GLOSSA psycholinguistics

Lombard, A., Huyghe, R., & Gygax, P. (2024). Morphological productivity and neological intuition. *Glossa Psycholinguistics*, 3(1): 18, pp. 1–41. DOI: https://doi.org/10.5070/G60111291

eScholarship University of California

Morphological productivity and neological intuition

Alizée Lombard, University of Fribourg, Av. de Beauregard 13, CH-1700 Fribourg, CH, alizee.lombard@unifr.ch
Richard Huyghe, University of Fribourg, Av. de Beauregard 13, CH-1700 Fribourg, CH, richard.huyghe@unifr.ch
Pascal Gygax, University of Fribourg, Rue P.A. de Faucigny 2, CH-1700 Fribourg, CH, pascal.gygax@unifr.ch

This paper investigates the relationship between morphological productivity and neological intuition, defined as the ability to identify novel words as such. It can be hypothesised that the more productive a word-formation process is, the less salient the neologisms it forms will be. We test this hypothesis experimentally on neologisms formed with prefixes and suffixes of variable productivity. Three experiments are conducted, involving lexical identification and reading tasks with eye tracking, to provide a comprehensive description of neological intuition. The negative correlation between productivity and neological salience is supported by experimental results, but only in the case of suffixed neologisms, as opposed to prefixed ones. The effect of affix type on neological intuition can be explained by differences in the grammatical nature of prefixes and suffixes. Broadly speaking, investigating the linguistic factors of neological intuition provides an original approach to both linguistic and psycholinguistic issues related to word structure and lexical processing.

1. Introduction

Neologisms are new lexical units in a language, be they words with a new form, words with a new meaning, or new multiword expressions. They can be constructed from elements of the reference language or borrowed from another language. Various aspects of neologisms are commonly investigated in dedicated studies, from the definition and classification of neologisms (Cabré, 2006; Renouf, 2013; Sablayrolles, 2000; Tournier, 1985; a.o.) to the conditions of their integration in the lexicon (Arndt-Lappe et al., 2018; Bauer, 1983; Blank, 2001; Foubert, 2021; Hohenhaus, 2005; Lipka, 1992; a.o.). In the last decades, research on neologisms has benefited from methodological advances in linguistics, in particular from access to large and diverse corpora. The study of the emergence of neologisms is now assisted by computational techniques that can be used to automatically detect novel forms or novel word meanings (Cabré & Estopà, 2009; Cartier et al., 2018; Gérard et al., 2017; Kerremans et al., 2018; Renouf, 2014; Reutenauer, 2012). Large inventories of neologisms provide material for case studies in different languages, across textual genres and linguistic communities.

The cognitive and psycholinguistic aspects of neologisms are an additional point of interest. Researchers have investigated how novel expressions and meanings are entrenched in the mental lexicon and how speakers react to neologisms (Bakker et al., 2014; Kaczer et al., 2018; Vaan et al., 2007). Neologisms have also been used as unbiased material to study lexical processing and the structure of the mental lexicon without the influence of lexicalisation (Kaczer et al., 2015; Leminen et al., 2010; Rodd et al., 2002; Zheng et al., 2015). Particular attention has been paid to *neological intuition*, defined as the metalinguistic ability of speakers to identify neologisms (Ben Hariz Ouenniche, 2009; Gardin et al., 1974; Lombard et al., 2021; Sablayrolles, 2003). The exploration of neological intuition (henceforth, NI) provides indirect insight into both linguistic and psycholinguistic issues related to lexical structures, the representation of form-meaning associations, semantic transparency, and the processing of novel linguistic forms. Studies have shown that NI varies according to (i) linguistic factors such as neologism type, semantic features and base word frequency, and (ii) extralinguistic factors such as speakers' age, education, occupation, geographical origin and multilingualism (Favreau, 2020; Podhorná-Polická & Fiévet, 2018a, 2018b; Xu, 2001).

As far as linguistic factors are concerned, the regularity of lexical innovation processes, i.e. their ability to produce predictable expressions based on existing patterns, plays a crucial role in the variation of NI (Lombard et al., 2021). Irregular processes (e.g. blending, irregular polysemy) contrast with regular processes (e.g. affixation, regular polysemy) in that they generate more NI when used to coin novel words. Experimental studies have also shown that regular processes are highly heterogeneous with respect to NI, which calls for further investigation. It can be hypothesised that, regularity being a graded property, NI depends on how regular lexical processes are and how frequently they are realised in a given language.

In the case of semantic neologisms (i.e. words with a new meaning, such as *unicorn* metaphorically denoting a highly valued startup company), Lombard et al. (2023) have shown that NI depends on the degree of regular polysemy that applies to neologisms. Similarly, one may ask whether, in the case of morphological neologisms (i.e. newly derived words, such as *cakeage* resulting form the suffixation of *cake* with *-age*), NI is determined by differences in regularity of word formation processes. Given that morphological regularity depends on the frequency of instantiation of word formation processes, and, in particular, on their productivity and capacity to produce new derivatives, one hypothesis could be that the more productive a word formation process is, the less NI it triggers. In this study, we test this hypothesis on French morphological neologisms, adopting an experimental approach based on lexical identification and reading tasks.

The article is organised as follows. In Section 2, we outline the theoretical background for investigating NI and its relationship with morphological productivity. In Section 3, we describe the linguistic materials used in the study. In Sections 4 to 6, we present the methodology and results of three experiments conducted to address our main hypothesis. In Section 7, we discuss the experimental results and their implications, before concluding.

2. Theoretical background

In this section, we begin by examining the concept of NI as it has been discussed in the literature on lexical innovation. We then present morphological productivity and its relationship with NI. Finally, we describe the objectives of the present study.

2.1 Variation in neological intuition

NI is the speakers' metalinguistic ability to identify neologisms as such. The linguistic counterpart to this speaker-oriented property is *neological salience*, which is the capacity of words to appear as novel lexical items. NI is part of linguistic competence and, as such, participates in the mastery of a language (see e.g. Itkonen, 1981, 2005). It emerges from a comparison with the words included in one's mental lexicon and an evaluation of shared lexical knowledge. It follows that a full investigation of NI implies the analysis of both the processing of neologisms and metalinguistic judgements about them.

NI has been primarily examined with the aim of clarifying the definition of neologism, assuming that neologisms should generate NI. However, important variation in judgements about the neological character of lexical items has been observed among speakers and across words. This variation has ultimately led to debates about whether the ability to generate NI should be considered a defining property of neologisms or not (see e.g. Cabré & Estopà, 2009; Cartier, 2018; Sablayrolles, 2010). Regardless of the stance taken, the variable character of NI is obvious, and calls for further examination.

In the first study on NI conducted by Gardin et al. (1974), 17 linguists were asked to read a selection of press articles and to detect words and expressions that they considered to be neologisms. The results revealed important differences among participants, from which the authors inferred that neologisms might not exist as clearly delimited lexical units, but rather as fuzzily bounded segments in sentences. It can be concluded that NI cannot be used as a criterion in the definition of the concept of neologism, given its high variability. Sablayrolles (2003) and Ben Hariz Ouenniche (2009) used the same method as Gardin et al. (1974), but provided participants with an explicit definition and a typology of neologisms in order to increase experimental control and reduce NI variability. Even with a low number of experts taking part in their experiments, the results were unsatisfactory, insofar as the variation observed among annotators was still important. However, an important contribution of these studies was to show that NI varies according to the type of neologism (e.g. affixed word, compound, blend, multiword or semantic neologism).

Lombard et al. (2021) further investigated the linguistic factors that influence NI, using a different methodological approach. They experimentally manipulated two orthogonal properties of neologisms: (i) their formal novelty, depending on whether neologisms result from a morphological operation or are already existing forms that take on new meanings, (ii) their lexical regularity, depending on whether neologisms are created through regular linguistic processes or not. They coined semantic and morphological neologisms in French that were either regular or irregular, depending on whether they fitted into existing word-formation or polysemy patterns. For example, the derived word *vipérette* 'small viper' was used as a regular morphological neologism, as it was standardly formed with the diminutive suffix *-ette*, whereas the acronym *formupo* (based on *formule de politesse* 'salutation') was used as an irregular morphological neologism, on account of its idiosyncratic and unpredictable structure. Similarly, the noun *brassage* 'tossing', used to denote tossed food, was considered a regular semantic neologism, because it followed the ACTION → RESULT metonymic pattern, whereas *oursin* 'sea urchin', used to metaphorically denote an alcohol cocktail, was considered an irregular semantic neologism, because it did not fit into any existing pattern. 68 native speakers were asked to detect such morphological and semantic neologisms in short sentences. Results indicated that both formal novelty and lexical regularity determine NI, but also that regular neologisms are highly heterogeneous in terms of neological salience.

Based on the observation of heterogeneity in regular neologisms, Lombard et al. (2023) tested the hypothesis that NI depends on the degree of regularity of lexical innovation processes. They focused on semantic neologisms and ran an experiment with novel word senses fitting into polysemy patterns of variable regularity (e.g. ACTION → RESULT being more regular than BODY PART → PERSON). 168 native speakers were presented with sentences containing these semantic neologisms and asked to detect words used with a new sense. A negative correlation was found

between degrees of regularity and NI, both with metaphorical and metonymic extensions. It appears that the more regular a polysemy pattern is, the less salient the semantic neologisms that fit into it are. Although the study documented the influence of regularity in semantic neologisms, it did not address regularity in morphological neologisms, which might be of a different nature, since different factors are at stake. The aim of the present study is to investigate whether previous results concerning the salience of regular neologisms can be generalised to morphological neologisms created through various derivational processes.

2.2 The influence of morphological productivity

In the case of morphological neologisms, one can ask whether productivity, as the capacity of a word formation process to regularly produce new forms, determines the variation of NI. Morphological productivity is known to influence the lexical processing of complex words, although this influence has been little investigated directly.[1] Testing speakers' judgements about the naturalness of novel words coined with different suffixes in Japanese, Hagiwara et al. (1999) provided evidence for rule-based processing in the case of highly productive suffixes, as opposed to memory-based and analogical processing in the case of weakly productive suffixes. Based on lexical decision experiments, Bertram et al. (1999) and Bertram et al. (2000) showed that words including productive suffixes in Finnish and Dutch are more likely to be processed through morphological parsing than words including unproductive suffixes, especially in the case of unambiguous suffixes. Similarly, Lázaro (2012) and Lázaro et al. (2015) showed that words ending with a productive suffix in Spanish elicit shorter response times in lexical decision tasks than words ending with an unproductive suffix, and that pseudowords containing a productive suffix take longer to be rejected than pseudowords containing an unproductive suffix. Overall, these results suggest that productive affixes facilitate the retrieval and processing of complex words, and that productive morphological processes may be more available to speakers than non-productive ones. Considering productivity as a continuous property, it can be hypothesised that the more productive a word formation process is, the less NI it will generate when used to derive new words. To test this hypothesis still requires a scalar definition of morphological productivity and a method to measure degrees of productivity.

There are different approaches to productivity in morphological studies (see Bauer, 2001; Corbin, 1987; Dal & Namer, 2015; Fernández-Domínguez, 2013; Plag, 1999; Spencer, 2019; a.o.). Productivity is usually decomposed into availability and profitability, and considered accordingly as a categorical or a continuous property. Availability depends on whether a morphological

[1] According to Plag (2006), the effect of productivity on lexical processing is due to elementary properties such as parsability, relative frequency and semantic transparency of complex words. Most researchers have focused on these related properties when investigating the lexical processing of complex words.

process can or cannot be used to coin new words in a certain situation. For instance, *-ness* differs from *-th* in contemporary English, in that only the former is available to form novel deadjectival nouns. Profitability has received several definitions in the literature, but is essentially related to how frequently an available process is used to coin new derivatives. Profitability can be approached in relation to past or present production, and can be based on the number of existing words in a language that were formed through a morphological process, or the propensity of a morphological process to create new words synchronically.

Productivity as a continuous phenomenon calls for appropriate assessment, and different possible indices of productivity have been explored. For example, Aronoff (1976) has proposed to measure productivity by dividing the number of attested words by the number of possible words for a given morphological process. In diachrony, productivity can also be assessed based on the number of neologisms which entered the lexicon over a given period (Lindsay & Aronoff, 2013; Plag, 1999; Spencer, 2019; a.o.). More recently, Schlachli (2021) has proposed a measure of productivity based on the median of the frequency distribution of words formed through a given process. Nevertheless, the most frequently used and discussed measures of productivity remain those proposed by Baayen (1993, 1994, 2009), who introduced three indices to account for different aspects of productivity. The first one, *realized productivity*, is proposed to evaluate the extent of use of a morphological process and the size of the resulting vocabulary. It corresponds to profitability applied to attested derivatives only and is equivalent to the number of complex words with a given affix α in a corpus. The second index, *potential productivity*, takes into account the vitality of a word formation process by considering the relative proportion of novel formations among existing ones. This measure is based on large corpora and uses the number of hapax legomena (i.e. words with only one occurrence in a corpus) as a proxy for the number of neologisms. More precisely, it divides the number of hapax legomena affixed with α by the total number of occurrences of words affixed with α. The third index, *expanding productivity* (or *hapax productivity*), reflects the contribution of a morphological process to the renewal of the lexicon, in comparison to other processes. This measure consists in dividing the number of hapax legomena affixed with α in a corpus by the total of hapax legomena in the same corpus.

Baayen's productivity measures have been criticised, and researchers have discussed both their sensitivity to corpus size (Gaeta & Ricca, 2003, 2006) and possible diachronic biases (Dal et al., 2008). Additional concerns relate to the computability of the measures, due to problems in extracting the information required for the calculation of the indices (see 3.1). Nevertheless, Baayen's measures are the most widely used in studies on morphological productivity, and they return values that can be interpreted based on previous uses. We will rely on these measures in the present study, while taking necessary precautions in their computation and interpretation.

2.3 The present study

The present study investigates the linguistic factors that influence the neological salience of regular morphological neologisms, and, therefore, the NI that these words can generate. In particular, we intend to examine the relationship between the degree of productivity of a derivational process and the NI triggered by neologisms formed through this process. Our main hypothesis is that the more productive a word-formation process is, the less salient the neologisms it forms will be.

We tested this hypothesis separately for prefixes and suffixes, based on previous studies that report an effect of affix type on the lexical processing of derived words. In a seminal study, Marslen-Wilson et al. (1994) investigated the lexical representation of prefixed and suffixed words through a series of priming experiments. They found that semantically transparent base-derivative pairs prime each other for both types of affixed words, and that suffixed words, prefixed words and their bases all prime each other through shared morphemes, except for pairs of suffixed words. These results were replicated for Polish by Reid and Marslen-Wilson (2003). In a lexical decision experiment in Hungarian, Pléh and Juhász (1996) observed that pseudo-prefixed words with a violation of combinatory restrictions took significantly longer to be rejected than words with non-existing prefixes, whereas no such difference was noted for suffixed words. This result was taken as evidence that speakers would tend to strip out the prefix during lexical analysis. Feldman and Soltano (1999) also conducted a priming experiment in English in which the primes were either prefixed or suffixed words, and the target word was derived from the same base as the prime. They reported a facilitation effect in the recognition of complex words with prefixed primes, but not with suffixed primes, under cross-modal presentation conditions. Finally, Zweig and Pylkkänen (2009) found in a MEG experiment that both types of affixed words yielded an M170 effect in the right hemisphere, but that prefixed words, unlike suffixed words, also had an effect in the left hemisphere.[2] Overall, these studies suggest that the position of the affix may play a role in the lexical processing of derived words. Accordingly, it could have an influence on NI that is distinct from that of productivity.

We conducted three experiments using both online and offline measures based on explicit judgements, response times and eye movements. This variety of methods allows us to determine whether speakers identify neologisms as such, and whether neologisms elicit a specific reaction when encountered in a sentence, even in the case of negative judgement about their neological

[2] As a notable exception, Beauvillain (1994) did not find any difference between prefixed and suffixed words when investigating the role of the morphological structure of complex words in their visual recognition. The contrast with other studies may be due to differences in linguistic materials and experimental paradigms, since an unusual contrast display procedure was used to emphasise different segments of the words, and to determine the pertinence of these segments in the recognition process.

nature. The first experiment is based on a survey in which participants had to identify morphological neologisms in sentences. These neologisms are prefixed or suffixed words that fit into derivational patterns with different degrees of productivity. The aim of the experiment was to assess the effect of productivity on speakers' metalinguistic judgements, through a lexical detection task. The second experiment replicates the first one with additional eye-tracking, to further investigate the effect of productivity on the cognitive processes involved in the identification of neologisms as participants are processing them. Fixation times and response times were analysed to determine whether newly coined derivatives attract special attention or go unnoticed when encountered in context, independently of their explicit identification as neological items. The third experiment involves eye-tracking and the same stimuli as the two previous experiments, but differs in the nature of the task presented to participants. A reading-for-understanding task was proposed to participants, without any neologism identification task. This procedure allowed us to disentangle the processing of morphological neologisms from hesitation in assessing whether they are novel words. The third experiment was expected to provide more information about the cognitive processes related to the spontaneous comprehension of neologisms, independently of metalinguistic judgements on their neological nature.

3. Linguistic materials

The linguistic materials used in this study are stimuli sentences in French that contain morphological neologisms derived with affixes with different degrees of productivity. In this section, we present (i) how we selected affixes with different degrees of productivity, (ii) how we coined neologisms using these affixes, (iii) how we created stimuli sentences that include the affixed neologisms.

3.1 Selected affixes

The first step in the creation of the linguistic materials designed for our study was to select affixes of variable productivity. We decided to focus on prefixes and suffixes that are used to derive nouns in French (as opposed to verbs, adjectives or adverbs), in order to control for possible part-of-speech variation. We determined degrees of productivity based on the three measures proposed by Baayen (2009), which were computed from a list of nouns present in FRCOW16A, a large French web corpus crawled in 2016 and containing 10.8 billion tokens (Schäfer, 2015; Schäfer & Bildhauer, 2012). We selected 41 prefixes and 25 suffixes used to derive nouns in French, and, for each affix, we automatically extracted from the corpus the list of nouns beginning or ending with the sequence of letters composing the affix. The corpus was pre-processed to remove as many non-relevant items as possible before the extraction, e.g. by eliminating words with non-French characters or words that have less than three characters before or after the sequence of letters targeted.

Despite pre-processing, the automatically extracted data were still noisy, causing problems for a fine evaluation of productivity. First, due to tagging errors, some lemmas were wrongly identified as nouns. Second, some words contained sequences of letters that were identical to affixes without being morphemes (e.g. *-age* in *fromage* 'cheese' or *in-* in *intrus* 'intruder'). Third, the polyfunctionality of affixes could affect the assessment of their productivity. For example, there are two homonymous suffixes *-age* in French that can form deverbal nouns (e.g. *gonfler* 'inflate' → *gonflage* 'inflation') or denominal nouns (e.g. *feuille* 'leaf' → *feuillage* 'foliage'), and these two suffixes may have different degrees of productivity. The productivity of each derivational pattern associated with the same affix cannot be assessed based merely on the number of words that contain the affix.

It was possible to partially alleviate these problems. For instance, prefixes such as *in-* and *mi-* were removed, because of their frequent confusion with non-morphemic word segments. We also filtered the lists by excluding morphologically simple words, based on the inventory by Tribout et al. (2014), which allowed us to discard non-affixed words, such as *fromage* 'cheese'. Finally, we removed double entries for spelling variants of the same words (e.g. *hyper- sensibilité* and *hypersensibilité* 'hypersensitivity' were reduced to one entry). However, not all problems could be solved. In particular, it was not possible to compute distinct measures of productivity for the different derivational patterns associated with a given affix. Considering both the technical issues and the inherent limits of the productivity measures proposed by Baayen, we used these measures as a coarse estimation of productivity and reduced them to a two-level variable (high and low productivity). More precisely, we calculated indices of realized, potential and expanding productivity for each affix, in order to take into account the different aspects of morphological productivity. We then applied a hierarchical clustering method with Ward linkage to both the 40 prefixes and 24 suffixes under scrutiny,[3] based on the three productivity measures considered jointly. The results of the cluster analysis are presented as dendrograms in **Figure 1**. We divided both prefixes and suffixes into two main groups of high and low productivity. Levels of productivity were assigned to each group according to the average values of the different productivity measures per group, as indicated in **Table 1**. To ensure that high and low levels of productivity were comparable across affix types, we also realised a clustering analysis on all the affixes, without distinguishing between prefixes and suffixes. The clustering of all affixes into two main groups is consistent with the one presented in **Figure 1**, since prefixes and suffixes identified as weakly productive and prefixes and suffixes identified as highly productive fall into two distinct clusters.[4]

[3] The clustering analysis was performed using the *cluster* package (Maechler, 2018) in R (R Core Team, 2022). Note that we excluded *-ion* from the list of suffixes, because it was a clear outlier, with productivity measures greater than 2.5 SD above the average of all suffixes.

[4] The results of the global clustering are available in the supplementary materials.

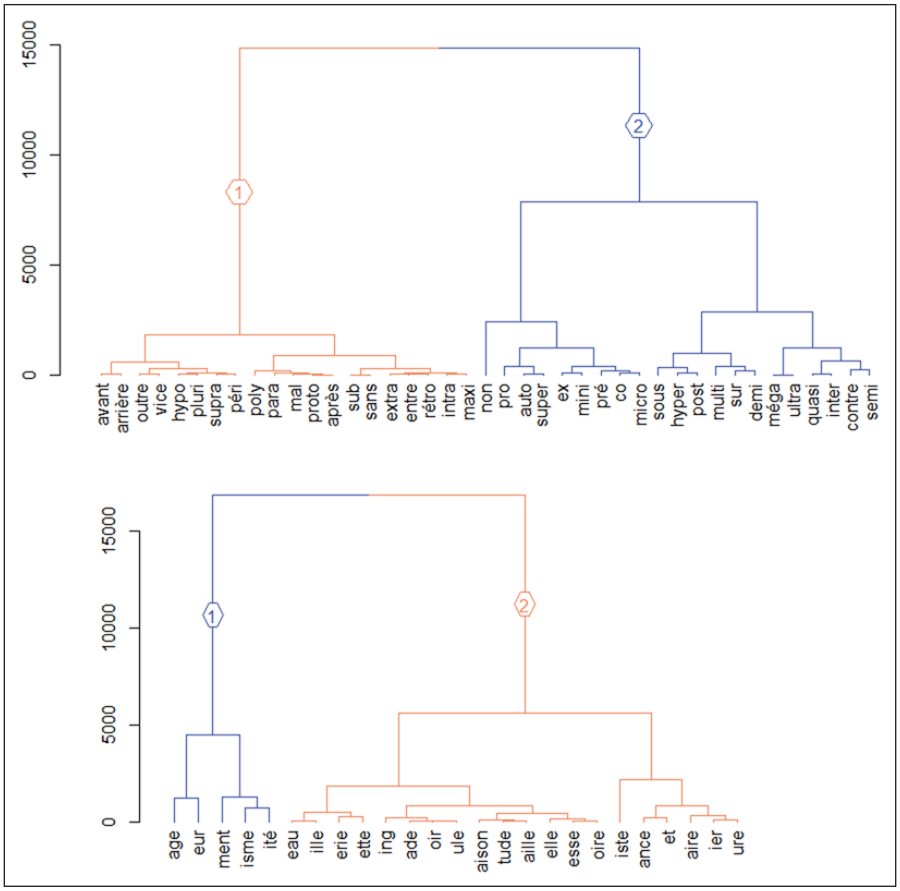

Figure 1: Results of the hierarchical clustering of the affixes. Prefixes (top) and suffixes (bottom) are divided into groups of low productivity (orange) and high productivity (blue).

Table 1: Average productivity (P) measures for the two main clusters of each affix type.

Affix type	P level	Number of affixes	Realized P	Potential P	Expanding P
Prefix	High	21	3915	7.3e-03	.027
Prefix	Low	20	634	5.7e-03	.005
Suffix	High	5	7343	1.8e-04	.04
Suffix	Low	20	1389	1.7e-04	.008

Three prefixes and three suffixes were randomly selected in each group (i.e. 12 in total) under additional constraints. First, we selected affixes that are used to form nouns of various semantic types (in particular, concrete and abstract nouns), both across affix types and degrees of productivity. Second, we selected prefixes that are or are not used with a hyphen, in equal proportions between highly and weakly productive prefixes (1 hyphenated and 2 non-hyphenated prefixes in each case). Third, we discarded affixes that have an autonomous use

as lexicalised words (e.g. *ex*, *ultra*, *anti*, which can be used as nouns). The selected affixes are presented in **Table 2**.[5]

3.2 Lexical material

We coined 5 neologisms[6] for each of the 6 prefixes and 6 suffixes selected in the study, following their derivational patterns. To ensure that these newly coined derivatives are neologisms, as opposed to lexicalized words, and that they are not familiar to French speakers, we verified that they do not have an entry in reference dictionaries (*Petit Robert*, *Trésor de la Langue Française informatisé*) and no more than 2 occurrences in the FRCOW16A corpus. The 60 resulting neologisms were balanced in the experimental material with 60 lexicalised derivatives formed with the same affixes and following the same derivational patterns (see **Table 2** for examples). These lexicalised words were used as control items to ensure that we can observe the effects of lexical novelty (as opposed to the effects of derivational processes only). We also added to the lexical material 15 distractor words which are highly salient neologisms, created through irregular morphological processes (i.e. acronymy and blending). These distractors were included in an attempt to avoid a possible ceiling effect in the identification of neologisms. The final material includes 60 neologisms, 60 lexicalised words and 15 distractors. These words are homogenised as much as possible in terms of length of bases and derivatives, as well as frequency of the bases.[7]

---

[5] The average measures of realized productivity (RP), potential productivity (PP) and expanding productivity (EP) for selected affixes are the following: RP = 581, PP = 1.2e-04, EP = .014 for weakly productive prefixes; RP = 5879, PP = 3.6e-03, EP = .035 for highly productive prefixes; RP = 684, PP = 1.2e-04, EP = .004 for weakly productive suffixes; RP = 8351, PP = 1.3e-04, EP = .045 for highly productive suffixes. The differences observed between high and low levels of productivity are roughly comparable for prefixes and suffixes. Differences in EP are higher for suffixes than for prefixes, but they are counterbalanced by differences in PP, which are higher for prefixes than for suffixes. Importantly, the values for highly productive affixes, on one hand, and weakly productive affixes, on the other, are comparable across affix types.

[6] Morphological neologisms differ from most nonwords and pseudowords used in psycholinguistic studies in that they are possible words, i.e. words that are morphologically, semantically and syntactically compliant with existing patterns of derivation (Aronoff, 1976; Plag, 2018). In particular, morphological neologisms can be assigned a meaning based on their internal structure. By contrast, nonwords (e.g. *gat*, *bint*, *mave* in English) and pseudowords (e.g. *freenels*, *gumfil*, *flipory* in English) have a phonological structure and possibly include identifiable segments, but they are not necessarily analyzable morphosemantically and do not have a compositional meaning. Only those pseudowords that result from the concatenation of existing morphemes and follow a morphological rule (e.g. *trueness*, *poority*, *habitic* in English) can be regarded as possible words.

[7] We did not control for the imageability of the neologisms, although imageability, defined as the ability of a word to elicit a mental picture of its referent, can be an important factor in lexical recognition (Balota et al., 2004; Cortese & Schock, 2013; Lázaro et al., 2022; a.o.). Measuring imageability by asking speakers how easy it is to form an image of a word's referent, as is usually done for existing words (Paivio et al., 1968; Rofes et al., 2018), may be biased in the case of neologisms by the fact that some of them can be more easily assigned a meaning out of context than others — precisely because of differences in the productivity of their constituent morphemes. Nevertheless, we controlled for the concreteness of the neologisms, while considering that imageability and concreteness are highly correlated (Connell & Lynott, 2012; Toglia & Battig, 1978; Vergallito et al., 2020; a.o.). Our lexical materials include 13 concrete and 17 abstract meanings for both prefixed and suffixed neologisms, as well as 13 concrete and 17 abstract meanings for both neologisms with a highly productive and a weakly productive affix.

Table 2: Selected affixes with examples of existing and newly coined derivatives.

Affix type	Productivity	Affix	Existing example	Neologism
Suffix	High	-age	nettoyage	modulage
			'cleaning'	'modulation'
		-eur	*utilisateur*	*traumatiseur*
			'user'	'traumatizer'
		-ment	*enseignement*	*esquissement*
			'teaching'	'sketching'
	Low	*-aison*	*démangeaison*	*broyaison*
			'itch'	'grinding'
		-eau	éléphanteau	*crabeau*
			'elephant calf'	'young crab'
		-esse	*vieillesse*	*abjectesse*
			'old-age'	'despicableness'
Prefix	High	*co-*	*coéquipier*	*coaudience*
			'teammate'	'co-audience'
		mini-	*minijupe*	*minipeigne*
			'miniskirt'	'mini-comb'
		non-	*non-retour*	*non-doublage*
			'non-return'	'non-dubbing'
	Low	*avant-*	*avant-propos*	*avant-moisson*
			'foreword'	'pre-harvest'
		entre-	*entrejambe*	*entrepavé*
			'crotch'	'interpavement'
		mal-	*maladresse*	*malinstruction*
			'clumsiness'	'misinstruction'

3.3 Stimuli sentences

We placed each target word in a short sentence to test neologisms in context, as illustrated in **Table 3**. The contextual use of morphological neologisms is necessary in order to fully test the properties of the derivational patterns under investigation, i.e. not only the formal, but also the syntactic and semantic, aspects of derivation. It allows for disambiguation when a newly derived word can be assigned different syntactic classes or lexical meanings (because of base ambiguity

Table 3: Examples of stimuli sentences in each condition.

Condition	Target word	Sentence
High-P suffix	modulage 'modulation'	Ils trouvent que le **modulage** de la voix accompagne bien les instruments. 'They find that the modulation of the voice accompanies the instruments well'
Low-P suffix	broyaison 'grinding'	Elle met toujours de la **broyaison** de noisettes dans sa tarte aux pommes. 'She always puts ground hazelnuts in her apple pie'
High-P prefix	non-doublage 'non-dubbing'	La tendance au **non-doublage** des films a des avantages économiques. 'The trend towards non-dubbing of films has economic advantages'
Low-P prefix	avant-moisson 'pre-harvest'	Les préparations de l'**avant-moisson** demandent plusieurs jours de travail. 'Pre-harvest preparations require several days of work'
Neutral	démangeaison 'itch'	Depuis ce matin, j'ai une terrible **démangeaison** à la cheville gauche. 'Since this morning, I have a terrible itch on my left ankle'
Distractor	climactiviste 'climate activist'	De nombreux **climactivistes** pique-niquent sur un pont de la ville. 'Many climate activists are picnicking on a bridge in the city.'

and affix polyfunctionality). To reduce learning effects, we varied the position of target words in the sentences, although we avoided positions at the beginning or at the end of a sentence. Target words were also assigned various syntactic roles (subject, object, oblique, modifier). The length of the sentences was homogenised across conditions, as well as the length of the segments before and after the target words.

To control for the contextualisation of neologisms and semantic constraints on target word positions in stimuli sentences, we ran a mask-filling task using the BERT language model (Devlin et al., 2018). Neologisms were masked in each sentence, and the 5 nouns most likely to fill the gap, according to BERT, were annotated semantically, following the classification and linguistic tests proposed by Haas et al. (2023). In the sentences designed for prefixed neologisms, 49 out of 75 BERT candidates (65%) have the same semantic type as the neologism in the high productivity condition, and 43 out of 75 (57%) have the same semantic type as the neologism in the low productivity condition. In the sentences designed for suffixed neologisms, 43 out of 75 BERT candidates (57%) have the same semantic type as the neologism in the high productivity condition, and 45 out of 75 (60%) have the same semantic type as the neologism in the low productivity condition. Chi-squared tests show that the semantic match between the

BERT candidates and the neologisms does not differ significantly between highly and weakly productive prefixes ($\chi^2(1, 150) = 1.012$, $p = .31$) or suffixes ($\chi^2(1, 150) = 0.110$, $p = .74$). Accordingly, the influence of the sentences on the semantic type of the noun expected at the target position can be considered equivalent across levels of productivity. The stimuli sentences will not generate a greater surprisal effect for words with highly productive affixes than for those with weakly productive affixes, and, therefore, will not bias their identification as neologisms.

4. Experiment 1

In our first experiment, participants were asked to identify neologisms in sentences. We monitored both identification rates per neologism and response times per sentence. Assuming that a strong NI results in high identification rates and short response times, we expected that neologisms formed with a weakly productive affix would generate (i) higher identification rates and (ii) shorter response times than neologisms formed with a highly productive affix.

4.1 Participants

The participants in Experiment 1 were 171 French native speakers, aged 18 to 29 years (Mean = 21.4, SD = 2.3). 71 participants were recruited during a course at the University of Fribourg, Switzerland, and 100 were recruited through the Prolific platform and financially compensated for their participation.

4.2 Procedure

The first experiment was based on a within-participants study design. The main factors investigated were affix type and productivity. The experiment took the form of a survey posted on the Internet. Participants completed it on their personal laptop in 17 minutes, on average.

In the first part of the experiment, participants had to read the stimuli sentences displayed on the screen one after the other in a random order, and to decide as quickly as possible whether or not each sentence included a “new word in French”. The term *neologism* was intentionally omitted, so as to avoid linguistic terminology and misunderstanding of the notion. Participants were asked to answer by pressing a ‘yes’ key (“I”) with their right index finger or a ‘no’ key (“R”) with their left index finger. In order to familiarise participants with the task, a short training session was presented, using neologisms created through morphological processes that were absent from the experiment (i.e. compounds such as *twittosphère* ‘Tweeter community’ or loanwords such as *jumpscare*).

In the second part of the experiment, participants had to identify novel words in the stimuli sentences that previously elicited a positive response. All these sentences were listed on the same page. Participants had to highlight neologisms by clicking on them, and they could take as long as they wanted to perform that task. Only one word per sentence could be identified.

We measured both identification rates and response times (i.e. the time between the display of the stimulus and the pressing of the button) in the first part of the experiment. When a participant gave a positive answer in the first part but was unable to correctly identify the target neologism in the second part, the neologism was considered as not identified.

4.3 Results

We first focus on the analysis of the identification of neologisms and then describe the response times, for the positive identifications. For the analysis, we excluded data from participants with identification rates for non-novel words greater than 2.5 SD above the average, and from participants who categorised as neologisms more non-novel than novel words (data from 6 participants were thus discarded). Responses shorter than 200 ms were also excluded (i.e. 316 responses, 1.6% of the data). The final identification rates per experimental condition are presented in the top panel of **Figure 2**.

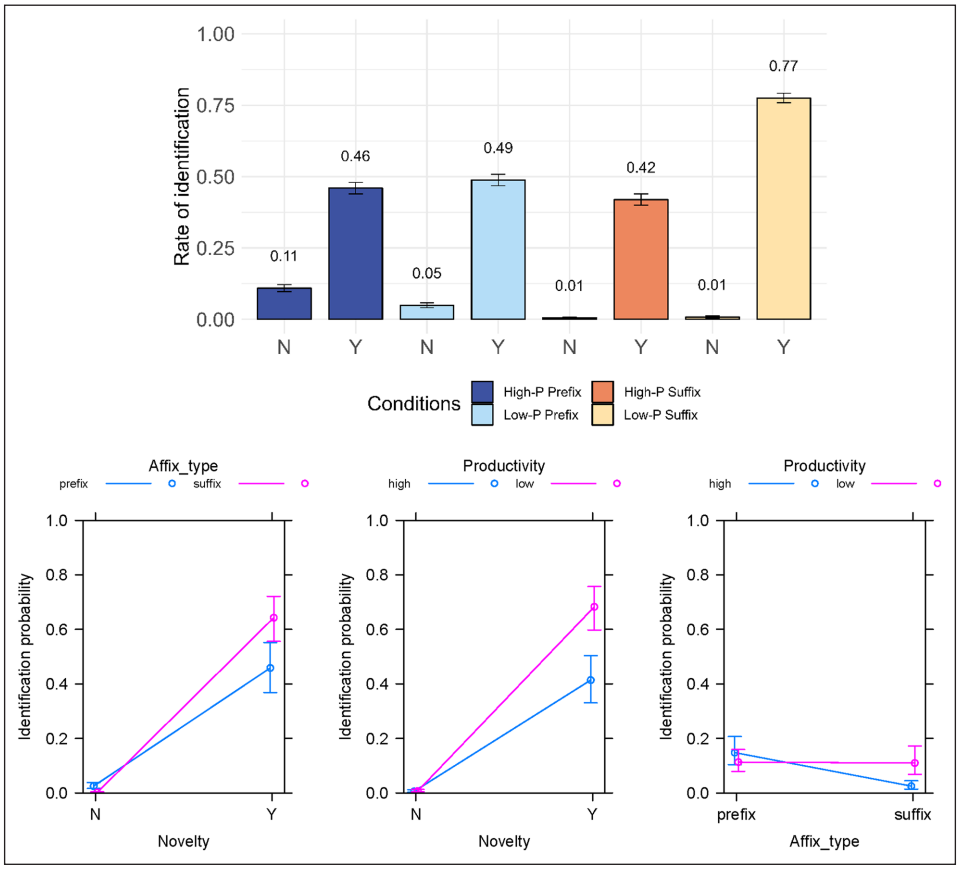

Figure 2: Identification of neologisms in Experiment 1. The top panel shows the average rate of identification observed in each experimental condition (with 99% Wald confidence intervals). The bottom panel shows the predictions of the logistic regression model.

Data were analysed using mixed-effects models with random effects for both participants and stimuli.[8] Models included the maximal structure for the random parameters, as long as it was supported by the data, following the method suggested by Bates et al. (2018). *P*-values were computed using type III Wald chi-squared tests. Numerical predictors were centred and factorial predictors were sum coded.

4.3.1 Identification

We performed a mixed-effects logistic regression to analyse the identification of neologisms, and we tested the influence of three main predictors: novelty (yes vs. no), productivity (high vs. low), affix type (prefix vs. suffix), and their interaction. We also included in the model the frequency of the morphological base and the length of the target word (in number of characters) as control variables. Significant effects were observed for three double interactions: one between novelty and affix type, one between novelty and productivity, and one between affix type and productivity (see **Table 4** and the bottom panel of **Figure 2**). The three-way interaction between the main predictors ($p = .756$), the frequency of the base ($p = .268$), and the length of the target word ($p = .810$) were not significant and were removed from the model when adding random slopes. The optimal random structure includes random intercepts for participants and stimuli, as well as two random slopes for participants (one for the interaction between novelty and affix type, and one for the interaction between novelty and productivity).

Table 4: Summary of the logistic regression model for neologism identification, with suffixed neologisms of low productivity as intercept. Predictors are sum coded.

Effect	Estimate	SE	*z*-value	*p*-value
Intercept	–2.39166	0.15017	–15.926	–
Novelty	–2.60073	0.14416	–18.040	–
Affix type	0.48493	0.13049	3.716	–
Productivity	–0.31284	0.11147	–2.806	–
Novelty × Affix type	0.86035	0.13060	6.588	<.0001
Novelty × Productivity	0.24263	0.10746	2.258	.02385
Affix type × Productivity	0.46731	0.09667	4.834	<.0001

Identification rates observed in the experiment indicate that productivity has a different effect for prefixed as opposed to suffixed words. In addition, non-novel prefixed words generate more

[8] Statistical analyses were performed using the *lme4* package (Bates et al., 2014) and the *lsmeans* package (Lenth, 2016) in R (R Core Team, 2022).

mistakes in identification than non-novel suffixed words (see the top panel of **Figure 2**). The mixed-effects model supports these observations, but also calls for a more detailed investigation. We explored the effect of modality shifts for each interaction effect present in the model. The examination of pairwise differences between modalities of novelty and affix type indicates that non-novel prefixed words are significantly more frequently classified as neologisms than non-novel suffixed words ($p < .001$), whereas suffixed neologisms are more frequently identified as novel words than prefixed neologisms ($p = .010$). Pairwise comparisons between modalities of novelty and productivity show that neologisms formed with a weakly productive affix are detected more frequently than neologisms formed with a highly productive affix ($p < .001$), whereas no such difference is observed in non-novel words formed with a weakly as opposed to a highly productive affix ($p = .981$). As for pairwise differences between modalities of affix type and productivity, they show that words formed with a weakly productive suffix are more frequently classified as neologisms than words formed with a highly productive suffix ($p < .001$). By contrast, the difference in neologism identification between words formed with a weakly productive prefix and those formed with a highly productive prefix is not significant ($p = .649$).

4.3.2 Response times

We analysed response times for neologisms that were correctly identified, using a mixed-effects linear regression model. To remove outliers, we trimmed the data by eliminating all trials with response times longer or shorter than 2.5 SD from by-participant and by-condition means. The data from 5,081 trials were analysed. The distribution of response times for each type of neologism is presented in the top panel of **Figure 3**. Response times were log-transformed to satisfy the assumptions of linear regression. We tested the influence of productivity and affix type, as well as their interaction. Three control variables were also included: the frequency of the base, the length of the target word, and the length of the sentence (in number of characters). Significant effects were observed for the interaction between affix type and productivity, and for the length of the sentence (see **Table 5** and the bottom panel of **Figure 3**). The frequency of the base ($p = .812$) and the length of the target word ($p = .053$) were not significant, and were removed from the model when adding random slopes. The optimal random structure included random intercepts for participants and stimuli, as well as a by-participant random slope for affix type.

As expected, longer sentence length elicited longer response times. Given the presence of an interaction effect in the model, we further analysed pairwise differences between modalities of affix type and productivity. A significant effect of productivity can be observed for suffixed neologisms ($p < .001$), but not for prefixed ones ($p = .940$), which is in line with the differences observed in identification rates. Participants identified neologisms formed with a weakly productive suffix more quickly than those formed with a highly productive one, while no such difference was observed in neologisms formed with a highly as opposed to a weakly productive prefix.

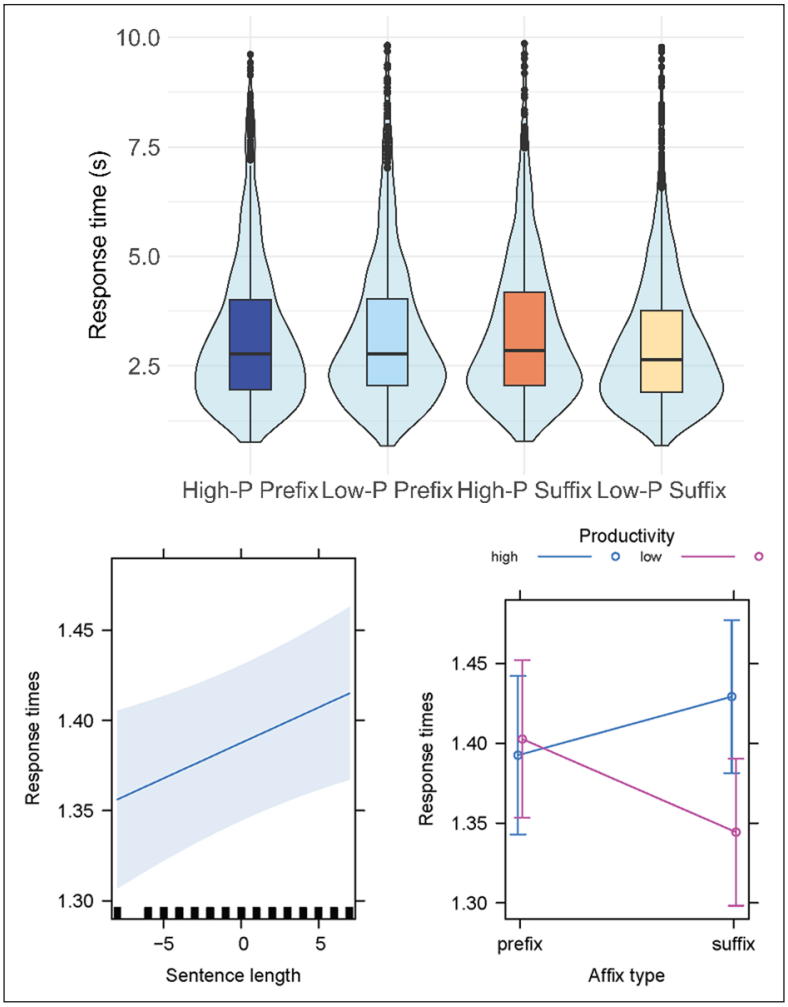

Figure 3: Response times for correctly identified neologisms in Experiment 1. The top panel shows the distribution of response times observed in each experimental condition. The bottom panel shows the predictions of the linear regression model.

Table 5: Summary of the linear regression model for response times, with suffixed neologisms of low productivity as intercept. Numerical predictors are centred and factorial predictors are sum coded.

Effect	**Estimate**	**SE**	***t*-value**	***p*-value**
Intercept	1.392189	0.021975	63.354	–
Affix type	0.005413	0.006922	0.782	–
Productivity	0.018687	0.006169	3.029	–
Sentence length	0.003923	0.001527	2.570	.0102
Affix type × Productivity	–0.023759	0.006160	–3.857	.0001

4.4 Discussion

Our initial hypothesis is only partially supported by the results of Experiment 1. A relationship can be observed between productivity and neological salience for suffixed words, but not for prefixed words. Derivatives formed through highly productive processes are less frequently identified as neologisms than those formed through weakly productive processes, but this effect is only observed in the case of suffixation. Derivatives formed with a weakly productive prefix do not show higher detection rates than those formed with a highly productive prefix. Furthermore, non-novel prefixed words are more frequently categorised as neologisms than non-novel suffixed words. NI seems less reliable for prefixed derivatives than for suffixed derivatives. Speakers frequently mistake existing prefixed words for neologisms, whereas NI about suffixed words is more stable and allows for more clear-cut distinctions with respect to lexical novelty.

Response times are congruent with identification rates, in that they indicate a significant effect of productivity for suffixed words, but not for prefixed words. Derived neologisms formed with a weakly productive suffix are more quickly identified as novel words than those formed with a highly productive suffix. In contrast, the time needed to identify prefixed neologisms does not depend on the level of productivity of the prefix. However, interpreting differences in response times remains problematic, because it is unclear whether these differences are caused by hesitations before taking a position on the neological nature of novel words, or by differences in the time needed to process and understand sentences that include novel words. These different interpretations ultimately raise questions about the cognitive mechanisms at play in the identification of neologisms, which we investigated in additional experiments.

5. Experiment 2

In Experiment 1, we estimated participants' NI based on a metalinguistic task of neologism identification. The observations collected in this experiment do not directly inform us about the processing of neologisms. Moreover, since neologisms are tested in sentences, we cannot distinguish between effects related to the processing of the stimuli sentences and those related to the processing of the neologisms themselves. To refine the analysis of neologism processing when performing the identification task, we replicated Experiment 1, while monitoring participants' eye movements as they were reading the stimuli. We concentrated on three different eye-tracking measures — first and total fixation times on target words, and regressions to target words — in order to access a fuller picture (including the time course) of neologism processing. In keeping with Godfroid (2019), *first fixation time* can be defined as the duration of the first fixation on the word of interest (i.e. the neologism), and is illustrative of early stages of lexical access (i.e. the ease with which a word meaning is accessed). Moving to higher level processes, on the early vs. late processing spectrum, are *total fixation times* on the target word and the presence (or not) of *regressions* to the target word. The former measure consists of the sum of all the fixation

durations on the target word, including first and subsequent passes, and the latter consists of the presence or not of a reanalysis of the actual word of interest after reading subsequent parts of the sentence (Godfroid, 2019). The two measures signal efforts to overcome difficulties in word-to-text integration (Siyanova-Chanturia & Elgort, 2023), in other words, semantic and/or syntactic access. In all, we analysed processes that occur on the early vs. late processing spectrum.

5.1 Participants

The participants in Experiment 2 were 49 French native speakers from the University of Fribourg, Switzerland, aged 18 to 27 years (Mean = 20.9, SD = 0.71). Students were compensated for their participation either financially or in academic credits.

5.2 Procedure

The procedure followed in Experiment 2 was the same as in Experiment 1, except that participants' eye movements were recorded during the experiment. Participants sat in front of a 22-inch computer screen where sentences were presented on a single line in Times New Roman, size 20. They were asked to use a chinrest to limit their head movements and to keep their two index fingers on the response buttons, so that they could keep their eyes constantly on the screen. Participants' eye movements were monitored at 2000 Hz using a non-invasive eye-tracking device (EyeLink 1000 Plus) mounted on a stand, 55 cm away from participants' eyes. The eye-tracking device was calibrated with a 9-point calibration. It was recalibrated after the practice trials and then every 20 trials. We examined fixation times and backtracking, in addition to the previous variables, i.e. neologism identification and participants' response times.[9]

5.3 Results

We applied the same criteria as in Experiment 1 to select the data for analysis. This led to the exclusion of 3 sets of data from participants who identified more non-novel than novel words as neologisms.

5.3.1 Identification

The same statistical method as in Experiment 1 was used to analyse neologism identification. As in Experiment 1, significant effects were observed for three double interactions: one between novelty and affix type, one between novelty and productivity, and one between affix type and productivity (see **Table 6**). The three-way interaction between the main predictors (p = .293), the frequency of the base (p = .336), and the length of the target word (p = .450) were not

[9] We did not control for the lexical class and length of the word following the target word in each stimulus sentence, which prevents us from studying spillover effects in the results.

Table 6: Summary of the logistic regression model for neologism identification, with suffixed neologisms of low productivity as intercept. Predictors are sum coded.

Effect	Estimate	SE	*z*-value	*p*-value
Intercept	–1.83306	0.19201	–9.547	–
Novelty	–1.67569	0.13362	–12.541	–
Affix type	0.46562	0.11073	4.205	–
Productivity	0.06933	0.10744	0.645	–
Novelty × Affix type	0.53399	0.09178	5.818	<.0001
Novelty × Productivity	0.23988	0.08888	2.699	.007
Affix type × Productivity	0.39417	0.08532	4.620	<.0001

significant and were removed from the model when adding random slopes. The optimal random structure included random intercepts for participants and stimuli, as well as three by-participant random slopes (one for novelty, one for affix type, and one for productivity). Additional pairwise comparisons between variable modalities in each interaction also show similar results as in Experiment 1.

5.3.2 Response times

The data from 1,260 trials were analysed for response times. We used the same statistical analysis as in Experiment 1, but found some differences between the results of the two experiments. The only significant predictor was that of sentence length (see **Table 7**). Affix type ($p = .377$), productivity ($p = .402$), their interaction ($p = .852$), the frequency of the base ($p = .813$), and the length of the target word ($p = .932$) did not have a significant effect on response times. They were removed from the model when testing random slopes; the optimal random structure only included random intercepts for participants and stimuli. Note that the median response time for neologisms formed with weakly productive suffixes (Median = 2.93) is slightly lower than the median response times observed for neologisms formed with highly productive suffixes (Median = 3.13), weakly productive prefixes (Median = 3.04), and highly productive prefixes (Median = 3.10), although the difference observed is not significant in the regression analysis.

Table 7: Summary of the linear regression model for response times, with suffixed neologisms of low productivity as intercept. The predictor is centred.

Effect	Estimate	SE	*t*-value	*p*-value
Intercept	1.418985	0.035854	39.577	–
Sentence length	0.004651	0.001807	2.574	.0101

5.3.3 Total fixation times

The eye-tracking data that proved to be the most relevant for evaluating NI were the total fixation times on target words, i.e. the cumulative times spent fixating on target words in each trial, regardless of the number or chronology of the fixations. All other measures, whether illustrative of early processing (i.e. first fixation duration) or later processing (i.e. presence of regressions) did not significantly vary across neologism types. Detailed results for all eye-tracking measures can be found in the OSF repository of the study (see the Data accessibility statement). The analysis of fixation times was performed on the same data as the identification rates. However, we additionally eliminated all trials with fixation times on target words longer or shorter than 2.5 SD from by-participant and by-condition means, as well as those in which the eye movements were detected less than 90% of the display time (417 responses, i.e. 7.6% of the data, were thus excluded).

The distribution of total fixation times observed in the experiment is presented in the top panel of **Figure 4**. We used a mixed-effects linear regression model to analyse these data, with novelty, productivity, affix type, and their interaction as the main predictors, and the frequency of the base and the length of the target word as control variables. Significant effects were observed for interactions between novelty and affix type, between novelty and productivity, and between affix type and productivity, as well as for the length of the target word (see **Table 8** and the

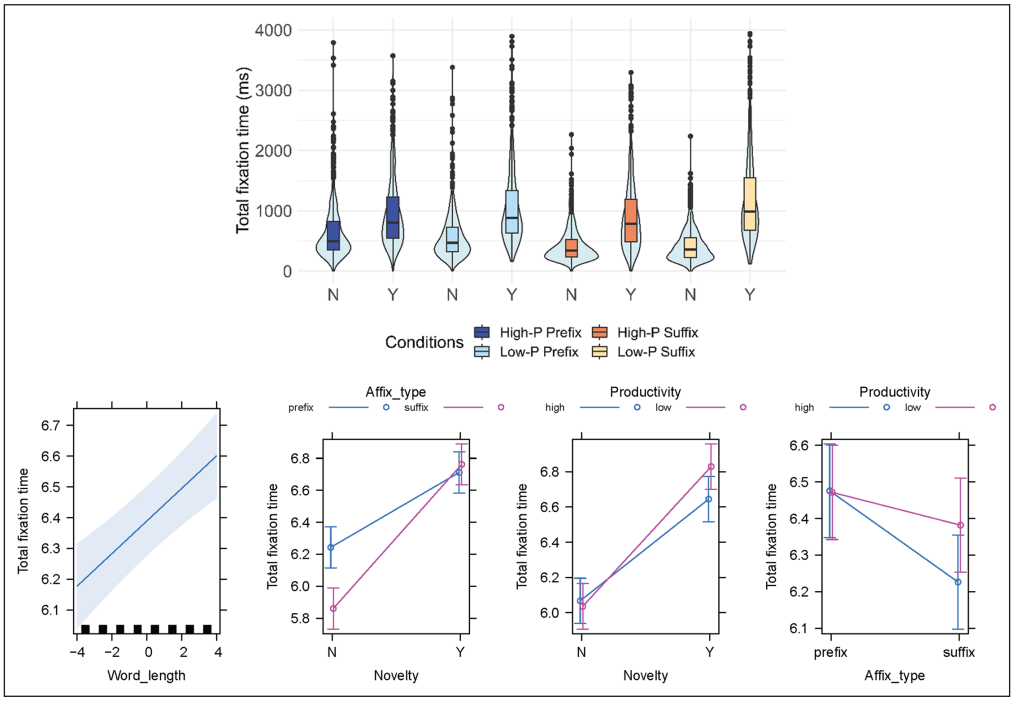

Figure 4: Total fixation times on target words in Experiment 2. The top panel shows the distribution of fixation times observed in each experimental condition. The bottom panel shows the predictions of the linear regression model.

Table 8: Summary of the linear regression model for total fixation times, with suffixed neologisms of low productivity as intercept. Numerical predictors are centred and factorial predictors are sum coded.

Effect	Estimate	SE	*t*-value	*p*-value
Intercept	6.39424	0.05704	112.091	–
Novelty	–0.34239	0.01905	–17.973	–
Affix type	0.08297	0.01874	4.427	–
Productivity	–0.03860	0.01856	–2.079	–
Word length	0.05286	0.01009	5.238	$<.0001$
Novelty × Affix type	0.10820	0.01877	5.764	$<.0001$
Novelty × Productivity	0.05410	0.01880	2.878	.004
Affix type × Productivity	0.03990	0.01866	2.138	.0325

bottom panel of **Figure 4**). The three-way interaction between the main predictors ($p = .327$) and the frequency of the base ($p = .373$) were not significant, and were removed from the model when testing random slopes. The optimal random structure only included random intercepts for participants and stimuli.

A closer examination of pairwise differences between modalities of novelty and affix type reveals that fixation times on non-novel prefixed words are significantly longer than those on non-novel suffixed words ($p < .001$), whereas no difference is observed between fixation times on prefixed vs. suffixed neologisms ($p = .783$). Pairwise comparisons between modalities of novelty and productivity show that fixation times are significantly longer for neologisms formed with a weakly productive affix than for neologisms formed with a highly productive affix ($p = .003$), whereas no difference is observed between non-novel words formed with a weakly vs. a highly productive affix ($p = .936$). Finally, pairwise comparisons between modalities of affix type and productivity indicate that speakers spend significantly more time fixating on neologisms formed with a low-productivity suffix than those formed with a high-productivity suffix ($p = .015$), whereas no such effect is observed for prefixed neologisms ($p = 1$).

5.4 Discussion

Experiment 2 confirms the results of Experiment 1 in two ways. On the one hand, the same combined effects of novelty, productivity, and affix type are observed in the identification of neologisms in both experiments. In particular, words formed with a highly productive suffix appear to be less salient as neologisms than words formed with a weakly productive suffix, whereas no significant difference is found for prefixed words. The only difference observed between the two experiments concerns response times, since no interaction effect could be

detected between affix type and productivity in Experiment 2. This difference may be due to a lack of statistical power in Experiment 2, because of a lower number of data points than in Experiment 1, or to the change in experimental setup and to the practical constraints related to the use of the eye-tracking device in Experiment 2.

On the other hand, the eye-tracking results are consistent with the identification rates. The same significant effects are observed for fixation times on target words and neologism identification. In particular, an interaction effect between affix type and productivity is observed for fixation times that parallels the one observed for neologism identification. In the case of suffixed derivatives, productivity has a significant effect on neological salience that manifests itself both in the time spent fixating on neologisms and in their explicit identification as novel words.

More information can be inferred from fixation times. First, since variations in fixation times are consistent with the differences in response times observed in Experiment 1, we can hypothesise that the latter may be explained by differences in neologisms, as opposed to other elements in the stimuli sentences. Second, assuming that fixation times reflect cognitive effort (i.e. word-to-text integration effort), it appears that some neologisms require more effort than others and that this effort is directly correlated with NI. As a consequence, NI may be characterised by speakers' cognitive effort. The correlation between NI and cognitive effort can be observed in the differences between derivatives with a weakly productive suffix and derivatives with a highly productive suffix, as well as in the differences between non-novel prefixed words and non-novel suffixed words.

The question that remains unanswered is whether this cognitive effort is related to the metalinguistic task of identifying neologisms or, more basically, to the lexical processing of the target words. One may ask whether the cognitive effort revealed by eye movements is dedicated to the categorisation of neologisms as such or, more basically, to their understanding and interpretation. To answer that question, the salience of novel words should be investigated without testing neologism identification.

6. Experiment 3

Experiments 1 and 2 showed how morphological productivity can influence NI. However, since these experiments relied on explicit judgements about words, some experimental data, such as response times and fixation times, could not be unequivocally interpreted. To overcome these issues, we conducted a third experiment, using the same materials as in the two previous experiments, but involving only a reading task, as opposed to a lexical identification task. This task enables us to ensure that the eye-tracking measures (i.e. first fixation times, total target word fixation times, and the presence of regressions) as well as the self-paced reading times are really representative of the effort to process neologisms in relation to the semantic and syntactic components of the stimuli sentences, and are not simply a consequence of having to make a forced lexical identification.

6.1 Participants

The participants in Experiment 3 were 47 French native speakers from the University of Fribourg, Switzerland, aged 18 to 26 years (Mean = 21.6, SD = 1.9). Students were compensated for their participation either financially or in academic credits.

6.2 Procedure

Experiment 3 used the same procedure as Experiment 2, except that a different task was administered to participants. Stimuli sentences were presented in a random order, and participants were asked to simply read and understand them. To ensure that they read the sentences carefully, they were informed that they might be asked a yes/no comprehension question occasionally. 47 sentences were followed by a comprehension question (i.e. around one third of the material). Participants answered using the same two buttons as in Experiment 2. We measured participants' reading times (i.e. the time between the display of the stimulus and the pressing of the button), as well as fixation times and regressions in eye movements.

6.3 Results

We applied the same criteria as in Experiments 1 and 2 to select the data for analysis. No complete set of data was excluded, since no participant responded positively to more stimuli with non-novel words than to stimuli with novel words.

6.3.1 Reading times

We analysed reading times for sentences with a neologism using a mixed-effects linear regression model. We trimmed the data by eliminating all trials with reading times shorter than 200 ms, or longer or shorter than 2.5 SD from by-participant and by-condition means. The data from 2,820 trials were analysed. The distribution of reading times for each experimental condition is presented in the top panel of **Figure 5**. Reading times were log-transformed to satisfy the assumptions of linear regression. We tested the influence of productivity and affix type, as well as their interaction. Three control variables were also included: the frequency of the base, the length of the target word, and the length of the sentence. Significant effects were observed for the interaction between affix type and productivity, and for the length of the sentence (see **Table 9** and the bottom panel of **Figure 5**). The frequency of the base (p = .340) and the length of the target word (p = .988) were not significant, and were removed from the model when testing random slopes. The optimal random structure only included random intercepts for participants and stimuli.

Longer sentences elicited longer self-paced reading times. Pairwise comparisons across modalities of affix type and productivity indicated that sentences containing a neologism with a weakly productive suffix required longer reading times than sentences containing a neologism

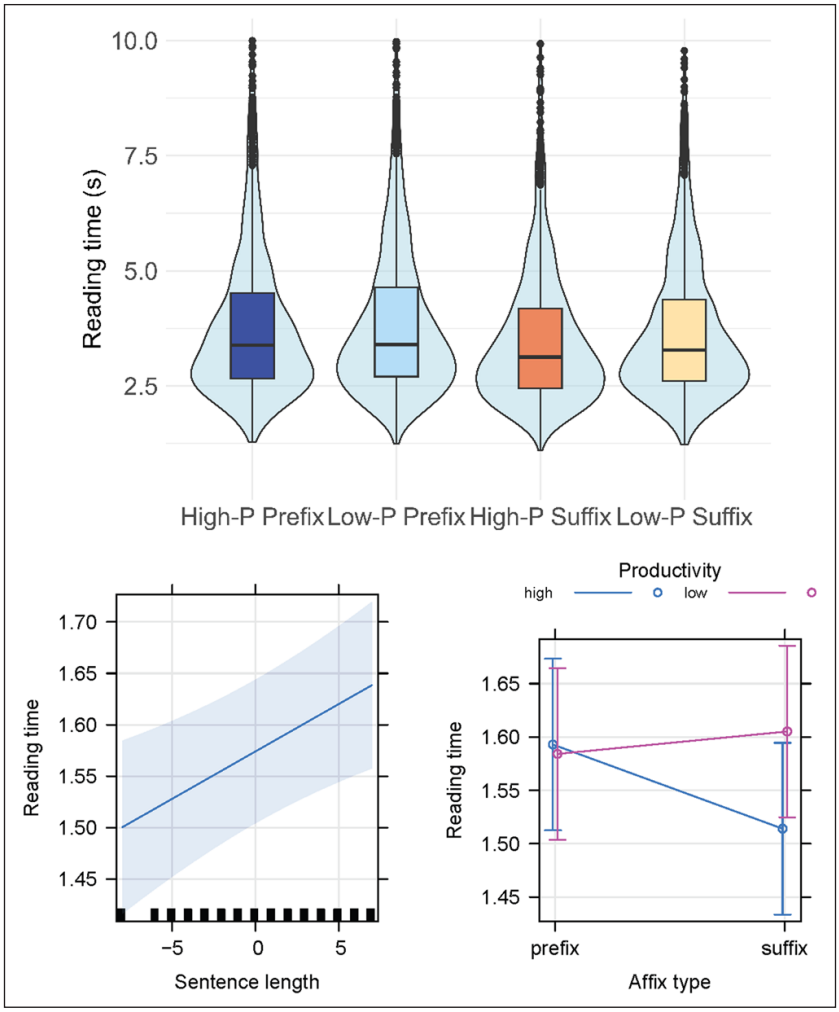

Figure 5: Reading times of sentences containing a neologism in Experiment 3. The top panel shows the distribution of reading times observed in each experimental condition. The bottom panel shows the predictions of the linear regression model.

Table 9: Summary of the linear regression model for self-paced reading times, with suffixed neologisms of low regularity as intercept. Numerical predictors are centred and factorial predictors are sum coded.

Effect	**Estimate**	**SE**	***t*-value**	***p*-value**
Intercept	1.592956	0.041016	38.838	–
Affix type	–0.078872	0.033672	–2.342	–
Productivity	–0.008796	0.033627	–0.262	–
Sentence length	0.009198	0.002994	3.072	.0021
Affix type × Productivity	0.099894	0.047560	2.100	.0357

with a highly productive suffix ($p = .043$), but no significant effect could be observed between sentences that contain neologisms formed with a highly vs. a weakly productive prefix ($p = .994$).

6.3.2 Total fixation times

As in Experiment 2, the most relevant eye-tracking data for the study of NI were total fixation times on target words. Detailed results for the other eye-tracking measures can be consulted on the OSF repository of the study (see Data accessibility statement). The analysis of total fixation times was performed on both non-novel and novel words. We eliminated all trials with fixation times on target words longer or shorter than 2.5 SD from by-participant and by-condition means, as well as those in which the eye movements were detected less than 90% of the display time (204 trials, i.e. 3.6% of the original data, were thus excluded). The distribution of fixation times for each experimental condition is presented in the top panel of **Figure 6**. We used the same statistical method as in Experiment 2. Significant effects were observed for interactions between affix type and novelty, and between productivity and novelty, as well as for the length of the

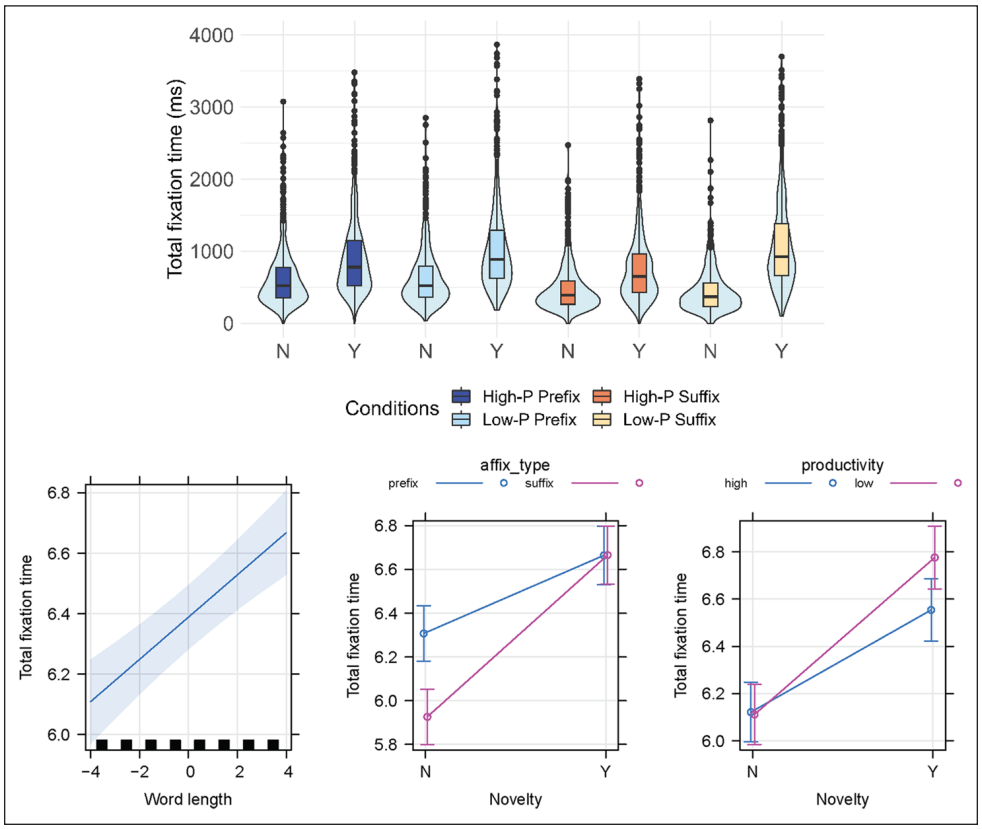

Figure 6: Total fixation times on target words in Experiment 3. The top panel shows the distribution of fixation times observed in each experimental condition. The bottom panel shows the predictions of the linear regression model.

target word (see **Table 10** and the bottom panel of **Figure 6**). The three-way interaction between the main predictors ($p = .051$), the interaction between productivity and affix type ($p = .303$), and the frequency of the base ($p = .453$) were not significant and were removed when testing random slopes. The optimal random structure included random intercepts for participants and stimuli, as well as a by-participant random slope for novelty.

Table 10: Summary of the linear mixed-effects model for total fixation time with suffixed neologisms of low regularity as intercept. Numerical predictors are centred and factorial predictors are sum coded.

Effect	Estimate	SE	*z*-value	*p*-value
Intercept	6.39069	0.05392	118.520	–
Novelty	–0.27414	0.02344	–11.697	–
Affix type	0.09511	0.02148	4.427	–
Productivity	–0.05302	0.02128	–2.492	–
Word length	0.06997	0.01150	6.083	$<.0001$
Novelty × Affix type	0.09555	0.02151	4.441	$<.0001$
Novelty × Productivity	0.05802	0.02154	2.694	.0071

The examination of pairwise differences between modalities of affix type and novelty indicates that fixation times are significantly longer for non-novel prefixed words than for non-novel suffixed words ($p < .001$), whereas no significant difference is observed between prefixed and suffixed neologisms ($p = 1$). Pairwise comparisons between modalities of productivity and novelty show that fixation times are significantly longer for neologisms formed with a weakly productive affix than for neologisms formed with a highly productive affix ($p = .001$), whereas no significant effect is observed between non-novel words formed with highly vs. weakly productive affixes ($p = .998$).

6.4 Discussion

The results of Experiment 3 show that affix productivity not only influences metalinguistic judgements about lexical novelty, but more generally affects the processing of neologisms, and thus confirm the hypothesis that emerged from Experiment 2. Furthermore, the comparison between Experiment 3 and Experiments 1 and 2 allows us to refine the interpretation of response times and fixation times in the neologism identification task. Assuming that reading times depend on the cognitive effort required to decode linguistic expressions, the differences in reading times observed in Experiment 3 indicate that some neologisms are more difficult to process than others. Such is the case for neologisms formed with a weakly productive suffix, compared to neologisms

formed with a highly productive suffix. Suffixed neologisms differ in that respect from prefixed neologisms, and a similar interaction effect between productivity and affix type was already observed in the neologism identification task. It appears that the most salient neologisms are also the ones that require the most important cognitive effort to be processed, which confirms the findings in Experiment 2 about the relationship between neological salience and the cognitive cost of processing novel words. As a corollary, the differences observed in Experiment 1 not only are related to neologism identification, but also attest to fundamental differences in the processing of novel words.

The differences in response times observed in Experiment 1 can be reinterpreted in light of reading times. Significant differences in response times and reading times are found between the same types of neologisms, but with opposite effects. The neologisms that elicit the longest reading times in Experiment 3 are the ones that elicit the shortest response times in Experiment 1. In particular, neologisms with a low-productivity suffix take more time to be read, but less time to be identified as novel words, than neologisms with a high-productivity suffix. The response times in Experiment 1 therefore depend on reflection on, and possible hesitation about, the neological nature of the target words.

Fixation times in Experiments 2 and 3 are comparable, in that they show the same interaction effects between novelty and affix type, on one hand, and novelty and productivity, on the other hand. Congruent results indicate that the processing of existing prefixed words requires more effort than that of existing suffixed words, and that the processing of neologisms with a weakly productive affix requires more effort than that of neologisms with a highly productive affix. As far as these effects are concerned, the fixation times in Experiment 2 were therefore caused by the interpretation of neologisms, rather than their identification as novel words.

However, one interaction effect between affix type and productivity was also found in Experiment 2, but not in Experiment 3. Affix productivity influences fixation times for suffixed but not prefixed words in Experiment 2, whereas no such difference was observed in Experiment 3. This interaction seems to be specific to the neologism identification task. High morphological productivity does not facilitate categorisation as a neologism in the case of prefixed derivatives. It appears that prefixed words are particularly subject to questions and doubts when identifying neologisms. Considering both similar and dissimilar results in Experiments 2 and 3, we can conclude that the fixation times in Experiment 2 are due partly to lexical processing, and partly to effort involved in neologism categorisation.

7. General discussion

Taken together, the results of the three experiments partially confirm the hypothesis of a negative correlation between morphological productivity and neological salience. The expected effect is observed for suffixed neologisms, but not for prefixed ones, due to an interaction between

affix type and productivity. In this section, we further discuss these results and their theoretical implications.

The relationship between productivity and NI in the case of suffixed words stems from the close link between productivity, frequency of use, and familiarity. Highly productive suffixes (e.g. *-age*, *-eur*) are frequently used in the formation of novel words, which makes both the form of the derivatives and the semantic pattern of derivation more familiar to speakers than in the case of weakly productive suffixes (e.g. *-esse*, *-eau*). This variable familiarity influences the neological salience of derived words: the more familiar a suffixation process is, the less salient the neologisms are that it produces. Neologisms coined with a productive suffix (e.g. *modulage* 'modulation') can be inserted into morphological series that are both rich and expanding (e.g. *atterrissage* 'landing', *formatage* 'formatting', *hameçonnage* 'phishing'), which may facilitate their morphosemantic processing. Assuming that neological salience is related to the cognitive effort required to process novel forms, similarities with abundant existing derivatives should make neologisms weakly salient. One likely effect of familiarity is that it facilitates the entrenchment in the mental lexicon of newly derived words. Neologisms ending with productive suffixes may easily enter the mental lexicon and therefore be unnoticed by speakers. Thus, our results indicate that morphological productivity, usually defined as the capacity to produce new derivatives, can have an influence on novel word processing. Differences in productivity are correlated with variations in NI, and, accordingly, productivity can be characterised by both linguistic properties and psychological effects.

The effect of suffix productivity on neological salience is consistent with the idea that productivity affects lexical processing in general. It can be seen as a confirmation of previous studies that point to differences in the processing and representation of suffixed words, depending on morphological productivity (Bertram et al., 2000; Ford et al., 2010; Hagiwara et al., 1999; Lázaro et al., 2015; a.o.). In particular, the low salience of neologisms with highly productive suffixes could be explained by the fact that words with highly productive suffixes are frequently processed through decomposition. Prone to decomposition, novel words with highly productive suffixes would be weakly salient as neologisms. On the contrary, the high salience of neologisms with weakly productive suffixes could be explained by the fact that words with weakly productive suffixes are processed as whole words rather than by decomposition. Morphosemantic patterns would be less identifiable and accessible in the case of weakly productive suffixes, causing neologisms to be less easy to decompose, more costly to process, and therefore more salient as novel words.

It remains the case that the influence of morphological productivity on NI and lexical processing varies according to affix type. A causal relationship between productivity, familiarity and neological salience can be assumed for suffixed words, but not for prefixed words, which

requires further explanation. The differences observed in our three experiments between prefixed and suffixed words may be related to grammatical differences between the two types of affixes. In general, prefixes can be distinguished from suffixes by their greater autonomy and lower level of lexical integration. Prefixes are less clearly distinguished from free morphemes than suffixes, and closer to words that can be used as modifiers. In particular, the linguistic boundary between prefixes, prepositions and adverbs can be fuzzy, whereas suffixes are clearly distinct from lexical and grammatical words (Amiot, 2004, 2015; Amiot & De Mulder, 2002; Benacchio et al., 2017; Biskup, 2009). The ability to transform morphological bases is also known to be greater for suffixes than for prefixes (Štekauer et al., 2012; Van Goethem, 2020). Prefixes do not necessarily preserve the lexical class of the base, but they allow for fewer combinations of different input and output lexical classes and are less frequently used in class-changing derivation than suffixes (Corbin, 2001). This difference is correlated with semantic properties. Prefixes operate semantically as modifiers, adding, for example, information about size (*mini-*), intensity (*hyper-*), polarity (*non-*), or aspectuality (*re-*), while not affecting the referential category of the base. By contrast, suffixes often signal the semantic type of the derivative (e.g. by indicating whether the derivative refers to an event or a participant in verb-to-noun derivation). Accordingly, suffixes play a crucial role in lexical interpretation, and they seem more deeply integrated than prefixes into the semantic structure of derived words. Based on these differences, prefixes and suffixes can be assumed to occupy different positions on a scale of grammaticality ranging from the most autonomous linguistic forms to the most dependent ones.[10] Prefixes in French tend to be less grammatical than suffixes, due to their greater phonological, morphological, syntactic, and semantic autonomy. This difference in grammaticality is reflected in the fact that prefixes are more frequently lexicalised than suffixes (e.g. *ex* 'ex', *anti* 'anti', *pro* 'person in favour of something', and *ultra* 'extremist' can be used as nouns). One can note, as an additional clue, that the most grammatical affixes in French, i.e. inflectional affixes, are suffixes and not prefixes.

The grammatical differences between prefixes and suffixes may explain why the effect of morphological productivity on neological salience is not observed for prefixed words. Since prefixes are less dependent and less integrated in derivatives than suffixes, the contrast between existing and novel affixed words may be less pronounced with prefixed derivatives than with suffixed derivatives, and the neological nature of novel prefixed words may be less salient than that of novel suffixed words. Such a difference is supported experimentally by less accuracy in NI for prefixed neologisms than for suffixed neologisms and by the fact that

[10] Scales of grammaticality have been proposed in studies of grammaticalisation, degrammaticalisation and lexicalisation to account for the gradual evolution of linguistic forms towards greater grammaticality or greater lexicality (Hopper & Traugott, 2003; Kouteva et al., 2019; Kuryłowicz, 1965; Lehmann, 2015; Norde, 2009; a.o.).

non-novel prefixed words are frequently mistaken for neologisms. The similarity in salience between prefixed neologisms, whether they contain a highly or weakly productive prefix, and suffixed neologisms with a highly (vs. weakly) productive suffix could also be an indication that prefixed words are always processed through decomposition, independently of variation in productivity. Decomposition would neutralise the effect of morphological productivity on neological salience for prefixed words, thus explaining our experimental results. As a corollary, productivity in general would only influence the processing of suffixed words, as opposed to prefixed words — to our knowledge, studies highlighting the influence of productivity on morphological processing have mainly focused on suffixed words and rarely investigated prefixed words.

Another conclusion may be that affix type influences the processing of derived words, which is consistent with previous findings on the difference between prefixed and suffixed words (Feldman & Soltano, 1999; Marslen-Wilson et al., 1994; Pléh & Juhász, 1996; Reid & Marslen-Wilson, 2003; Zweig & Pylkkänen, 2009). The contrast we observed between prefixed and suffixed neologisms can be seen as confirmation that the two types of derived words are represented and accessed differently. As noted for morphological productivity, the linguistic properties of affixes seem to have a psycholinguistic counterpart that affects NI and the processing of affixed words. Prefixes and suffixes are distinct forms of derivation and differ in their grammatical nature. Their distinctive properties are correlated with psychological effects that may determine the organisation of the mental lexicon. Our findings on neological salience could thus motivate future research on the relationship between productivity and affix type, and its influence on the lexical representation of morphologically complex words.

8. Conclusion

In this study, we have investigated the relationship between morphological productivity and NI through experiments based on lexical identification and reading tasks. The results have revealed the existence of a negative correlation between productivity and neological salience, but only in the case of suffixed words as opposed to prefixed words. The more productive a suffix is, the less NI it generates, but no such effect is observed for prefixed neologisms. These findings suggest that both morphological productivity and affix types influence the mental representation and processing of derived words, since NI is conditioned by the organisation of existing words in the mental lexicon. Conversely, the salience of morphological neologisms highlights the importance of the grammatical differences between derivational prefixes and suffixes.

Productivity, as the variable capacity of a morphological process to produce novel words, is one of the linguistic factors that influences NI. It can be considered as a particular aspect of a more general phenomenon, which is lexical regularity, defined as the production of predictable expressions based on morphological or semantic patterns. Various degrees of regularity can

be distinguished, not only through the production of neologisms, but more generally through the effective application of a lexical pattern to possible inputs. Accordingly, a full account of the neological salience of novel expressions should be based not only on productivity but more broadly on the effects of lexical regularity. The appropriate measure for regularity and its computability still require further research and discussion. Generally speaking, the study of neological intuition addresses original research questions about lexical innovation, while also providing indirect insights into both linguistic issues (e.g. morphological structure, semantic transparency) and psycholinguistic issues (e.g. organisation of the mental lexicon, processing of lexical form and meaning). To widely explore these issues, the investigation of the linguistic factors of NI should be extended to the most diverse types of neologisms, including loanwords, syntactic neologisms, and multiword expressions.

Data accessibility statement

The complete data sets as well as the scripts used for corpus extraction and statistical analysis are available at the following URL: https://osf.io/e542u/.

Ethics and consent

All experiments have been approved by the Ethics Committee of the University of Fribourg, Switzerland (Request #2021-685), and all participants have granted written informed consent before the experiment.

Acknowledgements

We are grateful to the three anonymous reviewers for their valuable comments and suggestions on an earlier version of this paper. We would also like to thank Agathe Herold and Justine Salvadori for their help in testing and improving the experimental design used in the study.

Competing interests

The authors have no competing interests to declare.

Author contributions

AL, RH, and PG conceived the project and designed the experiments; AL extracted the necessary information to compute the productivity measures; AL collected the experimental data with the help of PG; AL analysed the experimental data with the help of RH; AL, RH, and PG wrote and edited the manuscript; RH supervised the project.

Funding information

This research was supported by the Department of French at the University of Fribourg.

ORCiD IDs

Alizée Lombard: https://orcid.org/0000-0002-6603-1497

Richard Huyghe: https://orcid.org/0000-0002-9494-0102

Pascal Gygax: https://orcid.org/0000-0003-4151-8255

References

Amiot, D. (2004). Préfixes ou prépositions? Le cas de *sur*(-), *sans*(-), *contre*(-) et les autres. *Lexique*, *16*, 67–83. DOI: https://doi.org/10.3917/rai.016.0083

Amiot, D. (2015). The grammaticalization of prepositions in French word-formation. In P. Müller, I. Ohnheiser, S. Olsen, & F. Rainer (Eds.), *Word-Formation: An International Handbook of*

the Languages of Europe (pp. 1811–1824). De Gruyter Mouton. DOI: https://doi.org/10.1515/9783110375732-016

Amiot, D., & De Mulder, W. (2002). De l'adverbe au préfixe en passant par la préposition: un phénomène de grammaticalisation? *Lingvisticæ Investigationes*, *25*(2), 247–273. DOI: https://doi.org/10.1075/li.25.2.05ami

Arndt-Lappe, S., Braun, A., & Moulin, C. (2018). *Expanding the lexicon: Linguistic innovation, morphological productivity, and ludicity*. De Gruyter Mouton. DOI: https://doi.org/10.1515/9783110501933

Aronoff, M. (1976). *Word formation in generative grammar*. MIT Press.

Baayen, R. H. (1993). On frequency, transparency and productivity. In G. Booij & J. van Marle (Eds.), *Yearbook of morphology 1992* (pp. 181–208). Springer. DOI: https://doi.org/10.1007/978-94-017-3710-4_7

Baayen, R. H. (1994). Derivational productivity and text typology. *Journal of Quantitative Linguistics*, *1*(1), 16–34. DOI: https://doi.org/10.1080/09296179408589996

Baayen, R. H. (2009). Corpus linguistics in morphology: Morphological productivity. In A. Lüdeling & M. Kytö (Eds.), *Corpus linguistics: An international handbook* (pp. 899–919). De Gruyter Mouton. DOI: https://doi.org/10.1515/9783110213881.2.899

Bakker, I., Takashima, A., van Hell, J. G., Janzen, G., & McQueen, J. M. (2014). Competition from unseen or unheard novel words: Lexical consolidation across modalities. *Journal of Memory and Language*, *73*, 116–130. DOI: https://doi.org/10.1016/j.jml.2014.03.002

Balota, D. A., Cortese, M. J., Sergent-Marshall, S. D., Spieler, D. H., & Yap, M. J. (2004). Visual word recognition of single-syllable words. *Journal of Experimental Psychology*, *133*(2), 283–316. DOI: https://doi.org/10.1037/0096-3445.133.2.283

Bates, D., Kliegl, R., Vasishth, S., & Baayen, R. H. (2018). Parsimonious mixed models. *arXiv*, 1506. DOI: https://doi.org/arXiv:1506.04967v2

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2014). *lme4: Linear mixed-effects models using Eigen and S4*. R package version 1.1-6. http://CRAN.R-project.org/package=lme4

Bauer, L. (1983). *English word-formation*. Cambridge University Press. DOI: https://doi.org/10.1017/CBO9781139165846

Bauer, L. (2001). *Morphological productivity*. Cambridge University Press. DOI: https://doi.org/10.1017/CBO9780511486210

Ben Hariz Ouenniche, S. (2009). Diminuer les fluctuations du sentiment néologique. *Neologica*, *3*, 37–51. DOI: https://doi.org/10.15122/isbn.978-2-8124-4229-2.p.0041

Beauvillain, C. (1994). Morphological structure in visual word recognition: Evidence from prefixed and suffixed words. *Language and Cognitive Processes*, *9*(3), 317–339. DOI: https://doi.org/10.1080/01690969408402122

Benacchio, R., Muro, A., & Slavkova, S. (2017). *The role of prefixes in the formation of aspectuality*. Firenze University Press. DOI: https://doi.org/10.36253/978-88-6453-698-9

Bertram, R., Laine, M., & Karvinen, K. (1999). The interplay of word formation type, affixal homonymy, and productivity in lexical processing: Evidence from a morphologically rich language. *Journal of Psycholinguistic Research*, *28*, 213–226. DOI: https://doi.org/10.1023/A:1023200313787

Bertram, R., Schreuder, R., & Baayen, R. H. (2000). The balance of storage and computation in morphological processing: The role of word formation type, affixal homonymy, and productivity. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *26*(2), 489–511. DOI: https://doi.org/10.1037/0278-7393.26.2.489

Biskup, P. (2009). Prefixes as prepositions and multiple cases. In G. Zybatow, U. Junghanns, D. Lenertová, & P. Biskup (Eds.), *Studies in formal Slavic phonology, morphology, syntax, semantics and information structure. Proceedings of FDSL 7, Leipzig 2007* (pp. 3–17). Peter Lang. URL: https://home.uni-leipzig.de/biskup/Handout%20FDSL7%20Prefixes%20as%20Prepositions..pdf

Blank, A. (2001). Pathways of lexicalization. In M. Haspelmath, E. König, W. Oesterreicher, & W. Raible (Eds.), *Language typology and language universals* (pp. 1596–1608). De Gruyter Mouton. DOI: https://doi.org/10.1515/9783110194265-049

Cabré, M. T. (2006). La clasificación de neologismos: Una tarea compleja. *Alfa: Revista de Linguistica*, *50*, 229–250. URL: https://periodicos.fclar.unesp.br/alfa/article/view/1421

Cabré, M. T., & Estopà, R. (2009). *Les paraules noves: Criteris per detectar i mesurar els neologismes*. Eumo, Universitat Pompeu Fabra.

Cartier, E. (2018). *Dynamique lexicale des langues: Éléments théoriques, méthodes automatiques, expérimentations en français contemporain*. Mémoire d'Habilitation à diriger des Recherches, Université Paris 13-Villetaneuse.

Cartier, E., Sablayrolles, J.-F., Boutmgharine, N., Humbley, J., Bertocci, M., Jacquet-Pfau, C., Kübler, N., & Tallarico, G. (2018). Détection automatique, description linguistique et suivi des néologismes en corpus: Point d'étape sur les tendances du français contemporain. *SHS Web Conference*, *46*. DOI: https://doi.org/10.1051/shsconf/20184608002

Connell, L., & Lynott, D. (2012). Strength of perceptual experience predicts word processing performance better than concreteness or imageability. *Cognition*, *125*(3), 452–465. DOI: https://doi.org/10.1016/j.cognition.2012.07.010

Corbin, D. (1987). *Morphologie dérivationnelle et structuration du lexique*. Niemeyer. DOI: https://doi.org/10.1515/9783111358383

Corbin, D. (2001). Préfixes et suffxes: Du sens aux catégories. *French Language Studies*, *11*, 41–69. DOI: https://doi.org/10.1017/S0959269501000138

Cortese, M. J., & Schock, J. (2013). Imageability and age of acquisition effects in disyllabic word recognition. *Quarterly Journal of Experimental Psychology*, *66*(5), 946– 972. DOI: https://doi.org/10.1080/17470218.2012.722660

Dal, G., Fradin, B., Plancq, C., Grabar, N., Lignon, S., Namer, F., Yvon, F., & Zweigenbaum, P. (2008). Quelques préalables au calcul de la productivité des règles constructionnelles et premiers résultats. *1er Congrès Mondial de Linguistique Française, 142*. DOI: https://doi.org/10.1051/cmlf08184

Dal, G., & Namer, F. (2015). La fréquence en morphologie: Pour quels usages? *Langages*, *197*(1), 47–68. DOI: https://doi.org/10.3917/lang.197.0047

Devlin, J., Chang, M.-W., Lee, K., & Toutanova, K. (2018). BERT: Pre-training of deep bidirectional transformers for language understanding. *arXiv*. DOI: https://doi.org/10.48550/arXiv.1810.04805

Favreau, H. (2020). Commentaires épilinguistiques et sentiment néologique: Évaluation comparative de quelques néologismes par deux groupes d'étudiants. In J. Carlos de Hoyos, C. Poix, A. Renwick, & C. Veleanu (Eds.), *Desafíos de la neología en las lenguas románicas en el siglo XXI/Défis de la néologie en langues romanes au XXIe siècle* (pp. 79–90). Ediciones de la Universidad de Murcia.

Feldman, L. B., & Soltano, E. G. (1999). Morphological priming: The role of prime duration, semantic transparency, and affix position. *Brain and Language*, *68*(1–2), 33–39. DOI: https://doi.org/10.1006/brln.1999.2077

Fernández-Domínguez, J. (2013). Morphological productivity measurement: Exploring qualitative versus quantitative approaches. *English Studies*, *94*(4), 422–447. DOI: https://doi.org/10.1080/0013838X.2013.780823

Ford, M. A., Davis, M. H., & Marslen-Wilson, W. D. (2010). Derivational morphology and base morpheme frequency. *Journal of Memory and Language*, *63*(1), 117–130. DOI: https://doi.org/10.1016/j.jml.2009.01.003

Foubert, O. (2021). Institutionalisation, conventionalisation and the social nature of neologisms. *Neologica*, *15*, 117–132. DOI: https://doi.org/10.48611/isbn.978-2-406-11896-1.p.0117

Gaeta, L., & Ricca, D. (2003). Italian prefixes and productivity: A quantitative approach. *Acta Linguistica Hungarica*, *50*(1–2), 93–112. URL: http://www.jstor.org/stable/26189815. DOI: https://doi.org/10.1556/ALing.50.2003.1-2.6

Gaeta, L., & Ricca, D. (2006). Productivity in Italian word formation: A variable-corpus approach. *Linguistics*, *44*(1), 57–89. DOI: https://doi.org/10.1515/LING.2006.003

Gardin, B., Lefèvre, G., Marcellesi, C., & Mortureux, M.-F. (1974). À propos du « sentiment néologique ». *Langages*, *36*, 45–52. DOI: https://doi.org/10.3406/lgge.1974.2273

Gérard, C, Bruneau, L., Falk, I., Bernhard, D., & Rosio, A.-L. (2017). Le Logoscope: Observatoire des innovations lexicales en français contemporain. In J. García Palacios, G. de Sterck, D. Linder, J. Torre del Rey, M. Sánchez Ibanez, & N. Maroto García (Eds.), *La neología en las lenguas románicas: Recursos, estrategias y nuevas orientaciones*. Peter Lang. URL: https://hal.archives-ouvertes.fr/hal-01388255

Godfroid, A. (2019). *Eye tracking in second language acquisition and bilingualism: A research synthesis and methodological guide*. Routledge. DOI: https://doi.org/10.4324/9781315775616

Haas, P., Barque, L., Huyghe, R., & Tribout, D. (2023). Pour une classification sémantique des noms en français appuyée sur des tests linguistiques. *Journal of French Language Studies*, *33*(1), 52–81. DOI: https://doi.org/10.1017/S0959269522000187

Hagiwara, H., Sugioka, Y., Ito, T., Kawamura, M., & Shiota, J. (1999). Neurolinguistic evidence for rule-based nominal suffixation. *Language*, *75*(4), 739–763. DOI: https://doi.org/10.2307/417732

Hohenhaus, P. (2005). Lexicalization and institutionalization. In P. Štekauer & R. Lieber (Eds.), *Handbook of word-formation* (pp. 353–373). Springer. DOI: https://doi.org/10.1007/1-4020-3596-9_15

Hopper, P. J., & Traugott, E. C. (2003). *Grammaticalization*. Cambridge University Press. DOI: https://doi.org/10.1017/CBO9781139165525

Itkonen, E. (1981). The concept of linguistic intuition. In F. Coulmas (Ed.), *A festschrift for native speaker* (pp. 127–140). DOI: https://doi.org/10.1515/9783110822878-009

Itkonen, E. (2005). Concerning the synthesis between intuition-based study of norms and observation-based study of corpora. *Sky Journal of Linguistics*, *18*, 357–377. URL: https://api.semanticscholar.org/CorpusID:53991180

Kaczer, L., Bavassi, L., Petroni, A., Fernández, R. S., Laurino, J., Degiorgi, S., Hochman, E., Forcato, C., & Pedreira, M. E. (2018). Contrasting dynamics of memory consolidation for novel word forms and meanings revealed by behavioral and neurophysiological markers. *Neuropsychologia*, *117*, 472–482. DOI: https://doi.org/10.1016/j.neuropsychologia.2018.07.001

Kaczer, L., Timmer, K., Bavassi, L., & Schiller, N. O. (2015). Distinct morphological processing of recently learned compound words: An ERP study. *Brain Research*, *1629*, 309–317. DOI: https://doi.org/10.1016/j.brainres.2015.10.029

Kerremans, D., Prokic, J., Würschinger, Q., & Schmid, H.-J. (2018). Using data-mining to identify and study patterns in lexical innovation on the web: The neocrawler. *Pragmatics & Cognition*, *25*, 174–200. DOI: https://doi.org/10.1075/pc.00006.ker

Kouteva, T., Heine, B., Hong, B., Long, H., Narrog, H., & Rhee, S. (2019). *World lexicon of grammaticalization*. Cambridge University Press. DOI: https://doi.org/10.1017/9781316479704

Kuryłowicz, J. (1965). The evolution of grammatical categories. *Diogenes*, *13*(51), 55–71. DOI: https://doi.org/10.1177/039219216501305105

Lázaro, M. (2012). The effects of base frequency and affix productivity in Spanish. *Spanish Journal of Psychology*, *15*, 505–512. DOI: https://doi.org/10.5209/rev_SJOP.2012.v15.n2.38861

Lázaro, M., Illera, V., García, S., & Ruíz Sánchez de León, J. M. (2022). Morphological processing of complex and simple pseudo-words in adults and older adults. *Language and Cognition*, *14*(3), 385–400. DOI: https://doi.org/10.1017/langcog.2022.6

Lázaro, M., Sainz, J., & Illera, V. (2015). The role of derivative suffix productivity in the visual word recognition of complex words. *Psicológica*, *36*, 165–184.

Lehmann, C. (2015). *Thoughts on grammaticalization*. Language Science Press. DOI: https://doi.org/10.26530/OAPEN_603353

Leminen, A., Leminen, M. M., & Krause, C. M. (2010). Time course of the neural processing of spoken derived words: An event-related potential study. *Neuroreport*, *21*(14), 948–952. DOI: https://doi.org/10.1097/WNR.0b013e32833e4b90

Lenth, R. V. (2016). Least-squares means: The R package lsmeans. *Journal of Statistical Software*, *69*(1), 1–33. DOI: https://doi.org/10.18637/jss.v069.i01

Lindsay, M., & Aronoff, M. (2013). Natural selection in self-organizing morphological systems. In F. Montermini, G. Boyé, & J. Tseng (Eds.), *Morphology in Toulouse: Selected proceedings of Décembrettes 7* (pp. 537–556). Lincom Europa.

Lipka, L. (1992). Lexicalization and institutionalization in English and German. *Linguistica Pragensia/Akademie Ved CR, Ústav pro Jazyk Ceskỳ*, *92*(1), 1–13. DOI: https://doi.org/10.5282/ubm/epub.5105

Lombard, A., Huyghe, R., Barque, L., & Gras, D. (2023). Regular polysemy and novel word-sense identification. *The Mental Lexicon, 18*(1), 94-119. DOI: https://doi.org/10.1075/ml.21002.lom

Lombard, A., Huyghe, R., & Gygax, P. (2021). Neological intuition in French: A study of formal novelty and lexical regularity as predictors. *Lingua, 254*. DOI: https://doi.org/10.1016/j.lingua.2021.103055

Maechler, M. (2018). Cluster: Cluster analysis basics and extensions. *R package version 2.0. 7-1*. URL: https://CRAN.R-project.org/package=cluster

Marslen-Wilson, W. D., Komisarjevsky Tyler, L., Waksler, R., & Oldername, L. (1994). Morphology and meaning in the English mental lexicon. *Psychological Review, 101*(1), 1–33. DOI: https://doi.org/10.1037/0033-295X.101.1.3

Norde, M. (2009). *Degrammaticalization*. Oxford University Press. DOI: https://doi.org/10.1093/acprof:oso/9780199207923.001.0001

Paivio, A., Yuille, J. C., & Madigan, S. A. (1968). Concreteness, imagery, and meaningfulness values for 925 nouns. *Journal of Experimental Psychology, 76*(1, Pt.2), 1–25. DOI: https://doi.org/10.1037/h0025327

Plag, I. (1999). *Morphological productivity: Structural constraints in English derivation*. Mouton de Gruyter.

Plag, I. (2006). Productivity. In B. Aarts & A. McMahon (Eds.), *Handbook of English linguistics* (pp. 537–556). Blackwell. DOI: https://doi.org/10.1002/9780470753002.ch23

Plag, I. (2018). *Word-formation in English*. Cambridge University Press. DOI: https://doi.org/10.1017/9781316771402

Pléh, C., & Juhász, L. (1996). Processing of multimorphemic words in Hungarian. *Acta Linguistica Hungarica, 43*(1–2), 211–230. https://www.jstor.org/stable/44306758

Podhorná-Polická, A., & Fiévet, A.-C. (2018a). La circulation du néologisme SWAG: Résultats d'une enquête par questionnaires auprès de jeunes de la région parisienne et de Nice. In C. Jacquet-Pfau, A. Napieralski, & J.-F. Sablayrolles (Eds.), *Emprunts néologiques et équivalents autochtones: Études interlangues* (pp. 147–158). Wydawnictwo Uniwersytetu Łódzkiego. DOI: https://doi.org/10.18778/8088-785-5.10

Podhorná-Polická, A., & Fiévet, A.-C. (2018b). La dynamique du français des jeunes: Deux périodes à sept ans d'intervalle (1987–1994 et 2010–2017). *ELAD-SILDA, HS 1*. URL: http://publications-prairial.fr/elad-silda/index.php?id=298

R Core Team. (2022). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. URL: https://www.R-project.org/

Reid, A. A., & Marslen-Wilson, W. D. (2003). Lexical representation of morphologically complex words: Evidence from Polish. In R. H. Baayen & R. Schreuder (Eds.), *Morphological structure in language processing* (pp. 287–336). Mouton de Gruyter. DOI: https://doi.org/10.1515/9783110910186.287

Renouf, A. (2013). A finer definition of neology in English. In H. Hasselgård, J. Ebeling, & S. Oksefjell Ebeling (Eds.), *Corpus perspectives on patterns of lexis* (pp. 177–207). John Benjamins. DOI: https://doi.org/10.1075/scl.57.14ren

Renouf, A. (2014). Semantic neology: The challenges for automatic identification. *Neologica*, *8*, 185–220. DOI: https://doi.org/10.15122/isbn.978-2-8124-2999-6.p.0185

Reutenauer, C. (2012). *Vers un traitement automatique de la néosémie: Approche textuelle et statistique*. [Doctoral dissertation]. Université de Lorraine.

Rodd, J., Gaskell, G., & Marslen-Wilson, W. D. (2002). Making sense of semantic ambiguity: Semantic competition in lexical access. *Journal of Memory and Language*, *46*(2), 245–266. DOI: https://doi.org/10.1006/jmla.2001.2810

Rofes, A., Zakariás, L., Ceder, K., Lind, M., Blom Johansson, M., de Aguiar, V., Bjekić, J., Fyndanis, V., Gavarró, A., Gram Simonsen, H., Hernández Sacristán, C., Kambanaros, M., Kuvač Kraljević, J., Martínez-Ferreiro, S., Mavis, I., Méndez Orellana, C., Sör, I., Lukács, A., Tunçer, M., Vuksanović, J., Munarriz Ibarrola, A., Pourquie, M., Varlokosta, S., & Howard, D. (2018). Imageability ratings across languages. *Behavior Research Methods*, *50*, 1187–1197. DOI: https://doi.org/10.3758/s13428-017-0936-0

Sablayrolles, J.-F. (2000). Néologismes: Une typologie des typologies. *Cahier du C.I.E.L. 1996–1997, UFR EILA, Université de Paris*, *7*, 11–48.

Sablayrolles, J.-F. (2003). Le sentiment néologique. In J.-F. Sablayrolles (Ed.), *L'innovation lexicale* (pp. 279–295). Champion.

Sablayrolles, J.-F. (2010). Néologie, classes d'objet et extraction automatique. In M. T. Cabré, O. Domènech Bagaria, R. Estopa, & M. Lorente (Eds.), *I Congrés International de Neologia de les Llengües Romàniques, May 2008, Barcelone, Espagne* (pp. 143–149). IULA. DOI: https://doi.org/10.1515/9783110194265-049

Schäfer, R. (2015). Processing and querying large web corpora with the COW14 architecture. In P. Bański, H. Biber, E. Breiteneder, M. Kupietz, H. Lüngen, & A. Witt (Eds.), *Proceedings of Challenges in the Management of Large Corpora E (CMLC-3)* (pp. 28–34). DOI: https://nbn-resolving.org/urnnbn:de:bsz:mh39-38367

Schäfer, R., & Bildhauer, F. (2012). Building large corpora from the web using a new efficient tool chain. In N. Calzolari, K. Choukri, T. Declerck, M. Uğur Doğan, B. Maegaard, J. Mariani, A. Moreno, J. Odijk, & S. Piperidis (Eds.), *Proceedings of the Eight International Conference on Language Resources and Evaluation (LREC'12)* (pp. 486–493).

Schlachli, G. (2021). The median threshold hypothesis: Measuring morphological productivity from frequency lists. *Third International Symposium of Morphology (ISMo 2021)*. URL: http://nabil.hathout.free.fr/ISMo2021/fichiers/abstracts/ISMo_2021_paper_42.pdf

Siyanova-Chanturia, A., & Elgort, I. (2023). Analysing reading with eye tracking. In S. Zufferey & P. Gygax (Eds.), *The Routledge handbook of experimental linguistics* (pp. 250–267). Routledge. DOI: https://doi.org/10.4324/9781003392972-19

Spencer, A. (2019). The nature of productivity (including word formation versus creative coining). DOI: https://doi.org/10.1093/acrefore/9780199384655.013.587

Štekauer, P., Valera, S., & Kőrtvélyessy, L. (2012). *Word-formation in the world's languages: A typological survey*. Cambridge University Press. DOI: https://doi.org/10.1017/CBO9780511895005

Toglia, M. P., & Battig, W. F. (1978). *Handbook of semantic word norms*. Lawrence Erlbaum.

Tournier, J. (1985). *Introduction descriptive à la lexicogénétique de l'anglais contemporain*. Champion-Slatkine.

Tribout, D., Barque, L., Haas, P., & Huyghe, R. (2014). De la simplicité en morphologie. *SHS Web of Conferences*, *8*, 1879–1890. DOI: https://doi.org/10.1051/shsconf/20140801182

Vaan, L., Schreuder, R., & Baayen, R. H. (2007). Regular morphologically complex neologisms leave detectable traces in the mental lexicon. *The Mental Lexicon*, *2*, 1–24. DOI: https://doi.org/10.1075/ml.2.1.02vaa

Van Goethem, K. (2020). Affixation in morphology. In *Oxford research encyclopedia of linguistics*. Oxford University Press. DOI: https://doi.org/10.1093/acrefore/9780199384655.013.678

Vergallito, A., Petilli, M. A., & Marelli, M. (2020). Perceptual modality norms for 1,121 Italian words: A comparison with concreteness and imageability scores and an analysis of their impact in word processing tasks. *Behavior Research Methods*, *52*, 1599–1616. DOI: https://doi.org/10.3758/s13428-019-01337-8

Xu, Z. (2001). *Le néologisme et ses implication sociales*. L'Harmattan.

Zheng, Z., Li, J., Xiao, F., Broster, L. S., Jiang, Y., & Xi, M. (2015). The effects of unitization on the contribution of familiarity and recollection processes to associative recognition memory: Evidence from event-related potentials. *International Journal of Psychophysiology*, *95*(3), 355–362. DOI: https://doi.org/10.1016/j.ijpsycho.2015.01.003

Zweig, E., & Pylkkänen, L. (2009). A visual M170 effect of morphological complexity. *Language and Cognitive Processes*, *24*(3), 412–439. DOI: https://doi.org/10.1080/01690960802180420