SUFFIXED WORD LEXICAL REPRESENTATIONS IN FRENCH

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ABSTRACT
Using a cross-modal priming paradigm combined with a lexical decision task we investigated the morphological priming effect between two suffixed words depending on the status of the stem they were derived from. We contrasted three types of stem: free stems (such as sport in sportif), verbal free stems (such as attest- in attestation), and bound stems (such as ocul- found in oculaire). Our results showed that, in French, suffixed words derived from the same stem prime each other and that this morphological effect is not modified by the type of stem these words are derived from. We confirmed that these effects were not due to semantic relationship between primes and targets by conducting a mask priming experiment with the same linguistic material. The results obtained in French contrast with those observed in English. In English and using a cross-modal paradigm, Marslen-Wilson, Tyler, Waksler and Older [3] did not observe a priming effect between two suffixed words derived from the same stem. This difference highlights the major role of the structure of languages on the way words are lexically accessed and represented.

1. INTRODUCTION
The way morphologically complex words are stored and accessed has been widely studied and many models have been proposed. The models suggested make claims about the processing of complex words and the kind of representation that is accessed. To a large extent, such models adhere to one of two extreme propositions: either a left-to-right processing associated with a global word representation, or a prelexical decomposition associated with a morpheme-decomposed representation (Taft & Forster, [6]). Many researchers have proposed some compromise between these extremes, some by assuming decomposition processing and/or representation only for particular complex words such as frequent words, semantically transparent words, words with productive affixes, suffixed words (versus prefixed words); and others by claiming two competing routes with a race between them. However, models of word processing are not independent of the language to which they apply. Psycholinguistic studies in languages other than English have revealed that the nature of lexical processes may differ across different languages. Studies on Serbo-Croatian, Turkish, Chinese, Hebrew and Arabic have illustrated this approach, and language-specific cognitive models of morphologically complex words have been proposed. However, for languages that have a closely related morphological system, the specificity of language is rarely discussed. Studies on derived morphology in English, Italian, Dutch, Spanish and French are usually interpreted in the framework of the same cognitive models (but see work on inflected morphology). The experiments presented here were, in part, done to compare the role of morphology in two languages that seem to have close morphological systems: French and English. Both languages have a concatenative morphology which is not extensively productive. They use the same kind of affixes: suffixes for inflection and prefixes and suffixes for derived morphology.

Derivational morphology in English is widely studied, and one of the most extensive papers on derivational morphology is Marslen-Wilson, Tyler, Waksler and Older [3] paper, which describes many cross-modal priming experiments investigating the relationship of different members of morphological families. The cross-modal priming paradigm has been fruitfully used to study morphological effects providing a way of tapping directly into the level of the central representation. In this paradigm subjects hear a prime word and, at its acoustic offset, see a target. Subjects have to make a lexical decision as to whether a word or a nonword has been visually presented. Morphological cross-modal priming effects are interpreted as reflecting repeated access to a lexical representation shared by prime and target (Marslen-Wilson et al., [3]). Marslen-Wilson et al., using a cross modal paradigm, observed priming effects between suffixed words and their stem, between two prefixed words, between prefixed words and suffixed words but not between two suffixed words (both words of each pair being derived from the same stem). One of the striking results reported is this lack of priming between two suffixed words. The authors attribute this lack of effect to the existence of inhibitory relations between suffixes that can be combined with a particular decomposed lexical representation. A competition effect between suffixed words derived from the same stem has also been shown in French (Meunier & Segui, [5]) using a simple lexical decision task with an auditory presentation of the words. Suffixed words with more frequent suffixed candidates derived from the same stem are recognised slower than suffixed words with less high frequency competitors. But when using a cross modal paradigm in French, we do observe a priming effect between two suffixed words (Meunier, [4]). The first experiment presented in the present article had the aim of testing if using exactly the same method and design as Marslen-Wilson et al. [3] we would observe, in French, a priming effect between two suffixed words derived from the stem.
Another issue we have investigated was the role of the type of stem affixed words are derived from. Experimental evidence in the area of morphology derives from different perspectives: studying different languages, using different paradigms, different tasks, focusing on different populations... The results obtained are difficult to interpret unequivocally within a single framework. However, what seems clear overall is that there is a role of morphological structure during word identification and there is a decomposed lexical representation for some complex words. It remains to specify which characteristics of words are taken into account to allow decomposition to take place during identification. We thought that the type of stem that affixed words are derived from could be one such characteristic. As Taft and Forster [7] pointed out, a strictly morphological decomposition becomes intuitively less attractive when considering affixed words with a bound stem (a stem that can not appear on its own) such as rejuvenate. Are complex words derived from a bound stem less likely to be decomposed than words derived from a free stem? The experiments presented in this paper investigate the role of the status of the stem (free or bound) in the representation of morphologically complex words.

In French we can distinguish free stems, such as triste found in tristement from bound stems such as ocul- found in oculaire. In our experiments, we have also contrasted verb free stems (stems that appear on their own only as verb form) such as attest- found in attestation, with noun and adjective free stems such as sport found in sportif. This latter distinction arises from the idea that verb stems may be different from noun or adjective stems, as they are more frequently used as morphological compounds.

To summarise, in the first experiments presented in this paper we asked two questions: do two suffixed words derived from the same stem prime each other, and if so does this priming vary as a function of the type of stem (free, verbal or bound) they are derived from.

2. EXPERIMENT 1

In this first experiment, using a cross modal paradigm, we contrasted three conditions where prime and target are two suffixed words derived from the same stem but where the type of the stem varies. We also add conditions where suffixed words are primes and their stems the target, in order to have a comparison for the amount of priming (if found) for morphological priming in the case of two suffixed words. The fifth condition consisted of primes and targets that were morphologically unrelated but phonologically very similar.

2.1. Method

We selected prime-target pairs, falling into the five conditions. Conditions 1, 2 and 3 consisted of pairs of suffixed words derived from the same stem. In Condition 1, the stem from which the suffixed word was derived could appear in the language on its own (e.g. tristement - triste). In Condition 2 the stem could appear in the language but only as a verb form (e.g. fumage – fum-). In Condition 3 the suffixed words were derived from a bound stem (e.g. oculiste – oculaire). Condition 4 consisted of pairs of free stem targets associated with primes (e.g. tendresse-tendre). Condition 6 contained pairs of words that were not morphologically or semantically related but which were formally related (e.g. gardien-gardin).

2.1.1 Design and Procedure

The test items were divided into two versions. These were balanced so that all the targets appeared once in each version, half preceded by a prime and half preceded by a control word. The primes were recorded by a French native speaker. They were played out binaurally to the listeners over headphones. The target was presented on a screen at the end of the auditory prime word. Participants had to do a lexical decision task on the visual target. Response times were measured from the appearance of the target word on the screen.

2.1.2 Participants

We tested 22 native speakers of French living in Cambridge (UK) for less than six months.

2.2 Results

Analyses of variance (ANOVA) were conducted on the reaction time data. Less than 1% of reaction times were greater than 1500ms; these were eliminated from the statistical analysis. There were 6% of errors overall. Two items yielded more than 50% errors (papaliste and gou-verne), and were excluded from the analyses. The mean reaction times and response error rates for the data are given in Table 1.

<table>
<thead>
<tr>
<th>Type of verbs</th>
<th>Primes</th>
<th>Targets</th>
<th>RT(ms)</th>
<th>Priming effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free stem</td>
<td>tristement</td>
<td>tristesse</td>
<td>546</td>
<td>24**</td>
</tr>
<tr>
<td>Verbal stem</td>
<td>fumage</td>
<td>flumeur</td>
<td>531</td>
<td>44**</td>
</tr>
<tr>
<td>Bound stem</td>
<td>oculiste</td>
<td>oculaire</td>
<td>542</td>
<td>22**</td>
</tr>
<tr>
<td>Suffixes / stem</td>
<td>tendresse</td>
<td>tendre</td>
<td>511</td>
<td>24**</td>
</tr>
<tr>
<td>Formal overlap</td>
<td>gardien</td>
<td>gardon</td>
<td>555</td>
<td>9</td>
</tr>
</tbody>
</table>

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For the comparison between the prime effects obtained between two suffixed words according to the type of stem they are derived from, we observed no effect of the type of stem \(F(1,2.42)=1\times 1; \ F(2.92)<1\) but a clear effect of morphological priming \(F(1,1.21)=31.26; \ p<0.001; \ F(2.92)=62.93; \ p<0.0001\). There were no interactions between these two factors \(F(2.42)=2.59; \ n.s.; \ F(2.92)=2.13; \ n.s.\).

Conditions 4 shows the classical morphological priming effect between a suffixed word and its stem \(F(1.21)=29.74; \ p<0.001; \ F(2.61)=32.98; \ p<0.0001\). We do not observe any priming effect in the formal overlap condition \(F(1.21)=3.80; \ n.s.; \ F(1.31)=3.34; \ n.s.\).

2.3 Discussion

Our results show that in the cross-modal immediate repetition priming task suffixed words do prime their stem but also prime another suffixed word belonging to the same morphological family. These effects can not be attributed in any simple way to formal overlap between prime and target. Formally related but morphologically unrelated pairs, like lentille - lent or gardien - garden, do not prime each other, whereas morphologically related pairs do prime.

We observed a priming effect between two suffixed words derived from the same stem. This result is contrary to that observed in English by Marslen-Wilson et al. [3] (who did not observe any priming effect between two suffixed words derived from the same stem) but replicates results obtained in French with other experimental words. This difference, as we will discuss in the general discussion, may be related to the organization or representation of morphological information in the two languages.

The results of the present experiment also show no interaction between the morphological priming effects and the status of the stem (bound, free or verbal stem). This suggests that the type of stem from which suffixed words are derived does not modify the way these words are lexically represented. However, a major concern in cross-modal experiments is to determine if priming effects observed for morphologically related pairs are due to shared morphemes in a morphologically structured mental lexicon, or if they are due to the semantic relationships between the morphologically related pairs. We investigated this in a second experiment by using a masked priming technique (Forster and Davis, [1]). The masked priming technique has been shown to be highly sensitive to overlap at the level of form (Forster, Davis, Schoknecht, & Carter, [2]), but not of meaning.

3. EXPERIMENT 2

3.1. Method

3.1.1 Material and Design

Our second experiment used a masked-priming paradigm with the same stimuli as for the previous experiment. We added a semantic condition, where the prime and the target are semantically linked (blouson - manteau), to make sure that the masked priming paradigm indeed did not pick up semantic effects. We also split Condition 5 in two distinct formal overlap condition: one in which the two words share their first sequence as gardon - garten and another where the target was totally embedded in the prime as lentille - lent.

3.1.2 Procedure

The same hardware and software were used as in the previous experiment. Each trial consisted of three visual events. The first was a forward pattern mask consisting in a sequence of hash marks (`#'); the second was the display of the prime word for 47 ms and the third event was the presentation of a target word or nonword for 500ms. The prime was in lower case and the target in upper case. Subjects were asked to make a quick and accurate lexical decision on the target. At 47 ms, the combination of the forward and the backward masking prevents the subject from consciously seeing or even noticing the presence of the prime. The consequence of this is that the participant's responses are not influenced by a conscious appreciation of the relationship between the prime and the target.

3.1.3 Participants

Another 22 native French speakers from the same age and population as before took part in the experiment.

3.2 Results

We conducted an analysis of variance (ANOVA), on the reaction time data. Less than 1% of reaction times were greater than 1500ms and were therefore eliminated from the statistical analysis. There were 6% errors overall. One item yielded more than 50% errors (blessable), and was excluded from the analyses. The mean reaction times and response error rates for the data are given in Table 2.

For the comparison between the prime effect obtained between two suffixed words according to the type of stem they are derived from, we observed no effect of the type of stem \(F(1,2.42)=1.47; \ n.s.; \ F(2.92)<1\) but a clear effect of morphological priming between two suffixed words derived from the same stem \(F(1.21)=53.20; \ p<0.001; \ F(2.92)=56.35; \ p<0.0001\). There were no interactions between these two factors \(F(2.42)=1.13, n.s.; \ F(2.92)=1.25, n.s.\).
Table 2: Results of Experiment 2

<table>
<thead>
<tr>
<th>Type of verbs</th>
<th>Primes</th>
<th>Targets</th>
<th>RT (ms)</th>
<th>Priming effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free stem</td>
<td>tristement</td>
<td>tristesse</td>
<td>627</td>
<td>25**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>652</td>
<td></td>
</tr>
<tr>
<td>Verbal stem</td>
<td>fumage</td>
<td>fumeur</td>
<td>613</td>
<td>42**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>655</td>
<td></td>
</tr>
<tr>
<td>Bound stem</td>
<td>oculiste</td>
<td>oculaire</td>
<td>611</td>
<td>43**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>654</td>
<td></td>
</tr>
<tr>
<td>Suffixed word</td>
<td>tendresse</td>
<td>tendre</td>
<td>564</td>
<td>21**</td>
</tr>
<tr>
<td>l/stem</td>
<td></td>
<td></td>
<td>585</td>
<td></td>
</tr>
<tr>
<td>Formal overlap 1</td>
<td>gardien</td>
<td>gardon</td>
<td>601</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>619</td>
<td></td>
</tr>
<tr>
<td>Formal overlap 2</td>
<td>lentille</td>
<td>lent</td>
<td>582</td>
<td>-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>579</td>
<td></td>
</tr>
<tr>
<td>Semantic</td>
<td>altitude</td>
<td>hauteur</td>
<td>599</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>604</td>
<td></td>
</tr>
</tbody>
</table>

Conditions 4 shows a morphological priming effect between a suffixed word and its stem (F(1,21) = 16.75; p<.001; F(2,162) = 18.78; p<.0001). We do not observe any global priming effect in the formal overlap conditions (F(1,21)=3.03, n.s.; F(2,146)=1.3, n.s.) and no interaction with the type of overlap (F(1,21)<1; F(2,146)<1). We also do not observe any semantic priming effect (F(1,21)<1; F(2,123)<1).

We also observed that while the effect sizes vary significantly between the suffixed words/stem condition and the equivalent orthographic control (t(11)=2.08, p<.05; t(25)=2.18, p<.04), the effect in the suffixed word/suffixed word condition is not significantly different from its orthographic control (t(11)=1.65, p=.11; t(25)=1.42, p=.16). It may be that this difference is not significant because the increased of the orthographic priming of partial overlap (gardien-gardon) and not because of differences between morphologically related conditions.

3.3 Discussion

Using a masked priming technique we still observed a morphological priming effect, suggesting that effects observed in the previous experiment were not simply due to the semantic relationship between primes and target.

4. GENERAL DISCUSSION

Our experiments show no effect of the type of the stem suffixed words are derived from. The amount of priming between two suffixed words does not vary according the type of their stem (free or bound). Also, using a cross-modal paradigm we have shown that two suffixed words derived from the same stem prime each other. Marslen-Wilson et al. [3] did not observe any priming between two English suffixed words. The French and the English experiments were closely matched on their design and characteristics of the linguistic material. Indeed in the two experiments the suffixed words used were derived and semantically transparent (as established by equivalent pretest); The suffixes used had an essentially syntactic role and were productive. Taken in isolation, English and French derivation processes are very similar in the way they are applied. But the overall picture of morphology in the two languages is very different. We argue that it is the specific properties of the language, such as the frequency and/or the productivity of affixes in the language, or even the type of inflectional morphology, that could explain our results. Another explanation could be found in the rhythms of the two languages. English is a stress language with a strong-weak pattern. The stress is on the first part of the word so the suffix is not acoustically salient. Maybe strong competition between different suffixes is necessary because of this ambiguity. French is a syllabic language with a short-long pattern. The suffix is long so always salient; there is no ambiguity. Then strong competition between suffixes would not be necessary. Further experiments should be done to clarify the picture.

Our experiments suggest that the morphological system cannot be considered independently. Cross-linguistic comparisons may only be informative if general characteristics of the languages are also taken into account.

5. ACKNOWLEDGEMENTS

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6. REFERENCES