

Language-Dependent Recall of Autobiographical Memories

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Two studies of autobiographical memory explored the hypothesis that memories become more accessible when the linguistic environment at retrieval matches the linguistic environment at encoding. In Experiment 1, Russian–English bilinguals were asked to recall specific life experiences in response to word prompts. The results supported the hypothesis of language-dependent recall: Participants retrieved more experiences from the Russian-speaking period of their lives when interviewed in Russian and more experiences from the English-speaking period of their lives when interviewed in English. In Experiment 2, the language of the interview was varied independently from the language of the word prompts. Both variables were found to influence autobiographical recall. These findings show that language at the time of retrieval, like other forms of context, plays a significant role in determining what will be remembered.

Since Tulving and Thomson (1973) first introduced the encoding specificity principle a quarter of a century ago, cognitive psychologists have investigated context-dependent memory in a number of different domains. Researchers have found memory retrieval to vary with environmental context, with mood and internal context, and with mental reinstatement of context (see Davies & Thomson, 1988, for a review). The present article argues that linguistic context may lead to similar effects. We propose that memories become more accessible when language at retrieval matches language at encoding. We show that the retrieval language influences recall in two distinct ways: (a) by associations between specific words and (b) by an overall effect of linguistic ambiance. Generally speaking, any increase in the similarity between the linguistic environments at encoding and at retrieval should facilitate recall.

One can expect linguistic context to influence recall in a number of different ways, some corresponding loosely to forms of context-dependent memory that have already been established. First, the language spoken aloud in any given situation creates an external context, analogous to the context of the physical environment (e.g., Smith, 1988). Second, the language in which one carries out mental activity creates an internal context, analogous to the mental states that (at least sometimes) produce the phenomenon of mood state-dependent recall (e.g., Bower, 1981). Finally, mental reinstatement of the language used on an earlier occasion may produce increased recall just as mental reinstatement of context does (e.g., Geiselman, 1988). Language-dependent recall combines features

from each of these phenomena but also has unique properties characteristic to language alone.

Language-dependence effects may appear in many situations. For example, when one is suddenly surrounded by “baby talk” and child-directed speech, one may experience a surge in memories related to one’s own early experiences. Those memories may include not only personally experienced events but also semantic material such as rhymes and songs. Thus, language dependence may manifest itself in remembering semantic, general-knowledge material as well as in personal autobiographical memories. Investigation of language-dependent recall may shed light on the intricate relationship between memory and language.

Although one might use a number of different approaches to study language-dependent recall, a good place to begin is with the autobiographical memories of bilinguals. Bilinguals experience some life events while using one language and some while using another, and the drastic differences between those linguistic environments may be particularly conducive to linguistic context effects. If language is a key factor in encoding, the language of retrieval should affect the accessibility of a bilingual individual’s memories. Anecdotal evidence supporting this hypothesis is abundant. On one occasion, when asked for her apartment number in her native language, a bilingual who had lived in the United States for over a decade erroneously provided the number of her former flat in her native country. On correcting herself, she explained the immediate response by saying that the number of the old apartment “just popped into my mind” because of the way the question was asked (A. Pavlenko, personal communication, 1998). In another case, a bilingual child who had learned a French song while on vacation in France could not recall the song on his return to the United States. However, once finding himself in a French-speaking environment again, he remembered it without any effort (E. Spelke, personal communication, 1998).

Studies have reported similar effects for autobiographical recall. From a clinical perspective, several psychoanalytically oriented articles have reported that autobiographical memories are more accessible in the language of origin. Javier, Barroso, and Munoz (1993), for example, found that the memories of five bilingual speakers were richer and more elaborate when accessed in the

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language in which the events had taken place than in the other language. Aragno and Schlachet (1996) reviewed three cases in which use of the first language with bilingual clients resulted in more successful psychoanalytic sessions.

Experimentally, researchers have conducted most of the work on the relationship between language and memory in bilinguals at the lexical level (Schreuder & Weltens, 1993). The main questions have been whether lexical organization is language-specific or shared across languages (DeGroot & Kroll, 1997) and whether language processing in bilinguals is serial or parallel (Harris, 1992). This research has used a wide range of methodologies: word translations, word associations, lexical decisions, picture naming, lexical priming, and others. In contrast, studies that have focused on bilinguals' episodic memory (memory for real-life events) are limited. One can find an early report of sampling bilingual memory for personally experienced events in an article by Bugelski (1977). When Bugelski prompted Spanish-English bilinguals with English words, they drew 70% of their "thoughts" primarily from the adult life period and only 13% from childhood. When these bilinguals were prompted with the same words in Spanish, 43% of the "thoughts" were from adulthood and 45% were from childhood.

Recall of autobiographical events by bilinguals was also the focus of Otoya's (1987) dissertation research. Otoya examined the effect of cultural transition and language on autobiographical memory in bilinguals. In her study, bilingual participants were cued with 10 word prompts in each language; 6 of these prompts were translation equivalents of each other. She found that Spanish prompts triggered earlier memories than English prompts, the difference being significant for three of the word pairs.

In a recent study with elderly Spanish-English bilinguals, Schrauf and Rubin (1998) asked their participants in what language each autobiographical memory "came to them" internally. They found that about 20% of their participants' memories were retrieved internally in the language that was not being spoken in the interview. These spontaneous switches to the other language probably resulted from the contents of the recollections themselves. If a particular event takes place in a Spanish context and includes Spanish verbalization, the memory of that event may "come" to the bilingual internally in Spanish, even if it is cued by an English prompt. It is likely then, that this "language of internal retrieval" is in fact indicative of the language at encoding. As one might expect, Schrauf and Rubin found that memories recalled internally in Spanish came from an earlier, pre-emigration age, whereas memories recalled internally in English came from a later, post-immigration age.

On the other hand, Schrauf and Rubin's (1998) main hypothesis—that bilinguals would recall memories from different ages when prompted in the two languages—was not supported. There was no overall tendency for first-language prompts to elicit earlier memories than second-language prompts. This may have resulted because mean age at the time of the remembered event is not a sensitive measure of language effects, especially in bilinguals who have used both languages concurrently for most of their lives. In Schrauf and Rubin's experiment, for example, the average age of participants at immigration was about 28 years, whereas their age at the time of the interview was about 65. During this post-immigration period of about 37 years, these bilinguals used both languages, so they may have encoded memories from this period

on occasions when English, Spanish, or both English and Spanish were spoken. The overall mean age of the reported memories was well after immigration, regardless of the language of the prompt words. Given this linguistic history, age at the time of a remembered event may not be a reliable index of the match or mismatch between the languages of encoding and retrieval. (However, if measures other than mean age are considered, some of Schrauf and Rubin's data are consistent with the hypothesis of language-dependent recall. For example, the number of memories retrieved from ages 5–20 was higher with Spanish than with English prompts, whereas the number of memories retrieved from ages 20–55 was higher with English than with Spanish prompts.)

Rather than using the mean age at the time of the remembered event, our research focused on the language used during the original event and its match (or mismatch) with the language of retrieval. If the retrieved memory referred to an event that occurred at a time when Russian was spoken by, to, or around the participant, we called it a *Russian memory*. If it referred to an event that occurred at a time when English was spoken, we called it an *English memory*. And if the retrieved memory referred to an event in which a mixture of both Russian and English was spoken, we called it a *mixed memory*. Because all participants had spent their childhoods in Russia and then immigrated to the United States, the language of the original event correlated roughly with the participant's age at the time. However, although childhood recollections were always Russian memories, post-immigration recollections were not always English memories. Our participants often used Russian or a mixture of Russian and English in situations that occurred after their arrival to the United States, usually when interacting with family members or other Russian speakers. For these memories, establishing the language of the original event was particularly important.

In the two experiments reported here, we considered the match between the language of encoding and retrieval as the primary independent variable. (However, we also recorded age at the time of the event.) We designed Experiment 1 to exhibit the basic phenomenon of language-dependent recall. We predicted that our participants would produce more memories of events during which their first language was spoken when they were interviewed in the first language and more memories of events during which their second language was spoken when interviewed in that second language.

Going beyond the first experiment's demonstration of language-dependent recall, Experiment 2 explored the mechanisms underlying this phenomenon. We considered two possible explanations. On the one hand, the effect may depend on the congruity of specific words heard at the time of recall with words that had been heard or uttered in the original event. These words may themselves have mnemonic effects. A prompt word presented at the time of retrieval, for example, may remind the participant of some earlier experience in which that very word was spoken. Such direct associations might be enough to give rise to language-dependent recall in their own right, without any contribution from a more general language ambience. On the other hand, the context established by the linguistic environment may produce language-dependent recall without any contribution from the specific words embedded in it. It is possible that the linguistic ambience at the time of retrieval establishes a language mode that leads to context effects on memory. In this case, the important congruity would be

between the language ambiance at encoding and at retrieval. Finally, both effects may occur. We explored these possibilities in Experiment 2, in which the ambient language and the language of the word prompts were varied independently.

Bugelski (1977), Otoy (1987), and Schrauf and Rubin (1998) all used what is known as the *word-prompt technique* (Crovitz & Schiffman, 1974; Galton, 1879; Robinson, 1976). This technique consists of presenting participants with prompt words and asking them to report the first autobiographical memory that each prompt brings to mind. We also used this method, but with an important modification. Our participants did not know that they were participating in a memory experiment. Instead, they were led to believe that we were interested in the characteristic "narrative styles" of the two languages. We described the experiment as part of a larger linguistic study in which properties of narratives in different languages were being investigated. We told participants that in this case we were examining Germanic and Slavic languages and that we would like them to provide a few narratives for our multilanguage database. They were also led to believe that the reason for using word prompts was to help them come up with a range of different narratives. We used this disguise in order to prevent participants from guessing our hypothesis and perhaps deliberately providing answers that would support it. To minimize the possibility that participants might deliberately avoid the mention of certain memories, we told them that their responses would be timed and that they were to respond as quickly as possible, narrating the first story that came to mind. We were also concerned with avoiding the demand characteristics that arise when bilinguals get the same cues twice, once in each language. To circumvent this problem, we presented each participant with different word prompts in the two languages, with the language of each prompt counterbalanced across participants.

In sum, this article proposes the idea of language-dependent recall and supports it with results from two empirical studies of autobiographical memory in bilinguals. Experiment 1 showed that memories are more accessible when the languages of encoding and recall are the same than when they differ. Experiment 2 showed that this phenomenon is not a mere result of associations to specific word prompts that had also occurred in the original event; it is also influenced by the overall linguistic ambiance at recall.

Experiment 1

The first experiment investigated whether Russian-English bilingual immigrants would show language-dependent recall of autobiographical events. We predicted that the language at recall would influence which memories would be accessed, with participants recalling more Russian memories when interviewed in Russian than in English and more English memories when interviewed in English than in Russian.

Method

Participants. Twenty Cornell students participated in the experiment, 9 women and 11 men. All participants were Russian-English bilinguals, fluent in both languages, who had immigrated to the United States at the mean age of 14.2 years ($SD = 4.1$). Their mean age at the time of the experiment was 21.8 years ($SD = 2.9$). Four participants indicated that Russian was their preferred language of communication, 12 participants

indicated that English was their preferred language of communication, and 4 participants stated no language preference.

Materials. Sixteen Russian-English pairs of cue words were selected such that each member of a pair was the direct translation of the other. Pilot work had shown that these words were effective prompts for autobiographical memories. The following two sets of eight prompt words were used: (Set 1) *summer, neighbors, birthday, cat, doctor, getting lost, frightened, bride*, and (Set 2) *snow, friends, holiday, dog, blood, contest, laughing, and newborn*. Their Russian translations, respectively, were: (Set 1) *лето, соседи, день рождения, кошка, врач, потеряться, испугаться, невеста*, and (Set 2) *снег, друзья, праздник, собака, кровь, конкурс, смеяться*, and *новорожденный*. Half of all the participants received Set 1 in Russian and Set 2 in English. The other half of the participants received Set 1 in English and Set 2 in Russian. The order of the presentation of the two sets was also counterbalanced.

Procedure. Participants were interviewed individually; all interviews were tape-recorded. The interviews consisted of two parts, an English part and a Russian part. The order of the languages was counterbalanced across participants. In each part, an effort was made to establish a very definite linguistic milieu. The instructions and consent forms were presented twice, once in each language part. Both the experimenter and the participant spoke only in the language appropriate for that part. In each part, participants were welcomed to a study of "storytelling in different languages" and were told that we were comparing the psycholinguistic properties of Russian and English narratives. They were asked to tell brief stories of specific events from their lives. They were also told that, because it might be difficult to come up with numerous stories on request, they would be prompted with some words to facilitate the storytelling process. In each case, their task was to describe an event from their own life that the prompt had brought to mind. They were encouraged to respond as quickly as possible and to tell the first story that came to mind. We disguised the purposes of the study to prevent participants from guessing the real focus of the experiment. Postexperimental debriefing showed that the disguise was successful: none of the participants identified the experiment as a study of memory.

In each part, a warm-up task followed the instructions. The goals of the warm-up tasks were to get participants comfortable with the target language, to emphasize that code-switching (using words from the other language) was not acceptable, and to make sure that participants provided specific events from their lives rather than loose associations, preferences, thoughts, or opinions. In the warm-up task for the first part, participants were asked to tell four stories from specific periods of their lives. No cue words were given for these stories. Instead, we roughly divided each participant's life span into four quarters based on age and asked them to tell a story about an event that took place in each of those periods. For example, a 22-year-old participant would be asked to tell a story about an event that took place before the age of 7, another about an event that took place between the ages of 8 and 12, a third story from between the ages of 13 and 17, and the last one about an event that took place after the age of 18. In this case, each period except the first is 5 years long. (The first period is lengthened to compensate for the fact that most people cannot access autobiographical memories from the first 2 years of life.) This first warm-up task was designed to encourage participants to access memories from their entire life span. In the warm-up task for the second part, they were asked to describe their experience of immigrating to the United States in some detail. This event was chosen in order to not bias participants toward either the before- or the after-immigration period. Spending some time in conversation about this experience helped participants make the transition from the language used in the first part of the interview to the one used in the second part.

In each part, participants received eight prompts in the assigned language and responded by narrating eight specific events from their lives. The latencies of their responses were timed on-line with a stopwatch, measuring from the onset of the prompt word to the beginning of the

narrative response. This procedure helped motivate participants to respond as fast as possible, producing the first memory that came to mind rather than selecting the most appealing story. We expected participants to access memories more quickly when the language of recall and the language of encoding were the same than when they were different.

After all 16 memories had been recorded, participants were asked to indicate the language they had spoken, had been spoken to in, or were surrounded by at the time when each recalled event took place and to estimate their age at the time.

Results

We collected a total of 318 autobiographical memories (1 participant was unable to produce memories in response to two word prompts). These memories were of three types. A *Russian memory* refers to an event in which the only language used (by anyone) was Russian. Many such events occurred before the participant left Russia, but some took place after immigration while in the company of other Russian speakers. An *English memory* refers to an event in which the only language used was English. These memories occurred after the participant immigrated to the United States, while surrounded by other English speakers. A *mixed memory* refers to an event in which both languages were spoken, either in the company of bilingual Russian-English speakers (who switched back and forth between the two languages) or in the mixed company of Russian speakers and English speakers. All but one of these mixed memories occurred after participants arrived to the United States. Altogether, the participants produced 160 Russian memories, 92 English memories, and 66 mixed memories.

We conducted analyses on each type of memory separately, and the results appear in Figure 1. (These three analyses are not independent; the number of Russian, English, and mixed memories must add up to 16 for each participant.) Participants accessed more Russian memories when interviewed in Russian (5.15 memories out of a possible 8) than when interviewed in English (2.85 memories out of a possible 8), $t(19) = 4.48, p < 0.001$. Similarly, they accessed more English memories when interviewed in English ($M = 3.35$) than when interviewed in Russian ($M = 1.30$), $t(19) = 5.71, p < 0.001$. Participants accessed mixed Russian-English memories more or less equally in the Russian ($M = 1.45$) and English ($M = 1.75$) interviews, $t(19) = 1.07, p > 0.1$. As would be expected given these results, participants recalled memories from an earlier age when interviewed in Russian ($M = 13.1$ years) than when interviewed in English ($M = 16.1$ years), $t(19) = 4.83, p < 0.001$. We found no significant effects of order.

Although our principal finding concerns the number of memories of each type, it is also interesting to compare the reaction latencies. Where English memories are concerned, this comparison can best be made for the 12 participants who produced one or more English memories in both parts of the interview. Participants accessed these English memories more quickly when the interview language was English ($M = 5.57$) than when it was Russian ($M = 7.64$). The difference was significant, $t(11) = -2.64, p < 0.05$. A similar analysis based on the 19 participants who produced Russian memories in both parts of the interview showed that Russian memories were accessed faster when the interview language was Russian ($M = 4.37$) than when it was English ($M = 5.12$). However, this difference was not significant, $t(18) = -1.06, p > 0.1$.

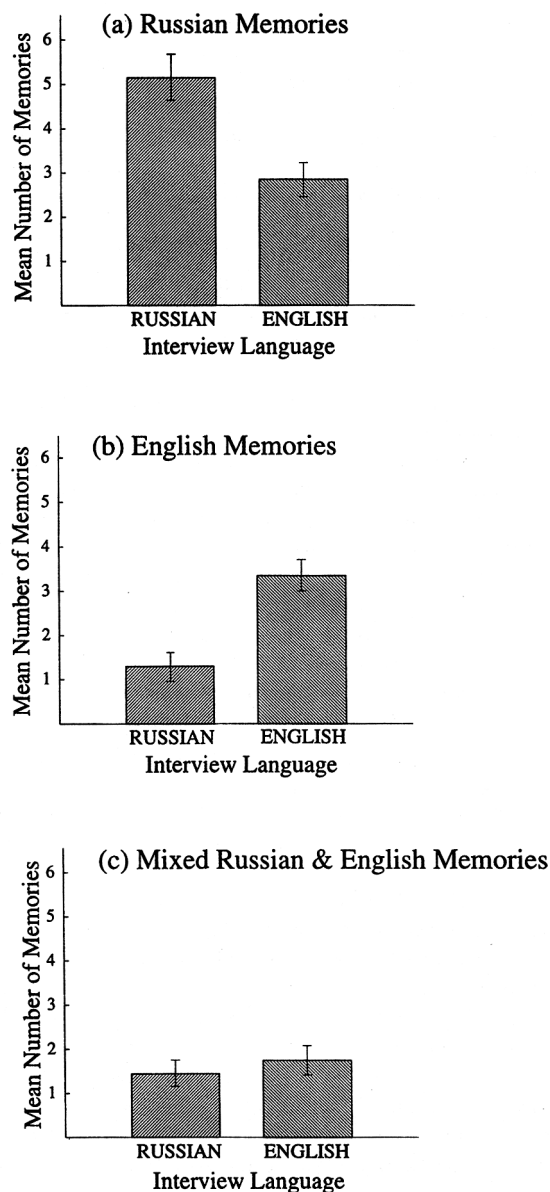


Figure 1. Mean number of Russian, English, and mixed memories recalled in Experiment 1 by language of interview.

Discussion

These results indicate that the language used at the time of retrieval influences what memories bilingual participants will access. Bilinguals are more likely to retrieve events in which a given language was spoken if that same language is also used in the retrieval setting. It appears that this phenomenon is not simply a result of demand characteristics but an authentic effect of retrieval language on autobiographical recall.

Why does the language used at the time of remembering influence retrieval in this way? At least two possible explanations suggest themselves. The first explanation focuses on the prompt words themselves. In some cases these words—*birthday, friends, snow*, etc., or their Russian equivalents—may have actually been

spoken during the original event on which the memory is based. In such a case, a simple association between the two occurrences of the same word, once at retrieval and once in the original event, may be enough to bring that event to mind.

The second possible explanation is perhaps more interesting. In theoretical discussions of bilingualism, scholars often suggest that bilingual individuals have two distinct "language modes" (Grosjean, 2000). Using a given language does not merely involve uttering certain words; it creates a general mind-set, a way of thinking, that is different from the mind-set that would go with a different language. These states of mind may be quite distinct—as distinct as the "states" that have been postulated to explain "state dependent memory." If so, they may have a similar effect on recall. On this hypothesis, language-dependent recall is produced by the general ambient language of the interview rather than by specific associations to individual cue words. It is also possible, of course, that both mechanisms exist and make independent contributions to language-dependent recall. We designed our second experiment to explore these possibilities.

Experiment 2

To distinguish between cue-word associations and ambient language as factors underlying language-dependent memory, we manipulated these variables separately in Experiment 2. Again, we conducted the two parts of the interview in different languages, but the language of the word prompts did not always correspond to the ambient language of the interview. In each interview language, four of the word prompts were given in Russian and the other four were given in English. Regardless of the language of the word prompt, the experimenter always spoke and the participant always responded in the ambient language of the interview.

Method

Participants. Twenty-four Russian-English bilingual Cornell students participated in Experiment 2, 12 men and 12 women (none of whom had participated in Experiment 1). Their mean age at the time of the experiment was 20.2 years ($SD = 2.0$), and their mean age at the time when they immigrated to the United States was 13.4 years ($SD = 2.4$). Five of them indicated that Russian was their preferred language, 13 stated that English was their preferred language, and 6 indicated no language preference.

Materials. The 16 Russian-English pairs of cue words from Experiment 1 were also used in Experiment 2. Each participant received four Russian word prompts and four English word prompts in the Russian part of the interview, and another four Russian and four English word prompts in the English part of the interview. The language of the prompts was varied in ABBA order (e.g., Russian-English-English-Russian) in each part of the interview.

Procedure. Except for the language of the prompt words, the procedure was identical to that of Experiment 1. Again, the experiment was disguised as a study of storytelling in different languages, and again participants were given a warm-up task in each language. Language at time of event, age at time of event, and response latencies were recorded as before.

In each of the two parts, the ambient language was the language in which the experimenter spoke to the participants, the participants narrated all their stories, and all the interactions took place. The only exception was that four of the prompt words were spoken by the experimenter in the other language. These were the only occasions on which the nonambient language appeared in the interviews. In each part, participants were warned that the facilitating prompts might be presented in either language. They were

instructed to respond in the language appropriate to that part, regardless of the language of the prompts, and not to switch to the other language at any point. To avoid ambiguity, all the prompts presented in the nonambient language were clear phonetic exemplars of that language—none were cross-linguistic homophones (words that sound similar across languages but differ in meaning). Thus, memories were retrieved in four conditions: (a) Russian ambient-Russian word prompt, (b) Russian ambient-English word prompt, (c) English ambient-Russian word prompt, and (d) English ambient-English word prompt.

Results

We collected a total of 384 memories in Experiment 2. Of these, 248 were memories of events in which Russian was spoken, 91 were memories of events in which English was spoken, and 45 were memories of events in which a mixture of Russian and English was spoken. The total numbers of Russian, English, and mixed memories recalled by participants in each of the four possible conditions (Russian ambient-Russian word prompt, Russian ambient-English word prompt, English ambient-Russian word prompt, and English ambient-English word prompt) appear in Table 1.

We conducted three $2 \times 2 \times 2$ (Ambiance Language \times Word-Prompt Language \times Order) analyses of variance (ANOVAs). The first, on recall of Russian memories, showed significant effects of both ambient language and word-prompt language on the number of Russian memories recalled. Averaged across word prompts, participants recalled more Russian memories when interviewed in the Russian ambient ($M = 5.88$) than when interviewed in the English ambient ($M = 4.46$), $F(1, 22) = 13.30$, $p = 0.001$. Averaged across ambiance, they also recalled more Russian memories to Russian word prompts ($M = 5.58$) than to English word prompts ($M = 4.75$), $F(1, 22) = 6.88$, $p < 0.05$. There was no interaction between the ambient language and the word-prompt language, $F(1, 22) = 0.05$, $p > 0.1$. The order in which the two languages were used did not affect recall of Russian memories and did not interact with the ambiance and word-prompt effects.

The second ANOVA, on English memories, showed similar effects of ambient language and word-prompt language. Participants recalled more English memories when interviewed in an

Table 1
Number of Russian, English, and Mixed Memories Retrieved in Various Conditions in Experiment 2

Memories retrieved	RA	EA	Total
Russian			
RW	75	59	134
EW	66	48	114
Total	141	107	248
English			
RW	10	27	37
EW	17	37	54
Total	27	64	91
Mixed			
RW	11	10	21
EW	13	11	24
Total	24	21	45

Note. EA = English ambient; EW = English word prompts; RA = Russian ambient; RW = Russian word prompts.

English ambience ($M = 2.67$) than when interviewed in a Russian ambience ($M = 1.13$), $F(1, 22) = 25.83$, $p < 0.001$; they also recalled more English memories to English word prompts ($M = 2.25$) than to Russian word prompts ($M = 1.54$), $F(1, 22) = 8.30$, $p < 0.01$. We found no interaction between the ambient language and the word-prompt language, $F(1, 22) = 0.11$, $p > 0.1$, nor were there any significant effects of or interactions with order.

A similar $2 \times 2 \times 2$ ANOVA on recall of mixed memories revealed no significant effects of ambience language, word-prompt language, or order.

Because both ambient language and word-prompt language had significant effects on recall of autobiographical memories, we performed analyses to determine which effect was stronger. For each participant separately, we computed a measure of the ambient-language effect for English memories by subtracting the number of English memories recalled in the Russian ambience from the number of English memories recalled in the English ambience. We computed a similar measure of the word-prompt effect on English memories by subtracting the number of English memories recalled to Russian word prompts from the number of English memories recalled to English word prompts. We evaluated the difference between these two effects on recall of English memories with a t test, and the results showed that the effect of ambient language ($M = 1.54$) was significantly stronger than the effect of word-prompt language ($M = 0.71$), $t(23) = 2.32$, $p < 0.05$. For Russian memories, a similar comparison of the ambience effect ($M = 1.42$) and word-prompt effect ($M = 0.83$) produced a difference in the same direction, but it did not reach significance, $t(23) = 1.13$, $p > 0.05$.

As noted in the introduction to this article, analyses based on age are not the most effective way to examine effects of language on memory. Nevertheless, it may be worth noting that the age from which memories were recalled in the Russian ambience ($M = 13.14$) was lower than the age from which memories were recalled in the English ambience ($M = 14.40$); this result was marginally significant, $F(1, 23) = 3.96$, $p = 0.06$. In contrast, the age of memories recalled to Russian word prompts ($M = 13.46$) was not significantly different from the age of memories recalled to English word prompts ($M = 14.08$), $F(1, 23) = 2.89$, $p = 0.1$. The age from which memories were drawn was lowest when both ambience and word prompt were Russian ($M = 12.73$) and highest when both ambience and word prompt were English ($M = 14.61$), with mixed-language conditions in between (Russian ambience–English prompts, $M = 13.56$; English ambience–Russian prompts, $M = 14.18$).

We also used a $2 \times 2 \times 2$ ANOVA to examine differences in reaction times. In this experiment (unlike Experiment 1), we found no significant effects. Reaction times were not significantly influenced by the ambient language, the language of the word prompt, or order.

Discussion

In the recall context provided by a given ambient language, participants tended to recall events that had originally been experienced in that same language. This predicted effect of ambience was independent of the language in which individual prompt

words were presented. But the language of those prompts had a similar effect, independent of ambience: A prompt in a given language tended to elicit events that had originally been experienced in that same language. Thus, ambient language and word-prompt language both contribute to language-dependent recall. The fact that ambience has an effect independent of word-prompt language—indeed, possibly stronger than word-prompt language—may be regarded as strengthening the analogy between language-dependent recall and other forms of context dependency.

General Discussion

Autobiographical memory is saturated with language. Not only do we use words to express what we remember, but the remembered events themselves often include conversations or other forms of linguistic behavior. The contexts in which those events are later recalled may include language, too, as in the case of prompted recollections or shared conversations about the past. Such experiences are so common that one of their key features is often taken for granted: the presence of the same linguistic context at both encoding and recall. The principle of encoding specificity suggests that recall should be better when the two contexts are the same than when they are different. We obtained exactly that result in both of the experiments reported here.

Ours is the first study of autobiographical memory in bilinguals to focus directly on the language match between encoding and retrieval. The encoding specificity hypothesis predicts that Russian memories should be better recalled in the Russian language interview, whereas English memories should be better recalled in the English language interview; these predictions were confirmed. Other studies, in contrast (Bugelski, 1977; Otoy, 1987; Schrauf & Rubin, 1998), have typically used age at the time of the original event as a dependent variable instead. Although it is true that immigrants' later memories are more likely to include their second language than their first, this correlation is far from perfect.

Another difference between our study and those of other investigators is that our participants were unaware of the real aims of the study. Post-experimental debriefing showed that all of them had accepted our cover story about narrative styles; none thought the experiment was about memory. Thus, our results are probably not due to the perceived demand characteristics of the experimental situation itself.

Once the existence of language-dependent recall had been established, the next task was to identify the features of the linguistic environment that were responsible for it. There seemed to be two main possibilities. The fact that every memory in our study was cued by a particular word prompt suggested that perhaps what mattered was the language of the prompts themselves. By similarity alone, the English retrieval cue *birthday* may be more likely to elicit memories including "birthday" than memories including "день рождения," the Russian words for *birthday*. The other possibility, perhaps more interesting, was that the overall language ambience of the interview may create a certain state—what Grosjean (2000) called a *language mode*—specific to the language in question. Such an effect would strengthen the analogy between language-dependent recall and other forms of state-dependent memory.

Experiment 2 explored these possibilities with a design that varied the prompt language and the ambient language indepen-

dently. The results showed that both variables contribute a significant main effect to language-dependent recall, with the ambient effect being somewhat larger than the prompt-word effect. This finding that ambient language affects recall provides support for the idea of language mode, with linguistic ambiance likely to be a form, or at least a component, of language mode. With respect to autobiographical memory, our findings suggest that future research need not restrict itself to the prompt-word method. Any procedure that establishes a language-specific ambiance should be enough to produce language-dependent recall.

Although our results support the concept of language mode, they do not bear on the distinction between single- and double-store memory organization in bilinguals. The hypothesis of linguistically distinct memory stores is unnecessary in order to explain our findings, just as it would be unnecessary to postulate a separate memory store for each mood in mood-dependent memory or for each environmental context in context-dependent memory. Indeed, such ideas would seem ludicrous. There are a number of ways to account for language-dependent recall of autobiographical memories from a common memory store. Consider, for example, transfer appropriate processing (e.g., Morris, Bransford, & Franks, 1977), wherein performance on retention tests has been shown to vary with the extent to which procedures required on the test recapitulate those used during encoding (Durgunoglu & Roediger, 1987). Language-dependent recall is a similar concept.

Two other findings, less directly related to our main hypothesis, should also be mentioned. One of these is our failure to find consistently significant response latency effects. Experiment 1 showed significant differences in reaction times for English, but not Russian memories; Experiment 2 showed no significant differences in reaction times at all. Schrauf and Rubin (1998) also found no effect of recall language on reaction times. This may be because reaction times for autobiographical recall are intrinsically difficult to measure. All an external observer can do is stop a timer when the informant begins the overt account of a particular event either orally (as in our experiments) or in writing (as in Schrauf & Rubin, 1998). These are crude measures, because the participant may access a memory several seconds (or more) before he or she actually finds a way to formulate it. Furthermore, participants often frame their narratives in complex ways before beginning to present the specific episode itself. Until researchers devise a better measure of the actual memory onset, reaction time measures of autobiographical memory will continue to be unsatisfactory.

Our second subsidiary finding concerns the distribution of memories across ages. In both experiments, our participants recalled relatively few memories from the period around and just after immigration—fewer than from either their childhoods in Russia or their adult lives in America. A detailed analysis of this finding will be the subject of future work. It may just be another effect of mismatching languages: Many of the participants' experiences at that time must have included a mixture of Russian and English rather than being pure cases of either language. On the other hand, one could also interpret this drop in memories in terms of schema theory, according to which people understand and remember events by integrating them into existing frameworks or schemata (Bartlett, 1932). In the period immediately after immigration, our participants must have had many new experiences that did not fit their existing schemas. Once participants created the appropriate

schemas, events could again be integrated into these schemas and, hence, could be recalled more easily.

As noted in the introduction to this article, the phenomenon of language-dependent recall is probably not restricted to bilingualism or to autobiographical memory. It may appear wherever different linguistic registers are used: in child-directed speech, socially modulated speech, or special domains of language use. Language-dependent recall may also appear in semantic memory—recall of general knowledge, songs and poems, and so on may also be affected by linguistic environments at encoding and retrieval. In general, information that is acquired in a certain linguistic ambiance is likely to become more accessible when recall takes place in that same ambiance. Moreover, changes in the linguistic environment may also lead to an altered self-concept and other changes in cognitive structure. Thus, the phenomenon of language-dependent memory may be a useful framework for studying the complex relationships among memory, language, and cognition.

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