

Formal variation does not affect morphological processing: evidence from Italian

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1. Introduction

Psycholinguistic research on morphological processing conducted on a number of different languages has provided evidence for the role of morphology in the organization of the mental lexicon, at least when formal and semantic relationships among words are transparent, e.g. *dark* - *darkness*. When phonological/orthographical variation (allomorphy) occurs, however, the picture seems to be less clear, as contrasting evidence, mainly based on primed lexical decision tasks, has been produced. The investigation of the nature of allomorphic relations among inflected and derived words and their bases, e.g. *fall* - *fell*, *broad* - *breadth*, is of special interest for the understanding of how words are organized in the mental lexicon.

Traditional theoretical frameworks (mainly, generative approaches) account for allomorphic phenomena by either listing all possible stem variants in an arbitrary way or hypothesizing the existence of a stored underlying form from which all its possible surface realizations can be computed. According to the latter, existent allomorphs are not assumed to be stored, except for extreme cases such as those represented by strong suppletion, e.g. *go* - *went*, which will be necessarily stored in the lexicon. On the other hand, most usage-based theories differ in this respect, as they do not posit a clear-cut distinction between lexicon and rules. Rather, all complex words would be stored with varying degrees of morphological connections arising among them. That is, all types of formal variants will also be stored, embedded in the inflected or derivative forms that contain them. In particular, schema-based models of morphology view the lexicon as a highly structured ensemble organized in terms of paradigmatic relationships arising among morphologically related words, which cluster together in morphological families and morphological series (Bybee 1985, 1995; Booij 2010). While in these accounts morphological relatedness is perceived as a consequence of systematic form-meaning correspondences, formal variation is not assumed to block the perception of morphological schemas among words, which is instead considered a “robust process [...] not impeded by phonological differences” (Booij 2010: 251), at least as long as semantic consistency among forms is preserved.

Similarly, controversies also arise as far as the psychological implementations of such views are concerned. On the one hand, word-based models of lexical access, such as the supralexicale model proposed by Giraud and Grainger (2000, 2001; see also Giraud & Voga 2014 for its revised version), assume an abstract morphological level arising from the connections establishing among whole words in the lexicon. Importantly, this level would emerge despite phonological/orthographic variations found among related words. On the other hand, morpheme-based models (Taft & Forster 1975; Rastle et al. 2004) posit an obligatory morphemic decomposition which should fail to occur with stem alternants, such as those found in *fall* - *fell* or *broad* - *breadth*. A third possibility is represented by connectionist accounts, in which no explicit morphological level is assumed. In these models, it is only the degree of formal and semantic overlap among words to determine the establishment of the relationships arising among them.

So far, the debate on the impact produced by allomorphic variation on the recognition of morphological relations among words has mainly concentrated on the domain of inflection and tends to coincide with the regular *versus* irregular debate, in which the controversy has centred on the specific *casus belli* represented by irregular past tense forms, e.g. *teach - taught*. In the present study, we focus on the more neglected field of derivation, for which evidence about this specific issue is still scarce. More specifically, we considered the case of Italian derived nominalizations in *-tura* and *-zione* and their relationship with two of their potential bases of derivation, namely, the past participle and the infinitive form. As will be explained in more detail later, this choice has been motivated by the possibility to explore the relationship between two possible bases showing different degrees of formal transparency with respect to the same derivative, which should shed more light on the role played by allomorphic variation in morphological processing.

2. Previous studies on allomorphic relationships

Most studies investigated this issue by means of priming methodologies, which are particularly suited to the exploration of relationships among words, given that they involve the presentation of pairs of stimuli and assess the facilitation induced by one on the recognition of the other. Briefly, when the priming protocol is combined with a lexical decision task (the most common task in psycholinguistic studies), subjects are asked to decide as quickly and accurately as possible whether a stimulus (target) presented on a screen is a word or not. Target stimuli are preceded by so-called prime stimuli (which can be visible or not depending on the amount of time they remain on the screen) that can determine subjects' latencies depending on their relationship with the prime. Primes which are related to the targets will determine faster reaction times and fewer errors, while unrelated ones will trigger slowest responses. Priming methods have been widely used to investigate factors which can alter the perception of morphological relatedness among words and will therefore be exploited in the present work too. Before presenting our study, we will first discuss the main findings which emerged from priming studies on the issue of allomorphic variation.

2.1 Inflection

As hinted above, previous studies concerning the processing of allomorphic relationships have mainly concentrated on inflection, and especially on irregular past tense forms and the relationship with their verbal stem. The seminal study by Stanners et al. (1979) was among the first to investigate this issue by means of a lexical decision task with a long-lag priming design, where primes are visible to participants but separated from their targets by a number of intervening items, in order to reduce subjects' development of response strategies. In their study, Stanners et al. (1979) presented verbs which could be preceded by either regular, e.g. *pour - poured*, or irregular, e.g. *hang - hung*, past tense forms. While priming effects arose in both cases, the facilitation effect induced by regular bases was stronger than the one produced by bases exhibiting stem allomorphy, as revealed the comparison of these effects with those determined by an identity condition, where the prime is equal to the target and, therefore, fastest reaction times are usually observed. Similar empirical findings emerged in studies investigating different languages and using different priming protocols.¹ Such results were taken as evidence

¹ Cf. on English: Napps (1989), Marslen-Wilson (1999), Marslen-Wilson et al. (1995) with cross-modal and masked priming; on German: Sonnestuhl et al. (1999) with cross-modal priming; on Hebrew: Frost et al. (2000) with masked priming.

for the existence of two different mechanisms driving lexical access. Specifically, proponents of so-called dual-model accounts (Pinker 1991; Clahsen 1999) argued that structural properties of words should converge with their processing properties (Clahsen 1999: 996). Thus, regular forms (combinations of stem + affix) would be decomposed upon lexical access and only the stem would be accessed. Repeated access to the same shared stem would then produce its full activation. On the contrary, irregular forms would not be connected with their present forms via a shared stem, but through a set of associative links yielding reduced priming.

This picture is, however, complicated by the numerous studies in which equivalent facilitation effects triggered by regular and irregular forms were found.² While it is difficult to explain such disparate findings, Pastizzo and Feldman (2002) proposed to reconsider the framework within which such studies are interpreted; instead of positing a rigid dichotomy between regular and irregular categories, such results could be analyzed as a continuum of regularity. In this respect, an interesting insight can be gained from their study; they considered the priming effects of regular and irregular English past forms, by further dividing the set of irregular verbs into two subsets, according to their degree of formal overlap with the base. Interestingly, they obtained priming effects for regular and irregular forms with similar degrees of overlap, e.g. *hatched* - *hatch* and *fell* - *fall*, both sharing around 68% of their letters, but no effect was found for those irregular forms which are more formally distant from their base, e.g. *taught* - *teach* (56% of overlap). Their proposal entails that it is not the fact of being irregular *versus* regular to affect priming, but rather other dimensions, such as the degree of formal similarity, in which words may differ in a crucially gradient way.

2.2 Derivation

When we consider derivation, however, the picture is less clear, mainly due to the scarcity of studies on the issue of formal variation within the realm of derivation. There are good reasons to consider derivation separately from inflection. Even if we do not ascribe to the view proposed by certain types of dual-mechanism models (among others, Clahsen et al. 2003) which posit categorical differences between the two domains, there is no doubt that derivation and inflection exhibit different properties. Most notably, the semantic complexity derivational processes often add to the newly created word is generally greater than that brought about by inflection. Given that, in most cases, inflected forms are more tightly related to their base from a semantic point of view, it may be not surprising to find that the relationship between, for example, *fell* and *fall* is not affected by the formal disruption of the stem (Pastizzo & Feldman 2002; Crepaldi et al. 2010). Indeed, usage-based models typically predict semantic associations to be stronger than phonological ones in determining morphological relatedness. In addition, inflectional verbal paradigms benefit from the fact that their members belong to the same syntactic category, which could further reinforce the perceived degree of relatedness among their forms. Derivatives, on the other hand, can show greater variation in semantic complexity, both if compared to inflection, but also when derived pairs are examined (consider, for instance, cases of lexicalizations such as *department*).

Having said that, there are only a few studies, mainly on English, which have concentrated specifically on the issue of allomorphy in derivation. The above-mentioned study by Stanners et al. (1979) also compared the priming effects of inflection and derivation. The results that emerged highlighted that both derived words involving allomorphy, e.g. *describe* - *description*,

² Cf. on English: Pastizzo and Feldman (2002) with masked priming; on Italian: Orsolini and Marslen-Wilson (1997) with cross-modal priming; on French: Meunier and Marslen-Wilson (2004) with both cross modal and masked priming; on German: Smolka et al. (2007) with overt visual priming.

and inflected words, e.g. *burn - burned*, do prime the recognition of their stems, albeit only partially, i.e. to a significant lesser extent than identity primes do. In contrast, Fowler et al. (1985), using the same methodology and testing the same language (English), found equivalent priming effects for both allomorphic and non-allomorphic primes. In their study, the allomorphic variation could involve both the orthographic and phonological dimensions, e.g. *clear - clarify*, or only the phonological one, e.g. *heal - health*. No difference was found in both kinds of allomorphic variation compared to the facilitation produced by a transparent prime on the same target (*heal - healer, clear - clearly*). Similar results were obtained by Marslen-Wilson et al. (1994) through a cross-modal priming design (where the prime is auditory and the target is visual). Their study compared the priming effects triggered by formally transparent (*friendly - friend*) and opaque derivations (*elusive - elude, vanity - vain*), finding that these were equivalent.³ Importantly, they also included an orthographically (but not morphologically) related set of items (*tinsel - tin*) and demonstrated that the effects found for truly morphological relatives were not due to their degree of formal overlap.

Two more recent studies investigated further the issue of allomorphic processes using a masked priming methodology, in which participants do not consciously see the prime. This methodology, which is also used in the present study, can therefore provide a picture of the early phases of lexical access which could crucially differ from the one emerging from studies where the prime is visible, such as the above-mentioned. The first study was conducted on English by McCormick et al. (2008) and focused mainly on minor formal alterations occurring at the boundary between stems and affixes that impede perfect segmentation. Specifically, the study considered derivatives exhibiting: (i) a missing 'e' at the morpheme boundary, e.g. *adorable - adore*, (ii) a shared 'e' at the morpheme boundary, e.g. *lover - love*, (iii) a duplicated consonant at the morpheme boundary, e.g. *wrapper - wrap*. Interestingly, the priming effects induced by morphologically complex stimuli characterized by such orthographic alterations were found to be equivalent in magnitude to those induced by morphologically complex stimuli that can be parsed perfectly into their morphemic constituents. However, as noted by the authors themselves, the types of formal change considered in this study are highly predictable, to the point that they can be used productively in word formation (McCormick et al. 2008: 309). On the basis of such results, the authors conclude that a process of obligatory decomposition can take place during the early stages of word recognition despite the presence of minor orthographic alterations, at least when these can be predicted. The orthographic representations of the stems are thus claimed to be underspecified.

Interesting developments of this line of research were provided by the study by Orfanidou et al. (2011), which focused on cases exhibiting more disruptive stem changes in Greek complex words. The study aimed at exploring two stages of lexical access, by using both a masked priming and a delayed priming design. In the masked priming experiment, derivations containing allomorphic stems did not prime their verbal stem (e.g., *poto - pino*, 'drink - I drink'), contrary to what happened in formally transparent derivatives (e.g., *grafi - grafo*, 'writing - I write'). Notably, non-morphological and semantically unrelated prime-target pairs exhibiting the same degree of orthographic overlap of pairs like, e.g. *tricha - trivo* 'hair - I rub', did not prime each other either, while semantically unrelated, but orthographically transparent forms primed their targets, e.g. *mania - mana* 'mania - mother'.

On the other hand, both types of morphological primes facilitated the recognition of their targets in the delayed priming experiment, i.e. when the prime was fully visible, while both types of non-morphological and semantically opaque primes (*tricha* and *mania*) failed to

³ See also Marslen-Wilson and Zhou (1999) for analogous findings using an intra-modal auditory priming protocol.

facilitate their targets (*trivo* and *mana*). From these results, it seems that, when formal stem alterations are more extensive, the relationship between base and derivative is impaired, but only in the early phases of lexical access. At later stages, semantics would come into play ensuring priming in the *poto* - *pino* cases and inhibiting it in the *mania* - *mana* pairs.

Taken together, the interpretation arising from the findings from both studies is that, at early stages of word recognition, morphological relatives exhibiting minor and predictable formal changes would be flexible enough to undergo morpho-orthographic segmentation. Crucially, according to both studies, it is not the contribution of semantics that ensures priming effects, but merely a superficially ‘morphological’ structure exhibited by the prime words. When changes in the stems are more disruptive, however, this mechanism would be impaired, and, given that semantics plays no role according to the approach proposed by both studies,⁴ there would be no source of facilitation for the recognition of the targets.

3. The present study

Given the scarce amount of evidence concerning derivation, we propose to further contribute to the debate, focusing on Italian, a language for which evidence from priming studies is even less available (see, however, Orsolini & Marslen-Wilson 1997 for inflection). In particular, we focus on deverbal nominalizations in *-tura* and *-zione*. From a synchronic point of view, the base of derivation of most derivatives with these suffixes can be considered to be either the verbal theme or the past participle form, e.g. *bocciatura* ‘failure’ might equally derive from the past participle *bocciato* ‘failed’ or the verbal theme in the infinitival *bocciare* ‘to fail’; similarly, *riparazione* ‘repair’ might equally derive from *riparato* ‘repaired’ or *riparare* ‘to repair’. Analyses which take the infinitival stem or the participial stem have been proposed and can account for the formation of many such nominalizations.⁵ However, a number of nominalizations in *-tura* and *-zione* can only be thought of as derived from the past participle form of the verb (as many of them are in fact learned borrowings from the Latin past participle) and not from the verbal theme, e.g. *scritto* ‘written’ - *scrittura* ‘writing’, but not *scrivere* ‘to write’ - *scrittura*; *illuso* ‘deluded’ - *illusione* ‘illusion’, but not *illudere* ‘to deceive’ - *illusione* ‘illusion’. To elaborate, in the first set of verbs, both the past participle and the infinitival form hold a transparent relationship with the nominalization. In the second set of verbs, however, formal transparency is ensured only with respect to the participial stem, but not to the infinitival one, where the phonological shape appears to be altered.

On such grounds, our research question is centered on the understanding of whether the different amount of formal overlap found in given verbal paradigms can affect the perception and the recognition of a morphological relationship. In other words, we wonder whether such difference can influence the recognition of *illusione* when primed by *illuso* and by *illudere*. In order to investigate this question, we made use of a lexical decision task combined with the masked priming technique, in which we compared latencies to derived nominalizations of both types preceded by past participle and infinitival forms of the base verb. According to a morpheme-based view of lexical access, we should expect facilitation to arise only for the pair *illuso* - *illusione*, since the stem *illus-* should be pre-activated by the presentation of the prime and latencies should benefit from repeated stem activation. On the other hand, in a word-based model characterized by connections among words, positive links would be established among

⁴ Their interpretation, specifically, follows the morpho-orthographic segmentation account originally proposed by Rastle et al. (2004), and Rastle and Davis (2008).

⁵ See Thornton (2015), for a review of the debate on which one should be considered the base and her own proposal of an abstract stem formally coinciding with the imperative form.

all forms participating in the same morphological family and inflectional paradigms. Therefore, *delusione* is predicted to be connected with both *deluso* and *deludere* and, accordingly, priming effects should be observed among the two forms and the derivative.

3.1 Method

3.1.1 Participants

40 native speakers of Italian, 14 males and 26 females, aged from 20 to 33 years (mean age: 22,8), with normal or corrected-to-normal vision, participated in the experiment. All of them had high-school or university education and took part in the experiment voluntarily.

3.1.2 Stimuli and design

We selected 80 nominalizations in *-tura* and *-zione* as critical items to be used as targets in this experiment. They were further divided into two subsets, so that half of them (40) held a transparent relationship with both stem allomorphs and the other half was transparent only with respect to the participial stem. The experimental design comprised five prime conditions: (i) an identity condition, (ii) a morphological condition represented by past participle forms, (iii) another morphological condition represented by infinitival forms, (iv) an orthographic condition, and (v) an unrelated condition. For the purpose of the task, 80 non-words were constructed through the combination of a non-existent root and an existent suffix (either *-tura* or *-zione*, to prevent participants to develop response strategies), such as *crellosazione*, which, in the two morphological conditions, could be preceded by *crellosato* or *crellosare*. Five experimental lists were created, each containing 160 items, in which the prime conditions were rotated by means of a Latin square design. Each target word appeared only once in each list, primed by one of the possible primes (identity, morphological past participle, morphological infinitive, orthographic, and unrelated), so none of the participants saw the same target twice. The experimental design is summarized below:

Table 1: Experimental design

Condition	Transparent set	Opaque set
Identity	violazione/VIOLAZIONE	illusione/ILLUSIONE
Morphological (P. Part.)	violato/VIOLAZIONE	illuso/ILLUSIONE
Morphological (Inf.)	violare/VIOLAZIONE	illudere/ILLUSIONE
Orthographic	violino/VIOLAZIONE	illustre/ILLUSIONE
Unrelated	scadere/VIOLAZIONE	condire/ILLUSIONE

For the selection of the critical items, some criteria were followed: (i) we excluded cases where neither the verbal theme nor the participle form can be considered the base, e.g. *aggressione* ‘aggression’, which synchronically can be derived from neither *aggreddire* ‘to assault’ nor *aggreddito* ‘assaulted’, (ii) even though many of these deverbal nouns often have more than one semantic value, we avoided cases of semantic drift in which no explicit semantic link is present and semantic compositionality is lost, e.g. *statura* ‘height’, diachronically derived from *stare* ‘stay’. Moreover, all prime stimuli in both sets were carefully matched for frequency, with frequency estimates taken from the ItWac corpus. Word length was also controlled, so that

primes for the same target could differ in maximum two letters. Mean frequency and length values are given in table 2:

Table 2: Mean frequency and length values for primes

Overall		
Prime type	Frequency	Length
Morphological (P. Part.)	3,74	7,4
Morphological (Inf.)	3,65	8,3
Orthographic	3,64	7,9
Unrelated	3,69	7,6
Opaque set		
Prime type	Frequency	Length
Morphological (P. Part.)	3,79	6,7
Morphological (Inf.)	3,65	8,5
Orthographic	3,61	8,0
Unrelated	3,69	7,5
Transparent set		
Prime type	Frequency	Length
Morphological (P. Part.)	3,69	8,1
Morphological (Inf.)	3,66	8,1
Orthographic	3,67	7,8
Unrelated	3,70	7,7

Since a key feature of this experiment was the degree of formal overlap between primes and targets, particular attention was devoted to this aspect. On the one hand, transparent and opaque primes had to exhibit different degrees of orthographic overlap with their targets, for the experiment to be able to shed light on potential differences in facilitation effects. On the other hand, we tried to match the orthographic primes in both sets in order to distinguish form from form-and-meaning associations and to be able to evaluate their consequences for the recognition of the targets. Computation of formal overlap was performed using the MatchCalculator application by Davis and Bowers (2006). The relevant information is shown in table 3:

Table 3: Mean degree of overlap exhibited by primes and targets

Mean degree of overlap between primes and targets		
	Transparent set	Opaque set
Morphological (P. Part.)	0,77	0,82
Morphological (Inf.)	0,78	0,58
Orthographic	0,56	0,59

3.1.3 Procedure and apparatus

The experiment was run on a PC computer using the DMDX software (Forster & 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 500ms. The mask was immediately followed by the prime, which appeared on the screen for 66ms. 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 20 practice trials, participants received the 160 items in two blocks.

4. Results

Correct response times (RTs) were averaged across participants after excluding outliers (RTs that were two standard deviations above and below the mean, 4,63% of the data). Results are presented in Table 4. An ANOVA was performed on the data with prime type factor (identity, past participle, infinitive, orthographic, and unrelated) and transparency factor as within-participant factors. Since a Latin Square design was used, we did not perform separate subject and item analyses, but only a F1 statistic test, as recommended by Raaijmakers et al. (1999).

The analysis of RTs latencies showed a main effect for Transparency, $F(1,39)= 24.24$, $p < .0001$ and Prime Type, $F(4,156)= 15.42$, $p < .0001$. The interaction of transparency by prime was not significant, $F(4,156)=2.26$, $p > .05$. Significant differences ($p < .05$), as revealed by pairwise comparisons, are indicated in Table 4. An analysis of the error rates showed no main effect (All Fs < 1).

Table 4: Reaction Times and SD (in milliseconds), error rates (in %) for lexical decisions to word targets in each transparency and priming condition, with net priming effects relative to the identity, orthographic and the unrelated prime conditions. *: $p < .05$

	Prime type	RTs (SD)	Errors	U-I	O-I	U- Mpp	U- Mi	O- Mpp	O- Mi	Mpp- Mi
Opaque set	Identity	577(86)	1,25%	19*	22*	20*	21*	23*	24*	1
	Morphological pp	575(88)	0,94%							
	Morphological inf	575(74)	2,19%							
	Orthographic	599(92)	0,94%							
	Unrelated	595(79)	2,50%							
	Transparent set	Identity	589(95)	0%	42*	29*	41*	46*	28*	33*
Morphological pp	590(84)	1,88%								
Morphological inf	585(85)	1,56%								
Orthographic	618(95)	1,88%								
Unrelated	631(98)	2,50%								

Significant facilitation effects arose when the target was preceded by both types of morphological primes, suggesting that morphological relatedness is strongly perceived between nominalizations and both the possible bases in the verbal paradigm. Importantly, this was true for both transparent and opaque sets, indicating no advantage of more transparent primes in determining facilitation effects on the recognition of the derived form. Morphological effects were significant when compared to both the unrelated and the orthographic control conditions.

Moreover, there was no significant difference between the effects induced by the past participle and the infinitive primes in both sets. Priming effects induced by morphological primes in both the transparent and the opaque set did neither differ significantly from those triggered by identity primes, suggesting comparable magnitudes of facilitation.

5. General discussion

The findings that emerged from the present experiment clearly show equivalent amounts of facilitation induced by both past participle and infinitival primes in the recognition of Italian deverbal forms with *-zione* and *-tura*, irrespective of their formal transparency. This seems to indicate that the degree of morphological relatedness between two forms is not impaired when phonological alterations occur, as predicted by the above-mentioned word-based models of morphology. According to morpheme-based approaches, only the transparent stem *illus-* should be contacted during processing and, therefore, facilitation effects should be observed only when *illuso* is presented as a prime for *illusione*. However, the fact that even the less transparent form *illudere* yields significant priming would seem to suggest that access does not actually proceed through segmentation of morphemic constituents and identification of the stem.

The observed pattern of facilitation effects is in line with most research studies investigating allomorphic relationships through priming techniques. However, it is worth reminding that, in these works, facilitation effects were mainly observed through the use of cross-modal and overt priming methodologies, which, crucially, are supposed to reflect later stages of lexical access, tapping into a more central level of lexical representations. However, Orfanidou et al. (2011) obtained different patterns of facilitation effects depending on the methodology used; crucially, formally opaque morphological forms primed their targets in the delayed priming task, but failed to do so in the masked priming task. At this point, it is worth highlighting that while masked priming effects with allomorphic variants are not predicted within purely morpheme-based decompositional approaches, they have indeed been observed and accounted for by Crepaldi et al. (2010), as far as inflection is concerned. Using a masked priming experiment, the authors observed that, in English, a form such as *fell* facilitates the recognition of its base *fall* more than an orthographically-matched form, e.g. *fill*, and an unrelated control item, e.g. *hope*. To account for such results, Crepaldi et al. (2010) hypothesize the existence of a higher-level mediating between a semantic and a morpho-orthographic level, a so-called “lemma level”, where inflected words share their representation irrespective of orthographic transparency. Interestingly, according to this view, the lemma level would not have the primary role of capturing form-meaning covariation, but rather of storing individual lexical entries defined by a specific meaning and a set of lexical-syntactic properties. For this reason, the lemma level would concern only inflected words, while derived words would have independent representations.

In a similar vein, Orfanidou et al. (2011) propose to account for their data by assuming separate orthographic representations for the two allomorph stems, which share some features at a higher semantically informed level. According to the interpretation proposed by the authors, morphological relatedness among formally opaque items would not be perceived during the early phases of morphological processing, but would arise at later stages. They explain these findings by advocating the fact that semantics would only come into play at this later stage, while semantically-blind morphemic decomposition would operate at early phases. Variations in the phonological shape of the stem would determine failure for this decompositional process to apply, given that superficial phonological/orthographic consistency between the stem and its realization in the derivative is fundamental in this approach to acknowledging morphological relations, since no reliance on semantics is possible. Within this line of interpretation, facilitation found in the study by McCormick et al. (2008) is explained by proposing that this

segmentation is tolerant to predictable phonological changes, but not to more disruptive and unpredictable variations in the stem.

This approach cannot, however, account for the results presented in our study. Specifically, it is hard to reconcile the lack of reliance on semantics with the observed effects, since it seems unlikely that formal similarity alone can be sufficient to trigger priming effects, when the degree of such formal similarity is lessened, especially when we consider that orthographic control primes (matched for degree of overlap) did not induce significant facilitation. What is more, the kind of variation investigated here is not phonologically motivated and, therefore, not predictable. We propose, instead, that a word-based semantically informed model of lexical access such as the one proposed by Giraudo and Grainger (2000, 2001) can better integrate the present findings. In this model, the facilitation effects emerging with both the formally transparent (e.g., *illuso*) and the opaque (e.g., *illudere*) primes might be due to the fact that both forms, irrespective of their degree of transparency, activate the target by virtue of their connections with it, by means of the morphological schemas in which they participate. In fact, *illudere*, *illuso* and *illusione* can be conceived of as members of the same morphological family and, in addition, *illuso* and *illudere* also participate in a verbal paradigm, which, in Italian, constitutes a very rich inflectional pattern. This could further strengthen the relationship between the more opaque form *illudere* and the derivative *illusione*, therefore boosting facilitation effects among them. In this model, importantly, words would be accessed through their whole-form and priming effects would arise as a consequence of an abstract level of morphological representation emerging from connections among word units organized around morphological families, inflectional paradigms, and morphological series. Given the robustness of morphological family size effects (DeJong et al. 2000) and the fact that these have been shown to be semantic in nature, i.e. they are significantly stronger when only semantically consistent members of a family are taken into consideration, it seems more likely that priming effects among members of the same family derive from a morphological level informed by semantics. If no abstract symbolic level was present, on the other hand, we should have observed graded priming effects arising only as a consequence of the different degrees of formal overlap between primes and targets. Since this was not the case, our findings seem also to rule out a strong version of connectionist models which do not acknowledge an abstract morphological level.

Finally, it is to be noted that it is not necessarily the case that our data contradict those obtained by Orfanidou et al. (2011). In fact, although both studies made use of a masked priming methodology, different prime durations were used: 66 ms in the present work *versus* 42 ms in the Orfanidou et al. study. To elaborate, an alternative proposal could take into consideration the time-course of morphological priming effects. In other words, it may well be the case that the two studies reflect different windows in early phases of lexical access. Clearly, further evidence based on masked priming experiments is needed to settle this issue.

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