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Bilingual Episodic Memory: How Speaking Two Languages Influences Remembering

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Abstract

In this chapter, we consider how bilingualism affects memory for events from one's personal past, such as a person's first day of school many years prior or a conversation held just a few hours ago. We first review studies indicating that the language a bilingual is using at retrieval improves access to experiences that were encoded when that same language was being used. Next, we discuss research showing that how a bilingual encodes and retrieves episodic memories depends on the linguistic structure and cultural associations of the specific language the bilingual is using. Finally, we consider research suggesting that the cognitive and linguistic consequences of long-term bilingual experience can affect encoding and retrieval and might lead bilinguals to show enhanced memory for non-linguistic aspects of events and poorer memory for linguistic aspects. Collectively, these studies reveal that learning and using two languages affects what bilinguals remember and how well they remember it.

Introduction

"What is memory if not the language of feeling, a dictionary of faces and days and smells which repeat themselves like the verbs and adjectives in a speech, sneaking in behind the thing itself, into the pure present…" - Julio Cortázar

A remarkable feat of human memory is the ability to vividly remember details from many past experiences – ranging from meaningful, distant memories, such as a family member's wedding over a decade ago, to mundane, recent memories, like dinner last night. These kinds of experiences, and memories for them (known as episodic long-term memories[1]), are often imbued with language. For example, an event like a wedding contains speech and language in many ways – the bride and groom saying their vows, speeches given by the best man and maid of honor, music with lyrics played during the father-daughter dance, and *thank you* notes sent out after the wedding. Even when language is not overtly present – for instance, during the bride and groom's first kiss after being pronounced husband and wife – language may still be present to some extent, through internal speech (i.e., *self-talk*). Moreover, when a person attempts to retrieve an event like a wedding from their memory, aspects of the event might come to the person linguistically (Schrauf & Rubin, 2000), and memories are often probed and reported through speech and language.

Given the ubiquity of speech and language in events and event retrieval, language is likely to have a strong impact on episodic memory. Indeed, in a classic study illustrating an effect of linguistic framing on event memory, Loftus and Palmer (1974) played a video of a car accident and then asked participants to remember how fast the cars had been moving. Participants who were probed with, *How fast were the cars going when they smashed into each other*? reported that the cars had been moving considerably faster than those who were asked, *How fast were the cars going when they hit each other*? These linguistic effects on episodic memory are not limited to within-language manipulations, as they have also been observed across languages. For instance, Fausey and Boroditsky (2011) compared English monolinguals and Spanish monolinguals on their memory for who was at fault in accidental events. In English, accidental events are often described using agentive language, whereas in Spanish, such events are often described with non-agentive language. (In agentive language, the speaker indicates the subject that performs the action of the verb, e.g., *She broke the vase;* in non-agentive language, the speaker does not include the performer of the action, e.g., *The vase broke*). After watching videos of accidental events, English monolinguals described the events using more agentive language and remembered the agents better than Spanish monolinguals. These studies and others (Fausey & Boroditsky, 2010; Gentner & Loftus, 1979) illustrate how language can affect episodic memory, by capitalizing on linguistic variability within and between languages and examining memory in speakers of a single language. In the present chapter, we consider how knowing and using two different languages influences episodic memory. For the bilingual person, the linguistic aspects of encoding and retrieval can occur in one of their two languages or both. Moreover, bilingual experience shapes a range of linguistic and cognitive processes, some of which may underlie encoding and retrieval of events (Bialystok, Craik, Green, & Gollan, 2009). It is therefore likely that bilingualism exerts an influence on episodic memory over and above the effects found in monolinguals.

This chapter review studies that have examined and identified effects of bilingualism on remembering events. First, we lay the groundwork by delineating the general principles that underlie encoding and retrieval of episodic memories. We then consider three ways in which bilingual experience influences these encoding and retrieval processes. We first discuss findings indicating that the language a bilingual is using at retrieval increases the accessibility of memories that were encoded in a matching language context and decreases access to memories that were encoded in another language context. Then, we review studies indicating that how events are encoded and retrieved depends on the linguistic structure and cultural associations of the specific language the bilingual is using at the time. Finally, we discuss research suggesting that bilingual experience can positively and negatively affect various cognitive and linguistic processes that underlie episodic memory, which, in turn, leads bilinguals to show enhanced memory in certain situations and impaired memory in other situations.

The Functional and Biological Principles of Episodic Memory

In the first section, we outline some general principles of how episodic memories are formed and later recalled, with a focus on processes that, as we discuss later, are influenced by bilingualism. To delineate these principles, let's imagine witnessing two cars approaching each other and then making contact in a minor car accident. The initial step in forming a memory of such an event involves allocating one's attention to aspects of the event while it occurs (Craik, Govoni, Naveh-Benjamin, & Anderson, 1996). If one's visual and cognitive attention are

focused elsewhere (e.g., if you're looking at a map while the cars approach each other, or if you see the cars heading toward each other but are in deep thought about something else), a recording of the car accident might not be encoded very well. However, if attentional resources are devoted to the event, the aspects of the event that are selectively focused on can be successfully encoded – that is, transformed into a mental representation that can be stored in memory. When attention is applied, the observer can encode the different forms of sensory and perceptual information that constitute an event. Such information can be visual, auditory, as well as olfactory (smell), gustatory (taste), and haptic (touch). For example, the car accident scene likely contains auditory stimuli (such as the two cars making contact and post-accident dialogue between the drivers), visual stimuli (such as the faces of the drivers and their respective cars), and other stimuli as well. These different types of stimuli have some commonalities in how they are processed – for example, they are processed by the frontal lobes, which underlie the executive functioning processes involved in controlling attentional resources during encoding (Blumenfeld & Ranganath, 2007; Buckner, Kelley, & Petersen, 1999; Kapur, Craik, Tulving, Wilson, Houle, & Brown, 1994; Otten, Henson, & Rugg, 2001; Postle, Berger, & D'Esposito, 1999). The various aspects of an event also have some notable differences. For instance, there are particular areas of the brain that are devoted to auditory input (e.g., the temporal lobes) and brain areas specialized for visual input (e.g., the occipital lobes). Moreover, in the frontal lobes (and medial temporal lobes), information that is linguistic (e.g., the label *car*) is primarily lateralized to the left hemisphere, and non-linguistic information (e.g., the novel faces of the drivers) is lateralized to the right (Kelley, Miezin, McDermott, Buckner, Raichle, Cohen, Ollinger, Akbudak, Conturo, Snyder, & Petersen, 1998; Wagner, Poldrack, Eldridge, Desmond, Glover, & Gabrieli, 1998). Information that is presented non-verbally but that is associated with a label (e.g., a picture of a car) is processed extensively by both hemispheres. Thus, events often include multiple sources of information, and these various types of information have some commonalities and differences in how they are encoded.

In addition to differing in their type of sensory information (e.g., visual or auditory), the aspects of an event can also differ in whether they are central to the event or instead are peripheral and form part of the context of the event. For example, the two cars bumping into each other is a central part of the event and is likely encoded. In addition, certain peripheral or contextual parts of events are often encoded as well (Godden & Baddeley, 1975; Smith, Glenberg, & Bjork, 1978; Smith & Vela, 2001). For instance, while viewing the car accident, the observer may encode a scent that is the air (possibly burnt rubber), his or her mood (frightened or surprised), the temperature outside, whether it is dark or light outside, etc. Also, if there is a heated post-crash argument between the two involved parties, the meaning of their words is central and likely encoded, and less-central information, such as their voice (high or low pitched), may be encoded as well (Palmeri, Goldinger, & Pisoni, 1993). Thus, context information is encoded in addition to central information, can affect episodic retrieval (as will be discussed below).

The different aspects of an event, which, as we noted, are initially processed by the frontal lobes and by different cortical areas (e.g., the occipital lobes for visual information), are further processed by the hippocampus and the medial temporal lobe. The hippocampus is known to play an important role in episodic memory formation. Its significance is famously illustrated by the case of H.M., whose medial temporal lobe was removed (Scoville & Milner, 1957). After brain surgery, H.M. was unable to acquire new episodic memories or learn new semantic information, a condition known as anterograde amnesia. While the specific purpose of the

hippocampus is still debated, it is thought by many that the hippocampus binds all of the disparate aspects of an event into an integrated memory representation (Cohen, Ryan, Hunt, Romine, Wszalek, & Nash, 1999; Squire, 1992). That is, the hippocampus receives information about the auditory and visual aspects of the event, and the central and peripheral aspects of the event, from various parts of the brain and combines them into a cohesive representation. Memory retrieval of events then relies on the hippocampus for some time after encoding. Indeed, H.M. also had difficulty recalling events that were experienced before the surgery, known as retrograde amnesia. The amnesia was temporally graded, such that memories encoded in childhood were still intact but memories from a few years before the surgery were impaired. This pattern of memory loss suggests that episodic memory relies on the hippocampus for a period of time after encoding, but eventually memory becomes less dependent on the hippocampus, as memories are represented at the cortical sites in which they were initially processed at encoding (Alvarez & Squire, 1994, but see Nadel & Moscovitch, 1997 for a different view).

After encoding, an event that has already happened can be brought to mind and mentally relived through episodic retrieval. The specific event that is reactivated (and how well it is reactivated) depends in large part on cues that are present at the time. In addition to other cues, one cue that plays a role in directing memory retrieval is the context present at retrieval (Godden & Baddeley, 1975; Smith, Glenberg, & Bjork, 1978; Smith & Vela, 2001). Earlier, we noted that external and internal contextual factors, such as smells and sounds in the environment and the person's state of mind at the time, are encoded as a component of the event. If some of these factors recur later on, they may cue one's memory for the event, bringing it to mind – processes known as context-dependent memory and encoding specificity. As cues trigger memory for parts of an event, a process of pattern completion is thought to occur. Pattern completion involves recalling additional specific components of a memory and reactivating the cortical regions that were originally activated during the event, ultimately yielding a more complete memory (McClelland, McNaughton, & O'Reilly, 1995; Nyberg, Habib, McIntosh, & Tulving, 2000).

These two processes (memory cueing and pattern completion) work in collaboration with the executive control functions of the frontal lobes (Anderson & Neely, 1996; Henson, Shallice, & Dolan, 1999; Simons & Spiers, 2003). The executive processes are necessary for devising a retrieval plan and for self-generating cues, especially when cues from the environment are not sufficient for successful memory activation. Retrieval cues are then held in working memory as one's memory is probed, and if the cues are effective, they will reactivate aspects of the event. When events come to mind, the executive control system is involved in holding the retrieved memories in working memory and monitoring their relevance as well as their accuracy. Sometimes, cues trigger irrelevant or inaccurate memories, and inhibitory control is recruited for memory suppression and selection. These executive processes thus support a cue-directed search through memory and then control the output of the search, leading to effective retrieval.

Even when these retrieval processes are effective, and cues reactivate many aspects of the original event, there are frequently still gaps in the memory. In such cases, memory is often filled in and reconstructed based on many factors (Schacter, Norman, & Koutstaal, 1998). A key factor that may help construct the rest of a memory is a person's semantic knowledge or view of how certain events work, such as what normally occurs in a car accident (Graesser, Woll, Kowalski, & Smith, 1980). These are scripts and schemas, and it is important to note that they can affect not only retrieval, but also encoding, by directing a person's attention based on

knowledge of how such an event is likely to unfold and therefore which components are important (Bartlett, 1932; DeWitt, Knight, Hicks, & Ball, in press; Graesser, Singer, & Trabasso, 1994). In sum, retrieval is a matter of cueing a previous event, reactivating additional parts of that experience, and using our knowledge of how events work to produce a coherent memory.

Episodic Memory in Bilinguals

With the general processes of episodic memory outlined above, we now discuss how bilingualism affects some of these processes. We first revisit the role of peripheral factors in memory and the concept of context-dependent memory, and consider how the language a bilingual is using is a contextual factor that gets encoded during an event, and guides memory at retrieval. Next, we return to the concepts of allocation of attention during encoding and the use of schemas during encoding and retrieval, and suggest that the linguistic structure and cultural associations of the particular language a bilingual is using determine what is encoded during an event and how memories are reported. Finally, we revisit the ideas that different types of stimuli are processed differently and that memory involves executive control, and we discuss how and why bilingualism may differentially affect memory for linguistic and non-linguistic episodes.

The linguistic context at retrieval influences memory accessibility

In the previous section, we described the important role that internal and external contexts play at encoding and retrieval by discussing context-dependent memory and encoding specificity. The idea of context-dependent memory and encoding specificity is that incidental factors that coincide with an event – for example, a person's mood or a particular scent – are often encoded and become part of the memory trace. Subsequently, if these contextual factors are reinstated they may serve to cue one's memory for the event. In the current section, we review work that has extended these effects from contexts such as mood and odor to linguistic contexts. These studies find that the language being used at the time of an event is a strong contextual factor and is encoded along with the primary event. Thus, when one of the bilingual's two languages is being used at retrieval, either externally or internally (e.g., Russian is being spoken aloud or the participant is using inner speech in Russian), it may activate and increase access to memories that were encoded in that linguistic context (Russian) more so than memories that were encoded in a different linguistic context (e.g., English).

For example, Marian and Neisser (2000) elicited autobiographical memories from Russian-English bilinguals by prompting them with a cue word (e.g., friend, birthday, frightening, etc.), and then having them report aloud the first memory that came to mind. When the interview was conducted entirely in Russian, the majority of the memories that were recalled were encoded at a time when Russian was being used. Likewise, when English was being used at retrieval, participants were more likely to recall memories that were encoded in an English-speaking context (see Figure 1). In a follow-up experiment, the language of the cue-word prompts and the language of the interview were manipulated separately. For instance, in the Russian Language condition, the experimenter gave all instructions in Russian and the participant responded in Russian, but the cue word could be either a Russian word or an English word. The results indicated that regardless of whether the cue word came in English or Russian, if the interviewer and participant were otherwise speaking Russian, the participant most often recalled memories that were encoded in a Russian language context. These findings suggest that

the results found in the first experiment were not entirely due to the cue word reminding the bilingual of another time when that word was used. Rather, the results were driven in part by the fact that the general linguistic ambience (i.e., the overall language context) at retrieval guided the bilingual to remember a time when that same linguistic context was present.

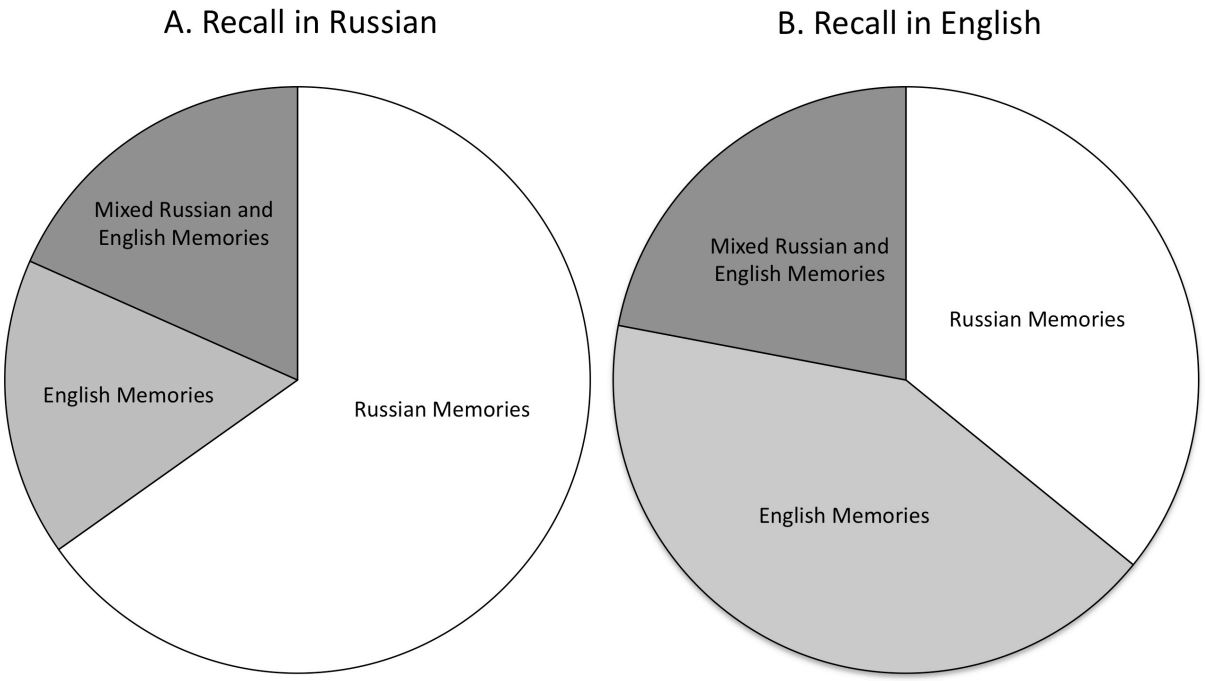

Figure 1. These graphs illustrate that (A) when Russian was used at retrieval, bilinguals were more likely to recall memories encoded in Russian than in English, and, likewise, (B) when English was used at retrieval, bilinguals recalled more English memories than Russian memories.

These experiments showed that the language being *overtly* used at retrieval directs memory by preferentially activating memories that were encoded in that language. Language can also be used internally, as some of our thinking may be linguistic in nature. Schrauf and Rubin (1998, 2000) found that memories that came to participants internally in their native language were for events that were encoded at a younger age (when the native language was being used), and those that came in their second language corresponded to memories that happened later in life (when their second language was being used). An explanation for these results is that the internal language being used at retrieval may have activated memories that were encoded in a matching linguistic context.

The above studies demonstrated external and internal language-dependent memory, and they did so for memories that were autobiographical in nature – that is, memories that were personally meaningful and likely part of a person's narrative. Moreover, these studies assessed memory in a situation where participants could often select from a variety of personal experiences stored in memory. For example, for the cue word birthday, participants could report any of their many birthday experiences. Thus, there were low constraints on what the person recalled. This kind of situation is common in everyday life. Take, for instance, a job interview in which the employer asks the prospective employee to recall a time when he or she overcame a

challenge to achieve a goal. The employee's memory would likely be autobiographical and less constrained. Frequently, though, events are less personally meaningful, and thus are not strictly autobiographical. Furthermore, there are times when a person is trying to recall a specific memory – that is, a memory is highly constrained. An example would be a student learning new information in a class and then taking a test on that material the next day. There may only be a single correct answer for some of the test questions, and that information may not impact the student's personal narrative. How does bilingualism affect memory for this type of information – i.e., material that is highly-constrained and non-autobiographical? If the language being used at retrieval serves to cue memories that were encoded in the same linguistic context (as was shown in the above studies), then if the linguistic context of encoding and the linguistic context of retrieval are the same, the memory could be easier to access, leading to better remembering of the information. However, if the language being used at retrieval is different than the language that was used at encoding, the language of retrieval might fail to cue the relevant memory, instead cuing irrelevant memories and leading to decreased accessibility and poorer memory.

Evidence in support of this idea came from a recent study by Marian and Fausey (2006), which tested college-age students on newly-learned academic information. Academic material is stored in semantic memory, but learning the material likely contains an episodic component as well, because aspects of the learning context may also be remembered by the learner. To assess bilingual memory for academic material, Marian and Fausey presented Spanish-English bilinguals with fictional academic information about biology, mythology, history, and chemistry in the form of short texts. For half of the stories, the text was in Spanish and for the other half, the text was in English. Participants read these stories, and then answered several questions about them. At test, half of the questions were asked in English and half were in Spanish. The questions were arranged so that, for half of the questions, the same language was used at both encoding and retrieval (match questions), and for the other half, a different language was used at retrieval and encoding (mismatch questions). These tests were high constraint in that there was only a single correct answer, and the content was not likely to be personally relevant, making them non-autobiographical. The balanced Spanish-English bilinguals displayed higher accuracy and faster reaction times for match trials and lower accuracy and slower reaction times for mismatch trials, suggesting that memory performance is better when information is encoded in a language and then recalled in that same language, and worse when information is encoded in a language and then recalled in a different language. In addition to retrieval being faster and more accurate when the language used at retrieval matches the language used at encoding, other studies have found that memory is richer and more elaborate (Javier, Barroso, & Munoz, 1993) and more emotionally intense (Marian & Kaushanskaya, 2004) when there is a language match. Collectively, these studies demonstrate language-dependent memory effects both internally and externally and for different types of memories.

These language-dependent memory effects likely work in a similar way as other context-dependent memory. There may however be additional mechanisms at work that are specific to language. A potential language-specific mechanism relates to the idea that the language a person speaks may shape how a person thinks and behaves. That is, the linguistic structure and cultural associations of a language give rise to a certain way of viewing events. As an example, in English, utterances often include the manner in which a person moved during an event (e.g., crawled, skipped, walked), whereas other languages, such as Greek, frequently omit information about manner. These differences could lead Greek-English bilinguals to pay more attention to the manner of motion while speaking English and less attention to it while speaking Greek. (We

devote an entire section to a discussion of the effects of language on thought.) These effects can result in language-dependent memory in the following way. If the bilingual is using Greek at retrieval, the way of thinking and behaving that is associated with Greek (e.g., the attentional patterns while viewing an event) may cue other memories that were encoded when the bilingual was thinking and behaving in that same way. Thus, it may not be the internal and external speech and language per se that activate certain memories, as we suggested earlier; rather, memories may be cued by a particular way of thinking or acting, which is determined by the characteristics of the language being used. These mechanisms are speculative, and more research is needed to understand how language-dependent memory works.

To conclude our discussion of language-dependent memory, we note that these effects have practical implications. The linguistic context has been found to affect memory for newly-learned facts (Marian and Fausey, 2006) and for longer-term semantic knowledge (Altarriba, Kroll, Sholl, & Rayner, 1996; Marian & Kaushanskaya, 2007), suggesting potential implications for school performance. In other studies, language-dependent memory has been evaluated in psychoanalytic sessions, as memory for traumatic events can be affected by whether the language of retrieval is the same or different than the language that was present at the time of the trauma (Aragno & Schlachet, 1997; Javier, 1995).

The specific language being used shapes encoding and retrieval

As we discussed earlier, the way in which one's attention is allocated during an event determines what is encoded. Moreover, there are factors that influence how attention is deployed, such as a person's view of how that particular type of event unfolds. Thus, encoding is not a completely passive and bottom-up process, as top-down factors, such as one's knowledge and existing schemas, also play a role.[2] Similarly, we noted that during retrieval, in the reconstruction of a memory, top-down factors can affect how an event is remembered. In this section, we posit that the language a person knows and uses is one such top-down factor that determines how an event is encoded and later reported. For the bilingual, that means that encoding and retrieval may vary depending on which language is being used. It also means that knowledge and use of one of the bilingual's two languages might influence memory when a bilingual is using their other language, via a cross-linguistic interaction.

A way in which language may influence encoding and retrieval is through the linguistic characteristics (e.g., grammatical rules) of the particular language being used. For example, some languages require the speaker to state the direction of motion when describing such events, whereas others do not. According to the thinking-for-speaking hypothesis (Slobin, 1996), if a certain part of an event (e.g., the direction of motion) needs to be lexicalized in the description, a speaker's attention will be directed to that aspect so that it can be included in the utterance. The person will thus fixate on that aspect, and likely encode it and remember it later on. Alternatively, if the language does not lexicalize that notion, the speaker does not need to fixate on that component of the event, reducing the chances of that aspect being encoded and remembered. On a stronger view (such as the Whorfian linguistic relativity view that language has a pervasive effect on all thought processes), these encoding patterns may occur not just in linguistic situations where a person is describing an event. They may also occur in non-communicative situations, as the habitual practice of attentionally favoring certain aspects during speaking will affect one's attention (and therefore memory) in all situations (Levinson, 1996;

Whorf, 1940). What these hypotheses mean for a bilingual speaker is that encoding processes may differ when using one language versus the other.

For example, consider the study by Boroditsky, Ham, and Ramscar (2002), with Indonesian-speaking monolinguals, English-speaking monolinguals, and bilingual speakers of Indonesian and English. Indonesian differs from English in that, in Indonesian, verbs do not convey tense. Indonesian speakers can indicate tense using certain temporal words (e.g., soon and recently), but these words are optional, and often the linguistic utterance does not clearly state the time of the event. If Indonesian speakers do not mark tense in their utterances, then when viewing an event, they may not encode (and later may not remember) the temporal components as well as English speakers. Moreover, under a strong view, Indonesian speakers may not remember temporal components as well as English speakers not only in communication situations but also in non-communication situations. Furthermore, extending these hypotheses to bilingual speakers, Indonesian-English bilinguals might remember temporal events better when in an English mode and worse when in an Indonesian mode. To examine these hypotheses, Boroditsky, Ham, and Ramscar had participants view a series of pictures depicting someone performing an action (such as a man kicking a ball). Some of the actions had taken place in the past, some were unfolding in the present, and some were about to occur. Subsequently, participants viewed a picture that had already been presented (for example, a man kicking a ball in the present) along with two other pictures depicting the other tenses (past and future). Participants then had to indicate which picture they had seen, and thus their memory for tense was being assessed. Participants did not have to describe the event at encoding or retrieval, so it was a largely non-communication situation. However, instructions were given to some of the bilinguals in English and to others in Indonesian. The results showed that Indonesian monolinguals demonstrated worse memory for tense than English monolinguals, and bilinguals who received instructions in Indonesian had poorer recall than those who received instructions in English. These findings suggest that a bilingual's encoding of and therefore memory for an event may differ based on which language the bilingual is using, even in non-speech situations.

To give another example of how bilingual memory may depend on the linguistic features of the language being used at the time, consider the impact that grammatical gender may have on memory. Grammatical gender is a classification system used by many languages, in which a feminine or masculine gender is assigned to each noun (as opposed to all nouns being gender-neutral as in English). For example, the grammatical gender for the noun 'apple' is feminine in Spanish and masculine in German. Boroditsky, Schmidt, and Phillips (2002) studied the effect of grammatical gender on memory by testing Spanish-English speakers and German-English speakers' ability to learn proper names for common objects. For example, participants were taught that an apple is named Patricia. For some name-object pairings, the gender of the name and the gender of the object were congruent. For instance, Patricia-apple is congruent for a Spanish speaker because both are masculine, and Patrick-apple is congruent for a German speaker because both are feminine. For other pairings, the gender of the name and the gender of the object were incongruent (e.g., Patricia-apple for a German speaker and Patrick-apple for a Spanish speaker). Spanish-speaking and German-speaking participants showed better memory for pairings that were congruent in their language relative to pairings that were incongruent in their language. Thus, information may be encoded and retrieved differently depending upon which language a bilingual is using at the time.

A study by Marian and Kaushanskaya (2004) provided further evidence that memory performance can vary depending on the language a bilingual is using. Marian and Kaushanskaya

analyzed autobiographical memories provided by late Russian-English bilinguals. The authors found that when the Russian-English bilinguals described memories in Russian (a language associated with a collectivist society), they included more first person *plural* pronouns (e.g., we); when they described memories in English (a language associated with an individualistic culture), they used more first person *singular* pronouns (e.g., I) Moreover, the main agent in the English reports was frequently one's self, whereas in the Russian reports, it was frequently either one's self and someone else or just someone else. Thus, when Russian was being spoken, memories were reported in a way that was consistent with Russian culture, and when English was being spoken, memories were reported in a manner that was consistent with North American culture. A possible explanation of the results is that language can activate its associated culture, which, in turn, can serve as a schema that affects how events are viewed during encoding and reconstructed during retrieval.

To provide another example, consider the cultural differences between East Asians and North Americans in scene perception. East Asians have been found to process scenes more holistically and fixate on contextual information, whereas North Americans apprehend scenes in a more analytical way, and focus on central aspects (Masuda & Nisbett, 2001). A bilingual who speaks English and an East Asian language, like Japanese, may therefore encode and retrieve episodes in one way when speaking Japanese (corresponding to the holistically-oriented Japanese culture and the Japanese language structure), and in a different way when speaking English (based on the analytically-oriented North American culture and the linguistics of English).

Yet another way in which differences between languages may affect bilingual memory is through cross-linguistic interactions. That is, experience using one language for encoding and retrieval can transfer over and influence how encoding and retrieval takes place in the bilingual's other language. For example, consider a bilingual who speaks English and Spanish. In Spanish the manner of motion is describe outside of the verb in an optional prepositional phrase, whereas in English the manner of motion is described in the verb. Consequently, Spanish speakers frequently omit the manner of motion (skipping, running, limping), as compared to English speakers, who often include it. For example, while in English a speaker might say *She skipped out of the house*, in Spanish a speaker might say *Salió de la casa*, which would translate to *She exited the house*. Spanish-English bilinguals, therefore, accrue experience not encoding the manner of motion when they are using Spanish, and that practice may lead the bilingual to encode motion less (relative to an English monolingual) when using English. In line with that hypothesis, Filipovic (2011) observed worse memory for manner of motion in a group of early Spanish-English bilinguals who were encoding in English-speaking context, relative to English monolinguals. Additionally, the L2 has been found to influence L1 event descriptions and vice versa (Brown & Gullberg, 2008; Jarvis & Odlin, 2000), further suggesting that experience with one language may cross over to affect processing in the other language.

In this section, we reviewed evidence indicating that the particular languages a bilingual speaks have an impact on memory performance. The linguistic makeup and the cultural features of the language a bilingual using at a given time will partly determine the nature of encoding and retrieval. Moreover, encoding and retrieval in the language being used at the time might be altered by experience using a different pattern of encoding and retrieval in the other language.

Bilingualism differentially affects linguistic and non-linguistic memory

In the first section, we discussed how different aspects of an event are processed differently at encoding. For example, it was noted that linguistic aspects are encoded in a different way than non-verbal aspects. In this section, we consider how bilingual experience affects the ability to remember linguistic and non-linguistic episodes. Specifically, we suggest that bilinguals may show a disadvantage in remembering linguistic information relative to monolinguals, which may be due to bilinguals having a deficit in certain linguistic processes. In contrast, we suggest that bilinguals may be advantaged in remembering non-verbal information, and that better non-verbal episodic memory in bilinguals may be due to their better executive control (which as we mentioned before, plays a key role in encoding and retrieval).

In a study examining the effect of bilingualism on linguistic aspects of episodic memory, Fernandes, Craik, Bialystok, and Kreuger (2007) had younger and older monolingual and bilingual adults perform a word recall task. In this task, participants listened to a series of words, and then verbally reported all of the words they remembered hearing. Bilinguals recalled fewer words than their monolingual peers (see Figure 2). These results suggest that bilinguals may be at a disadvantage when remembering events or aspects of an event that are linguistic in nature. A possible reason for the bilingual disadvantage is that bilingualism appears to have a negative effect on certain aspects of linguistic processing, especially at the lexical/word level. For example, bilingual young adults have been found to have a smaller vocabulary in each language[3], more tip-of-the-tongue states, slower response times in naming pictures, and lower accuracy in recognizing words presented in noisy conditions (Bialystok, Craik, Green, & Gollan, 2009; Gollan & Kroll, 2001). These deficits in accessing and retrieving words may extend to linguistic episodic memory, and lead to a difficulty in remembering words that were part of an event.

When events or aspects of events are non-verbal in nature (i.e., visual information that is not easily labeled), bilinguals may not show a disadvantage, since lexical demands are reduced. In fact, bilinguals might even demonstrate better performance than monolinguals. Bilinguals have been found to exhibit advantages in executive control, presumably due to their extensive practice using these abilities to manage their two languages (Bialystok, Craik, Klein, & Viswanathan, 2004; Costa, Hernandez, & Sebastian-Galles, 2008). Since executive control plays a crucial role in episodic memory (for example, in carrying out a controlled search through memory), better executive control in bilinguals may lead to better episodic memory. With this hypothesis in mind, Schroeder and Marian (2012) had bilingual and monolingual older adults perform a picture recall task. In this task, participants encoded a series of pictures depicting scenes. The chosen scenes were complex, and the older adults were not given much time to scan each scene (2000 milliseconds), thereby discouraging linguistic encoding and encouraging visual encoding instead. Moreover, participants did not know they would later have to recall the pictures, which decreased the chances of participants labeling the pictures as a strategy for remembering. Thus, the lexical demands were reduced at encoding. At retrieval, participants verbally reported all of the pictures they remembered seeing. Since participants could use synonyms or circumlocution to describe the pictures, the lexical demands were also reduced at retrieval. With the involvement of linguistic processing minimized, bilinguals recalled more pictures than monolinguals, and, within the bilingual group, early and more bilingual experience was associated with better recall (see Figure 2). Thus, for aspects of an event that are non-verbal in nature, bilinguals may demonstrate better episodic memory and reduced age-related decline. In line with that notion, bilinguals who have Alzheimer's dementia show memory-related symptoms at a later age than monolinguals, suggesting that bilingualism can improve memory in

some ways and protect against normal and diseased memory decline (Bialystok, Craik, & Freedman, 2007).

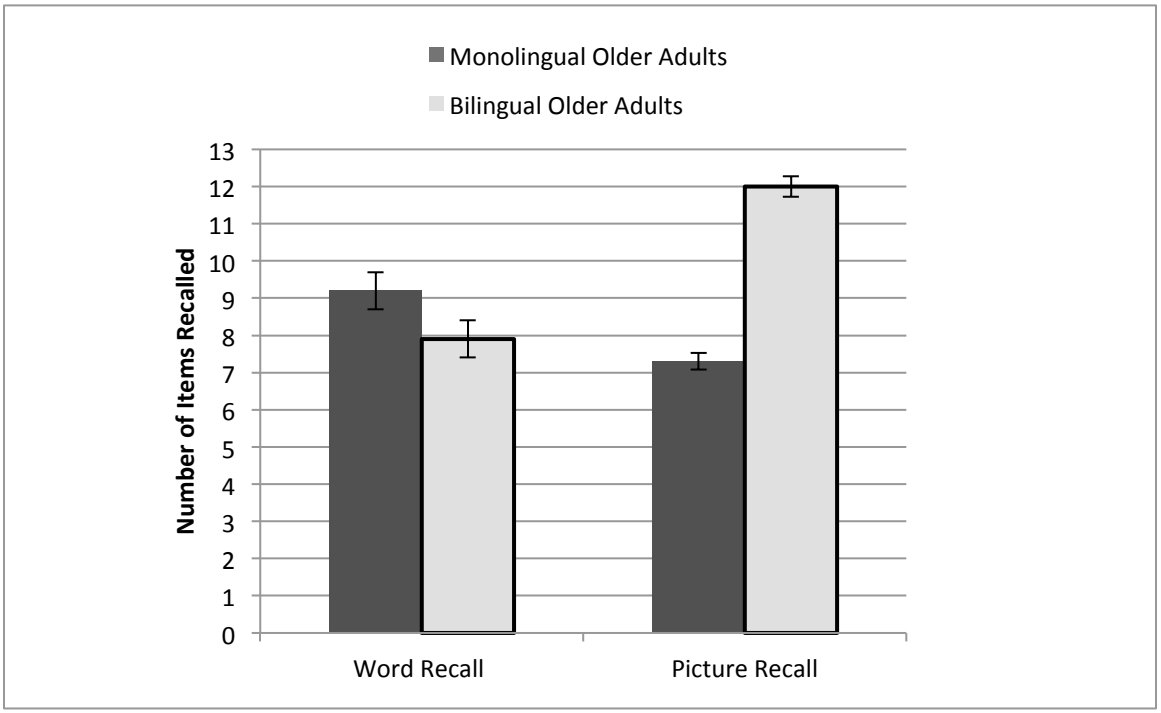

Figure 2. This graph illustrates that bilinguals recalled fewer items than monolinguals in an experiment testing word recall (Fernandes, Craik, Bialystok, & Kreuger, 2007; performance in the undivided attention condition) and more items than monolinguals in an experiment testing picture recall (Schroeder & Marian, 2012).

The notion that bilingualism helps memory for non-linguistic episodes but can hinder the ability to remember linguistic episodes is largely supported by Wodniecka, Craik, Luo, and Bialystok (2010). This study used the process dissociation procedure, which uses recognition tests to yield estimates of familiarity and recollection. Familiarity is an automatic process that refers to a vague sense that an item has been seen before, without recovering details of the event. Recollection is a controlled process that refers to a vivid sense of remembering, and involves recalling contextual details, such as when and where the event occurred. In two experiments, there were no consistent differences between groups in familiarity, but there was some evidence of bilingual effects in recollection, which involves executive control processes. In the first experiment, bilinguals demonstrated some evidence of better recollection than monolinguals when non-linguistic materials were used (novel faces), but worse recollection when linguistic materials were used (words). In experiment two, which tested a different group of participants, bilinguals again demonstrated a trend for better recollection of non-linguistic materials (abstract objects). Surprisingly, bilinguals also demonstrated better recollection for linguistic materials. It is noteworthy that bilinguals in the second experiment actually had larger English vocabularies than monolinguals, which is the opposite of what has been found in several other studies (for large-scale, multi-study analyses, see Bialystok and Luk, 2011 and Bialystok, Luk, Peets, and

Yang, 2010), suggesting that the bilinguals may not have been representative of the population. However, the results also suggest that bilinguals with moderate-to-advanced lexical processing abilities might be able to use their improved executive control processes to overcome a bilingual deficit in verbal memory.

In sum, these studies indicate that bilinguals may show a disadvantage for linguistic aspects of an event, which may be due to a lexical processing deficit. Bilinguals may instead show a performance advantage when non-verbal materials are used. A useful framework to account for a bilingual enhancement in picture memory is the dual-coding theory and its bilingual extension (Paivio, Clark, & Lambert, 1988; Paivio & Desrochers, 1980). According to the dual-coding theory, images can elicit two representational codes: a visual code and a verbal code. When the verbal code is disrupted by making it difficult for participants to label the pictures (for example, by rapidly presenting complex scenes or presenting abstract objects), participants may rely exclusively on visual encoding. Since visual memory is closely tied to executive control, bilinguals may show memory advantages, given their enhancements in executive control. Consistent with this notion, in Schroeder and Marian (2012), bilinguals exhibited better performance in both episodic memory and executive control, and there was evidence for an association between the two. In Wodniecka et al. (2010), better performance emerged in recollection, which involves executive control, but not in familiarity, which is not heavily reliant on executive control. Yet another explanation is that the hippocampus and medial temporal lobe memory system that are involved in visual and verbal memory are enhanced by bilingualism (Ullman, 2001). As second language acquisition is subserved by these systems, bilingualism might improve their functioning, leading to better memory. Alternatively, the verbal code might not have been totally disabled in these experiments, and bilinguals might have formed two verbal codes, one for each language, according to the dual-coding theory. This may have aided in memory by enabling deeper encoding and providing two retrieval routes. Moreover, the better performance may also be due in part to language-dependent memory. These studies took place in a context in which English was being spoken. Thus, the episodes – be they linguistic or non-linguistic – were encoded and retrieved within an English-speaking context. So, at retrieval, memories encoded in English would be cued for both the bilinguals and monolinguals. However, bilinguals might have fewer memories to search through, because some of their memories were not encoded in English (they were encoded in their other language), and therefore would not be highly activated. This decreased competition might lead to more effective retrieval in bilinguals. These explanations are tentative, and the data are currently limited, necessitating more research on how bilingualism affects linguistic and visual memory. Moreover, because events in the real-world are typically multi-sensory and contain both auditory linguistic information and visual information, it is also important to investigate how bilinguals integrate multi-sensory information during encoding, and ongoing work in our lab is examining this topic.

Conclusion

In this chapter, we considered how bilingualism influences memory for events. We first discussed how language is part of the context of an event at both encoding and at retrieval. Consequently, the language a bilingual is using at the time of retrieval often cues memories that were encoded in the context of that language, facilitating access to those memories and hindering access to memories that were encoded in the context of the other language. Next, we addressed

how the linguistic and cultural aspects of the language one speaks determines what is encoded and how it is retrieved. Thus, a bilingual's memory for the same event may differ depending on which language was being used. Moreover, these effects might cross over to the other language, and experience in encoding and retrieving information in one language can influence how information is encoded and retrieved while using the other language. Finally, we discussed that bilingualism may enhance memory for non-verbal episodes, perhaps due to better executive control in bilinguals compared to monolinguals, but might hurt memory for verbal episodes, perhaps due to a bilingual deficit in lexical processes.

In closing, we consider how these different effects of bilingualism might come into play in a real-world situation. Consider the previously-described car accident example. Imagine that the two cars were driving toward each other going in the opposite direction, when one of them inattentively veered into oncoming traffic and grazed the side of the other car. Afterward, the two drivers argued over who was at fault. Because they couldn't resolve the disagreement, the case went to court, and a Spanish-English bilingual witness testified. Would the witness's knowledge and use of both English and Spanish have affected performance on the witness stand? If the witness and the drivers had been speaking Spanish at the time of the event, but the testimony was carried out in English, then, according to context- and language-dependent memory, the testimony may have been less accurate, with fewer details, than if the testimony was conducted in Spanish. Also, regardless of which language was used during the testimony, if the bilingual witness had been using Spanish instead of English at the time of encoding, the witness's memory for which of the two drivers was at fault may have been less accurate. The reason for making that prediction is that, in Spanish, the person who is at fault is often not included in the description of accidental events, and, consequently, Spanish speakers pay less attention to the agent and do not remember the agent as well as English speakers (Fausey & Boroditsky, 2011). Additionally, if the witness was asked to report the exact words that the drivers had uttered in their post-accident disagreement, compared to a monolingual, the bilingual witness might not have been as good at remembering, because bilinguals have been found to show a deficit in memory for linguistic information. However, if asked to identify the drivers in a police lineup, the bilingual witness might have been better at remembering than a monolingual witness, as bilinguals have been found to have better memory for non-linguistic information. These are all hypotheses and predictions born out of existing research on bilingual episodic memory, illustrating that bilingualism can influence encoding and retrieval in many ways, and that these effects can have real-world consequences.

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Footnotes

[1] Episodic long-term memory is distinguished from semantic long-term memory. Episodic memory refers to memory for a unique event and its corresponding spatial and temporal context, like an authobiographical life experience. Semantic memory, on the other hand, refers to memory for general knowledge about the world, independent of the time and place in which it was initially learned. While it is generally accepted that semantic memory and episodic memory interact, with some memories shifting from one type to the other, it is a matter of debate as to which comes first. For a discussion of this issue, see Schank (1982) and Tulving (2002).

[2] In cognitive psychology, bottom-up processing refers to perceptual experience that is driven solely by sensory processing of the stimulus, whereas top-down processing refers to perception that is affected by previous experience, existing knowledge, expectations, and motivation.

[3] A reduced vocabulary size within a single language in bilinguals (compared to monolinguals) has been demonstrated in two large-scale analyses using the English version of the Peabody Picture Vocabulary Task, where participants hear an English word and identify the picture that best represents the word (Bialystok & Luk, 2011, Bialystok, Luk, Peets, & Yang, 2010). While bilinguals may have a smaller vocabulary in each language compared to monolinguals, it is important to note that bilinguals are thought to know at least the same number of concepts and often more words overall (i.e., across both languages) compared to monolinguals.

Additional Information for *Bilingual Episodic Memory*

A. Final Summary

This chapter delineated three ways in which knowing and using two languages can influence memory for events. First, the language used at retrieval serves as a cue, eliciting memories that were encoded in the same language (to a greater extent than memories encoded in the other language). Second, bilinguals encode and recall their experiences differently in their two languages, with event perceptions and descriptions influenced by the linguistic features and cultural associations of the specific language being used at the time. Third, bilingual experience can shape the cognitive abilities that underlie verbal and non-verbal episodic memory; it can negatively affect lexical processing, which may lead to difficulty in remembering verbal aspects of events, and it can positively affect executive control, which may result in enhanced memory for visual-spatial aspects of events. The chapter describes the wide-ranging effects that bilingual experience can have on episodic memory, from verbal to non-verbal aspects of events, from simple to complex experiences, and from initial encoding to retrieval several years later.

B. List of Key Words

Alzheimer's disease, Amnesia, Autobiographical memory, Bilingualism, Context-dependent memory, Cross-linguistic interactions, Culture, Dual-coding theory, Encoding, Encoding specificity, Episodic memory, Executive control, Frontal lobes, Grammar, Hippocampus, Language-dependent memory, Lexical access, Linguistic relativity hypothesis, Medial temporal lobes, Retrieval, Sapir-Whorf hypothesis, Second language acquisition, Semantic memory, Thinking-for-speaking hypothesis, and Vocabulary

C. 5-10 Thought Questions

1. To what extent do you think the effects of bilingualism on episodic memory extend to bidialectals? (Bidialectals are people who speak two dialects of the same language, such as African-American Vernacular English and Standard American English.) Would bidialectals exhibit language-dependent memory? Why or why not? Would bidialectals encode and recall experiences differently when using one dialect versus the other? Why or why not?

2. How do you think episodic memory changes when bilinguals acquire a third language and become trilingual? Specifically, would deficits in verbal memory and enhancements in non-verbal memory be larger in trilinguals as compared to bilinguals? Why or why not?

3. What effects do you think age of acquisition of the second language has on bilingual episodic memory? We discussed how the linguistic structure of a language can affect the way a bilingual encodes an event. For example, we mentioned that Indonesian speakers frequently omit tense and that Indonesian bilinguals may exhibit worse memory for the temporal aspects of an event

when they are in an Indonesian context (even when the event is non-verbal). To what extent do you think the effects of language structure on memory encoding depend on when the language was acquired? How might the effects be different if the language was learned in childhood versus adolescence versus adulthood?

4. Bilinguals often encode an event in one language and then retrieve it in their other language. How do you think this affects subsequent retrieval? Is this memory more likely to come to mind when the language of encoding is being used, when the language of retrieval is being used, or in a mixed environment when both languages are being used? Moreover, can retrieving the memory in a different language (i.e., not the language of encoding) hurt memory by leading the bilingual to recall the memory less faithfully and thereby distorting the actual event? Can retrieving memory in a different language also help memory by providing a new retrieval route through a second language?

5. There are reports of bilingual aphasics who lose ability in one of their languages while maintaining ability in their other language. Based on our discussion of language-dependent memory, to what extent do you think these aphasics will have difficulty remembering experiences that were encoded in the language they seem to have lost? If you think they will have episodic memory difficulties, can you think of ways that would help these patients recover their memories?

6. We discussed several neural correlates of episodic memory (e.g., the hippocampus and the frontal lobes). However, no study to date has examined the neural correlates of bilingual episodic memory. For some of the bilingual effects we discussed (i.e., language-dependent memory and potentially enhanced visual-spatial memory in bilinguals), how do you think these effects would manifest at the neural level?

D. Applied Issues in Learning and Memory in the Acquisition of a Second Language and Vocabulary Learning

While episodic memory seems to relate only tenuously to second language acquisition, this connection may be stronger than it appears, since new vocabulary items may initially be stored as an episodic memory (as there is a time and place associated with learning the new words). Subsequently, this knowledge can be decontextualized from its initial learning context, making it solely a semantic memory. Because second language acquisition may start off as episodic in nature, some of our discussions in the chapter may be applied to instructional techniques for learning.

1. Based on our coverage of context-dependent memory, one might expect that memory for vocabulary words learned in the classroom would be remembered well in the classroom, but perhaps not as well outside of the classroom. As the point of school instruction is to transfer knowledge outside of the classroom, it is most likely beneficial to simulate non-academic interactions inside the classroom or even take field trips to practice in a non-academic setting.

2. A potential way to successfully transfer vocabulary knowledge from a contextualized episodic

memory to a decontextualized semantic memory is to present material in many different contexts. For example, students may benefit if to-be-learned words are presented in different sentence contexts, in different types of exercises, in different classrooms, and in different modalities.

3. For bilinguals learning a third language, a potentially effective way to convert a newly learned word from an episodic memory into a context-free semantic memory is to gain exposure to the word in the contexts of both of their already-known languages, not just in one language. Moreover, linking old words to new words (e.g., teaching the Spanish word for water 'agua' by linking *water-agua*) might not be as effective for bilinguals as it is for monolinguals since bilinguals can have difficulty retrieving lexical information in an already-known language. Instead, it might help to link the new word with non-lexical information like images and environmental sounds.

E. Suggested Research Projects for Students

1. In this project, you will attempt to replicate the language-dependent memory effect. First, write down a list of 20 high-frequency concrete English nouns that are not cognates in your other language but that have a translational equivalent. Then, randomly choose half of these words and translate them into your other language. Take the list of 10 English words and 10 non-English words and put them in a random order. Next, find a friend or classmate who knows both languages and read the list of 20 words to them. Then, after a 5-minute delay, have them write down all of the words they remember hearing and have them do so in English. Did they recall more English words than non-English words? If so, you found evidence for language-dependent memory. If not, think of reasons why and consider how this study differed from the studies that were discussed in the chapter.

2. For the second project, you will explore whether memories are recalled differently when bilinguals are using one language versus the other. Interview a bilingual who speaks one language associated with an individualistic culture and another language associated with a collectivist culture (Refer to Hofstede, 1980, 2001 for discussions of the individualistic-collectivist distinction). Think of 5 cue words that that elicit memories (such as *birthday, doctor, and cat*; see Marian & Kaushanskaya, 2004 for more cue words). Provide the 5 cue words in one language and, for each word, have them report the first memory that comes to mind using that same language. Then, present the 5 cue words in the other language and have them describe a different memory in that language. Record their responses and count the number of first-person singular pronouns and first-person plural pronouns. Did the bilingual use more first-person singular pronouns when recalling experiences in the individualistic language and more first-person plural pronouns when recalling experiences in the collectivist language? Did you notice any other differences between the memories reported in one language versus the memories reported in the other language?

F. Suggested Readings

Altarriba, J., & Isurin, L. (Eds.). (2012). *Memory, Language, and Bilingualism: Theoretical and Applied Approaches*. Cambridge University Press.

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Marian, V., & Kaushanskaya, M. (2007). Language context guides memory content. *Psychonomic Bulletin & Review*, *14*(5), 925-933.

Marian, V., & Neisser, U. (2000). Language-dependent recall of autobiographical memories. *Journal of Experimental Psychology: General*, *129*(3), 361-368.

Nolde, S. F., Johnson, M. K., & Raye, C. L. (1998). The role of prefrontal cortex during tests of episodic memory. *Trends in Cognitive Sciences*, *2*(10), 399-406.

Schrauf, R. W., Pavlenko, A., & Dewaele, J. M. (2003). Bilingual Episodic Memory An Introduction. *International Journal of Bilingualism*, *7*(3), 221-233.

Tulving, E. (1983). *Elements of episodic memory* (p. 123). Oxford: Clarendon Press.

Tulving, E., & Thomson, D. M. (1973). Encoding specificity and retrieval processes in episodic memory. *Psychological review*, *80*(5), 352-373.

Wheeler, M. A., Stuss, D. T., & Tulving, E. (1997). Toward a theory of episodic memory: the frontal lobes and autonoetic consciousness. *Psychological bulletin*, *121*(3), 331.

G. Related Internet Sites to the Specific Topic of Bilingual Memory

Bilingual episodic memory entry in Wikipedia:
http://en.wikipedia.org/wiki/Bilingual_memory#Bilingual_Episodic_Memory

Website for the *Bilingualism and Psycholinguistics Research Group*
http://comm.soc.northwestern.edu/bilingualism-psycholinguistics/

Website for Colbertian, a language used to assess language learning and memory
http://comm.soc.northwestern.edu/bilingualism-psycholinguistics/colbertian/

A blog written by psycholinguist Francois Grojean about Life as a Bilingual
http://www.psychologytoday.com/blog/life-bilingual

Website for the National Association of Bilingual Education
http://www.nabe.org/

Website for the journal Bilingualism: Language and Cognition
http://journals.cambridge.org/action/displayJournal?jid=bil

Website for the International Journal of Bilingual Education and Bilingualism
http://www.tandfonline.com/toc/rbeb20/current

Website for the International Symposium on Bilingualism
http://linguistics.hss.ntu.edu.sg/ISB9/Main.html