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# Morphological salience effects of prefixes and suffixes embedded in French words

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7 Keywords: affix processing<sub>1</sub>, letter-search task<sub>2</sub>, word recognition<sub>3</sub>, morphological salience<sub>4</sub>, French<sub>5</sub>.

## 8 **Abstract**

9 According to the affix-chunking hypothesis, a letter search should be harder for a letter embedded in  
10 an affix compared with a non-affixed letter sequence because affixes have a functional significance.  
11 On the other hand, the decomposition hypothesis claims that derived (e.g., *hunter*) and pseudo-derived  
12 words (e.g., *corner*) are processed indifferently, lexical access being driven by affix stripping followed  
13 by the activation of the remaining stem to reach the mental lexicon. We carried a letter-search task to  
14 test these hypotheses using both prefixed (e.g., *détour* ‘detour’), suffixed (e.g., *acteur* ‘actor’) words,  
15 compared with matched pseudo-prefixed (e.g., *décor* ‘decor’), pseudo-suffixed (e.g., *fleur* ‘flower’)  
16 words. Decision latencies on letter targets were compared to non-affixed words for each type of affix  
17 (e.g., *drogue* ‘drug’ for *détour*, *décor* and *tâche* ‘task’ for *acteur*, *fleur*). Two different patterns of  
18 results were observed for suffixes and prefixes suggesting qualitative different processes operating  
19 during complex word recognition: while a clear ‘morphological salience’ effect based on genuine  
20 morphological constructions was found only in the real suffixed condition, these suffixed chunks  
21 embedded in real words did induce harder letter detection but, on the contrary, facilitated the RTs.

## 22 **1 Introduction**

23 Does morphological structure drives word acquisition? Word recognition? If so, how it functions? The  
24 ability to recognize, analyze and manipulate morphemes has been found to be linked to literate  
25 outcomes such as word reading, spelling, and reading comprehension, morphological awareness  
26 (Carlisle, 2000) seeming to function like an anchor in children (Deacon & Francis, 2017; Levesque,  
27 Breadmore & Deacon, 2021). In skilled reading, morphemes capture the recurrence of formal and  
28 semantic patterns in language, then they can be seen as potential units to increase efficiency in storage  
29 (in terms of an economic lexical organization) and/or processing (in terms of efficient lexical access).  
30 Various theoretical models aiming at explaining morphological effects in word recognition were  
31 proposed through the literature (see Milin, Feldman & Smolka, 2017 for a review) while much research  
32 on morphological processing, mainly using the visual masked priming paradigm (Forster & Davis,  
33 1984), has been dedicated to test the dominant “early decompositional hypothesis” based on “morpho-  
34 orthographic segmentation” process (e.g., Rastle et al., 2004; Grainger & Beyersmann, 2017).  
35 According to these approaches, it has been claimed that any item (derived word, e.g., *hunter* and  
36 pseudo-derived word, *corner*, derived nonword, e.g., *adorage*) displaying morphological complexity  
37 at its “surface” is automatically decomposed into stem and affix, access taking place via the activation  
38 of the remaining stem. Many studies carried in various languages have indeed systematically found  
39 equivalent priming effects in both complex (e.g., *hunter-hunt*) and pseudo-complex (e.g., *corner-corn*)

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40 conditions (see Amenta & Crepaldi, 2012; Rastle & Davis, 2008 for reviews). Given the numerous  
41 cases in which complex and pseudo-complex words bear orthographic alterations at their  
42 morphological frontier (e.g., *dropper*, *fetish*), McCormick et al. (2008) tested the robustness of  
43 morpho-orthographic segmentation by manipulating less segmentable derived and pseudo-derived  
44 words. The results revealed the resilience of this process by showing equivalent priming effects in both  
45 segmentable and less segmentable words (e.g., *dropper-drop*) and pseudo-complex words (e.g., *fetish-*  
46 *fete*), reinforcing the morpho-orthographic segmentation hypothesis.

### 47 Morphological effects as emerging patterns of systematic formal-meaning overlaps

48 Many linguists propose a different view of morphology, in which the word – whether it is complex or  
49 simple – is the central element while morphemes are secondary units. According to these word-based  
50 approaches, the *Construction Morphology* (Booij, 2010) and *Relational Morphology* theories  
51 (Jackendoff & Audring, 2020), which are heirs of other kinship theories of morphology (Bybee’s  
52 *Network Model*, 2010; *Word-based Morphology*, e.g., Blevins, 2006; *Word Grammar*, Hudson, 1984),  
53 consider words as constructions in aiming to describe, analyse and predict existing as well as new  
54 words. Accordingly, word construction is defined as: “a bundle of associated structures containing  
55 semantic, pragmatic, morphosyntactic, and phonological (and orthographic in the case of written  
56 language) information” (Audring, 2021: 3.2). More precisely, systematic correspondences between  
57 form and meaning in a set of complex words can be expressed by a constructional schema which is  
58 linguistically “motivated” by opposition with “generated”. Instead of analyzing a complex word as a  
59 concatenation of morphemes, such as *reader* = read<sub>Verbal base</sub> + er<sub>Agentive suffix</sub>, a complex word is analysed  
60 relatively to other complex words sharing form and meaning: for example *reader*, *buyer*, *eater*, *baker*  
61 share *-er* as the mark of an agentive function expressed by the verbal base, i.e., [[x]Ver]N ‘one who  
62 Vs’. This pattern expresses a generalization about the form and meaning of deverbative nouns attested  
63 in *-er* cataloged in the lexicon and can also serve as a starting point for creating new English nouns in  
64 *-er* from verbs. In other words, whether regular or irregular, productive or unproductive, schemas are  
65 not only able to specify the properties of the stored words but also how new words can be coined. Rules  
66 and schemas are acquired based on sufficient exposure and storage of sets of similar complex words  
67 and their properties, following the principle of usage-based theories, according to which associations  
68 among words (schemas) emerge through their use. The processing perspective of these theory considers  
69 the mental lexicon as a multi-layered architecture constituted of phonological/orthographical,  
70 morphosyntactic, semantic associated levels, that contain constructional schemas englobing the holistic  
71 properties of the word and the properties of its structural parts.

72 Which features determine the recognition of such constructions is definitely a relevant question for  
73 lexical access modelling: the strength of the morphological effects observed through the literature so  
74 far and in particular, the ones suggesting that the “morphological decomposition is a process that is  
75 applied to *all* morphologically structured stimuli, irrespective of their lexical, semantic, or syntactic  
76 characteristics” (Rastle and Davis, 2008: 949), questions the role of pure perceptual factors in word  
77 processing. Blumenthal-Dramé (2012), in a study on morphological entrenchment that refers to the  
78 strengthening of the mental representation of a linguistic structure through repetition to the point that  
79 the use of the structure becomes automatic, highlighted that this could be a relevant parameter for  
80 complex word recognition: «it was found that derivatives involving proportionally longer suffixes are  
81 significantly less entrenched [...] this finding seems intuitively plausible, as a longer suffix will be  
82 perceptually more salient and therefore presumably more prone to extraction» (: 191). The perceptual  
83 salience of linguistic information (including morphology) could indeed drive the learning process as  
84 well as word recognition. Recently, Girauo and Dal Maso (2016a) have discussed the issue of

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85 morphological processing through the notion of morphological salience - defined as the relative role  
86 of the word and its parts - and its implications for theories and models of morphological processing.

87 They suggested that if morphological salience relates to the surface structure of words, this salience  
88 guides indeed the early stages of word recognition but cannot be called ‘morphological’ since  
89 morphological relationships are, by definition, consubstantial pairings of form and meaning (Blevins,  
90 2014). However, according to the authors this structural salience effect does not exclude a genuine  
91 morphological salience effect emerging from paradigmatic relationships between the word  
92 representations coded within the mental lexicon. In other words, the co-existence of both  
93 morphological structure and whole-word salience effects are assumed, but while the former depends  
94 on quantitative factors such as the statistical occurrence of letter clusters (including those that  
95 correspond to morphemes), the latter is determined by qualitative variables (e.g., the degree of semantic  
96 transparency) resulting from morphological relationships shared by words.

97 Unfortunately, the issue of the relative prominence of the whole word and its morphological  
98 components has been totally over shadowed by the fact that psycholinguistic research has progressively  
99 focused on purely formal and surface features of words, drawing researchers’ attention away from what  
100 a word really is: “a linguistic sign, a pairing of form, and meaning. The form of a word in its turn  
101 comprises two dimensions, its phonological form, and its morpho-syntactic properties. Hence, each  
102 word is a pairing of three types of information. Morphology affects all three dimensions of words »  
103 (Booij, 2010 : 3).

### 104 **What does a letter-search task tell us about the processing of morphological structure?**

105 In the “Natural Morphology” approach, salience is one of the factors that contribute to the ‘naturalness’  
106 of a linguistic item or structure, which in turn determines how easily it can be processed by the human  
107 brain (Dressler et al., 1987: 11). Within this framework, Korecky-Kröll, Dressler, Freiburger, Reinisch,  
108 Mörth & Libben (2014) tested the hypothesis according to which when morphotactics and phonotactics  
109 interact, it helps in the decomposition of words into morphemes. One experiment was carried out with  
110 German-speaking adults using a letter-search task (i.e., find a letter like for example ‘T’ at different  
111 positions – initial, medial, final - in a visual word like in *taub* ‘dove’, *dankte* ‘thanked’ and *packt*  
112 ‘packs’) in order to investigate whether sub-lexical letter sequences were found faster when the target  
113 sequence was separated from the word stem by a morphological boundary (e.g., *packt*) than when it  
114 was a part of a morphological root (e.g., *lift*). The results showed that the presence of a morpheme  
115 boundary led to shorter reaction times (RTs) and fewer errors, regardless whatever the target cluster’s  
116 position in the word. This result was interpreted as a supportive effect of morphology on the speed with  
117 which individual phonemes or two-phoneme phonotactic sequences are processed.

118 In Beyersmann, Ziegler & Grainger’s study (2015) French adult speakers had to detect a letter target  
119 embedded in nonwords that can be either prefixed or suffixed (e.g., ‘R’ in affixed *propoint* or in  
120 suffixed *filmure*) or created with non-prefix beginning or non-suffix ending but varying in terms of  
121 frequency (e.g., ‘R’ in non-affixed high frequency *cropoint* or non-affixed low frequency *vropoint*).  
122 The results showed an absence of letter cluster frequency effects on letter search performance but a  
123 processing asymmetry between prefixed and suffixed items: letter search took longer in suffixes  
124 compared with non-suffix endings, while no such difference was found for prefixes compared with  
125 non-prefix beginnings. According to the authors, these results first suggest that not all frequent letter  
126 clusters form ‘functional’ units in the reading system. Secondly, the difference in processing suffixes  
127 relative to non-suffixes was interpreted as reflecting a chunking/affix stripping mechanism that  
128 operates on ‘functional’ units such as suffixes (i.e., frequent spelling patterns associated with a specific

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129 meaning) during pre-lexical access. Basing their reasoning on the different semantic-syntactic  
130 functions of prefixes relative to suffixes, the authors proposed that prefixes might have a ‘quasi-lexical’  
131 status (given their main semantic function) relative to the ‘sublexical’ status of suffixes, given that  
132 prefixes play a role at both the morpho-lexical and morpho-syntactic levels. We suggest that, according  
133 to the mandatory decomposition hypothesis, this last claim could indirectly signify that only stems and  
134 suffixes stand as access units to the mental lexicon while prefixes are coded at a more central  
135 (lexical/word) level of processing.

136 Earlier, Giraudo and Grainger (2003) had already found an asymmetry in the processing of prefixed  
137 vs. suffixed words in a series of masked priming experiments conducted with French complex words.  
138 More precisely, they found differential effects between affixed and pseudo-affixed primes, but only in  
139 the case of prefixed words. Only prefixed primes like *enjeu* ‘stake’ significantly facilitated the  
140 recognition latencies of another prefixed target like *envol* ‘flight’. This effect was found relative to  
141 both a pseudo-complex prime like *ennui* ‘boredom’, in which *en-* is not a prefix and an unrelated  
142 baseline condition. Moreover, the pseudo-word priming condition did not differ from the baseline  
143 condition, suggesting the activation of the prefix series, i.e., word representations connected by virtue  
144 of their common prefix. Given that prefixes usually carry more transparent semantic information than  
145 suffixes, morphological priming effects would then rely on the semantic relationships in prime-target  
146 pairs, given that prefix priming effects have been clearly obtained. Suffix priming effects were later  
147 deeply studied by Giraudo and Dal Maso (2016b) in a masked priming experiment manipulating Italian  
148 suffixes with different degrees of functional consistency (i.e., the ratio between suffixed and non-  
149 suffixed words in a series of words ending with a given letter string). While suffix priming effects  
150 failed to emerge, replicating the previous results obtained with French materials, their results crucially  
151 showed that the recognition of the stem was affected by suffix consistency, conferring to suffix units a  
152 secondary role during lexical access.

153 Beyond these contradictory results found in French speakers, this result challenges decompositional  
154 models that situate morphological effects at a sublexical level, which is insensitive to semantics. The  
155 conclusion about the cognitive processes underlying prefixed and suffixed word processing is unclear,  
156 and the interpretation of the effects obtained with a letter search task must be re-examined. Given that  
157 Beyersmann et al. tested non-words instead of real words, they could not control the morphological  
158 salience of their material. More precisely, the crucial comparison between real affixed and pseudo-  
159 affixed words was not possible. Therefore, it is worth conducting a new experiment using real words  
160 to tease apart morpho-semantic effects from morpho-orthographic effects in affixed word recognition.

161 Working with non-words offers the advantage of easily creating materials that control formal aspects  
162 like letter sequences and frequency, and it also removes any influence of whole-word properties.  
163 However, manipulating non-words, even if they are morphologically complex, restricts the conclusions  
164 derived from the results. According to us, results on non-word processing cannot be simply extended  
165 to the interpretation of word access. First, even if one acknowledges that a suffix has a mental  
166 representation, in language use, it is still a bound morpheme that needs to be combined with a stem to  
167 exist and have a functional status. As claimed by Booij, “bound morphemes do not have a meaning of  
168 their own” (Booij, 2015: 5). Consequently, it is the constructional schema as a whole that imposes its  
169 interpretation.

170 Secondly, as far as the morphological issue is concerned, word patterns/constructions are defined by  
171 their phonological/orthographic (i.e., the word form), semantic (i.e., the word meaning), and syntactic  
172 (i.e., the word grammatical class) characteristics. Given this, all the words coded in memory are  
173 embedded in a network formed by morphological families and series. As a consequence, the

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174 manipulation of non-words also suppresses the two morphological dimensions of complex words, their  
175 syntagmatic and their paradigmatic structure (see Blevins, 2016, for discussion), and ‘de-  
176 morphologizes’ the observed effects.

### 177 **The present study**

178 Experimental studies on the relationship between words belonging to the same morphological series  
179 (i.e., sharing the same affix) have been scarce so far and have produced inconsistent results regarding  
180 the prefix-suffix asymmetry issue. The scientific motivation for a new experiment on this issue is to  
181 replicate (with some modifications) and compare results to deepen the understanding of affix salience.  
182 Previous studies showed that when testing affix chunking in a letter search experiment (Beyersmann  
183 et al., 2015), an advantage for suffixed legal and pronounceable non-words (e.g., *filmure*) over pseudo-  
184 suffixed non-words (e.g., *filmire*) was found, but not for prefixed non-words (i.e., *propoint* was not  
185 slower to recognize than *cropoint*). The asymmetry was interpreted as a reflection of different  
186 underlying processes for the recognition of suffixed and prefixed items.

187 In the present experiment, we aim to assess the perceptual salience of affixes in both prefix and suffix  
188 positions. Specifically, we are investigating whether there is a facilitation effect for genuine affixes  
189 compared to pseudo-affixes embedded in real words, as predicted by the notion of morphological  
190 salience. Beyersmann et al.'s study (2015) utilized legal and pronounceable non-words to eliminate the  
191 influence of whole words and control for letter cluster frequency. However, because these targets were  
192 non-words, any morpho-semantic effects arising from paradigmatic relationships encoded within the  
193 mental lexicon were effectively suppressed, limiting their functional significance. Consequently, the  
194 decomposition process may have relied solely on the syntagmatic structure, which represents only one  
195 aspect of what defines a word (and morphology) linguistically, neglecting the paradigmatic dimension.

196 To test the pseudo-affixation effect, we selected French affixed and pseudoaffixed words in order to  
197 distinguish between morpho-orthographic effects and genuine morphological effects. We then  
198 examined letter detection performances on real affixed words (e.g., *injuste* ‘unfair’; *tueur* ‘killer’) were  
199 then tested against both pseudo-affixed (e.g., *insect* ‘insect’; *fleur* ‘flower’) and non-affixed control  
200 words.

## 201 **2 Methodology**

### 202 **2.1 Participants**

203 Thirty participants from the University of XXX, all French native speakers, took part to the present  
204 experiment. Their ages ranged from 18 to 30 years old, with an average age of 23. All participants  
205 were right-handed and had normal or corrected-to-normal vision.

### 206 **2.2 Material**

207 The stimuli consisted of 24 prefixed and suffixed French words, along with 48 simple words (24  
208 pseudo-affixed and 24 non-affixed). These stimuli were matched as closely as possible in terms of  
209 frequency and length across conditions. Word properties measures were obtained from the Lexique  
210 database, where frequency is reported in occurrences per million (New et al., 2001). The six  
211 manipulated conditions were as follows:

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212 Prefixed: 12 morphological complex words composed with a free stem and a prefix: *re-*, *de-*, *en-* or *in-*  
 213 . The target letter to search included in these words was “E” (seven times) or “N” (five times). Example:  
 214 *injuste* ‘unfair’.

215 Pseudo-Prefixed: 12 mono-morphemic words that did not include a free stem but letter clusters *re-*,  
 216 *de-*, *en-* or *in-* at the beginning of the word, but that did not function as prefix. The target letter to  
 217 search included in these words was “E” (seven times) and “N” (five times). Example: *insecte* ‘insect’.

218 Prefix Control: 12 mono-morphemic words that did not include neither a free stem or the prefixes *re-*  
 219 , *de-*, *en-* or *in-*; but did include the letters “E” (seven times) or “N” (five times). Example: *conteste*  
 220 ‘contest’.

221 Suffixed: 12 morphologically complex words that included a free stem and a suffix: *-age*, *-ale*, *-ard*, *-*  
 222 *al*, *-eur*, *-eux* or *-et*. The target letter to search included in these words was “E” (seven times) or “A”  
 223 (five times). Example: *acteur* ‘actor’.

224 Pseudo-Suffixed: 12 monomorphemic words that did not include a free stem but letter clusters *-age*, *-*  
 225 *ale*, *-ard*, *-al*, *-eur*, *-eux* or *-et* at the end of the word but did not function as suffix. The target letter to  
 226 search included in these words was “E” (seven times) or “A” (five times). Example: *fleur* ‘flower’.

227 Suffix Control: 12 monomorphemic words that did not include neither a free stem or the letter  
 228 clusters *-age*, *-ale*, *-ard*, *-al*, *-eur*, *-eux* or *-et*. The target letter to search included in these words was  
 229 “E” (seven times) or “A” (five times). Example: *tâche* ‘task’.

230 We added 72 mono-morphemic words as fillers. They were matched to the critical conditions in both  
 231 frequency and length and did not include neither the critical affix nor the critical word.

232 Accordingly, the item list contained a total of 144 words.

233 Stimuli characteristics are reported in Table 1, the complete list of words used as stimuli included in  
 234 the Supplementary material.

235

<i>Condition</i>	<i>Example</i>	<i>Frequency</i>	<i>Length</i>	<i>Fillers</i>	<i>Frequency</i>	<i>Length</i>
Prefixed	<i>injuste</i>	9.1	6.5	Prefixed	10.7	6.17
Pseudo-Prefixed	<i>insecte</i>	11.44	6.17	Prefixed	10.37	6.42
Control	<i>conteste</i>	9.96	6.42	Prefixed	13.73	5.73
Suffixed	<i>acteur</i>	9.26	5.75	Suffix	9.27	5.75
Pseudo-Suffixed	<i>fleur</i>	15.63	5.75	Suffix	16.41	5.75
Control	<i>tâche</i>	13.73	5.73	Suffix	13.73	5.73

236 Table 1: Stimuli characteristics: average frequency reported in occurrences per million from the  
 237 Lexique Corpus (New et al., 2001) and length reported in average number of letters.

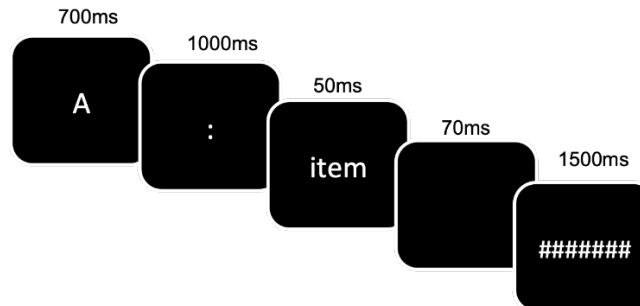
### 238 2.3 Procedure

239 Participants were seated 50 cm away from the computer screen and performed a letter-search task.  
 240 They were instructed to respond as quickly and accurately as possible to whether the critical letter (e.g.,  
 241 "A", "E", or "I") was present in the word displayed on the screen, without focusing on the specific word  
 242 or its meaning. Participants indicated "yes" by pressing one of two response buttons with the forefinger

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243 of their right hand, and "no" by pressing the other response button with the forefinger of their left hand.  
244 Stimuli presentation and data collection were managed using DMDX software (Forster & Forster,  
245 2003).

246 Each trial followed this sequence (see Figure 1): the target letter (i.e., A, E, or I) was displayed in  
247 uppercase for 700 ms, followed by a fixation mark for 1000 ms. Next, a French word in lowercase was  
248 shown for 50 ms, which was then replaced by a mask (#####) remaining on the screen until the  
249 participant responded, with a maximum duration of 1500 ms. After completing 10 practice trials,  
250 participants proceeded to complete 144 experimental trials presented in a randomized order. The total  
251 duration of the experiment was approximately 20 minutes.  
252



253  
254 Figure 1: Trial example of the procedure of the Letter Search Task.

### 255 256 3 Results

257 Behavioral results indicated that all participants achieved over 80% accuracy in their responses.  
258 Reaction times (RT) were recorded and analyzed using ANOVA.

259 For the RT statistical analysis, error trials were excluded (8% of the data). Subsequently, data  
260 preprocessing involved removing trials that were more than 2.5 standard deviations above or below  
261 each participant's mean RT (2% of the remaining data). RTs and error rates were analyzed individually  
262 for each participant (see Table 2).

263 A main ANOVA comparing the results for the 30 participants on the 6 conditions showed a main effect  
264 for the condition factor  $F(5,145) = 5.66, p < .0001$ . The main effect of affix conditions (prefix vs. suffix)  
265  $F(1,29) = 7.53, p < .01$ , and morphological condition (real vs. pseudo vs. control)  $F(2,58) = 6.54, p <$   
266  $.01$ , were significant. The interaction (affix x condition) was also significant  $F(2,58) = 3.4, p < .05$ .

267 Planned comparisons revealed that the suffix condition was significantly faster than both the pseudo-  
268 suffixed condition (+64 ms,  $p < .002$ ) and its control condition (+62ms,  $p < .001$ ). Pseudo-suffixed and  
269 control-suffix conditions did not differ (-2ms,  $p > .05$ ). This suggests that the letter identification is  
270 facilitated only when it is embedded in a real suffixed word, as no such an effect was found for pseudo-  
271 suffixed words. As for the comparison between prefixed and pseudo-prefixed words the difference  
272 (+21 ms) was not significant ( $p > .05$ ). However, the difference between the prefixed and control  
273 conditions and the one between the pseudo-prefixed and control conditions was significant (+31 ms,  $p$   
274  $< .01$  and +53 ms,  $p < .03$ ).

275 Analyses performed on errors did not show any significant effects (all  $p_s > .05$ )



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276 Table 2: Reaction times (RTs), Standard deviation (SD) and Error Rates (%ER) for the Critical  
277 Conditions on Target-Present Trials, Averaged Across Items for Each Participant.

<i>Conditions</i>	<i>Prefixed</i>		<i>Suffixed</i>	
	<i>RTs (SD)</i>	<i>% ER</i>	<i>RTs (SD)</i>	<i>% RE</i>
Affixed	646 (187)	13	564 (134)	3
Pseudo-Affixed	625 (153)	9	628 (151)	4
Control	678 (191)	25	626 (149)	15
<i>Rt differences</i>				
Pseudo-affixed - Affixed	-21		+64*	
Control - Affixed	+32*		+62*	
Control - Pseudo-affixed	+53*		-2	

278 Overall, genuine morphological effects were observed primarily in suffixed words, where letter-search  
279 times were significantly shorter for target letters embedded in suffixed compared to pseudo or non-  
280 suffixed conditions. In contrast, when examining prefixed words, the morphological consistency did  
281 not show a significant effect. Both prefixed and pseudo-prefixed words facilitated letter identification  
282 relative to monomorphemic controls and did not significantly differ from each other in terms of letter-  
283 search times.

## 284 4 Discussion

285 First, our results replicate the asymmetry previously reported for French prefixed and suffixed words  
286 (in Beyersmann et al., 2015 using the same task, and also in Grainger & Giraud, 2003 with the masked  
287 priming paradigm), showing that letter-search effects are restricted to suffixes only. More crucially, in  
288 the present study, we found a genuine morphological effect: a significant difference was observed in  
289 response times between real suffixed words and pseudo-suffixed words. This ‘real morphological  
290 effect’ allows for a more comprehensive interpretation compared to simply comparing non-words with  
291 or without ‘real suffixes’. The underlying processes involved in recognizing words and non-words  
292 differ significantly. Using nonword materials prevents the inclusion of a pure morpho-orthographic  
293 condition that would allow for a direct comparison of complete morphological effects versus partial  
294 morphological effects. As a result, any morphological effects observed in non-word processing provide  
295 an incomplete picture of holistic word processing, which inherently involves both surface features  
296 (from the initial stages of word processing as a unified entity) and deeper morphological effects  
297 (emerging at a more central level through the co-activation of interconnected mental representations  
298 within the mental lexicon).

299 Secondly, contrary to Beyersmann et al. (2015) who found significantly longer RTs on suffixed than  
300 on non-affixed nonwords, we observed significantly shorter RTs when a letter-search is engaged on  
301 suffixed words relative to both pseudo-suffixed and non-suffixed control conditions. More crucially,  
302 the pseudo-suffixed condition did not differ from the non-suffixed condition. Obviously, the lexicality  
303 of the manipulated items has impacted the letter-search task. While the presentation of affixed  
304 nonwords slows down the identification of a letter embedded within a suffix, the presentation of affixed  
305 words increases its perceptive saliency. A possible interpretation of these opposed effects could be  
306 based on the different strategies used by the participants in the letter-search task. In such a task, which  
307 is completely unnatural for the reader, the process of searching for the target letter can be broken down  
308 into two stages: the overall visual perception of the displayed item, followed by scanning the letter  
309 sequence until the target is identified. The structure of the complex nonwords used by Beyersmann et  
310 al. (2016) consisted of a monosyllabic free stem and an affix (both familiar and frequent in French),  
311 as in *mieleur*, *goûture*, *bruitage* (examples taken from the materials list used by the authors). These

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312 items were compared and matched with nonwords combining the same free root and a non-affix of the  
313 same length in number of letters, such as *mieleuf*, *gôûtire*, *bruitide*. These were presented in a list  
314 mixed with the same number of non-affixed fillers that did not contain target letters, forming a total of  
315 90 non-words presented to each participant in the experiment. Even though the participants were  
316 informed that none of the items existed in French, such instructions are not without consequences on  
317 the strategy employed to provide a response. It is therefore highly likely that the presentation of  
318 morpheme combinations, among which there was a free stem, induced in the participants, consciously  
319 or subconsciously, a process of understanding the entire item based on the meaning of the stem and the  
320 suffix. The suffixes being not only bound morphemes (thus without meaning of their own) but also  
321 semantically polyfunctional affixes, at least in French (Salvadori & Huyghe, 2023), we can argue that  
322 the segmentation into stem + suffix was relatively easy. However, the uncertainty of the meaning of a  
323 combination of a salient unit—the free stem—in its morphological sense (transparent form and  
324 meaning) associated with a perceptually salient unit (the suffixes used by these authors were all  
325 frequent) and semantically polyfunctional could have hindered the identification of the target letter.  
326 Thus, relative to the non-suffixed conditions of high and low frequency, the response times were  
327 longer. The explanation for the absence of observed effects in the case of prefixed non-words can be  
328 elaborated following the same logic, which is based on the morphological salience of the units used to  
329 create prefixed non-words. In the study, the prefixed non-words were constructed following the same  
330 principles as the suffixed non-words: a prefix + a free root. However, from a linguistic point of view,  
331 there is a notable difference between French prefixes and suffixes, particularly on the semantic level.  
332 According to Corbin (1999), "it is the semantic instruction of affixes that determines their categorial  
333 instruction, which adapts to the properties of the bases to which it applies" (:66). However, in French,  
334 prefixes have a less prototypically affixal character compared to suffixes: they are fewer in number (a  
335 property of all languages that have both classes of affixes, Mel'ëuk, 1999 cited by Corbin), have  
336 homophones corresponding to free units such as adverbs or prepositions (e.g., *sous-marin* 'submarin'-  
337 *sous la table* 'under the table', *supersonique* 'supersonic' – *c'est super!* 'it's super!'), and some prefixes  
338 can acquire the properties of lexical units in their own right, which is impossible for suffixes. Finally,  
339 they enter into fewer heterocategorical morpheme combinations (i.e., grammatical classes). Therefore,  
340 according to Corbin (1999), prefixes are characterized by greater semantic autonomy (compared to  
341 suffixes), which gives them behaviour akin to that of words. That being said, if we return to the study  
342 by Beyersmann et al. (2016), the prefixed non-words would have engaged more efficient processing  
343 mechanisms for the letter search task. The prefixed non-words, due to their non-lexicality and the  
344 perceptual and morphological salience of their constituents, would have quickly allowed for the  
345 association of a global compositional meaning to the perceived unit, which would have facilitated the  
346 search for the target letter in the non-word, resulting in a lesser cognitive difficulty than in the case of  
347 suffixed non-words. It is also interesting to note here that, although it was not a significant difference,  
348 the response times were 17ms shorter for prefixed non-words than for non-prefixed non-words. This  
349 suggests that the presence of a prefix could have slightly benefited the identification of the target letter  
350 compared to the same search at the beginning of a non-prefixed non-word, thus supporting our earlier  
351 argument.

352 Continuing with our interpretive logic, we hypothesize that the lexicality of the items to be processed  
353 in this letter search task explains the inverse results we obtained. Indeed, in our study, we used real  
354 affixed words. Therefore, the step of reconstructing the meaning of the item from its constituent  
355 elements (as well as its semantic strangeness) was absent from the process of searching for and  
356 identifying the target letter imposed by the experimental task. The morphological effect, however,  
357 revealed an asymmetry between the two classes of affixes: compared to a non-affixed condition and a  
358 pseudo-affixed condition, the identification of the target letter within the affix of a real affixed word  
359 was faster, but only in the case of suffixed words. In the case of prefixed words, the response times

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360 indicate equivalent facilitation effects for the prefixed and pseudo-prefixed conditions compared to the  
361 non-prefixed control condition (+32ms and +53ms, respectively). Besides the non-significant  
362 advantage of 21ms for the letter search in pseudo-prefixed words compared to prefixed words, it seems  
363 interesting to note that the presence of a bound root in the prefixed words did not contribute to the  
364 target letter identification process since our pseudo-prefixed words, although lacking a root, showed  
365 shorter response times compared to the control condition. We propose an explanation based on the  
366 particular morphological characteristics of prefixes which, as mentioned earlier, give them a status  
367 close to that of words. Thus, they benefit from a perceptual and morphological salience (to which a  
368 positional advantage at the beginning of the word may also be added), such that the identification of  
369 one of the letters they contain is relatively quick compared to that in a non-prefixed word (our control  
370 condition).

371 Our results and their interpretation contradict those previously presented by Beyersmann et al., based  
372 on their postulate that "The affix-chunking hypothesis straightforwardly predicts that letter search  
373 should be harder when the target letter is embedded in an affix compared with a non-affix letter  
374 sequence" (2015: 2). They are also opposed to the conclusions of studies supporting the morpho-  
375 orthographic segmentation hypothesis, which does not envisage a more central role for morphology  
376 manifested through paradigmatic relationships, that is, those based on the systematic relationships of  
377 form and meaning shared by the mental representations of word forms coded in the lexicon. At most,  
378 these studies have proposed a level of morpho-semantic representation situated at the interface of the  
379 formal (word forms) and semantic levels, for which the content of the units is not really specified,  
380 especially considering the polysemy that generally characterizes the set of morphemes in languages.  
381 Indeed, if this level is situated in the lexicon, it would, according to the models proposed so far, be  
382 constituted of independent morphemic units. However, this hypothesis, which should be more aptly  
383 termed 'piecological' than morphological, cannot simply account for the wide variety of phenomena  
384 produced by word construction, both on a purely formal level: How to account for phenomena like  
385 allomorphy and suppletion, for example? but also on a semantic level: How to account for the different  
386 degrees of semantic transparency produced by word constructions?

387 Given that this segmentation mechanism obviously depends on the integrity of the remaining stem after  
388 affix stripping, the numerous cases in which the recognition of the stem is hindered, as it the case in  
389 morphological processes like allomorphy (i.e., slight formal change of the stem) and suppletion (i.e.,  
390 the unpredictable formal change of the stem) can call into question this hypothesis. The following  
391 examples of derived words in French illustrate well this challenging issue:

- 392 (1) Fr: in *vaguelette* 'little wave', the remaining stem is *vaguel-* and not *vagu-*;  
393 (2) Fr: in *surdité* 'deafness', the remaining stem is *surd-* and not *sourd-*;  
394 (3) Fr: in *aquatique* 'aquatic', the remaining stem is *aquat-* and not *eau-*;

395 Recently, Beyersmann and Grainger (2023) have pointed out this problem for the morpho-orthographic  
396 segmentation hypothesis: affix stripping often leaves morphemes that do not function as bases (e.g.,  
397 *late* in *relate*) and have nuanced the respective role of stem and affixes in this process (see also the first  
398 developments initiated by Grainger & Beyersmann, 2017). In their Word and Affix model, the full  
399 morpho-orthographic decomposition process is still operating but integrates the postulate according to  
400 which "stems and affixes have different status in the reading system" (: 27). The detailed description  
401 of their model proposes the explanation of numerous morphological effects previously reported in the  
402 psycholinguistic literature on morphological processing. However, elements related to linguistic  
403 theories, particularly concerning phenomena of constructions and morphological operations (e.g.,  
404 Booij, 2010), are not properly addressed and may question the psychological reality of a holistic model

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405 of the recognition of morphologically simple and complex words. This hierarchical model, based on a  
406 principle of interactive activation within and between levels (e.g., McClelland & Rumelhart, 1981),  
407 integrates a process of semantic activation linking representations coded at the formal level and those  
408 coded at the semantic level, thereby differentiating truly morphologically complex words (e.g., *farmer*)  
409 from pseudo-complex words (e.g., *corner*). However, it reaffirms the purely sublexical locus of  
410 morphological effects, leading to an automatic and mandatory decomposition process of all types of  
411 units, lexicalized or not, manifesting through the activation of morphemic units, including surface  
412 morphemes, contained in the visual forms to be recognized. While this proposal explains the effects  
413 resulting from the syntagmatic structure of words, it does not consider their paradigmatic dimension.  
414 Yet, these two dimensions inherent in the description of morphology are crucial for explaining the  
415 morphological operations involved in word construction. Not considering the network of semantic-  
416 formal relationships that words in the lexicon maintain with each other amounts to viewing words as  
417 strictly independent units. It is precisely this network that explains phenomena of irregularity, variation,  
418 and change observed in natural language, and also helps to understand the underlying processes of new  
419 word formation. For example, the ease with which the word *Macronisme* is not only produced but also  
420 understood by all standard French speakers (and certainly by non-French-speaking speakers).

421 While we do not deny that formal features can play a role in word processing, an account of the general  
422 mechanisms of lexical access also needs to consider the perceptual and functional salience of  
423 morphologically constructed words (as proposed for example by Giraudo & Dal Maso, 2016a). In other  
424 words, if the reader's sensitivity to the morphological structure is undeniable, morphemes could  
425 correspond to secondary units of description/analysis/construction that do not need to be represented  
426 as separated units of processing but rather as more abstract constructional schemas (as proposed by  
427 Booij's (2010) *Construction Morphology* or Jackendoff and Audring's (2020) *Relational Morphology*  
428 theories) the within the mental lexicon. "As Goldberg (2003: 223) famously put it: "The network of  
429 constructions captures our knowledge of language in toto - in other words, it's constructions all the  
430 way down." (cited in Audring, 2021, : 3.2).

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518

### 519 1 Data Availability Statement

520 The datasets for this study can be found in the following repository:

521 <https://mycore.core-cloud.net/index.php/s/liaV2UobJtcmenF>

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### 530 2 Supplementary Material

531 Items:

Letter	Condition	Word	Condition	Word	Condition	Word
a	Suffixed	rouage	PoSuffixed	stage	controlS	baril
a	Suffixed	fiable	PoSuffixed	érable	controlS	vilain
a	Suffixed	friable	PoSuffixed	stable	controlS	sachet
a	Suffixed	criard	PoSuffixed	lézard	controlS	volcan
a	Suffixed	loyal	PoSuffixed	métal	controlS	rangée
e	Suffixed	sueur	PoSuffixed	choeur	controlS	barque
e	Suffixed	loueur	PoSuffixed	tumeur	controlS	dingue
e	Suffixed	boueux	PoSuffixed	odieux	controlS	ballet
e	Suffixed	tueur	PoSuffixed	fleur	controlS	tasse
e	Suffixed	nageur	PoSuffixed	majeur	controlS	balade
e	Suffixed	acteur	PoSuffixed	moteur	controlS	plaine
e	Suffixed	jouet	PoSuffixed	carnet	controlS	tache
e	Prefixed	recoin	PsPrefixed	revilainin	controlP	clown
e	Prefixed	réunir	PsPrefixed	rébus	controlP	friche
e	Prefixed	défait	PsPrefixed	débris	controlP	crédit
e	Prefixed	dégoût	PsPrefixed	dessin	controlP	puzzle
e	Prefixed	réjouir	PsPrefixed	record	controlP	aspect

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e	Prefixed	détour	PSPrefixed	décor	controlP	drogue
e	Prefixed	démuni	PSPrefixed	dédain	controlP	jungle
n	Prefixed	enjeu	PSPrefixed	engin	controlP	échine
n	Prefixed	invalide	PSPrefixed	inceste	controlP	asperge
n	Prefixed	incolore	PSPrefixed	industrie	controlP	version
n	Prefixed	injuste	PSPrefixed	insecte	controlP	contexte
n	Prefixed	informe	PSPrefixed	infect	controlP	dynastie

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533