Morphological priming of inflectional suffixes

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Abstract

Morphologically complex words are processed through their constituent morphemes during visual word recognition. While this has been primarily established through the stem priming paradigm, the role of shared affixes is more controversial. Also, most evidence on affix priming comes from derivation, while inflectional priming remains largely unaddressed. Here we present two lexical decision, masked priming experiments filling this gap. Taking advantage of the rich inflectional pattern of Slovene, we assessed inflectional suffix priming (*mest***am**–*HALJAM*), and compared it to the well-established stem priming effect (*haljov*–*HALJAM*): while the latter is solid as expected, the former seems to be weak to non-existing. Results further indicate that there is no interaction between sharing a stem and sharing an inflectional suffix—neither stem nor suffix priming is boosted when primes and targets also share the other morpheme. These data indicate an important difference between stems, derivational affixes and inflectional affixes, which we consider in the context of models of visual word identification and information theory.

Morphological priming of inflectional suffixes

Introduction

It is now widely accepted that morphologically complex words (words that are made up of smaller meaning-bearing units, such as *kind-ness*, *move-ment* or *basket-ball*) are processed through their constituent morphemes during visual word recognition (e.g., Amenta & Crepaldi, 2012; Bradley, 1979; Rastle, 2011; Rastle et al., 2000; Taft & Forster, 1976). This was primarily established through the priming paradigm, in which the relationship between two words in the mental lexicon is assessed by measuring how the presentation of one (the prime) influences the response to the other (the target) (e.g., Boudewyn et al., 2012; Camblin et al., 2007; Sebastiani et al., 2015). There is now substantial evidence showing that facilitation emerges when primes and targets are morphologically related, over and above their orthographic and semantic similarity (e.g., Feldman, 2000; Longtin et al., 2003; Rastle et al., 2004).

The vast majority of this priming literature, however, has focused on *stem* priming, showing that stem words, e.g., *kind*, are identified more quickly when preceded by a morphological relative, e.g., *kindness*, compared to an unrelated word, e.g., *boldness*. The key in this paradigm is that primes and targets share their stem, hence the name. What happens when primes and targets share an affix, instead, has been somewhat more controversial, particularly when suffixes are considered (e.g., *kindness-vagueness*).

In a masked priming study in Spanish, Duñabeitia et al. (2008) observed clear effects of suffix priming, regardless of whether the primes were: (i) suffixes in isolation (e.g., *dad* and *IGUALDAD*, equality); (ii) suffixes inserted into symbol strings (e.g., %%%*dad* and *IGUALDAD*); or (iii) real words (e.g., *brevedad*, brevity, and *IGUALDAD*). Facilitation was consistently larger than that observed when the prime–target pairs shared non-morphological letter endings (e.g., *men*, and *CERTAMEN*, contest), thus suggesting a genuine morphological nature for this effect.

Results from a masked priming study carried out in French were less encouraging, though. [Giraud and Grainger \(2003\)](#) presented their participants with prime words that shared with their targets either a valid suffix (e.g., *veston*, little jacket, and *CHATON*, little cat) or a pseudosuffix (e.g., *béret*, beret, and *MURET*, little wall). These conditions were tested with an unrelated baseline (e.g., *crabe*–*MURET*), and gave rise to no consistent facilitation—out of four experiments, some (statistically weak) priming only emerged for transparent suffixed words that were also orthographically similar to the targets, and for which the morphological boundary overlapped with the syllabic one.

The use of word primes in these experiments has likely triggered lexical competition (e.g., [Davis & Lupker, 2006](#)), which may have interacted with the morphological dynamics making it difficult to assess suffix priming per se. This issue does not affect the experiments in [Crepaldi et al. \(2016\)](#), where nonword primes were used. These authors observed clear effects of suffix priming when targets were preceded by nonword primes with a shared suffix (eg., *sheeter*–*TEACHER*), compared to when they were preceded by a nonword (i) with a different suffix (*shetal*–*TEACHER*), or (ii) with an unrelated non-morphological ending (e.g., *sheetub*–*TEACHER*). Additionally, no effect was observed in a fully non-morphological set of conditions with the same degree of orthographic overlap—*APPAREL* was identified as quickly after *colourel*, *colouric* or *colourut*, ruling out the possibility that the observed effect could be assigned to similarity in form. Overall, these data provide strong support for the existence of suffix priming.

Note that establishing suffix priming is of some theoretical importance, given that theories of visual word identification place different emphasis on the relative role of stems and affixes ([Grainger & Beyersmann, 2017](#)). If the two types of morphemes yield priming similarly, then it is likely that they are similarly represented in the lexical identification system. This would also be notable from an information theory point of view; the distribution of stems and affixes in the language is in fact very different. While affixes are few, and tend to be highly frequent, lexical stems are many, and generally of lower

frequency. Thus, stems are more informative on word identity—knowing that a word contains, e.g., *-ment* leaves the reader with lots of viable options (that is, with high uncertainty), while knowing that it contains, e.g., *flavour* constrains the cohort of possible candidates down to a handful of alternatives. That the visual word identification system is insensitive to this informational asymmetry would be very interesting, and possibly revealing on its computational architecture. On the other hand, the suffixes' higher frequency may make them easier to identify quickly, which may give an important headstart to the visual identification process.

Importantly, the aforementioned studies all assess *derivational* suffixes, which leaves open another interesting question: what happens with *inflectional* suffixes? There are several reasons to believe that the latter may have a very different role in the lexical system. Linguists draw a strong dichotomy between inflection and derivation (e.g., [Haspelmath & Sims, 2010](#)): (i) inflection never indicates the change of grammatical category (e.g., dog–dogs) while derivation often does (e.g., dark–darkness), (ii) inflection is typically more semantically transparent (relationship between dog–dogs is identical to the relationship between car–cars), while derivation is more idiosyncratic (e.g., a *gardener* is a person who takes care of the garden, while a *juicer* is a kitchen appliance that makes juice; e.g., [Crepaldi et al. \(2010\)](#)), and (iii) inflection never introduces a new meaning to their base morphemes, while derivation can (e.g., person–personal).

Some information about inflectional priming comes from a group of studies based on Slavic languages, which are aptly inflectionally rich. [Reid and Marslen-Wilson \(2000\)](#) report on a cross-modal priming experiment carried out in Polish. They considered four affix conditions, in which all the primes were existing words: (i) verbs with shared aspectual prefix (*skorzystać*, to benefit, perfective, *stracić*, they lost, perfective), (ii) verbs with shared derivational prefix (*nagrzać*, to heat up, *nakroić*, to cut), (iii) nouns with shared diminutive suffix (*kotek*, little cat, *ogródek*, little garden), and (iv) nouns with shared derivational suffix (*kucharz*, cook, *piłkarz*, footballer). Priming was only

significant when the data for all affixal conditions were considered together as a group; inflectional suffixes alone (condition (i) and (iii)) did not yield any facilitation.

A more recent study was carried out in Russian ([VanWagenen & Pertsova, 2014](#)). There, all primes were all existing words in this language, either nouns or verbs, which either shared their inflectional suffix with the target (e.g., *vernyot*, *return-3p.sg.pres.*)–*tryasyot*, *shake-3p.sg.pres.*), or only overlapped with it orthographically and phonologically (e.g., *podshyot* (*count (n)*)–*tryasyot* (*shake-3p.sg.pres.*)). Verbs yielded significant facilitation, but nouns did not. However, while verbs were presented in isolation, noun primes appeared within a prepositional phrase. Therefore, it is difficult to establish whether this represents a genuine grammatical class effect, or rather a by-product of the different contexts where the primes were presented.

Another group of studies that addressed inflectional priming were carried out on Semitic languages (e.g., Arabic, [Boudelaa and Marslen-Wilson \(2004\)](#), and Hebrew, [Deutsch et al. \(1998\)](#); [Frost et al. \(1997\)](#)), where inflections take the form of word patterns that are intertwined to lexical stems, e.g., the morpheme *drrx*, which conveys the meaning of ‘stepping’, is inserted in the nominal pattern *mi-a-a*, which results in the noun *midraxa*, pavement ([Deutsch et al., 1998](#)). These studies also yielded mixed results. The Arabic data revealed priming with one type of inflectional morpheme (i.e., consonant–vowel pattern), but not with another (i.e., vocalic melody), despite the fact that they both encode inflectional information ([Boudelaa & Marslen-Wilson, 2004](#)). On the other hand, evidence from Hebrew suggested root priming in nouns and verbs, while word–pattern priming only emerged with the latter grammatical class ([Deutsch et al., 1998](#); [Frost et al., 1997](#)). This would be in line with the data provided in Russian by [VanWagenen and Pertsova \(2014\)](#).

Overall, the existing evidence is quite inconclusive. There are reports of inflectional suffix priming, but this effect is far from consistent. As illustrated above, however, the experiments carried out so far are very diverse—to mention just a few factors, scholars presented primes in different contexts, investigated languages with very different

morphologies, and used different prime presentation times and modalities. Although diversity is clearly important in psycholinguistics, in this specific instance it makes it difficult (impossible?) to establish whether inflectional priming is truly weak or nonexistent, or rather the inconsistent pattern of results emerges right from this diversity. We thus felt that a novel, more systematic investigation of inflectional suffix priming was in order.

The two experiments we present here have a few key features. First, primes were kept outside of the participants' awareness, thus making them blind to our experimental manipulation; this grants us protection from any effect of meta-cognitive strategy that participants may put in place. Second, inflectional priming is compared directly with stem priming in a within-target design; this would speak to the potential stem-suffix asymmetry that we discussed above. Third, we used nonwords as primes, thus allowing a better control of the experimental material and excluding lexical competition dynamics that may interfere with the morphological effects we are most interested in¹.

The experiments were carried out in Slovenian, taking advantage of its very rich inflectional system. Slovenian nouns have six cases, three genders and three grammatical numbers, all of which are combined into one inflectional suffix (e.g., *bratu*, brother, singular, dative; *bratoma*, brother, dual, dative). This granted us a considerable amount of flexibility in the construction of our stimuli, which we exploited to guarantee a well-controlled, within-target design. In Experiment 1, we focused on assessing stem and suffix priming, each against their ideal control conditions, i.e., primes that are identical in all aspects except for the critical morpheme that is shared with the target (e.g., stem priming: *haljov*–**HALJAM** vs. *jahtov*–**HALJAM**; suffix priming: *mestam*–**HALJAM** vs. *mestov*–**HALJAM**). In Experiment 2, we varied the sharing of stem and suffix

¹ There is one exception in Experiment 2, where we did use existing words as primes in one condition. However, these word primes are actually repetition primes, which still avoids triggering lexical competition dynamics. We take up this issue more fully below.

parametrically—the same target *HALJAM* was primed by *haljam* itself, stem+suffix+, *haljov*, stem+suffix−, *mestam*, stem−suffix+, and *jahtov*, stem−suffix−. This generated a fully crossed, 2×2 design that allowed us to: (i) assess the independent contribution of a shared stem and a shared suffix; and (ii) gauge the possible interaction between the sharing of the two morphemes.

Experiment 1

Methods

Participants. Sixty native Slovenian speakers (F=41) took part in the study. Their mean age and education was 30.8 (range=20-60) and 15.2 years (range=12-18), respectively. They all grew up in a monolingual environment and had normal or corrected-to-normal vision. They all signed an informed consent form to take part into the study, and received 2 Euros in exchange for their time.

Materials. The stimulus set was based on 40 Slovenian nouns to be used as targets. These were all feminine nouns inflected in the dative plural case² (e.g., *sestram*, (to the) sisters). Each target word was paired with four different nonword primes, which were all built as non-existing combinations of an existing stem and an existing affix (corresponding examples in English would be *builded* and *drawed*). There were no phonological/orthographic modifications in either the stem or the suffix in all primes. In the suffix-related condition, the prime and the target shared the same suffix (e.g., *oknam*–*MAMAM*, windows–MOTHERS). In suffix-control, the prime was made up of the same stem, now paired with a different suffix (e.g., *oknov*–*MAMAM*). The stem priming conditions were built similarly; related primes shared their stem with the target word (*mamov*–*MAMAM*), whereas their controls featured a different stem, attached to the same suffix (*čajov*–*MAMAM*, teas–MOTHERS). An overview of the four experimental

² This particular inflection was chosen as it results in a two-letter suffix, which is unambiguously assigned to this gender-case combination. Other inflections result either in a one-letter suffix, or are ambiguous when a noun is presented in isolation (i.e., the same suffix belongs to more than one nominal inflection).

conditions is offered in Table 1.

The within-target design guarantees perfect matching across conditions on this front; further care was taken to also ensure prime comparability. Overall, stem and suffix length were matched pairwise between related and control primes; stem frequency was also matched as closely as possible (Table 2). Because matching on this latter variable was not perfect, we used it as a covariate in the analysis (see below). Prime-target orthographic overlap was calculated through the computer program *MatchCalculator* (Davis, 2006), based on orthographic spatial coding (Davis, 2010). Because stems are generally longer, stem primes were unavoidably more similar to their targets than suffix primes; therefore, we adjusted orthographic overlap in the control conditions so that the difference between related and control primes was the same for stems ($.62 - .27 = .35$) and suffixes ($.42 - .13 = .29$).

Our stimulus set also included 40 nonword-target trials, which required a NO response from the participants. Targets in these trials were built in four groups of 10 items: existent stem+existent suffix (e.g., *knjigta*), existent stem+non-existent suffix (e.g., *vodla*), non-existing stem+existing suffix (e.g., *rohom*), and non-existing stem+non-existing suffix (e.g., *gamdem*). The last three groups guarantee that not all target stimuli were combinations of existent morphemes, which was critical to prevent participants from engaging in a mere morphological check, rather than a lexical decision task. Each nonword target was paired with a nonword prime based on the same design described above for the word-target, experimental trials; this guarantees that the prime structure was non-informative as to the lexicality of the target.

Procedure. Participants were presented with a lexical decision task, in which they were instructed to press one of two buttons as quickly as possible according to whether the presented letter string was an existent Slovenian word. They were informed that the letter string would be preceded by a string of hash marks, but they were not informed about the presence of the prime words. They sat approximately 56 cm from the computer screen

where the stimuli were displayed. A Cedrus response box (https://cedrus.com/rb_series/) was used to collect their responses, on which the YES response button was always controlled by the participant's dominant hand. At the beginning of the experiment, participants underwent a short practice session with 10 trials, to properly familiarize themselves with the task before the onset of the actual experiment.

The trial timeline was as follows. A fixation cross appeared in the middle of the screen for 400ms, followed by a visual mask (#####) for 500ms. Afterwards, the prime was presented in lowercase for 36ms, followed by the uppercase target word, which remained on the screen for 2s. Participants had up to 2s to give their response, before the new trial began.

In order to avoid repetition effects, each participant was presented with each target in only one of the four experimental conditions, via a classic Latin Square design with four rotations.

Data Analysis. Response times (RT) in correct trials were analyzed through linear mixed models (LMMs) using R ([R Development Core Team, 2008](#)), [Rstudio](#) ([RStudioTeam, 2016](#)), and its packages [lmerTest](#) ([Kuznetsova et al., 2017](#)) and [Effects](#) ([Fox & Hong, 2009](#)). RT were inverse-transformed in order to achieve symmetrically distributed residuals, and were modelled as a function of prime relatedness (related vs. control), priming morpheme (suffix vs. stem) and their interaction, with subjects and target words as crossed random intercepts. Treatment coding was used to code the contrasts for each factor in all models. A fixed effect of stem frequency was also included in the model as a covariate. Significant effects were checked for their dependence on outliers following [Baayen \(2008\)](#)—models were re-run after excluding data points whose standardised residuals were larger than 2.5 in absolute value. Only those effects that survived this procedure are reported as significant.

All data and analysis scripts are available to the reader at <https://osf.io/m4vh5/>.

Results

We excluded from the analysis one participant who performed close to chance on nonword trials (52% accuracy), and one target word that elicited an overall accuracy below 70%. The mean overall response time and accuracy are 715ms and 95%, respectively. The descriptive statistics by condition are offered in Table 3.

The analysis suggests a main effect of prime relatedness, $F(1, 2111.2) = 12.19$, $p < .001$, a main effect of priming morpheme, $F(1, 2114.3) = 9.15$, $p = .002$, and no interaction between the two factors, $F(1, 2110.9) = 2.09$, $p = .15$.

The model parameters show that sharing a stem yields solid priming, $\beta = -.06$, $t(2110.0) = -3.49$, $p < .001$, and that suffix priming doesn't differ from stem facilitation, $\beta = .03$, $t(2109.0) = 1.45$, $p = .15$. Importantly though, when the reference level for *priming morpheme* was set to *suffix*, so that the model parameters inform directly on suffix priming, this effect was not significant, $\beta = -.02$, $t(2109.0) = -1.42$, $p = .15$.

Figure 1 presents the model-based estimated effects, which amount to 24ms for stem priming, and 11ms for suffix priming.

Discussion

The results of Experiment 1 suggest solid morphological priming when inflected nouns (e.g., *MAMAM*, (to the) mothers) are primed by morphologically complex nonwords sharing the same stem (e.g., *mamov*), compared to when they are primed with an unrelated nonword (e.g., *čajov*).

Data are less clear on inflectional suffix priming. On one hand, there is no significant interaction between prime relatedness and priming morpheme; this would suggest that suffix priming isn't different from stem priming. On the other hand though, the model estimates reveal a numerically smaller effect for suffixes than for stems (11ms vs. 24ms); and, perhaps more importantly, when the reference level for *priming morpheme* is set to assess suffix priming directly, the effect does not come out as statistically significant.

Experiment 1 was designed to contrast each related prime with its closest possible control (e.g., *haljov*–**HALJAM** vs. *jahtov*–**HALJAM**). Essentially, everything remained the same in related and control primes, except that the priming morpheme was changed with a matched, target–unrelated one. Experiment 2 is another attempt at assessing stem and suffix priming, this time using a fully factorial design where each target word (e.g., *LISAM*) is preceded by a prime with: (i) the same stem and the same suffix, making up a repetition prime; (ii) the same stem and a different suffix, e.g., *lisov*; (iii) a different stem and the same suffix, e.g., *gibam*; and (iv) a different stem and a different suffix, e.g., *berov*. This fully factorial design allows us to assess the contribution of a shared stem and a shared suffix independently; this may be particularly useful to shed light on the somewhat unclear results on suffix priming that emerged in Experiment 1. Moreover, it permits us to check for an interaction—would stem/suffix priming be stronger/weaker when targets and primes also share their other morpheme? Of course, such a design forced us into using word primes in one of the four conditions; these word primes, however, would be the target words themselves, which keeps us clean of effects of lexical competition and/or complex lexical dynamics that may obscure the purely morphological effects.

Experiment 2

Methods

Participants. Sixty-two native Slovenian speakers (F=46) participated in Experiment 2, none of whom took part in Experiment 1. Their mean age and education was 24.6 (range=19–42) and 14.9 years (range=12–20), respectively. They all grew up in a monolingual environment and had normal or corrected-to-normal vision. They all granted their informed consent to take part into the study before the beginning of the experiment, and received 2 Euros in exchange for their time.

Materials, procedure and data analysis. Identically to Experiment 1, the stimulus set was based on 40 Slovenian word targets, which were also used in the previous

study. Each target (e.g., *MOČEM*) was paired with four different primes, following a crossed, 2×2 design: (i) same stem and same suffix, making up a repetition prime (e.g., *močem*); (ii) same stem and different suffix (e.g., *močov*); (iii) different stem and same suffix (e.g., *domem*); and (iv) different stem and different suffix (e.g., *župov*).

The statistics of this stimulus set are reported in Table 4. The presence of repetition primes, the fully factorial design and, again, the fact that stems are generally longer than suffixes create an imbalance in prime–target orthographic overlap—if one averages stem–related vs. non–stem–related primes, and suffix–related vs. non–suffix–related primes, the former comparison displays a larger difference in orthographic overlap than the latter ($.81 - .31 = .50$ and $.71 - .41 = .30$, respectively). This means that stem priming might be unduly inflated by prime–target form similarity as compared to suffix priming. We will take care of this confound statistically (see below).

All other aspects of the Experiment 2 were kept identical to Experiment 1, including the number and structure of nonword trials, the procedure, the trial timeline and the data analysis approach.

Results

No participant or target word met the exclusion criteria; thus, all datapoints were retained into the analyses. The mean overall response time and accuracy in this experiment were 714ms and 94%, respectively; quite nicely, these figures are very similar to those observed in Experiment 1. The descriptive statistics by condition are offered in Table 5.

The model suggests solid stem priming, $F(1, 2223.6) = 15.46$, $p < .001$ (model estimates $\beta = -.06$, $t(2223.5) = -3.93$, $p < .001$), but no suffix priming, $F(1, 2222.7) = 1.75$, $p = .19$ (model estimates $\beta = .02$, $t(2222.6) = 1.32$, $p = .19$), nor any interaction between the two, $F(1, 2224.2) = 2.00$, $p = .16$ (model estimates $\beta = -.03$, $t(2224.0) = -1.42$, $p = .16$). The estimated effect size is 33ms for sharing a stem, and 3ms for sharing an inflectional suffix. Figure 2 presents the model–based estimates for each design cell.

As we discussed above, the difference in prime–target overlap between related and control primes is larger for stem than for suffix priming in this experiment (see Table 4). It is logically possible, then, that stem priming emerged as a side effect of form similarity; perhaps primes and targets were just similar enough orthographically when they shared a stem, but not when they shared a suffix. In order to exclude this possibility, we checked that stem priming remains significant in a model that also includes orthographic similarity as a covariate, centered around zero; this was indeed the case, $\beta = -.06$, $t(2233.1) = -3.08$, $p = .002$. We also checked that sharing a stem still brings significant time savings on the residuals of a model that accounts for orthographic overlap, that is, on that part of the response times that orthographic similarity can’t account for; and again, this was indeed the case, $t(61) = -1.69$, $p = .05$ ³. So, it really seems that the nature of the stem priming effect is morphological in nature.

Discussion

In line with much of the previous literature (e.g. Forster & Azuma, 2000; Marslen-Wilson et al., 1994; Rastle et al., 2000, 2004), Experiment 2 fully confirms the solid stem priming effect observed in Experiment 1. It also shows that this effect is morphological in nature, and not entirely accountable in terms of prime–target orthographic overlap.

Experiment 2 brings no evidence, instead, for savings related to primes and targets sharing their inflectional affix. This may elucidate the somewhat unclear results that emerged in Experiment 1, where suffix priming was on the verge of statistical significance, and nearly significantly different from stem priming. Statistics are fully unambiguous in this new experiment—while stem priming is very solid, there is virtually no evidence for any suffix priming.

³ We carried out a simple t test here because the crossed random effects of participants and targets were already accounted for in the orthographic overlap model, which made unnecessary to use mixed models a second time.

Interestingly, there is no evidence for any interaction between stem and suffix priming. Namely, a shared suffix did not add any further facilitation when the stem was also shared between the prime and the target; and vice versa, a shared stem did not enhance suffix priming. This result also confirms that the lexical status of the primes in the repetition priming condition (stem+suffix+) did not influence the facilitation pattern, or otherwise we would have registered a difference between repetition primes (which were real words) and stem+suffix- primes (which were not real words). Instead, the two types of primes yield very similar time savings.

General discussion

Building on one of the most well-established paradigms in single word visual identification, that is, masked priming, we investigated inflectional priming in Slovenian, and compared it to stem priming. This latter effect emerged clearly, whereas, overall, our data do not seem to support inflectional suffix priming. We also observe that there is no interaction between sharing a stem and sharing an inflectional suffix; the overall priming effect seems to be best described as the mere sum of an existent and solid stem priming, and a nonexistent (or at best, very weak) suffix priming.

Stem priming is already a very well established phenomenon (e.g., [Amenta & Crepaldi, 2012](#); [Feldman, 2000](#); [Marslen-Wilson, 2007](#); [Marslen-Wilson et al., 1994](#); [Rastle et al., 2000](#); [Stanners et al., 1979](#)). However, we report it in a language that was previously unaddressed in this respect, and that differs in many aspects from the languages where most of the evidence on morphological priming was obtained, such as English, German or Spanish. Most notably, the Slovenian noun inflectional system is way richer than any of these languages; stem priming does seem to hold smoothly irrespective of this factor. Slavic languages are in general understudied in psycholinguistic literature (but see e.g., [Filipović-Đurđević et al., 2009](#); [Kostić, 1991](#); [Milin et al., 2009](#), for notable exceptions); so these experiments also provide an important contribution towards a psycholinguistic

knowledge that is more appropriately based on a diversity of languages (Frost, 2012; Reid & Marslen-Wilson, 2000).

Overall, our data seem to suggest no inflectional suffix priming—there is no reliable facilitation in the recognition of a complex word that is preceded by a morphologically structured nonword with the same inflectional suffix (*prstam*–*HALJAM*). Importantly, these results come from a paradigm and a language that arguably set the ideal stage for inflectional suffix priming to emerge. As mentioned above, nominal inflection is ubiquitous in Slovenian, and also the result of a very complex system where three different numbers (singular, dual and plural), three different genders (masculine, feminine and neuter) and six different cases (nominative, genitive, dative, accusative, locative and instrumental) get blended in one inflectional suffix. Moreover, our target words were all suffixed—despite masked priming kept our experimental manipulation out of our participants’ awareness, this feature should have, if anything, directed even more attention to inflections. Yet, no solid inflectional priming emerged.

This absence of inflectional suffix priming is particularly interesting. Previous research suggests that derivational suffixes do play an active role in the visual identification of complex words (e.g. Crepaldi et al., 2016; Duñabeitia et al., 2008). In the presence of further evidence that assigns a similar role to prefixes (e.g., Chateau et al., 2002; Dominguez et al., 2010; Giraudo & Grainger, 2003; Reid & Marslen-Wilson, 2000, 2003), one could assume that these findings can be just generalized to any kind of affix (Crepaldi et al., 2016). Here, however, we show that this might not be the case—inflectional suffixes do not seem to play a big role in complex word identification.

While it may seem surprising that derivational suffixes would contribute to complex word processing, whereas inflectional suffixes would not, it is possible that the reason for this discrepancy lies in the nature of the information they carry. While inflectional suffixes only provide morpho-syntactic information, derivational suffixes typically carry lexical

knowledge. For example, derivational suffixes determine grammatical class (*kind**ness***, *bitter**ness*** and *ill**ness*** are all nouns), while inflectional suffixes never do (a noun is a noun by virtue of its stem, no matter which inflectional affix that stem takes on each specific instance). From this perspective, derivational suffixes are more similar to stem morphemes, whose role in complex word processing is undisputed.

A different interpretation would point to the informational structure of stem and suffix frequency distribution, particularly of inflectional suffixes. As anticipated in the Introduction, stems are more informative on lexical identity. Nearly all English nouns take an *-s* to form a plural, thus knowing that the word we are trying to identify contains that morpheme is virtually useless to constrain our lexical search—we would be left with thousands of candidates. Knowing which stem we are looking at, instead, would typically leave us with a handful of candidate words. Perhaps the visual word identification system captures this informational asymmetry, and consequently focuses on stems way more than on suffixes. Admittedly, derivational suffixes would be somewhat puzzling on this account. They generally carry more lexical information than inflectional suffixes (e.g., there are less words containing *-ness* than words containing *-ing* in English). Yet, they are also less informative than stems; therefore, it is not obvious that they should yield solid priming, which is what data seem to indicate. At a general level, this account emphasises the informational value of morphemes as derived from their frequency distribution, thus reducing the role for their semantic and syntactic content.

From the point of view of representational, localist models of complex word identification (e.g., [Crepaldi et al., 2010](#); [Grainger & Ziegler, 2011](#); [Taft & Nguyen-Hoan, 2010](#)), these results would suggest that inflectional suffixes are not explicitly represented in the visual lexicon. The classic interpretation of priming effects, in fact, rests on the prime and the target words contacting the same representation (e.g., ‘deal’ in ‘dealer’ and ‘dealing’). So, if inflectional affixes were indeed represented, we should have obtained priming from pairs like ‘read*ing*’ and ‘deal*ing*’. Therefore, these results seem to suggest

that not all morphemes develop a representation in the lexicon, and inflectional information is computed outside of this cognitive structure.

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Table 1

Prime–target pairs across the four experimental conditions in Experiment 1.

Condition	Prime	Target word
Suffix related	ok nam	MAM A M
Suffix control	okn ov	MAM A M
Stem related	mam ov	MAM A M
Stem control	čaj ov	MAM A M

Table 2

Stimuli characteristics across conditions in Experiment 1, reported with means and SDs.

	Target word	Suffix prime	Suffix control	Stem prime	Stem control
Stem length	4.32 (1.12)	4.32 (1.12)	4.35 (1.10)	4.32 (1.12)	4.32 (1.12)
Suffix length	2.0 (0)	2.0 (0)	2.0 (0)	2.0 (0)	2.0 (0)
Stem frequency	1.46 (.65)	1.30 (.81)	1.30 (.81)	1.46 (.65)	.97 (.82)
Orthographic overlap		.42 (.09)	.13 (.09)	.62 (.05)	.27 (.12)

Table 3

Mean (SD) and median (IQR) reaction time, reported in ms, and accuracy (SD), reported in %, across the four conditions of Experiment 1. Statistics are based on unaggregated data.

	Mean RT	Median RT	Accuracy
Stem control	709.84 (209.80)	662 (229.00)	95 (.21)
Stem priming	687.94 (205.76)	639 (211.50)	95 (.21)
Suffix control	738.17 (227.80)	690 (265.50)	94 (.23)
Suffix priming	724.37 (217.38)	672 (253.75)	93 (.25)

Table 4

Stimuli characteristics across conditions of Experiment 2, reported with means and SDs.

	Target word	Suffix prime	Stem prime	Repetition prime	Control
Stem length	4.32 (1.12)	4.32 (1.12)	4.32 (1.12)	4.32 (1.12)	4.32 (1.14)
Suffix length	2.0 (0)	2.0 (0)	2.0 (0)	2.0 (0)	2.0 (0)
Stem frequency	1.46 (.65)	1.30 (.81)	1.46 (.65)	1.46 (.65)	1.25 (.73)
Orthographic overlap		.42 (.09)	.62 (.05)	1.0 (0)	.19 (.10)

Table 5

Mean (SD) and median (IQR) reaction time, reported in ms, and accuracy (SD), reported in % correct, across the four conditions of Experiment 2. Statistics are based on unaggregated data.

	Mean RT	Median RT	Accuracy
Stem priming	699.95 (223.88)	647 (238)	95 (.22)
Suffix priming	732.29 (217.56)	680 (233)	95 (.22)
Repetition priming	693.66 (221.40)	645 (238)	94 (.24)
Control	730.80 (243.23)	672 (239)	93 (.25)

Figure 1. Estimated response times in the four conditions of Experiment 1. Error bars represent 95% CIs. Note: ●/▲, control condition/priming condition.

Figure 2. Estimated response times in the four conditions of Experiment 2. Error bars represent 95% CIs. Note: ●/▲, stem not shared / stem shared condition.