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Zero-derived forms in the mental lexicon: Experimental evidence from Italian

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Abstract: Our paper investigates how zero-affixed verbal forms (specifically, denominal and deadjectival verbs) are processed by native speakers of Italian during visual word recognition. More specifically, we verify whether, and possibly to what extent, the processing of such forms differs from or resembles the processing of verbs resulting from two other productive word formation schemas in Italian, i. e., suffixation and parasynthesis. The interest of such a comparison lies in the fact that the three considered schemas behave similarly from a functional point of view, i. e.: i) they all change the category of the base, ii) they select the same base category (nouns and adjectives), and iii) they show similar semantic characteristics. However, this shared function is realized by means of different formal exponents (both overt and covert) which might imply different degrees of complexity. Crucially, suffixation and parasynthesis display an overt derivational marking, while zero-affixation obviously does not. On such premises, to verify whether the strength of connections between morphologically complex words and their bases is affected by the nature of the transcategorization marking (overt vs covert) or whether other factors play a more determining role, we conducted a psycholinguistic experiment involving a lexical decision task combined with the masked priming paradigm, which allows focusing on such relations in the mental lexicon. Results indicate that the processing of zero-affixed verbs resembles that of suffixed but differs from that of parasynthetic forms. We interpret such results discussing the possibility that the perception of a morphological relationship might depend less on the overtness of the marking, and more on the overall derivational complexity of the morphological process.

Keywords: zero affixation, morphological processing, masked priming

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1 Introduction

Word formation processes realized without the adjunct of a formal exponent have traditionally posed a challenge for theoretical linguistics. Depending on the different theoretical frameworks, various interpretations have been proposed to account for such processes (see Bauer and Valera 2005; Valera 2014 for review). Among such interpretations, a commonly adopted solution consists in postulating the existence of a zero-affix, which would share the same function of its overt analogues, i. e., of traditional derivational affixes. Along this line of reasoning, zero-derivation (as has been defined within such frameworks) could be thought of as not too dissimilar from canonical derivation, if not for the ‘covertness’ of its derivational marking. Indeed, a question that might potentially arise within this view relates to how covert markings really differ from overt ones in terms of processing mechanisms and lexical representations.

The present study proposes to contribute to the theoretical debate surrounding zero-derivation by taking a psycholinguistic stance on this issue, i. e., by experimentally investigating what the psychological reality for the average speaker might be. In other words, we propose to focus on how the relationship between a zero-derived form and its base is perceived in the speakers’ mental lexicon, and specifically, whether such relationship is perceived in any way differently from the ones establishing between overtly marked derived words and their bases. To this aim, in our experimental study we will compare the processing of zero-derived forms, both denominal (*spazzola* ‘brush’ > *spazzolare* ‘to brush’) and deadjectival (*preciso* ‘to clarify’ > *precisare* ‘precise’), to that of suffixed verbs (*simbolo* ‘symbol’ > *simboleggiare* ‘symbolize’ and *banale* ‘trivial’ > *banalizzare* ‘trivialize’) and parasynthetic verbs (*veleno* ‘poison’ > *avvelenare* ‘to poison’ and *leggero* ‘light’ > *alleggerire* ‘to lighten’) in Italian. We decided to focus on such a comparison because the three selected schemas behave similarly from a functional point of view: i) they all change the category of the base, ii) they select the same base category (nouns and adjectives), and iii) they show similar semantic characteristics. However, this shared function is realized by means of different formal exponents (both overt and covert) which imply different degrees of complexity. As it will be discussed in Section 2, zero-derived verbs are opposed to suffixed and parasynthetic verbs on the basis of:

- i) the covert vs overt nature of the derivational marking;
- ii) the degree of formal complexity (zero-derivation displays a lower degree of formal complexity compared to suffixation and parasynthesis);
- iii) the degrees of prototypicality of the derivational marking (zero-derivation and parasynthesis can be considered as less prototypical means with respect to suffixation to mark derivative forms in Italian).

By observing these three morphological schemas, we will be able to verify whether the covert nature of the derivational marking determines the processing of derived verbal forms or whether such other factors dealing with formal complexity and prototypicality are more likely to affect the processing mechanisms.

Before providing the details of our study and outlining how specifically it will address the issue of the psychological reality of such covert markings, we will first briefly review the existing psycholinguistic literature on zero-derivation.

2 Theoretical background

Over the course of the last decades, morphological processing has been extensively investigated through a combination of different (both behavioral and neurolinguistic) techniques, usually involving participants' reaction time measures. While many strands of research have been pursued, to date, the experimental literature on the processing of zero-derived forms appears rather scarce. Only recently, a number of studies have specifically been dedicated to this topic, though, as will emerge, through a different perspective from the one we will adopt here. Two main research questions have been addressed by the experimental studies carried out so far.

A first line of research has focused on whether the underlying complexity of zero-derived forms affects their processing and whether superficially similar forms are processed differently on the basis of their derivational depth. This issue has been mainly investigated by opposing one-step derivations to two-step derivations. Pliatsikas et al. (2014), for instance, carried out an fMRI experiment in which subjects had to perform a lexical decision task (i. e., deciding whether a word presented on a screen is a real word or not) on English *-ing* word forms which could either be directly derived from verbs (e. g., *soaking* < *soak-V*) or whose base verbal form was in turn zero-derived from a noun (e. g., *bridging* < *bridge-V* < *bridge-N*). Their results revealed an increased amount of brain activity when two-step derived forms (*bridging*) were presented, while such activity was less pronounced for one-step derived forms (*soaking*). Such results, which were interpreted as consequence of the higher processing costs induced by double-derived forms, seem to suggest that morphological processing is sensitive to the underlying morphological complexity of forms.

Results on the processing of the same materials obtained in a series of follow-up experiments carried out by the same group of researchers using behavioral methods are less easily interpretable, though. In such studies, the authors exploited the priming paradigm, a methodology which is widely used to investigate morphological processing in the psycholinguistic domain. The rationale of this

technique is that the prior presentation of a word (*prime*) facilitates the recognition of another word (*target*), if they are somehow perceived as connected with each other (Forster and Davis 1984). For what concerns the domain of morphology, experimental research has convincingly demonstrated that morphologically complex words typically induce faster reaction times on the recognition of their bases and this result has been interpreted as proof of the fact that members of the same morphological family are connected in the speakers' mental lexicon (see Amenta and Crepaldi 2012 for review). Wheeldon et al. (2019) presented the same materials used in Pliatsikas et al. (2014), combining the lexical decision task with different priming modalities (masked, visible and delayed) and could observe a significant difference between the facilitation effects induced by one-step and two-step derivatives only with longer prime durations (i. e., only when participants could fully see the prime). The authors concluded that different morphological priming patterns emerge for one-step and two-step verbs, confirming Pliatsikas et al.'s conclusion that underlying complexity affects the processing of superficially similar forms.

A second line of research has aimed to verify whether ambiguous forms resulting from word-class conversion engender greater processing time and brain activation than unambiguous ones (Stolterfoht et al. 2010; Lukic et al. 2019; Opitz and Bordag 2020). In this perspective, converted words have been typically presented in contexts where they were assigned to different word categories, which were supposed to induce different processing costs. Experimental tasks and techniques used across experimental studies varied significantly: self-paced reading was used in Stolterfoht et al. (2010); priming was adopted by Opitz and Bordag (2020) and fMRI associated with grammaticality judgment tasks was exploited in Lukic et al. (2019). What emerges from this series of studies is that converted ambiguous forms seem to require longer reaction times and greater neural activation, but the findings so far obtained are not conclusive (Opitz and Bordag 2020, for instance, take a different position). As a consequence, based on the evidence available to date it remains difficult to determine whether word-category information is encoded at the lexical level (according to the lexicalist approach) or whether lexical units are stored in the mental lexicon as unspecified entries which are assigned a syntactic category once they enter a specific context (syntactic approach), which was one of the ultimate interests of this line of research.

3 The present study

As we have seen, previous experimental studies have mainly considered zero-derived forms with different degrees of underlying complexity, with the aim of

verifying whether their varying derivational complexity affects speakers' processing mechanisms, even in the absence of any superficial formal difference.

For our research, we decided to adopt an alternative and, in many ways, complementary perspective which will allow us to contrast the processing of zero-derived forms with the processing of overtly derived forms with comparable syntactic and semantic features. More specifically, in our experiment we focus on zero-derived verbs in Italian (*precisare* 'to clarify' < *preciso* 'precise') comparing them with suffixed (*banalizzare* 'to trivialize' < *banale* 'trivial') and parasynthetic verbs (*alleggerire* 'to lighten' < *leggero* 'light'). The three morphological schemas have been selected because, from a functional point of view, they exhibit similar behaviors: not only they all create verbs starting from nominal and adjectival bases (thus sharing a transcategorizing function), but also, and most importantly, they show similar semantic characteristics, since the verbs resulting from these three morphological processes have mainly inchoative / causative and resultative meanings, besides locative and instrumental ones (Grossmann 2004a, 2004b; Iacobini 2004). Despite those similarities, however, the word formation patterns considered vary along three main dimensions: i) the overt or covert nature of the transcategorization marking; ii) the degree of formal complexity (how easily speakers can perceive the shared base in morphologically connected words); iii) the overall prototypicality of the transcategorization marking, i. e., its typical locus and means of realization.

Clearly zero-derived verbs, both denominal (*spazzolare* 'to brush' < *spazzola* 'brush') and deadjectival (*precisare* 'to clarify' < *preciso* 'precise'), have the highest degree of formal simplicity, both in terms of how easily perceivable the base is and in terms of how much overlap there is between the derived form and its base. Indeed, zero-derived verbs only exhibit an additional inflectional ending with respect to the base (*precis-are*, 'to clarify'), contrary to what happens with parasynthesis (*in-grass-are*, 'to put on weight') and suffixation (*banal-izzare*, 'trivialize'), which both imply the presence of a derivational affix besides the inflectional marker. On the other hand, a covert expression of the transcategorization process is not prototypical. For Italian, however, the claim that zero-derivation is fully covert should probably be mitigated since inflection is always required and a formal (inflectional) adjunct is present in most of the zero-derived verbal forms (Pavesi 1994: 135). In suffixed verbs, on the contrary, the transcategorization function is expressed by means of an overt marking, and typically a highly salient (bisyllabic) one, e. g., *-izz(are)* as in *banalizzare* 'to trivialize' < *banale* 'trivial', *-ific(are)* as in *intensificare* 'to intensify' < *intenso* 'intense', and *-eggi(are)* as in *simboleggiare* 'to symbolize' < *simbolo* 'symbol'. In a way, because suffixation makes use of a formal exponent to create verbs, this morphological schema can be considered as more iconic than zero-derivation (on the notion of iconicity, see

Dressler 1995, among others), besides being also the most prototypical means for changing the syntactic category in the Italian word formation system, as well as in other languages (see, among others, Hawkins and Gilligan 1988). Finally, denominal and deadjectival parasynthetic verbs, in which a derivational prefix and an inflectional suffix are present (*avvelenare* ‘to poison’ < *veleno* ‘poison’ and *alleggerire* ‘to lighten’ < *leggero* ‘light’, respectively), appear to have the highest degree of formal complexity. It should be noted that this formal complexity is independent from the theoretical interpretation assumed for parasynthesis, which is indeed not unanimously agreed upon in the literature. Among the various proposals, three main accounts of such a word formation phenomenon have been provided (see Iacobini 2004; Todaro 2017 for review). Specifically, parasynthesis can either be viewed as:

- i) a simultaneous adjunct of a prefix and a suffix: $[in+[grasso]_A+are]_V$ as in Darmesteter (1877), Crocco Galèas and Iacobini (1993), Iacobini (2004);
- ii) a type of prefixation followed by suffixation: $[[in+[grasso]_A]_V+are]_V$ as in Corbin (1987); see also a similar view in Montermini (2008), Todaro (2017);
- iii) suffixation followed by prefixation: $[in+[[grasso]_A+are]_V]_V$ as in Scalise (1990).

Each position entails that, from a cognitive point of view, parasynthesis displays a higher degree of complexity with respect to zero-derivation and suffixation. On the one hand, both the accounts posited by Corbin (1987) and Scalise (1990) would imply a two-step derivational process. On the other hand, the simultaneity of processes advocated by Crocco Galèas and Iacobini (1993) and Iacobini (2004) permits to view parasynthesis as a one-step process. However, this view also implies the presence of a special kind of circumfix, whose constituents are the prefix and a process of zero-derivation (or conversion, adopting the term used by the authors).¹ Such a process, which would be covert in nature, is however here overtly signalled by the prefix, which does not add any semantic value, but merely signals the transcategorizing process (see Iacobini 2004: 168–170 on the semantics of prefixes in Italian parasynthesis). All in all, whether we chose to adhere to such a proposal or the ones which view parasynthesis as a two-step derivation, it is evident that in parasynthetic verbs the transcategorization is overtly marked as in suffixed verbs. However, parasynthesis displays a higher degree of formal complexity with respect to suffixation and, importantly, according to both the prefixation and the circumfixation hypotheses, a less prototypical means to express that

¹ Crocco Galèas and Iacobini (1993) specify that the suffixal element of this circumfix is not the inflectional suffix appearing in parasynthetic verbs, but the process of transcategorization itself, which they define as *morphological metaphor*.

function, since in Italian the category change is generally not expressed by either a marking preceding the base (following Corbin 1987) or by a discontinuous affix (following Crocco Galèas and Iacobini 1993 and Iacobini 2004).

To summarize, in our study zero-derived verbs are opposed to suffixed and parasynthetic verbs on the basis of i) the overt vs covert nature of the trans categorization marking; ii) their degree of formal complexity; and iii) the different degrees of prototypicality of the trans categorization marking.

3.1 Research questions

Based on the foregoing, our experimental study aims at answering to the following research questions: i) is the processing of zero-derived verbs affected by the covert nature of its trans categorization marking, with respect to the open (and more iconic) marking exhibited by suffixed and parasynthetic verbs? ii) is the processing of zero-derived verbs affected by their formal simplicity, with respect to the higher degree of complexity of suffixed and parasynthetic verbs? iii) is the processing of zero-derived verbs affected by the low degree of prototypicality of the trans categorization marking in the Italian word formation system? In order to answer these questions, we conducted a psycholinguistic experiment, whose design will be outlined below.

3.2 Method

For our experiment we used a Lexical Decision Task (LDT) associated with the masked priming paradigm (Forster and Davis 1984). With this protocol, crucially, target items are preceded by prime stimuli which appear very briefly on the screen (usually 50 ms), so that participants are not aware of their presence. Although not consciously perceived, the prime typically induces a facilitation effect (in terms of word recognition times) in the recognition of the target, if it is perceived by the participant to be in some way connected to it. Such a facilitation is interpreted as the result of the pre-activation of the target induced by the presentation of a connected prime. A priming effect induced by a morphologically related prime is therefore considered proof that prime and target are connected in the mental lexicon. In Forster's words: "the most common interpretation of priming is that the cortical representations of the prime and target are interconnected or overlap in some way such that activating the representation of the prime automatically activates the representation of the target word" (Forster 1999: 5–6). Such

methodology is therefore particularly suited to investigate the automatic mechanisms which take place during the early phases of visual word recognition: because participants are not aware of the presence of the prime, which appears on the screen only for a few milliseconds, they cannot rely on any conscious response strategies based on the relationship manipulated between the prime and the target. The interest of using this experimental paradigm for our research questions is that it focuses on the (potential) connection between the mental lexical representation of nominal and adjectival base words and the verbs derived by them through either zero-derivation, suffixation, or parasynthesis. Therefore, through this methodology we should be able to observe not only the presence or absence of a transfer of activation, but also the strength of such connections between base words and their derivatives.

With respect to our research questions, if processing mechanisms are driven by formal simplicity principles, we should be able to observe a significant facilitation for zero-derived verbs with respect to suffixed and parasynthetic verbs. More precisely, we might expect to obtain a graded pattern, where zero-derivation yields the shortest RTs and parasynthesis the longest. On the other hand, if prototypicality plays a role during processing, zero-derived and parasynthetic verbs should not induce a significant facilitation, while suffixation should. Finally, if the overt vs covert nature of the transcategorization marking determines processing principles, we expect to observe different priming patterns for zero-derived verbs on the one hand, and suffixed and parasynthetic verbs on the other.

3.3 Stimuli and design

Thirty critical targets for each word formation process were selected for the present experiment. Overall, ninety critical prime-target pairs were created. Target items were presented to participants in one of the following three priming conditions: i) identity, i. e., prime and target were identical (in this condition, reaction times should be the fastest); ii) morphological, i. e., the prime was morphologically related to the target; iii) unrelated, i. e., the prime was not related to the target (in this condition, reaction times should be the slowest). Morphological and unrelated primes were matched as closely as possible for frequency and length both within the same set of items and across different sets (i. e., Zero-derivation, Suffixation and Parasynthesis), with priority given to frequency, since this variable is widely acknowledged to influence word recognition times (see Baayen et al. 2016 for review). As for the morphological primes, we decided to use the infinitival form. We acknowledge that this choice might potentially raise some concerns for the zero-derived items, which in this way superficially display

an overt marking (albeit not a derivational one). However, because we chose this form across the three sets of items (Zero-derivation, Suffixation and Parasynthesis), the degree of overlap between zero-derived morphological primes and their targets was still reduced compared to that of parasynthetic and suffixed primes and their targets, as envisioned in the design of this experiment. Moreover, among the eligible forms in terms of frequency, the infinitival forms were the only ones which allowed us to avoid cases of homonymity between prime and target within the zero-derived set of materials. Homonymity can occur with both first and third person inflected forms, with denominal verbs as in (*lei / lui*) *spazzola* ‘s/he brushes’ – *spazzola* ‘brush’ and deadjectival verbs, as in (*io*) *preciso* ‘I clarify’ – *preciso* ‘precise’. With respect to frequencies, t-tests showed that there were no significant differences between the target items belonging to the three sets, nor there was any significant difference between the frequency values of words used as morphological and unrelated primes within the same set of items (zero-derivation: $t(29) = 0.23$, $p > .10$; suffixation: $t(29) = -0.77$, $p > .10$; parasynthesis: $t(29) = -1.17$, $p > .10$). For the sake of consistency, across the three different sets of items, we strived to keep a balanced proportion for what concerns the syntactic category of target items and the semantic values added by the three derivational processes. Specifically, across the three sets of items, both nouns and adjectives were selected as targets (15 nouns and 15 adjectives for each set of items, with the exception of the Suffixation set, for which, due to frequency constraints, 12 nouns and 18 adjectives were selected). As for the semantics of the derived forms, we selected primarily causative/inchoative and resultative meanings, since such semantic values are the most commonly shared by the three different processes. Even though semantics was not a variable under study in this experiment, this was taken as a cautionary measure, since a number of studies found semantics to impact on word recognition even at early stages of lexical access (e. g., Feldman et al. 2009). We therefore strived to avoid such a potential confound and committed to compare derived forms exhibiting similar types of meaning. The experimental design, along with mean frequency (per million) and length values, is summarized in Tables 1 and 2.

In addition to the critical items, 90 non-word targets were created and for each nonword target, the correspondent identity, morphological and unrelated primes were created. Overall, this resulted in a total of 180 word and nonword targets. Three lists of stimuli were created where prime-target pairs were rotated across the three priming conditions by means of a Latin square design, so that participants, who received only one list, could see each target only once, in one of the possible three conditions.

Table 1: Experimental design.

	Priming conditions	Prime	Target
Zero-derivation	Identity	<i>preciso</i> ‘precise’	<i>PRECISO</i> ‘precise’
	Morphological	<i>precisare</i> ‘to clarify’	
	Unrelated	<i>diminuire</i> ‘decrease’	
Suffixation	Identity	<i>banale</i> ‘trivial’	<i>BANALE</i> ‘trivial’
	Morphological	<i>banalizzare</i> ‘to trivialize’	
	Unrelated	<i>inghiottire</i> ‘to swallow’	
Parasynthesis	Identity	<i>leggero</i> ‘light’	<i>LEGGERO</i> ‘light’
	Morphological	<i>alleggerire</i> ‘to lighten’	
	Unrelated	<i>schacciare</i> ‘to press’	

Table 2: Mean frequency and length values.

	Mean frequency and length values					
	Identity Morphological				Unrelated	
	Frequency	Length	Frequency	Length	Frequency	Length
Zero-derivation	4,0 (0,4)	6,8 (1,4)	3,1 (0,6)	10,4 (2,1)	3,1 (0,6)	9,6 (1,9)
Suffixation	4,2 (0,4)	7,1 (1,4)	3,1 (0,4)	12,1 (1,2)	3,1 (0,4)	10,9 (1,4)
Parasynthesis	4,1 (0,5)	6 (1)	3,2 (0,3)	10,4 (0,9)	3,2 (0,3)	9,4 (1,2)

3.4 Participants and procedure

29 adult native speakers of Italian, aged from 20 to 29 years (mean age: 23;3), participated in the experiment on a voluntary basis. All participants reported normal or corrected-to-normal vision and they all had university education. The experiment was run on a PC computer using the DMDX software (Forster and Forster 2003). Each trial consisted of three visual events: the first was a forward mask made up of a series of hash marks that appeared on the screen for 500 ms. The mask was immediately followed by the prime, which appeared on the screen for 50 ms. The target word was then presented and remained on the screen until participants responded or timed-out (after 3000 ms). To minimize visual overlap, primes were presented in lowercase and targets in uppercase, both in Arial 16. Participants were instructed to decide as quickly and accurately as possible whether the target stimuli they saw were words or not, by pressing the appropriate buttons on the keyboard. They were not aware that a prime word was presented.

After 10 practice trials, participants received the 180 items in two blocks.

3.5 Results

Data were cleaned considering accuracy rates for participants and items: given the high accuracy rate (higher than 89 %), none of them were excluded. Incorrect responses were removed and data points which were 2.5 SD above mean RTs for each condition were considered outliers and were trimmed accordingly (2,7 % of observations). By-subject analysis of variance was conducted with Prime Type and Process Type as within-participant factors. The analysis of reaction times showed a significant main effect of Prime Type ($F(2,56) = 21.33, p < .00001$). Process Type, on the other hand, approached significance ($F(2,56) = 2.45, p > .05$), while the interaction of Prime by Process Type did not ($F(4,112) = 1.15, p > .10$). Planned comparisons showed that the effect of morphological primes was significantly different from that induced by unrelated ones in both the suffixation and zero-derivation sets (respectively, $F(1,28) = 9.91, p < .01$; $F(1,28) = 6.63, p < .05$), and such facilitation was not significantly different from the one induced by identity primes ($F(1,28) = 0.05, p > .10$; $F(1,28) = 1.81, p > .10$). On the other hand, results for the set of parasynthetic items showed that morphological priming was only marginally significant compared to the effect yielded by unrelated primes ($F(1,28) = 3.01, p > .05$). Moreover, in this set of items, reaction times after parasynthetic primes were significantly different from those registered after identity primes ($F(1,28) = 10.25, p < .01$). All in all, therefore, we observed full priming effects on the recognition of the targets when the primes were either suffixed or zero-derived verbs, while the facilitation effect produced by the parasynthetic primes was only limited, and not comparable to the one induced by identity stimuli priming the same targets. Mean reaction times and net priming effects are summarized in the table below. An analysis of the error rates showed no main effect ($F_s < 1$), thus we did not analyze errors any further.

4 Discussion

The present study was aimed at comparing three productive word formation processes that derive verbs from nouns and adjectives. Specifically, we were interested in verifying whether three processes which are similar from the functional point of view exhibit any difference in the way they are perceived by speakers on the basis of the different formal exponents with which they are constructed and the degree of prototypicality of the function they realize.

There were several different lines of hypothesis according to which the relationship between base and derived forms might be perceived differently through

Table 3: Mean reaction times (RTs), standard deviations (SD), and net priming effects (*= $p < .05$).

	Prime Type	RTs	SD	Unrelated / Morphological	Unrelated / Identity
Zero-derivation	Identity	604	86	26*	14
	Morphological	617	72		
	Unrelated	643	89		
Suffixation	Identity	611	80	37*	3
	Morphological	614	92		
	Unrelated	651	94		
Parasynthesis	Identity	586	86	18	33*
	Morphological	620	90		
	Unrelated	637	87		

one of these three processes. One hypothesis we formulated is that, if speakers need the derivational relationship to be overtly expressed to be perceived, suffixation and parasynthesis should show strong priming effects, given that this condition is fully realized by the two processes. Along this line of reasoning, zero-derivation, on the other hand, was supposed to yield weaker (or absent) facilitation effects, since this could be thought of as the less iconic process, i. e., the less overtly marked one. However, following a competing hypothesis, greater priming patterns could also be anticipated for zero-derived forms, since these exhibit the highest degree of formal simplicity, even in a language like Italian, where verbal inflection is obligatory. Despite such obligatory inflectional marking, compared to parasynthesis (which exploits two affixes or what could be considered as a discontinuous affix), and to canonical verbal suffixation (which exhibits an overt derivational marking), zero-derivation is certainly the simplest among the three processes. On such grounds, therefore, it could be hypothesized that the relationship between zero-derived and their base forms should be, from a perceptual point of view, maximally transparent. Finally, if we consider the prototypicality of the means of realization of the transcategorizing function, suffixed words should have been favored, given that derivational suffixation is the canonical means to transcategorize a base into a new derived word.

Looking at the patterns of facilitation found in our study, we cannot confirm the hypothesis that the overtness of marking plays a role in the early stages of lexical access. This seems to be disconfirmed on the basis of two main observations. On the one hand, robust priming patterns were observed for the recognition of targets presented after a related zero-affixed verb, a fact which would not be expected if overtness were to play a role. Of course, one could argue that, in languages like

Italian, the process underlying zero derivation is not fully covert, given the presence of the obligatory inflectional ending. This observation, however, does not explain the weak patterns of activation observed between members of an overtly marked derivational relationship such as the one instantiated by parasynthesis. Facilitation effects induced by parasynthetic primes only marginally approached significance and were also significantly different from those induced by the identity baseline, representing what in the priming literature might be defined as *partial priming*. Our findings, therefore, cannot confirm the expectation that an overt marking should make the relationship between base and derivative more perceivable. The fact that parasynthetic verbs, which fully realize such overtness of marking, are less easily connected to their bases, indicate that such a parameter likely plays a minor role in the processing of morphologically complex words.

On the other hand, considerations about the formal complexity exhibited by the three processes might provide a better explanation for our results. When we consider the formal means through which the three processes are realized, a first intuitive interpretation pertains to the different amount of orthographic overlap between the base and the derivative. It could be tempting to interpret such results in these terms, especially when we consider that the masked priming methodology is supposed to be particularly sensitive to the formal characteristics of the stimuli. Indeed, while such an interpretation cannot be totally discarded, we argue that drawing such a conclusion might be unwarranted. When we consider the amount of overlap, zero-affixed verbs certainly are more closely related to their bases, while parasynthetic verbs overlap considerably less with their targets. On the other hand, a similarly reduced amount of orthographic overlap is exhibited by suffixed verbs. Interestingly, when trying to quantify such amounts of overlap based on the items used in our experiments,² we observe no significant difference between suffixation and parasynthesis ($t(29) = 1.16, p > .10$). Based on such observations, considering orthographic overlap as a major factor influencing the perception of the relationship between derived and base forms seems difficult to accept since in our experiment morphological prime-target pairs with similarly reduced orthographic overlap between base and derivatives (i. e., suffixation and parasynthesis) exhibited different priming patterns. Rather, suffixed words behaved similarly to zero-derived ones (i. e., words which overlap more with their bases). While the effects found for suffixed prime-target pairs cannot be directly

² Quantification of overlap was carried out with Match Calculator Davis and Bowers (2006), using the spatial coding option, which considers letters' serial position while also accounting for orthographic similarities between words even when the letters they share are shifted by one or more positions.

compared to those found for zero-affixed ones, a more graded pattern of results could have more straightforwardly singled out orthographic overlap as a determining factor. This is also compatible with what we know from the literature on masked priming effects, whose results have ruled out the possibility that orthographic overlap alone can determine facilitation patterns. On the one hand, a number of studies observed robust priming effects with allomorphic (i. e., showing formal variation) prime-target pairs (see e. g., McCormick et al. 2008; Pastizzo and Feldman 2002; Piccinin et al. 2018). On the other hand, words which overlap formally do not always necessarily prime each other, as shown not only by studies using orthographic primes (with no morphological relationship with the target), but also, and more importantly, by studies which find reduced effects for morphologically prime-target pairs, despite a high degree of formal overlap. The study by Neubauer and Clahsen (2009), for example, which found reduced priming for German irregular past participles in *-en* (*gefressen* < *fressen* ‘eat’), shows that highly overlapping prime-target pairs (in such participles, the overlap between the verb base form and its participle is considerably high) are not necessarily strongly connected in the mental lexicon, not even when forms of a same inflectional paradigm are considered. Based on such evidence, formal overlap alone is not, in our opinion, key to understanding our results, despite being part of their possible explanation, especially for what concerns parasynthesis. The (lack of) effect found for such a process is worth discussion because it sheds light on what factors are relevant in the perception of relationships between derived and base forms in the mental lexicon.

Formal complexity, however, intended as how easily perceivable is the base of a derivative, is not solely connected to a mere calculation of the overlap between two related words but could, in the case of parasynthesis, be more related to the presence of an initial element in the verbs created through this word formation pattern. With respect to the other two morphological schemas investigated, parasynthesis crucially differs for the presence of an initial prefixal element: it could, therefore, be argued that the base might for this reason be less perceivable for speakers. The literature on word recognition has indeed shown that word onsets are perceptually more salient than word endings and that language users generally prefer to process affixes after stems (see Cutler et al. 1985 for review), therefore, it could seem legitimate to assume that stimuli differing for their initial segments are more likely to be recognized slower. However, when we look at the literature on masked priming with prefixed stimuli, this interpretation seems less applicable. Psycholinguistic experiments focusing on prefixation are undoubtedly less frequent and their results do not always point to the same direction. A series of studies, using different methodologies, have highlighted the existence of differential patterns of results when prefixed words were used as critical items. However,

most of such studies have been conducted with either unprimed or overtly primed lexical decision tasks, therefore focusing on later stages of lexical access. When it comes to masked priming studies, the asymmetries between prefixed and suffixed words appear to be markedly reduced, since robust facilitation effects have been observed with various prime-target configurations, that is, either when both prime and target are prefixed (e. g., *deform* / *CONFORM*, Pastizzo and Feldman 2004) or when a prefixed item primes its simple target (e. g., *rename* / *NAME*, Diependaele et al. 2009). A growing number of studies have recently converged on the conclusion that base activation is likely position-independent. Heathcote et al. (2018), for example, found that base position (either initial, followed by a suffix, or final, preceded by a prefix) did not impact on priming patterns when primes were prefixed or suffixed English nonwords (e. g., *subcheap* / *CHEAP*, *cheapize* / *CHEAP*), and similar results were found with French nonword stimuli in the study by Beyersmann et al. (2016). The same conclusion is drawn in the study conducted on German by Ciaccio and Clahsen (2020), which directly compares the priming effects of prefixed and suffixed primes on the same targets (e. g., *sauber* ‘clean’ was primed by *Sauberkeit* ‘cleanliness’ and *unsauber* ‘unclean’), finding no significant differences. Such results seem robust enough to exclude the hypothesis that the presence of an affix before the base *per se* necessarily delays access to the base, thus hindering the perception of the derived-base relationship. It is, however, to be noted that, in parasynthesis, besides the derivational prefix we also find an inflectional suffix. Whether we consider such a process to be a two-step affixation (Corbin 1987; Scalise 1990) or a special kind of circumfix (Crocco Galèas and Iacobini 1993), as we have seen above, parasynthesis is likely to entail more perceptual complexity with respect to zero-derivation and suffixation. Despite this, the embedding of the base alone is not, in our view, *per se* sufficient to hinder its recognition. If that was the case, we should not be able to observe priming effects in those cases where any kind of discontinuous affix is present. That is not what we see, for example, in several studies on German regular past participle formation, where forms such as *gedichtet* ‘composed’ successfully prime *dichte* (e. g., Neubauer and Clahsen 2009; Silva and Clahsen 2008). Crucially, however, what parasynthesis adds with respect to such examples, is the category-changing function, and a semantic contribution to the derivative word thus created.

The alternative interpretation we therefore propose involves two potentially interplaying factors: on the one hand, the perceptual complexity of the morphological process instantiated by parasynthesis might be more relevant. Differently from what we see with suffixation and zero-derivation, parasynthesis entails the combination of two formal exponents to be attached to the base to realize the transcategorization process. Crucially, if we adhere to the theoretical proposals by either Corbin (1987) or Crocco Galèas and Iacobini (1993) we can consider such a

transcategorizing function to be realized in a less prototypical way, i. e., by means of prefixation (according to the former) or circumfixation (following the latter). Our results seem indeed to be compatible with such theoretical interpretations. Along this line of reasoning, we argue that it is precisely the combination between a low degree of prototypicality and the perceptual circumstance of having two affixal elements to hinder the recognition of the relationship between parasynthetic derivatives and their bases. Since zero-derivation is a less prototypical way to derive words too, we do not think that prototypicality alone could clarify the differing priming patterns we observed, while its combination with the perceptual characteristics of the derivatives might instead provide a better explanation. Such an interpretation has, in our view, some important implications for the understanding of zero-derivation, because it helps shed light on what organizing factors determine lexical storage and impact on subsequent lexical access, giving an insight into how relationships based on zero-derivation might be perceived by speakers. In this respect, zero-derivation does not behave differently from both its overt analogues, but only from parasynthesis, making it clear that overtness alone is not a sufficient condition for morphologically related words to be perceived as such. While it may be argued that zero-derivation is different from the canonical way of deriving words (i. e., overt suffixation), the results show that, from the speakers' point of view, these two word-formation patterns basically behave in a similar way. In our view, indeed, neither formal factors (either in terms of orthographic overlap or perception of the base) nor a supposedly lower degree of prototypicality alone can explain the results obtained with zero-derivation on the one hand, and with parasynthesis on the other. The fact that both the conditions of low prototypicality and reduced perception of the base are realized in parasynthesis seems to be compatible with a view that attributes a major role to their combined effect, rather than to their separate ones. On a related note, these results could also question the degree of prototypicality we might be tempted to attribute to zero-derivation, which appears as a process closer to canonical suffixation than could be thought.

5 Conclusions

The aim of our study was to verify whether the processing of zero-derived verbs in Italian differs from the processing of overtly derived verbs with similar functional and semantic characteristics, namely suffixed and parasynthetic verbs. The effect of the overt vs covert nature of the morphological process has been observed along with other parameters on which the three word-formation patterns diverge, i. e.,

their formal complexity and the prototypicality of their transcategorization marking. Because in our masked-priming experiment we obtained full priming effects for both zero-derived and suffixed verbs, we suggest that the overtness of the morphological process does not *per se* determine the perception of the morphological relationship between verbal derivatives and their bases. The fact of overt marking alone does not facilitate the activation of morphology at the early stages of word recognition is confirmed by the limited effect observed for parasynthetic verbs. Based on the priming patterned obtained with parasynthetic verbs, we therefore propose that an overt marking might hinder the perception of the morphological relationship when the transcategorizational function is realized in a less prototypical position. With respect to our research questions, the fact that zero-derivation behaves similarly to canonical suffixation supports, on the one hand, the view that zero-affixed forms are more similar to their overt analogues than we could think. However, on the basis of our results we stress that it seems to be less a matter of overtness/covertness, and more a matter of the combined effect of the overall perceptual complexity of the morphological schema and the prototypicality of its function that might determine how strongly morphologically related words are connected in the mental lexicon.

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