ACROSS-LANGUAGE PRIMING IN BILINGUALS: DOES ENGLISH BET PRIME FRENCH BÊTE?

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ABSTRACT

Different languages often share speech sounds, and some degree of phonological similarity or equivalence is commonly assumed between these shared sounds. We investigated phonological representations in late bilinguals through a phonological priming paradigm, where participants heard an English CVC prime followed by a French CVC target. Prime-target pairs either matched (e.g. bet, bête) or mismatched (e.g. seed, pâte). If the prime and target share a phonological representation, then responses to the target should be speeded in the matching condition relative to the mismatching condition. In three lexical decision experiments, we tested both French–English and English–French bilinguals. We found no evidence that phonologically matching primes facilitate lexical access. We discuss these results in light of our understanding of phonological representations in bilinguals, language-switching, and priming.

Keywords: phonological priming, auditory priming, interlingual homophones, lexical decision

1. INTRODUCTION

Spoken languages often share similar sounds. For bilingual or multilingual speakers, this raises a question about mental representation: to what extent do these speakers represent the phonemes of different languages with the same abstract units? Consider English peel /pil/ and French pile ‘battery’ /pil/. Although these words differ in phonetic detail ([pʰiː*l] and [pil] respectively), many speakers regard these words as having ‘the same sounds’. Indeed, pile\textsubscript{F} is regarded as more similar to peel\textsubscript{E} than it is to, say, pale\textsubscript{E} or teal\textsubscript{E}.\footnote{Prior work has claimed that words ‘with the same sounds’ facilitate lexical access for bilinguals in unambiguous environments. For example, faster picture naming was observed for (near-)matching words (Catalan gat, Spanish gato) than for non-matching words (Catalan taula, Spanish mesa) [4, 9]. Similar results have been found in the domain of speech perception [11, 14]: for example, a visual-world study found that German–English and English–German bilinguals were briefly distracted by a competitor image of a lid (German Deckel) when searching for the target desk, even though the experiment was entirely in English [1]. The consensus that emerges from this literature is that cross-linguistic phonological competitors (‘interlingual homophones’) influence lexical access.}

What is unclear, however, is what exactly constitutes a phonological competitor. For the most part, the previous literature has simply assumed that equivalence exists between some pairs (e.g. English /f/ and French /f/) but not between others (e.g. English /k/ and French /œ/). These assumptions are largely uncontroversial. However, some phonemes appear to have multiple possible correspondents in the other language, or none at all. Returning to the pile\textsubscript{F} example from earlier: we suggested that this word is most similar to peel\textsubscript{E}, but another plausible mapping is to pile\textsubscript{E}. It has been proposed that in cases like this, the most phonetically similar mapping is primary while the other is secondary [17]. However, it has been noted that structural issues (such as patterns of allophony, phonotactics, and featural oppositions) are just as, if not more, relevant than plain phonetic similarity [2].

Phonological priming can be used as a diagnostic in determining the similarity of phonemes [8, 16], and could be useful in disentangling these questions. A first step is therefore to determine if the phonological priming paradigm can be used to assess interlingual equivalence in general. This paper reports on three experiments which attempt to answer this question. These all followed the same method: Participants were presented with an English prime, followed by a French target. The task was lexical decision on the target. If an English prime (such as
form full lexical access on the target word. Words ‘sounded similar’; they instead had to perform French lexical decision on the prime, and immediately respond with their decision if the target is phonetically similar to the prime. While the inclusion of non-French-sounding primes does not entirely invalidate this strategy, it allows for it to be tested and controlled at the analysis stage. That is, if this strategy is being used then we expect to observe faster responses to French nonwords following non-French-like primes and French lexical words following French-like primes, relative to all other conditions.

All words (primes and targets) were preceded by a grammatically appropriate particle, such as *the* or *le*.* This step was taken to maximize intelligibility of the short stimuli by L2 listeners, and because many bare nouns in French are ungrammatical without a particle. While most research on phonological priming has used bare words (e.g. [6, 13]), short phrases have been shown to lead to equivalent priming effects [16].

The different trial types are summarized in Table 1. Four counterbalanced lists were constructed, each consisting of 56 words and 56 nonwords with French-sounding primes, and 22 words and 22 nonwords with non-French-sounding primes. Of the word trials, 28 were matching and 50 non-matching; and of the nonword trials, 11 were matching and 68 non-matching. No participant was presented more than once with a given prime or a given target.

The prime phrases were recorded by a male native speaker of English, and the target phrases by a female native speaker of French.

2.3. Procedure

Participants were randomly assigned to one of the counterbalanced lists. The procedure followed that of [16]: The prime phrase was presented on screen. The recording of the prime was presented over headphones 500 ms later. At the offset of the audio, the visual display was replaced by a fixation cross. After another 500 ms delay, the target was presented over headphones. Participants responded “word” or “nonword” to the last word of the target phrase. The next trial began 750 ms after a response was registered. Every 7 trials, participants were prompted by question on the screen where they were asked if they
had encountered a particular prime before. This second-
ary task was intended to ensure that participants
were paying attention to the primes; they received
visual feedback on their accuracy.

2.4. Analysis

A mixed-effects linear regression model was con-
structed to predict (log-transformed) reaction time to
correctly answered target trials. Fixed effects were
match condition (matching vs not matching), prime
type (French-like prime vs non-French-like prime),
target word frequency (z-transformed), and prime
word frequency (z-transformed). Random intercepts
of prime word, target word, and participant were in-
cluded along with a random slope for match condi-
tion by prime word, target words, and participant.
This was the largest random slope structure that led
to reliable convergence.

An additional analysis was undertaken in order to
check for the use of the task-specific strategy of per-
foming lexical decision on the English prime as if it
were French, and then accepting or rejecting the tar-
get if there was an approximate phonological match
between the words. For each participant, a t-test was
performed to compare the reaction times of trials
which were eligible for this strategy to the reaction
times of other trials.3

2.5. Results

Mean reaction times are reported in Table 2. All
participants scored above chance on the lexical de-
cision task, and so none were excluded. Thirty-eight
items were removed for having accuracy rates be-
low chance. This left 1499 correct responses to tar-
get items that could be analyzed. No significant ef-
fects in the mixed-effects model were observed (all
p > .3). Thus, there was no systematic difference
between the conditions, even when accounting for
the ability of the prime to be interpreted as a French
word. The t-tests revealed no evidence for strategic
bias in the results. (Three participants actually re-
sponded significantly more slowly to trials with the
hypothetically beneficial conditions.)

2.6. Discussion

This experiment revealed no evidence of priming
from English into French for French–English late
bilinguals. It is plausible that the lack of an effect
could be attributed to the fact that English is the L2
of these participants, and we expect greater influ-
ence of L1 on L2 processing than vice versa (i.e. lan-
guage transfer [7]). That is, to observe true interlin-

table

<table>
<thead>
<tr>
<th>Prime type</th>
<th>Similarity</th>
<th>RT (ms)</th>
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<tbody>
<tr>
<td>French-like</td>
<td>Match</td>
<td>760 (172)</td>
</tr>
<tr>
<td>French-like</td>
<td>Mismatch</td>
<td>771 (160)</td>
</tr>
<tr>
<td>Non-French-like</td>
<td>Mismatch</td>
<td>763 (164)</td>
</tr>
</tbody>
</table>

gual priming we may need to use the L1 to prime the
L2. This possibility motivated Experiment 2, where
we tested English–French bilinguals.

3. EXPERIMENT 2

3.1. Participants

Eleven English L1 French L2 bilinguals (9 female)
participated in this experiment. Their mean age was
24.5 years (min: 21; max: 28). The participants
were working or studying in Paris at the time of the
experiment, and began learning French at a mean
age of 12.5 (min: 5; max: 22). Each participant had
been resident in France for between 1 and 6 years at
the time of the experiment.

3.2. Stimuli, procedure, analysis

The stimuli and procedure were identical to those of
Experiment 1, with one exception: the prime was
only auditory, not visual. This was done because it
was thought that the participants, being English na-
tives, would not need visual assistance in compre-
hending the prime. Analysis followed that of Ex-
periment 1. Due to convergence issues no random
slopes were included.

3.3. Results

Mean reaction times are reported in Table 3. No
participants were excluded: 478 data points from
correctly-answered target word trials were thus
available for analysis. More frequent words had
faster reaction times than less frequent words (β =
−0.078, t = −2.549, p = .014). No other signifi-
cant effects were observed (all p > .4). The t-tests
revealed no evidence for strategic bias in the re-
sponses.

3.4. Discussion

A comparison of overall mean accuracy rates sug-
sists that these English–French bilinguals (mean:
70.1%) were less adept at the lexical decision task
Table 3: Mean of by-subject mean reaction times for Experiment 2, split by condition. Standard deviations in parentheses.

<table>
<thead>
<tr>
<th>Prime type</th>
<th>Similarity</th>
<th>RT (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>French-like</td>
<td>Match</td>
<td>839 (180)</td>
</tr>
<tr>
<td>French-like</td>
<td>Mismatch</td>
<td>870 (164)</td>
</tr>
<tr>
<td>Non-French-like</td>
<td>Mismatch</td>
<td>846 (218)</td>
</tr>
</tbody>
</table>

than the French–English participants of Experiment 1 (mean: 79.5%). Nevertheless, the lack of any indication of a priming effect is surprising. A possible confound is the high cognitive load of the experiment—the stimulus phrases varied in syntactic class, and different word classes are known to be processed differently [10, 3]. Experiment 3 therefore restricted the stimuli to nouns only.

4. EXPERIMENT 3

4.1. Participants

Nine English L1 French L2 bilinguals (seven female) participated in the experiment. Their mean age was 26.7 years (min: 20; max: 32). The participants were working or studying in Paris at the time of the experiment, and began learning French at a mean age of 15.1 (min: 7; max: 27). Each participant had been resident in France for between 1 and 6 years at the time of the experiment.

4.2. Stimuli, procedure, analysis

A subset of the stimuli from Experiment 1 were chosen. Only nouns were selected, and organized into three lists of 106 prime–target pairs each, with the same proportions of words–nonwords and French-sounding and non-French-sounding primes as in Experiments 1 and 2. Leading particles were omitted from both prime and target, since all stimuli were nouns. The procedure followed that of Experiment 2. Analysis followed that of Experiment 2. Due to convergence issues the random intercept of prime word was not included.

4.3. Results

Mean reaction times are reported in Table 4. Two participants had accuracy at chance level and were not included in the analysis. As a result, 235 correct responses to target words were available for analysis. No significant effects in the mixed-effects model were observed (all \( p > .2 \)). The t-tests revealed no evidence for strategic bias in the results.

Table 4: Mean of by-subject mean reaction times for Experiment 3, split by condition. Standard deviations in parentheses.

<table>
<thead>
<tr>
<th>Prime type</th>
<th>Similarity</th>
<th>RT (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>French-like</td>
<td>Match</td>
<td>788 (323)</td>
</tr>
<tr>
<td>French-like</td>
<td>Mismatch</td>
<td>708 (337)</td>
</tr>
<tr>
<td>Non-French-like</td>
<td>Mismatch</td>
<td>675 (217)</td>
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</table>

5. DISCUSSION AND CONCLUSIONS

Three experiments did not reveal evidence of cross-language phonological priming, from either L2 to L1 (Experiment 1) or L1 to L2 (Experiments 2 and 3). This result is surprising, as previous studies have observed competition and interference effects between L1 and L2 [1, 4, 9, 11, 14], as well as monolingual phonological priming in similar contexts to the current study [16].

Despite their relatively low number of participants, Experiments 2 and 3 had sufficient power to observe effects of equivalent magnitude to identity priming in monolingual contexts [16]. Indeed, examination of the condition means in Tables 3 and 4 suggest that there was not even a hint of a pattern towards priming. Repeating our modeling on pooled data from both of these experiments revealed the same pattern of non-significant results.

An alternative explanation for these null results might relate to the cost of language switching. Specifically, each trial involved such a switch, as the prime had to be processed in English and the target in French. Language switching is cognitively costly [12], and a prior study has reported a mean switch cost of over 100 ms in picture-naming tasks [15]. This delay is larger than the usual size of phonological priming effects [5, 13, 16], so it is possible that the language switching simply ‘overwhelmed’ any phonological priming effect. If this is the case, then the phonological priming paradigm is ultimately inappropriate for answering questions of phonological similarity between languages.

Future work could use a visual world paradigm, following [1], where the non-target language is implicitly rather than explicitly primed. Such an approach would avoid the possible issues of language switching. However, it is not clear whether the visual world paradigm is sensitive enough to detect the differences in magnitude of priming between, say, peel_{E} and pile_{F} versus pill_{E} and pile_{F}. Further research towards achieving this long-term objective is clearly warranted.
6. ACKNOWLEDGEMENTS

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7. REFERENCES


1 Subscript E and F denotes English and French words respectively.

2 The complete set of all stimuli, and the four counterbalanced lists, is available at https://github.com/roryturnbull/PhonologicalPrimingICPhS19.

3 A reviewer asks why we did not simply include this factor as a fixed effect in our models. A fixed effect would only assess whether there was a strategic bias in aggregate across all participants in a given experiment. Since we did not expect a strategic bias, if present, to exist for all participants, we instead looked for the presence of bias in each participant individually.