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Title: Does morphology play a role in L2 processing? Evidence from inflectional and derivational priming with Greek speakers of English

In the domain of bilingual/second language processing, the existence and exact role of linking representations in the organisation of the lexicon summarizes the questioning of a large body of psycholinguistic research over the last years. According to Bybee (1985; 1988), morphology is the factor that clusters the (monolingual) lexicon and this organisation transcends languages. Such an organisation would have deep implications for second language acquisition and would therefore be reflected in bilingual online processing.

Indeed, recent psycholinguistic literature investigates L2 processing with various methodologies among which masked priming is a privileged technique. From studies examining the role of morphology on cognate and non-cognate processing, with protocols in which both languages of the bilingual are presented, under same-script (e.g. Spanish-Catalan, Sánchez-Casas & García-Albea, 2005; Duñabeitia, Dimitropoulou, Morris & Diependaele, in press) or cross-script conditions (ex. Greek-French: Voga & Grainger, 2007; Voga 2005), research shows growing interest for L2 processing in advanced learners and bilinguals.

Debate has recently centered on the interpretation of persistent errors in morphological accuracy, focusing on the degree in which a lack of morphological accuracy indicates that the underlying syntactic component is permanently impaired (Prévost & White, 2000). In this context, a set of papers by Clahsen and colleagues have suggested that the computational component of morphological processing is impaired in both competence and processing (Clahsen, Felser, Neubauer, Sato & Silva, 2010; Silva & Clahsen, 2008). Instead of computational processing, second language learners are supposed to rely on declarative memory to list forms in the lexicon rather than create them with stems and affixes as native speakers.

Clahsen et al. (2010) as well as Silva & Clahsen (2008, henceforth referred to as S&C in this paper), confirm this hypothesis by putting forward evidence in favour of what we could call an insensitivity to morphological priming in L2 (English), particularly for inflectional priming. This insensitivity is based on what S&C call an "attenuation of the procedural and enhancement of the declarative system" (p. 246). In a masked priming protocol (with a 60 ms prime duration) inflectional priming is completely absent: advanced English learners with a rich morphological marking system in L1, like German speakers, did not perform better than learners with morphologically poor L1 systems (Chinese) in processing (English) inflections. The results for derivational priming indicate arithmetically important effects, which the authors admit as reflecting morphological parsing.

The results of the S&C study have been criticized on two accounts: the first one relates to protocols where the performance of native English and non-native is compared. Diependaele, Duñabeitia, Morris & Keuleers (2011) explore morphological processing using derivational relationships (e.g. *walker-WALK*) with a group of native English speakers and two groups of bilinguals with varying levels of proficiency in their English (L2) levels (Spanish-English and Dutch-English bilinguals). Results have shown similar priming patterns for the native participants and the two groups of bilinguals (i.e., no significant differences in the magnitude of the morphological priming effects). According to the these data, at medium and high levels of L2 proficiency, derived words from a non-native language are decomposed early and accessed through the constituent morphemes in a fashion similar to that of a native language. In other words, expertise or proficiency in a given language does not seem to be a prerequisite for masked morphological priming effects. Moreover, morphological decomposition of polymorphemic words, which is considered by the above authors as an automatic process, does not depend on the proficiency of the reader, in the language concerned. We observe here that the point the authors wish to make concerns the mandatory decomposition supposed to occur for all kinds of morphologically complex words and for all levels of proficiency. Note that, as we will see in the last part of this presentation, data exists against this "mandatory decomposition", but for the moment we prefer to keep focusing on the inconsistency between the S& C study and the Diependaele et al. study.

This inconsistency goes even further: a second, more direct criticism comes from a "modified replication" of the S&C study by Rehak & Juffs (2011), in which they obtain the opposite pattern for regular inflections. Moreover, a difference between the two L2 groups is found, with native Spanish speakers' reaction times patterning more like native English speakers than the Chinese L2 group. The modification relative to the S&C study concerned adding a Spanish-speaking group and also using prefixes. For the rest of the study, stimuli, task (lexical decision) and duration were identical. Despite these above differences, we can consider Rehak & Juffs a real replication (for the "critical experiments" 1, 2 and 3, since experiments 4 and 5 use prefixes) that does not yield the same results.

Given the importance of the issue (does morphology play a role in L2 acquisition and processing or not? Should we validate the hypothesis of "attenuated" sensitivity of L2 learners in priming effects for inflectional morphology?) it seemed important to us to replicate the S&C study with English advanced/proficient learners (as in the original study) whose L1 is a morphologically complex one, but written with a different alphabet: Greek. If our Greek subjects show "attenuated sensitivity" for L2 (English) morphology, Clahsen's position would be validated. If our Greek subjects show important inflectional priming, along with the studies presented before (Rehak & Juffs as well as Diependaele et al.), Clahsen's conclusions lose a lot of their validity.

We ran a replication of S& C with exactly the same stimuli, same masked priming protocol, with subjects who had Greek as L1 and English as L2, which they had learned as a foreign language. The task we used was lexical decision, and the only difference one can find is a 10 ms difference in the SOA: in the S&C study the prime duration was of 60ms, and in our study, it was of 50ms. Nevertheless, diminishing the SOA from 60 to 50 ms should normally diminish the amplitude of the morphological priming, since it is commonly admitted that increasing the SOA (while of course keeping it under the threshold of conscious perception) can influence positively morphological priming effects, given that the processing system has more time to process the prime (for an example in cross-script morphological priming, see Voga & Grainger, 2007; for an example in same-script priming, see Giraudo & Grainger, 2001, as well as Forster, Mohan & Hector, 2003).

Before going further, let us describe briefly the masked priming technique (Forster & Forster, 1984), widely used in several domains of psycholinguistic research, which allows us to shed light on the underlying representations without being influenced by strategic and episodic factors. This technique is used in order to study morphological relationships, e.g. Giraudo & Grainger (2001) for French, but also in a multitude of other domains, as for example same or cross-script bilingual processing (see first paragraph for references), with various degrees of connection to morphology. The general scheme is the following: the prime stimulus temporarily modifies the system in such a way that the recognition of the target will be facilitated, compared to the unrelated condition (control condition). For example, for the prime-target pair *fork-plate*, the prior (and very brief, 50ms in our case) presentation of the prime *fork* will activate the corresponding lexical entry *fork* but also other lexical entries semantically related as *knife*, *glass*, etc. and among them the target *PLATE*, whose identification time will be reduced, compared to the unrelated control condition (stimulus not related semantically, nor orthographically with no common letters in the same position). In morphological priming, for example, the unrelated condition (prime : *happy*; target: *BARE*) will be compared to the identity (repetition) condition *bare – BARE*, as well as the morphological condition, *bareness – BARE,* to take an example from the S&C derivation experiment. The difference between the unrelated and the related conditions will represent the morphological or the repetition effect. Usually, the repetition effect is considered to represent maximal facilitation, i.e. facilitation induced by the prime on processing the target.

Two experiments will be presented here, with the same participants, one on inflectional priming and the other on derivational priming. For methodological reasons, half of the subjects responded first to the inflectional and second to the derivational priming protocol and the other half the other way round. Participants were 30 native speakers of Greek, with an advanced level in English. Table 1 gives the results for the inflection and the derivation experiment.

Table 1. Reaction Times (RTs, in Milliseconds) lexical decisions to target words for the 50ms prime duration in the Repetition, Morphological (inflection in Exp.1a and derivation in Exp. 1b), and Unrelated conditions. Priming effects are calculated by subtracting the repetition and morphological condition from the unrelated condition (Un. – Rep. and Un. – Morph.).

	Repetition	Morphological	Unrelated	Net priming effects	
				Un - Rep	Un – Morph.
Exp. 1a Inflection	669	664	722	53	58
Exp. 1b Derivation	711	721	752	41	31

The statistical analysis, that we are not going to present extensively here, revealed a significant main effect of the prime type. Planned comparisons examined the effects of morphological primes relative to the unrelated prime condition on the one hand, and the repetition condition on the other. To summarize, inflection as well as derivation primes produced significant facilitation relative to the unrelated condition. Moreover, repetition did not differ from morphological conditions. These results reveal that not only robust morphological priming is obtained with Greek L2 learners of English (arithmetically more important for inflections than for derivations), but also that morphological priming induces the same facilitation than repetition priming, representing, in this kind of protocol, the maximal facilitation between prime and target.

These results are contradictory to those of S&C for the inflectional part, given that they do not find any inflectional priming, neither for the German nor for the Chinese learners' group, with which our Greek learners' reaction times seem to pattern quite well for the repetition as well as the unrelated conditions (in our study, 669 and 722 ms respectively, in the S&C study 646 and 730ms). For the derivational part, our Greek subjects seem to replicate the pattern found for German learners in the S&C study, i.e. 31ms for derivations in –ness (ex. *mildness – MILD*), vs 52ms in the original study, though our subjects' RTs are somewhat longer and do not exhibit the same repetition priming.

In the last part of this presentation, we will try to answer the question of how we should view morphology within the bilingual lexicon. By referring to data from various experiments using the masked priming paradigm, we will try to outline an account appropriate enough to include the following experimental facts:

a) That L2 learners exhibit inflectional and derivational priming in L2 protocols (Rehak & Juffs, 2011; the present non-replication of S&C; Diependaele et al., 2011).

b) That L2 (French) advanced learners (L1: Greek) exhibit morphological priming not only in the L2-L2 direction of priming (as in the studies cited above), but also, in the far more problematic direction L2 to L1. Cognate and morphological cross-language priming is obtained in the L2 to L1 direction for a certain type of stimuli (cognates etymologically belonging to L1, Voga, in press; Voga & Anastassiadis-Symeonidis, 2012), under circumstances where the orthographic cue (due to the difference of alphabet between L1 and L2) is present. This finding suggests that L2 words are not independent of morphological structuring of languages co-existing in the speakers' competence. It also corroborates the hypothesis related to the morphological nature (co-occurrence between meaning and form, Bybee, 1985; 1988) of connecting representations between the two languages; In other words, it points to the existence of morphological representations transcending languages.

c) That decomposition (in the monolingual domain) is less mandatory than it was believed to be until recently, since the tenants of this approach (Crepaldi, Rastle, Coltheart, & Nickels, 2010) admitted the possible "existence of a second higher-level source of masked morphological priming" and proposed a lemma-level composed of inflected words acting "at an interface between the orthographic lexicon and the semantic system" [see Giraudo & Voga (2013) for a more extensive discussion on this interesting point].

d) That whole-word processing may indeed be the locus of many effects, as Clahsen et al. (2010) suggest, and as data from various experiments show [e.g. monolingual French: Voga & Giraudo, 2009; monolingual Greek: Voga, Giraudo & Anastassiadis-Symeonidis (2012); bilingual Greek-French: studies cited in (b)]. Nevertheless, this should not be taken as evidence that the identification mechanism is blind to co-occurrences between meaning and form.

e) Finally, in cross-script bilingual processing (Voga & Anastassiadis-Symeonidis, 2012), as well as in same-script bilingual experiments (for ex. interlingual homograph recognition, Dijkstra, Moscoso del Prado Martin, Schulpen, Schreuder & Baayen, 2005) the influence of the morphological size variable seems to indicate that the decomposition of the morphologically complex word in smaller parts does not give us the whole picture, and sources outside the word itself should be considered, as for example its morphological family.

These facts orientate us towards a view where processing and storage of L2 words are not independent of morphological structuring of the languages co-existing in the speaker's competence, and morphology should not be omitted from the debate, as the recent studies on "attenuated sensibility to morphology" do. Our data (particularly the non-replication) are contrary to the hypothesis that "L2 learners mainly rely on full-form storage, while morphological parsing is underused or even absent in L2 processing" (S&C, p. 246). In order to advance our knowledge on bilingual/2nd language representation and processing, we have to specify the kind

of morphology we are speaking of: the converging point of the experimental data discussed in the last part of this presentation aims to demonstrate that morphology should not be considered as the concatenation of morphemes. The mandatory decompositional mechanism should be considered as the part of word processing applicable only to the surface form of words, whereas morphological processing deals with their internal structure and morphological effects are translated within the various kinds of relationships shared by related words.

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