *first presentation*, *MD* = 3.24s *second presentation*, *MD* = 4.55s *third presentation*). The result of the LME analysis indicated that the RT for first presentations was significantly faster than the RT for third presentations (b = -0.26, p < .001). Second presentations also elicited significantly faster retrievals than third presentations (b = -0.25, p < .001). The RT difference between first and second presentations was not significant (p >.05).

Consistent with the previous findings, direct retrieval (*MD* = 2.37s) was faster than generative retrieval (*MD* = 4.75s; b = -0.54, p < .001). As illustrated in Figure 12, the speed of directly retrieved and generated memories is characterized by two different distributions with some degree of overlap. This implies that the participants were able to distinguish memories that were directly triggered by the cue from those that had to be recalled after searching for additional information. The direct-menu (*MD* = 3.11s) and generative-menu (*MD* = 3.18s) groups had comparable RT values. There was no main effect of a strategy question on RT (p > .05). However, the interaction between retrieval strategy, repetition type, and strategy question (b = -0.17, p < .05) revealed that the two groups displayed different patterns with respect to the relationship between retrieval strategy and cue repetition.

Figure 12. *Reaction time frequency distributions (top) and cumulative distributions (bottom)*

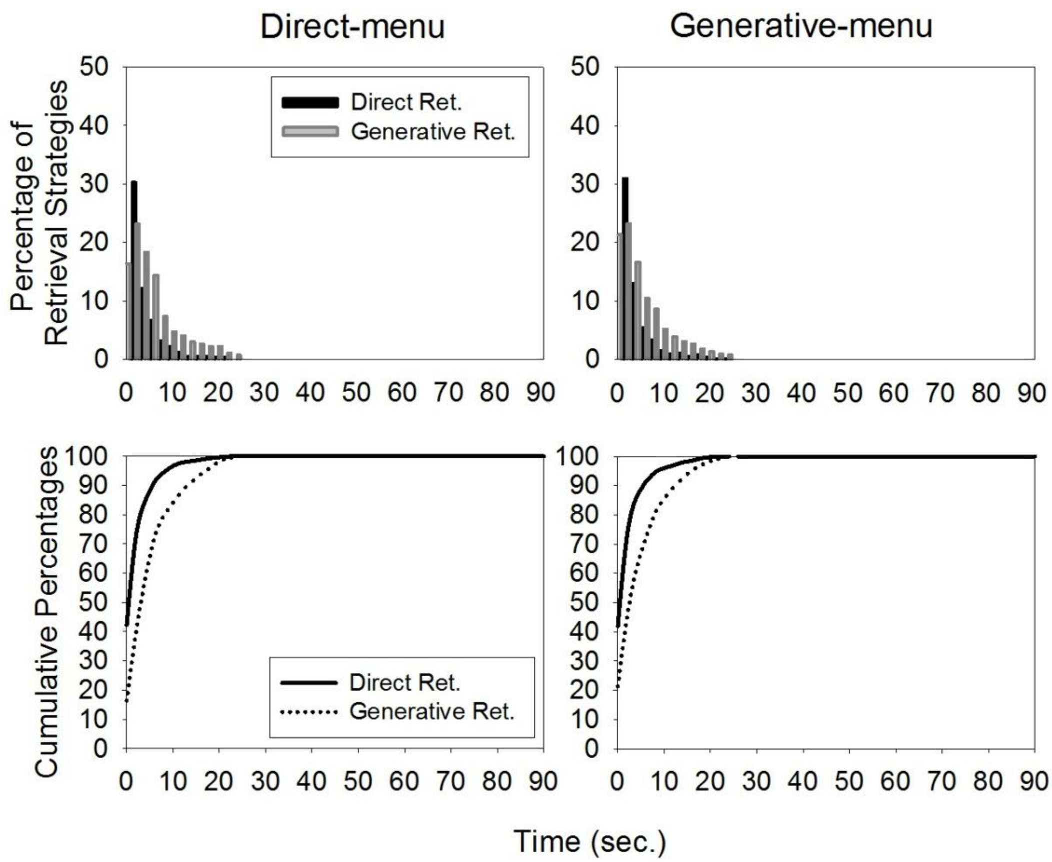
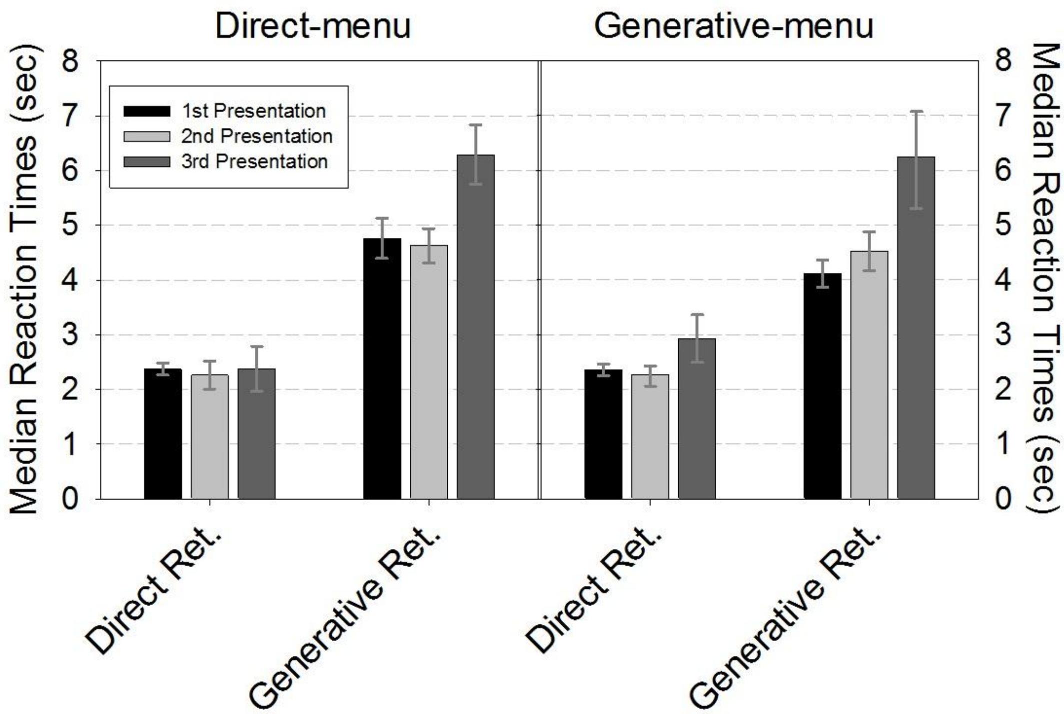


Figure 13 provides a graphical representation of the interaction between retrieval strategy, repetition type, and strategy question on RT. For participants who received the direct-menu, RTs for directly retrieved memories cued by first (*MD* = 2.37s), second (*MD* = 2.26s), or third (*MD* = 2.38s) cue presentations did not differ ($p > .05$). But generated memories in response to first presentations (*MD* = 4.76s) were retrieved faster than generated memories in response to third presentations (*MD* = 6.29s; *Mean Difference* = -0.21, 95% CI [-0.30, -0.12], $p < .05$). Generative retrievals for second presentations (*MD* = 4.62s) resulted in faster RT than those for third presentations (*Mean Difference* = -0.23, 95% CI [-0.32, -

0.14], $p < .05$). The RT difference between first and second presentations for generative retrievals was not significant ($p > .05$).

Figure 13. *Median reaction time by retrieval strategy, repetition type and question format*



Participants who were presented with the generative-menu demonstrated a different pattern. For this group, direct retrievals for first presentations (*MD* = 2.36s) had a faster RT than direct retrievals for third presentations (*MD* = 2.93; *Mean Difference* = -0.24, 95% CI [-0.33, -0.13], $p < .05$). Second presentations (*MD* = 2.27s) also elicited significantly faster direct retrievals than third presentations (*Mean Difference* = -0.24, 95% CI [-0.35, -0.14], $p < .05$). The RT difference between first and second presentations was not significant ($p > .05$). Generated memories resembled directly retrieved memories in the direct-menu group. Generated memories recalled in response to first presentations (*MD* =

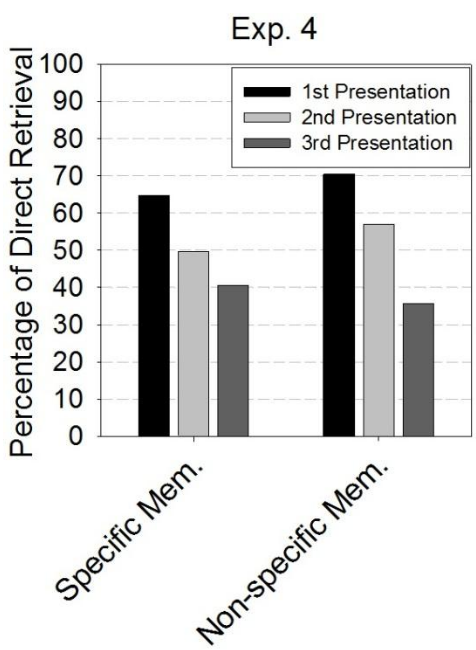
4.12s) were retrieved faster than generated memories recalled in response to third presentations (*MD* = 6.24s; *Mean Difference* = -0.26, 95% CI [0.34, -0.17], $p < .05$). Generative retrievals for second presentations (*MD* = 4.53s) also had a faster RT than those for third presentations (*Mean Difference* = -0.25, 95% CI [-0.34, -0.16], $p < .05$). The RT difference between first and second presentations for generative retrievals was not significant ($p > .05$). Interestingly, cue repetition also increased RT for directly retrieved memories in this group. When the same cue is presented three times, the third directly retrieved memory is accessed with more of a delay.

These results are also consistent with the negative priming account. Cue repetition impacts the speed of generated and directly retrieved memories differently. RTs for generative retrieval increase with the number of cue repetitions, and the speed of direct retrieval is only unaffected in the generative-menu group. The reason why RTs for directly retrieved memories increase with cue replication in direct-menu group requires further investigation.

Consistent with previous research, there was no RT difference between autobiographical memories cued by people - (*MD* = 3.03s) and location- (*MD* = 3.23s) type T-DECs ($p > .05$). Cue repetition did not affect the relation between retrieval strategy and cue type as indicated by a non-significant interaction between repetition type, retrieval strategy and cue type ($p > .05$).

Memory Content, Retrieval Strategy, Repetition Type, Strategy Question, and RT. A coding framework identical to the one presented in the previous chapter was applied to distinguish between specific and non-specific memories. Level of agreement was again high (90%) among coders. Most of the reported memories (93%) were specific events as demanded by the instructions (N = 9690) in this experiment. Direct retrieval was very common among both non-specific (63%) and specific memories (57%). LME analysis indicated that non-specific memories were more likely associated with direct retrieval than with specific memories ($b = -0.24$, $p < .05$). A lack of interactions between repetition type, memory content, (Figure 14) and cue type indicated that this pattern held for all levels of repetition and both T-DEC types ($p > .05$). Furthermore, the strategy question did not affect memory content ($p > .05$). The present study indicates that general events are more likely associated with direct retrieval than with specific instances. However, directly retrieved, specific memories were more common than directly retrieved, general events. Thus, we can conclude that the prevalence of direct retrieval does not arise from retrieving general events.

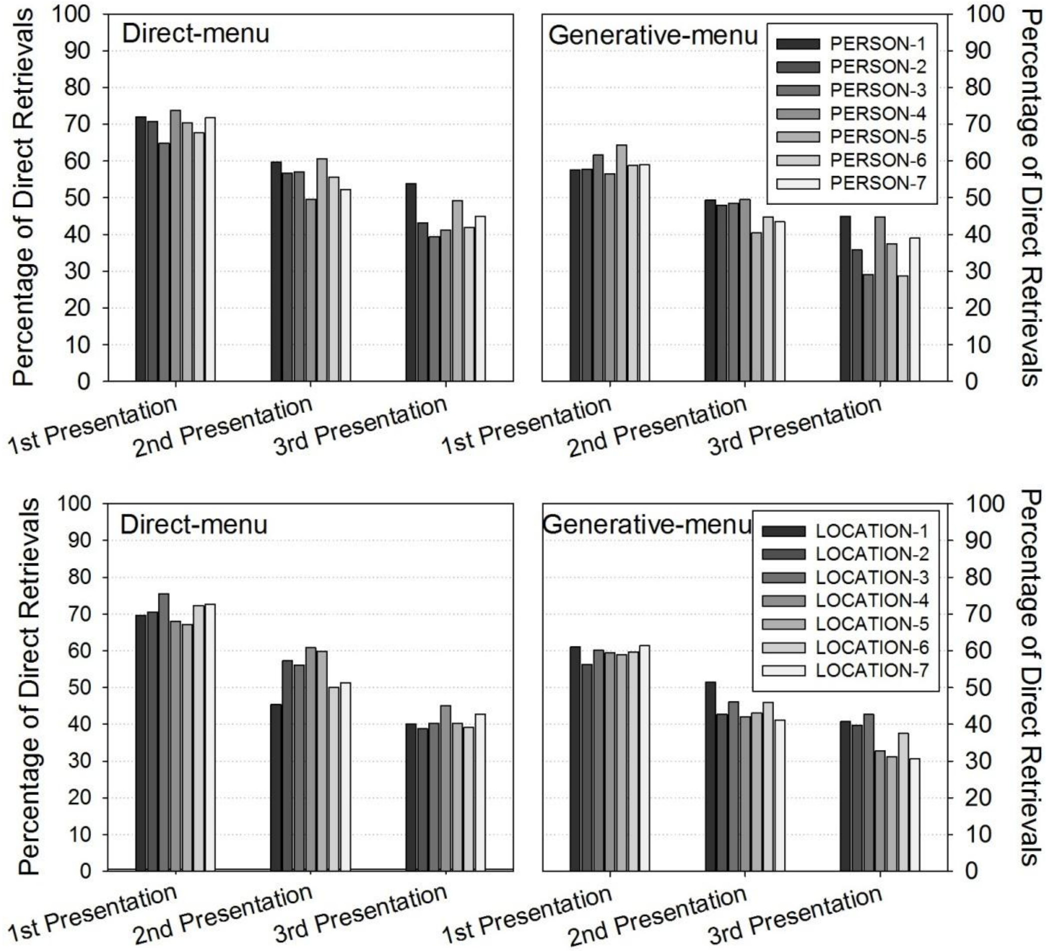
Figure 14. *Percentage of direct retrieval by memory content and repetition type*



There was no difference in overall retrieval speed ($p > .05$) between non-specific (*MD* = 2.43s) and specific event memories (*MD* = 3.19s). The RT for non-specific memories (*MD* = 2.27s *first presentation*, *MD* = 2.56s *second presentation*, *MD* = 3.40s *third presentation*) was not different from the RT for specific memories for each level of cue repetition (*MD* = 2.95s *first presentation*, *MD* = 3.28s *second presentation*, *MD* = 4.62s *third presentation*; $p > .05$). Direct retrieval was also equally fast (*MD* = 2.40s *specific memories*, *MD* = 2.00s *non-specific memories*) and generative retrieval was equally slow for specific (*MD* = 4.79s) and non-specific memories (*MD* = 4.00s; $p > .05$). All other possible interactions between memory content, repetition type, strategy question, and cue type were non-significant. These results indicate that memory content did not influence the relationship between other variables of interest (e.g., repetition type) and memory retrieval.

T-DEC Order, Repetition Types, and Strategy Prevalence. The order in which participants generated people and locations from their lives was also entered as a random factor in the analyses. In this way, a control was established for the possibility that T-DECs recalled early during Phase 1 might elicit more direct retrieval than those elicited later. As displayed in Figure 15, T-DEC order did not have an effect on direct retrieval. Thus it cannot be argued for example that the most available T-DECs (i.e., the one recalled first) were more likely to elicit directly retrieved memories than less available T-DECs (e.g., the one recalled last).

Figure 15. *Percentage of direct retrieval by repetition type, T-DEC order, and question format*



Discussion

In previous research, I found that it is common to directly retrieve autobiographical memories in response to word cues and personal cues. This finding raises an interesting issue: why are we not bombarded by directly retrieved memories cued by every-day familiar surroundings? For instance, every time we walk from home to work, we see the same streets, houses, parks, restaurants, and supermarkets on our way, but most of the time, none of these familiar locals trigger memories. To understand why cues do not always give rise to a memory, I first attempted to determine which circumstances would decrease or increase direct retrieval. For example, does recalling an experience with a friend named John activate other John-related memories so that it becomes easier and faster to recall one when John is repeated as a cue the second time? Or does the John-related memory recalled first impair access to other John-related memories? For this purpose, the present study investigated how repeated exposure to the same cues affects the direct retrieval of personal memories.

Above, I considered two ways that cue repetition might affect direct retrieval, and hence influence the frequency of involuntary memories. The positive priming account suggests that direct retrieval should increase when autobiographical memories are primed by the same cues repeatedly. Alternatively, the negative priming account argues that cue repetition should decrease direct retrieval. I compared these approaches by asking participants to retrieve memories in response to multiply presented T-DECs. Some of these T-DECs were presented only once; others were shown on two or three successive trials. Retrieval time and a measure of information use during retrieval were collected on each trial. I found that the prevalence of direct retrievals dropped rapidly as the number of cue repetitions increased. This finding favors the negative priming account and suggests that repeated exposure to the same cue decreases accessibility of some autobiographical memories, at least temporally.

I also found that memories were retrieved more slowly as the number of cue repetitions increased. However, direct retrieval and generated retrieval were affected in different ways. In general, generation became more difficult as the number of cue repetitions increased. This is consistent with the negative priming research, and implies that repeated retrieval makes it difficult to access associated memories.

In contrast, direct retrieval times were unaffected or little affected by cue repetition. Interestingly, we also observed that this relationship was further modified by how I the retrieval question was asked. More specifically, when participants confirmed that they did not use additional information to recall the memory, the speed of directly retrieved memories was unaffected by cue repetition. However, when participants said that they did not need additional information to recall the memory, retrieval times for directly retrieved memories increased as the number of cue repetitions increased. Direct retrieval, which is a fast and direct route, should take the same amount of time regardless of how many times the cue is repeated. Why one type of strategy question format failed to show this pattern requires further research. Nevertheless, the way cue repetition impacts retrieval strategies is generally quite consistent with the negative priming account and completely inconsistent with the positive priming account's predictions.

Although there appeared to be a modest confirmation bias in response to strategy questions, direct retrieval was common in the present study. Moreover, memory content analyses confirmed that direct retrieval was not restricted to the retrieval of non-specific event memories. There was a concern as to whether the order in which participants provided their T-DECs would influence the rate of direct retrieval. These analyses also implied that the T-DEC generation order did not affect the frequency with which direct retrieval occurred.

Overall, the results of the present study support the negative priming account, and suggest that repeated exposure to the same cue hinders accessibility of other memories. Positive priming of autobiographical memories occurs when the prime word is presented soon before the target cue word, and the person is asked to provide a memory in response to the target word (Conway, 1990; Conway & Bekerian, 1987; Reiser et al., 1985). In event clustering studies (N. R. Brown, 2005; N. R. Brown & Schopflocher, 1998a, 1998b) and the IMC phenomenon (Mace, 2005, 2006, 2009, 2010), recalling the first memory facilitates the recall of the second, which has at least one element in common with the first. Therefore, when the person is presented with the prime cue or memory once, prime cue's or memory's partial activation spreads and similar items or memories are also activated, which in turn speeds up their processing and makes them a more likely response for a later stimulus. However, when the same item or cue has to be repeated to prompt a memory, accessing the associated memories becomes harder. This has been observed with the RIF effect. Here, the negative priming effect was replicated with a different autobiographical memory task, one which required participants to retrieve personal memories in response to the same cues repeatedly.

If cue repetition reduces the direct retrieval and slows the retrieval process, then what is the mechanism responsible for this decline? Interference and inhibition have been proposed to explain how repeated retrieval impairs recall performance. Proponents of the inhibition theory suggest that inhibitory processes are employed to suppress inappropriate responses (M. C. Anderson, 2003; M. C. Anderson & Spellman, 1995; Levy & M. C. Anderson, 2002). For example, in explaining RIF effect, M. C. Anderson et al. (1994) assume that during the practice session studied items from the same category (Rp+ and Rp-) are competing with each other. Because of this competition, non-target items (RP-) are suppressed and, as a consequence, are less likely recalled on the final recall test. In other words, inhibition is considered an active process, which is initiated to reduce the activation of competing memory traces. On the other hand, according to classical interference theory (McGeoch, 1932, 1942), when there is a competition between two or more items associated with the same cue, the probability of retrieving the target item reduces. Thus, interference is considered a passive process that does not require actively inhibiting memory traces. The target memory is less likely to be retrieved because there is a change in the strength of the connection between memory traces. This also refers to another important difference between inhibition and interference. In inhibition, the memory trace itself is inhibited. In interference, forgetting occurs because the competition between memories related to the cue increases, and as a result the cue becomes weaker to activate the target memory (M. C. Anderson & Neely, 1996; Camp, 2006).

Related to the cueing paradox and negative priming literature, Levy and M. C. Anderson (2002) also discussed the mechanisms that allow people to limit awareness of interfering memories. They propose that the ability to control distracting memories is achieved by an executive-control system. An executive-control system (i.e., central executive or supervisory attention system) generally refers to abilities that enable people to inhibit their thoughts and use their attention in a goal-directed way (e.g., Baddeley, 1986; Norman & Shallice, 1986; Posner & DiGirolamo, 2000; for a review see Gathercole, 2008). Levy and M. C. Anderson (2002) argue that executive-control systems recruit inhibitory processes to eliminate competition from distracting information so that relevant response can be selectively given. Consistent with this argument, previous research showed that intrusive memories might be related to deficits in executive control functioning such as difficulty in inhibiting interference from irrelevant information (Brewin & Beaton, 2002; Brewin & Smart, 2005; Kane & Engle, 2000; Lustig, Hasher, & May, 2001; Rosen & Engle, 1998; Verwoerd & Wessel, 2007; Verwoerd, Wessel, & de Jong, 2009).

Both inhibition and interference accounts correctly predict that as the number of cue repetitions increases the prevalence of direct retrieval and average RT should increase. In other words, this study cannot differentiate whether inhibition or interference is responsible for the reduction in direct retrieval. Because an empirical investigation was required to determine whether cue repetition would increase or decrease direct retrieval, the present study was specifically designed to test between positive and negative priming possibilities rather than to compare the inhibition and the interference alternatives.

To further differentiate between inhibition and the interference account, this study could be extended by introducing a lag manipulation. For instance, while some cue words would be presented only once (e.g., JOHN, LIBRARY, TABLE), some would be shown repeatedly in one trial after another (e.g., BOX, BOX). Some would be presented twice but with a one filler word interval (e.g., JODI, CAR, JODI), and others would be presented twice but with a two filler words (e.g., HUB MALL, ASHLEY, CUP, HUB MALL) interval. We expect that there should be more directly retrieved autobiographical memories in response to the first presentation than in response to the second presentation with zero filler word interval. If we observed this pattern, this would replicate the present experiment and confirm that direct retrieval decreases with cue repetition.

Importantly, the interference and the inhibition views make different predictions concerning the way that delay might affect cue repetitions. Proponents of the interference account hold that activation between the cue and the memory recalled in response to the cue diminishes as the interval between identical cues increases. Thus, as lag increases the previously recalled memory should be less likely to interfere with other cue-related memories. Therefore, the frequency of direct retrievals should increase again in response to the second presentation with one and two filler words intervals, according to the interference view. In contrast, supporters of the inhibition account argue that when people retrieve the target memory in response to the cue, all competing memories are inhibited. Hence, the inhibition account predicts that direct retrievals will decrease further or at least will not increase further with intervals.

To sum up, I have already demonstrated that when people are asked to remember personal memories in response to random words or more familiar elements from their lives, such as their friends, much of the time they do so without much effort. This brings up an interesting question: why do these spontaneously retrieved memories not take place all the time? In searching for an answer to this question, my first step has been to investigate the prevalence of directly retrieved memories when people were exposed to the same cues multiple times. I conclude that presenting same cues repeatedly impairs direct retrieval.

Another important step in understanding the cue paradox is to figure out which mechanism (e.g., interference or inhibition) is responsible for this inability to easily retrieve a memory. Understanding these mechanisms is also important in helping us to identify how unwanted/irrelevant items become inaccessible. This, in turn, helps us to make more efficient use of our memories. For instance, in the case of autobiographical memory retrieval, is the inhibition process operating to provide selective retrieval, as Conway (2005) suggested? Or can interference explain the cue paradox?

The RIF procedure provided some alternatives (e.g., the independent cue probe) to differentiate between interference and inhibition in memory when studying the list-learning type of material. In the independent cue probe studies, the category cue in the final test was a new category (i.e., it had not been studied in the study phase). The new category was semantically associated with studied exemplars. For example, participants studied GREEN- lettuce, GREEN- emerald and SOUP – mushroom and they were presented with the category word VEGETABLE on the final recall test. The RIF effect was observed with an independent cue-probe task. This finding supports the inhibition account because the inhibition account holds that unpracticed items from practiced categories (Rp) are inhibited. Therefore, the inhibition account predicts the RIF effect with any other cue associated with Rp- items. Conversely, followers of the interference account propose that the category cue activates Rp+ items. This strong activation to Rp+ items prevents access to the Rp- items. If a new category cue which does not activate Rp+ items is presented, there should be no RIF effect (M. C. Anderson & Bell, 2001; M. C. Anderson, Green & McCulloch, 2000; M. C. Anderson & Spellman, 1995; Camp, 2006; Goodman, 2005; Hughes, 2005; William & Zucks, 2001). However, as Barnier et al. (2004) mentioned, adapting an independent cue technique to complex autobiographical memories is difficult and may lead to complications. For instance, a target cue word (e.g., happy) and its semantically related counterpart (e.g., pleased) might not be equally related to the same memory. Thus, I suggest that further appropriate modifications of this cue repetition study (e.g., the extension study proposed above) would provide a more plausible method to test interference and inhibition accounts with autobiographical memories.

To restate, the present study indicates a negative effect of cue repetition in retrieving autobiographical memories. This demonstration is novel and theoretically interesting. Furthermore, I suggest that this cue repetition design and its further revisions can provide an efficient method to explore more issues related to how and when memories become less accessible.

Chapter IV

SUMMARY AND CONCLUSIONS

The focus of the present project is understanding how people recall autobiographical memories. Remembering past experiences is an important act that we often perform without appreciating its significance. In fact, recalling personal memories is central in many cognitive aspects of daily life (Reiser et al., 1985), such as learning, comprehending, planning, and problem solving (Kolodner, 1983; Mace, 2010; B. H. Ross, 1984; Schank, 1982). We encode our life experiences and store traces of many encoded experiences. Consequently, we have many memories available. However, without retrieval processes these mnemonic representations of the past cannot be converted into conscious experience, and remembering cannot take place. Therefore, retrieval processes are critical (Roediger, 2000; Tulving, 1983, 1991). Many researchers have pointed out the critical role of retrieval processes in understanding memory (Bartlett, 1932; Köhler, 1947; E. F. Loftus & G. R. Loftus, 1980; Mace, 2010; Melton, 1963; Neisser, 1967; Roediger, 2000; Roediger & Guynn, 1996; Tulving, 1991). For example, Tulving and Thompson's encoding specificity research (1973) implies that whether we remember something depends not only on how we encode the event but also how retrieval processes and retrieval cues interact with encoding conditions. Tulving (1991) also states that stored information is an essential condition for the act of remembering, but stored information cannot be understood and identified in the absence of retrieval.

In sum, understanding the processes involved in retrieving autobiographical memories is important in understanding autobiographical memory and other related cognitive activities. It is also essential to consider retrieval processes because the act of retrieval may tell us how memories are represented and how people recover these memories based on the context and retrieval cues.

There are different ways to retrieve memories. We sometimes remember our previously experienced events after an effortful search (i.e., generative retrieval). At other times, a memory can come to mind without any apparent effort (i.e., direct retrieval). As noted above, differences in accessing our memories may result from what is stored and also from the characteristics of available retrieval cues. This project took into consideration the importance of cues and the context for understanding autobiographical memory retrieval. To that end, it addressed an empirical issue concerning how frequently people directly retrieve memories in response to real-life cues, word cues, and repeating cues. The studies reported in this thesis indicated that direct retrieval is the default process when recalling autobiographical memories in response to word cues and real-life cues. It was also found that access to memories is obstructed in situations where retrieval requires remembering events in response to the same cues multiple times.

For many years, autobiographical memory researchers have employed cue-word method to elicit autobiographical memories. In many of these, researchers have manipulated the nature of the cues presented to their participants and then measured the time required for participants to retrieve cue-related personal memories. (Conway & Bekerian, 1987; Fitzgerald, 1980; Larsen & Plunkett, 1987; Robinson, 1976; Schalgman & Kvavilashvili, 2008). For the most part, these researchers assume that people always rely on a generative retrieval strategy when confronted with word cues or phrase-length cues. Under this assumption, generation is more difficult when people have to reformulate the cue to recall an appropriate memory. In contrast, generation is easier when cues readily access cue-related memories through strong associative links. These researchers interpret retrieval times as an index of the effort required to generate a memory. Therefore, they claim that retrieval is slower when generation process is difficult (i.e., the former), and retrieval is faster when generation doesn't require much effort (i.e., the latter). While researchers who use the Crovitz cue-word method (Crovitz & Schiffman, 1974) and its variants emphasize generative retrieval psychologists who study involuntary memories focus on direct retrieval. Involuntary memory research indicates that external and internal cues elicit an automatic and effortless retrieval of specific autobiographical memories, and that this form of retrieval is observed in natural settings (Ball & Little, 2006; Bertnsen, 1996,1998, 2009; Mace, 2007).

In brief, both generative and direct retrieval have been reported in autobiographical memory literature. However, the extent to which direct and generative retrieval are common in recalling autobiographical memories remained an empirical question. Uzer et al. (2012) responded to this question and demonstrated that direct retrieval is at least as common as generative retrieval in recalling word-cued autobiographical memories. This finding argues against the commonly held belief that personal memories are usually generated in studies that use the Crovitz word-cueing task (Conway & Pleydell-Pearce, 2000; Haque & Conway, 2001; Rubin, 1998; Rubin & Schulkind, 1997a, 1997b; cf. Conway, 2005, Reiser et al., 1986). The authors also replicated the classic cue-type effect and found that participants were faster at retrieving autobiographical memories when they were cued with object terms than when they were cued with emotion terms (Conway & Bekerian, 1987; Fitzgerald, 1980; Larsen & Plunkett, 1987; Robinson, 1976). Uzer et al. (2012) accounted for this effect by demonstrating that participants were more likely to directly retrieve an event memory when they were cued with an object term. In addition, these authors argued that the prevalence of direct retrieval implies the existence of pre-stored representations and suggests that these representations are very common. Therefore, this study provided an empirical challenge to the SMS model and other strongly reconstructive accounts of autobiographical memory (Bluck et al., 2010; Bluck & Habermas, 2000; Botzung et al., 2008; Burgess & Shallice, 1996; Conway, 1990, 2005; Conway & Bekerian, 1987; Conway & Loveday, 2010; Conway & Pleydell-Pearce, 2000; Conway et al., 2004; Grysman & Hudson, 2011; Mace, 2007, 2010; Sumner et al., 2011; J. M. G. Williams et al., 2007).

Uzer et al. (2012) studied direct retrieval with word cues. The next step was using cues from people’s own lives. Chapter II presented three experiments that investigated the frequency of directly retrieved autobiographical memories cued by personally relevant cues (T-DECs). Specifically, Experiment 1 and Experiment 2 compared the proportions of directly retrieved memories cued by person, location and activity cues to those cued by concepts. T-DEC cues were collected in the lab in Experiment 1. To avoid priming T-DEC related memories, in Experiment 2 participants provided their T-DECs a couple of months before coming to the lab (i.e., during mass testing). Experiment 3 focused on comparing the retrieval efficacy of person, location, activity and possession cues. In all three experiments, on each trial, RT was measured, and participants reported their retrieval strategy by selecting one of two options: “The memory came almost immediately into mind” or “I had to actively search to find the memory.”

One motivation for collecting these data was to determine whether direct retrieval is more common when participants are presented specific and individuated cues (such as the name of a friend or the name of a location) than when they are presented with generic cues such as object terms. Another motivation was to assess how well the current autobiographical memory models explain the relationship between cue content and the retrieval of autobiographical memories. The SMS model and Transition Theory differ in the assumptions they make concerning the organization, representation, and retrieval of autobiographical memories. Furthermore, these two models make competing predictions concerning the way that autobiographical memories are retrieved in response to personal cues and object cues. For instance, the SMS theory suggests that life-time periods (e.g., college years), general events (e.g., driving to school every day), and event-specific knowledge are the basic units. These units are represented as a hierarchically connected network in the autobiographical knowledge base. In this model, it is assumed that specific autobiographical memories are almost always retrieved as a result of a top-down search and reconstruction process that gathers information from these three levels.

In contrast, Transition Theory proposes that T-DECs are the basic units, and they define the content and organization of autobiographical memories. Another organizational element is the life-time period. A major life-time period is the timespan that falls between major transitions, and each life-time period consists of a fairly stable set of T-DECs. In Transition Theory's view, transitional events organize autobiographical memory by marking the end of one period, and the beginning of another.

Based on these arguments, the SMS theory predicts that, regardless of cue type (i.e., T-DECs or object terms), generative retrieval should be more common than direct retrieval in retrieving autobiographical memories. Alternatively, the Transition Theory predicts that T-DECs should elicit more direct retrievals than object terms.

Three experiments showed that person, location, activity, and possession cues elicited a high rate of directly retrieved autobiographical memories. Participants were more likely to use direct retrieval when they were cued with T-DECs than when they were cued with object terms, and as a consequence, they were responded faster, on average, to the former than to the latter.

Consistent with Transition Theory, these results imply that autobiographical memory is likely to contain many pre-stored event representations, which are indexed by T-DECs. T-DECs define the content and organization of autobiographical memories, and they provide the closest link between memories. Therefore, when people are cued with their own T-DECs, these cues easily and frequently evoke a memory. Together with research presented by Uzer et al. (2012), set of findings indicate that autobiographical memories typically are not retrieved by reconstructing event representations from a hierarchically structured knowledge-base. Therefore, these data imply a serious revision for models proposing such types of structural and process assumptions (e.g., SMS theory).

The prevalence of direct retrieval in response to real-life cues raises a paradox– why are we not overwhelmed with directly retrieved memories cued by every-day familiar surroundings? To answer this question, I first wanted to understand whether repeated exposure to a cue decreases or increases the frequency of direct retrieval.

It is common in life to encounter the same stimulus many times. Take, for example, my daily routine in the office. I walk in my office every morning and sit on my office chair. I turn on my computer and organize my office table. I check my e-mails and respond to them. Then I start to read or write for my research etc. So, every time I walk in my office I see all these objects in the office, and during my stays I actively use some of these objects multiple times. I have many past experiences related to these objects. However, these objects do not constantly remind me of prior experiences.

Motivated by the cue paradox, Chapter III explored how repeated exposure to the same cues impacts the prevalence of direct retrieval. In Experiment 4, participants were required to retrieve memories in response to their

T-DECs. Some of these T-DECs were presented only once, others were presented on two or three successive trials. Retrieval time and a measure of information use during retrieval were collected on each trial.

The literature on memory retrieval indicates that retrieval of some memories can influence retrieval of others. Some researchers focus on positive priming and point out that retrieving a memory facilitates retrieving other memories (Bäuml & Samenich, 2012; Geiselman, Fisher, MacKinnon, & Holland, 1985; Mace, 2005, 2006, 2009; McDermott & Watson, 2001; McNamara, 2005; Roediger, Balota, & Watson, 2001; Roediger & McDermott, 1995). In contrast, others have found retrieval to be a self-restricting process; in other words, retrieval can sometimes impede retrieval of other information (M. C. Anderson, 2003; M. C. Anderson et al., 1994; M. C. Anderson et al., 2000; M. C. Anderson & McCulloch, 1999; Bäuml & Hartinger, 2002; Bauml & Samenieh, 2012; Mueller & Watkins, 1977; Roediger, 1973,1974; Rundus, 1973; Slamecka, 1969; Smith & Hunt, 2000; Watkins, 1975;). Positive priming is thought to occur as a result of spreading activation (e.g., Collins & E. F. Loftus, 1975; McNamara, 2005) from the prime cue to its associated memories. Negative priming is explained by an increased competition between memories associated with the same cue (i.e., interference) or by an active suppression of memory traces associated with the same cue (i.e., inhibition). Considering previous literature on memory retrieval and cue paradox, there were two possibilities on how cue repetition might influence direct retrieval. One possibility (i.e., positive priming) was that cue repetition should increase direct retrieval. Alternatively, direct retrieval should decrease, if autobiographical memories are cued by same items repeatedly.

Results obtained in Experiment 4 indicated that direct retrieval decreased as the number of cue repetitions increased. Cue repetition slowed down the retrieval process. In general, people's search/generation process became more difficult as the number of cue repetitions increased. In contrast, direct retrieval was not affected, or at least it was less affected by cue repetition. Considering the rate with which direct retrieval decreased with cue repetition, we can argue that repeated exposure to the same cue creates a significant impairment in autobiographical memory recall. This result encourages further investigation as to whether interference or an active inhibitory mechanism is responsible for the self-limiting property of retrieval.

In conclusion, the findings of this thesis contribute to the research area, and offer theoretically interesting directions for future research. In the remainder of the chapter, I will review these contributions, examine some issues that need to be addressed, and discuss additional questions that follow from the present set of studies.

Chapter I proposed a dual-strategies approach that disputes generation as the canonical form of autobiographical memory retrieval. The dual-strategy position's main arguments are:

a) Autobiographical memories can be directly retrieved or generated and direct retrieval is common even in response to experimenter-provided retrieval cues.

b) Average RTs are a frequency-weighted blend of two types of responses: fast responses that occur when a memory is directly recalled, and slow responses that occur when generation is required.

c) Averaging over retrieval types, by assuming that memories are always generated, results in unrepresentative RT values that reflect neither one retrieval strategy nor the other.

By taking this process approach and measuring retrieval strategies, Uzer et al. (2012) demonstrated the prevalence of direct and generative retrievals in recalling autobiographical memory. This was important because assessing retrieval processes via RT and a self-reported retrieval strategy provided a reliable technique for studying how common each strategy is and for understanding RT differences obtained in cue-word experiments.

Another important contribution has been to extend how researchers identify retrieval processes and autobiographical memory structures. Prior to this line of research, autobiographical memory retrieval was thought to be a constructive search following a hierarchical path through an autobiographical knowledge base. Lifetime periods, general events, and ESK were considered as basic event representations organized hierarchically. Thus, for example, to retrieve a specific memory, first a life-time period representation must be accessed. Then, it should lead to access to a related general event level. Finally, the general event level should bring ESK. However, the evidence presented in Experiments 1, 2, and 3 demonstrates that specific memories are often directly accessed by personal cues and suggests that autobiographical memory consists of many pre-stored event representations indexed by event components called T-DECs.

This thesis also contributed to our understanding of how memory works in the real world. Particularly, this project is concerned with the conditions of cue effectiveness in autobiographical memory retrieval. For example, I see my office chair every time I walk into my office, and it does not remind me of any memory. But if I were given the cue, “my office chair,” and asked to retrieve an event from my life, I would immediately remember one. This raises the question, what are the conditions under which a cue gives rise to a specific memory? Tulving (1983) argues that simply having had relevant past experience and an overt cue does not guarantee conscious access to the past. In order for episodic retrieval to occur, one must be in retrieval mode. Tulving (1983) also states that “We know next to nothing about retrieval mode, other than it constitutes a necessary condition for retrieval” (p.169). Bertnsen (2009), on the other hand, argues that internal or external cues create the occurrence of unbidden memories, especially when there is a match between the current recall situation and the retrieved memory (e.g., see Tulving & Thompson’s (1973) encoding-specificity hypothesis for a similar argument).

Experiment 4 implies that even when the system is in the retrieval mode (e.g., when participants are required to retrieve a memory) and personally relevant cues (e.g., T-DECs) are used, the probability that a cue brings a memory to mind decreases with the repetition of the cue. Therefore, although the mind may be in a cognitive state that enables stimuli to be processed as retrieval cues (i.e., the retrieval mode), and appropriate cue(s) might exist, repeated stimulation of these cues create a blocking mechanism, which prevents memories from entering consciousness. It could also be that a memory isn't accessed when the same cue is repeatedly presented. In real life, in addition to impairment caused by repeated presentations of many different cues, our attention is often occupied by other tasks (e.g., reading, planning class presentations, etc.). Previous research supports this argument and suggests that involuntary memories mostly occur when the person's attention is diffuse or when the current activity does not produce a high cognitive load (e.g., knitting, washing dishes, etc.; Berntsen, 1996,1998, 2009). Involuntary recollections are considered important to update environmental information (Rasmussen & Berntsen, 2009; Schank, 1982) and to predict where and when something is likely to happen again (Hintzman, 2011). However, they might also be intrusive and maladaptive as observed in Post-Traumatic Stress Disorder (PTSD) (Ehlers & Clark, 2000; Ehlers, Hackmann, & Michael, 2004; Ehlers & Steil, 1995; van der Kolk & Fisler, 1995; Verwoerd & Wessel, 2007; Verwoerd et al., 2009). Although there are different theories (e.g., dual-representation theory) on how intrusive memories might develop (Brewin, Dalglesih, & Joseph, 1996), some researchers believe that such memories are related to deficits in executive control functioning (Brewin & Beaton, 2002; Brewin & Smart, 2005; Kane & Engle, 2000; Lustig et al., 2001; Rosen & Engle, 1998). For instance, research showed a relationship between experiencing intrusive memories and the inability to inhibit interference from irrelevant information (Verwoerd & Wessel, 2007; Verwoerd, et al., 2009). These studies and this thesis indicate that retrieval from autobiographical memory is, much of the time, a non-strategic and effortless process. However, under demanding conditions (e.g., when the same cue is used multiple times to elicit autobiographical memories, when the person is engaged with a cognitively effortful activity), cognitive efficiency is maintained by either a passive interference process resulting from an increased competition between memories, or by the active inhibition of potentially interfering, unwanted recollections.

Further research is required to explore issues related to when memories become less accessible. Experiment 4, for example, can be modified to determine whether a reduction in direct retrieval is caused by interference or inhibition. A multiple cueing study can also be conducted with people suffering from PTSD to see whether people with and without PTSD respond differently to cue repetition.

Another fruitful research direction is investigating the relationship between autobiographical memory specificity and direct retrieval. The literature on depression and over-general memory suggests that individuals suffering from depression have trouble remembering specific memories because their retrieval cycle terminates prematurely at the general event level (J. M. G. Williams, Barnhofer, et al., 2007; J. M. G. Williams, Chan, et al. 2006). In the present project, there was weak evidence showing that general events are directly retrieved more often than specific events. Furthermore, event specificity was not directly manipulated. Therefore, if future studies require people (with and without depression) to retrieve autobiographical memories at different levels of specificity (e.g., specific and general) and measure retrieval strategies, the relations between retrieval processes, event specificity and depression will be identified better.

There are still other questions that need to be addressed, especially those regarding indirect retrieval. Although direct retrieval appears to be the default retrieval strategy when recalling autobiographical memories in the world and in the lab, I believe that we have to learn more about what people do when they deliberately search for specific autobiographical memories.

In the Introduction, I discussed the importance of understanding retrieval processes in understanding autobiographical memory. This thesis provides insight into the retrieval and organization of autobiographical memory. The studies presented above emphasize that direct retrieval is the most typical way of accessing autobiographical memories. This challenges the constructive view of memory and suggests that autobiographical memory system consists of pre-stored event representations, which are largely governed by associative mechanisms. A significant rate of decline in direct retrieval by cue repetition implies that inhibitory processes also influence retrieval. This highlights the idea that our retrieval processes are flexible to ensure optimal use of stored information and limited attention. Put another way, autobiographical memory retrieval has two facets, which operate selectively and adaptively to use memory efficiently. Associative mechanisms are primarily at work. To override dysfunctional side-effects of associative mechanisms, inhibitory processes operate to stop unwanted recollections and prevent constant flow of memories.

Overall, this thesis contributes to theory in the area of autobiographical memory by emphasizing associative nature of retrieval processes as opposed to reconstructive memory notion, and by demonstrating that different cueing conditions influence the way retrieval is facilitated or inhibited. I conclude that utilizing our autobiographical memory system depends on dynamic interplay between associative and inhibitory processes. In the end, I believe that retrieval processes denote how we use our memories efficiently in real-life and that retrieval can be understood as selective use of stored information.

Endnotes

[1] A version of this chapter has been published. Uzer, Lee, & N. R. Brown 2012. Journal of Experimental Psychology: Learning, Memory, and Cognition. 38: 1296-1308.

[2] As noted above, generation and reconstruction refer to different indirect retrieval processes. I rely on the terms “generation” and “generative” when discussing indirect retrieval. This convention has been adopted in part to simplify the exposition and because the data suggest that indirect retrieval is more likely to involve cue generation than memory reconstruction.

[3] Confidence intervals that mix within and between subject responses are not valid for drawing inferences regarding statistical probability and are used here only to illustrate the variability within these data. Instead, I employ linear mixed-effects models to infer statistical differences.

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