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# DIFFERENTIAL PROCESSING EFFECTS WITHIN 2<sup>ND</sup> GROUP MODERN GREEK VERBS

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**ABSTRACT:** On-line processing of Greek 2nd group verbs was examined through a psycholinguistic experiment using the masked priming technique. The critical comparison concerned the effect of past tense primes on present tense targets between the two forms of the same verb: 2nd group basic verbs and their alternative forms. Results showed that alternative forms benefit from morphological priming whereas basic forms do not, and this cannot be compatible with a decompositional approach. We propose an interpretation with a lexeme based approach and the interactive activation model (IAM, McClelland & Rumelhart, 1981). In this discussion, we underline the difficulty in avoiding methodological caveats when transferring logic and material constitution techniques (mostly based on orthographic-phonological criteria) directly from one language to another. The experiment presented here highlights the need to consider the verbal system in its complexity when depicting morphological processing in a given language.

**KEYWORDS:** Aorist, masked priming, lexeme based approach, typological variation.

## 1. INTRODUCTION

Since Rumelhart & McClelland (1986) first presented their connectionist model of the English past tense system, the nature of morphological representation has divided psycholinguists. This question is central to debates about the nature of cognition, since it concerns the understanding of how the lexicon is organized in terms of structural units, and how these units interact with each other during lexical access. One of this domain's important controversies concerns the description of the core units of the lexicon, namely the *morpheme versus lexeme* problem. The former posits that a unit smaller than the word, preserving basic semantic and orthographic/phonological characteristics and commonly called *morpheme* is the structural unit of the lexicon, whereas the later argues that morphology is primarily a set of systematic correspondences between the forms and meanings of the words, and that the source of morphology is the network of paradigmatic relations between the existing words of a language. This position implies that it is the word that forms the basis of morphological operations, and that morphology cannot be defined as the concatenation of morphemes into words. As pointed out by Aronoff (1994), it is better to speak of *lexeme-based morphology*, because the term '*word-based*' has led to the misunderstanding that it is the concrete form of a word that is the basis for morphological operations. However, it is often an abstract stem form of a lexeme, which never surfaces as a concrete word form, that constitutes the basis for morphology, and hence, the term "lexeme-based" is more appropriate. This lexeme-based view of morphology is shared by many morphologists (Bybee, 1988; 2001, Booij, 2007): morphology is not the "syntax of morphemes" but the extension of patterns of existing systematic form-meaning correspondences between words.

The morpheme based approach has led to models claiming a general and mandatory decomposition of the surface form (Taft & Forster, 1975) as well as to theorizations in which decomposition occurs for some words, but not for others (e.g., Caramazza, Laudanna & Romani, 1988; Marslen-Wilson, Tyler, Waksler, & Older, 1994, Schreuder & Baayen, 1995; Pinker, 1991). Complex words are recognized either by applying a general computational rule that parses the word into its morphemes or by retrieving directly from memory the whole word form. This approach, including a large variety of theoretical frames, has to face findings that suggest that morphological processing is not an "all or

none” phenomenon and that different levels of semantic, orthographic or phonological similarity induce graded effects of morphological facilitation, at least as far as the priming technique is concerned (Frost, Deutsch, & Forster, 2000; Plaut & Gonnerman, 2000, Rueckl, Mikolinski, Raveh, Miner & Mars, 1997; Seidenberg & Gonnerman, 2000; also Velan, Frost, Deutsch, & Plaut, 2005). More recently, some authors have proposed that “morphological decomposition is a process that is applied to *all* morphologically structured stimuli, irrespective of their lexical, semantic, or syntactic characteristics” (Rastle & Davis, 2008: 949). This claim allows us to conclude that morphology does not play any particular role within the mental lexicon except in speeding up lexical access by splitting words into morpheme parts. Moreover, it rejects all morphological effects observed with non-decomposable words (e.g., fell – FALL, as in Pastizzo & Feldman (2002) where effects are estimated relative to orthographic controls, e.g. fill).

One of the difficulties of the study of morphology for alphabetic languages within psycholinguistic experimental settings is that morphology is correlated with semantic, orthographic and phonological factors. If we take the example of the masked priming paradigm which has been extensively used to shed light on early automatic processes relative to lexical access in general and morphological processing of inflections and derivations in particular (see Kinoshita & Lupker, 2003 for an overview of the technique), it manipulates word forms that can be easily (e.g. *walked*) or less easily (e.g. *taught*) segmented into morphemes. The first problem is thus that the different word forms entertain different kind of relations that can interfere with the morphological relation during on-line experiments.

The second characteristic of natural language morphology is that the verbal (or nominal) system from which the researcher has to extract his experimental stimuli cannot be described on the basis of the same criteria cross-linguistically, which means that distinctions and descriptions relevant for one language, (e.g. English) may be less relevant for another. Additionally, because of the nature of the experimental design, and given the fact that the psycholinguistic materials have to obey various types of constraints (from balanced frequencies to approximately same length and equivalent orthographic/phonological overlap within and across different categories of primes and targets, just to take the example of masked priming studies), linguistic description is not without its consequences. Or, to put it differently, the way in which linguistic description is instantiated on stimuli selection and experimental design has great implications regarding the outcome of the psycholinguistic research. To this respect, the discussion on the representation and processing of verbal inflection remained for a long time orientated to the regularity-irregularity dichotomy, with the tenants of the symbolic approach (Pinker & Prince, 1988, 1994) positing the segmentation process for regular and the direct look-up path for the irregular ones, and the connectionist approach positing the existence of a general mechanism, processing both regular and irregular inflections (e.g. Rumelhart & McClelland, 1986, Plaut & Gonnerman, 2000). We are not going to insist on the details of the conflict between the two approaches, neither the more recent attempts to bridge the gap between them (see for ex. Frost, Grainger & Rastle, 2005). What is of more interest to us is the fact that this discussion influenced to a considerable degree the working hypotheses and subsequently experimental designs in a multitude of languages, where this kind of distinction may be less useful than in English.

The verbal system of Modern Greek (MG) is such a case, where, first, the question of regularity vs irregularity is not of great interest (as Tsapkini, Kehayia & Jarema (2002) have demonstrated, see section 3 for further details) and second, where the grammatical description is not likely to reach psychological reality. Before going further, let us briefly emphasize the question that our contribution addresses and that the experiment reported below will underline. Given the “blank zones” of grammatical description, *a fortiori* in verbal systems of a great complexity, as the one of Modern Greek on the one hand, and the constraints induced by methodological considerations (constraints at least as rigid for designs coming from a “small” language like MG as for a language like English) on the other hand, is the experiment always tapping on the process it is supposed to? Or does it, in order to satisfy these methodological constraints locally (in the context of a particular psycholinguistic experiment), override certain important characteristics of the stimuli (and the language itself), given that these characteristics do not appear as especially relevant to the “main” discussions of the field? The study reported here will try to shed light on this kind of methodological bias.

## 1.1 Description of the MG verbal system

M. Triantafyllidis (1941: § 880, 901, 902) has distinguished two groups according to the stress: the 1st group, e.g. *δένω* ‘to tie’ and the 2<sup>nd</sup> group, e.g. *αγαπώ*<sup>1</sup> ‘to love’. In the 2<sup>nd</sup> group he distinguishes two classes, *αγαπώ, -άς* ‘to love, in the first and the second person’ and *λαλώ, -είς*, ‘to speak, in the first and the second person’. Finally, in the first class of the 2<sup>nd</sup> group he recognizes, as linguistic variation, the following alternative form: *αγαπά/-άει* ‘to love, in the third person’ (literary use).<sup>2</sup>

According to Babiniotis (1972), the simultaneous use of the two forms represents a dynamic trend to restructuring of the verbal system of MG, which has the possibility to change. He notes that *-άω*, ‘alternative ending of the first person’ is stronger than *-ώ*, ‘ending of the first person’ and he makes the prediction that *-άω* will prevail. He emphasizes that due to the evolution of *αγαπ-ώ* ‘to love’ to *αγαπά-ω* ‘to love alternative form’ an isosyllabic stem is obtained, as is the similarity of the tonic scheme to that of the 1<sup>st</sup> group and finally the creation of a V-ending stem. Despite all this, in his *Dictionnaire of the Modern Greek Language* (1998), the main lemma is *αγαπώ*, following the lexicographic tradition.

Holton, Mackridge & Philippaki (1997: 134-139) distinguish two groups according to the position of the stress: *γράφω* ‘to write’ (the vast majority of verbs) and *αγαπώ/-άω* ‘to love’ (the second, less official form).

Iordanidou (1992: 308) notes that in oral speech and in prose, verbs in *-άω* dominate, and that this dominance is not correlated to the social background of the speaker. Also, for speakers of lower educational level, *-άω* extends to other verbs (ending normally in *-ίζω* as well as *-ώ/-είς*) and in written language *-ώ* dominates (in cases where the *-ώ* does not dominate, there is not a great difference between the two). Finally, she notes that the choice of the speaker is predetermined and depends on the level of education, register (formal – informal) and/or the kind of language (oral-written, literary or academic).

Ralli-Hadjipanayotis (1987: 272-275) presents the two groups without any mention of the alternative form because her description does not specifically treat the inflectional morphemes. The alternative form ending in *-άω* appears only in the diachronic description (293-294).

Mackridge (1987: 263-264) refers to alternative forms as different on the basis of familiarity: *σ’ αγαπώ* ‘I love you’ is much less familiar than *σ’ αγαπάω* ‘I love you’ and the [+savant] prefers the ending *-ώ*, e.g. *διαθλώ* ‘to refract’.

Nevertheless, in grammar books and dictionaries the norm for the 2<sup>nd</sup> group is the form ending in stressed *ω* (*-ώ*<sup>3</sup>) with *-άω* as the alternative form. Consensus has it that dictionaries always present as the lemma the form ending in stressed *ω*, and they present the other one (*-άω*) as the alternative one (when they do present it), however, the causes of this tradition are not the object of the present work.

This raises the question of what is considered as the norm in a system. Kilani-Schoch (1988: 107) stresses that the norm is what dominates statistically, and is characterized by a certain stability, for ex. a stable inflectional class increases its members with neologisms as well as alternative forms. In this respect, we remark that all verb-formation suffixes are combined exclusively with the inflectional (non-stressed) *-ω* (e.g. *-ίζω, -άρω, -ώνω*), that in neological verbs the *-ω* is applied and that many [+savant] verbs in *-ώ* have developed the alternative form in *-ω*, e.g. *ανανεώ – ανανεώνω* ‘to renovate’, *συμβιώ – συμβιώνω* ‘to live together’, *ζωγραφώ – ζωγραφίζω* ‘to draw’. It is thus difficult to accept the claim that the *-ώ* is the norm, even though dictionaries and many grammar books treat it as such. From a psycholinguistic point of view, it would be highly unlikely that *-ώ* shares the same status with *-ω* in on-line processing and representation. This is what our experiment is designed for.

<sup>1</sup> Contrary to AG, in MG there is no infinitive, therefore the lemmatic form is in the first person of the Indicative present.

<sup>2</sup> From now on, on the basis of grammar descriptions we will call the form ending in *-ώ* basic and the one ending in *-άω* alternative.

<sup>3</sup> In the Dictionary of Modern Greek (of the Manolis Triantafyllidis Institute) we find 2731 verbs of the 1<sup>st</sup> group, 517 verbs of the 2<sup>nd</sup> group. Within the second group there are 258 learned verbs, e.g. *-ποιώ* ‘-do’, *-γραφώ* ‘-write’, *-δοτώ* ‘-give’, etc..

## 1.2 Residual activation of the “base” form.

The inherent complexity of the MG verbal system put aside, another area of interest, particularly for masked priming experiments and one which is connected to a previously raised issue (is the experiment always tapping on the process it is supposed to?), is the following : what should we consider as the “base” form of the verb and consequently use as the target ? Moreover, should we always use the base form of the verb as the target ? In the vast majority of masked priming studies, targets are the base forms of their morphological primes – inflections or derivations. Base or infinitive forms are at the same time the most frequent members of the paradigm, and, because of their high frequency, have quite a low threshold of activation. Consequently, a base/infinitive form is the easiest member of the paradigm to activate. Voga & Giraudo (2009), with French stimuli, show that when lexical decision is no longer operated on the member of the inflectional paradigm that is already the most activated (i.e. the infinitive form, as in Experiment 1a of the study), but on another member of the paradigm (the 1<sup>st</sup>/PL. inflexion, as in Exp. 1b of the same study), a larger window of processing can be observed. As the results of the two experiments taken together show, lexical interference effects arise, suggesting the influence of lexical competition. The detailed results are not of great interest here, but the link to the present work is quite clear: given that there is not a satisfactory answer as to which one of the two forms of 2<sup>nd</sup> group Greek verbs (basic or alternative) should be considered as the “base”, it would be interesting to compare them, within the same experiment in order to determine if one of the two forms has a special status within the paradigm. The most salient one should be the more pre-activated unit and therefore should benefit more from the presentation of the prime.

## 2. THE EXPERIMENT

### 2.1 Method

The experiment presented here uses 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. Drews & Zwitserlood (1995) for German and Dutch, Marslen-Wilson, Tyler, Waksler & Older (1994) for English, Giraudo & Grainger (2001) for French, but also in a multitude of other domains, as for example same or cross-script bilingual processing (e.g. Gollan, Forster & Frost (1997) for English-Hebrew, Voga & Grainger (2007) for Greek-French), with various degrees of connection with morphology.

Without entering into detail, 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) 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).

**Participants.** 51 native speakers of Greek, reporting normal or corrected vision participated in the experiment. They were students of the Aristotle University of Thessaloniki and they were not rewarded.

**Stimuli and design.** 120 verbs and 120 pseudoverbs were used as targets, always 1<sup>st</sup>/SG. There were three categories of targets (see Table 1 for examples):

- a) 30 verbs of the 2<sup>nd</sup> group, for example *τολμώ*, /*tolmó*/ ‘to dare’. Mean printed frequency of these verbs was of 5.2 occurrences<sup>1</sup>, in the corpus of 22.326.469 words.
- b) 30 verbs of the 2<sup>nd</sup> group, exactly the same as the verbs of category (a), in their alternative form, ex. *τολμάω*, /*tolmáo*/ ‘to dare’. Mean frequency of these verbs was of 13.9 occurrences (in the same corpus);

- c) 30 verbs of the 1<sup>st</sup> group, for ex. *ανθίζω*, /anθízo/ ‘to blossom’. Mean frequency of this group was of 17.2 occurrences (in the same corpus).

Finally, 30 verbs were included as fillers because the same subject responds, in the same list, to the form *τολμώ* as well as its alternative form *τολμάω*.

Each target was primed by three types of prime:

- the present inflection, 3<sup>rd</sup>/PL., for ex. *τολμάνε* /tolmánε/ for the target *τολμάω* /tolmáo/ and *τολμούν* /tolmoún/ for the target *τολμώ* /tolmó/ ‘to dare’.
- the past tense (aorist) inflection, for ex. *τόλμησα*, /tólmissa/, exactly the same for the categories (a) and (b) of targets.
- the control condition, i.e. another verb, without common letters (excepted the final *-ω*) in the same position.

We do not have enough space here to include a full description of the MG aorist, nevertheless we should briefly remark the following: first, as far as the stress position is concerned, the stress in the aorist inflection is always in the n-1 syllable compared to the stress in the present inflection, as can be seen in Table 1. This is the case for all categories of verbs, 1<sup>st</sup> and 2<sup>nd</sup> group alike, basic as well as alternative forms. Second, aorist formation in MG implies the adjunction of the sigmatic aspectual marker *-σ-* /s/, which, in the presence of consonants as φ /f/ or χ /x/ becomes *-ψ-*, psi, /ps/ or *-ξ-*, /ksi/ respectively. In this case, the sigmatic aspectual marker is present phonemically but has no graphemic instantiation. In order not to introduce any bias due to the aspectual marker, our stimuli have been matched one by one for the *-σ-* /s/ and the *-ξ-*, /ksi, /x/ aspectual marker of the aorist. For more details, see the grammar of Tonnet (2006) or the one of Holton, Mackridge & Philippaki-Warbuton (2004).

120 pseudoverbs were created respecting the phonotactic constraints of the language, and were matched for length with the real verbs. The primes of the pseudoverb targets matched the verb primes in terms of orthographic overlap and were constructed so as to mimic the present inflection, the past inflection as well as the unrelated primes for the verb primes. Three experimental lists were created by rotating the targets across the three priming conditions, using a Latin-square design. Given that target categories (a) and (b) correspond to the same verb [/tolmó/ for (a) and /tolmáo/ for (b)] and thus in a given list the basic as well as the alternative form for the same verb co-exist, we mixed the lists in order to remove the influence of repetition. We did so in such a way that, for a given subject, both target (basic and alternative) appeared in a given list, but were never preceded by the same prime. That means that the subject never saw the same prime-target pair more than once. Thus, each target appeared only once (for the 2<sup>nd</sup> group verbs, once for the basic and once for the alternative form), but was tested in all priming conditions across participants. The participants were randomly assigned to one of the three lists.

	Targets	Primes				
		Present	Orth. ovrl	Aorist	Orth. ovrl.	Unrelated
2 <sup>nd</sup> gr.	<i>πετώ</i> /petó/ [4.73lt] fly	<i>πετούν</i> /petoún/ [6.73 lt.]	3.73 lt.	<i>πέταξα</i> /pétaksa/ [6.6 lt.]	3.57 lt.	<i>σώνω</i> /sóno/ save
2 <sup>nd</sup> gr. altern.	<i>πετάω</i> /petáo/ [5.73 lt] fly	<i>πετάνε</i> /petáne/ [6.73 lt.]	4.73 lt.	<i>πέταξα</i> /pétaksa/ [6.6 lt.]	3.87 lt.	<i>φεύγω</i> /févgo/ leave
1st gr.	<i>πιάζω</i> /piézo/ [6.4 lt.] push	<i>πιέζουν</i> /piézoun/ [8.40 lt.]	5.43 lt.	<i>πίεσα</i> /piesa/ [6.46 lt.]	4.47 lt.	<i>κρίνω</i> /kríno/ judge

TABLE 1. SAMPLE STIMULI, WORD LENGTH AND DEGREE OF PRIME-TARGET OVERLAP FOR THE DIFFERENT PRIMING CONDITIONS (PRESENT INFLECTION, AORIST INFLECTION AND UNRELATED) AND THREE TYPES OF TARGETS (2<sup>ND</sup> GROUP, 2<sup>ND</sup> GROUP ALTERNATIVE, AND 1ST GROUP) TESTED IN THE EXPERIMENT.

**Procedure and Apparatus.** The experiment was conducted on a PC using DMDX software (Forster & Forster, 2003). Each trial consisted of three visual events. The first was a forward mask consisting of a row of nine hash marks that appeared for 500 msec. The mask was immediately followed by the prime. The prime was, in turn, immediately followed by the target word, which remained on the screen until the participants responded. The intertrial interval was 500 msec. The prime duration was 48msec. Primes appeared in the middle of the screen presented in lowercase characters (12 point). Targets were presented in 16-point Times New Roman in order to minimize purely visual overlap<sup>4</sup>. The participants were seated 50 cm from the computer screen. They were requested to make lexical decisions on the targets as quickly and as accurately as possible by pressing the appropriate key on the computer keyboard. After 16 practice trials, the participants received the 240 experimental trials in one block. A prime visibility test was conducted on a sub-group, but no participant reported seeing anything prior to the target.

## 2.2. Results

Correct RTs were averaged across participants after excluding outliers (RTs > 1500msec and RT < 350msec, 2.62% of the data). The results are presented in Table 2. An ANOVA was performed on the data, with prime type (present inflection, past inflection, unrelated) and type of target (2nd group, 2nd group alternative, and 1st group) as independent variables. As a Latin Square design was used in the present experiment, we did not performed separate subject and item analyses (as recommended by Raaijmakers, Schrijnemakers, & Gremmen, (1999), but only a *F*1 statistic test. The list factor was not significant and is not included in the analysis presented below.

There was a significant main effect of prime type,  $F(2, 100) = 34.08, p < .0001$ , with targets preceded by a related prime being responded to more quickly than those preceded by unrelated primes. The main factor ‘verb type’ was significant,  $F(2, 100) = 5.17, p < .01$ , as well as the interaction between prime type and category of verb,  $F(4, 200) = 3.76, p < .001$ .

Planned pairwise comparisons showed that the difference between the present tense and the unrelated conditions was significant for 2<sup>nd</sup> group basic verbs,  $F(1, 50) = 13.33, p < .0001$ , as well as for 2<sup>nd</sup> group alternatives,  $F(1, 50) = 14.08, p < .0001$ , and 1<sup>st</sup> group verbs,  $F(1, 50) = 16.39, p < .0001$ . When it comes to aorist priming, the effect is significant for 2<sup>nd</sup> group alternatives (28ms),  $F(1, 50) = 16.71, p < .0001$ , and 1<sup>st</sup> group verbs (39ms),  $F(1, 50) = 34.42, p < .0001$ , but not for 2<sup>nd</sup> group basic verbs (7ms),  $F(1, 50) = 1.21$ . Finally, the difference between present tense and aorist conditions is not significant for the 2<sup>nd</sup> gr. alternatives ( $F < 1$ ), where present and past tense priming have equivalent amplitude, but it is for 2<sup>nd</sup> gr. basic verbs,  $F(1, 50) = 4.78, p < .05$ , as well as for 1<sup>st</sup> gr. verbs,  $F(1, 50) = 6.26, p < .01$ .

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<sup>4</sup> We note that as far as the masked priming technique in MG is concerned, and contrarily to what happens for other languages, targets as well as primes are presented in lowercase letters, and not in uppercase for targets and lowercase for primes, as for ex. in English protocols. The aim of this adjustment is to conserve the tonic accent (on the right phoneme), given that stress removal or displacement for polysyllabic words may lead to lexeme disambiguation problems and thus slow down reaction times for critical items.

	Primes				
	Present (Pr.)	Aorist (Ao.)	Unrel. (U)	Net priming effects	
				U – Pr.	U-Ao.
2 <sup>nd</sup> gr. basic	608 (1.73)	623 (1.73)	630 (3.65)	22	7
2 <sup>nd</sup> alternatives	609 (1.53)	608 (1.73)	636 (2.5)	27	28
1 <sup>st</sup> gr.	628 (1.34)	612 (1.53)	651 (1.15)	23	39

TABLE 2. REACTION TIMES (RTS, IN MILLISECONDS) AND PERCENTAGES OF ERRORS FOR LEXICAL DECISIONS TO TARGETS IN THE PRESENT TENSE, AORIST AND UNRELATED PRIME CONDITIONS AND THE THREE CATEGORIES OF VERBS (2<sup>ND</sup> GR. BASIC, 2<sup>ND</sup> GR. ALTERNATIVES AND 1<sup>ST</sup> GR. VERBS), WITH NET PRIMING EFFECT RELATIVE TO THE UNRELATED PRIME CONDITIONS.

### 2.3. Discussion

The results of the experiment provide a straightforward response to the question of whether the 2<sup>nd</sup> gr. basic verbs should be considered the norm in MG: they perfectly illustrate a processing difference for aorist inflections between the basic 2<sup>nd</sup> group verbs and their alternatives (7 vs 28ms), whereas present tense inflections seem to be processed equally well for both 2<sup>nd</sup> group categories as well as the verbs of the 1<sup>st</sup> group (22 vs 27 vs 23ms respectively). The 11 ms difference in the aorist effect between 1<sup>st</sup> gr. and 2<sup>nd</sup> gr. alternatives (39 vs 28ms) did not reach significance and we will not comment on this any further. This 1<sup>st</sup> gr. priming condition was included in the experiment in order to ensure that, in the case of regular verbs ending in -ω, both types of inflection produced equivalent facilitation. We will focus instead on the processing difference between the two possible forms of the same verb, i.e. 2<sup>nd</sup> group basic and 2<sup>nd</sup> group alternative verbs.

With respect to the hypotheses under study, it is critical to stress that the two categories of 2<sup>nd</sup> gr. verbs do not differ either with regards to regularity or decomposability, yet their past inflections (aorist) behaved differently concerning the facilitation they provided on processing the two 2<sup>nd</sup> gr. targets, basic and alternative. The 2<sup>nd</sup> gr. alternative verbs benefited from aorist priming while the 2<sup>nd</sup> gr. basic did not. The fact that the present inflections for 2<sup>nd</sup> gr. basic verbs elicited priming of the same amplitude for the three categories of verbs, as well as the low error rate, ensures that the protocol was successful and that subjects really did process the stimuli.

The absence of past priming on basic 2<sup>nd</sup> gr. verbs cannot be explained on the basis of form factors either, i.e. that the preservation of the thematic vowel “a” between the present and the aorist (πετ-ά-ω, /pet-á-o/ and πέτ-α-ζα, /pét-a-xa/ ‘to fly’ and ‘flew’ respectively) for 2<sup>nd</sup> gr. alternatives but not for basic 2<sup>nd</sup> gr. verbs (πετ-ώ, /pet-ó/ and πέτ-α-ζα, /pét-a-xa/ ‘to fly’ and ‘flew’ respectively) would be responsible for the main result of our study. This claim that the differential aorist priming between the two forms of 2<sup>nd</sup> gr. verbs is nothing else than form priming (due to the presence of an extra phoneme in common *versus* its absence for basic verbs), having nothing to do with morphology, would have to explain a couple of other issues as well: first, why, under the conditions of our protocol, supposedly very favorable to form factors, does the difference in orthographic overlap between primes and targets for present conditions (3.73 graphemes for 2<sup>nd</sup> gr. basic, 4.73 for 2<sup>nd</sup> gr. alternatives and 5.43 for 1<sup>st</sup> gr., that is –almost - two graphemes between the first and the third group) leave unaffected present priming? Second, if the two-grapheme difference (in which is included the thematic vowel) in the overlap leaves unaffected present priming, on what grounds should the one-grapheme difference for aorist conditions (3.57 for basic, 3.87 for alternatives and 4.47 for 1<sup>st</sup> group) affect aorist priming?

It becomes clear that, even if one admits that the protocol is sensitive to form factors, these low-level form factors have not (or at least equally) influenced our results, as can be seen from their general pattern. At last, we have to underline that from the 30 alternative forms [category (b) of



targets] used in the experiment, only 11 kept the thematic vowel “a” in the same position (and two conserve it in a n-1 position). The 17 remaining forms did not instantiate the “a” as thematic vowel but another vowel (η, /i/), so that we cannot speak in this case of conservation of the thematic vowel.

### 3. GENERAL DISCUSSION

The main outcome of our study, i.e. differential past tense priming for the two forms of the same 2<sup>nd</sup> group verb (basic and alternative) raises the question of the morpheme versus lexeme problem. Indeed, it is difficult to see how a traditional decompositional model (Taft, 1994, Caramazza, Laudanna, & Romani, 1988, Schreuder & Baayen, 1995) could fit our results. If any complex form, whether the prime or the target, is systematically divided into its constituent morphemes at the morphological level, the aorist related forms should prime the basic as well as the alternative 2<sup>nd</sup> group verbs equally well since they are *all* equally decomposable (for example, *τολμ-άω* – *τόλμ-η-σα*, /*tolm-áo* – *tólm-i-ssa*/, ‘*I dare* – *I dared*’, does not differ in this respect from *τολμ-ώ* – *τόλμ-η-σα*, /*tolm-ó* – *tólm-i-ssa*/, ‘*I dare* – *I dared*’). Thus, the morphemic account has to be excluded, since it cannot provide an explanation for different priming effects for equally decomposable and regular forms (moreover of the same verb).

The interpretation we propose integrates a lexematic approach of verbal inflection, within a model based on interactive activation (IAM, McClelland & Rumelhart, 1981, Rumelhart & McClelland, 1982). In this kind of model, as well as in the model of serial search (Forster, 1976) and in the organization of the mental lexicon presented by Bybee (2007), a lexical unit with an important token frequency will have an activation threshold lower than a unit with a lower frequency, for ex. *τολμάω* > *τολμώ*. Consequently, the target *τολμάω* will be easier and quicker to activate, because of its elevated (relative) frequency. Our study showed that as far as 2<sup>nd</sup> group MG verbs are concerned, the alternative form should be considered as the base, i.e. the most easily activated member of the paradigm. This processing inside the verbal paradigm would be fully compatible with a supra-lexical representation of morphology in the mental lexicon (Giraud & Grainger, 2003; Voga & Giraud, 2009), according to which the morphological level is situated above the lexical level, in a way that what happens in the lexical (whole-word) level influences morphological processing. With such an architecture, it is clear that different frequencies of use (in our case much more different in oral than in written speech) will lead to differential priming effects. We have to remark here that within this interpretation and given the supposed equivalence of connections within the verbal paradigm (equivalence that, in our sense, serves mostly symmetry in visualizing morphological representation, despite the existence of psycholinguistic data showing that all inflections do not behave uniformly), we should obtain differential present priming as well, or, at least, different present effects for the basic and the alternative types of 2<sup>nd</sup> group verbs, which is not the case with our results. We can nevertheless neutralize this caveat if we hypothesize a stronger connectivity between members of the present paradigm, than between members of the present and the aorist paradigm. Following the analysis by Aronoff (1994), Bonami, Boyer & Kerleroux (2009) propose a description for the French inflection based on a collection of radicals - instead of a single and unique radical - and assume a network of dependency relations between the different themes (or radicals) of a verbal lexeme. In such an organization of the inflectional paradigm, the more oral, more frequent alternative type of 2<sup>nd</sup> group verbs would be connected equally well to members of the present paradigm and to those of the aorist paradigm. On the other hand, less frequently used basic forms would have direct connections with the present paradigm, but less direct ones with the aorist paradigm (possibly because of the competition they undergo from the alternative present forms).

If we turn now to methodological issues, the fact that the psycholinguistic discussion on morphology has for a long time been orientated towards regularity and decomposability is not by chance, but due to the fact that the field remained, for more than two decades, centered on English. As far as the study of MG is concerned, we can give the example of the comparison of categories formed on the basis of purely orthographic-phonological criteria, for ex. the presence versus absence of the

aoristic *-σ-* in Tsapkini, Jarema & Kehayia (2002), which constitutes the basis for the categorization on regularity (based on Ralli-Hatzipanayiotis, 1987). This study, in which the verbs of the 2<sup>nd</sup> group are represented (but as far as we know, not in their alternative form), reaches the conclusion that the four, different on regularity, categories do not significantly differ between them. Nevertheless, the results show important arithmetic differences between the categories, which render the generalization throughout Greek verbs rather problematic.

We can reasonably enough wonder why only the basic form of 2<sup>nd</sup> group verbs is taken into account in Tsapkini, Jarema & Kehayia (2002). In Voga & Grainger (2004) the alternative form is taken into account, but not because of its ecological validity for the psycholinguistic experiment, but rather because it serves the same-grapheme-in-the-same-position count, crucial for the purposes of the experiment. Even though the reasons are not identical, we can say that these two studies follow the logic described above i.e. comparing categories formed on purely orthographic-phonological criteria.

One can reply that this is precisely the logic of creating experimental materials for masked priming experiments, since masked priming first started to be used, because the experimentalist cannot circumvent the numerous methodological constraints of the protocol.

The second possible answer has to do with the influence of the distinctions, hypotheses and rationale (along with the unavoidable and of course necessary constraints of experimental material constitution) of international (quite influenced by English) as well as English and American psycholinguistics with which authors of studies in small languages try to be consistent, as far as design and materials are concerned. From this perspective, the distinction between more familiar, more (orally) frequent and less familiar, less (orally) frequent forms, is void of interest *per se* for the study of morphology and can only be studied as subordinate to formal ortho-phonological categorizations (as in Voga & Grainger, 2004).

We can possibly ask ourselves if the tendency to adopt the same frames and settings, trying to reproduce the same “scale” of materials as in English, and, at the same time, excluding from study some hypotheses or distinctions of a given “small” language, is due to a classic pressure-to-norm self-censorship. This is especially pertinent given the impressive amount of perfectly conducted, very interesting psycholinguistic studies on English morphology, where different forms of the same verb simply do not exist, at least for processing written morphology. If psycholinguistics’ aim consists in providing a general theory of morphological processing, it is of crucial importance not only to take into account a variety of languages, but also to consider these languages in their (possible and not mandatory) differences arising from historical or other reasons. The elucidation of mechanisms underlying morphological representation and processing should not pass by the rejection of typological variation in order to produce protocols resembling those of languages for which the hypotheses have originally been formulated. We think that removing these pre-established ways of working with small languages will be beneficial to morphology in general.

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<sup>i</sup> As stated above, alternative forms are seldom used in dictionaries and are usually absent from printed frequency databases. In order to control the frequency factor in the best possible way, we used frequencies from a dynamic corpus of Greek newspapers, one of the very few including alternative verb forms. The frequency database, based on the Dictionnaire Inverse (2002), was kindly provided to us by Dimitra Alexandridou, Université Paris XIII. We sincerely thank her for her help.