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False memory across languages: Implicit associative response vs fuzzy trace views

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We investigated false recognition across languages using the Deese-Roediger-McDermott (DRM) paradigm. A group of English–French bilinguals studied lists of converging associates, some lists in English and some in French, and then performed a recognition test containing studied list items and nonstudied critical lures whose language matched or mismatched the language at study. Participants were instructed to answer *old* only if the test cue was in the same language as the studied word. The results yielded a robust false memory rate both within-language and across-languages. The effect of the study–test language shift was much larger for list items than for critical lures. This finding suggests that memory representations for critical lures contain primarily semantic gist traces and little surface information, and hence is more consistent with the fuzzy trace view than with the implicit associative response view. In sum, the study demonstrates the existence of false memory across languages, and provides information about the memory traces underlying veridical and illusory recognition.

In recent years, numerous studies have investigated a striking memory illusion. In the memory paradigm known as Deese-Roediger-McDermott (Deese, 1959; Roediger & McDermott, 1995) or simply DRM, participants are exposed to a list of words (e.g., *thread*, *pin*, *eye*, *sewing*, *sharp*, *point*, *haystack*, *pain*, *injection*, etc.) which are all highly associated to a word that is not presented (e.g., *needle*), and later they display a strong tendency to falsely recall or recognise the nonpresented common associate or critical lure (for reviews, see Roediger, McDermott & Robinson, 1998; Schacter, Norman, & Koutstaal, 1998). In the present experiment, we examined the mechanisms underlying this memory illusion by manipulating the language of the words at study and test.

The most popular theoretical accounts of the false memory illusion are the implicit associative response (IAR) view and the fuzzy trace view (for review of theoretical accounts, see Roediger et al., 1998). According to the IAR view (e.g., McDermott, 1996, 1997; Roediger & McDermott, 1995; Roediger et al., 1998; Underwood, 1965), critical lures are explicitly or implicitly generated during encoding, and hence they are later recalled and recognised just like other words in the study list. According to the fuzzy trace view (e.g., Brainerd & Reyna, 1990; Payne, Elie, Blackwell, & Neuschatz, 1996; Schacter, Verfaellie, & Pradere, 1996), two different kinds of representation are created during encoding: *gist traces*, which preserve the general meaning of the events but lack perceptual detail, and *specific traces* (Schacter et al., 1996), which preserve specific features of each event. Thus, when subjects are exposed to a list of converging associates, they not only encode

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specific traces for each of the words but also a semantic gist trace for the whole list. False recall and recognition of the critical lure reflects the retrieval of the gist trace.

IAR and fuzzy trace views share the idea that a memory representation corresponding to the critical lure is stored during encoding. However, they differ regarding the nature of this representation. The IAR view proposes that the critical lure is generated during encoding—possibly consciously (McDermott, 1997), and hence it assumes that the representation of the critical lure contains both semantic and surface (e.g., phonological) information, just like the representations of list items. In contrast, the fuzzy trace view assumes that representations of list items include semantic and surface information, whereas the gist trace corresponding to the critical lure includes only semantic information. Thus, the critical difference between the two views is whether the representations of critical lures and list items differ in terms of perceptual detail. According to the IAR view, they involve similar amounts of surface information, whereas according to the fuzzy trace view, critical lures involve much less surface information than list items.

This last idea is consistent with subjects' introspective reports, which tend to show differences between list items and critical lures in terms of the vividness of perceptual detail (Mather, Henkel, & Johnson, 1996; Norman & Schacter, 1997). Unfortunately, introspective reports do not provide objective evidence that surface information is more available for list items than for critical lures. Differences in introspective statements could reflect reporting biases rather than objective differences. Also, differences in perceptual detail could be detectable but inconsequential. To provide objective evidence that surface information is more available for list items than for critical lures, one needs to demonstrate that subjects can *use* surface information to make retrieval decisions in the case of list items but not in the case of critical lures. In the present study, we tested this prediction of the fuzzy trace view by manipulating language of presentation in bilingual subjects.

Research on bilingual subjects indicates that the two languages differ at the level of surface representations but access the same semantic representations (for a review, see Francis, 1999). For example, study–test language shifts tend to produce a strong effect on memory tasks that depend primarily on surface representations, such as word fragment completion (Durgunoglu & Roediger, 1987; Watkins & Peynircioglu, 1983), but little or no differences on tests that tap mainly conceptual representations, such as free recall (Durgunoglu & Roediger, 1987; Erwin, 1961; Rose & Carroll, 1974). Memory tasks that involve both perceptual and conceptual processing, such as recognition, show intermediate effects (Durgunoglu & Roediger, 1987). Thus, the fuzzy trace view predicts that specific traces for list items should differ across languages whereas gist traces for critical lures should be language-independent.

In the present experiment, subjects studied lists of converging associates in English and French, and then performed a recognition test containing list items and critical lures whose language matched or mismatched the language at study. Subjects were instructed to answer *old* only if the test cue was identical to the studied word, i.e., in the same language. Under these conditions, positive recognition of a word presented in a different language would reflect the retrieval of semantic information in the absence of surface information.

IAR and fuzzy trace views make a similar prediction regarding list items: the tendency to recognise list items as "old" should be higher within-language, when test cues match study items at both surface and semantic levels, than across-languages, when they match them only at the semantic level. However, the two views make different predictions about critical lures. Given the reasonable assumption that critical lures are generated in the same language of the study list, the IAR view predicts that recognition of critical lures should be affected by study–test language shifts. In contrast, the fuzzy trace view assumes that recognition of critical lures is based on language-independent semantic gist traces, and hence it predicts little or no effect of study–test language shifts on false recognition. In sum, if language shifts produce similar effects on the recognition of critical lures and list items, the IAR view will be supported, whereas if they produce a stronger effect on the recognition of list items than on the recognition of critical lures, the fuzzy trace view will be endorsed.

METHOD

Participants

A total of 30 English–French bilingual students of Faculté Saint-Jean, University of Alberta, participated in the study. Participants were highly proficient in both languages and used them both in everyday life. Of these participants, 24 had English as first language, 3 had French as first language, and 3 did not indicate language of preference.

Materials

A total of 30 converging associate lists were selected from Stadler, Roediger, and McDermott's (1999) norms. Each list consisted of the strongest 12 associates (e.g., *pin, haystack*, etc.) to a ''critical lure'' (e.g., *needle*). The words were translated into French, and the translation was checked by bilingual undergraduate students to ensure it was appropriate for the subject population.

Procedure

Three factors were completely crossed within-participant: study language (English, French), test language (English, French), and item type (list item, critical lure). Additionally, unrelated new words in English and French were included in the test as distractors. Testing was done in two groups, corresponding to two different classes at Faculté Saint-Jean. Participants were given a booklet with ten lists in English and ten in French, one list per page. French and English lists appeared in a different random order for each subject. Critical lures were not included in the study lists. Participants were instructed to study each list for a subsequent memory test, which was not specified. Every 15 seconds, the experimenter signalled students to turn a page of the booklet and study a new list.

After the study phase, the recognition test was distributed. For each word in the test list, participants had to indicate whether or not they had read exactly the same word in the study booklet (i.e., in the same language). The test list consisted of 60 words, of which 20 words were unrelated new words, 10 in English and 10 in French, 20 words were list items, 10 in English (5 from lists studied in English and 5 from lists studied in French) and 10 in French (5 from lists studied in English and 5 from lists studied in French), and 20 words were critical lures, 10 in English (5 from lists studied in English and 5 from lists studied in French) and 10 in French (5 from lists studied in English and 5 from lists studied in French). The 30 word lists were divided into six sets, which were counterbalanced across the six study–test conditions: (1) English–English, (2) French–English, (3) Nonstudied–English, (4) French–French, (5) English–French, and (6) Nonstudied–French.

RESULTS

The proportions of ''old'' responses in the recognition test are shown in Table 1. To evaluate the level of veridical and illusory recognition in the standard within-language condition, a first analysis was conducted including only within-language conditions plus the new item condition. In this 3 (item type: critical lure, list item, new item) $\times$ 2 (test language: English, French) ANOVA, the effect of item type was significant, $F(2, 58) = 35.4$, $p < .0001$, but the effect of test language, $F < 1$, and its interaction with item type, $F(2, 58) = 2.9$, $p > .05$, were not. PLSD analyses indicated that the proportion of ''old'' responses was significantly greater for list items than for new items ($p < .0001$), for critical lures than for new items ($p < .0004$), and for list items than for critical lures ($p < .0001$). Thus, in the standard within-language condition there was a robust level of false recognition (critical lures > new items), which was similar for words tested in English and for words tested in French.

To evaluate the existence of false memory across languages, a similar ANOVA was performed but this time including the across-language conditions instead of the within-language conditions. This analysis yielded a reliable main effect of test language, $F(1, 29) = 4.6$, $p < .05$, , and a significant effect of item type, $F(2, 58) = 7.5$, $p < .002$. The interaction between the two factors was nonsignificant, $F(2, 58) = 2.6$, $p > .08$. PLSD analyses indicated that the proportion of ''old'' responses was significantly greater for list items than for new items ($p < .0001$) and for critical lures

TABLE 1
Proportion of ''old'' responses as a function of item task and the match-mismatch between language at study and at test

	Tested in English	*Tested in French*
Within-language		
List items	.69	.59
Critical lures	.41	.40
Across-languages		
List items	.32	.32
Critical lures	.25	.39
New items	.18	.24

than for new items ($p < .0004$), with no reliable difference between list items and critical lures ($p > .9$). Thus, as in the within-language conditions, the across-languages conditions yielded a robust level of false recognition, both for words tested in English and for words tested in French. This result demonstrates the existence of false memories across languages.

Finally, to investigate whether or not the representation of critical lures contains surface information we conducted an analysis collapsing across the two test languages and including only list items and critical lures. Since false alarms to new words differed across languages (.18 vs .24), we adjusted recognition rates for list items and critical lures by subtracting false alarm rates. The resulting data are displayed in Figure 1. The data were analysed with a 2 (language shift: within-language, across-languages) × 2 (item type: list item, critical lure) ANOVA. This analysis yielded a significant effect of language shift (within > across), $F(1, 30) = 25.1$, $p < .0001$, a significant effect of item type (list item > critical lure), $F(1, 30) = 17.3$, $p < .0002$, and a significant interaction between these two factors, $F(1, 30) = 6.3$, $p < .0001$. The highly significant interaction occurred because the language shift effect was much larger for list items than for critical lures. Pairwise t tests indicated that the language shift effect was highly significant for list items, $t(30) = 6.3$, $p < .0001$, but only marginally significant for critical lures, $t(30) = 1.97$, $p = .057$. Within-language, the proportion of items classified as "old" was much greater for list items than for critical lures, $t(30) = 5.1$, $p < .0001$, whereas across-languages, they were about the same, $t(30) = 0.05$, $p > .9$. These results are more consistent with the fuzzy trace view than with the IAR view, but they are inconsistent with an extreme version of the fuzzy trace view.

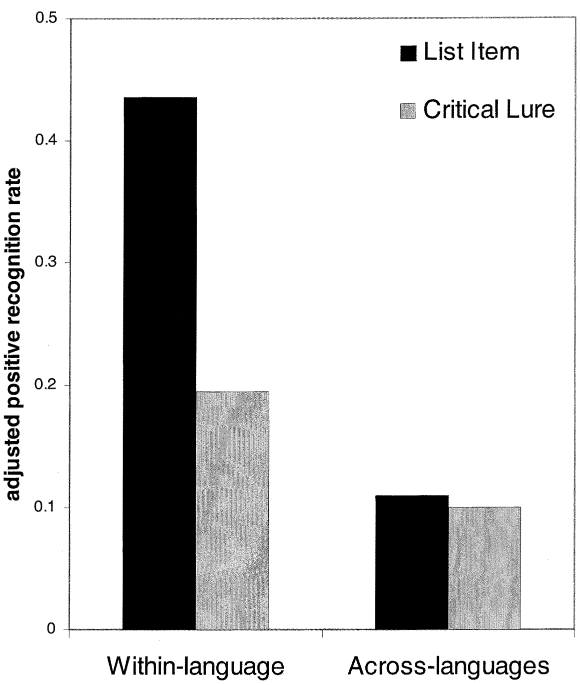

Figure 1. Effect of study–test language shifts on adjusted recognition responses (proportion of *old* responses to list items and critical lures minus proportion of *old* responses to new items).

DISCUSSION

The main result of the study was the finding that the effect of the study–test language shift manipulation was greater for list items than for critical lures. This dissociation is consistent with the fuzzy trace view because this view assumes that recognition of critical lures involves mainly the retrieval of gist traces, which are common across languages, whereas recognition of list items also involves the retrieval of specific traces, which differ across languages. In contrast, the IAR view has difficulty accounting for the differential effect of language shifts on list items and critical lures: if critical lures are explicitly or implicitly generated during encoding in the same language as list items, then recognition of critical lures should be affected by language shifts just like recognition of list items. Thus, the present results are more consistent with the fuzzy trace view than with the IAR view. At the same time, the current data are inconsistent with an extreme version of the fuzzy trace view which assumes that recognition of critical lures depends *exclusively* on semantic gist traces. The fact that language shifts produced a small effect on critical lures suggests that their memory representations contain a certain amount of surface information.

Finally, an interesting aspect of the data was the level of false recognition in the standard within-language English–English condition (.41), which was much lower than in other studies using the DRM paradigm (e.g., .70–.80). This lower level of false recognition could reflect the role of *recollection failure* (Brown, Buchanan, & Cabeza, 2000) or the use of the *distinctiveness heuristic* (Schacter, Israel, & Racine, 1999). Brown et al. (2000) proposed that people might rely on the absence of recoverable episodic information (recollection failure) to reject critical lures. Likewise, Schacter et al. (1999) proposed that subjects' metamemorial belief that they ought to remember distinctive information (distinctiveness heuristic) may decrease the number of false alarms to critical lures. Consistent with these ideas, conditions that enhance the diagnostic value of recollection failure (Brown et al., 2000) or the availability of distinctive information (e.g., Dodson & Schacter, 2001; Israel & Schacter, 1997; Schacter et al., 1999) have been associated with lower levels of false recognition. Similarly, presenting study items from two different sources instead of one tends to reduce false recognition (Hicks & Marsh, 1999), possibly because it encourages source monitoring (Johnson, Hashtroudi, & Lindsay, 1993) during the test. A similar phenomenon could have happened in the present experiment due to the presentation of words in two different languages: people expected to remember words in a particular language and the absence of such information could have helped them reject critical lures.

In summary, the present study demonstrated the existence of false memories across languages, and provided evidence supporting a moderate version of the fuzzy trace view which assumes that critical lures depend mostly on gist traces but that they also involve a small amount of specific traces. These results suggest that study–test language shift may be used to investigate the nature of memory representations underlying veridical and illusory memory.

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