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# Language-Dependent Memory

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## Abstract

Research with bilinguals may provide insights into the complex relationship between autobiographical memory and language. The present paper suggests existence of language-dependent memory, where linguistic factors at the time of recall influence memory retrieval. In two experiments, Russian-English bilingual immigrants were interviewed using the word-prompt technique. In the first experiment, bilinguals retrieved more autobiographical memories when there was a match between language of recall and language of encoding than when there was a mismatch. More memories from the period before immigration were recalled in Russian than in English and more memories from the United States were recalled in English than in Russian. To examine the mechanisms underlying these results, the ambient language and the word-prompt language were considered separately in the second experiment. Both the linguistic ambient and the word prompt were found to influence recall of autobiographical memories. These results, and particularly the effect of linguistic ambient on recall, suggest language-dependent memory.

## Language-Dependent Memory

Since the encoding specificity principle was first introduced a quarter of a century ago (Tulving & Thomson, 1973), cognitive psychologists have investigated context-dependent memory in a number of different domains (see Davies & Thomson, 1988, for reviews). Environmental-context-dependent memory has been found when the encoding and retrieval contexts have been drastically manipulated, as, for example, when encoding took place under water and recall took place on land (Godden & Baddeley, 1975). Context-dependent memory has also been studied with more moderate changes of context, as, for example, in studies where encoding and recall took place in different rooms (e.g., Smith, Glenberg, & Bjork, 1978; Smith, 1979). Similarly, mood-state dependent memory has been supported and challenged by numerous studies with both clinical and normal populations, using both real-life as well as laboratory memory material (for reviews, see Bower, 1981, Christianson, 1992, and Eich, 1995). The main idea behind the work on context-dependent memory is that memories become more accessible when environmental or internal factors at retrieval are similar to circumstances at encoding.

In the present paper, it is proposed that language may lead to similar state-dependency effects. The concept of language-dependent memory is introduced, suggesting that the linguistic ambient at the time of retrieval influences recall of memories, so that memories become more accessible when language at retrieval matches language at encoding. In its broad application, language-dependent memory may occur both for semantic and for episodic memories. It may be observed with monolingual as well as multilingual speakers, when factors in the linguistic environment undergo significant change.

The phenomenon of language-dependent memory appears to be particularly evident in the memories recalled by bilinguals. Bilinguals have an opportunity to experience life events while using different languages, and the drastic differences between the two linguistic environments may be particularly conducive to studying language dependency. If language is a key factor in memory encoding, then language of retrieval should affect the accessibility of a bilingual's memories. Indeed, anecdotal evidence supporting this hypothesis is abundant. For example, when asked for her apartment number in her native language, a bilingual who has lived in the United States for over a decade has erroneously provided the number of the flat in her native country. Upon quickly correcting herself, she explained the immediate response by saying that the number of the old apartment just popped into her mind because of the way the question was asked. In another case, a bilingual child who learned a French song while on vacation in France could not recall the song upon return to the United States. However, once finding himself in a French-speaking environment again, he remembered the song without any effort. The phenomenon that appears to underlie such effects underlies the present investigation.

In general, most work on the relationship between language and memory in bilinguals has been at the lexical level (see deGroot & Kroll, 1997, for reviews). For autobiographical recall, the idea that bilinguals' memories may be more accessible in the language of origin has been proposed mainly from a clinical psychoanalytic perspective (Aragno and Schlachet, 1996; Javier, 1995; Javier, Barroso and Munoz, 1993). For example, Aragno and Schlachet (1996) review three cases in which using the first language with bilingual clients resulted in more successful psychoanalysis sessions. Similarly, Javier, Barroso and Munoz (1993) found that the memories of five bilingual speakers were richer and more

elaborate when accessed in the language in which the events took place than in the other language.

Empirical studies attempting to demonstrate similar effects have traditionally used the word-prompt technique (Galton, 1879, Robinson, 1976), where subjects were presented with a word and asked to produce the first memory that came to mind. Bugelski (1977) found that, when prompted with English words, Spanish-English bilinguals accessed 70% of "thoughts" primarily from the mature life period and 13% of "thoughts" from childhood. When prompted with the same words in Spanish, 43% of the "thoughts" were from maturity and 45% were from childhood.

In a study examining the role of cultural transition and language on memory encoding and recall, Otoya (1987) cued bilinguals with 10 word prompts in each language. Of these, six were translation equivalents of each other. She found that English words triggered later memories than Spanish words, the difference being significant for 3 words.

Contrary to Bugelski (1977) and Otoya (1987), Schrauf and Rubin (1997) found no such tendency to recall earlier memories when prompted in the first language than when prompted in the second language with elderly Spanish-English bilinguals. A possible explanation for Schrauf and Rubin's (1997) failure to find language-dependent memory is that age at which the event took place may not be a sensitive measure of language effects in bilinguals who used both languages concurrently for most of their lives. In Schrauf and Rubin's study, participants' mean age at immigration was about 28 years, and their mean age at the time when the experiment took place was 64.58. During the post-immigration period of almost 40 years, participants used both Spanish and English in parallel. Memories from that post-immigration period may have been encoded at times when English, or Spanish, or both languages were spoken. And, with the mean age from which memories were accessed considerably later than immigration (39.79 years in Spanish and 40.55 years in English), age may indeed not show any language effects. Instead, it may be more useful to establish, for each memory accessed, what language was spoken at the time when the remembered event took place.

The match between encoding and retrieval languages, and its effect on the memories retrieved, became the main focus of the present investigation. The effect of language on recall of autobiographical memories was examined through two experimental studies. We hypothesized that individuals who acquired a second language later in life will exhibit language-dependent memory, eliciting more memories from times when the first language was spoken when interviewed in the first language, and more memories from times when the second language was spoken when interviewed in the second language. The first experiment sought to establish the existence of language-dependent memory. In the second experiment,

the mechanisms underlying this phenomenon were examined more carefully.

One advantage of the present research over previous work is that it actively tried to avoid the demand characteristics that arise when subjects get cues in two different languages while participating in what they know to be a memory experiment. To avoid this problem, the present experiment used a cover task: our Russian-English bilingual subjects were led to believe that we were interested in the characteristic narrative styles of the two languages rather than in the particular memories they recalled. Participants were told that the experiment is part of a larger linguistic study in which properties of narratives in different languages are investigated. They were told that in this case we are examining Germanic and Slavic languages and that we would like them to provide a few narratives for our multi-language database. Participants were also led to believe that the reason for using word prompts was to assist them in coming up with stories.

Another advantage of our study was that subjects were not prompted with the same words in both languages. Instead, the word prompts were presented in the two languages in counterbalanced order across subjects. Finally, in addition to comparing the ages from which memories were accessed in different languages, we also considered the match between language of encoding and language of retrieval. If participants accessed more memories when the language of retrieval matched the language of encoding, then language-dependent memory is concluded.

For purposes of clarity and simplicity, in the present paper, a memory is called a *Russian memory* if it refers to an event that comes from a time when Russian was spoken by, to, or around the participant. A memory is called an *English memory* if it refers to an event that comes from a time when English was spoken by, to, or around the participant. And a memory is called a *Mixed memory* if it comes from a time when a mixture of both Russian and English was spoken by, to, or around the participant.

## Experiment 1

The first experiment investigated whether Russian-English bilingual immigrants show language-dependent memory in their recall of autobiographical events. We hypothesized that bilinguals would access more memories when the language of recall matched the language of retrieval.

## Methods

### Participants

Twenty Cornell students participated in the experiment, 9 females and 11 males. All were Russian-English bilinguals, fluent in both languages, who had immigrated to the U.S. 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 subjects indicated that Russian was their preferred language of communication, twelve subjects indicated that English was their preferred language of communication, and four subjects 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 16 prompt words were used: summer, neighbors, birthday, cat, doctor, getting lost, frightened, bride, snow, friends, holiday, dog, blood, contest, laughing, and newborn. Their Russian translations, respectively, were: лето, соседи, день рождения, кошка, врач, потеряться, испугаться, невеста, снег, друзья, праздник, собака, кровь, конкурс, смеяться, and новорожденный. Each participant received 8 of these prompt words in one language, and 8 in the other language.

## Procedure

Each participant was interviewed individually; all interviews were tape-recorded. Upon arrival, participants were welcomed to a study of "storytelling in different languages" and 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, since it may be difficult to come up with numerous stories upon request, they will 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. Disguising the study as one of "storytelling in different languages" was necessary in order to prevent subjects from guessing the real focus of the experiment. With this and other similar instructions, indeed none of the participants identified the experiment to be a study of memory, as became evident during the post-experimental debriefing.

Participants were interviewed in two parts, an English part and a Russian part. The order of the languages was counterbalanced across subjects. In each part, participants received 8 word prompts in the assigned language. An effort was made to establish a very definite linguistic milieu for each language. Both the experimenter and the participant spoke only in the assigned language. In each part, the participant began by reading and signing a consent form in the appropriate language, followed by a warm-up task. In the warm-up task for the first part, the participant was asked to tell four stories from four specific periods of his or her life (no cue words were given). In the warm-up for the second part, the participant was asked to describe the experience of immigrating to the U.S. in some detail. The warm up tasks were mainly used to get the subject comfortable with the target language, to indicate that code-switching (using words from the other language) is not acceptable, and to make sure that they provide specific events from their lives, rather than loose associations, preferences,

thoughts, or opinions. After all memories were collected, each participant was asked to indicate what language s/he spoke, was spoken to, or was surrounded by at the time when the event took place and to estimate his or her age at the time.

## Results

A total of 318 autobiographical memories were collected. Of these, 160 were memories of events that were experienced at a time when Russian was spoken, either before or after immigrating to the U.S. (Russian memories). Ninety-two were memories of events that were experienced at a time when English was spoken after immigrating to the U.S. (English memories). The remaining 66 were memories of events that were experienced at a time when a mixture of Russian and English was spoken; all except one are post-immigration memories (Mixed memories).

Analyses on the ages from which subjects drew their memories showed that participants consistently recalled memories from an earlier age (before emigration) when interviewed in Russian ( $M=13.1$  years) than when interviewed in English (after immigration,  $M=16.1$  years),  $t(19)=4.829$ ,  $p<0.001$ .

Separate analyses on each type of memories showed that participants accessed more Russian memories when interviewed in Russian ( $5.15$ ,  $SD=2.28$ ) than when interviewed in English ( $2.85$ ,  $SD=1.69$ ),  $t(19)=4.479$ ,  $p<0.001$ . Similarly, participants accessed more English memories when interviewed in English ( $3.35$ ,  $SD=1.57$ ) than when interviewed in Russian ( $1.3$ ,  $SD=1.26$ ),  $t(19)=5.712$ ,  $p<0.001$ . Mixed Russian-English memories were accessed more or less equally in Russian ( $1.45$ ,  $SD=1.32$ ) and in English ( $1.75$ ,  $SD=1.44$ ),  $t(19)=1.071$ ,  $p>0.1$ . No significant effect of order was found. The results of the first experiment are shown in Figure 1.

Finally, the distribution of memories across the lifespan showed a drop in the number of memories accessed from the period immediately following immigration.

## Discussion

These results indicate that bilinguals typically access different autobiographical memories in their two languages. Bilingual speakers are more likely to retrieve memories in which the language at the time of retrieval matches the original language of the event. It appears that this effect is not simply a result of demand characteristics, but rather a robust relationship between the language of retrieval and the autobiographical memories retrieved.

Two possible mechanisms may account for the observed language-dependent memory. On the one hand, it is possible that the language milieu at the time of retrieval may establish a mindset that functions like the "states" of state-specific memory. In this case, the important congruity is between the language ambiance at encoding and at retrieval. On the other hand, the effect may depend on the cue word itself, and its specific congruity with words that were spoken at the time of the original event. The second experiment was designed to investigate these two hypotheses.

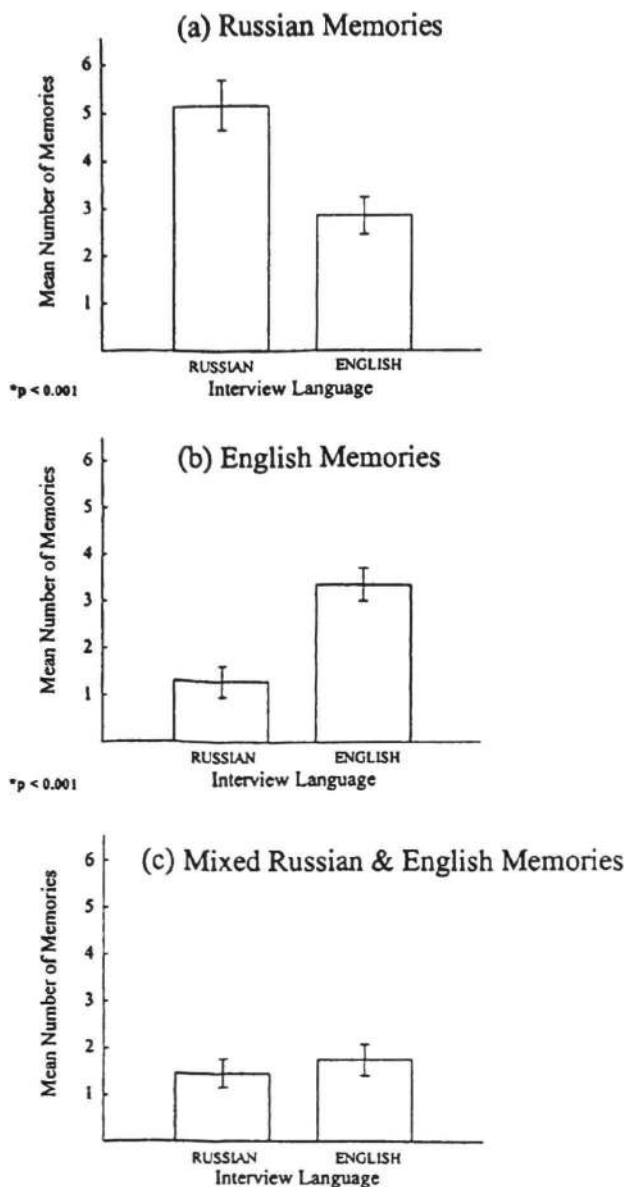


Figure 1: Number of Russian, English and Mixed memories retrieved in each language in Experiment 1.

## Experiment 2

The possible mechanisms underlying language-dependent memory were explored by examining the effect of the language ambiance and the effect of the cue words separately from each other. While the interviews continued to be conducted in either the first or the second language, the word prompts did not always correspond to the language of the interview. That is, when interviewed in Russian, half of the word prompts were given in Russian and half of the word prompts were given in English. Regardless of the language of the word-prompt, participants were always to respond and the experimenter was always to interact in the language of the interview. This second experiment was designed to investigate which of the two variables—language ambiance or word-

prompt language—was responsible for the language-dependent recall of autobiographical memories.

## Methods

### Participants

Twenty-four Russian-English bilingual Cornell students participated in the study, 12 males and 12 females. Their mean age at the time of the experiment was 20.2 ( $SD=2.0$ ), their mean age at the time when they immigrated to the U.S. was 13.4 ( $SD=2.4$ ). Five indicated that Russian was their preferred language at the time when the experiment was conducted, 13 indicated that English was their preferred language, and 6 indicated no language preference.

### Procedure

The procedure used in the second experiment was identical to the one used in experiment 1. Again, the experiment was disguised as a study of storytelling in different languages, and again participants had to undergo a warm-up task in each language. The main difference in this experiment was the separation of ambiance language from word prompt language. The ambiance language refers to the language of the interview, that in which both the experimenter and the participant spoke, and that in which the stories were narrated. However, in each interview, the experimenter pronounced half of the prompt words in the other language. For example, a participant may be interviewed in Russian first and in English second. Of the 8 word prompts used in the Russian interview, only the first, the fourth, the sixth, and the seventh were presented in Russian (ABBA design). The remaining 4 word prompts were presented in English. Thus, autobiographical recall was tested in four conditions: (1) Russian ambiance--Russian word prompt, (2) Russian ambiance--English word prompt, (3) English ambiance--Russian word prompt, and (4) English ambiance--English word-prompt. The same sixteen Russian/English pairs of cue words as in the first experiment were used in experiment two.

## Results

A total of 384 memories were collected in the second experiment. Two hundred and forty eight were memories of events from times when Russian was spoken, 91 were memories of events from times when English was spoken, and 45 were memories of events from times when a mixture of Russian and English was spoken. The number of memories accessed in each condition (by ambiance and word prompt language) are shown in Table 1.

A  $2 \times 2 \times 2$  analysis of variance (ambiance language  $\times$  word prompt language  $\times$  order) showed that recall of Russian memories was significantly influenced by the language of the ambiance and by the language of the word prompt. Participants recalled more Russian memories when interviewed in a Russian ambiance (5.9,  $SD=1.5$ ) than when interviewed in an English ambiance (4.5,  $SD=1.8$ ),  $F(1, 22)=13.306$ ,  $p=0.001$ . Participants also recalled more Russian memories when prompted with Russian word prompts (5.6,  $SD=1.6$ ), than when prompted with English word prompts

Table 1: Total number of Russian, English and Mixed memories retrieved in each condition in Experiment 2. (RA–Russian Ambiance; EA–English Ambiance; RW–Russian Word Prompts; EW–English Word Prompts.)

a. Russian Memories Retrieved			
	RA	EA	Total
RW	75	59	134
EW	56	48	114
Total	141	107	N=248

b. English Memories Retrieved			
	RA	EA	Total
RW	10	27	37
EW	17	37	54
Total	27	64	N=91

c. Mixed Memories Retrieved			
	RA	EA	Total
RW	11	10	21
EW	13	11	24
Total	24	21	N=45

(4.7, SD=1.5),  $F(1,22)=6.875$ ,  $p<0.05$ . There was no interaction between the effect of ambiance language and the effect of word prompt language,  $F(1,22)=0.048$ ,  $p>0.1$ . 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.

A similar analysis on English memories showed that recall of English memories was also significantly affected by both ambiance language and word prompt language. Participants recalled more English memories when interviewed in an English ambiance (2.7, SD=1.6) than when interviewed in a Russian ambiance (1.1, SD=1.2),  $F(1,22)=25.83$ ,  $p<0.001$ , and more English memories when prompted with English word prompts (2.3, SD=1.3) than when prompted with Russian word prompts (1.5, SD=1.4),  $F(1,22)=8.3$ ,  $p<0.01$ . No interaction between the ambiance language and the word prompt language was found,  $F(1,22)=0.108$ ,  $p>0.1$ . The effect of order on recall of English memories was non-significant and did not interact with ambiance and word-prompt effects.

Analyses on recall of Mixed memories revealed no effect of ambiance language, word prompt language, order, or interactions between any of these factors. Mixed memories were accessed about equally when the ambiance was Russian (1, SD=0.8) as when the ambiance was English (0.9, SD=0.9),  $F(1,22)=0.279$ ,  $p>0.1$ , and

when the word prompt was Russian (0.9, SD=0.8) as when the word prompt was English (1, SD=0.8),  $F(1,22)=0.4$ ,  $p>0.1$ .

Since both ambiance language and word prompt language had significant effects on recall of autobiographical memories, analyses on the amplitude of each effect were performed to determine which of the two was stronger. A t-test comparing the word prompt effect versus the ambiance language effect showed that ambiance language had a significantly stronger effect than word prompt language on recall of English memories,  $t(23)=2.318$ ,  $p<0.05$ . For Russian memories, the effect was in the same direction, but did not reach significance,  $t(23)=1.127$ ,  $p>0.05$ .

Finally, the distribution of memories accessed in the second experiment replicated the pattern observed in the first experiment, and showed that fewer memories were recalled from the period immediately following immigration.

## Discussion

Analyses on the effect of ambiance language on recall showed that more memories were accessed when the language in which the event was experienced matched the language of the ambiance, and analyses on the effect of word prompt language on recall showed that more memories were accessed when the language in which the event was experienced matched the language of the word prompt. No interaction was observed between ambiance language and word prompt language, or between these two factors and order. Instead, the effects of ambiance and word order were cumulative. Thus, both interview language and word prompt language were found to influence recall. The effect of ambiance language tended to be stronger, significantly so for English memories.

An interesting observation emerged from the inspection of the distribution of memories across the lifespan. In both experiments, there is a drop in the number of memories accessed from the period immediately following immigration. A number of possible hypotheses can be advanced to explain why those memories were less accessible. It is possible, for example, that the cognitive load present during the period immediately following immigration is higher, not allowing for memories to be processed in the same manner and to the same depth as during the more usual cognitive load. These differences in cognitive processing at the time of encoding may make the memories less accessible. Another explanation may be that memories encoded during that period are less reliant on language, less language-loaded, and therefore linguistic cues such as word prompts will not trigger recall as successfully. Yet another explanation can be linked to the schema theory, according to which a person seeks to integrate new events into existing frameworks or schemata (Bartlett, 1932). If these frameworks rely on language, however, then the drop in post-immigration memories can be explained with the fact that many of the newly experienced memories do not fit existing schemas. For example, the American experiences of using drive-throughs, writing checks, using credit cards and ATMs, shopping at a mall or for groceries, are only some of the instances that required new or different schemas. Once relatively operational schemas have been created, new

events can again be integrated into existing frameworks and are recalled more easily, as indicated by the observed increase in memories after just a few post-immigration years<sup>1</sup>.

### Conclusions

Bower (1981) proposed that different emotions can create dissociative states in such a way that when a person "feels angry and aggressive, one set of memories, beliefs, and competencies are activated; when he feels romantically or sexually aroused, a different set of memories, beliefs and competencies are activated" (p.147). Perhaps we can think in the same manner about language. Changing the linguistic environment may lead to alterations in recall, whether the change is from language to language, or within the same language, as in child-directed speech and baby-talk, or across domains of use. All these are venues that remain to be pursued in the future. To extend this work to semantic memory and knowledge, future efforts will include investigating whether semantic information learned in one language becomes more accessible when recall takes place in the same language. Studies that experimentally extend the language-dependent memory phenomenon to monolingual speakers may gradually reveal which specific factors in one's linguistic environment can facilitate access of memories. Finally, it is even possible that changes in the linguistic environments may lead to altered self-perception, with language and culture intertwined together in their effect on cognition. Studies of the latter may, for example, consider the content of freely recalled memories in the two languages (e.g., comparing references to self versus others, comparing references to internal states, or comparing references indicative of gender attitudes). With research possibilities looming large, the idea of language-dependent memory may prove to be a useful tool for studying the complex relationship between memory and language.

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<sup>1</sup> Although the length of time it takes to show an increase in autobiographical memories after immigration varies from subject to subject, it appears that, on average, this increase occurred about 3 to 4 years after immigration. These findings may be useful in thinking about childhood amnesia. The two patterns of recall--immigrants learning a second language upon immersion into a new culture and children acquiring their first language early in life--may exhibit some similar patterns. The schema/framework theory may be one way to explain these results. Future research may show whether these similarities are real and whether they could provide interesting insights into the complex relationship between autobiographical memory and language.

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