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Native and non-native processing of morphologically complex words in Italian

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ABSTRACT

The present work focuses on the organization of the mental lexicon in native and non-native speakers and aims at investigating whether words are connected in the mind in terms of morphological criteria, i.e., through a network of associations establishing when a co-occurrence of form and meaning is found. Psycholinguistic research on native lexical access has demonstrated that morphology indeed underlies the organization of the mental lexicon, even though controversies about the *locus* of this level of organization remain. On the other hand, research in the field of second language acquisition has only recently turned to investigate such issues and its findings so far have been controversial. Specifically, the debate centers on whether native and non-native speakers share the same processing systems. According to recent proposals (Heyer & Clahsen 2015), this would not be the case and L2 processing would be more affected by formal rather than morphological criteria. In this light, the present work is aimed at verifying the impact of formal characteristics in native and non-native lexical access focusing on the processing of formally transparent versus non-transparent words in Italian. Two morphological phenomena are investigated by means of four psycholinguistic experiments involving a lexical decision task combined with the masked priming paradigm. Experiments 1 & 2 compare the processing of allomorphic vs non-allomorphic derivatives, to investigate whether formal alterations impair the appreciation of the relationship between two morphologically related words. Experiments 3 & 4 are focused on lack of base autonomy found in so-called bound stems, i.e., stems which cannot occur in isolation and are aimed at determining whether the processing of free and bound stems differs. The results of Experiments 1 and 2 indicate that allomorphic variation does not influence the associations established among related words in native speakers, in line with the predictions that can be formulated within usage-based perspectives on language. Non-native speakers, on the other hand, seem to be more pervasively affected by the phonological/orthographical properties of words, but not to the point that transparent morphological relations can be reduced to mere form overlap shared by morphological relatives. Likewise, stem autonomy was not found to affect the way

words containing bound and free stems are processed by native speakers, at least under certain conditions, suggesting that boundedness is not an issue influencing the establishment of morphological relationships among words. Non-native speakers, however, were found to be sensitive to the isolability of the stem, in a way that suggests that free bases may be more salient morphological units for them, as opposed to bound stems, which are seemingly more closely associated with orthographic strings resembling each other. Taken together, the findings of the present work suggest a model of the native mental lexicon based on words and morphological schemas emerging from the relationships establishing among them, despite phonological variations and stem boundedness. While it is unclear whether such a system of connections and schemas is equally strong in the non-native lexicon, morphological relationships still appear to drive lexical organization. Crucially, however, such organization is modulated by form, as demonstrated by the effects of phonological variations and lack of base autonomy.

SOMMARIO

Il presente lavoro è incentrato sulla questione dell'organizzazione del lessico mentale di parlanti nativi e non nativi e si prefigge l'obiettivo di verificare se le parole siano tra loro connesse secondo criteri morfologici, ovvero tramite una rete di associazioni emergenti sulla base di una correlazione sistematica tra forma e significato. I risultati della ricerca psicolinguistica sull'accesso lessicale di parlanti nativi hanno dimostrato che la morfologia organizzerebbe di fatto il lessico mentale, sebbene il dibattito sia ancora acceso riguardo al *locus* in cui questo livello di organizzazione sarebbe contenuto. D'altra parte, la ricerca nel campo dell'acquisizione di lingue seconde si è solo recentemente rivolta verso questo tipo di questioni e i risultati sino ad ora prodotti rimangono controversi. Nello specifico, il dibattito è incentrato sulla possibilità che parlanti nativi e non nativi abbiano accesso agli stessi meccanismi di processazione. Secondo una recente proposta (Heyer & Clahsen 2015), ciò non sarebbe possibile e gli apprendenti sarebbero di fatto influenzati in misura maggiore da caratteristiche puramente formali piuttosto che da quelle morfologiche. Alla luce di tale proposta, il presente lavoro si propone

di verificare l'impatto delle caratteristiche di forma durante la fase di accesso lessicale in parlanti nativi e non nativi, concentrandosi sulla processazione di forme trasparenti e non trasparenti in italiano. Nello specifico, due fenomeni morfologici sono indagati tramite quattro esperimenti psicolinguistici in cui il compito di decisione lessicale è combinato con il paradigma del prime mascherato.

Gli esperimenti 1 e 2 paragonano la processazione di forme derivate allomorfe e non, al fine di capire se alterazioni ti tipo formale indeboliscano la percezione di una relazione tra due forme correlate tra loro morfologicamente. Gli esperimenti 3 e 4 si concentrano invece sulla questione della mancata autonomia della base nelle cosiddette basi legate, ovvero quelle basi che non possono ricorrere da sole. Tali esperimenti sono mirati a determinare se la processazione di basi libere e legate differisca. I risultati degli esperimenti 1 e 2 indicano che la variazione allomorfica non influenza le associazioni tra forme correlate in parlanti nativi, in linea con quanto previsto sulla base di modelli linguistici usage-based. D'altra parte, i parlanti non nativi sembrano essere più influenzati dalle proprietà fonologiche/ortografiche delle parole, ma non al punto che le relazioni morfologiche trasparenti possano essere unicamente assimilate a relazioni di mera forma. Similmente, non si sono trovati effetti dell'autonomia della base sul modo in cui parole che contengono basi legate o libere vengono processate dai parlanti nativi, perlomeno in certe condizioni. Ciò suggerisce che il fatto che una base sia legata non impedisce lo stabilirsi di relazioni morfologiche tra parole. I parlanti non nativi si sono però rivelati essere sensibili a questa variabile, in un modo che sembra suggerire che le basi libere possano di fatto rappresentare delle unità morfologiche più salienti, al contrario di ciò che avviene per le basi legate, che sarebbero invece percepite come più vicine a stringhe ortograficamente simili. Da un punto di vista globale, i risultati della presente ricerca potrebbero suggerire un modello del lessico mentale nativo basato su parole e su schemi morfologici che emergono a partire dalle relazioni instauratesi tra queste ultime e ciò nonostante l'eventuale presenza di variazioni fonologiche o di basi legate. Sebbene non sia chiaro se un tale sistema basato su connessioni e schemi sia ugualmente forte nel lessico non nativo, relazioni di tipo morfologico sembrano comunque guidare l'organizzazione lessicale. Tale organizzazione sarebbe però allo stesso tempo maggiormente influenzata dal ruolo

della forma, come dimostrato dagli effetti dovuti alle variazioni fonologiche e alla mancanza di autonomia della base.

RÉSUMÉ

Le présent travail porte sur l'organisation du lexique mental chez les locuteurs natifs et non natifs de l'italien et vise à déterminer si les mots sont connectés selon des critères morphologiques, c'est-à-dire à travers un réseau d'associations qui s'établissent lorsqu'une cooccurrence de forme et de sens est reconnue. La recherche psycholinguistique sur l'accès lexical natif a démontré que l'organisation du lexique mental est largement fondée sur paramètres morphologiques, même si des controverses subsistent quant au locus de ce niveau d'organisation. Par contre, la recherche dans le domaine de l'acquisition des langues secondes s'est tournée vers l'étude de ces questions seulement récemment et ses conclusions ont jusqu'ici été relativement controversées.

Plus précisément, la question se pose de savoir si les locuteurs natifs et non natifs partagent les mêmes systèmes de traitement des mots morphologiquement complexes. Selon des propositions récentes (Heyer & Clahsen 2015), ce ne serait pas le cas puisque le traitement de la L2 serait davantage affecté par des critères formels que morphologiques.

Dans cette perspective, le présent travail vise à vérifier l'impact des caractéristiques formelles dans l'accès lexical natif et non natif en se focalisant sur le traitement des mots formellement transparents par rapport aux mots non-transparents en italien. Deux phénomènes morphologiques sont étudiés au moyen de quatre expériences psycholinguistiques impliquant une tâche de décision lexicale combinée avec le paradigme d'amorçage masqué. Les expériences 1 et 2 comparent le traitement des dérivés allomorphes et non allomorphes, afin de déterminer si les altérations formelles réduisent la perception de la relation entre deux mots morphologiquement reliés. Les expériences 3 et 4 portent sur le manque d'autonomie des bases qui se trouvent dans les racines liées, c'est-à-dire des racines qui n'apparaissent pas isolément et visent à déterminer si le traitement des racines libres et liées diffère.

Les résultats des expériences 1 et 2 indiquent que la variation allomorphique n'influence pas les associations qui s'établissent entre mots morphologiquement reliés chez les locuteurs natifs, conformément aux prédictions qui peuvent être formulées dans le cadre des perspectives linguistiques basées sur l'usage. D'autre part, les locuteurs non natifs semblent être plus sensibles aux propriétés phonologiques/orthographiques des mots ; cependant les relations morphologiques transparentes ne relèvent pas d'une simple proximité formelle.

De même, l'autonomie de la racine n'affecte pas la manière dont les mots contenant des racines liées et libres sont traités par des locuteurs natifs, ce qui suggère que le manque d'autonomie n'empêche pas l'établissement de relations morphologiques entre les mots. Par contre, les locuteurs non natifs se sont montrés sensibles à l'isolabilité de la racine, suggérant que pour ces locuteurs les bases libres sont des unités morphologiques plus saillantes par rapport aux racines liées.

Dans l'ensemble, les résultats de la présente étude favorisent un modèle du lexique mental natif basé sur les mots et les schémas morphologiques qui émergent des relations s'établissant entre eux, ce malgré les variations phonologiques et le manque d'autonomie de la racine. Bien qu'il ne soit pas clair qu'un tel système de connexions et de schémas soit tout aussi efficace dans le lexique non-natif, les relations morphologiques semblent toutefois intervenir dans l'organisation du lexical. Cette organisation est davantage modulée par la forme, comme le montrent les effets des variations phonologiques et le manque d'autonomie de la base.

Table of contents

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INTRODUCTION

The present work is aimed at investigating how the lexicon is organized in the mind of native and non-native speakers and specifically, the way in which morphology appears to drive such an organization and, as a consequence, lexical access. The study proposes to investigate more in detail the field of visual recognition of derivational morphology in Italian, a language on which a certain amount of evidence has been presented as for the domain of inflection, but less so for derivation. Moreover, since the vast majority of the studies conducted on this topic in Italian are based on results coming from lexical decision tasks, we propose here new evidence deriving from the combination of such methods with the psycholinguistic protocol of the masked priming paradigm. This method has enjoyed a good amount of fortune in studies on other languages, for the numerous advantages it implies and its capability to provide an account of the automatic processes underlying lexical access.

The present work thus intends to provide further contribution to the understanding of such mechanisms, testing its predictions through a series of psycholinguistic experiments and grounding the theoretical discussion that will follow on a solid body of data. More specifically, the study intends to shed light on aspects pertaining access in both native and non-native processing of Italian, with a special focus on the role played by the formal transparency of words.

To this purpose, the research is concentrated on the analysis of two morphological phenomena which are thought to be particularly adequate to this aim, i.e., allomorphic relationships between derivatives and bound stems.

My dissertation is divided into two parts and is organized as follows. The first part was conceived to provide the theoretical background on the most relevant aspects of morphological processing. In particular, Chapter 1 is devoted to the presentation of the controversies that have characterized the debate on the mental lexicon, from both the linguistic (§1.2) and psychological (§1.3) perspectives. In particular, the controversy between connectionist and symbolic models in morphological theory is presented (§ 1.2.2) and the theoretical framework chosen here is described (§ 1.2.3). From the psycholinguistic perspective, a general overview of the main

models of lexical access is given (§ 1.3.1) and the main results of existing experimental research are briefly outlined (§ 1.3.2).

Chapter 2 is focused on the specific field of morphological processing in second language acquisition. In the first part of the chapter (§ 2.1.), existing proposals on non-native processing of morphology are discussed, whereas the second part (§ 2.2) presents a review of the psycholinguistic studies so far conducted on the topic.

The second part of this work introduces the specific topics of research of the present study and presents the empirical evidence relating to them. Specifically, Chapter 3 outlines the phenomenon of allomorphy from a descriptive point a view (§ 3.1), before considering how such a phenomenon is accounted for in the chosen linguistic framework (§ 3.2). Existing empirical evidence is then provided (§ 3.4), alongside with how allomorphy is viewed and predicted to impact in models of lexical access (§ 3.5). Finally, the chapter ends (§ 3.6) with the rationale for the experiments presented in the following experimental chapter on allomorphy.

Chapter 4 contains this experimental part. Experiments 1 (§ 4.1) and 2 (§ 4.2) are presented separately, alongside with very general observations on their main results. A general discussion from a unified perspective is then provided (§ 4.3).

Chapters 5 and 6 focus on the phenomenon of bound stems and are designed so as to mirror the structure of Chapters 3 and 4. Therefore, Chapter 5 concentrates on the theoretical definition of bound stems (§ 5.1), with a particular focus on Italian (§ 5.2), and how these are to be treated in our framework of reference (§ 5.3). Previous experimental studies on the topic are then reviewed (§ 5.4) and the predictions of psycholinguistic models considered (§ 5.5). The rationale for Experiments 3 and 4 is then spelled out at the end of the chapter (§ 5.6).

These experiments are described in Chapter 6, where the two have been treated separately (§ 6.1 and § 6.2). A general discussion of the results deriving from both follows (§ 6.3).

An integrated perspective on all the experiments presented in this work is depicted in the concluding chapter (Chapter 7), where the implications for both the native (§ 7.1) and non-native (§ 7.2) mental lexicon are discussed.

PART I: THEORETICAL BACKGROUND

Chapter 1: Morphology and the mental lexicon

1.1 – Defining the scope

Even if precise definitions of the term 'mental lexicon' are scarce in the literature (Jarema & Libben 2007), the investigation of its nature and the way it is accessed has been the focus of research of cognitive sciences for decades. Very roughly, the mental lexicon can be described in terms of the ensemble of knowledge a speaker has of words and the properties associated with them. Nearly forty years of psycholinguistic research on the nature of the mental lexicon have sparked an intense debate over the way words would be represented and accessed in the speakers' mind during word comprehension and production. Specifically, the role of semantic, orthographic, phonological, morphological, and syntactic information and the way words are organized according to these dimensions have constituted the matter of an intense debate. While all of these aspects have been found to play a role in how words are organized and accessed in the mental lexicon, in this work, we limit the scope to the investigation of the specific role played by morphology and the way this variable can modulate lexical processing during word comprehension. In this regard, controversies have centred on what constitutes access representations, in what ways they are connected to central representations in the lexicon and whether and which additional factors model lexical access. Despite the vast amount of theoretical positions and corresponding models that have consequently been produced, we will attempt in this chapter to outline the main points on which the discussion is focused and to give a comprehensive view of the most robust evidence so far provided. Although some positions assume lexical access to be amodal (i.e., not distinct depending on whether recognition is auditory or visual), in the discussion of the proposed psycholinguistic models, we will limit our description to the domain of visual word recognition, as this is the modality under investigation in the present work.

1.2 – Linguistic perspectives on morphological representation

1.2.1 – Basic notions of morphology

The fact that words can exhibit varying degrees of internal complexity constitutes the domain of morphology, i.e., the branch of linguistics involved in the study of a word's internal structure[1]. Although languages differ in the extent to which they are morphologically developed, words are rarely simple atomic units. The possibility to recognize smaller units inside a word has led to the analysis of their internal structure as based on morphemes, traditionally defined as the smallest meaningful units. Morphological theories distinguish between lexical and grammatical morphemes depending on the semantic content conveyed by them: the former are used to describe concrete meanings, such as those expressed, for instance, by *book* or *sleep*; the latter refer to more abstract meanings, more properly grammatical functions such as those conveyed by *-s* in *books* (i.e., plural) or *-ing* in *sleeping* (i.e., gerundive). Another distinction is drawn between free and bound morphemes: the former is used when referring to morphemes which can occur in isolation (e.g., *book*), while the latter involves those which can only occur combined with other morphemes (e.g., *-ing*). While it is generally the case that grammatical morphemes are bound, the reverse is not necessarily true: in a language like Italian, it is instead a very frequent case that lexical morphemes are bound. *Libro* ('book'), for example, is formed by two bound morphemes, *libr-* (a lexical morpheme) and *-o* (a grammatical morpheme expressing the inflectional class of the noun). Grammatical morphemes are generally defined as affixes and can differ with regard to their position relative to the base they attach to. If they precede the base, they are defined as prefixes (*un-* in *untie*); if they follow it, they are known as suffixes (*-ness* in *darkness*). In addition, some affixes can also occur inside the base (infixes) or on both sides of the base (circumfixes; e.g., *ge - t* in German past participles such as *gearbeitet* 'worked'). Among affixes, another relevant distinction can be drawn according to the nature of their function: if they create new words, they are called

[1] The present paragraph is only to be intended as a brief summary of the terms which will occur throughout this work. For comprehensive overviews on the basics of morphology see, e.g., Haspelmath (2002); Aronoff & Fudeman (2005); Booij (2005).

derivational (e.g., *-ness* in *darkness*), while when they only specify grammatical information without modifying the meaning of the base, they are called inflectional (*-s* in *books*). As for bases, they can differ depending on their degree of complexity: the base of *personality*, for example, is *personal*, in which we can in turn recognize another affix *-al* and another base *person*. *Person* is also defined as a root – in that no further analyzability is possible – and at the same time can be defined as a *stem*, when referring to it as the base of inflectional processes (although the term *stem* is sometimes found for derivational processes too). *Personal*, on the other hand, can be a stem, but not a root.

Having defined the basic terms of morphology, with which we will be dealing in the present work, we will consider in the following sections how these concepts are assumed to modulate word organization in a speaker's lexicon according to linguistic and psycholinguistic models and which specific factors have been found to be more relevant to morphological processing in experimental research.

1.2.2 – The connectionist *versus* symbolic debate (the words and rules debate)

The issue of the representation of complex words in the mind has been the subject of prolonged debate within linguistic theories of morphology. The so-called connectionist *versus* symbolic debate has been the center of controversies for years and partially overlaps with the single *versus* dual-route opposition. Stated very basically, the heart of the matter lies on whether a single or a dual mechanism is involved in the organisation of complex words. According to single associative connectionist models, the mental lexicon is best represented by way of a network of interconnected units, where correlations among frequently co-occurring patterns are established (Rumelhart & McClelland 1986; Seidenberg & Gonnerman 2000; Sereno & Jongman 1997). Dual models, on the other hand, drawing on the separation between lexicon and grammar advocated by traditional grammars (Bloomfield 1933), make a distinction between regular and irregular complex words, positing the existence of two different systems handling them (Chomsky 1981; Chomsky 1995; Clahsen 1999). The former would be computed by symbolic rules applying to their parts, whereas the latter, being unpredictable, would be stored as a whole in the lexicon. Dual-route models, therefore, posit the existence

of a symbolic level at which rules operate, while connectionist accounts typically deny the existence of such symbolic representations[2] and claim that linguistic knowledge is strictly exemplar-based. For years, the specific *casus belli* has been represented by the acquisition of the English past tense in its regular and irregular forms, on whose (assumed) differential treatment theoretical positions have not been unanimous.

Variants of dual-models share many assumptions, but also slightly differ in some specific aspects and predictions. A first distinction concerns what they consider to be their basic unit of analysis, i.e., the morpheme (Halle & Marantz 1993; Ullman 2001a; Pinker 1999) or the word (Jackendoff 1975; Aronoff 1976; Anderson 1992). This bears some consequences for the way affixes and other bound morphemes are represented: according to morpheme-based accounts, roots and affixes have their own independent representation, while word-based theories assume only words to have a lexical representation. The majority of all these models predict that a regular complex form will be computed online, by means of symbolic operations applying to underlying forms. Therefore, such forms need not be stored in the lexicon as wholes, although exceptions assuming so exist (Jackendoff 1975; Aronoff 1976). Claims about the treatment of irregular forms (e.g. *go – went*; *sing – sang*) vary with respect to the type of memory system involved. Early generative theories generally posit that irregulars will be rote-learned and stored, albeit not all in the same way. Strong suppletive forms such as *go – went* will be memorised in a list-like fashion, while patterns of subregularity will be captured by rules of grammar in those forms which preserve part of the stem (*sing – sang*; *ring – rang*). For such forms, morphophonological stem readjustment rules (e.g., changing *i* to *a* in past tense forms such as the above-mentioned *ring – rang*) have been proposed (Chomsky & Halle 1968; Halle & Marantz 1993; Ling & Marinov 1994). However, some criticism towards such rules has been raised by proponents of a different variant of the dual model (Pinker 1991; Pinker 1999; Ullman 2001b). The proposed morphophonological operations would only be designed to account for the resemblance between verbs stems and their past forms (e.g. *swim – swam*), but

[2] At least, in the purest versions of parallel-distributed processing systems.

would not be able to explain the similarity among different verbs (*swim – swam*; *sing – sang*)[3]. A popular alternative to such models is represented by those dual accounts (Pinker 1999; Ullman 2001b) which assume that irregular forms are stored in a distributed associative memory system resembling the one proposed by single associative approaches.

Specifically, the declarative/procedural model proposed by Ullman (DP model, Ullman 2001a; Ullman 2004) posits a distinction between two specific components, presenting distinct cognitive, computational, and neural bases. The procedural memory system subserves the domain of regular and productive complex words, which would be computed – as theorized by other dual models – by way of rules operating on bases and affixes. The declarative memory system, on the other hand, handles the storing of irregular forms, be they suppletive or not. Importantly, this memory system is not to be considered as a rote memory containg a list of forms, but rather involves a mechanism associating representations based on mappings between phonological form and semantic content. This system learns the mappings of individual complex forms (*sing – sang*) and the patterns common to those of different forms (*sing – sang*, *ring – rang*). It may then generalize such patterns to new forms. Much like connectionist associative systems (see below), the declarative memory is therefore productive. However, differently from them, the phonological representations in this system are assumed to be structured, i.e. mirroring the morphophonological and phonological structure of stored words. The declarative/procedural model shares many assumptions with other dual models (Pinker 1994; Pinker 1999; Chomsky 1995; Clahsen 1999), the central being its claim that two distinct systems subserve the mental lexicon and the mental grammar. This two components are modular, i.e. informationally encapsulated, with respect to each other, meaning that they are assumed to run in parallel, with no input exchange between the two. The only kind of information transmitted from one to the other concerns the success of the declarative system in the retrieval of a

[3] Pinker (1991) points out how a rule like "change *i* to *a* when it appears after a consonant cluster and precedes *ng*" would successfully apply to forms like *spring – sprang*, *drink – drank* and *shrink – shrank*, but would fail in cases such as *swim – swam* and *begin – began*. Moreover, it would also produce an incorrect form in the case of *bring – brought* and *fling – flung* (Pinker 1991: 531).

complex word. When this happens, the rule system is blocked; conversely, if no signal is sent, computation in the procedural component takes place.

However, in the DP model, there is no categorical reason why a morphologically complex regular form should not be in principle stored in the declarative memory. The likelihood for a form to be stored and retrieved from the associative system is crucially linked to its frequency, i.e., low-frequency default forms will be more likely to be rule-computed. In addition, specific differences with other dual models concern domain specificity: contrary to most dual accounts, according to this model, neither of the two systems proposed is specifically dedicated to language functions. The declarative system is involved in the learning and representation of knowledge about facts (semantic knowledge) and events (episodic knowledge), while the procedural memory underlies the learning of motor and cognitive skills and habits.

This lack of domain specificity is probably one of the very few assumptions the declarative/procedural model shares with a whole different class of models of word representation, namely, **connectionist** approaches. These single associative models take the strong position of rejecting the classical distiction between two components, one dealing with language systematicy and the other with idiosyncrasy. Rather then positing the existence of symbolic rules, they treat all complex morphological forms in the same way, i.e., as a network of mappings from base form to derived/inflected form, able to memorise individual patterns and to generalise on the basis of the regularities found. Such a system was shown to reliably predict the way a child acquires the English past tense without the formulation of an explicit rule in a simulation implemented by Rumelhart & McClelland (1986). Not limited to the domain of inflection, the central tenet of this theoretical perspective is that, since the concept of regularity is a very blurred one and gradiency characterizes much part of the language, there is no reason why a single network-like system would not be able to account for morphological structure. Rather than arbitrarily deciding what is regular and what is not, this approach emphasizes that there exists a full range of phenomena which are hard to classify in the light of a dual model perspective. Plaut & Gonnerman (2000), for example, point out how the word *dresser* can be hardly categorised as fully

semantically transparent, since a *dresser* is not 'someone who dresses' (as the suffix *-er*, which often carries an agentive meaning, would lead us to believe), or fully opaque, given that a *dresser* is a piece of furniture holding clothes and is thus related to the activity of dressing (Plaut & Gonnerman 2000: 447). They argue that a system based on neural network modeling could more readily account for the graded degrees of systematicity found in language.

As hinted above, connectionism is by no means an approach specifically designed to explain facts of morphology or language only; rather, its aim is to model various aspects of human cognition and behaviour. While the implementations of the model can vary depending on the specific domain they apply to, the basic shared assumption is the effort to characterise the system underlying cognitive processes as a dynamic network, which changes over time as it learns and develops. Representations in such networks are constituted by patterns of activation over units[4] and, crucially, by connection weighs linking such units - taken to be remnants of previous experience of the input - which can be excitatory or inhibitory. Such a network of units and weighs continually readjusts itself on exposure to input, reinforcing patterns of activation between the units. Frequency of occurrence is therefore predicted to underlie the strength of such links. Within a connectionist framework, morphology is seen as a set of learned mappings between the surface forms of words (orthography and phonology) and their meanings (semantics). Morphological structure, therefore, ultimately arises from graded sistematicity among surface forms of words and their meanings, rather than being an inherent independent level *per se*.

[4] At least in the purest forms of parallel-distributed processing systems. Some versions of connectionist models allow dedicated units to represent discrete pieces of information, such as words or letters (localist networks). The system would still be connectionist, in that it allows for the spreading of activation from one unit to the next in a parallel manner (Dörnyei 2009: 92). Dörnyei (2009) points out how the belief that a distributed, non-symbolic representation is at the core of the connectionist approach is not accurate, given the existence of such localist versions.

1.2.3 – Paradigmatic approaches to morphology

Even though the above-mentioned debate has been the centre of linguistic debate for quite some time, symbolic and connectionist approaches are not the only viable options to understand how words are represented in the mind. Intermediate solutions which can integrate, to a certain extent, some of the stances of both, are indeed probably more adequate to capture the way morphological relations can shape lexical organization.

Specifically, approaches which avoid a strictly rule-based view in favour of a schema-based perspective have been shown to come with numerous advantages, among which the possibility for schemas to co-exist with full listing of words in the lexicon (Bybee 1995; 2001; Booij 2010).

A common belief of these approaches and connectionism is the absence of a clear cut-off point between regular and irregular morphology. Following Langacker's criticism of the list/rule fallacy (Langacker 1987), i.e., the belief purported by dual-route models that a word is either generated by a rule or listed in the lexicon, such models support a view in which all words, together with generalizations arising on the basis of shared features among them (schemas), can be listed in the lexicon. Such models, importantly, do not posit a rule-based view of morphological processes, i.e., they do not assume the existence of rules building words from an input base to an output complex word. As clarified by Bybee, schemas, differently from rules, «have no existence independent of the lexical units from which they emerge» (Bybee 2010: 74). Rather, they emerge precisely on the basis of such individual lexical units and remain linked to them. Rules, on the other hand, are conceived as contained in a separate module.

The notion of schema, moreover, allows for productivity to be assumed as being gradient instead of categorically determined: «schemas are highly affected by the number of participant items: a schema ranging over many different verbs, for example, is more productive than one ranging over only a few» (Bybee 2001: 27). This is in sharp contrast with the generative view according to which rules can either be productive or unproductive (for in-depth discussion of the differences between rules and schemas see, e.g., Bybee 2001; Booij 2010).

Such a category of models is represented by a certain type of paradigmatic models, namely, those posited by Bybee (1985; 1995) and Booij (2010).These two models share many beliefs (but also differ in some respects, as we will see), among the most important that of being predominantly usage-based, and to a certain extent, incorporate some of the characteristics of the two opposing views considered above. Since such models will constitute the framework of this study, we outline here their basic tenets.

1.2.3.1 – The Network Model (Bybee 1985; 1995)

Bybee's Network Model (1985; 1995) is probably closer to connectionist stances[5], even though she does point out some differences with these approaches, as we will see. In her model, a network system of representations is hypothesized, in which all words are listed in the lexicon, with no separate rule component applying to parts of them. As she clarifies in her discussion of rules and schemas, «the basic proposal is that morphological properties of words, paradigms and morphological patterns once described as rule emerge from associations made among related words in lexical representation» (Bybee 1995: 428). Her model integrates part of the connectionist principles, in its claim that lexical connections based on phonological and semantic correspondences are established among words, which are crucially modulated in terms of associations subject to change due to usage and exposure. The strength of such connections is in fact assumed to depend on quantitative factors such as type and token frequency. On the one hand, if a given phonological and semantic similarity is repeated in a large number of words (type frequency), a morphological connection will emerge as such and a generalization (schema) will be established. On the other hand, token frequency can potentially impair the connections establishing among words, in that words which have higher token frequency are also predicted to have greater lexical autonomy. As a result of their

[5] As a matter of fact, she is often referred to as connectionist in the literature and she is known to have defended connectionist positions (e.g., Bybee & McClelland 2005; McClelland & Bybee 2007). Broadly speaking, her model is certainly close to localist versions of connectionism, while it has been variously defined as *exemplar plus associative network* (McClelland & Bybee 2007), *exemplar-cum-network* (Bybee & Beckner 2010), or *exemplar-cum-schema* (Schmid 2015).

being more entrenched, they will also be more likely to have weaker connections with other words. It is usage, therefore, which can modulate the strength of the network of associations establishing among words.

Bybee's view of token frequency, however, differs from the one posited by connectionist models: while they assume the frequency of the mapping between base and derived form to be significant, in her model, it is the word's token frequency to be a determinant factor, since it affects its lexical autonomy (Bybee 1995: 432-433). Moreover, her characterization of the generalizations arising from the lexicon also differs from the ones posited by connectionist models. Specifically, of such generalizations, she distinguishes two types, reflecting the two ways in which morphologically complex forms relate to each other. Source-oriented schemas are those generalizations arising from pairs of basic and derived words, such as *walk* and *walked* (Bybee 1995: 430). The second, and most innovative with respect to other previously known theories[6], are product-oriented schemas, i.e., generalizations over sets of complex forms such as *strung*, *flung*, *hung* or *washable*, *readable*, *believable*, etc, showing what features these derived forms have (Bybee 1995: 430). The latter are not included in connectionist approaches, which, moreover, also seem to fail to abstract schemas from relationships among words. To clarify the role of such product-oriented schemas, the appearance of the suffix -*able* in a great number of words will mark the emergence of a schema containing that affix, the strength of which intuitively depends on the number of words sharing that same schema.

[6] Bybee (1995) points out how source-oriented schemas could roughly be equated to generative rules, while no counterpart exists for product-oriented schemas in generative nor in connectionist approaches.

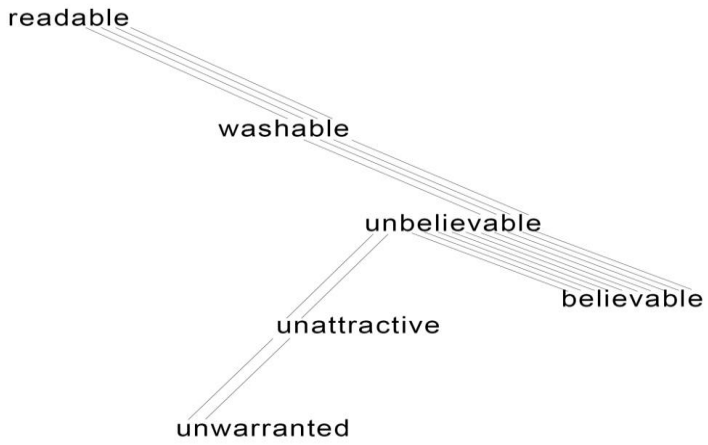

Figure 1 - The internal structure of *unbelievable* emerges from connections to related words (Bybee & Beckner 2010: 835)

In this model, there is willingly no attempt to avoid redundancy and therefore both types of schemas may exist for the same morphological relation. It is clear how the fact that all word forms can be stored in the mental lexicon does not necessarily imply that they are not morphologically structured. In the above figure, the morphological structure of *unbelievable* emerges from its connections with other words that share its constituent parts. At the same time, the lexicon in such emergentist, usage-based account is based on words, rather than on morphemes. The issue of the representation and access of morphologically complex words can be reformulated as stated by Bybee: «even though words entered in the lexicon are not broken up into their constituent morphemes, their morphological structure emerges from the connections they make with other words in the lexicon» (Bybee 1995: 428).

1.2.3.2 – Construction Morphology (Booij 2010)

The recently proposed framework of Construction Morphology (Booij 2010) shares many assumptions with the Network Model, namely, the adoption of a schema-based view and the rejection of a categorical distiction between rules and the lexicon. It differs from it, however, in its proposal of a hierachical lexicon, i.e., a highly structured ensemble, whose units are words and schemas generalizing properties of words participating in them. Crucially, moreover, this framework

assumes the existence of a symbolic level, which co-exists along with words in the lexicon, i.e., predicts that speakers may have word representations along with a symbolic level capturing relations among them. While both models assume the formation of schemas, these are not overtly notated in Bybee's model, but rather assumed to be emergent and implicit (Bybee & Beckner 2010: 834). Bybee's position, importantly, differs in her claim that novel word formation only proceeds through analogical patterns, i.e., it is strictly connected with existing exemplars, while Booij's framework entails both analogical and symbolic processes to occur. It does not necessarily have to be a matter of either/or, since from analogical patterns a more abstract schema can develop and be productively used to coin new words independently of the first item that originated it (Booij 2010: 89-90). Interestingly, Bybee herself clarifies that Booij's schemas could provide adequate explicitation of the generalizations capturing relations in the network (Bybee & Beckner 2010). While Bybee's detailed characterization of the connections among words will provide a useful frame of reference in the understanding of how the mental lexicon is organized, the present work will more evidently support a view in which a symbolic level is not denied and can co-exist with words in the lexicon. Indeed, Construction Morphology (CxM) proposes a clear formalization of such abstractions and of the hierarchical system they create according to their varying degrees of abstraction. The lexicon is thus hierarchically structured from higher, more abstract schemas to lower more specific subschemas. Like in the Network Model, when a systematic form-meaning correspondence can be detected, a generalization emerges, which can be formalized as the following example, taken from Booij (2015), shows:

steady unsteady

social unsocial

suitable unsuitable

stressed unstressed

$<[un[x]_{Ai}]_{Aj} \leftrightarrow [\text{NOT } SEM_i]_j>$ (Booij 2015: 189)[7]

The abstraction formalized above is called a 'constructional schema', while complex words whose structure and semantics is expressed by the schema are defined as morphological constructs. The meaning of the set of words in the right column is therefore captured by this schema, which specifies the meaning of the affix *un-* when occurring in this particular type of morphological structure. This abstract schema dominates all its instantiations, i.e., all complex words which can be defined according to it. There may also exist intermediate levels of abstraction, captured by so-called 'subschemas', which can specify, for instance, the possibility of an affix to occur with bases belonging to different syntactic categories or the polysemy conveyed by some affixes as in the following example:

$[x - ist]_{Ni} \leftrightarrow [\text{PERSON WITH ABILITY, IDEOLOGY, DISPOSITION } Y]$

$[[x]_{Nj} - ist]_{Ni} \leftrightarrow [\text{PERSON WITH ABILITY, IDEOLOGY, DISPOSITION } Y \text{ RELATED TO } SEM_j]_i$

$[[x]_{Aj} - ist]_{Ni} \leftrightarrow [\text{PERSON WITH ABILITY, IDEOLOGY, DISPOSITION } Y \text{ RELATED TO } SEM_j]_I$

(Booij 2010: 30-31)

Importantly, the model assumes constructions to have holistic properties. The affixes *un-* or *-ist*, for example, have no meaning on their own: their semantics is instead defined in terms of the constructional schema they enter into. There is no independent meaning, therefore, that can be associated to affixes, which do not have a lexical representation on their own. Consistently with this view based on words and representational schemas (rather than rules), the Construction Morphology approach also emphasizes the importance of output-oriented schemas, i.e., generalizations arising on the basis of relationships among sets of derived words

[7] In CxM, the angled brackets represent a constructional schema, while the double arrow stands for the systematic correlation between form and meaning (Booij 2015).

exhibiting the same degree of complexity. Such 'second-order' schemas can capture the paradigmatic relationships among words belonging to the same morphological family, such as, e.g. *alcoholism – alcoholist*:

> $< [x - ism]_{Ni} \leftrightarrow SEM_i > \approx < [x - ist]_{Nj} \leftrightarrow$ [person with property Y related to $SEM_i]_j >$ (Booij 2010: 33)

To summarize, the lexicon posited by CxM is an ensemble of both schemas, subschemas, and second-order schemas and complex words instantiating them. Even though many of the properties of words can be represented symbolically by such generalizations, there is no need to assume complex words not to be represented along with such abstractions. The advantage of a notion of morphological schemas lies in their capacity of expressing predictable properties of complex words, extending to the coinage of novel words (i.e., their productivity; Booij 2010: 52), and providing a way to structure the lexicon, which is not seen in this approach as a chaotic ensemble of listed words (Booij 2010: 4).

1.3 – Psycholinguistic perspectives on word recognition

A surprisingly great number of psychological models on the representation and processing of complex words have been put forward during the last forty years. While a comprehensive review of such models is beyond the scope of the present work, we will try to outline the main theoretical questions which have driven research in this field and to group models according to their main tenets (for more detailed reviews, see McQueen & Cutler 1998; Domínguez, Cuetos & Segui 2000; Diependaele, Grainger & Sandra 2012; Feldman & Weber 2012; Libben 2015).

Psycholinguistic research on morphological processing has been trying to provide an answer to two fundamental issues: i) how words are represented in the lexicon ii) how they are accessed. Although the two questions are strictly related, models can vary considerably as to what kind of linguistic unit they assume to be contained in these two levels and how they interact with each other. Generally speaking, theories of word recognition posit the existence of modality specific access representations and a-modal representations in the central lexicon. Specifically,

access representations act as an intermediary level in the process of mapping the input (orthographic or spoken) onto lexical representations in the central lexicon. In these terms, lexical access is said to occur when a specific entry is selected. Firstly, the nature of such access units needs to be specified, i.e. researchers are interested in determining whether they are morphemes, whole words, or both. Secondly, the extent to which the central lexicon itself is morphologically structured is under investigation. While extreme positions (morphemes only - morpheme-based lexicon or words only - no morphological structure) have been proposed, at present most theories acknowledge that such views can hardly provide a plausible picture.

1.3.1 – Overview of the models

The first (and perhaps most influential for quite some time) account of lexical access is the one proposed by the seminal study by Taft & Forster (1975). By means of a lexical decision task (a very popular task in the field of word recognition, where subjects are asked to decide as fast as possible whether a presented stimulus is a real word or not), they showed that subjects took longer to classify pseudo-words which were real (bound) stems (*juvenate*, which is contained in the word *rejuvenate*) than pseudo-words that were not (*pertoire*, which can be found in *repertoire*). In another experiment, they found the same pattern of results when such pseudo-words were combined with existent prefixes (*dejuvenate*, *depertoire*). On these grounds, they proposed the so-called 'Prefix-stripping model': complex words would be obligatorily parsed in constituent morphemes and stripped off their prefix in order to isolate the stem, which crucially provides the means to access the central lexicon. At this level, all words sharing a stem would be listed under it in their decomposed form. Thus, during processing, after the affix has been stripped off, the root functions as the access code for a serial search in the central lexicon. If a matching stem entry is found, all morphological complex variants of this stem are listed under this stem entry. This is demonstrated, in their view, by the fact that pseudo-words such as *juvenate* and *dejuvenate* take longer to reject compared to *pertoire* and *depertoire*, since *pertoire* would not be listed in the central lexicon and therefore would be discarded faster.

The opposite view was suggested by full-listing models (e.g., Manelis & Tharp 1977), according to which there would be no morphemic access representation, but rather, the input would map directly onto the whole-word form. Moreover, morphological structure would not play any role in the organization of the mental lexicon. Despite the existence of an intense debate between these two opposite views, at present, many researchers agree on the fact that neither of the two can fully account for the vast array of effects found in psycholinguistic research. In particular, while the prefix-stripping model was met with quite some success, a number of issues indicating it as non-tenable were pointed out. Following this theoretical account, there would be many incorrect analyses slowing down the overall process of lexical access, especially in those languages with many pseudo-prefixes (orthographic strings which can correspond to affixes in some words, but not in others, such as the *re-* of *repertoire*). Since there is no contribution of lexical information about the word as a whole, it should be impossible for the processing system to distinguish pseudo-affixes from real affixes (Schreuder & Baayen 1994). Moreover, at present, researchers tend to agree that the lexicon is not likely to be a monolithic entity, in which a serial search takes place, much in the same way we would look up words in a dictionary (Libben 2015).

On the other hand, a view such as the one proposed by full-listing models is equally subject to criticism: it is hard to reconcile the robust evidence collected in favour of effects such as morphological family size and the frequency of word constituents (see §1.3.2.3) with proposals which exclude a role for the morphological organization of the lexicon. Such an approach also does not seem to explain how novel complex words would be comprehended and produced.

A different and less extreme view was provided by the so-called network (Fowler, Napps & Feldman 1985; Grainger, Colé & Segui 1991) and satellite models (Lukatela et al. 1980; Feldman & Fowler 1987). Such frameworks share the assumption of full-listing models that whole-word access representations would drive lexical access. However, they propose a lexical level which is highly structured by morphology. Morphologically complex words have separate lexical entries, but they cluster around a nucleus (the morphological form with fastest recognition times) in satellite models or are linked by connections in a network

fashion in the corresponding network models. Morphological information is thus assumed to be contained in the central lexicon and reflected by connections among words.

A similar perspective is shared up to a point by the so-called supra-lexical model, originally proposed by Giraudo & Grainger (2000; 2001) and later developed by Giraudo & Voga (2014). In this model, morphologically structured stimuli are accessed through their whole-forms, which in turn contact the morphemic units they are made up of. Such units stand at the interface between whole-forms and meaning representation and organize words in morphological families. Lexical processing is based on two types of facilitation springs, a bottom-up excitation from the word-form level and a top-down facilitation from a supra-lexical level, where morphological representations are contained. This level would be emergent in the sense that its units emerge as a result of the systematic co-occurrences of form and meaning. Such abstract units operate as connecting nodes for words belonging to the same morphological family and word forms and concepts (Giraudo & Voga 2016).

A direct opponent of this account is the one suggested by Rastle, Davis & New (2004), the so-called 'morpho-orthographic' model. According to the authors, all morphologically structured words, even those which only exhibit a pseudo-morphological structure (i.e., those that are made up of segments which formally coincide with morphemes), will undergo an initial stage of obligatory decomposition based solely on orthography. The theory is reminiscent of the prefix-stripping model formulated by Taft & Forster (1975) and Taft (1994), while differing from it, in that for decomposition to be triggered an item must be superficially analysed as composed by roots and affixes (e.g., words such as *corner* will be decomposed, but words such as *brothel* will be not, see also § 1.3.3.3).

So far, we have considered models which, at least from the point of view of access representations, clearly point to either whole forms or morphemes. An intermediate perspective is offered by so-called dual-route models, which posit both types of units as possible candidates for access. Indeed, the term 'dual-route' refers to the co-existence of a prelexical parsing route and a direct full-form route. According to the Augmented Addressed Morphology (AAM) approach proposed by Burani &

Caramazza (1987) and Caramazza, Laudanna & Romani (1988), all known words have their own full access representation. These access representations are connected to central representations consisting of a network containing roots which are positively linked to the affixes they can combine with and negatively linked to affixes they cannot combine with. In the central lexicon, the representation of a complex word is computed on-line. Another viable access option is constituted by a morphological parsing process which decomposes the orthographic input string into its morphological components. The choice of one route over the other crucially depends on frequency factors (in the original version, the parsing route was only allowed for novel words)[8]: importantly, the parsing route would operate on low frequency words with high frequency morphemic constituents only when the direct route fails.

Similarly, the Morphological Race Model proposed by Frauenfelder & Schreuder (1992) and later developed by Schreuder & Baayen (1995), admits both routes, differing, however, for the fact that both would operate in parallel, in a sort of race against each other (hence, the name of the model). The direct route maps the full-form access representations directly onto the corresponding 'lemmas' (integration nodes coding possible combinations of stems and affixes). Upon parsing, on the other hand, the access representations of stems and affixes activate their corresponding central representations and a subsequent licensing procedure checks the compatibility of the activated morphemic constituents. A number of variables can determine which route is the winner in the race, including word frequency, productivity and frequency of affixes, phonological and semantic transparency.

Finally, to conclude this overview, let us briefly consider the processing model proposed by parallel-distributed connectionist accounts. As we have seen before, such accounts, differently from the ones that we have dealt with so far, do not include a separate representational level or access procedure for morphology. However, they neither exclude *tout court* a role for morphological structure, which would rather emerge as «a graded interlevel representation that reflects the

[8] While frequency is indeed predicted to be a determining factor, Burani & Laudanna (1992) stress other relevant variables, such as the phonological and orthographic transparency of the derived word relative to its base root and the properties of affixes (on this point, see also § 1.3.2.3).

systematic though probabilistic relationships among phonological, orthographic, and semantic codes» (Gonnerman, Seidenberg & Andersen 2007: 16). When these codes converge, morphological subunits arise, though they differ from the traditional discrete category of morphemes, in that they can vary along a graded continuum. Lexical processing occurs through interactions among this pool of units, governed by weighed excitatory and inhibitory links between them. When input is encountered, units update their activations as a function of the total input they receive via connections from other units. It is thus important to underline that connectionist approaches do not exclude a morphological organization of the lexicon, but they refute the imposition of traditional fixed morphological categories, in favour of a psychologically plausible morphological system which arises as a consequence of exposure to the input.

In a similar vein, the recently proposed Naïve Discriminative Learning Model (NDL, Baayen et al. 2011) proposes to do away with morphology, assuming the existence of a two-layer system, involving neither morphemes nor complex words. In the NDL model, the only form representations are letter bi/trigrams. The basic unit in such an 'amorphous' approach is an abstract unit called *lexome*. Morphological effects would be the consequence of co-occurrence statistics of these n-gram cues and the lexomes. In other words, differences in visual word recognition tasks between the RTs induced by primes on a given target reflect the extent to which sublexical letter trigrams are associated with the target lexome. The model is learning-based, in the sense that «as a cue occurs more often in contexts where it does not pertain to a given target lexome, the connection strength from this cue to this target lexome will be reduced» (Milin, Smolka & Feldman 2017).

To sum up, while many variants of the above-described models exist, we can very broadly group them based on what they assume to be their access units (morphemes, whole words or both), at least as far as those involving a morphological level are concerned. As for their linguistic counterparts, as will be clear in the course of the discussion, some models could most readily account for a specific position (e.g., broadly speaking, decompositional models best account for morpheme-based views, while supra-lexical ones fit best into word-based positions), but a unique correspondence might not be always found.

1.3.2 – Psycholinguistic evidence on morphological processing

Having outlined the main theoretical accounts on how processing works, we shall now consider some of the most robust evidence so far obtained through experimental studies on word recognition. It is necessary to point out, however, that sometimes these studies produced contradictory results and, therefore, a number of issues are still fiercely debated on. It is also to be highlighted that, depending on the methodology exploited, different aspects of processing may be revealed. Therefore, before considering the evidence found for the role of specific variables, we will briefly outline the methodologies most used in psycholinguistic research on morphological processing during word comprehension.

1.3.2.1 – Methods

The most extensively used technique in psycholinguistic research on word recognition is certainly the **lexical decision task**. In this methodology, speakers are presented with a visual stimulus appearing on a screen and must decide whether such a stimulus is a real word or not. An insight of the processes occurring during lexical access is provided on the basis of reaction times (i.e., the time needed to give an answer) and errors committed by the tested subjects. The rationale behind this kind of experiment is that longer latencies to morphologically complex words should be informative of morphemic analysis, since checking viable base + affix combinations should take longer than accessing a memorized full form. Initially, in order to investigate the role of morphology, particular attention was dedicated to response times to morphologically complex pseudo-words, i.e. non-words constructed in such a way as to show a morphologically complex structure (Taft & Forster 1975; see Caramazza, Laudanna & Romani 1988 for Italian). The interest of focusing on non-existing forms lies in the fact that, as we have briefly discussed above, if non-words constructed through illegal combinations of existent bases and affixes (e.g., *dejuvenate*) are rejected more slowly than non-words in which no morphemic constituent can be recognized, this should indicate reliance on morphological structure.

Lexical decision research, however, was not limited to the domain of pseudo-words: studies manipulating the frequency of morphemic constituents and of whole words

conducted on existent words are also numerous in the psycholinguistic literature. After the seminal study presented by Taft & Forster (1975) (see § 1.3.1), research on morphological processing carried out with lexical decision tasks flourished and results acknowledging a role for morphology abounded (see, for example, Taft 1979; Colé, Beauvillain & Segui 1989; Burani & Caramazza 1987; Schreuder, Burani & Baayen 2003).

While the lexical decision task has had certainly a predominant role, there are at least two other techniques which can reveal additional aspects related to morphology. A line of research is represented by **eye-tracking studies**, involving reading tasks where subjects are administered reading tasks (the methodology can be potentially combined also with the lexical decision task) while their ocular movements are simultaneously recorded through the use of sophisticated machinery. The advantage of this method for the study of morphological processing is constituted by the possibility to trace with great detail and accuracy where the eye fixates when participants are presented with complex words. Research exploiting this methodology has consistently shown the role of morphological structure in modulating eye-fixations while reading (Kuperman et al. 2009).

Another method, somewhat less exploited, is the reading aloud task. In this task, subjects are presented with visual stimuli (words and pseudo-words), which they are required to read as quickly and accurately as possible. Naming latencies are recorded from the onset of pronunciation together with registration of errors. Such methodology is based on the assumption that there are two routes to reading: a lexical route and a slower orthographic-phonological conversion route, which is crucially exploited for unknown words (Coltheart 1987; Coltheart et al. 1993). On such premises, research on morphological processing is focused on the presentation of pseudo-words, which can either be constructed through morphemic constituents or not. Shorter latencies for those pseudo-words which are composed of morphemes are indicators that those pseudo-words are accessed through a morpho-lexical route rather than through the slower grapheme-phoneme conversion (Burani & Laudanna 2003).

Priming methods

Given its relevance to the present study, we dedicate here a specific section to one of the most popular evolutions of the lexical decision task, namely, its variant combined with the experimental protocol known as priming.

This technique is based on the so-called repetition effect, i.e. the fact that the same stimulus presented twice is faster recognized on its second occurrence. In this light, priming experiments are aimed at investigating whether faster responses are also triggered by stimuli that, despite not being identical, are related to those on which the decision has to be made. Participants are presented with a 'target' stimulus, i.e., the item that must be recognized, preceded by a so-called 'prime' stimulus. Depending on the relationship between the two, the prime can determine facilitation on the recognition of the target, i.e., faster response times. Typically, an identity condition (the prime coincides with the target, e.g., *sweet*/*SWEET*) serves as the baseline against which comparison is made, as the same stimulus repeated twice triggers the maximum facilitation. On the other hand, the other baseline is represented by an unrelated condition, i.e., the presentation of a completely unrelated stimulus (e.g., *lazy*/*SWEET*), which does not produce any kind of facilitation. To investigate the role of morphology, the test condition is represented by the presentation of a prime which is morphologically related to the target (e.g., *sweetness*/*SWEET*). A significant facilitation in the test condition is interpreted as proof of the organization of the lexicon on a morphological basis, since such a facilitation is assumed to derive from the previous activation of the shared morphological constituent (*sweet*). 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).

The priming paradigm is currently probably the most used type of behavioral measurement and can be differentiated according to the time interval occurring between the presentation of primes and targets (i.e., the stimulus onset asynchrony, henceforth SOA) and the presentation modality of the two. Early studies made extensive use of so-called *overt* priming protocols, where the prime is consciously

perceived by participants and can either be presented immediately before the target (*immediate* priming, typically 100-200 ms) or with a variable number of items intervening between the two stimuli (*long-lag*). The results that emerged from such experiments showed that morphologically related primes induce a significant amount of facilitation on the recognition of their targets (Stanners et al. 1979; Fowler, Napps & Feldman 1985). Moreover, these effects were found not to be due to the mere orthographic resemblance between the stimuli: for instance, Murrell & Morton (1974) showed that the presentation of *card* did not produce any facilitation on the recognition of *car*. Likewise, in Italian, the recognition of *volete* ('you want') was not facilitated by the presentation of the orthographically similar stimulus *volume* ('volume') in the study conducted by Laudanna & Burani (1986).

All in all, robust evidence supporting the role of morphological structure in processing was found in a variety of languages (German and Dutch: Drews & Zwitserlood 1995; French: Meunier & Segui 2002; Spanish: Sánchez-Casas, Igoa & García-Albea 2003; Serbian: Feldman, Barac-Cikoja & Kostić 2002) and using both an entirely visual protocol or a cross-modal one (auditory prime, visual target; see, e.g. Marslen-Wilson et al. 1994).

Despite the informativity of such studies, it has been repeatedly pointed out that overt priming may not be the best technique to investigate processing (Forster & Davis 1984; Diependaele, Grainger & Sandra 2012): since participants are aware of the presence of the prime, they could understand that the prime-target relationship is under investigation and, as a consequence, develop response strategies to perform the task. To rule out this possibility, the **masked priming paradigm** was developed (Forster & Davis 1984). In this technique, since the time between the prime and the target is considerably brief (usually between 40 and 60 ms), the prime is virtually invisible for the majority of subjects. Moreover, a forward mask consisting of a string of hash marks is presented prior to the prime for 500 ms in order to further minimize the possibility of seeing the prime stimulus. The advantage of this methodology is that since participants are not aware of the presentation of the first stimulus – as they do not consciously realize that it was presented – any observed facilitation cannot be considered to derive from the conscious appreciation of the relation between the prime and the target (Forster

1999). As a consequence, they cannot be possibly able to develop any predictive response strategy. For this reason, the masked priming experimental technique is now considered by many researchers as able to provide a better understanding of the processes that lie behind the activation of target words, and consequently, a more adequate tool to explore the automatic and unconscious processes occurring in the mind during word processing. Experiments using this paradigm have basically confirmed many of the results described above, finding robust priming effects for morphologically related pairs of words in a number of different languages (Frost, Deutsch & Forster 2000; Rastle et al. 2000; Giraudo & Grainger 2001; Diependaele, Sandra & Grainger 2005). On the other hand, the use of this methodology has opened a breach with respect to some issues, such as the role of the frequency of constituents and of semantic transparency (see discussion below). In the following sections, we will briefly summarize the most interesting outcomes on morphological processing revealed by word recognition studies and discuss the role of some specific variables which have been found to affect morphological processing.

1.3.2.3 – Main findings

Frequency effects

A rich body of psycholinguistic literature has highlighted the important role played in word recognition by frequency, both of the whole word and of its morphemic constituents. The word frequency effect, i.e., the effect a word's surface frequency, is probably the most robust and widely documented result obtained from years of psycholinguistic research (early works trace back to Scarborough, Cortese & Scarborough 1977; Gernsbacher 1984). The empirical findings of decades of psycholinguistic research on the issue have proved this variable to be one of the strongest predictors of lexical processing, showing that counts of word occurrences highly correlate with chronometric measures in lexical decision tasks, with results produced by eye-movement experiments and even with the brain's electrophysiological response to lexical stimuli (for a comprehensive review, see Baayen, Milin & Ramscar 2016). In other terms, high-frequency words are generally perceived and produced more quickly than low-frequency words. Such

results have emerged especially within the context of simple lexical decision tasks in a variety of languages: words with higher surface frequency were found to be responded to faster in the studies by Taft (1979) (English), Colé, Beauvillain & Segui (1989) (French) and Burani & Caramazza (1987) (Italian). Additionally, whole-word frequency effects have emerged also within the context of eye-tracking studies: Niswander, Pollatsek & Rayner (2000), for instance, found a significant effect of gaze duration in reading inflected and derived suffixed English words, such that high frequency words exhibited shorter gaze durations compared to low frequency words (see also Beauvillain 1996 on derived prefixed and suffixed words in a semantic relatedness task combined with the eye-tracking methodology). In eye-tracking studies, this effect was found to be significantly affected by the length of the affix: word-frequency effects were larger when the affix (both prefixes and suffixes, respectively in Niswander-Klement & Pollatsek (2006) and Kuperman, Bertram & Baayen (2010) contained in the complex word was shorter.

Although it might be tempting to interpret whole-frequency effects as evidence in favour of word-based models of lexical access, it must be highlighted that the effect can be easily reconciled with other accounts, which, in some way or another, admit a level containing whole-word forms (e.g., the AAM and Race Model, but also the interactive activation implementation of the decompositional model by Taft 1994). Moreover, many of the above-mentioned studies crucially investigated not only the effect of surface frequency, but also of the frequency of morphemic constituents. The rationale behind such studies is that, if the frequency of a morpheme contained in a word is found to speed up lexical recognition or decrease eye fixation duration, this should mean that the word is decomposed and its constituents are accessed. For instance, Burani, Salmaso & Caramazza (1984), in a study on Italian inflected words, found that lexical decision times were influenced not only by the word surface frequency, but also by the frequency of their root: when surface frequency was controlled, reaction times were faster for words containing a high-frequency root, e.g. *chiamavi* 'you called' versus *fiutavo* 'I sniffed'(for similar results with derived words, see Burani & Caramazza 1987 on Italian; Colé, Beauvillain & Segui 1989 on French; Schreuder, Burani & Baayen 2003 on Dutch). Similarly, frequency of the root emerged as a reliable indicator of shorter gaze duration in the eye-

tracking studies by Niswander-Klement & Pollatsek (2006) and Niswander, Pollatsek & Rayner (2000) (both on English) and Holmes & O'Regan (1992) and Beauvillain (1996) (on French).

With regard to the issue of the frequency of constituents, it is worth noticing that it has been pointed out (Schreuder, Burani & Baayen 2003) that there are different possible counts of constituent frequency: Base Word Form Frequency refers to the frequency of a word form in isolation; Base Lemma Frequency cumulates this count with the count of all the inflectional variants of a word; finally, Family Frequency represents the frequency count of all derivational and compounded forms in which the word is contained. Moreover, there are some studies (e.g., Colé, Beauvillain & Segui 1989), which make use of what they call a cumulative root frequency count, which includes summed frequencies counts of all the affixed forms in which the root is contained. Although a role for each of these counts has been found (Baayen, Dijkstra & Schreuder 1997; Colé, Beauvillain & Segui 1989), contrasting results have emerged for family frequency which has been repeatedly found to be non-significant in facilitating response times in lexical decision tasks (see Baayen, Lieber & Schreuder 1997; Schreuder & Baayen 1997; Baayen, Tweedie & Schreuder 2002; but Taft 1979:19). Nevertheless, it seems that the role of the frequency of the base has been convincingly demonstrated in the literature.

We must be very careful, however, in drawing clear-cut conclusions from such findings. There is no explicit way in which such effects could favor one model or another, since, except for the most extreme version of the full-listing position, all theoretical accounts acknowledge a role for morphology, be it at the access level (e.g., prefix-stripping model), at higher levels (e.g., supra-lexical model), or less explicitly stated (e.g., connectionist models).

Moreover, the investigation of frequency effects by means of the masked priming methodology has raised some issues with respect to the time-course and level at which morphemic and whole-word effects would appear. Specifically, the study by Giraudo & Grainger (2000) manipulated the frequency of derived primes in French: they presented a base target (e.g., *ami* 'friend') which could be preceded by either a high (e.g., *amitié* 'friendship') or low (e.g., *amiable* 'friendly') surface frequency derived form. They observed significant facilitation effects only for the former,

demonstrating that surface frequency of morphological primes affects the size of morphological priming. Moreover, they also found that cumulative root frequency does not influence the size of morphological priming, since suffixed word primes facilitated recognition of targets with both low and high cumulative frequencies. While it seems hard to reconcile such evidence (see also Voga & Giraudo 2009; Giraudo & Orihuela 2015) with the results emerged from unprimed lexical decision tasks, it could be argued that the frequency effects observed for morphemic constituents are post-lexical, i.e., reflecting the organization of the lexicon rather than the mechanisms involved during the access phase.

Controversial evidence has, however, been presented on this issue by the priming study by McCormick, Brysbaert & Rastle (2009) on English derived words. Contrary to the results of Giraudo & Grainger (2000), the authors obtained similar priming effects induced by low and high frequency derived primes, leading them to the claim that an obligatory decomposition occurs for all kinds of morphologically structured primes, irrespective of their frequency. Moreover, the results from the above-mentioned eye-tracking study by Niswander, Pollatsek & Rayner (2000) highlights a time-course pattern for morphemic frequency effects which is opposite to the one posited by Giraudo and colleagues. Specifically, the root frequency effect is claimed to arise early in processing, given that it was observed during first-fixation on the target, while the effect of word frequency would emerge later, as it was found to have a larger effect on gaze duration, i.e., the sum of all fixations on the target before the word is left in either direction.

To sum up, while disputes over their exact time course and locus at which they arise are still part of the ongoing debate, there is robust evidence that both whole word and root frequency can modulate word recognition. All in all, what these findings show, therefore, is that it is extremely likely that a word-based and a morpheme-based level interact during word recognition.

Morphological family size

There is yet another measure of frequency that has been demonstrated to have a well-established effect, and one which could cast more light on the organization of the lexicon, i.e., the so-called morphological family size count. As we have

mentioned, family frequency does not seem to help facilitating lexical decisions. What was found to be more relevant, instead, is the actual number of derived and compound words sharing a root, i.e., a type frequency count. Evidence for this variable has been widely attested in the results of unprimed lexical decisions conducted on different languages (De Jong, Schreuder & Baayen 2000) on Dutch; De Jong et al. 2002 on English; Lüdeling & De Jong 2002 on German; Moscoso del Prado Martín et al. 2004 on Finnish). Moreover, it has been demonstrated to be a predictor for latencies to both simple and derived words (Bertram, Baayen & Schreuder 2000; Moscoso del Prado Martín et al. 2004). In other words, the presentation of either *work, worker* or *working* has been found to benefit from the number of derived and compound words in which *work* occurs. This type of evidence is of particular importance for models of lexical access, because it shows that words which are not present in the input but are morphologically related to the stimulus presented are co-activated in the mental lexicon. Moreover, this effect was found to be semantic in nature, since this measure better correlated with reaction times when semantically opaque family members were removed (Schreuder & Baayen 1997; Bertram, Baayen & Schreuder 2000). The effect of this factor then would seem to be better accounted for in those models that posit an organization based on semantic connections such as the supra-lexical and connectionist ones, but also in the parallel dual model implementation of Schreuder & Baayen (1995), where the lemma nodes of words with similar meanings have overlapping sets of semantic representations (De Jong, Schreuder & Baayen 2000).

Affixal properties

So far, when considering morphemic constituents, we have mainly discussed factors concerning the characteristics of the base of morphologically complex words. However, although less developed and unanimous in their results, there exists also a growing body of research which concentrates on the specific properties exhibited by affixes. The study by Laudanna & Burani (1995) proposes four variables which are predicted to play a role in processing: i) orthographic confusability ii) affix length iii) affix frequency iv) affix productivity. While the studies reported in Laudanna & Burani (1995) found an effect of the first two

variables, further investigation concerning the other two factors has also been carried out, as we will briefly consider here.

The first property, also variously referred to as affix ambiguity or affix reliability (Nefs, Assink & Knuijt 2003), refers to the possibility for an affix to be confused with an identical non-morphemic orthographic string. According to Laudanna & Burani, the higher the ratio between words containing a real affix and words which do not, the greater the possibility for that affix to emerge as a processing unit. The results obtained by a lexical decision task presented in Laudanna, Burani & Cermele (1994) seem to confirm this intuition (see, however, Burani & Laudanna 2003 for differential patterns in a naming task). Pseudowords containing a more 'reliable' prefix such as *ri-* (in the pseudoword *riviale*) were found to be slower to reject when compared to pseudowords containing the same word preceded by non-morphemic sequences (*paviale*). The second study reported in Laudanna & Burani (1995), besides confirming such findings, also points out the role played by prefix length: pseudowords containing longer prefixes led to more errors and longer latencies during lexical decision. Such findings are interpreted within the light of the potential contribution of length to the overall perceptual salience of the affix, which would be boosted, and, as a result, likely to make the affix emerge as a unit. The role of this variable has emerged more recently in the eye-tracking study by Kuperman, Bertram & Baayen (2010), which has highlighted its importance also when suffixes are concerned. Words containing shorter suffixes were in fact found to be more likely processed holistically (in that a word frequency effect during eye-fixation arose) compared to those with longer suffixes. The role of suffix length was further demonstrated by the recent study by Sánchez-Gutiérrez et al. (2017), which took into consideration latencies to over 4000 English suffixed words. Crucially, among other factors, suffix length was found to facilitate target recognition in a lexical decision task.

The effects of the other two factors posited by Laudanna & Burani (1995), i.e., frequency and productivity, is admittedly somewhat harder to detect, given the close interrelation of the two. The studies conducted by Burani et al. (1997) and Burani & Thornton (2003) on Italian both concentrated on suffix frequency, albeit with different kinds of materials and tasks. The former made use of pseudowords

constructed as combinations of existing roots and either existing suffixes (*guardismo*, made up of *guard-* 'watch-' and *-ismo* '-ism') or frequent non-affixal word endings (*guardosta*). Crucially, the selected suffixes had either low or high frequency. Interestingly, lexical decision latencies were found to be slowed down by the presence of suffixes, but only when their frequency was high. Such results were confirmed by parallel faster naming latencies to the same pseudowords. Similar findings in the lexical decision task were obtained by the latter study with pseudowords composed of non-existent roots (*cempenista* versus *cempenosto*). However, when the authors tested the effect of suffix frequency in recognition responses to real words (e.g., *bassezza* 'lowness' versus *frutteto* 'orchard'), it was revealed that it is the frequency of the root that plays a major role in affecting response times (e.g., *bassezza*, which has a frequent root, is responded to faster than *saldezza* 'firmness', in which the root has low frequency).

As hypothesised by Laudanna & Burani (Laudanna & Burani 1995: 20; see also Burani 2006: 121), productivity seems to be, on the other hand, a better predictor of morphemic effects. Bertram, Laine & Karvinen (1999) stress the relevance of this variable, in that unproductive suffixes were found to hinder morphological activation in a task of visual word recognition in Finnish (on affix productivity, see also Ford, Davis & Marslen-Wilson 2010 on English; Lázaro 2012; Lázaro, Sainz & Illera 2015 on Spanish).

In the same study, another potential variable emerged, i.e., affixal homonymy, defined as the possibility for an affix to serve two semantic or syntactic functions. This factor was found to be critical in determining the way complex words are processed in both Finnish and Dutch. Specifically, Bertram, Schreuder & Baayen (2000b) found no effect of base frequency for inflected and derived words in *-er*, an ambiguous suffix (expressing both comparative and agentive meanings), while a word frequency effect emerged for such stimuli. On the contrary, latencies to words containing an unambiguous suffix (e.g., *-heid* 'ness') were modulated by base frequency.

1.3.3.3 – Problematic issues

While there are potentially many aspects that still remain not entirely clear, we will deal here with some specific issues which are still very much open to debate and which will be relevant to the results presented in this study, namely, the regular/irregular debate, the role of semantic transparency in early stages of word recognition, and the potential processing asymmetries of suffixed and prefixed words.

The regular/irregular debate

We have seen in § 1.2.2 how there is little agreement on the number of mechanisms underlying language processing. Depending on whether single or dual-processing mechanisms are involved, different predictions are made with regard to the processing of regular and irregular forms. The controversy originated within the context of the so-called 'past tense debate'. The seminal study by Stanners et al. (1979) showed, with a long-lag priming design, that verb bases such as *pour* were primed by their regular past tense forms (*poured*) as effectively as by their identical form (*pour*). Irregular past forms such as *hung* were also found to prime their bases (*hang*), but crucially to a lesser extent. The terms 'full' and 'partial' were adopted to indicate the difference between such effects, and such results were considered proof of the existence of two different mechanisms driving the processing of regular and irregular forms. Specifically, proponents of dual-model accounts (Pinker 1991; Clahsen 1999) argued that the 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 the stem only 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 to their present forms via a shared stem, but through a set of associative links yielding reduced priming. Similar empirical findings followed in different languages and using different priming protocols (English: Napps 1989; Marslen-Wilson 1999, cross-modal and masked priming; German: Sonnenstuhl, Eisenbeiss & Clahsen 1999, cross-modal priming; Hebrew: Frost, Deutsch & Forster 2000, masked priming). However, the picture is by no means clear-cut, since contrasting evidence showing

equivalent facilitation effects triggered by regular and irregular forms was also obtained (English: Forster et al. 1987; Pastizzo & Feldman 2002, masked priming; Italian: Orsolini & Marslen-Wilson 1997, cross-modal priming; French: Meunier & Marslen-Wilson 2004, cross modal and masked priming; German: Smolka, Zwitserlood & Rösler 2007, overt visual priming).

It may seem hard to account for such disparate results, as there seems to be no indication of task-specific or language-specific explanation. However, the picture becomes somewhat clearer by not assuming a rigid distinction between regular and irregular categories, but a continuum of regularity. An interesting insight in this respect comes from the study by Pastizzo & Feldman (2002): they considered the priming effects of regular and irregular English past forms, further dividing the set of irregular verbs into two subsets, according to their degree of orthographic overlap with their base. Interestingly, they obtained priming effects for regular and irregular forms with similar degrees of overlap (*hatched – hatch* and *fell – fall*, both sharing around 68% of their letters), but no effect was found for those irregular forms that were more formally distant from their base (*taught – teach*, 56% of overlap). Therefore, it seems that it is not the fact of being irregular *versus* regular that affects priming, but rather other dimensions, along which words may differ in a gradient way. Besides formal transparency, Feldman & Weber (2012) mentioned a number of other variables, such as semantic density, i.e., the number and interconnectivity among semantic associates of the stem (Baayen & Moscoso del Prado Martín 2005), family size, and neighborhood density (the number of words that are similar in form). Given the importance of such factors, it is argued that when they are not well controlled in studies with factorial designs, this may lead to misinterpretations of the results. More in general, the point these authors wish to make is that it is hardly possible to ascribe differences in priming effects to a unique morphological source, namely, a categorical distinction between regularity and irregularity. On the other hand, connectionist models seem more adequate to account for graded effects of similarity among related words, since they specifically predict different amounts of connections along the dimensions of form and semantics.

To summarize, the evidence so far collected does not seem to favor a uniform interpretation. While connectionist and associative models might seem to fit better

into the picture, a dual-mechanism account that does not rigidly distinguish regular and irregular categories (e.g., Schreuder & Baayen 1995) and that relies on variables such a frequency and semantic cues could also account for graded effects. Finally, it may also well be the case that methodological aspects need to be more carefully considered before drawing any definite conclusion. Crucially, when dealing with priming methodologies, different prime durations (and the possibility to consciously perceive the prime) may also lead to different results, as they are supposed to reflect different stages of lexical access.

Semantic transparency

Another issue which is very much open to debate concerns the role of semantic transparency. So far, we have considered many studies in which the domain of inflection was under investigation. The question of semantic transparency is not much relevant in this area, since related inflected forms tend to be maximally transparent. On the contrary, derivation is much less simple to investigate when semantics comes into play: we have already discussed the example of *dresser* in § 1.2.2, where the semantic relatedness between the derived form and its base is less evident than, e.g., that between *teach* and *teacher*. Moreover, there are many derivations, such as *department* (from *depart*) which are completely opaque with respect to their base. A question which must be answered then is how these forms are represented and accessed. The issue is of particular interest, because different models predict different behaviors for such opaque pairs.

One of the first studies to focus on semantic transparency is Marslen-Wilson et al. (1994): with a cross-modal priming design, the authors found facilitation effects for transparent primes such as *departure* (with *depart* as a target), but not with opaque ones (*department*). The results, interpreted within a decompositional perspective, were taken to indicate that opaque forms are not represented in a decomposed manner, and therefore no activation from prime to target can occur. Similar results were obtained by Feldman & Soltano (1999) and Rastle et al. (2000) in visual priming paradigms, at least when the prime was visible (SOA > 230 ms). The picture, however, becomes less clear when brief prime exposures are considered: Feldman & Soltano (1999) did not find reliable differences between the facilitation

effects induced by the opaque prime *casualty* and the transparent prime *casually* on the recognition of *casualness* at a SOA of 48 ms. Similarly, Rastle et al. (2000) report facilitation effects for opaque prime-target pairs (*apartment-apart*) at a SOA of 43 ms, although these were smaller than those observed for transparent pairs (*departure-depart*).

Rastle, Davis & New (2004) further tested this issue. What they found is that, with a SOA of 42 ms, pseudo-morphological primes, i.e., words that superficially have a morphology-like structure such as *corner* (which could be analyzed as *corn* + *-er*), facilitate the recognition of their (pseudo)stem (*corn*) as much as semantically transparent primes (*darkness*) do with their base. Importantly, it was shown that words like *brothel*, in which a stem (*broth*), but not an affix (*-el* rarely functions as such in English) could be isolated, do not prime their pseudo-stem. According to their morpho-orthographic segmentation theory, all words manifesting a morphological structure are parsed during processing, independent of their semantic relatedness (see also Longtin, Segui & Hallé 2003 for similar conclusions with French materials). While other studies were able to obtain similar findings (see Rastle & Davis 2008 for a review), a number of problems with these theories have also arisen. Firstly, there are studies demonstrating an effect of semantic transparency as early as 48 ms (Feldman, O'Connor & Moscoso del Prado Martín 2009) and 34 ms (Feldman et al. 2015). Secondly, it has been pointed out how the selection of materials in the Rastle et al. study may have affected results: the inclusion of prime-target pairs such as *fruitful – fruit* in the opaque set does not seem methodologically correct if one considers how *fruitful* means 'successful' and *fruit* has also a related figurative meaning as in 'the fruits of one's labors' besides its literal meaning (Baayen 2014). Moreover, Milin et al. (2017) observed that the orthographic string *-er*, contained in stimuli such as a *corner*, does not function as a suffix in 57% of the English words ending with it. This seems to call into question the main tenet of the morpho-orthographic segmentation theory, according to which only morphologically structured items would be decomposed, since *-er* evidently is not the best representative of suffixes, given its inconsistency. Other conflicting findings come from the above-mentioned study by Pastizzo & Feldman (2002), in which we have seen that prime-target pairs such as *fell – fall* prime each other

significantly. This is contrary to what the morpho-orthographic segmentation theory would predict, since *fell* is not decomposable, but its semantic relationship with *fall* is clear. Given that semantic transparency should not matter at early stages of processing, it is not clear why *fell* should prime *fall*, especially when considering that orthographically matched primes (*fill*) did not produce any facilitation effect. The effect of *fell* on *fall* cannot therefore be ascribed to orthography only, but must evidently comprehend shared semantics (see also Crepaldi et al. 2010 for analogous results).

All in all, what seems to emerge is that opaque primes can prime the recognition of their (formally) related target at short SOAs, but only to a certain extent. It seems more plausible to recast the issue in terms of gradience effects, i.e., along a continuum from semantically transparent morphological to opaque primes, rather than positing an obligatory semantically-blind decomposition.

Prefix – suffix asymmetries

The majority of the findings so far reported come from studies which concentrated on suffixed words. Interestingly, when it comes to prefixed (derived) words, the picture appears to be less clear. A number of studies, through the use of different methodologies, have highlighted the existence of differential patterns of results when prefixed words were used as critical items.

The above-mentioned study by Colé, Beauvillain & Segui (1989) on root frequency effects, for instance, found this variable to be a reliable predictor only for suffixed and not for prefixed words[9]. Specifically, suffixed words were found to be recognized faster in a lexical decision task when their base frequency was high (e.g., *jardinier* 'gardener') compared to those which had low base frequency (e.g., *policier* 'policeman'). The same was not true, however, for prefixed words, which showed similar reaction times, independent of their base frequency (e.g., *rechercher* 'to search' and *repousser* 'to delay').

Asymmetries between the processing of prefixed and suffixed words were also found in priming studies, though results are not always consistent. Marslen-Wilson

[9] See also the study by Beauvillain (1996) for similar results using an eye-tracking methodology.

et al. (1994), using a cross-modal priming design, found traces of affix inhibition when two suffixed words containing the same stem (e.g., *confession – confessor*) primed each other[10], but not when two prefixed words were used as primes and targets (*unfasten – refasten*). Interestingly, no such inhibition was found in the study by Meunier & Segui (2002), who, exploiting the same methodology with French materials, found that both prefixed and suffixed derivatives primed each other effectively. This study, on the other hand, highlighted another difference between prefixed and suffixed words, namely that only the former primed their base even in cases of phonological opacity (e.g., both *partial – impartial* 'partial – impartial' and *barbe – imberbe* 'beard – beardless' primed each other), while the latter were only efficient when they were transparent relative to their base (e.g., *brutal* 'crude' primed *brute* 'crude', but *circulaire* 'circular' did not prime *cercle* 'circle').

Finally, differences between the two types of derivatives are also found as far as affix priming (i.e., the priming effects to be found between derivatives sharing the same affix) is concerned. Even though studies concentrating on this issue are still scarce, while prefix priming seems to be solid (Chateau, Knudsen & Jared 2002; Giraudo & Grainger 2003), facilitation effects between derived suffixed words sharing the same suffix failed to emerge in the masked priming studies by Giraudo & Grainger (2003) and Giraudo & Dal Maso (2016a), respectively in French and Italian. On the other hand, in the masked priming study conducted by Duñabeitia, Perea & Carreiras (2008) with Spanish materials, priming effects emerged for suffixed pairs such as *brevedad – igualdad* 'brevity – equality'[11]. Moreover, such effects were also found in the cross-modal study by Marslen-Wilson et al. (1996) which tested priming among English derivational prefixes and suffixes (e.g., *darkness – toughness* and *rearrange – rethink*).

Keeping in mind that affix priming appears to be still understudied, such a variety of results presents some interpreting difficulties. Proposals to account for an (assumed) asymmetry between the processing of prefixation and suffixation span from hypotheses which consider position (and the assumed left-to-right processing

[10] See also Feldman & Larabee (2001), which found similar effects with cross-modal configurations, but not with visual ones.

[11] See Giraudo & Dal Maso (2016a) for criticism of the design used in this study.

direction) as a critical factor (Segui & Zubizarreta 1985; Colé, Beauvillain & Segui 1989) to those which highlight language specific variables (Meunier & Segui 2002) and experimental modality issues (Feldman & Larabee 2001).

Chapter 2: Second language processing of morphology

In recent years, considerable attention has been dedicated by research on second language acquisition to the development of the L2 lexicon (Singleton 1999). Research on the processing of the L2 lexicon has been very much focused on the understanding of the nature of its connections with the L1 lexicon and whether meaning is achieved via L1 mediation (see, e.g. the Revised Hierarchical Model proposed by Kroll & Stewart 1994). Currently, within the perspective of an integrated bilingual lexicon (the Bilingual Interactive Activation – BIA+, Dijkstra & Van Heuven 1998; 2002), studies are focused on whether processing is language selective or not, i.e., whether both languages are available when processing words of one of them or whether bilingual speakers can 'switch off' the one which is not relevant at that given moment. However, as pointed out recently by Obler & Goral (2007), morphology is often neglected in these models, which do not seem to take into consideration its contribution to the structuring of L2 linguistic representations. While this picture seems likely to be changing rapidly, the focus of this strand of research is still very much set on the cross-linguistic influence the L1 can have on the processing of the L2 (e.g., through cross-language priming studies, where the prime is presented in one language and the target in the other). As we will see in the next sections, however, parallel explorations of the role of morphology in the organization of the L2 lexicon have flourished in the last decade, though many questions are still left unsolved.

2.1 – Morphology in the second language

While research on morphological processing within the context of the L1 has been abundant during the last decades, it is only recently that this topic has been introduced as subject of investigation in the field of second language acquisition, at least through the use of online reaction time experimental methods (Juffs 2001).

It is worth noticing here that, if in the studies on L1, morphology has been found to affect the organization of the mental lexicon (albeit with all the controversial points of debate that we discussed in Chapter 1), it is still not entirely clear whether morphology plays a role in L2 at all. Moreover, a central question in this field of research concerns the existence of differences or similarities in the underlying

mechanisms of access. To elaborate, positions vary not only with regard to the role of morphology, but also with regard to how morphology is assumed to shape the relationships among words, i.e., through rule-based or associative mechanisms. This distinction is indeed of central relevance within those models which assume two different mechanisms to be operating in L1 processing. Thus, in summarizing the main positions about L2 morphological processing, it will be worth highlighting the different premises about L1 processing (in terms of dual *versus* single mechanism) on which the different accounts are built. We will first consider theoretical accounts which support the existence of structural differences between first and second language *versus* those which do not. Psycholinguistic evidence supporting the two different approaches will be then briefly considered. Specific attention will be devoted to the (few) studies on derivation, since this area is the main interest of the present work, with an in-depth look at the issue of formal influences in second language processing.

2.1.2 – Models supporting the existence of different mechanisms in L1 and L2 morphological processing

2.1.2.1 – The Declarative/Procedural Model (Ullman 2001; 2005)

Theoretical positions assuming fundamental differences between the ways native and non-native speakers process morphology are to be found mainly within the context of dual-mechanism accounts (but see Diependaele et al. 2011, who, although proposing a dual model, support the opposite position). Among the most influential of such accounts is the application of Ullman's Declarative/Procedural model to the field of SLA. We have seen in Chapter 1 as, according to this approach, a distinction is posited, following the trend of traditional dual models, between a memorized mental lexicon and a computational mental grammar, along with a specific correlation between these two components and the declarative and procedural memory systems. Ullman (2001b; 2005) further expanded the model to account for L2 processing of syntax and morphology. The basic tenet of his theoretical account is that procedural memory, and thus grammatical computation, is largely affected by maturational constraints, i.e., age of exposure (the first encounter with the L2). It is generally assumed that this variable can greatly

influence native-like attainment of an L2 (Birdsong 1999; see Dörnyei 2009 for a review), that is, L2 speakers who started learning past childhood or puberty are claimed to experience more difficulties than young learners. In Ullman's approach, age of exposure affects the procedural memory to a larger extent than it does with the declarative memory. As a result, so-called 'late learners' will tend to rely more on the declarative memory, which, on the contrary, improves with age (Ullman 2001b: 109). Therefore, grammatical computations, which mainly rely on the procedural memory system in native and young L2 speakers, will crucially depend on the declarative system and thus be processed differently. As for morphology, this would mean that complex words like *happiness* or *walked*, which are supposed to be computed by the procedural system in native speakers, will be more likely to be memorized instead in the declarative/lexical knowledge in late learners. A point which needs to be highlighted is that this does not mean, in this model, that such forms will be memorized as unanalysed wholes, but rather as morphologically structured whole-forms. Indeed, it is important to recall here that the lexicon posited by the Declarative/Procedural model is assumed to be organized in terms of associative links, much like the one assumed in single associative models. Thus, in a way, the DP model predicts that L2 speakers will tend to rely more on a single associative system, whereas this system is only assumed to function for unproductive irregular forms in the L1 processing system («the lexicon/grammar dissociations of associations posited for L1 should be weaker or perhaps even absent in L2» (Ullman 2001b: 110). Importantly, the model predicts that both regular and irregular complex forms will exhibit associative memory effects, i.e., frequency and phonological neighbourhood effects, while such effects are typically expected only for irregulars in L1 processing. Similarly, the specific claims about the localization of the neural correlates of the two memory systems made for L1 processing are reshaped according to the L2 shift from procedural to declarative. For the L2, both regular and irregular forms are linked to temporal/ temporo-parietal structures, mainly located in the left hemisphere, as opposed to what happens in L1, where these structures are only involved for the processing of the lexicon and not for grammatical computations (which are located in the left frontal/basal ganglia structures). While age of exposure is posited to be a strong determinant for this shift

from the procedural to the declarative memory, the DP model does not categorically rule out the possibility for late learners to improve learning via the procedural route as a consequence of practice. Indeed, following the line shown by studies which observed adult acquisition of non-linguistic skills by procedural memory (Schacter & Tulving 1994), the DP model proposes that practice and increased exposure to the L2 may in principle lead L2 speakers to nativelikeness in their dependence on the procedural system.

2.1.2.2 – The Shallow Structure Hypothesis (Clahsen & Felser 2006)

A related account on the supposedly different mechanisms guiding L1 and L2 processing is the Shallow Structure Hypothesis (SSH) proposed by Clahsen & Felser (2006). Originally presented to explain the L1 and L2 differences found in the domain of syntax, the theoretical model has been later applied also to the specific area of morphology[12] through a subsequent series of psycholinguistic studies investigating morphological processing (Silva & Clahsen 2008; Neubauer & Clahsen 2009; Clahsen & Neubauer 2010; Kirkici & Clahsen 2013; Jacob, Fleischhauer & Clahsen 2013; Heyer & Clahsen 2015; Bosch & Clahsen 2015; Clahsen & Veríssimo 2016). Like the DP model, this account is set within the dual-mechanism framework in L1 processing and therefore distinguishes storage and computation respectively for irregular and regular complex words (but see the discussion below for some differences). The SSH assumes the existence of a weak L2 grammar, unable to provide the information required to process complex syntax and morphology in a nativelike way. As a consequence, L2 learners would resort to 'shallow' parsing strategies, carrying a less detailed representation of the structure of complex words and largely dependent on lexical-semantic cues (Clahsen et al. 2010: 23). Importantly, with specific regard to morphological processing, the model draws its main prediction from Ullman's DP model, suggesting that L2 learners largely depend on memory storage, unlike native speakers do. It is to be highlighted, however, that this approach posits a threefold – rather than twofold – distinction in

[12] It is worth noticing, however, that the original proposal by Clahsen & Felser (2006) posited a distinction between the two domains, namely, the existence of different L1 and L2 mechanisms for syntax, but not for morphology.

L1 processing and this is supposed to reflect on L2 processing in a slightly different way from that predicted by Ullman. Clahsen, Sonnenstuhl & Blevins (2003) in a study on derivational and inflectional L1 processing, aimed at demonstrating the existence of processing differences for the two domains. While a detailed description of the (still ongoing) debate about such differences in L1 is beyond the scope of this work, it seems necessary here to summarize briefly their position, as this crucially also reflects on the predictions they make for L2 processing. In their study, the authors proposed a «refinement of the Dual Mechanism Model that distinguishes three types of elements: i) frozen irregular forms, stored in entries, ii) productively derived stem *entries* and iii) productively inflected word *forms* which are not represented in lexical entries» (Clahsen, Sonnenstuhl & Blevins 2003: 3). Basically, like other dual accounts, they claim for combinatorial mechanisms to apply to both regularly inflected and derived words, but not to irregulars. However, inflected and derived regular words are assumed to be in turn different from each other in that the result of a derivational rule is an entry (thus represented in the lexicon), while the output of an inflectional rule is a form (not stored as such in the lexicon). In this light, the authors explain the psycholinguistic data obtained in their study on inflection and derivation: specifically, they observed similar morphological priming effects for both inflected and derived regular words, but not for irregular (inflected) forms. However, contrary to the predictions of other dual accounts (e.g., Ullman's DP model), they also found a difference in the processing of inflected and derived regular words, i.e., a surface frequency effect only for the latter. Crucially, since surface frequency effects were also found for irregularly inflected words, the authors conclude that both regular derivations and irregular inflections are listed at some level, while this possibility is excluded for regular inflections. How this threefold distinction reflects in L2 processing, however, appears to be not entirely clear from the above cited studies by Clahsen and colleagues (see discussion in § 2.2.2.1 for derivation). Given their claim that L2 speakers rely more on storage than computation, we would expect to find regularly and irregularly inflected and derived words to be processed by means of the declarative system. It is not evident, however, whether a more fine-grained

distinction among all these forms should be found in terms of experimental evidence and which patterns or results are expected.

The only consistent prediction so far proposed by the authors is that regular inflection should be differentiated from regular derivation and irregular inflection, although the reason is far from being clear. If processing of all complex words in L2 is posited to be handled by a declarative memory system which resembles an associative learning system, we should at least expect a pattern of gradient effects, possibly modulated by semantic and formal similarity, and thus expect similar treatment at least for regular inflection and derivation. We will return on this point later in the discussion of psycholinguistic evidence.

Before turning to the hypotheses that support the existence of shared L1 and L2 mechanisms, it is important to highlight the marginal role attributed by the SSH to factors such as L1 transfer and learners' proficiency in shaping the processing mechanisms exploited by L2 speakers. Specifically, Clahsen's approach explicitly posits that the assumed overreliance on non-grammatical computation is independent of a learner's L1, i.e., no transfer effects should be found. Similarly, proficiency is largely underestimated in this proposal (but see the recent modification by Clahsen & Felser (2017), who take a more cautious approach on this issue), while age of acquisition is claimed to be a predictor of nativelike attainment stronger than length of exposure and language use (Clahsen & Veríssimo 2016; Veríssimo et al. 2017). Indeed, this view takes a strong approach on the existence of a so-called critical period (Lenneberg 1967) for second language acquisition, i.e., a window of time (generally until the end of puberty) after which nativelike processing mechanisms would become unavailable. While many scholars in the tradition of SLA research agree that of age of acquisition can have an impact on successful learning (DeKeyser 2000), a problem with this view is that it is often very difficult to disentangle the role of potential confounds, such as practice deriving from long exposure, which is often a consequence of early age of acquisition[13] or the amount of instruction in the target language and the degree of

[13] An interesting way to disentangle the role of practice and age of acquisition in the domain of morphological processing is however attempted by the study by Gor & Cook (2010: 201), which considers the case of heritage speakers, i.e., early interrupted speakers.

social integration in the L2 community (see, e.g., Hakuta, Bialystok & Wiley 2003 and Dörnyei 2009 for a review of the debate).

2.1.3 – Alternative views

An alternative hypothesis to that described above is one which proposes that L1 and L2 processing systems basically share the same mechanisms and ascribes potential differences between the performances of native and non-native speakers to a multiplicity of alternative causes which are not categorically assumed to block nativelike attainment. From this perspective, the role of biologically age-related factors is therefore minimized. Among proponents of these positions, both dual (Diependaele et al. 2011; Gor & Jackson 2013) and single associative models (Basnight-Brown et al. 2007; Feldman et al. 2010) are found. Despite starting from different premises and positing different effects of some specific variables, such as L1 transfer, proficiency, and the role of the morphological structure of the target language, they both reject the idea of the existence of fundamentally different ways of handling the input.

It is worth noticing here that the dual models sharing this position are generally of a very different nature from the one posited by Clahsen and colleagues for native processing. As pointed out by Gor & Jackson (2013), the strong dichotomy between regular and irregular, and derivation and inflection, is not compatible with so-called 'hybrid models' (Diependaele, Sandra & Grainger 2009). Such accounts, rather than assuming different routes for different categories of words, highlight the role of variables such as semantic transparency, affix homonymy, neighbourhood size, and morphological family size in determining which route prevails (Baayen, Dijkstra & Schreuder 1997).

Along this line of interpretation, it is a natural consequence that all such factors will also play a role in the development of L2 sensitivity to morphological structure. Interestingly, single associative models are similar in this respect for the importance attributed to these variables. Indeed, one of the main tenets of usage-based constructionist approaches to SLA predicts learning to occur via form-meaning pairings (i.e., constructions), which will likely be easier to acquire the more reliable these pairings are (Ellis 2006; Ellis & Wulff 2015). On the one hand, within such

a perspective, raw frequency is assumed to be one of the driving forces of L2 learning, which, as a consequence, implies that learners will benefit from greater exposure: «through experience, a learner's perceptual system becomes tuned to expect constructions according to their probability of occurrence in the input» (Ellis & Wulff, 2015: 77). On the other hand, token frequency is not enough to guarantee successful learning, as cue reliability, i.e., reliable mapping of a cue and its outcome, is also a key determinant (Beckner et al. 2009; Ellis 2006; MacWhinney 1997)[14]. To elaborate, in the specific domain of morphology, for instance, allomorphy (i.e., one meaning – multiple forms) and morphemic polysemy (i.e., one form – multiple meanings) will pose somewhat more difficulties to learners. Similarly, those constructions which are both low in salience and redundant in the understanding of meanings will be more probably overshadowed, since they will often be considered unnecessary. This is the case, for instance, of inflectional markers, whose presence will be most likely overlooked when other cues are present (e.g., a temporal adverb may cause tense markers to go unnoticed), and conversely, in production, will be more likely to be omitted[15].

Supporters of qualitative similarities between native and non-native processing indeed point out how in L2, but also in L1, language-specific properties play a major role in determining learning. This is especially true also from the more general perspective of the typological differences between the morphological structures of the language. On the one hand, the role of the L1 might be strong enough to lead learners to rely on the morphological structure of their first language even when processing the L2. Thus, should L1 transfer have an effect, speakers of an isolating language like Chinese, for instance, might be less sensitive to the morphological structure of those languages which are morphologically very rich (Basnight-Brown et al. 2007; Portin et al. 2008). On the contrary, if the target language itself determines the way processing occurs, L1 morphological properties should have

[14] Contingency of mapping is acknowledged in domain-general cognitive research as a driving force of learning (Shanks 1995).

[15] According to Ellis & Wulff, this aspect of learning is much more influential in SLA than in L1 acquisition, since children acquire the meanings of temporal adverbs relatively late, while L2 speakers already know them from their L1 experience (Ellis & Wulff 2015: 82).

little impact (Diependaele et al. 2011). The two aspects are likely to be intertwined though, so that at initial stages a learner's L1 might play a more prominent role, given the priority of associations established in the L1, while with increasing practice and proficiency, the learner's mind should gradually tune to the L2's properties.

This observation brings us to the much-debated role proficiency would play in L2 processing. The great majority of studies holding a shared mechanism view propose that any supposedly qualitative difference between native and non-native processing is likely to vanish as the level of proficiency increases, suggesting a quantitative, rather than qualitative, change (Feldman et al. 2010; Perani & Abutalebi 2005; Coughlin & Tremblay 2015; Diependaele et al. 2011; but see Foote 2015). Moreover, the results from the study by Perani et al. (2003) highlighted the existence of neuroanatomical differences which would be specifically related to this variable. It is not entirely clear, however, how the effect of proficiency should translate in terms of morphological processing, as this crucially depends on the architecture of the model believed to operate in L1 processing. Indeed, according to those perspectives which believe that whole form frequency crucially regulates the choice between storage and computation, L2 speakers should show a developmental trajectory moving from computation for low proficiency learners to storage for highly proficient ones (Gor & Jackson 2013; Portin, Lehtonen & Laine 2007). That is, since high (and medium, depending on the patterns found in a specific language) frequency words are assumed to be processed as whole forms by native speakers, low proficiency learners are believed not to have fully developed stored whole-word representations and therefore to rely primarily on decomposition. On the other hand, traditional dual accounts such as Clahsen's, would posit an opposite trajectory, i.e., from storage to decomposition, since the latter is assumed to be the privileged route for native speakers (at least for regular inflections). Usage-based accounts, on the other hand, being less concerned with the storage *versus* computation debate, simply expect instead to observe the same morphological effects of L1 processing (i.e., word frequency effects for all types of words and priming effects between morphological relatives) arising as a function of proficiency, highlighting how this could sometimes result in an overreliance of

non-native speakers on the formal characteristics of complex words (Feldman et al. 2010). From the above considerations, it is clear that, since assumptions for L1 processing are very different across the models, we need to be especially careful when interpreting experimental evidence, crucially comparing the patterns found for L2 learners with those of native speakers.

Finally, a hypothesis which has been put forward as a possible explanation for the observed differences in L1 and L2 grammatical processing proposes that native-like attainment is impaired due to limitations in general cognitive processes, i.e., low memory capacity, slower processing speed in L2, and poor L2 decoding. Specifically, this account consistently reduces the role ascribed to the existence of a critical period, which would categorically impair grammatical processing in late learners. Within this perspective, different patterns of performance between L1 and L2 are claimed to be not qualitative in nature, since non-native performances are shown to be possibly replicated by native speakers when put under noise and stress conditions (McDonald 2006).

2.2 – Psycholinguistic evidence on L2 morphological processing

The bulk of the studies on L2 morphological processing has focused on the domain of inflection, with transpositions of the L1 past tense debate (see § 1.3.3.3). Since a critical analysis of such a debate is beyond the scope of this work, which is instead focused on the processing of derivation, we will here first report the main general findings of the psycholinguistic studies so far conducted[16] and dedicate a specific section to the findings and issues related to the domain of derivation. Like in L1 processing research, the most exploited methodology in the field of word recognition is the lexical decision task, either by itself or combined with a priming paradigm. Since evidence obtained through each of the two highlight different aspects of morphological processing, we will consider them separately.

[16] Given the psycholinguistic nature of the experiments presented in the following chapters, we only concentrate here on the psycholinguistic evidence obtained through on-line methods, specifically in the domain of visual word recognition. For a review of neurolinguistic findings see Perani & Abutalebi (2005); Ullman (2001b).

2.2.1 – Lexical decision tasks

Unprimed lexical decision tasks have been mainly employed in studies on L2 morphological processing to observe whether words are accessed as whole forms or through morphemic decomposition[17] and whether the pattern shown by L2 learners matches that of native speakers. Importantly, these studies often manipulate frequency, given that the underlying assumption is that high frequency words are more likely to be entrenched and thus accessed as whole-forms, while low (and possibly medium) frequency words should be retrieved through morphemic parsing. In such studies, monomorphemic and polymorphemic words matched for surface frequency are presented to participants. By definition, if reaction times for polymorphemic and monomorphemic words are comparable, this is taken as evidence that complex forms are accessed through full-form retrieval. On the other hand, longer reaction times for polymorphemic words should reflect the processing costs of morphemic analysis.

An important consideration advanced by most studies adopting a hybrid dual-mechanism view is that, according to the morphological richness of the specific language under investigation, storage or decomposition might be preferred in L1 processing (e.g., Chinese native speakers are assumed to apply storage for all words, given the isolating nature of this language, while the reverse might be true for morphologically richer languages such as agglutinative ones)[18]. Therefore, it is clear that a comparison with native performances is mandatory before advocating any hypothesis for L2 processing[19]. Most importantly, hypotheses about L2 sensitivity to the morphological structure of the L1 have been put forward on the basis on these studies.

[17] We use here the terms whole-word storage and decomposition, which are typical of dual-mechanism models (be they traditional or hybrid), since the majority of the described studies are set within such theoretical frameworks.

[18] See Lehtonen & Laine (2003).

[19] This is especially true for the medium-frequency range. While it may seem evident that storage should be preferred for high frequency words and decomposition for low frequency words, the prediction for the medium range might change according to the morphological structure of the language.

In a study by Lehtonen & Laine (2003), Finnish native speakers showed full-form access for high frequency words, while the morpheme-based route was preferred for low and medium frequency words. Swedish learners of Finnish, however, were found to employ morpheme-based decomposition for words belonging to all frequency ranges. The interpretation given by the authors is that, on the one hand, bilinguals are exposed to these forms not often enough to develop whole-word representations. On the other hand, learners might be tuned towards morphemic analysis for all words because Finnish is a morphologically rich language (contrary to Swedish). In a subsequent study by Lehtonen et al. (2006), the design was reversed, in that the authors tested the processing of Swedish inflected forms by native speakers and by learners with Finnish as L1. Interestingly, both groups showed similar patterns, i.e., full-form retrieval for high and medium frequency words and decomposition only for low frequency items. Taken together, these results seem to make a strong case for the influence of the structure of the target language in L2 processing.

Subsequent works on L2 Swedish by Portin and colleagues also highlight the importance of age of acquisition and L1 transfer. More specifically, Portin, Lehtonen & Laine (2007) found that even late learners with Finnish as L1 (as opposed to the early learners considered in the Lehtonen et al. study) showed the same pattern of results exhibited by native speakers (decomposition only for low frequency words), concluding that despite late exposure non-native speakers can attain nativelike processing mechanism. Transfer effects were instead obtained in Portin et al. (2008), where Hungarian and Chinese speakers of Swedish L2 exhibited different recognition times: Chinese speakers showed full-form retrieval for all the three frequency ranges considered (low, medium, and high), while Hungarian speakers only employed this route for high frequency forms, adopting decomposition for low and medium ranges. Given the typological difference between Chinese and Hungarian, respectively an isolating and an agglutinative language, the authors propose an L1 transfer explanation, according to which Chinese speakers would be more prone to apply the mechanism which is typical of their language.

Finally, the study by Neubauer & Clahsen (2009), conducted on L1 Polish speakers of L2 German, was aimed at investigating the emergence of frequency effects for regular and irregular German past participles. Given that native speakers only appeared to be sensitive to surface frequency when presented with irregular forms (i.e., these forms were responded to faster), the finding that L2 speakers exhibited this sensitivity to all the forms, irrespective of regularity/irregularity, led the authors to conclude that learners rely more on storage (in accordance with Clahsen's general proposal, i.e., the SSH, and Ullman's DP model).

To sum up, the majority of these studies highlight the potential impact of the variables considered in § 2.1.3 (L1 transfer, exposure and age of acquisition, the role of the morphological structure of the target language), pointing towards an L1-L2 shared mechanism interpretation. Importantly, however, the study by Neubauer & Clahsen (2009) seems to make a point for the opposite hypothesis. Given the reduced number of studies and especially of languages considered (Finnish, German, and Swedish), a strong proposal based on such evidence is still far from being reached.

2.2.2 – Priming studies

Like in L1 research, the lexical decision task combined with the priming paradigm is becoming an increasingly popular method to investigate the early phases of processing in the L2. Priming effects can be less straightforward to interpret, but provide a more nuanced picture of the way morphological relatedness between words is perceived by non-native speakers. After the work by Silva & Clahsen (2008) conducted on L2 English, an increasing number of studies have since appeared. Results, however, could not settle the controversy between the two opposite camps, as a number of issues still remain unexplained.

The study by Silva & Clahsen (2008) put forward the hypothesis that L2 speakers do not make use of the morphological structure of words during processing, based on the diverging patterns of priming effects yielded by regularly inflected forms on the recognition of their stem. Given that the authors also found that priming with

derived forms, albeit present, was significantly reduced in L2 speakers[20], they conclude that non-native speakers rely more on the declarative system as opposed to native speakers, whose processing mechanism depends on the procedural system. Moreover, since their study tested three groups of L2 learners with different L1s (German, Chinese, and Japanese) and found no differences among the three, the possibility of L1 transfer was ruled out. As mentioned above, however, we should be careful in the interpretation of the facilitation effects induced by morphological relatives, since it is hard to tell whether they are the result of a combinatorial operation or of associations among related words. What is more, it is rather surprising that, if L2 speakers rely more on full-form access for both derived and inflected words, they did not show any priming for the inflected forms, while they did for the derivatives.

In the light of this proposal, many following studies proposed to confirm or disconfirm these findings in both L2 English and other languages. Specifically, many of such studies have been aimed at verifying, on the one hand, the existence of potential differences between the processing of inflection and derivation; on the other hand, within the specific domain of inflection, a much-debated issue concerns the processing of regular *versus* irregular forms.

As for the former, two recent works on L2 Turkish and German (Kirkici & Clahsen 2013; Jacob, Heyer & Veríssimo 2017) support the claim of the Silva & Clahsen study. Kirkici & Clahsen (2013), investigating the processing of targets primed by regularly (Aorist) inflected primes and deadjectival *-lIk* nominalizations, found that while L1 speakers were facilitated by both, L2 learners were only primed by the latter. Jacob et al. (2017) confirmed the same patterns of results in L2 German using the same target verb primed by either its past participle form or its nominalization in *-ung*.

[20] The authors distinguish between full and partial priming. Both indicate a significant priming effect obtained in the test condition (in this case, the morphological condition) relative to the unrelated baseline, but, crucially, only the former produces no significant differences between the identity and the test condition, which means that the test prime yields as much facilitation as the identity prime. The distinction was first introduced in the study by Stanners et al. (1979).

Contradictory evidence was however found by the study by Voga, Anastassiadis-Symeonidis & Giraudo (2014), who, running a (partial) replication of the Silva & Clahsen experiment with Greek learners, observed equally robust priming effects in both L1 and L2 processing of inflection[21].

Another much-debated issue concerns the processing of irregular and regular inflected forms. According to the line of thought promoted by Clahsen and colleagues, since native speakers would process regular forms through morphological parsing and irregular forms through whole-word retrieval, results pointing towards the exclusive use of the latter by non-native speakers should be taken as evidence in favour of their SSH (and possibly, the DP model). Many studies have found evidence of such an unbalance: Neubauer & Clahsen (2009), for instance, in a masked priming lexical decision task on L2 German (with speakers of L1 Polish), found that both native and non-native speakers exhibited partial priming with irregular primes, but only the former were fully primed by regular inflections. Since no priming was found in L2 speakers, the authors argue that the combinatorial operation from which regular forms are created is not available for L2 learners. Irregular inflections, on the other hand, would be stored as separate whole-word representations (a strategy which is available to learners) in both groups of speakers, and are consequently not able to reactivate the base stem (hence, the partial effect). Similar results in L2 German were found in a later study by Jacob, Fleischhauer & Clahsen (2013) with a cross-modal priming experiment with L1 Russian subjects. Interestingly, this experiment examined two types of irregular past participle forms, differing for the degree of formal overlap with the base stem (forms with no stem change such as *geschlafen – schlafe* and forms with stem change such as *gestohlen – stehle*). Regular forms (*gedruckt – drucke*) were also

[21] It is worth noticing that, although they used the same materials of the Silva & Clahsen study, Voga and colleagues also implemented some slight modifications, in that they included less filler items (42 as opposed to the 303 presented in the original study) and presented the primes for 50 ms instead of 60 ms. As for the latter, Voga and colleagues point out that longer prime durations should enhance morphological effects. Therefore, 10 ms less should, if anything, have impaired such effects (Voga et al. 2014: 376). On the other hand, Clahsen & Veríssimo (2016) suggested the possibility that the modified number of filler items could have artificially promoted morphological priming due to the high proportion of related prime-target pairs (Clahsen & Veríssimo 2016: 691).

included. While native speakers were fully primed by regular participles and partially by both types of irregulars (irrespective of stem change), L2 speakers exhibited partial facilitation for regular forms and irregulars with stem change, but no priming for irregulars without stem change. It is not entirely clear, however, why these forms should not produce priming when irregulars with stem change, which are formally more distant, do[22].

These and other results from studies on L2 German (Bosch & Clahsen 2015; Krause, Bosch & Clahsen 2015) are challenged, however, by a number of works in different languages showing contradictory results.

Basnight-Brown et al. (2007), for instance, compared irregular and regular English verb forms using a cross-modal priming procedure. Their study also included two types of irregulars differing for their degree of stem formal overlap (nested stem such as in *drawn – draw* and stem change such as in *ran – run*). Results for English native speakers and the two groups of learners tested (Serbian and Chinese) revealed differences, which do not however match those found in the above-described experiments. Native speakers were facilitated in a similar way by all the types of morphological primes considered, while Serbian and Chinese learners exhibited differences, but only as far as the irregular forms were concerned. Specifically, Serbian speakers were facilitated by nested past forms (*draw – drawn*), while Chinese by neither of the two types. Importantly, both groups were primed by regular forms. According to the authors, it is crucially the differing degree of formal overlap to provide an explanation, at least for the performances of Serbian subjects. To elaborate, the hypothesis is that, in non-native processing, there would be enhanced importance of a word's formal characteristics and attenuation of its semantic properties. The fact that Chinese and Serbian learners differed from each other, on the other hand, calls for a role of L1 transfer.

Similar results emerged from a study on English regular and irregular past forms by Feldman et al. (2010), which registered the same amount of facilitation in L1 and L2 subjects (with L1 Serbian), at least when compared to an unrelated baseline. No effects were however found against an orthographic baseline for less proficient

[22] The proposed explanation is some sort of competition arising between the past participle *geschlafen* and its infinitive form *schlafen*, which would be co-activated.

speakers, whereas more proficient subjects showed facilitation for regularly inflected primes. Such evidence led the authors to conclude that the morphological effects shown by non-native subjects might be modulated by the speakers' level of proficiency and, more importantly, confirmed the role attributed to the formal characteristics of primes.

Non-native speakers have also shown to be able to process irregular forms like native speakers do in the study by Gor & Cook (2010) (see also Gor & Jackson 2013 for similar results). Using an auditory priming lexical decision task[23], Gor & Cook found the same amount of facilitation in native and non-native English speakers of L2 Russian for regularly inflected Russian verbs (e.g., *rabotaju – rabotat'* 'I work – to work'), semi-regular (e.g., *xozhu – xodit'* 'I go – to go') and irregular (e.g., *zovu – zvat'* 'I call – to call') verbs.

Finally, two recent studies on L2 French and Spanish (Coughlin & Tremblay 2015; Foote 2015) further seem to cast doubts on the existence of different processing mechanisms for L1 and L2 speakers, at least with regard to regular inflection. Both studies were conducted on learners with L1 English and revealed that they were sensitive to the morphological structure of the primes like native speakers were. However, they diverge in the role they assign to proficiency: while intermediate and advanced learners performed similarly in the study by Foote, Coughlin & Tremblay's results show that the size of L2 learners' morphological priming increased with their proficiency in French.

To summarize, it appears that no conclusive evidence has been provided so far with regard to the factors affecting L2 morphological processing. It seems, however, that strong claims about a qualitative difference between native and non-native speakers come primarily from research on L2 German (Silva & Clahsen 2008). Among proponents of the opposite view, on the other hand, there is still little agreement on the role of proficiency, L1 transfer, and a word's formal properties.

[23] In the auditory modality, both primes and targets are presented auditorily.

2.2.2.1 – Priming studies on derivation

Despite the abundance of attention dedicated to the processing of derivational morphology in L1 research, this domain has been somewhat more neglected in the field of second language acquisition and mainly studied only as opposed to inflection.

While there seems to be more consensus about the existence of facilitation triggered by derivational primes (Dal Maso & Giraudo 2014; Diependaele et al. 2011; Kirkici & Clahsen 2013; Voga, Anastassiadis-Symeonidis & Giraudo 2014), a point that needs clarification is the nature of such facilitation. Recall that earliest proposals by Clahsen and colleagues posited a lexically mediated access for derivation, a hypothesis which is to a certain extent shared by single associative perspectives (which indeed assume associative representation for all types of words). While it is hard to tell whether priming effects reflect this kind of access or a strictly decompositional one, observations about the magnitude of priming and comparisons with performances of native speakers can certainly shed more light on the way derivation is processed.

A first issue concerns the claim that priming would be reduced in L2 speakers (Silva & Clahsen 2008). The study by Clahsen & Neubauer (2010) makes the even stronger claim that learners would not rely *tout court* on any kind of morphological representation for derived words, based on the fact that their L2 participants failed to find any priming effect with *-ung* nominalizations in L2 German. To date, however, this is probably the only study showing such a pattern, and subsequent proposals of Clahsen and colleagues have been more cautious (Kirkici & Clahsen 2013; Jacob, Heyer & Veríssimo 2017).

A more interesting line of research, and importantly, one which will be further explored in the present work, considers the possibility that form might play a greater role in L2 processing. A strong version of this hypothesis has been recently brought up by the work of Heyer & Clahsen (2015), who made use of an orthographic control in a masked priming experiment on L2 English in order to disentangle morphological from purely formal effects. Their hypothesis is that the effects so far registered in L2 studies on derivation are formal in nature rather than morphological. What they found is that while L1 speakers were significantly

facilitated only by morphological primes, L2 subjects showed similar reaction times after morphological and orthographic primes. Based on such evidence, the authors therefore argue that early word recognition processes in non-native speakers are driven by surface-form properties and that what appears to be morphological is in fact formal. In support of their view, they point out that Diependaele et al. (2011) (and Feldman et al. 2010 for inflection) obtained moderate priming effects with semantically opaque items in L2 speakers, which could actually reflect an impaired access to semantics. If, on the one hand, these results seem to call into question the actual role of morphological organization in the L2 mental lexicon, on the other hand, a few remarks are necessary. Firstly, the study by Diependaele et al. (2011) compares the priming effects triggered by morpho-semantically transparent (*viewer – view*), opaque (*corner – corn*) and orthographic primes (*freeze – free*), finding little influence of the latter, significantly larger effects for transparent items and intermediate for opaque ones[24]. It is therefore worth noticing that what their study highlights is that there might be a somewhat greater influence of formal characteristics, but nevertheless the significant priming obtained for truly morphological pairs could be hardly explained in terms of mere formal overlap, given the fact that orthographic primes yielded only a small effect. While their results indicate greater reliance of L2 speakers on form features, the morphological nature of the effects found is not questioned and the conclusion drawn by the authors highlights the similarity between L1 and L2 processing.

Secondly, the study by Dal Maso & Giraudo (2014) obtained significant morphological priming in L2 speakers when compared to both an unrelated and an orthographic condition, which was additionally included as a baseline. Importantly, in this study, differently from the design of Heyer & Clahsen and Diependaele et al., the morphological, orthographic, and unrelated primes were presented before the same target, a methodological cautiousness which considerably empowers the

[24] Opaque primes also yielded an intermediate effect (i.e., smaller than the one triggered by transparent primes) with native speakers. On the other hand, purely orthographic primes did not facilitate L1 speakers, while they had a small effect on L2 learners (14 ms versus 1 ms).

validity of their results[25]. Taken together, such findings seem to be hard to reconcile with a view that assumes L2 facilitation to be derived only from formal overlap.

We believe that investigations of intermediate cases, such as the ones considered in the study by Diependaele et al., can provide more meaningful insights with respect to the still non-negligible issue of formal influence.

Finally, to complete the picture so far emerged on the L2 processing of derivational morphology, the impact of two additional variables was taken into consideration in the above-mentioned study by Dal Maso & Giraudo (2014). In a study on L2 Italian, they compared native and non-native performances on the recognition of targets primed by low and high surface frequency primes ending with the nominalizing suffixes *-ezza* and *-ità*. Interestingly enough, L1 and L2 performances differed in that the former were primed by all four types of primes, while the latter only exhibited facilitation for high frequency primes ending in *-ità*. Crucially, the two suffixes are different with respect to their distributional properties, i.e., *-ità* is more productive and appears in more word types. The implications for L2 processing are of particular interest because such a pattern of results seems to indicate that learners are sensitive to probabilistic features of the target language and therefore to language use. In other terms, non-native speakers may have more impoverished representations for those forms which are encountered less frequently and those affixes which have, in Bybee's terms, a less open schema (i.e., they participate in a smaller number of word types).

To sum up, priming effects yielded by derivational primes appear to be unquestionable. It is, however, still scarcely studied how these effects could be modulated by other factors, namely, the words' formal characteristics and the specificities of the target language.

[25] See also the recent study by Jacob et al. (2017), which, however, while acknowledging the importance of testing different types of primes on the same targets, includes a separate orthographic set of prime-target pairs. Importantly, nevertheless, their results show significant differences between the facilitation induced by morphological and orthographic primes with L2 speakers, at least as far as derivation is concerned.

PART II: CASE-STUDIES

Having outlined the theoretical framework and the main findings of the existing literature on morphological processing, the second part will be now focused on the contribution given by the present study. Specifically, the main focus of this work will be constituted by the investigation of the role played by form in morphological processing. Its aim is to verify the impact of formal characteristics in native and non-native lexical access by concentrating on the processing of formally transparent *versus* non-transparent words in Italian. While for native processing it is currently agreed on by most scholars that morphological priming effects cannot be reduced to mere form overlap in the most transparent conditions, form is assumed to be a relevant factor in some psychological accounts of lexical access. Moreover, when it comes to non-native processing, it is still widely unclear whether we can speak of morphological effects at all and if so, whether form has a more predominant role that it has in native processing.

To expand the debate on such issues, two morphological phenomena, namely, allomorphy and bound stems, are investigated by means of four psycholinguistic experiments involving a lexical decision task combined with the masked priming paradigm. Before going into the specifics of the two phenomena and presenting the experimental evidence pertaining to them, some methodological remarks are necessary. Given that they relate to all the experiments conducted, such a digression will be made here and its validity should be kept in mind for the whole body of the experimental evidence later presented.

Methodological remarks

The following remarks pertain more specifically to the selection phase of the experimental part of this work and to the problems related to it. The materials for the four experiments were created with the aid of both lexicographical resources and corpora of Italian. The use of corpora is fundamental in this kind of experiments as the items presented need to be carefully matched for frequency of occurrence. In many usage-based models, it is assumed that frequency strongly influences the representation of a lexeme in long-term memory, since, as exemplified above with

regard to the network model, words gain lexical strength according to their frequency of occurrence. The empirical results of psycholinguistic research have confirmed the role of frequency, as we have discussed in § 1.3.2.3: high-frequency words are generally recognized faster than low-frequency words.

Even though the present work does not specifically tackle this issue, as frequency was not manipulated, it is clear that a careful match for frequency must be carried out, in order to minimize the influence of a variable that has been widely acknowledged to affect word recognition. Central importance, therefore, needs to be devoted to the choice of a corpus whose frequency estimates reflect as closely as possible word usage in actual language. In this regard, some doubts have been recently raised about the validity of many corpora (for a review, see Brysbaert & New 2009). Almost twenty years ago, Burgess & Livesay (1998) noticed that the most frequently used corpus in studies on English (Kučera & Francis 1967, a corpus of written English derived from texts from the '60s) did not correlate well with results from naming latencies, casting doubts on the ecology of using these norms for material matching in psychological experiments. It is, however, the study by Balota et al. (2004) that further elaborated on the issue, collecting naming latencies and lexical decision tasks for 2400 English words and analyzing their correlation with five different corpora. What emerged from their results is a large variability in the amount of variance accounted for by the word-frequency estimates. Interestingly, once again the most frequently used corpus revealed to be the worst predictor. In a similar analysis, Brysbaert & New (2009) critically discuss the different features of the corpora taken into account, in order to highlight the critical points that should be avoided when choosing frequency estimates. The two major issues regard the size of the corpus and the sources on which the corpus is built. As for the former, through the correlation of frequency counts with lexical decision latencies, they demonstrated that the percentage of variance explained by the variable of word frequency does not significantly increase beyond a corpus size of 16 millions. In other terms, this means that it takes at least 16 million tokens for a corpus to be a good predictor, whereas smaller corpora may not be sufficient to explain the variance observed in lexical decision latencies. On the other hand, little advantage is gained by using much richer corpora, meaning that using them is often

not necessary. The other major problem concerns the type of language reflected in the corpus. If we consider the above mentioned Kučera & Francis, among its drawbacks was not only corpus size, but also the fact that its counts are extracted from written texts of the Sixties, thus representative of a language which has undoubtedly changed over the years. This proves to be of crucial importance if we think that the vast majority of participants of psycholinguistic experiments are young students in their twenties. On top of that, there are a number of other problems associated with language coming from written books and newspapers. Brysbaert & New (2009) enumerate three major drawbacks relating to this type of language: firstly, language in these contexts is often polished; secondly, there tends to be an exaggerated lexical variation, in an attempt to avoid repetition; lastly, the topics dealt with are often distant from actual everyday concerns. All in all, therefore, the language of this kind of corpora may not be really representative of the one people are most frequently exposed to. For these reasons, in the last fifteen years, also thanks to the advent of the Internet, researchers have more and more looked to new ways of collecting real language in its actual usage. These endeavors have led to corpora based on Internet newsgroups, web crawling, and movies and series subtitles. The predictive power of these resources is evident in both the analyses of Balota & al. and Brysbaert & New, where, interestingly, they perform much better than those based on books only, the only exception being a corpus (Zeno et al. 1995) extracted from primary and secondary school books. That spoken and written language can be widely different is, of course, no news; and to a certain extent, it is indeed true that, dealing with the realm of visual word recognition, it may seem reasonable to make use of language coming from that same context. However, results indicating a lower predictive power for books' language cannot be ignored. A feasible alternative seems to be represented by the above-mentioned corpora derived from the Internet, where larger variety is found, ranging from online newspaper versions to discussion groups, where, although written, the language used is less controlled. In such corpora, in a way, a more balanced mix of written language and language which resembles the one typically used in oral communicative settings may be found. Furthermore, in such resources, a wider range of topics is covered, assuring a more carefully balanced sample.

To sum up, corpus choice for frequency matching purposes evidently represents a delicate step in order to guarantee the validity of experiments: the risk connected to choosing a corpus with bad frequency estimates is that we might observe an effect triggered by frequency rather than by the variable of interest (Zevin & Seidenberg 2002; Brysbaert & New 2009).

As for the present work, even though no similar studies comparing the predictive power of corpora of Italian are available, it is reasonable to assume that the same conclusions hold here. Among the corpora freely available, we decided, therefore, to opt for ItWac (Baroni et al. 2009), part of the WacKy project (Web As Corpus kool ynitiative). In the recent years, researchers around this project have built corpora for various languages, using the web as a source for linguistic data. The result is a collection of very large corpora (> 1 billion words) built through web crawling. As for Italian, ItWac contains around 1.5 billion tokens and almost 4 million types in its final version (i.e., after post-crawl cleaning). The corpus was built in such a way as to guarantee content and genre diversification, ranging from academic and journalistic texts addressing socio-political issues, to blogs and bulletin boards. Such balance should ensure frequency estimates more closely mirroring language in use and thus more suited to the purpose of the experiments dealt with here. Furthermore, an additional reason to use this corpus is that, crucially, half of the participants of the experiments are second language learners. Although it is difficult to estimate which kind of language these speakers are exposed to (indeed, individual profiles may widely vary), we cannot underestimate the power of an ever-so-increasing communication tool such as the Internet. For all these reasons, therefore, the use of a web-based corpus seems to represent a satisfactory compromise, carrying some of the features of written language and some others more typically resembling oral speech.

ALLOMORPHY

The first part of this study is focused on the phenomenon of allomorphy, i.e., variation in the phonological shape of morphemes. We will first consider briefly the phenomenon of allomorphy, mainly with specific regard to Italian, and describe how it manifests in its most common types. We will then discuss how this phenomenon is accounted for in the usage based models considered in Chapter 1. This choice is motivated by the belief that such models, in their effort to focus on the cognitive and communicative functions of language in use, can provide a more plausible psychological picture of the speakers' mind during processing. The main findings of existent studies on morphological processing will be reported and, on the basis of such studies, we will discuss how this phenomenon is expected to impact on processing according to some of the proposed psychological models. At the end of Chapter 3, the rationale for the experiments presented in the following Chapter will be spelled out. Chapter 4 will be focused on the experimental phase: specifically, discussion on the selection of critical materials will be carried out, followed by the presentation and analysis of results obtained for native and non-native speakers. Finally, the chapter will conclude with a general discussion based on the findings of both the experiments.

Chapter 3: Background

3.1 – Allomorphy: definition and types

The term *allomorphy* traces back to the structuralist tradition of the 40s (Nida 1948) when it was first employed to describe the existence of multiple surface forms for a given morpheme. Allomorphs, although retaining the same semantic content, form a set of alternatives to the same morpheme. The phenomenon, therefore, entails a violation of the assumed biuniqueness of the linguistic sign, in that the supposed one-to-one correspondence between form and meaning is not respected. As such, allomorphy poses some problems to a variety of traditional descriptive models. These have tackled the issue of accounting for the phenomenon in a number of ways, ranging from the identification of an underlying representation, on which some operations must be performed in order to derive all the others, to the listing of all the possible variants, without the establishment of a hierarchical structure. Since it is beyond the scope of this work to illustrate the various explanations these models have come up with, we will limit ourselves here to treat allomorphy from a descriptive point of view, considering its manifestations along three different dimensions[26].

A first distinction is drawn between root and affix allomorphy: intuitively, the former refers to variants of the root, while the latter is involved when different affix variants are present. Both are found in Italian, e.g., *fiore – floreale* ('flower – floral') exemplifies a case where the shape of the lexical root is affected, while the adjectival suffix *-ale* can surface as *-are*, *-iale*, *-uale* as in, e.g., *lunare* 'lunar' (from *luna* 'moon'), *settoriale* 'sectional' (from *settore* 'sector'), *testuale* 'textual' (from *testo* 'text'). Identifying the locus of allomorphy is not always straightforward in Italian, as there are many cases where variation is found at the boundary between root and affix. Thus, in the adjective *problematico* 'problematic' (from *problema*

[26] Allomorphy has been extensively described especially with reference to the domain of inflection. We will here mainly show some examples taken from derivational morphology, as this will prove useful when considering the types of allomorphic variants used for the experiments of the present work. For more comprehensive overviews on allomorphy, see Carstairs (1987; 1988), Dressler (2015); Booij & Van der Veer (2015).

'problem'), allomorphy can synchronically either assumed to be in the root (*problema-* / *problemat-*) or in the suffix (*-ico* / *-tico*)[27].

Although allomorphy involves an alteration of the shape of a morpheme, the allomorphs of a given morpheme often resemble each other. Depending on their degree of similarity, allomorphy can be phonological, weak suppletive or strong suppletive (Haspelmath 2002). Phonological allomorphy is often the result of so-called phonological or morphonological (i.e., applying only to a subset of words) rules. For instance, in the prefix *in-* in Italian, the sound [n] is assimilated to the first consonant of the base to which it attaches in specific phonetic contexts (before labial, liquid, and vibrant consonants), leading to four different allomorphs ([im-], [in-], [il-], [ir-]), which could be described as the by-product of a rule of pronunciation (Haspelmath 2002: 30). Suppletive allomorphy, on the other hand, is a kind of variation which cannot be described according to phonological rules, although phonological similarity can still be present. Usually, suppletivism is defined as 'weak' or 'strong' according to the degree of formal similarity. Weak suppletivism is often the result of phonological rules which are no longer active, such as *nuovo – novità* 'new – novelty', where the diphthong occurs in the initial open stressed syllable of *nuovo*, but not in the unstressed syllable of *novità*[28], or the residue of Latinate loan words (such as *mensile* 'monthly', which was originally derived from Latin *mensis* 'month' and entered the lexicon at a later stage, while Italian *mese* 'month' underwent consonant cluster reduction). Finally, strong suppletivism, where the two (or more) forms do not exhibit any kind of similarity, such as in *fegato – epatico* ('liver – hepatic'), is due to the different etymological history of the words[29].

[27] See Tekavčić (1968), in which it is pointed out how the nature of such insertions is hard to classify on a synchronic basis and interpretations might vary depending on individual cases.

[28] That the so-called 'mobile diphthong' is no longer an active change is exemplified by those forms such as *suono – suonare* ('sound – to sound'), *buono – buonissimo* ('good – very good'), where the diphthongized form has prevailed (Booij & Van der Veer 2015).

[29] Notice that theoretical positions vary as to whether allomorphy and suppletivism should be considered two separate phenomena or the two extreme ends of a continuum, where intermediate cases are labelled as weak suppletivism (Haspelmath 2002).

According to another classifying criterion, allomorphy can be described with regard to its motivations, i.e., the specific factors that condition it. From this perspective, allomorphy can be phonologically, morphologically (or paradigmatically), and lexically conditioned. When allomorphy is conditioned by phonology, this means that morpheme variants are predictable based on the phonological context, i.e., the above-mentioned variants of the prefix *in-* or of the adjectival suffix *-ale*[30]. Morphological conditioning is often used to describe different stem variants within a paradigm (hence, the term paradigmatically conditioned), where the morphological context determines the choice of allomorphs. The phenomenon is widespread in Italian verbal paradigms, where alternations depend on person and number (e.g., the mobile diphthong in the paradigm of *sedere*, where the diphthongized form appears in the first three singular persons and the third plural: *siedo* 'I sit', *siedi* 'you sit', *siede* 's/he sits', *siedono* 'they sit', but *sediamo* 'we sit', *sedete* 'you sit'). Finally, when allomorphs are lexically conditioned, no prediction can be made about their appearance, which crucially depends on the lexeme itself. Instantiations of such cases are often represented by weak and strong suppletion, such as *floreale* 'floral' or the above-mentioned *epatico* 'hepatic'.

3.2 – Usage-based perspectives on allomorphy

In traditional generative phonology, allomorphy is accounted for in terms of the existence of a stored underlying form differing from its possible surface realizations. Basically, existent allomorphs are not assumed to be stored, but rather computed by means of a phonological rule. Only extreme and non-predictable cases, such as those represented by strong suppletion, will be stored in the lexicon. Most usage-based theories differ in this respect, in that, as mentioned earlier, they do not posit a clear-cut distinction between lexicon and rules. Rather, all complex

[30] Some positions further distinguish phonological from morphonological (i.e., phonological change which occurs only in certain morphological alternations; Booij 2000: 336) conditioning. In this perspective, the above-mentioned assimilation of *in-* would be more properly defined as morphonological in that it takes place only in this and another prefix (*con-*), but not in other contexts where the nasal sound [n] is followed by liquid or rhotic sounds (e.g., in prepositional phrases such as *in rete* 'on line', or adjectives like *panrusso* 'pan-Russian').

words are 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.

As mentioned above, allomorphy will be here considered along the lines of such theoretical models, with specific reference to the way in which it could prove meaningful (or not) to speakers when processing language. In other terms, the focus is on how the perception of morphological relatedness could be affected by those words which retain a common meaning but exhibit different variants. We will describe here the phenomenon in terms of representations in the mental lexicon, with a special focus on the consequences this formal variation may lead to in the way we establish relations among words in the mind. Within this perspective, some interesting predictions can be inferred from usage-based accounts, given the central role these theories attribute to the speaker as a language user. In particular, Bybee's Network Model and Booij's Construction Morphology (see § 1.2.3) offer some interesting insights with regard to the concept of morphological relatedness.

3.2.1 – Network Model

In her model, Bybee specifically tackles the issue of allomorphy, pointing out the weaknesses of both traditional structuralist and generative accounts in the arbitrariness of their treatment of the phenomenon. On the one hand, generative explanations, in their need to posit an underlying representation from which all the other allomorphs would be derived, often incur in problems in establishing which should be the underlying form and what kind of operations are needed. The main difficulty lies in the fact that, being allomorphs due to diachronic facts, it is often difficult to try to account for the operations that brought them about from the synchronic point of view. On the other hand, the structuralist tradition, which would list all allomorph variants in an unstructured way, cannot do justice to the hierarchy that characterizes the organization of words in the lexicon (Bybee 1985: 6). In contrast, the approach taken by Bybee's model assumes as a starting point that all words, included those which present morphophonemic alternations, are listed in the lexicon with relationships establishing among them. Indeed, she stresses that the existence of morphophonemic alternations is possible precisely because of the

possibility of rote learning, i.e., of the possibility of words to be all listed in the lexicon with relationships establishing between clusters of words which are characterized by shared morphological, syntactic, and lexical information. Although her discussion is centered on an example of paradigmatically determined allomorphy (the Spanish conjugation of the verb *dormir* 'to sleep'; Bybee 1985: 124), the same generalizations can be extended to other allomorphic phenomena. The basic proposal is that all words are listed in the lexicon, with stronger relationships establishing among those which share the same stem allomorph: in her example, *duerme* 's/he sleeps' would be more closely related to *duermes* 'you sleep' than *dormimos* 'we sleep'. Of course, however, connections between *dormimos* and *duerme* are also established, on the basis of both phonological associations (albeit these are predicted to be weaker) and crucially, of semantic and syntactic information (they are all present forms of the same verb). While the perception of semantic and syntactic similarities among allomorphic forms is still likely to be strong in inflectional paradigms, it is undeniable that relations between allomorphic derivations may be less strongly perceived, given that shared semantics is often diminished as a result of the creation of new words. Are we to expect then a pervasive role played by phonological alterations in the recognition of a morphological relationship between derived forms containing different allomorphs? Indeed, concerning the strength of associations among words, Bybee states that «where irregular morpho-phonemic differences exist between forms, the degree of morphological relatedness is lessened» (Bybee 1985: 123). Her theoretical account conceptualizes morphological relatedness as being essentially determined by three factors: i) the degree of semantic relatedness, which is determined by the number and the nature of shared features ii) the extent of phonological similarity between the items (e.g., *sing* and *sang* are more closely related than *bring* and *brought*) iii) word frequency, i.e., the fact that high-frequency words tend to form more distant lexical connections than low-frequency words makes them less dependent on their related base words.

We will leave aside frequency for the moment and concentrate on the first two factors[31]. Phonological distance is predicted to be a 'catalyst for lexical split' (Bybee 1985: 89), i.e., for rendering the words exhibiting this distance gradually more autonomous with respect to each other. As mentioned before, a greater degree of lexical autonomy will affect morphological relatedness in that the associations established on the basis of phonological similarities will be weaker or even absent. We can easily see, therefore, how allomorphy could trigger such a progressive separation. Importantly, however, in this model, the associations among words are accounted for in a gradient fashion, that is, there can be different degrees up to which words differ from each other along the dimension of phonological (and semantic) similarity. In other terms, instead of positing clear-cut distinctions, we might therefore observe that some pairs of words are simply more closely related than others. Crucially, connections are established on the base of identity features, so that, e.g., between the words *fiore* and *floreale* (['fjore], [flore'ale]), phonological associations will be established between [f], [o], [r] and [e], but not between [j] and [l]. The overall set of phonological connections will be, therefore, slightly weaker than that establishing between *musica* ['mu:zika] 'music' and *musicale* [muzi'ka:le] 'musical', but stronger than that between *acqua* ['akkwa] 'water' and *idrico* ['idriko] '(relating to) water'.

At the same time, however, phonological shape is not the only determinant for morphological relatedness, as shared semantics also plays a role. Crucially, the Network Model posits that «the semantic connections are the strongest and the most important in determining the closeness of the relations among words» (Bybee 1985: 118). It may well be the case, therefore, that speakers might still be able to perceive the relatedness between two forms, despite the presence of formal alterations, provided that these forms exhibit consistent shared semantic content.

[31] Word frequency is indeed assumed to be one of the greatest predictors for lexical autonomy, especially in the domain of derivation (Bybee 1985: 89). However, since this variable has been controlled for in the experiments here presented, we do not expand further its discussion here.

3.2.2 – Construction Morphology

A similar conclusion is reached by Booij's Construction Morphology framework. As in the Network Model, phonological variants are here also assumed to be stored in the lexicon contained in the whole forms in which they appear. An important case in point is constituted by those instances where a phonological rule has ceased to operate, yet its effects are maintained in some words (such as the above-mentioned case of the mobile diphthong in Italian). According to Booij, indeed, «the only way in which effects of a phonological rule can survive after the loss of its trigger is by these effects being encoded in the phonological representations of words in the lexicon at the time that the trigger is still present» (Booij 2010: 246). Once again, the question we should ask is whether and how such words are perceived as related. An important prediction of Construction Morphology is indeed that allomorphy should not impede appreciating the relatedness between two forms. As mentioned earlier, this model assumes the existence of a hierarchical lexicon in which both abstract paradigmatically related morphological schemas and complex words that instantiate those schemas are represented. Thus, lower nodes in the lexicon, i.e., morphologically complex words, inherit information from higher nodes, i.e., abstract schemas (Booij 2017). Importantly, information about a complex word is not only inherited by its dominating schema, but also by its base word. The central question, in these terms, is which of the properties of the dominating schemas and of base words should be maintained in order for the complex word not to lose motivation[32]. That is, using Booij's terminology, we have to identify which properties are 'absolute', that is, non-negotiable, and which ones can be instead overridden and are therefore 'defeasible'.

Crucially, while the phonological shape of a word is an important determinant for relatedness, Booij's model predicts that it is not, to a certain extent, an absolute

[32] Booij (2017) points out how the notion of inheritance is more properly characteristic of those impoverished entry theories that wish to underspecify entries as much as possible, thus omitting all predictable information derivable from higher nodes. Since Booij's account is instead a full entry theory which is not aimed to avoid redundancy, he highlights how the issue of inheritance should be restated in terms of motivation («a word formation schema motivates the existence of an individual complex word to the extent that it predicts some or all of its properties» Booij 2017: 19).

property, but rather a defeasible one. This, of course, provided that the semantic relationships are consistent enough. An important prediction made by this theoretical account is, therefore, that allomorphy need not to impede the perception of motivation between a base word and a related form: «Allomorphy does not impede establishing relations between words, and recognizing relationships between words is a robust process. Establishing a relationship between a complex word and its base word(s) is not impeded by phonological differences» (Booij 2010: 251). Complete inheritance of the phonological shape of the base word is not necessary for a complex word in order to be recognized as related to it.

3.3 – Characterizing morphotactic transparency

It is important to observe, at this point, that, although a certain degree of freedom from phonological identity is predicted in both the above-mentioned models, it is still somewhat left undetermined how extreme cases, such as suppletion, will affect the perception of word relatedness speakers might have. Since relatedness is a matter of gradience in such models, it could be legitimate to expect some degree of impairment in the recognition of relationships among words that more explicitly differ from each other. A fine-grained picture of violations of morphotactic transparency is provided within the framework of Natural Morphology, a morphological theory which describes languages focusing specifically on their degree of naturalness, i.e., specifying what are the traits that render a morphological system more natural than another. Since in Natural Morphology, the term 'natural' is «synonymous with cognitively simple, easily accessible, elementary and therefore universally preferred, i.e. derivable from human nature, or with the terms unmarked or rather less marked» (Dressler 2005: 267), we may well expect that those morphological choices that are less natural will likely be the ones posing more problems to speakers during word processing[33]. In Natural Morphology, a series of principles by which naturalness can be predicted have been enumerated: crucially, one among the most important is biuniqueness, i.e., relational invariance between

[33] As will be clear, Natural Morphology is basically a morpheme-based approach. However, precisely by describing cases of morphotactic opacity, this approach implicitly describes the limitations of postulating a strictly morpheme-based analysis.

signatum and *signans*. Given that biuniqueness enhances reliability of a sign in its communicative and cognitive function as it leaves little space for ambiguity (Dressler 1987: 112), it is evident how violations of such relational invariants could affect processing. Importantly, one such violation is allomorphy, where the *signatum* is represented non-uniquely by multiple *signans*. At the cognitive level, this phenomenon should be largely dispreferred, as it violates the general preference for a biuniqueness relation. This is further expressed by the principle of transparency, in its specification relative to morphotactics. From this perspective, the more transparent a form is, the more natural, where transparent means that morphemes are easily perceptible (and therefore identifiable). Importantly, allomorphy constitutes the end of a continuum which goes from the most transparent to the less transparent processes. The scale below as proposed in Dressler (1985) clearly shows this state of things:

I	most transparent	only intrinsic allophonic PRs interfere	excite$^{\$}$ + ment
II		re-syllabification interferes	exis$^{\$}$t+ence, exist
III		MPRs interfere	conclusion, conclude
IV	least transparent	allomorphic MRs (and MPRs) interfere	dec[i]sion, dec[ai]de

Table 1 - Morphotactic transparency scale (Dressler 1985)

As can be seen from the scale, purely phonological processes such as re-syllabification, are predicted to opacify ease of perception very little compared to allomorphic ones. On the other hand, the realm of allomorphy is further diversified depending of the kind of morphotactic disruption it entails:

IV	most transparent	MPRs (no fusion)	e.g. velar softening electric+ity, electric
V		MPRs with fusion	conclusion, conclude
VI		MRs intervene	e.g. Great Vowel Shift decision, decide
VII		weak suppletion	childr-en, child
VIII	least transparent	strong suppletion	be, am, are, is, was

Table 2 - Morphotactic transparency scale - allomorphy (Dressler 1985)

Quite evidently, strong suppletion is considered the least natural process, in that formal transparency is maximally violated. The most interesting cases are those represented by the immediately preceding stages, which, despite disrupting to a certain extent the morphotactic transparency between a base word and its derived form, still exhibit some degree of phonological similarity. Indeed, these will be the cases which will be dealt with in the first part of the set of experiments in the present work, where the relationships among words will be investigated from the point of view of their degree of transparency.

From what we have discussed so far, it is legitimate to expect that minor formal modifications only minimally impair the recognition of a relationship of morphological relatedness. On the other hand, strong suppletion should probably only trigger a relationship based on semantic similarity, given that in most cases there is complete loss of shared formal features. Less clear are those intermediate cases in which, despite the existence of a considerable amount of formal overlap, alterations cannot be predicted and somehow disrupt the integrity of the one element which is shared by base and derived words. i.e., the root.

3.4 – Previous studies on the processing of allomorphy

Previous studies concerning the processing of allomorphic relationships have mainly concentrated on inflection, and especially on irregular past tense forms and their relationship with their verbal stem. The rationale for such studies has been mostly framed within the regular/irregular dichotomy discussed before (see § 1.3.3.3), which will not be discussed further here. Suffice it to say that while controversies remain, there is a considerable number of findings highlighting similarities in the way formally opaque and transparent inflected forms are processed (English: Pastizzo & Feldman 2002; Crepaldi et al. 2010; French: Meunier & Marslen-Wilson 2004; German: Smolka, Zwitserlood & Rösler 2007; Italian: Laudanna & Burani 1986; Orsolini & Marslen-Wilson 1997; Greek: Voga & Grainger 2004; but see German: Sonnenstuhl, Eisenbeiss & Clahsen 1999; English: Marslen-Wilson, Hare & Older 1995; Hebrew: Frost, Deutsch & Forster 2000; for opposite findings).

However, when we consider derivation, the picture is far less clear. There are good reasons to consider derivation separately from inflection: even if we do not subscribe to the view proposed by certain types of dual-mechanism models (namely, the one proposed by Clahsen, Sonnenstuhl & Blevins 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 often greater than that brought about by inflection. Given that in most cases inflected forms are more tightly related to their base forms from the semantic point of view, it is not surprising to find that the relationship between, e.g., *fell* and *fall* is not affected by the formal disruption of the stem (Pastizzo & Feldman 2002; Crepaldi et al. 2010). Indeed, we have seen how in the Network Model semantic associations are predicted to be stronger that phonological ones. What is more, inflectional verbal paradigms benefit from the fact of belonging to the same syntactic category, thus reinforcing the degree of relatedness among their forms. Derivatives, on the other hand, can show greater variety of semantic complexity, both with respect to inflection and among each other (consider, for instance, cases of lexicalizations such as *department*).

Unfortunately, there are only a few studies which have concentrated specifically on the issue of allomorphy in derivation and their results do not consistently point towards a unique interpretation.

The seminal work of Stanners et al. (1979) investigated this issue through the use of a long-lag priming design focusing on both inflection and derivation: the results that emerged highlighted that allomorphic derived (e.g., *describe – description*) and inflected words do prime the recognition of their stems, albeit only partially, i.e., to a significant lesser extent than identity primes do. In contrast, Fowler, Napps & Feldman (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 (*clear – clarify*) or only the phonological one (*heal – health*). No difference was found for 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 through a cross-modal priming design by Marslen-Wilson et al. (1994). Their study compared the priming effects triggered by transparent (*friend – friendly*) and opaque derivations (*elude – elusive*; *vain – vanity*), finding that these were equivalent. Importantly, they also included an orthographically (but not morphologically) related set of items (*tin – tinsel*) 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, which, as mentioned before, is supposed to provide a picture of the early phases of lexical access. The first study was conducted on English by McCormick, Rastle & Davis (2008) and focused mainly on minor formal alterations occurring at the boundary between bases and affixes that impede perfect segmentation. Specifically, the study considered derivatives exhibiting: i) a missing 'e' at the morpheme boundary (*adore – adorable*) ii) a shared 'e' at the morpheme boundary (*love – lover*) iii) a duplicated consonant at the morpheme boundary (*wrap – wrapper*). Importantly, 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, Rastle & Davis 2008: 309).

Interestingly, the authors also included prime-target pairs which were not morphologically and semantically related, but exhibited the same orthographic structure (in terms of segmentability and degree of overlap with their target) of morphological primes (*fete* – *fetish*). These primes, although semantically unrelated, produced nonetheless priming effects similar to those triggered by morphological primes. All in all, the authors conclude that morpho-orthographic parsing[34] is fairly robust to minor orthographic alterations and operates independently of semantic transparency at early stages of word recognition. 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, Davis & Marslen-Wilson (2011), which considered instead those cases exhibiting more disruptive stem changes in Greek complex words. Interestingly, they focused on two stages of lexical access, by using both a masked priming and a delayed priming design. In the masked priming experiment, they found that derivations containing allomorphic stems did not prime their verbal stem[35] (*poto* – *pino*, 'drink – I drink'), contrarily to what happened for non-allomorphic derivatives (*grafi* – *grafo*, 'writing – I write'). Notably, non-morphological and semantically opaque prime-target pairs exhibiting the same degree of orthographic overlap of pairs like *poto* – *pino* (e.g., *tricha* – *trivo* 'hair – I rub') did not prime each other too, while semantically opaque but orthographically transparent primes such as *mania* 'mania' primed their targets (e.g., *mana* 'mother'). On the other hand, both types of morphological primes facilitated the recognition of their targets in the

[34] The study by McCormick, Rastle & Davis sets within the framework of the proposed theory of morpho-orthographic segmentation (Rastle & Davis 2008; Rastle, Davis & New 2004) and, therefore, posits automatic parsing at early stages of lexical access.

[35] The authors report «a hint of priming», which was however significantly smaller than that triggered by transparent primes.

delayed priming experiment (i.e., when the prime was presented on the screen for 1000ms, therefore, fully visible), while both types of non-morphological and semantically opaque primes (*tricha* and *mania*) failed to facilitate their targets (*trivo* and *mana*). From these results, it would appear, therefore, 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 of both these 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 to ensure priming effects, but merely the 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 this approach, there would be no source of facilitation for the recognition of the targets.

3.5 – Allomorphy in the psychological models

As can be easily noted, the predictions made by the above-mentioned masked priming studies are at odds with what word-based models would expect. In the psychological implementations of such models (mainly network and supra-lexical models), morphological relationships are assumed to emerge even when formal changes intervene. According to network implementations (Fowler, Napps & Feldman 1985) there is no need to posit the existence of a shared lexical entry, nor many different lexical entries for each stem alternant. The model posits instead separate word representations connected to a morpheme node which is abstract enough to tolerate phonological/orthographic variations. A similar prediction is made by the model proposed by Giraudo & Grainger (2000), in which morphemic units emerge at the supra-lexical level when a systematic form-meaning correlation is detected. Such abstract units would emerge despite differences in base forms and would thus receive and send back excitation to all the words for which that

systematic correspondence can be found, thus imposing morphological organization. Importantly, in this model, semantics is a key determinant for the organization of morphologically related words. It follows that, without a semantic association, an abstract morphemic level would fail to emerge. Moreover, in its most recent development (Giraudo & Voga 2014; 2016), graded effects possibly triggered by formally opaque relatives are accounted for, in that different sources of excitation are posited to operate based on the characteristics of the input. Namely, formally opaque morphological relatives would receive feedback connections from word forms and from the abstract base-lexeme level, but not from the recently integrated sub-lexical level in which orthographic strings resembling morphemes are contained[36], which are instead additionally triggered for those transparent items which can be decomposed (e.g., *bake – baker*).

Connectionist approaches, despite not positing an abstract morphemic level, make similar predictions about the role of semantics and the emergence of graded effects. Crucially, they expect diminished priming in the absence of semantic associations; close to none, if phonological associations are impaired too. For formally opaque morphological relatives, other factors being equal, facilitation effects should be a function of the increasing amount of formal overlap. The expectation is, therefore, that graded effects should be observed: words characterized by disruptive changes could still produce priming, but possibly to a smaller extent than that triggered by transparent relatives.

It is not entirely clear how morpho-orthographic theories account for allomorphic derivational bases, except for the above-mentioned considerations about the relative flexibility of the segmentation process (which succeeds when minor changes occur, but fails when more disruptive alterations intervene). A recent development by Crepaldi et al. (2010) has proposed the integration of an intermediate lemma level between the level of morpho-orthographic segmentation and the level of semantics. This modification would permit to account for priming effects found to emerge for opaque inflected forms such as *fell* on the recognition of their target *fall*. The

[36] This level resembles, to a certain extent, the one posited by morpho-orthographic accounts, except for the important remark made by the authors that the level is not to be intended as truly morphological.

proposal is that items such as *fell*, which cannot undergo segmentation, and *fall* are connected at the lemma level via a shared lexical entry *fall*. However, the model thus modified explicitly rules out the possibility of a shared entry for derived forms, which would be connected to their respective lexical entry at the lemma level. Indeed, according to this proposal, 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. As such, the lemma level would concern only inflected words, while derived words would have independent representations. The model makes explicit reference to regular derived forms though, without treating the issue of allomorphic changes in the domain of derivation (but, accordingly, the possibility of a shared entry should be even more unlikely). Tentatively, Orfanidou, Davis & Marslen-Wilson (2011) hypothesize that the orthographic representations for derivatives are separate, but concede some sort of feedback from a higher semantic level arising at later stages of lexical access (in line with what proposed by Rastle & Davis 2008), thus explaining the priming effects found in the delayed priming task.

Overall, it seems that the number of studies so far conducted on allomorphic derivation is still too small, however, to subscribe to one of these views.

Moreover, as far as L2 processing is concerned, we have no knowledge of any study which has attempted to tackle this specific issue in the domain of derivation. Some interesting findings have emerged, as we have seen before (see § 2.2.2), with regard to the processing of inflected forms exhibiting varying degrees of formal variation, which might hint towards a more pervasive effect of form for non-native speakers. Basnight-Brown et al. (2007), notably, showed that Serbian non-native speakers were affected by this variable to the extent that only minor modifications (nested stem past forms such as *drawn*) were tolerated. Interestingly, this kind of modifications did not affect the perceptibility of the stem. When higher disruptions, such as *brought – bring*, were investigated, on the other hand, no priming effect was found for non-native speakers. The picture is, however, complicated when one considers the opposite findings obtained by Jacob, Fleischhauer & Clahsen (2013) (facilitation from stem change primes, but none from stem preserved primes). All in all, given the scarce amount of research in both L1 and L2 processing, we propose

here to investigate the issue further, in the attempt to shed more light on the impact allomorphic alterations entail at early stages of lexical processing.

3.6 – Rationale for Experiments 1 & 2

It is worth noticing that what many of the studies on inflectional allomorphy were focused on what was mostly a dichotomy (regular/irregular) which does not always coincide with the same allomorphic phenomenon in different languages, not even when considering the same types of inflectional category, i.e., in this case, the irregular past forms. To exemplify, studies conducted on English irregulars often take into consideration cases of stem allomorphy such as the one observed in *teach – taught*, while in German the same kinds of irregulars are sometimes observed from the point of view of the inflectional affix allomorphs they exhibit, such as in *fahren – gefahren* ('to go – gone', where the allomorphy is not properly in the stem but in the circumfix, *ge-en* instead of the regular *ge-t*). To elaborate, many of these studies are more concerned with the regularity of the inflectional process than with the morphophonemic change *per se*.

In the present work, we will be more focused on the impact this change might have on the perceptibility of morphological relatedness between two related forms. We propose to investigate this aspect by concentrating on root allomorphy as showed by a derivational form with respect to its base word. While there seems to be little doubt that, at later stages of processing, the relationship between forms which exhibit changes in their phonological/orthographic shape and those which do not is fairly robust, the investigation of the early stages of lexical access is still under scrutiny, especially for what concerns allomorphic changes that cannot be predicted on the basis of the phonological context. In order to contribute to this debate, therefore, we chose to use the lexical decision task, combined with the masked priming technique, given its potential capability of capturing such early phases of processing. The experiments are therefore conceived and designed so as to capture an aspect – derivational morphology in its early stages of processing – to which little attention has been given so far. Moreover, the issue has been given even less importance in the field of L2 morphological processing. However, we believe that there are good reasons to study in depth this aspect with second language speakers.

The possibility that formal transparency might affect successful learning of target L2 morphology by non-native speakers has been raised by numerous usage-based accounts of second language acquisition, although especially with regard to inflectional morphology. We have already mentioned (see § 2.1.3) how form-function reliability is predicted to play a major role in shaping the way learners make the input they receive meaningful (that is, in the way they transform the input in intake). As such, violations of the one form-one meaning correspondence, such as those determined by polysemy and allomorphy, are potential obstacles for second language acquisition. The non-uniform coding of such correspondences is likely to affect the appreciation of morphological relatedness along two intertwined dimensions. On the one hand, some difficulties are posed by the fact that multiple forms express the same meaning. Given this redundancy, the possibility that only one of these forms, typically the most frequently encountered, will be overapplied is more likely. From the point of view of comprehension, this could possibly translate in undernoticing. On the other hand, the fact that in most cases (though not always) allomorphy involves a morphotactic disruption (e.g., *teach – taught*) could likely affect the appreciation of morphological relatedness between morphological relatives in that formal similarity between such relatives will be lessened. This, in turn, implies, on the one hand, a general decrease of the overall degree of formal overlap among words, given the smaller number of phonological associations. On the other hand, increasing morphotactic opacity will affect the salience of the morphological constituents of words. The notion of salience, despite remaining somewhat vague in most theoretical accounts, can be defined as the ease of perceptibility of a linguistic structure[37]. If we were to assume that morphology does

[37] Further confusion is determined by the fact that the term 'salient' can be used either in a narrow or in a loose sense. The former refers to the characteristics of the input itself: within this perspective, a fine-grained description has been attempted by Goldschneider & DeKeyser (2001), with specific reference to (inflectional) morphemes. Perceptual salience is here characterized as determined by i) phonetic substance (number of phones) ii) syllabicity (the presence or absence of a vowel in the surface form) iii) sonority. In the looser sense, however, the term is used to refer to all those factors that cause the input to become salient (Dulay & Burt 1978). Among these, favourite candidates are, for instance, variables such as type and token frequency, morphophonological regularity, and

play a role in L2 processing, one can easily see how the less recognizable (and, therefore, salient) a root or an affix is, the less relatedness should be perceived among words sharing that constituent. Indeed, there is evidence that the degree of salience of a morpheme is a strong predictor in second language acquisition. Goldschneider & DeKeyser (2001), for example, found that five salience-related factors can explain considerable variance in accuracy of L2 English morpheme use. Importantly, among the factors determining salience are morphophonological regularity and perceptual salience, i.e., «how easy it is to perceive a given structure» (Goldschneider & DeKeyser 2001: 22). While such considerations are especially relevant with regard to the initial stages of acquisition of the L2, we consider it legitimate to ask whether such difficulties could be still unresolved at the unconscious level and thus shape the automatized mechanisms characterizing the on-line processing of words.

semantic complexity. For a recent overview of salience in second language acquisition see (Gass, Spinner & Behney 2018).

Chapter 4: Experiments 1 & 2

The first two experiments of this study deal with the phenomenon of allomorphy and the impact it may have on the recognition of morphological relations, possibly affecting the morphological organization of words in the lexicon. While both experiments focus on root allomorphy, some differences in the designs and range of materials used have been introduced in order to investigate a wider spectrum of the phenomenon.

Before going through the details of each experiment, it is worth noticing that, in both, transparent morphological relationships have been also included. This was done for two reasons: firstly, given the very small amount of priming studies on Italian derivation, facilitation induced by transparent morphological relatives on the recognition of their targets, even if expected on the basis of studies on other languages, could not be taken for granted. Secondly, for what concerns Experiment 2, as will be explained thoroughly later, this allowed a direct comparison of the effects induced by transparent and less transparent morphologically related items on the recognition of the same targets, leading to a finer assessment of the potential differences caused by the different degree of formal similarity between words.

4.1 – Experiment 1

4.1.1 – Stimuli and design

In the first experiment, we focused on those cases of non-predictable allomorphy (weak suppletion) where formal variation affects the shape of the lexical root. In order to investigate whether transparent and less transparent morphological derivatives are perceived as related to their base, we compared the effects triggered by allomorphic suffixed words on the recognition of their base (e.g., *floreale*/*FIORE*, 'floral/FLOWER') and those produced by formally transparent suffixed words (e.g., *inferno*/*INFERNO*, 'hell/INFERNAL').

The experiment was designed as to comprise four priming conditions: i) an identity condition, which should trigger smallest latencies ii) a morphological condition iii) an orthographic condition, inserted in order to distinguish morphological from

formal effects iv) an unrelated condition[38]. The table below summarizes the experimental design:

CONDITION	TRANSPARENT SET	ALLOMORPHIC SET
Identity	inferno/INFERNO 'hell/HELL'	fiore/FIORE 'flower/FLOWER'
Morphological	infernale/INFERNO 'infernal/HELL'	floreale/FIORE 'floral/FLOWER'
Orthographic	infermiere/INFERNO 'nurse/HELL'	fiocco/FIORE 'ribbon/FLOWER'
Unrelated	smarrito /INFERNO 'lost/HELL'	osceno/FIORE 'obscene/FLOWER'

Table 3 – Experimental design of Experiment 1

A list of 80 target items and 80 corresponding primes for each condition was created for the experiment. Among these, 40 pairs of targets and morphological primes were chosen according to their allomorphic relation, while another set of 40 pairs constituted the transparent (non-allomorphic) set. The type of allomorphy involved was chosen according to precise criteria:

i) formal variation had to be in the core of the lexical root (e.g., *scuola – scolastico*, 'school – scholastic');

[38] A semantic priming condition (e.g., *diavolo*/*INFERNO*, 'devil/HELL') was not included in this and the following experiments. It could be argued that potential morphological effects might derive from the semantic overlap between prime and target (as morphologically related forms are also normally semantically related). We have summarized in § 1.3.3.3 the debate around the effects of semantic transparency and we have pointed out how the time-course of semantic effects is still very much questioned (see also the recent work by Heyer & Kornishova 2017, in which semantic transparency affects morphological priming patterns, but only at longer SOAs of 67 and 77 ms *versus* the study by Feldman, O'Connor & Moscoso del Prado Martín 2009 and Feldman et al. 2015, in which effects emerge as early as 48 and 34 ms). However, we wish to emphasize that priming effects between pairs which are only semantically related do not usually emerge at short SOAs in the masked priming literature (and in some cases, also at short SOAs under overt priming conditions, see, e.g., the study by Smolka, Komlósi & Rösler 2009, in which no semantic effect was found with a SOA of 300 ms).

ii) cases of strong suppletivism were avoided (e.g., *cavallo – equino*, 'horse – equine');

iii) ambiguous cases, where it is not straightforward whether allomorphic variation involves the base or the suffix were excluded (e.g., *affetto – affettuoso*, 'affection – affectionate');

iv) allomorphy that was only phonological, but not orthographic, was excluded (e.g., *critico – criticità* ['kritiko] – [kritiʧi'ta], 'critical – criticality').

The first criterion does not need much explanation, as it is already clear that this choice lies at the heart of the experiment. As for the others, the choice of excluding strong suppletivism derived from the desire to have a set of critical items as uniform as possible. Strong suppletivism involves major modifications which can significantly alter the perception of the relatedness between base and derivative: indeed, words such as *cavallo – equino* do not truly imply any morphological relation and can only establish semantic connections. Although this could represent an interesting starting point for future works, it did not seem to be compatible with the topic under discussion here. We would like to clarify, however, that even though many cases of strong suppletivism are due to the different etymons of base and derived words, common etymology was not necessarily behind stimuli selection. Although in the vast majority of cases (95%) base and derivative share the same origin, we decided to include cases such as *memoria – mnemonico* 'memory – mnemonic' (the base derives from Latin, while the derivative has Greek etymology) and to exclude cases such as *chiesa – ecclesiastico* 'church – ecclesiastical' (same Latin origin, although the derivative is a learned borrowing which entered later and thus did not undergo the same phonological changes that lead lat. *ecclēsiam* to it. *chiesa*). The reason behind this choice is that we decided to favor those relationships which may be synchronically perceived as morphological by the average speaker. Even if *chiesa* and *ecclesiastico* do have the same origin, their formal distance involves more than one single modification (the presence of the consonant cluster [kl] and the additional syllable in initial position in *ecclesiastico*), qualifying the pair as a case of strong suppletivism despite its etymology.

As for the third criterion, we decided to leave out the many cases where it is not clear whether the allomorphy involves the base or the affix. Among such cases, many can be found in adjectives in –(*u*)*ale* and –(*u*)*oso*: from a diachronic point of view, the vocalic sound [u] is actually part of the base, since it is a residue of the Latin base these nouns belong to (all belonging to the fourth declension, see Tekavčić 1968). However, due to the presence of some Italian derivations which have analogically realized this feature (e.g., *delitto – delittuoso* 'crime – criminal'), -(*u*)*oso* and -*(u)ale* can also be analyzed as allomorphic variants of the suffixes -*oso* and -*ale*. In order to avoid any confusion between base and affix allomorphy, we have tried to avoid any instance in which the boundary between these two phenomena could be perceived as being fuzzy.

Finally, cases of phonological allomorphy (not mirrored in orthography) were left out. In this regard, it is obvious that phonological variation is involved in all the selected materials since it is rarely the case in Italian that to an orthographic alteration a corresponding phonological one is absent. However, the contrary is not always true, as demonstrated by the above mentioned example ['kritiko] – [kritiʧi'ta]: even though the velar stop [k] undergoes palatalization before the anterior vowel [i], this is not mirrored by orthography, which maintains <c> in both words. The reason why such cases were not included is that the task we are dealing with is only visual, with no auditory stimuli provided. Of course, one may wonder whether phonology can still influence reading, and consequently response times. In other terms, it is legitimate to ask whether we mentally read aloud when being exposed to a visual stimulus. The issue of the potential interference of phonology has been subject of debate since the beginning of the '90s and experimental evidence (Ferrand & Grainger 1994; Grainger, Kiyonaga & Holcomb 2006) has demonstrated that orthographic and phonological effects follow different time-courses, the former arising earlier (specifically, within a masked-priming design, at 33 ms) than the latter (67 ms). Therefore, for the present study (where a SoA of 66 ms was used), we decided to leave out those cases where allomorphy was only phonological since their inclusion could have determined misleading results.

The morphological primes resulting from the above-listed guidelines are mainly denominal adjectives (77,5%), followed by deadjectival nouns (15%), deverbal

nouns (5%) and denominal nouns (2,5%), involving a variety of suffixes (the list of critical materials can be found in Appendix A).

Forty orthographic and forty unrelated primes were then selected in order to have four lists with prime types rotating across targets, so that the targets were the same on each list but preceded by different primes. An additional set of forty targets holding a transparent (non-allomorphic) relation with their morphological primes was subsequently selected trying to match the qualitative features (range of suffixes and syntactic category) of the allomorphic set as much as possible. This resulted in a set made up as follows: denominal adjectives (75%), deadjectival nouns (15%), deverbal nouns (5%), denominal nouns (2,5%) and deadjectival adjectives (2,5%). Orthographic and unrelated primes were then selected following the above mentioned procedure.

The frequency values of morphological primes were carefully matched with those of orthographic and unrelated prime stimuli (respectively, $t(39) = 0.57$, $p = 0.572$; $t(39) = -0.96$, $p = 0.342$ for the transparent set; $t(39) = 0.76$, $p = 0.449$; $t(39) = -0.07$, $p = 0.940$ for the allomorphic set), with frequency estimates taken form the ItWac corpus[39]. Word length was also controlled so that primes for the same target could differ for a maximum of two letters, whenever possible (except for the identity primes, which for obvious reasons were overall shorter that the other three types). In the selection process, priority was given to the matching of frequency values. Mean values are summarized in the table below:

Overall		
Prime type	**Frequency**	**Length**
Identity	4.33 (0.64)	6.1 (1.5)
Morphological	3.52 (0.6)	8.2 (1.8)
Orthographic	3.47 (0.6)	7.4 (1.3)
Unrelated	3.53 (0.6)	7.4 (1.2)
Allomorphic set		
Prime type	**Frequency**	**Length**

[39] Frequency counts were log-transformed following the standardized word frequency scale proposed by Van Heuven et al. (2014).

Identity	4.44 (0.62)	5.8 (1.4)
Morphological	3.38 (0.6)	7.8 (1.6)
Orthographic	3.31 (0.6)	7 (1.3)
Unrelated	3.38 (0.6)	7.2 (1.2)
	Transparent set	
Prime type	**Frequency**	**Length**
Identity	4.23 (0.66)	6.5 (1.6)
Morphological	3.66 (0.4)	8.6 (1.9)
Orthographic	3.63 (0.6)	7.7 (1.2)
Unrelated	3.68 (0.5)	7.6 (1.3)

Table 4 – Experiment 1: Mean prime frequency and length values (SD in brackets)

Since a key feature in this experiment is the degree of formal overlap between primes and targets, particular attention was dedicated to this aspect. On the one hand, allomorphic and non-allomorphic primes should exhibit different degrees of orthographic overlap with their targets, for the experiment to be able to shed light on potential differences in terms of facilitation effects. On the other hand, we tried to match the orthographic primes in both sets so to distinguish form only from form-and-meaning associations and be able to evaluate their consequences on the recognition of the targets. This raised the question of how to compute orthographic overlap between the pairs of stimuli. One of the easiest approaches to this issue is to adopt a position-specific slot coding scheme, i.e., assuming separate slots of position-specific letter codes. The problem with a slot-based coding scheme, however, is that it fails to capture the amount of overlap between all those pairs in which, due to diphthongization for instance, shared letters are shifted by one position. To clarify, if we consider the allomorphic pair *fuoco* – *focoso* ('fire – fiery'), a strictly positional coding scheme would predict that only the first letter is shared, without accounting for the shared letters that follow the diphthongization. Therefore, according to this approach, the prime would actually share only 20% of the prime. However, the same could be argued about the word *fiaba* (only the first letter is shared, therefore 20% of *fuoco*). While it is indeed true that allomorphy implies greater formal distance than transparent pairs (e.g., *danno* – *dannoso*, 100%

of base overlap), it does not seem that this coding scheme can give justice to the real amount of overlap between primes and targets. For this reason, we decided to opt for the spatial coding scheme proposed by Davis & Bowers (2006). In this approach, the relative order of the letters is encoded by a pattern of temporary values that are dynamically assigned to these letters (the first letter is assigned a value of 1, the second a value of 2 and so on). This does not dismiss serial position but can capture orthographic similarities between words even if the letters they share are shifted by one or more positions. To clarify, if we consider Davis' example, the words *stop*, *spot* and *post* all share the same letters, although these are aligned following different orderings. If we apply a slot-specific coding to *stop* and *post*, we obtain a value of 0, as no letter appears in the same position. Spatial coding accounts for both the shared letters and their relative position, assigning a value of 0.34 (calculated through Match Calculator, Davis & Bowers 2006). On the other hand, *stop* and *spot* share not only all their letters but also the position of two of them (the first one and the third one), therefore, their overlap (0.55) is greater than that between *stop* and *post*.

This method was applied to the materials of the present work, while at the same time attempting to preserve as much as possible the initial three letters of the stimuli in the selection of the orthographic primes. A summary of the degree of overlap between primes and targets in both the transparent and the allomorphic sets is given below:

Mean degree of overlap between primes and targets		
	Allomorphic set	**Transparent set**
Morphological	0.59	0.81
Orthographic	0.65	0.62

Table 5 – Experiment 1: mean degree of overlap of morphological and orthographic primes with their targets

Although perfect orthographic matching between morphological and orthographic primes in the allomorphic set was not possible ($t(39) = 2.11$, $p = 0.041$) due to the characteristics of the language, it is worth noticing that, in this experiment, the degree of formal overlap between the allomorphic primes and their targets was overall smaller than that between the orthographic primes and their targets.

Therefore, if facilitation effects are dependent on the degree of formal overlap, we should observe, if anything, smaller effects for the allomorphic primes compared to the orthographic ones, given the higher overlap exhibited by the latter. In any case, facilitation stemming from allomorphic primes but not orthographic ones would be difficult to reconcile with a view in which formal overlap determines perceptibility of relationships.

Finally, for the purpose of the task, 80 non-word target stimuli and 80 corresponding primes for each condition were created. Non-word targets were created in such a way as to not resemble any existent root, but nonetheless respecting the phonotactic rules of Italian (e.g., *sifelio*). Non-word primes in the morphological condition were made up of a non-existent root + an existent suffix (e.g., *sifeliale*), devoting attention to using the same suffixes of the word stimuli set.

The 160 items were inserted in four experimental lists in which the targets were rotated across the four priming conditions by means of a Latin square design, so that participants could see each target only once in one of the possible four conditions.

4.1.2 – Method

4.1.2.1 – Participants

42 native speakers of Italian, aged from 20 to 33 years (mean age: 24.4) and 34 learners of Italian[40], aged from 22 to 36 (mean age: 28.3), who were living in Italy at the time of testing, participated in the experiment on a voluntary basis. They all had normal or corrected-to-normal vision and high-school or university educational background. The proficiency level of non-native participants was self-assessed (proficiency levels ranging from B2 to C1 of the Common European Framework for Languages) with ratings given on: written production, oral production, listening and reading comprehension. None of the ratings on single abilities was below B2

[40] While sought for, it was not possible to have a homogenous L1 background. Participants exhibited a range of different L1s: Albanian (2), Bulgarian (3), English (5), French (7), German (4), Polish (1), Portuguese (3), Romanian (5), Spanish (4).

(Vantage). Participants were recruited among students at the University of Verona (where non-native students need to have at least a B2 certificate to be enrolled) or in private schools of Italian in Italy (in upper-intermediate or advanced courses). None of the L2 participants reported being bilingual.

4.1.2.2 – Procedure

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.

4.1.3 – Results

4.1.3.1 – L1: data analysis and results

The first step in data cleaning considered accuracy rates for participants and items: since all participants and items showed accuracy rates higher than 70%, none of them was excluded. Incorrect responses and timeouts were removed (1.16% of data points) and only correct responses to word trials were analysed. RTs that were two standard deviations above or below the mean were treated as outliers and consequently removed (4.6%). Remaining data were entered into by-subject and by-items ANOVAs, with Prime Type and Transparency types as within-participants factors in the subject analysis and Prime Type as within- and Transparency as between-participant factors in the item analysis.

The analysis of reaction times showed a significant main effect for Transparency ($F1(1,41) = 16.57$, $p < .0001$, $F2(1,78) = 4.36$, $p < .05$), with targets from the allomorphic set responded to faster than the items of the transparent set (582 ms vs

597 ms). This result is not surprising given that targets in the allomorphic set were on average more frequent than those in the transparent one. Prime Type also had a significant main effect ($F1(3,123) = 25.96$, $p < .0001$, $F2(3,234) = 19.81$, $p < .0001$), but the interaction of transparency by prime type was not significant ($F1(3,123) = 0.26$, $p > .10$, $F2(3,234) = 0.31$, $p > .10$). Average RTs for each set (allomorphic and transparent) are indicated in figures 2 and 3:

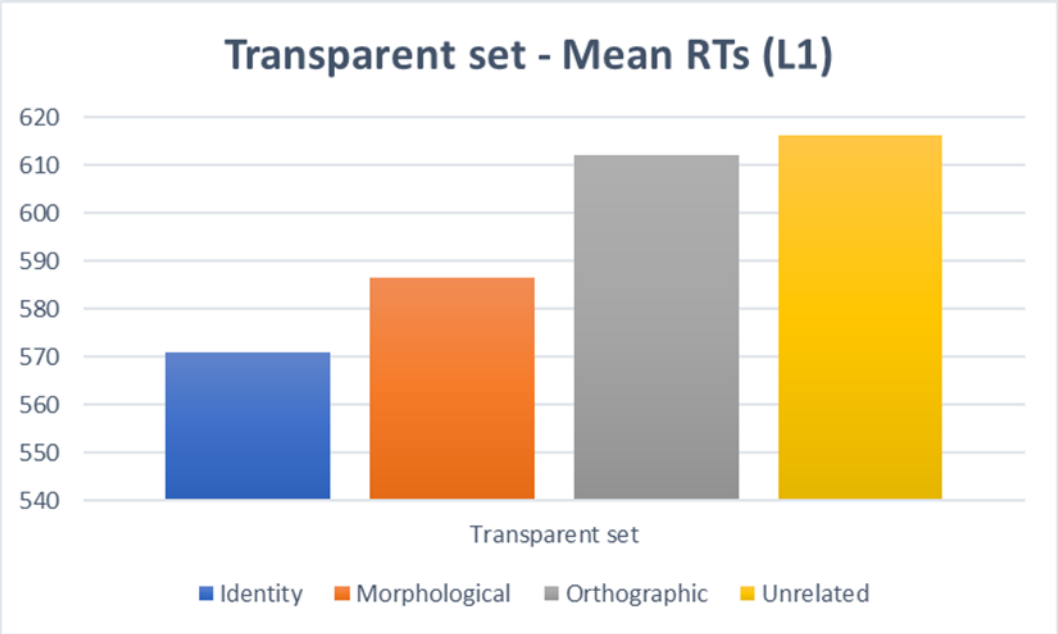

Figure 2 – Experiment 1: mean reaction times for the transparent set (L1)

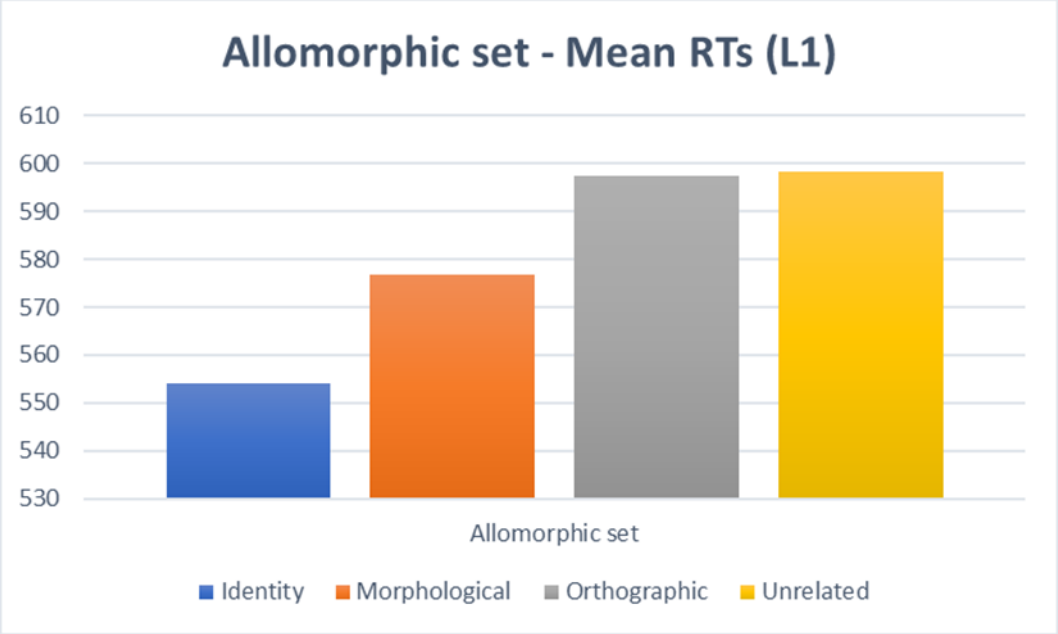

Figure 3 – Experiment 1: mean reaction times for the allomorphic set (L1)

Prime Type interacted partially with Transparency (transparent: $F1(3,123) = 15.72$, $p < .0001$; $F2(3,117) = 10.87$, $p < .001$; allomorphic: $F1(3,123) = 14.73$, $p < .0001$; $F2(3,117) = 9.25$, $p < .001$). Planned comparisons revealed an effect of identity primes as compared to both the unrelated and the orthographic baselines, in both the transparent (unrelated baseline: $F1(1,41) = 38.03$, $p < .0001$; $F2(1,39) = 18.86$, $p < .0001$; orthographic control: $F1(1,41) = 17.48$, $p < .01$; $F2(1,39) = 31.89$, $p < .0001$) and the allomorphic set (unrelated: $F1(1,41) = 36.29$, $p < .0001$; $F2(1,39) = 12.72$, $p < .01$; orthographic: $F1(1,41) = 47.74$, $p < .0001$; $F2(1,39) = 36.15$, $p < .0001$).

In the transparent set, as expected, a significant facilitation effect was induced by the presentation of morphological primes on the recognition of their targets. Such a facilitation was found to be significant relative to both the unrelated ($F1(1,41) = 18.29$, $p < .01$; $F2(1,39) = 17.90$, $p < .01$) and the orthographic ($F1(1,41) = 24.43$, $p < .0001$; $F2(1,39) = 6.94$, $p < .05$) conditions.

Crucially, significant morphological facilitation was also found in the allomorphic set (unrelated: $F1(1,41) = 5.93$, $p < .05$; $F2(1,39) = 4.35$, $p < .05$; orthographic: ($F1(1,41) = 7.79$, $p < .01$; $F2(1,39) = 7.58$, $p < .01$), despite the greater formal distance between primes and targets. Interestingly, the reaction times in the morphological condition also significantly differed from those registered in the identity condition ($F1(1,41) = 10.53$, $p < .01$; $F2(1,39) = 5.55$, $p < .05$).

In both sets, the orthographic and the unrelated conditions did not differ significantly ($Fs < 1$). Significant differences ($p < .05$) as revealed by pairwise comparisons are indicated in Table 6:

	Prime type	**RTs**	**SD**	**U-I**	**U-M**	**O-M**
Allomorphic set floreale – fiore ‘floral – flower’	Identity	554	91	44*	21*	20*
	Morphological	577	93			
	Orthographic	597	95			
	Unrelated	598	95			

Transparent set infernale – inferno 'infernal – hell'	Identity	571	93	45*	29*	25*
	Morphological	587	85			
	Orthographic	612	95			
	Unrelated	616	86			

Table 6 – Experiment 1: mean subject reaction times, standard deviations, and net priming effects (L1); * = p < .05.

Since the error rate was quite low, errors were not submitted to statistical analysis. Error rates per condition are shown in Table 7:

	Prime type	**Error rate**
Allomorphic set floreale – fiore 'floral – flower'	Identity	0,5%
	Morphological	1,9%
	Orthographic	0,5%
	Unrelated	1,2%
Transparent set infernale – inferno 'infernal – hell'	Identity	1,0%
	Morphological	0,2%
	Orthographic	1,2%
	Unrelated	2,9%

Table 7 – Experiment 1: error rates per condition (L1)

The pattern of results so far emerged reveal, firstly, that, in line with studies on other languages, derived items induce significant facilitation effects on the recognition of their base targets. Moreover, these data indicate that the existence of non-predictable formal disruptions affecting the shape of the lexical root does not

impede appreciation of morphological relatedness, as proved by the fact that derived primes exhibiting allomorphy also significantly accelerated target latencies.

4.1.3.2 – L2: data analysis and results

We followed the same procedure described above to clean the data of non-native speakers. Three subjects were excluded from the analysis because of accuracy rates falling below 70%. We then removed incorrect responses and timeouts (4.47 % of data points) and submitted to analysis only correct responses to word trials. RTs that were two standard deviations above or below the mean were treated as outliers and consequently removed (4.72 %). Remaining data were entered into by-subject and by-items ANOVAs.

The analysis of reaction times showed a main effect for Transparency ($F1(1,30) = 9.97$, $p < .01$, $F2(1,78) = 5.70$, $p < .05$) and Prime Type ($F1(3,90) = 6.78$, $p < .01$, $F2(3,234) = 6.98$, $p < .01$). Items in the allomorphic set were overall responded to faster (704 ms vs 730 ms), as was the case with native speakers. The interaction of transparency by prime was not significant, $F1(3,90) = 0.92$, $p > .10$, $F2(3,234) = 0.88$, $p > .10$). Average RTs for each set (transparent and allomorphic) are indicated in figures 4 and 5:

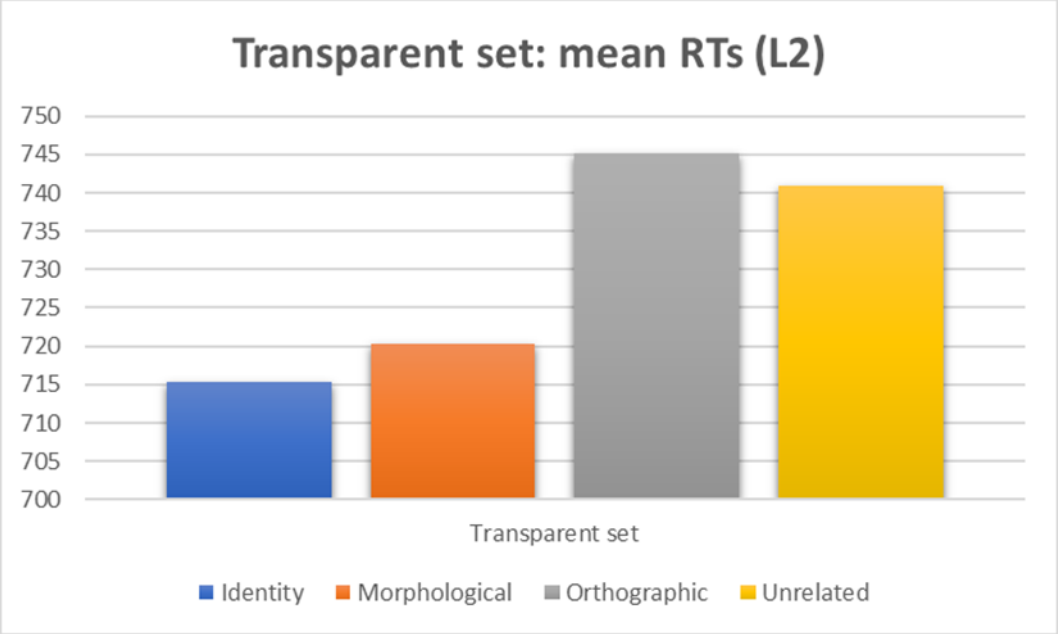

Figure 4 – Experiment 1: mean reaction times for the transparent set (L2)

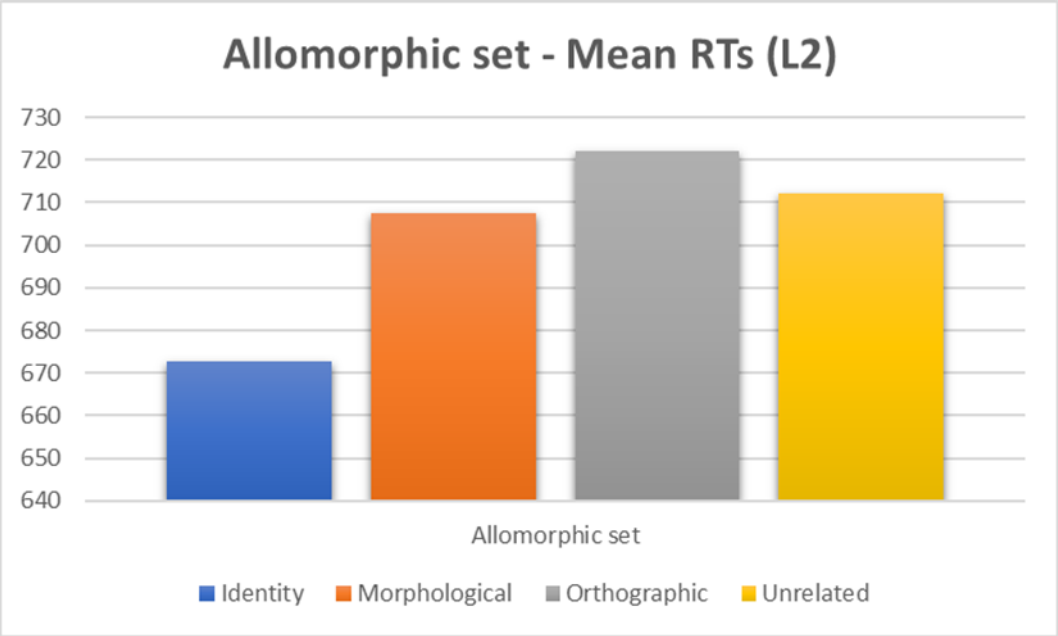

Figure 5 – Experiment 1: mean reaction times for the allomorphic set (L2)

Partial interactions between Prime Type and Transparency Type were observed (transparent: $F1(3,90) = 3.74$, $p < .05$; not significant $F2(3,117) = 1.57$, $p > .10$; allomorphic: $F1(3,90) = 4.02$, $p < .01$; $F2(3,117) = 7.17$, $p < .001$). Planned comparisons revealed that non-native speakers were also significantly facilitated by prior presentation of an identity prime, relative to the unrelated and the orthographic control conditions, in both the transparent (unrelated baseline: $F1(1,30) = 6.48$, $p < .05$; marginally significant in the item analysis, $F2(1,39) = 3.78$, $p = .06$; orthographic control: $F1(1,30) = 7.06$, $p < .05$; not significant in the item analysis, $F2(1,39) = 2.81$, $p = .10$) and the allomorphic sets (unrelated: $F1(1,41) = 7.81$, $p < .01$; $F2(1,39) = 20.17$, $p < .0001$; orthographic: $F1(1,41) = 8.47$, $p < .01$; $F2(1,39) = 14.80$, $p < .01$). In the analysis by participants, morphological primes induced fastest reaction times in the transparent set, as compared to both the unrelated ($F1(1,30) = 6.48$, $p < .05$; $F2(1,39) = 0.99$, $p > .10$) and the orthographic baseline ($F1(1,30) = 7.06$, $p < .05$; $F2(1,39) = 1.13$, $p > .10$).

Most interestingly, contrary to what we observed for native speakers, the morphological primes of the allomorphic set did not trigger significantly faster reaction times on the recognition of their targets (unrelated baseline: $F1(1,30) = 0.12$, $p > .10$; $F2(1,39) = 0.71$, $p > .10$; orthographic condition: $F1(1,30) = 1.41$, $p > .10$; $F2(1,39) = 1.00$, $p > .10$). Finally, in both sets, the orthographic and the

unrelated conditions did not differ significantly (Fs < 1). Significant differences (p < .05) as revealed by pairwise comparisons are indicated in Table 8:

	Prime type	RTs	SD	U-I	U-M	O-M
Allomorphic set floreale – fiore 'floral – flower'	Identity	673	108	39*	4	14
	Morphological	708	127			
	Orthographic	722	133			
	Unrelated	712	120			
Transparent set infernale – inferno 'infernal – hell'	Identity	715	126	26*	21*	25*
	Morphological	720	145			
	Orthographic	745	141			
	Unrelated	741	127			

Table 8 – Experiment 1: mean subject reaction times, standard deviations, and net priming effects (L2); *= p < .05.

An analysis of the error rates (given in Table 9) showed no main effect, therefore, errors were not further analysed.

	Prime type	Error rate
Allomorphic set floreale – fiore 'floral – flower'	Identity	5,2%
	Morphological	4,2%
	Orthographic	5,8%
	Unrelated	5,2%
Transparent set	Identity	3,9%

infernale – inferno 'infernal – hell'	Morphological	1,9%
	Orthographic	5,2%
	Unrelated	4,5%

Table 9 – Experiment 1: error rates per condition (L2)

Based on such results, we can infer that, for non-native speakers of Italian, morphological effects exhibit a different pattern of behavior with respect to what emerged for native speakers. First, we can observe that morphological effects which differed significantly from the unrelated condition do emerge, at least for transparent prime-target pairs. Importantly, the fact that reaction times in the morphological condition were also significantly faster than those registered in the orthographic condition seems to rule out the possibility that facilitation springs from simple orthographic similarity between items. On the other hand, a significant difference between RTs in the morphological condition and both the unrelated and the orthographic condition failed to emerge in the opaque set of items. While we cannot directly compare this result with the one registered for the transparent set, we cannot conclude that, as was the case for native speakers, formal disruptions of the root do not affect morphological organization in the learners' lexicon, given that no morphological effect arose when the primes were opaque derivations.

4.2 – Experiment 2

In the second experiment conducted on allomorphy, the class of Italian deverbal nouns in *–tura* and *–zione* constitutes the basis of the critical materials which have been used. Before introducing the technical details, a brief preliminary remark on an aspect of word formation in Italian which is relevant to the present experiment is necessary. We have chosen to concentrate on derivations with these two nominalizing suffixes, for reasons which will now be given. If we analyze the formation of such nouns from a synchronic point of view, the base of derivation of most derivatives with these suffixes can either be considered to be the verbal stem or the past participle form. To clarify, *bocciatura* 'failure' might equally derive from the past participle form *bocciato* 'failed' or from the verbal stem in the

infinitival *bocciare* ‘to fail’; similarly, *riparazione* ‘repair’ might derive from both *riparato* ‘repaired’ or *riparare* ‘to repair’.

Analyses which take the infinitival stem or the participial stem of the paradigm have been proposed and can account for the formation of many such nominalizations. It is beyond the scope of this work to review the different positions on the issue. Suffice it to say that, according to the analysis by Scalise (1983; 1990), the suffix would attach to a base that coincides with the past participle form. In his analysis, the suffixes are more properly *-ione* and *-ura* and they attach to the base by means of intervening readjustment rules (vowel deletion and a rule changing /(t)t/ to /(t)ts/ for *-ione* and only the former for *-tura*). On the other hand, alternative hypotheses consider the verbal stem as the base of derivation of such nominalizations, with positions differing on how to obtain it, i.e., from the infinitive form (Bisetto 1999) or from an abstract stem formally coinciding with the imperative form (Thornton 1990; 1991; 2005). While neither of the two analyses can account for the full range of nominalizations found in Italian, currently the most accepted hypothesis is Thornton’s (see, e.g., Gaeta 2004; see Thornton 2015 for a review of the debate centered on which form should be considered the base).

It is not the aim of this work to establish on psycholinguistic grounds which form is most likely to be considered the base. Indeed, from a usage-based perspective, there should be in principle no particular reason to consider one of the two forms as more prototypical (at least, not from a purely formal point of view). Importantly to the purpose of our investigation, both forms are transparent as far as the lexical root is concerned.

However, we are especially interested here in a number of nominalizations in *-tura* and *-zione* which, on phonological grounds, can only be thought of as derived from the stem of the past participle form of the verb (as many of them are in fact learned borrowings from the Latin past participle forms) and not from the verbal stem (e.g., *scritto* ‘written’ – *scrittura* ‘writing’, but not *scrivere* ‘to write’ – *scrittura*; *illuso* ‘deluded’ – *illusione* ‘illusion’, but not *illudere* ‘to delude’ – *illusione*). 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 of the root 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 the difference in the amount of overlap influences the recognition of *illusione* ('illusion') when primed by *illuso* ('deluded') and by *illudere* ('to delude'). In order to investigate this question, we made use of two different morphological primes, i.e., the past participle and the infinitive forms. Differently from the classic design usually exploited, the targets in this experiment are constituted by the derived forms, i.e., the deverbal nouns in *-tura* and *-zione*. Latencies in the decision on these derived nominalizations preceded by both types of morphological primes have therefore been compared.

4.2.1 – Stimuli and design

As can be anticipated from the above introduction, Experiment 2 slightly differs from the previous one in its design. To start with, we have here a reverse prime-target disposition: the target is represented by the derivative (e.g., *bocciatura*), while the morphological prime is an inflected form of the base word (the past participle or the infinitive form). All target stimuli are deverbal nouns ending with either the suffix *-zione* or *-tura*. Moreover, five conditions are here present, in that the morphological one appears twice: on the one hand, with the infinitive form of the base verb (e.g., *bocciare*); on the other hand, with the past participle of the verb (e.g., *bocciato*). Eighty of such nominalizations were selected as critical items to be used as targets. They were further divided into two subsets, so that half of them (forty) held a transparent relationship with both base forms and the other half was transparent only with respect to the participial stem.

The selected design has the advantage of allowing direct comparisons of the effects generated by two forms which are morphologically related to the same target and which exhibit different degrees of formal overlap with it. In the set to which we will refer as 'allomorphic', there are in fact at the same time opaque and transparent morphological primes. Despite this, we chose to add also a transparent set (as was

done in Experiment 1) to rule out the possibility that an effect was produced by a specific inflectional form as opposed to the other. In other words, we wanted to make sure that the potential observed effects were not triggered by, for example, a preference for, or more closely perceived association of the past participle form or the infinitive form with the target nominalization. If no such preference exists, we should be able to observe similar effects for both morphological primes in the transparent set.

As with Experiment 1, we followed some criteria in the selection of the materials:

i) cases where neither the verbal theme nor the participle form can be considered as the base were excluded (e.g., *aggressione* 'aggression', which synchronically can be derived neither from *aggredire* 'to assault' nor from *aggredito* 'assaulted');

ii) even though many of these deverbal nouns often have more than one semantic value, we avoided those cases of semantic drift where no explicit semantic link is present and semantic compositionality is lost (e.g., *statura* 'height', diachronically derived from *stare* 'stay').

Since five conditions are present in this experiment, we constructed five experimental lists with 80 target words each. For every target the corresponding orthographic and unrelated primes were created.

All primes were matched for frequency and length following the already mentioned guidelines (see § 4.1.1). Given the presence of two morphological primes which could not be perfectly matched for frequency between each other[41], matching orthographic and unrelated primes simultaneously with both of them was not always possible. Indeed, in the opaque set, while the mean frequency of the infinitive primes is not significantly different from the mean frequency of the orthographic and unrelated primes (respectively, $t(39) = 0.38$, $p = .706$; $t(39) = -1.65$, $p = .105$), those of participial forms could only be perfectly matched on

[41] Even if perfect matching was strived for, in the opaque set, given the reduced number of possible pairs to be used as critical materials, the t test for the frequency values of participle and infinitive forms shows a significant difference between the two, $t(39) = 2.92$, $p = .006$.

orthographic primes' values (t(39) = 1.85, p = .072), but not on unrelated ones (t(39) = 3.15, p = .003). This aspect will be considered, if relevant, in the data analysis. In the transparent set, on the other hand, all primes were matched for frequency and no significant difference existed bewteen their mean values (participle – orthographic: t(39) = 0.23, p = .817; participle – unrelated: t(39) = -0.05, p = .953; infinitive – orthographic: t(39) = -0.15, p = .881; infinitive – unrelated: t(39) = -0.85, p = .399). Infinitive and past participle primes were also matched (t(39) = .65, p = .518). A summary of mean values is given below:

Overall		
Prime type	**Frequency**	**Length**
Identity	3.98 (0.63)	10.1 (1.6)
Past Participle	3.74 (0.61)	7.4 (1.4)
Infinitive	3.65 (0.65)	8.3 (1.2)
Orthographic	3.64 (0.55)	7.9 (1.6)
Unrelated	3.69 (0.61)	7.6 (1.1)
Allomorphic set		
Prime type	**Frequency**	**Length**
Identity	4.11 (0.63)	9.5 (1.5)
Past Participle	3.79 (0.69)	6.7 (1.3)
Infinitive	3.65 (0.71)	8.5 (1.2)
Orthographic	3.61 (0.54)	8.0 (1.5)
Unrelated	3.69 (0.68)	7.5 (1.1)
Transparent set		
Prime type	**Frequency**	**Length**
Identity	3.86 (0.61)	10.8 (1.4)
Past Participle	3.69 (0.53)	8.1 (1.3)
Infinitive	3.66 (0.60)	8.1 (1.3)
Orthographic	3.67 (0.56)	7.8 (1.7)
Unrelated	3,70 (0.54)	7,7 (1.1)

Table 10 – Experiment 2: mean prime frequency and length values (SD in brackets)

As with Experiment 1, the degree of orthographic overlap was measured using the spatial coding scheme through the use of Match Calculator. The mean values are summarized in the following table:

Mean degree of overlap between primes and targets		
	Allomorphic set	**Transparent set**
Past Participle	0.82	0.77
Infinitive	0.58	0.78
Orthographic	0.56	0.59

Table 11 – Experiment 2: mean degree of overlap of morphological and orthographic primes with their targets

As shown above, in the transparent set, the degree of overlap between the two morphological primes and their targets does not vary ($t(39) = -1$, $p = .321$). On the other hand, the infinitive form in the opaque set does show a smaller degree of overlap, compared to its participial counterpart ($t(39) = 29.42$, $p < .0001$). Moreover, in this set, the overlap of the infinitival forms with their targets is comparable to the overlap of the orthographic forms with the same targets ($t(39) = 0.69$, $p = .493$). Past participle forms, accordingly, differed significantly in their degree of overlap with the targets compared also to the orthographic primes ($t(39) = 13.07$, $p < .0001$). To summarize, we ensured that, in the opaque set, the less transparent forms, i.e., the infinitive, was perfectly matched with the orthographically related primes for frequency and degree of overlap with their targets. This should guarantee that, if any facilitation effect was observed with the infinitive primes relative to the orthographic condition in this set, such an effect cannot be ascribed solely to their formal properties.

Finally, 80 non-words targets and 80 corresponding primes for each condition were created, following the same procedure used for Experiment 1. That is, such stimuli were made up of a non-existent root + the suffixes *-zione* or *-tura* (e.g., *crellosazione*), maintaining the same proportions of the word targets. Morphological non-word primes were constructed so as to resemble their possible infinitive (e.g., *crellosare*) and participial (e.g., *crellosato*) forms.

As in Experiment 1, the 160 items were inserted in five experimental lists in which the targets were rotated across the five priming conditions by means of a Latin square design, so that participants could see each target only once in one of the possible five conditions. The experimental design is summarized in the table below:

Condition	Transparent set	Allomorphic set
Identity	violazione/VIOLAZIONE 'violation/VIOLATION'	illusione/ILLUSIONE 'illusion/ILLUSION'
Past participle	violato/VIOLAZIONE 'violated/VIOLATION'	illuso/ILLUSIONE 'deluded/ILLUSION'
Infinitive	violare/VIOLAZIONE '(to) violate/VIOLATION'	illudere/ILLUSIONE '(to) delude/ILLUSION'
Orthographic	violino/VIOLAZIONE 'violin/VIOLATION'	illustre/ILLUSIONE 'illustrious/ILLUSION'
Unrelated	scadere/VIOLAZIONE '(to) expire/VIOLATION'	condire/ILLUSIONE '(to) season/ILLUSION'

Table 12 – Experimental design of Experiment 2

4.2.2 – Method

4.2.2.1 – Participants

The same population of Experiment 1 took part in this study (see § 4.1.2.1).

4.2.2.2 – Procedure

The procedure was exactly the same as that presented for Experiment 1. Since the same participants took part in the two experiments, participants were offered a long break before starting the second experiment. Moreover, no previously presented item was repeated in this experiment, to avoid repetition effects.

4.2.3 – Results

4.2.3.1 – L1: data analysis and results

Data were cleaned considering accuracy rates for participants and items: since the accuracy rate of two participants fell below 70%, their data were excluded from further analysis. Incorrect responses and timeouts were removed (1.59% of data points) and only correct responses to word trials were analysed. RTs that were two standard deviations above or below the mean were treated as outliers and consequently removed (4.78%). Remaining data were entered into by-subject and by-items ANOVAs, with Prime Type and Transparency types as within-participants factors in the subject analysis and Prime Type as within- and Transparency as between-participant factors in the item analysis.

The analysis of latencies showed a main effect for Transparency ($F1(1,39) = 28.89$, $p < .0001$, $F2(1,78) = 10.68$, $p < .01$) and Prime Type ($F1(4,156) = 15.30$, $p < .0001$, $F2(4,312) = 9.37$, $p < .0001$). Mean reaction times were overall faster in the opaque set (576 ms vs 596 ms), which can be explained on the basis of the higher mean frequency of targets in this set. The interaction of transparency by prime was not significant ($F1(4,156) = 1.97$, $p > .05$, $F2(4,312) = 1.02$, $p > .05$). Average RTs for each set are indicated in figures 6 and 7:

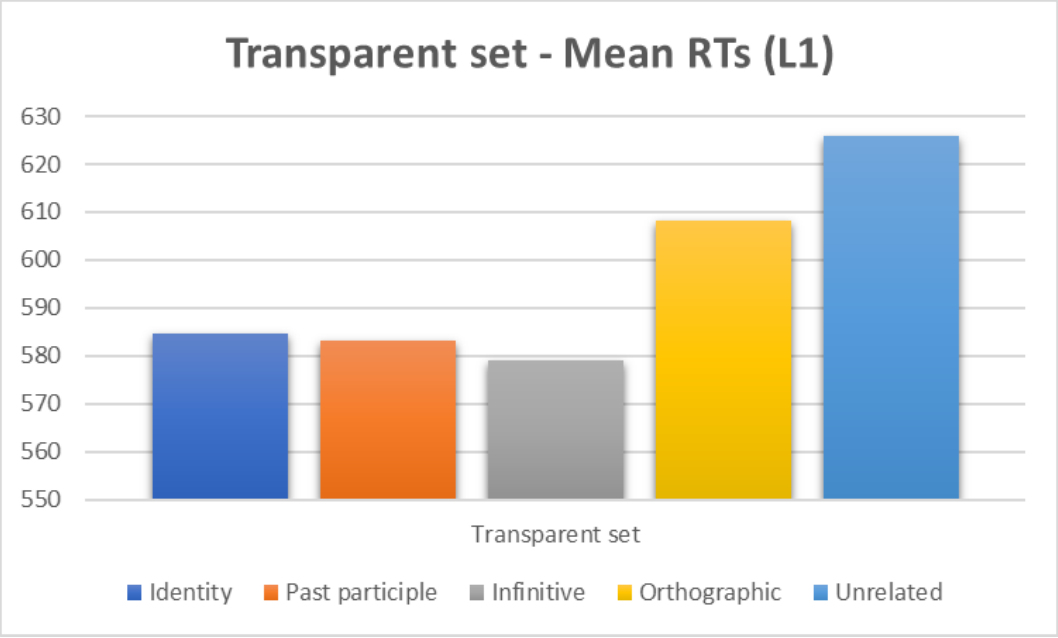

Figure 6 – Experiment 2: mean reaction times for the transparent set (L1)

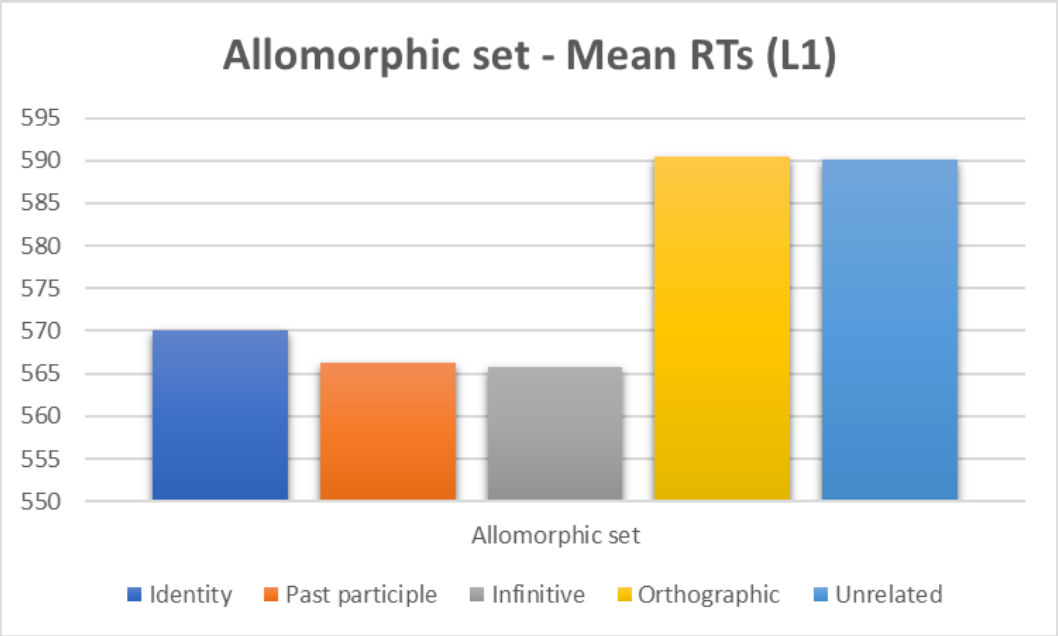

Figure 7 – Experiment 2: mean reaction times for the allomorphic set (L1)

Prime Type interacted partially with Transparency Type (transparent: $F1(4,156) = 15.25$, $p < .0001$; $F2(4,156) = 7.13$, $p < .0001$; allomorphic: $F1(4,156) = 5.41$, $p < .001$; $F2(4,156) = 2.64$, $p < .05$).

Planned comparisons show that identity primes triggered significantly faster reaction times compared to the unrelated and the orthographic conditions, in the transparent (unrelated baseline: $F1(1,39) = 28.11$, $p < .0001$; $F2(1,39) = 15.68$, $p < .01$; orthographic condition: $F1(1,39) = 7.61$, $p < .01$; $F2(1,39) = 5.81$, $p < .05$) and the allomorphic set (unrelated: $F1(1,39) = 9.82$, $p < .01$; $F2(1,39) = 4.24$, $p < .05$; orthographic: $F1(1,39) = 5.59$, $p < .05$; approaching significance in the item analysis, $F2(1,39) = 3.86$, $p = .06$).

As for the transparent set, both morphological primes produced a facilitation effect which was significant relative to the unrelated baseline (past participle: $F1(1,39) = 44.65$, $p < .0001$; $F2(1,39) = 18.42$, $p < .01$; infinitive: $F1(1,39) = 50.07$, $p < .0001$; $F2(1,39) = 16.02$, $p < .01$). Moreover, the effects induced by the two morphological primes were also significantly larger than those induced by the orthographic prime (past participle: $F1(1,39) = 13.22$, $p < .01$; $F2(1,39) = 7.77$, $p < .01$; infinitive: $F1(1,39) = 16.29$, $p < .01$; $F2(1,39) = 9.54$, $p < .01$). The effects produced by the past participle and the infinitival forms did not significantly differ from each other and neither from those produced by identity primes (all $Fs < 1$).

As for the less transparent set, not surprisingly, the past participle prime (i.e., the most transparent form in this set) produced an effect which was significant with respect to both the unrelated ($F1(1,39) = 7.72$, $p < .01$; nearly significant in the item analysis, $F2(1,39) = 3.88$, $p = .06$) and the orthographic ($F1(1,39) = 13.57$, $p < .01$; $F2(1,39) = 4.16$, $p < .05$) conditions. This is in line with the effects found in the transparent set for the past participle primes, which retain the same degree of transparency and, accordingly, behave alike. Interestingly, infinitive primes in the allomorphic set also triggered reaction times which were significantly faster than those induced by the unrelated condition ($F1(1,39) = 11.39$, $p < .01$; nearly significant in the item analysis, $F2(1,39) = 3.64$, $p = .06$) and by the orthographic condition ($F1(1,39) = 9.98$, $p < .01$; $F2(1,39) = 7.51$, $p < .01$). Moreover, such effects did not significantly differ from those yielded by identity primes (all $Fs < 1$).

Significant differences ($p < .05$) as revealed by pairwise comparisons are indicated in Table 12:

	Prime type	**RTs**	**SD**	**U-I**	**U-Past**	**U-Inf**	**O-Past**	**O-Inf**
Allomorphic set illudere – illusione 'to delude – illusion'	Identity	570	81	20*	24*	24*	25*	25*
	Past participle	566	74					
	Infinitive	566	59					
	Orthographic	591	78					
	Unrelated	590	76					
Transparent set violare – violazione	Identity	585	89	41*	43*	47*	25*	29*
	Past participle	583	75					
	Infinitive	579	72					

'to violate – violation'	Orthographic	608	83					
	Unrelated	626	80					

Table 13 – Experiment 2: mean subject reaction times, standard deviations, and net priming effects (L1); *= p < .05.

Since errors were too few to be submitted to statistical analysis, they were not further analysed. Error rates are given in the table below:

	Prime type	**Error rate**
Allomorphic set illudere – illusione 'to delude – illusion'	Identity	1.3%
	Past participle	0.9%
	Infinitive	2.2%
	Orthographic	0.9%
	Unrelated	2.5%
Transparent set violare – violazione 'to violate – violation'	Identity	0.0%
	Past participle	1.9%
	Infinitive	1.6%
	Orthographic	1.9%
	Unrelated	2.8%

Table 14 – Experiment 2: error rates per condition (L1)

To summarize what has been observed so far, significant facilitation effects arose when the target was preceded by both types of morphological primes, suggesting that morphological relatedness is strongly perceived among nominalizations and both their possible bases in the verbal paradigm. Importantly, this was true for both transparent and opaque sets, indicating no advantage for the most transparent prime

(the participial stem) in determining facilitation effects on the recognition of the derived form.

4.2.3.2 – L2: data analysis and results

The same procedure described above was followed to clean the data of non-native speakers. Consistently with what observed in Experiment 1, the accuracy rates of the same three subjects was found to be below 70% and were, therefore, excluded from further analysis. Incorrect responses and timeouts were also removed (5.28 % of data points) and correct responses to word trials were considered for analysis. RTs that were two standard deviations above or below the mean were treated as outliers and consequently removed (4.68 %).

The analysis of non-native speakers' latencies indicated a significant main effect for Transparency ($F1(1,30) = 16.69$, $p < .01$, $F2(1,78) = 7.36$, $p < .01$). As with native speakers, targets in the opaque set were overall responded to faster (739 ms vs 781 ms). Prime Type also had a significant main effect ($F1(4,120) = 4.91$, $p < .01$, $F2(4,312) = 2.85$, $p < .05$). The interaction of transparency by prime was not significant ($F1(4,120) = 0.38$, $p > .10$, $F2(4,312) = 0.23$, $p > .10$). Average RTs for each set are indicated in figures 8 and 9:

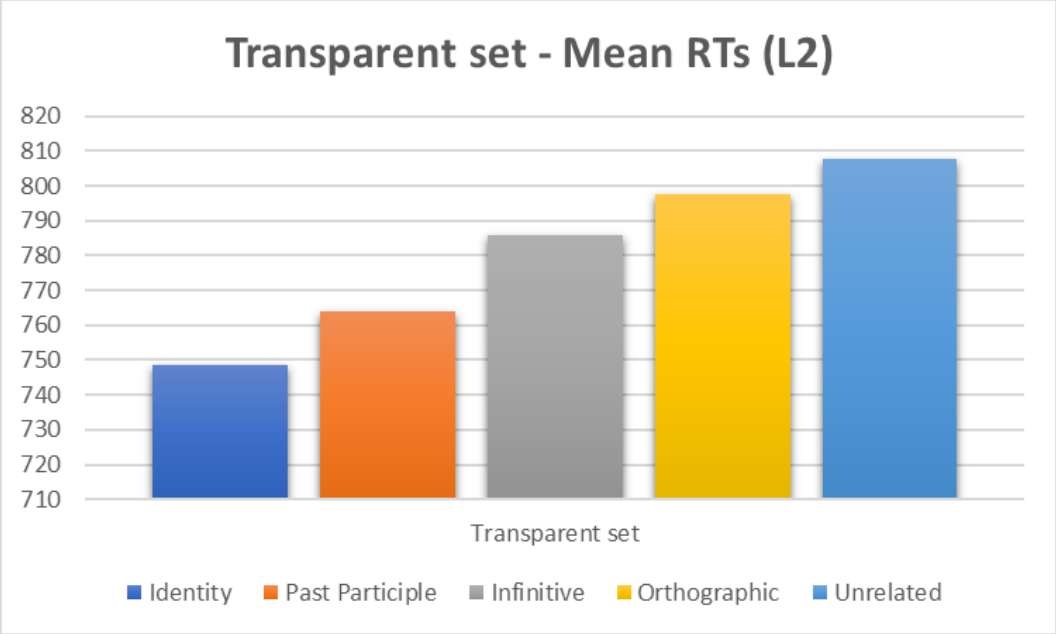

Figure 8 – Experiment 2: mean reaction times for the transparent set (L2)

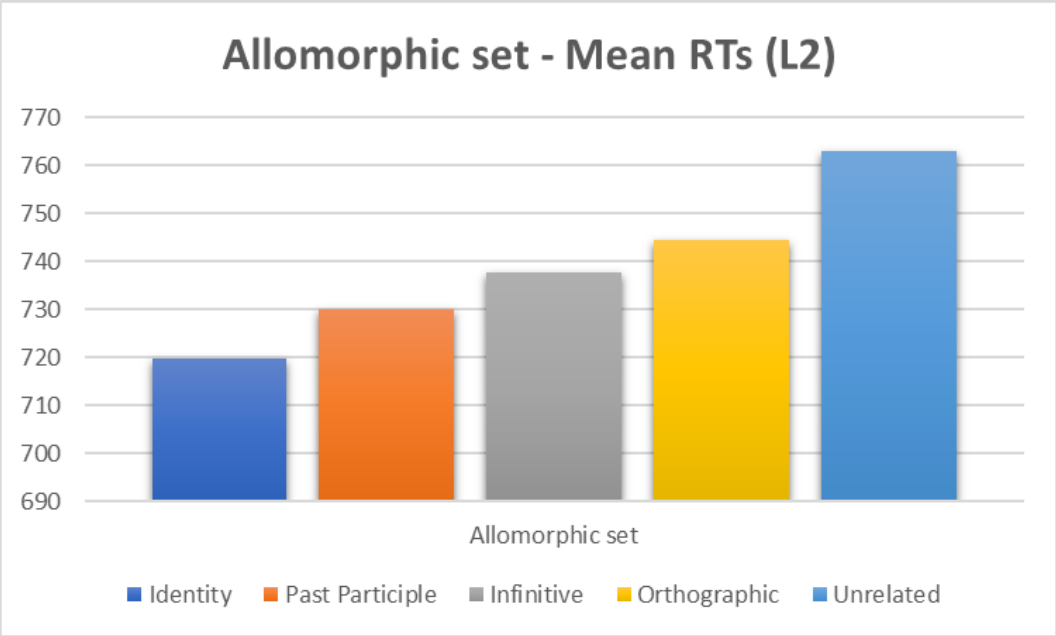

Figure 9 – Experiment 2: mean reaction times for the allomorphic set (L2)

Planned comparisons indicate an effect of identity primes in both sets with respect to the unrelated baseline condition (transparent: $F1(1,30) = 13.05$, $p < .01$; $F2(1,39) = 11.85$, $p < .01$; allomorphic: $F1(1,30) = 7.25$, $p < .05$; not significant in the item analysis, $F2(1,39) = 2.75$, $p > .10$). Analysis of the effects of the morphological primes revealed a picture quite different from that observed with native speakers: first, only the past participle forms induced shorter latencies relative to the unrelated condition and this was true in the analysis by participants for both the transparent ($F1(1,30) = 7.32$, $p < .05$; $F2(1,39) = 2.60$, $p > .10$) and the opaque set of items ($F1(1,30) = 4.45$, $p < .05$; nearly significant in the item analysis, $F2(1,39) = 3.29$, $p = .08$). Moreover, the facilitation observed was only significant with respect to the unrelated baseline, but not relative to the orthographic primes. Although orthographic primes did not facilitate target recognition compared to the unrelated ones (all p values > .10), the effects yielded by morphological past participle forms did not differ significantly from them, except for a tendency to significance in the subject analysis only of the transparent set (transparent: $F1(1,30) = 3.11$, $p = .09$; $F2(1,39) = 0.50$, $p > .10$; allomorphic: $F1(1,30) = 1.12$, $p > .10$; $F2(1,39) = 0.74$, $p > .10$). Finally, the numerical facilitation effect observed with infinitival forms failed to reach significance with respect to both the orthographic and the unrelated conditions (all p values > .10), and this was true not only for the less transparent

forms (i.e., those contained in the allomorphic set such as *scrivere*), but also for the more transparent ones (i.e., *bocciare*). Net priming effects and significant differences ($p < .05$) are indicated in Table 15:

	Prime type	RTs	SD	U-I	U-Mpast	U-Minf	O-Mpast	O-Minf
Allomorphic set illudere – illusione 'to delude – illusion'	Identity	720	132	43*	33*	25	15	7
	Past participle	730	125					
	Infinitive	738	150					
	Orthographic	745	146					
	Unrelated	763	144					
Transparent set violare – violazione 'to violate – violation'	Identity	748	148	60*	44*	22	34**	12
	Past participle	764	144					
	Infinitive	786	179					
	Orthographic	798	192					
	Unrelated	808	159					

Table 15 – Experiment 2: mean reaction times, standard deviations, and net priming effects (L2); *= $p < .05$; **= $.05 < p < .10$.

Errors were analysed after transforming proportions by means of an arcsine transformation, in order to stabilize variance and normalize data by reducing extreme skewness. In the error analysis, Prime Type had a significant main effect ($F1(4,120) = 3.95$, $p < .01$; $F2(4,312) = 3.38$, $p < .01$) and so did Transparency (although not in the item analysis, $F1(1,30) = 7.04$, $p < .05$; $F2(1,78) = 1.48$, $p > .10$). Overall, errors were more numerous in the transparent set (6.45% vs 4.11%). Moreover, the interaction of Prime Type and Transparency approached significance

in the subject analysis (F1(4,120) = 2.21, p = .07). Detailed inspection indicates that, in the transparent set only, the unrelated condition triggered a higher number of errors compared to all other conditions (except the past participle one). Error rates are shown (in raw percentages) in the table below:

	Prime type	**Error rate**
Allomorphic set (illudere – illusione 'to delude – illusion')	Identity	2.8%
	Past participle	6.0%
	Infinitive	2.0%
	Orthographic	5.2%
	Unrelated	4.4%
Transparent set (violare – violazione 'to violate – violation')	Identity	3.6%
	Past participle	6.9%
	Infinitive	3.6%
	Orthographic	6.5%
	Unrelated	11.7%

Table 16 – Experiment 2: error rates per condition (L2)

The findings emerging from this experiment point to a different direction compared to what we have observed with native speakers. A few considerations are in order here. Firstly, morphological facilitation does not seem to emerge in a clear way, even for the most transparent prime-target pairs. Indeed, the observed effects were only significantly different from those triggered by the unrelated prime condition, but crucially not from those registered after the presentation of orthographic primes. This result seems to contradict the findings of Experiment 1, where truly morphological effects emerged at least in the transparent set, and seems to undermine the claim that morphological effects can be disentangled from purely

formal effects in non-native processing. Secondly, an interesting and somewhat surprising element emerged from this experiment. Transparent primes triggered an effect against the unrelated baseline, but this was only observed for the past participle forms (*violato – violazione*) and not for the infinitive forms (*violare – violazione*) contained in the transparent set of prime-target pairs. This result is rather surprising when one considers that the infinitive forms exhibited the same degree of formal overlap with their targets as the past participle forms. Imperfect matching for frequency of past participle forms does not seem to be much informative here, given that this problem only occurred in the allomorphic set, but not in the transparent one. Based on such matching, we should have observed at least similar effects between the two morphological primes in the transparent set. A possibility which can be claimed to explain the present set of data could alternatively consider the role of the different inflectional forms. In other words, it may well be the case that the relationship between past participle forms and their corresponding deverbal nominalizations is more closely perceived than the one between such derivatives and the infinitive form of the corresponding verbs. This hypothesis will be further discussed in the next section.

4.3 – General discussion

4.3.1 – Native processing

Experiments 1 and 2 were designed to test whether formal variation in the shape of words could affect the way relationships among morphological relatives are perceived in the mental lexicon. While the experiments focused on the early phases of lexical access, the hypothesis underlying our theoretical framework is that words are organized according to morphological schemas, i.e., morphological families and morphological series. Such an organization should be reflected by the way in which we access the lexicon, in that words which are instantiations of such schemas should benefit from connections established among them. The purpose of the experiments was twofold: on the one hand, disruptive root changes in their (potential) power to affect priming patterns were investigated; on the other hand, we focused on two related but different cases of allomorphy. Experiment 1 was aimed at exploring the root alternation characterising some derivative processes, while Experiment 2

focused on those alternations which are present at the level of the inflectional verbal paradigm, which could crucially be reflected also in the relationship between two forms possibly perceived as bases and their corresponding nominalizations. Moreover, the specific design of this experiment allowed direct comparison of the facilitation effects triggered by a more transparent and a less transparent form on the recognition of the same target, thus permitting more accurate assessment of any potentially observed difference. As far as native processing is concerned, we aimed at verifying whether the previously observed facilitation effects in the domain of Italian derivation is affected by changes in the phonological/orthographic shape of the root.

The findings that emerged from the experiments conducted on native speakers clearly point to a role for morphology in the organization of the mental lexicon, in line with the results of previous psycholinguistic research on the topic conducted on different languages. Facilitation induced by transparent morphological derivatives on the recognition of their base targets provides evidence for this state of things, confirming the body of evidence emerging from simple and primed lexical decision tasks on Italian (Burani & Caramazza 1987; Burani & Laudanna 1992; Burani & Thornton 2003; Giraudo & Dal Maso 2016a).

The most interesting results concern the topic of investigation of this first part of the study, i.e., the processing of allomorphic relations. The data presented here clearly indicate that, despite the existence of ortho-phonological disruptions in the lexical root, morphological effects are robust. Such outcomes are, in our view, fully in accordance with the predictions formulated within the theoretical perspective of word-based morphology. As discussed above, the degree of morphological relatedness between two forms need not be impaired by phonological alternations. According to morpheme-based approaches, on the other hand, when complex words like *musicale* 'musical' are presented, obligatory segmentation should operate and extract *musica* 'music' and -*ale* as morphological units. Subsequent presentation of the target *musica* should at this point be speeded up by prior activation of the base *musica* from the derivative *musicale*. However, when words presenting ortho-phonological alterations, such as *floreale* ('floral'), are presented, the decomposition process would isolate the root *flore* (and the suffix -*ale*). Within this

view, it is hard to see how the subsequent presentation of *fiore* ('flower') could benefit from prior presentation of *floreale*, given that no pre-activation of *fiore* had occurred. The results of Experiment 2 further undermine such a view, since the direct comparison of the priming effects yielded by *illuso* ('deluded') and *illudere* ('to delude') on *illusione* ('illusion') leaves little space for possible shortcomings deriving from matching materials across the two sets. The data from this experiment clearly show equivalent amounts of facilitation induced by both past participle and infinitival primes on the recognition of deverbal forms with *–zione* and *–tura*, irrespective of their formal transparency. If only the most transparent root *illus-* was contacted during access, facilitation effects should have been observed only when *illuso* was presented as a prime for *illusione*. However, the fact that also the less transparent form *illudere* yielded significant priming would seem to suggest that access does not actually proceed through segmentation in morphemic constituents and identification of the root.

The observed pattern of facilitation effects is in line with most studies investigating allomorphic relationships in derivation 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 methods, which are supposed to reflect later stages of lexical access, tapping into a more central level of lexical representations. Indeed, Orfanidou, Davis & Marslen-Wilson (2011) obtained different patterns of facilitation effects depending on the method used: crucially, formally opaque morphological forms primed their targets in the delayed priming task, but failed to do so in the masked priming task (see § 3.4). The authors proposed to account for their data by hypothesizing separate orthographic representations for the two allomorph stems considered in their study, which would share however some features at a higher semantically informed level. According to their interpretation, morphological relatedness among formally opaque items would not be perceived during the early phases of morphological processing, but would arise at later stages. Accordingly, 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 acknowledge morphological relations, since no reliance on semantics is possible. The fact that facilitation was instead found in the study by McCormick, Rastle & Davis (2008) is explained, within this line of interpretation, through the proposal that this segmentation is flexible to predictable phonological changes such as those considered by McCormick et al., but not to more disruptive and unpredictable variations of 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 a similarity is reduced, 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, access occurs via whole word forms, which are supra-lexically organized on a higher morphological level, in which base lexemes are contained. Importantly, this level is at the interface between the word level and the semantic level and arises on the basis of systematic form-meaning correspondences. Within this model, priming effects arise not as a consequence of repeated access through the same decomposed root morpheme, but on the basis of bidirectional excitatory links established between all morphologically related forms and their abstract base morphemes contained at this supra-lexical level. Crucially, such units, therefore, drive the organization of the lower level of form representations in terms of morphological schemas, i.e., morphological families and morphological series. Moreover, and most importantly for the topic under investigation here, such supra-lexical units are abstract enough to tolerate ortho-phonological variations. Most determining is in fact in the model the degree of semantic transparency, based on which connections among supra-lexical units and all related forms at the lower level are shaped. Stronger links are established among semantically transparent members of a morphological family,

even among those in which formal transparency is impaired. Thus, forms like *floreale* would be connected at this higher level with their abstract unit and therefore activation would proceed from the derivative to this morphemic unit. Simultaneously, this would send back activation to all the related forms at the lower form level, such as *floreale, fiore, fiorista, fioraio*, etc… On subsequent presentation of *fiore,* this stimulus would thus benefit from prior patterns of activation including the whole word form for *fiore*.

Of course, one could still argue that *floreale* could be segmented in *flore* and *-ale*, and that the lexical entries for *flore* and *fiore* could be connected, which would in turn determine the observed facilitation effect in the recognition of *fiore*. However, following this line of reasoning, different facilitation effects should be observed between formally transparent and opaque prime-target pairs, given that the indirect connection between *floreale* and *fiore* (via *flore*) should be associated with a costlier processing route. Fortunately, the design of experiment 2 allowed us to compare reaction times determined by both types of primes on the same target. The fact that both *illuso* and *illudere* produced significant morphological priming on the recognition of *illusione* relative to the unrelated and the orthographic baselines and that no significant difference was observed between the latencies induced by the two primes seem to convincingly rule out the alternative scenario depicted above.

Another interesting alternative that has been suggested (though for inflection) with specific reference to Italian (Laudanna & Burani 1986) concerns the possibility that allomorphic roots can receive feedback from a higher semantic system: the roots *illud-* and *illus-* would be separately represented but receive feedback from a common semantic node for 'delude'. However, according to the predictions of this study, the allomorphic root should have produced less facilitation[42], which was evidently not the case here.

[42] In their study, focused on inflection, Laudanna & Burani (1986) found that *vorrebbe* 's/he would like' primed *volete* 'you want' less than *volevo* 'I wanted' did. They thus suggest that the roots *vol-* and *vorr-* are separately represented and accessed. It is worth noticing, however, that diverging results may also be a consequence of the different priming design exploited in their study, namely, a morphological repetition priming with 8-12 stimuli intervening between primes and targets.

Furthermore, our data also seem to contradict the predictions made by stronger versions of connectionist models, which assume no role for morphology and base their interpretation on the existence of semantic and formal associations alone. Our results could seemingly be integrated within such a perspective, in that priming was observed with morphologically related forms but not with solely orthographically related items. Morphological primes are indeed predicted to benefit from the fact that they share not only form, but also meaning, with their targets. However, if no abstract symbolic level was present – as predicted by these models – we should have observed graded priming effects arising as a consequence of the different degrees of formal overlap between morphological primes and targets. In this respect, the inclusion of formally transparent morphological primes allows us to exclude such a view, in that graded patterns should have arisen comparing the effects of allomorphic and transparent primes. Once again, Experiment 2 provides compelling evidence against this hypothesis.

It is, on the other hand, true that we observed, in Experiment 1, what might be interpreted as graded effects. Notably, formally opaque primes produced significant facilitation compared to both baselines (orthographic and unrelated), as transparent primes did, but a significant difference between identity primes and morphological primes was only observed in the allomorphic set. According to some views, this difference between 'full' and 'partial' priming should be interpreted as proof of such a gradience of effects. Considering the degree of formal overlap as responsible for such effects would lead us once again to the connectionist explanation. However, we have already discussed how this interpretation can be ruled out on the basis of the results of Experiment 2. Moreover, the degree of orthographic overlap between the allomorphic primes and their targets was comparable in the two experiments ($t(39) = 0.58$, $p = .557$). Therefore, we see no reason why this factor could have affected Experiment 1 but not Experiment 2. Nor can we envisage anything related to the different prime-target design to have influenced the observed results. A possible interpretation that can be put forward is based, within the perspective of a supra-lexical model such as the one above discussed, on the role of the size of morphological paradigms. According to the model, the common abstract representation at the supra-lexical level is fed by all the incoming forms respecting

the form-meaning correspondence which led to its emergence, with links being strengthened thanks to family size. We wish to emphasize that, in this model, priming effects arise as a consequence of an abstract level of morphological representation emerging on the basis of connections among word units organized according to morphological families, inflectional paradigms, and morphological series. Along this line of interpretation, the strength of the morphological families involved might have resulted in larger morphological effects. *Illudere*, *illuso* and *illusione* can be conceived 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, in our view, have further strengthened the relationship between the more opaque form *illudere* and the derivative *illusione*, therefore boosting facilitation effects among them. Although the size of the morphological paradigms in which the selected items participate was not a factor which we controlled for, we believe that a rich paradigm such as the verbal paradigm in Italian, which can contain approximately fifty forms (depending on the verb), might have positively contributed to the facilitation effects observed in the second experiment. Along this line of reasoning, the presentation of *illudere* might have activated its abstract unit and from this all related forms in the paradigm and in the family (both those containing *illus*- and those with *illud*-) could have benefited from activation. *Illusione* (belonging to the same morphological family), but also all the forms in the verbal paradigm, would have thus been activated, which in turn could have increased the patterns of activation among related forms.

Most importantly, this paradigm is not only numerous, but also highly semantically consistent, given that the forms of a verbal paradigm are strictly related from the semantic point of view, possibly, far more than forms in a derivational paradigm. Interestingly, the effect of belonging to a large inflectional paradigm has been the object of investigation in a series of studies on Italian (Colombo & Burani 2002; Laudanna, Voghera & Gazzellini 2002; Traficante & Burani 2003), which demonstrated higher likelihood for morphological activation in verbal paradigms[43].

[43] The cited studies, however, are set within the theoretical framework of the Addressed Augmented Morphology model (see § 1.3.1), and accordingly, are aimed at providing evidence for the existence

4.3.2 – Non-native processing

Non-native processing has seldom been investigated with regard to the issues of allomorphy in derivation, and even less so in Italian. The experiments presented here constituted a first general attempt to verify, on the one hand, whether morphological organization drives lexical organization in non-native processing too; on the other hand, clarification about the influence of form in second language processing was sought for.

When we turn to the data obtained from these two experiments on allomorphy with non-native speakers, the interpretation appears to be far less clear. Notably, it seems that overall, the results for native and non-native speakers are not completely converging. As far as the main topic of investigation is concerned, no significant facilitation effects on the recognition of targets were observed when the allomorphic primes were presented. This was true for both experiments, independent of the design and the types of morphological paradigms involved. Moreover, somewhat surprisingly, the results for transparent prime-target pairs were not unambiguous. In the first experiment, the fact that derived words such as *musicale* primed effectively reaction times for *musica* led us to the conclusion that morphology can indeed function as a driving force in the organization of the mental lexicon to the same extent that it does for native processing. Such a claim was supported by the fact that the effect was found relative to both the unrelated and the orthographic baseline. However, the picture should be at least modified with respect to the hypothesis that base lexemes in the supra-lexical level are tolerant enough to ortho-phonological disruptions. Evidently, this claim, while supported for native processing, would be unwarranted on the basis of our data with non-native speakers. A deeper influence of formal characteristics seems indeed to be a potential

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of different access routes to words, namely through morphological decomposition for verbs, and whole word forms for nouns. Although our views differ, we share the belief that larger morphological paradigms have the potential of boosting morphological activation. Larger reliance on morphological constituents may result in costlier processing times in unprimed lexical decision tasks, as was found in the above-cited studies. On the other hand, as far as priming paradigms are concerned, a larger inflectional family may result in stronger links among its members and, consequently, larger facilitation effects.

candidate for explanation. Before discussing this factor, however, we cannot neglect the fact that Experiment 2 generated a different pattern of results. While the data for allomorphic prime-target pairs agree with those of Experiment 1, the most striking result concerns here the morphological primes in the transparent condition. Two facts are hard to interpret, as we have anticipated earlier: the fact that the observed morphological facilitation was significant only relative to the unrelated baseline, but not to the orthographic condition; and the fact that only past participle primes induced facilitation, but not infinitive forms (neither opaque nor transparent).

We address this last issue first. The striking contrast between infinitive and past participle priming effects cannot be understood only in terms of the different degree of formal overlap of opaque and transparent primes with their targets, since in the design we included a sort of double check, i.e., a set where both the infinitive and the past participle forms were transparent relative to their target. As noted above, in the description of stimuli selection (§ 4.2.1), this was done exactly to rule out the possibility that past participle and infinitive forms might be perceived, for independent reasons, as relating to the nominalization to a different degree. Evidently, while this turned out to be redundant in the experiment with native speakers, it was not so with non-native participants. Without the inclusion of this additional set of materials, we might have been led to the wrong conclusion that the observed facilitation for past participle forms and the lack of it for the infinitive ones was due to the presence of a root disruption only, which would have been perfectly in line with the outcomes of Experiment 1. The explanation can neither be found in the degrees of formal overlap exhibited by past participle and infinitive forms with their targets, as these were matched in the transparent set (0.77 and 0.78, respectively). Closer inspection of the item characteristics of the transparent set highlighted a significant positive correlation in the item analysis between the frequency of the primes and the net priming effects induced by the morphological condition relative to the unrelated baseline. Such a correlation was found for both the past participle and the infinitive form (respectively, $r = 0.34$, $p = .03$; $r = 0.33$, $p = .03$). Such a correlation is not surprising, even if it was not paralleled in the L1 data, given the well-known effect of surface frequency in lexical access and in

boosting the priming effects when primes are very frequent (Giraudo & Grainger 2000; Voga & Giraudo 2009). However, when we selected a subset of items showing higher infinitive prime frequency (above 3.20), the analysis of item reaction times indicated a significant effect for past participle primes (+76 ms, $F2(1,27) = p < .05$ relative to the orthographic baseline; +92 ms, $F2(1,27) = p < .01$, relative to the unrelated baseline), but still no significant effect for the infinitive forms (p values > .10 for both the +45 ms effect relative to the unrelated condition and the +29 ms effect relative to the orthographic condition). It seems, therefore, that the past participle advantage is well established and cannot be accounted for in terms of the distributional characteristics of the items[44].

Given that there seems to be a preference for past participle forms, which are evidently perceived as more closely related to the target, we should consider why this should be the preferred form. It is a known fact in second language acquisition studies of Italian (and other languages too) that the past participle is among the first verbal forms to be acquired in both natural and instructed learning (Banfi & Bernini 2003). The past participle form is the first past tense form to appear and it is also widely overapplied in both basic and post-basic varieties of the interlanguage. On such grounds, this verbal form is most likely perceived as a very salient form and its preference might not be completely unexpected. Confirmation of the preference for the past participle form within an inflectional paradigm comes from the study of Marangolo et al. (2003). In this study, patients with brain damage were asked to produce a nominalization from a verb in Italian (e.g., *liberazione* 'liberation' from *liberare* 'to free') or the reverse (e.g., to produce *liberare* from *liberazione*). Interestingly, patients showed difficulties in producing the nominalization, which was erroneously substituted in most cases by the production of the past participle form of a given verb. According to the authors' interpretation, deriving nouns from verbs entails the activation of a large set of morphologically related forms (given the richness of the verbal paradigm in Italian), which act as competitors in the selection process. The past participle would be preferred because of its high frequency within the inflectional paradigm. Such a claim is supported in their study

[44] We can also exclude a role for lemma frequency given that the values for two forms belonging to the same verbal paradigm would be equal.

by the fact that patients made fewer errors in producing the infinitive form after the presentation of the corresponding nominalization and in producing derived nouns from adjectives (e.g., *gentilezza* 'kindness' from *kind* 'gentile'), which crucially have a much smaller inflectional family than verbs. Difficulties in generating nominalizations from the infinitival forms of verbs were also documented in the studies by Marangolo et al. (2006) and Silveri et al. (2018), respectively with healthy participants and patients with Parkinson's disease. Following this line of reasoning, there is a possibility that, even though we are dealing with different types of tasks (involving comprehension *versus* production), participants in our experiment were slowed down in the recognition of a nominalization after presentation of an infinitive form because of the competition of a high frequency form such as the past participle one. On the other hand, it may be argued that the same kind of competition should have occurred after the presentation of a past participle form (i.e., the infinitive form, because of its high frequency, should have been expected and thus competed against the derived noun). It is worth noticing that the infinitive is a very salient form as well, especially for L2 learners, in that it is the very first verbal form (along with simple present tense forms) to be acquired and it is overapplied for quite some time at the beginning stages of second language acquisition. Therefore, it remains unclear on which basis the past participle is perceived as more salient than the infinitive.

Interestingly, however, the development of past participle forms in second language acquisition is intimately tied to the development not only of the category of tense, but also and most importantly of those of aspect and actionality (Giacalone Ramat 2002; Banfi & Bernini 2003). More specifically, the past participle form (forming with its auxiliary the 'passato prossimo' in Italian) is first utilized as a marker for perfective aspect in learners of Italian, for whom, in its prototypical meaning, this category refers to «a single punctual event that occurred in the past, with a clear result or end state» (Dahl 1985: 78 in Giacalone Ramat 2002: 224). Following Giacalone Ramat, there would be a tendency to «put together features that are semantically congruent such as telicity, perfectivity and pastness» (Giacalone Ramat 2002: 225). Such a tendency to overapply the past participle forms to express perfectivity is attested even at advanced levels of acquisition (Banfi & Bernini

2003: 97). In this light, the past participle form could remain highly salient even at later stages, when the infinitive stops being overused as a basic lexical form. Moreover, there might be a connection between the inherent semantics of deverbal nominalizations that were used here as targets and the actionality expressed by the two verbal forms considered. In this regard, Gaeta (2004) notices how the actionality of deverbal nouns might depend on the type of nominalization process. The infinitive form, when used as a nominalization, is prototypically more closely connected to the semantic reading of an event in its ongoing process. Although there is no evidence that the nominalizing suffixes in *-zione* and *-tura* might more probably encode an event in its end state (as matter of fact, Melloni 2006 shows that the ambiguity of the event/result reading lies in the lexical characteristics of the verbs and that nominalizing suffixes can convey both readings), there might be a possibility that, for L2 learners, this reading is more salient and, possibly, more closely connected to the verbal form that prototypically expresses finiteness of action. What is more, we have mentioned above that past participle forms are frequently substituted to nominalizations by patients with brain damage. Notwithstanding the interpretation given by the authors in the study by Marangolo et al. (2003), there could be a possibility that this occurs because of the perceived closeness between the past participle form and the nominalization. Such speculations are, however, admittedly difficult to prove, at least on the basis of the data here provided.

Turning to the second critical point underlined above, the fact that morphological facilitation was only significant relative to the unrelated baseline and not to the orthographic one, poses a serious problem to the claim that such facilitation is indeed morphological and not merely due to shared form. Moreover, it seems to be at odds with what was observed for the transparent set of items of Experiment 1. A first objection to the results of Experiment 1 might be related to the imperfect matching of orthographic and morphological primes, which was, as a matter of fact, not possible. While this possibility should be kept into due consideration, we wish to highlight that in the transparent set of Experiment 1, the mean orthographic overlap between orthographic and morphological primes and their targets was, respectively, 0.62 and 0.81, while, if we take the mean values for the orthographic

and past participle primes and their targets in the opaque set of Experiment 2[45], such values are 0.56 and 0.82. Given the comparability of the overlap between morphological primes and targets across the two experiments, it seems hard to reconcile the idea of an effect due to orthographic overlap in the second experiment with the lack of such an effect in the first (where facilitation was significant relative to the orthographic baseline). It is rather difficult to explain why we should observe such an influence of form only in Experiment 2, where the overlap between orthographic primes and target was even lower (0.62 in Exp. 1 and 0.56 in Exp. 2, $t = -2.077$, $p = .0410$). Moreover, correlation analysis of item mean latencies in Experiment 2 revealed that while orthographic effects relative to the unrelated primes were positively correlated with the amount of overlap between primes and targets ($r = 0.26$, $p < .05$), the same was not true for the effects induced by past participle primes, which do not correlate with the amount of overlap between primes and targets ($r = -0.07$, $p > .10$; $r = -0.09$, $p > .10$; respectively, against the unrelated and the orthographic baseline). It seems that form does count, when orthographically related items are considered, but may not be the only factor when more powerful relationships such as morphological ones are taken into account.

There is yet one factor that might be able to explain the overall inconsistency found in Experiment 2 and is related to the design we exploited in this second study. The two experiments differed indeed with respect to the prime-target design, in that a derivative was presented as the prime in the first experiment and as the target in the second one. Generally speaking, we do not see reasons why the latter should work less than the former[46], especially given that no discrepancies were found in the data

[45] We take the opaque set because the overlap between morphological primes and targets is comparable to the one between morphological primes and targets of Experiment 1 (respectively, 0.82 and 0.81, $t = -0.738$, $p = .462$). However, we wish to remind the reader that, despite the name attributed to the set, past participle primes in the opaque set are, in fact, transparent.

[46] In fact, if anything, the reverse could have represented a more likely scenario, as discussed in Giraudo & Grainger (2001: 127). From a decompositional point of view (according to at least one version of it), base primes should be more effective, given that they do not require parsing, and consequently extra computational costs. Such a scenario was nevertheless excluded in the study by Giraudo & Grainger (2001), where similar effects were found for derived and root primes on the same targets.

of native speakers. On the other hand, it is to be noted that the peculiar design forced us to use non-word fillers constructed with the same suffixes (*-zione* and *-tura*) contained in the target words, since we did not want participants to develop response strategies (i.e., anticipating that targets in *-zione* and *-tura* were words and those which did not contain those suffixes were not). With regard to the role of the (pseudo)morphological complexity exhibited by non-words in priming studies, the recent study by Giraudo & Dal Maso (2016b) can shed light on what might have interfered with the arising of morphological effects. The authors claim, on the basis of primed lexical decision data on French, that the complexity of non-word distractors affects the overall results pertaining also to word trials. Specifically, they showed how differing patterns of priming effects on the same critical items arise as a consequence of non-word construction methods. When the non-word was simple (i.e., not containing any morphological constituent, e.g., *burtef*), strong morphological facilitation effects were observed for pairs such as *poterie – potier* 'pottery – potter', relative to both an unrelated (e.g., *gazelle – potier* 'gazelle – potter') and an orthographic condition (e.g., *potence – potier* 'gallows – potter'). On the other hand, when the non-word was composed of an illegal combination of a real root and a real suffix (e.g., *artier*), no effect was observed. Finally, when semi-complex non-words were presented (combinations of real roots and non-existing suffixes, e.g., *artoix*, or non-existing roots and real suffixes, e.g., *ortier*), priming effects reappeared, more effectively so when the root did not exist. All in all, the point the authors wish to make is that, when the non-word is morphologically structured, more difficulties are encountered in discriminating words and non-words when performing the task. While the situation where semi-complex non-words are presented is here relevant, we wonder whether the presence of suffixes such as *-zione* and *-tura* might have been of special difficulty for non-native speakers. While we made sure that roots did not exist in our non-word items (e.g., *crellosazione*), it is to be acknowledged that such suffixes might constitute a highly salient unit, the more so for non-native speakers. Following the operationalization proposed by Giraudo & Dal Maso (2016a), these two suffixes seem to qualify as highly perceptually salient. Specifically, they: i) are large in size, i.e., number of graphemes and phonemes (*-tura*: four letters, four phonemes; *-zione*:

five letters, five phonemes); ii) are not resyllabified, i.e., they constitute a two-syllable unit on their own; iii) have morphological boundaries coinciding with phonological ones; iv) always carry word stress. According to the analysis of Giraudo & Dal Maso, therefore, these two suffixes should be recognized as highly salient units and, as a consequence, might generate more confusion when presented embedded in non-words. The data obtained with pseudo-words made up of a non-existing root and a real suffix (e.g., *cempenista*) in the study by Burani & Thornton (2003) are also consistent with this hypothesis[47]. On such premises, the point we wish to make here is that, for non-native speakers, the nominalizing suffixes under consideration might have been perceived as very informative clues about word lexicality and, therefore, have interfered with the overall pattern of priming effects observed. Participants reporting feeling that the task was more difficult and overall slower reaction times than those registered in Experiment 1 seem to corroborate this interpretation. Related to this, it should also be noticed that the effects observed for non-native speakers were not always reliable in the analysis by items. While this may point towards some issues in the choice of stimuli, it is worth reminding that no analogous problem was found with native speakers. On the other hand, the validity of item matching procedures might be called into question as far as non-native speakers are concerned. Indeed, while items were the same for the two groups, it may be the case that what is taken to be representative of native language does not apply to learners in the same way. In the introductory methodological remarks to the experimental part of this work, we anticipated the problem of understanding the kind of input to which learners might be exposed. An inherent problem in second language acquisition research with control groups of native participants is represented by the choice of the corpus from which materials are drawn. Crucially, the use of learner's corpora might be ecologically more valid to grasp the reality of learners' exposure to target language, but could likely pose the same problem with respect to native speakers. While we wish to stress that corpus choice was determined taking into consideration such potential issues, we

[47] No claim, however, is made with regard to perceptual salience in this study. Rather, suffix frequency is taken into consideration.

acknowledge that a problem might have arisen with respect to this point, which would thus need deeper investigation.

As for the implications that our results have for the understanding of the mechanisms underlying second language processing, we postpone the discussion to the last chapter of the present work, where data from all the experiments will be considered jointly. For the moment, we limit the discussion to a few considerations relative to what previous L2 studies revealed.

Firstly, with regard to the claims made by some of the studies by Clahsen and colleagues (namely, Neubauer & Clahsen 2010 and Heyer & Clahsen 2015), we can exclude that morphological effects are purely derived from formal overlap. While inconsistencies arose in Experiment 2 with regard to the latencies relative to the orthographic condition, we have discussed above our hypothesis that form might not be able to explain the whole range of effects observed. The morphological effects found in Experiment 1 support a view in which at least transparent relatives are possibly organized on the basis of morphology. What is more, correlations between the amount of orthographic overlap of orthographic primes and their targets, but not of morphological primes and targets in Experiment 2 seem to further shed light on this point. Of course, however, we cannot neglect the impact which was evidently played by form disruptions in the effects induced by allomorphic primes. Even the non-significant effects of past participle primes relative to the orthographic baseline (but not to the unrelated) failed to emerge when opaque infinitive forms were presented prior to targets. Even if there seems to be a problem with infinitive forms in general, the similar lack of priming for allomorphic primes in Experiment 1 leaves little doubt about the influence of a word's formal characteristics. We believe that the hypothesis put forward by Heyer & Clahsen might be too strong, but it certainly highlights a relevant aspect in L2 processing. More in general, it seems that our patterns of results fit best those emerged in the studies by Basnight-Brown et al. 2007 and Feldman et al. 2010 on inflection, in which non-native speakers encountered more difficulties (in terms of priming effects) with stem-change irregulars (e.g., *taught*), but not with regular and (at least some of the tested groups of participants) nested irregulars (which keep the stem unchanged, e.g., *drawn*). Increasing formal overlap would therefore be a good

candidate for the observed differences with native speakers' data, but would not affect categorically morphological effects, which can still emerge in the most transparent conditions. While our study did not investigate inflection, such similarities do not seem to corroborate a view which supports a categorical distinction between the domains of inflection and derivation.

BOUND STEMS

The second set of experiments of the present study focuses on a different aspect of morphotactic opacity, namely, on the phenomenon of so-called 'bound stems', i.e., bases which lack autonomy. As in the previous section, in Chapter 5, we will first outline the problem posed by bound stems, discussing the nature of the phenomenon and its manifestations with a special focus on Italian. Given the lack of quantitative studies pertaining to this issue in Italian, we will first try to sketch a general picture related to the language under investigation. Its treatment in a usage-based perspective will then be outlined and psycholinguistic studies which explored the way such stems are processed will be considered. Since, to our knowledge, there is no previous study concentrating on the processing of such stems in the second language literature, this section will be necessarily limited to observations made within the context of L1 research. The predictions of the psychological models will be consequently spelled out and the rationale for Experiments 3 and 4 explained.

Chapter 6 will contain the experimental part of the study and present the way materials were selected, along with the results of the two experiments and their analysis. Finally, a general discussion of the findings concerning native and non-native processing of bound and free stems will be carried out.

Chapter 5: Background

5.1 – Definition

The great majority of affixes usually attach to bases which can correspond to free-standing occurring words. However, there are also words in which, though an isolable base cannot be identified, are seemingly polymorphemic. If we consider words such as *permit*, for instance, we could be tempted to dismiss them as monomorphemic words (and this is indeed one of the interpretations that have been proposed in, e.g., Marchand 1969), since no overt morpheme segmentation can be assumed (*-mit* never occurs alone). Yet, we can recognize a derivational affix and the complex structure of the word *permit* seems to be further confirmed by the fact that the same apparent base appears in other verbs such as *submit* and *emit*, where a prefix is still identifiable (which could seemingly lead us to exclude the possibility that such words simply contain homograph strings). Such cases raise a problem for the description of the part that remains if we remove the derivational affix. It is clear how *-mit* differs from, for instance, *form*, which can appear either alone or combined with affixes (e.g., *deform*, *reform*). Units such as *-mit* have been defined as bound stems (Aronoff 1976) or bound roots (Selkirk 1982)[48], in that they cannot occur in isolation, but need to have a derivational affix (either a prefix or a suffix) attached to it (see Aronoff 1976; Selkirk 1982 for descriptions of the phenomenon in English).

Identifying such elements might be relatively easy, despite their lack of autonomy, in those cases where a stable semantic nucleus can be found. Indeed, for instance, the class of apparently baseless nouns and verbs in *-ee* and *-ate* (e.g., *nominee* –

[48] We will use the term bound stem, for the sake of consistency with the existing (psycholinguistic) literature, keeping in mind that neither this nor the term bound root are probably adequate to refer to the phenomenon in Italian. Throughout the discussion we refer to bound stems to refer to an element which cannot freely occur when we remove the derivational affix neither in conjunction with an inflectional affix (e.g., *cand-* in *candido* 'candid', where *cand-* is bound as opposed to *centr-* in *centrale* 'central', where *centr-* is still technically bound, but not if considered in combination with the inflectional affix *-o*, i.e. *centro* 'centre').

nominate), discussed by Aronoff (1976: 88-89) as generated by truncation rules[49], appears to maintain a fairly recognizable meaning across the words which contain them. Despite its boundedness, the fact that *nomin-* can appear in other derived words maintaining the same semantic value should qualify it to be a morpheme, defined as the smallest meaningful element. What is more, such elements are combined with affixes which are «alive and regular in their operation» (Aronoff 1976: 88), i.e., they are productively used.

From a usage-based point of view, it could therefore be argued that such units should emerge as meaningful parts of the words containing them, to which an internal structure can be attributed. However, the issue is more problematic when bound morphemes such as *-mit* are considered, given that no clear shared semantics can be identified. For instance, in *permit*, a bound stem *-mit* can be recognized, but no specific meaning is identifiable, neither on the basis of other verbs containing that same stem (*emit*, *submit*) nor by itself. From a theoretical point of view, such entities pose the additional problem that it is hard to reconcile the lack of a stable meaning with the definition of morphemes as meaningful units. The status of problematic entities such as these has been extensively discussed (Aronoff 1976). As Aronoff points out, there are good reasons to consider words such as *permit* as polymorphemic. He discarded the idea of considering all the instances of the root *-mit* as different morphemes (*-mit*$_1$, *-mit*$_2$, *-mit*$_3$ and so on) of the *cranberry*-type (morphemes which only occur in one word, e.g., *cran-* in *cranberry*; see Aronoff 1976: 10). Despite the lack of shared semantics, verbs containing *-mit* do have a common feature, which cannot be neglected: they all show the same phonologically arbitrary variant before the suffix *-ion* (*permission*, *emission*, *submission*). Such a circumstance is, according to Aronoff, the ultimate evidence that we are dealing with a single morpheme. Of course, this means adjusting the definition of morpheme to «a phonetic string which can be connected to a linguistic entity outside that string. What is important is not its meaning, but its arbitrariness»; what is essential about a morpheme, therefore, is that «we are able to recognize it»

[49] According to the analysis proposed by Aronoff (1976), *nominee* would be derived from *nominate*, with the morpheme *-ate* being deleted.

(Aronoff 1976: 15). Aronoff's proposal, therefore, explores the possibility that a morpheme could be perceived as such not solely on the ground of meaning.

The problematic status of such entities constitutes an interesting topic along which to measure the impact of formal properties. On the one hand, the research question revolves around the relative autonomy exhibited by derivational bases. In other terms, we specifically address the issue of whether bases need to be autonomous to be recognized and identified as constituents. On the other hand, we focus on how semantic transparency might influence this identification, i.e., whether morphemic elements emerge as such even without a common core of meaning. It may be the case that the recurrence of one element in a high number of words and the shared morpho-phonological alternations in derivational processes, such as those described by Aronoff (1976), might be sufficient for speakers to perceive such elements as salient parts of complex words. The issue of the processing of words with such stems has been discussed in the literature mainly with regard to English word formation. Before reviewing such literature, we will discuss the types of bound stems found in Italian and the status assigned to these elements in usage-based models, along with the predictions that can be formulated within their perspectives.

5.2 – Bound stems in Italian

The existence of bound stems is usually due to etymological reasons: they are usually relics of previous stages of the linguistic history of a language or the result of loans from other languages in which only the derived words, but not the bases, have entered the target language. Though no systematic description of bound stems in Italian exist to our knowledge, from the empirical observations of corpora and lexicographic resources, it emerges that many words containing bound stems, quite obviously, derive from Latin[50]. As for the derivational processes involved, bound stems are frequent both in prefixation and suffixation, but some differences in terms

[50] Loanwords can also be found, however: it is the case of *turismo* and *turista*, which are derived, respectively, from the English derived words *tourism* and *tourist*.

of shared semantics and number of words in which they are contained can be found, as we will elaborate in the next sections.

5.2.1 – Suffixed bound stems

As for suffixation, many bound stems are found with specific suffixes. According to Grossmann & Rainer (2004), instances of cases where a base cannot be identified synchronically are found especially with the deadjectival suffixes *-ente*, *-ivo*, *-bile* and *-ido* and the denominal suffixes *-ismo* and *-ista*. Among the bound stems found with such suffixes, a distinction can be drawn between those which only occur in one derivative and those which occur with multiple suffixes. The former could be conceived of as *cranberry*-morphs (reversing the perspective, i.e., considering the affix as the recurring element), in that they only appear once in conjunction with what is clearly a derivational affix. Its status therefore does not emerge from their recurrence in many words, but, if anything, is defined in relation to the elements they attach to. Many of such stems are found, for instance, with the suffix *-bile*: *potabile* 'drinkable', *vulnerabile* 'vulnerable', *malleabile* 'pliable', *friabile* 'friable', for example, contain the stems *pota-*, *vulnera-*, *mallea-*, *fria-*, which are not found in combination with other affixes, and neither occur in isolation. Most of such words, however, constitute the base for subsequent derivational processes (*potabilità* 'potability', *vulnerabilità* 'vulnerability', *malleabilità* 'pliability', *friabilità* 'friability'), which might help recognizability of the original bound stem, especially when both words containing it preserve some meaning affinity. Productive derivational processes such as the one cited above (nominal derivation in *-ità*) often exhibit a strong semantic correlation. Thus, even if *pota-* has no meaning on its own, its participation in the word *potabile*, where *-bile* has the meaning of 'that can be V-ed', makes *pota-* emerge as a potential verbal stem. In addition, *potabilità* expresses the prototypical meaning conveyed by the suffix *-ità* – which often takes as bases adjectives in *-bile* – of a quality pertaining to the base adjective, and therefore, in this case, 'the property of being drinkable'. The same is true for *potabilizzare* and *potabilizzazione*, respectively, 'render something drinkable' and 'the action of rendering something drinkable'.

Besides these cases, however, there are also bound stems which attach to at least two (typically) different suffixes, and are therefore more properly identifiable as recurring elements. A very rich series is constituted by words ending with the adjectival suffix *-ente*/*-ante* and the corresponding nominalizing *-enza*/*-anza* (*indigente*, *indigenza* 'indigent', indigence'; *carente*, *carenza* 'lacking', 'lack') and by the two denominal *-ismo* and *-ista* (*nichilismo, nichilista*; 'nihilism', 'nihilist'; *sciovinismo, sciovinista*; 'chauvinism', 'chauvinist'). The existence of pairs like these is usually motivated etymologically by the fact that both derivatives, along with their base, existed in Latin, but only the former were preserved in modern Italian. For instance, both *ispettore* 'inspector' and *ispezione* 'inspection' derive from the past participle form of the Latin verb *inspĭcere* (*inspĕctum*) 'to look'. The latter, however, has not entered modern Italian. Besides these, there are also many pairs in which one word etymologically derives from the other, but synchronically both exhibit a morphological complexity which would posit as base of derivation another most basic form, crucially the original base of derivation of one of them. The rich series of adjectives in *-ente*/*-ante* and corresponding nouns in *-enza/-anza* typically exemplifies this circumstance: the adjective *carente* derives from the Latin present participle form (more specifically from the accusative form of *cărens*, *carĕntem*) of the verb *carēre* 'be lacking', and the noun *carenza* derives from the Late Latin plural neuter *carĕntĭam*, in turn derived from *cărens*, *carĕntis*. Even though from a diachronic point of view, it is typically the nouns in *-enza* /*-anza* to be derived from the adjective in *-ente*/*-ante*, there is no synchronic reason to presuppose the adjective as the base of derivation. Therefore, from a formal point of view, they should be considered as being hierarchically at the same level of derivation. Both forms have survived until the present day, while, on the other hand, the form which could be assumed as the base of derivation of both, the verb *carēre*, has not entered Italian. While no corresponding verb exists, *carente* and *carenza* are related from a semantic point of view, in that they both entail the concept of 'lack of'.

In other cases, the base still exists but has undergone semantic drift and can no longer be understood as the base of derivation. This is the case, for instance, for the adjective *capiente* 'capacious' and the noun *capienza* 'capacity', where *capiente*

derives from Latin *capere* ‘to grab’, which has however evolved in modern Italian in *capire* ‘to understand’. Conversely, in some cases, the derivatives may have acquired a new meaning, while the base of derivation has maintained the original semantic value: *elegante* ‘elegant’ and *eleganza* ‘elegance’ have both moved away from the meaning of the verb *elĭgere* ‘to choose’, evolved in Italian as *scegliere* (from Vulgar Latin *exeligere* > it. *scegliere*), to which they were originally related (Lat. *elegăntem* had the connotation of ‘having good taste in choosing’).

There are also cases where, even if only one derivative has entered the modern stages of the language, a new complex word is derived from it, by way of suffix substitution (or truncation, if we follow Aronoff’s analysis): *consulenza*, for instance, is derived, according to the *Disc* (*Dizionario della Lingua Italiana Sabatini Coletti*), from *consulente*, substituting a clearly perceived (though no base is attested) suffix *-ente*/*-ante* with the corresponding nominalizing -e*nza*/*-anza*. From a synchronic point of view, however, there is no difference between such derivatives and those considered above: they all display an apparently morphemic (if one chooses to consider them as polymorphemic) structure with recognizable suffixes, but no occurring base of derivation. The same line of reasoning holds true for those derivatives, whose etymology cannot be directly ascribed to the same base. *Fanatismo* ‘fanaticism’, for example, is not derived from the base *fānum* ‘temple’ from which *fanatico* ‘fanatic’ derives, but is a loanword from French, *fanatisme*, in its turn derived from *fanatique*. It is nonetheless evident that the two derivatives are highly related given that they have the same Latin antecedent and could be analyzed as being derived from that same Latin base.

Finally, interesting peculiarities are represented by those bound stems which, though tracing back to the same Latin antecedent, present specialized meanings according to the way they entered the lexicon. *Aviazione* ‘aviation’ and *aviatore* ‘aviator’, for instance, are both derived directly from French *aviation* and *aviateur*, which have as antecedent the Latin word *ăvis* ‘bird’. The bound stem *avi*-, however, is also present in the derivative *aviario* ‘avian’ (and in some compounds, such as *avicoltura* ‘aviculture’ and *avicolo* ‘avicultural’), which derives directly from the same Latin antecedent *ăvis* (more precisely, from the plural genitive form *aviārium*), but has the meaning of ‘being related to birds’. In this case, though there

is still some vague semantic relation between all the words containing *avi-*, the relationship between those directly derived from Latin and those mediated by French may be less straightforward.

To conclude, an important point to be stressed is that, even if many of such suffixed words appear to be the relics of previous stages of the language, we can recognize in them suffixes which are still productively used or for which, despite the absence of productivity, a form-meaning correspondence is still very much present. What is more, many of such bound stems are found in sets of words in which the meaning of both the stem and that of the relevant derivational schemas is kept constant (e.g., the above-mentioned *-nza* /*-nte*, but also non-productive sets such as *-ore* /*-ido* in e.g., *pallido – pallore* 'pale – paleness', *squallido – squallore* 'dreary – dreariness', *candido – candore* 'candid – candour').

All in all, therefore, the majority of suffixed words sharing a bound stem are generally strongly connected from the semantic point of view, which should render the recognition of the stem, despite its non-occurrence in isolation, more likely.

5.2.2 – Prefixed bound stems

A very different picture emerges when we consider the realm of prefixation, especially with regard to prefixed verbs of Latin origin. While prefixed bound stems can be found also in derivatives of other syntactic categories (e.g., with adjectives, such as in *perplesso* 'perplexed' and *complesso* 'complex'), a vast number of them is found among prefixed verbs of Latin origin. Despite being similar from the formal point of view, such stems have interesting characteristics in terms of quantitative aspects and types of semantics conveyed that differentiate them from the ones considered above. Like for those described above, among prefixed verbs with bound stems, we can also find examples of stems which are only contained in one word, such as in *rimuginare* 'to mull over', whose stem *-muginare* (from Vulgar Latin *muginări* 'to meditate on') cannot be found in other verbs. Similarly, cases where a free stem exists in Italian alongside with the bound stem, albeit with different phonological shapes and different meanings, are also present. For instance, the Latin verb *vĕrtere* 'to turn', has entered Italian with the free form *vertere* 'to concern' and the bound form *-vertire*, which can be found in the derivatives (of

Latin origin) *avvertire* 'to inform', *convertire* 'convert', *divertire* 'to amuse', *invertire* 'to reverse', *pervertire* 'to pervert', *sovvertire* 'to subvert'. It can be easily noticed how little the semantic connection is with the meanings expressed by *vertere* and its (Italian) derivatives (*controvertere* 'to argue', *estrovertere* 'to turn outwards', *introvertere* 'to introvert'). Such a circumstance can also be exemplified by those cases where the free stem, but not the bound, retains its original meaning, such as in *captāre,* intensive form of *căpere* 'to catch', which enters Italian as *captare* 'to catch, to grasp' in its learned form, but also as the bound element -*cattare* through its diachronic evolution (in *ricattare* 'to blackmail', *scattare* 'to snap', *riscattare* 'to redeem', *attaccare* 'to attach'), in whose derivatives, however, it is difficult to recover the original semantic value.

The weak semantic relatedness characterizing the derivatives sharing a bound stem is clear as well. Contrary to what has been observed above for suffixed words, it is hard to posit a common semantic core among many of the sets of prefixed verbs sharing a bound stem. Burani (1990) points out that compositionality of meaning tends to be impaired by bound stems, as opposed to prefixed verbs with free stems. While the boundedness of the stem can certainly play a role, it does not automatically entail vagueness of meaning, as we have seen above when considering bound stems which are suffixed[51]. According to Iacobini (2004), while full semantic compositionality would be in principle obtained in affixed words with an autonomous base and a productive affix, a wide range of cases exist which can disconfirm this prediction. Semantic compositionality should instead to be intended in terms of gradience:

> «Perché si abbia una piena composizionalità semantica occorre che la base sia una parola autonoma e il prefisso sia produttivo, ma dal momento che la trasparenza semantica è una nozione di tipo graduale, i parlanti possono ricostruire il significato e segmentare i costituenti di una parola morfologicamente complessa a diversi livelli (da ipotesi sul significato complessivo della parola, all'attribuzione di significato ad almeno un costituente, alla sua mera individuazione), anche qualora la parola contenga

[51] Indeed, Burani's work was focused on bound stems contained in Italian prefixed verbs.

> prefissi non produttivi, basi non autonome, o vi sia stata un'alterazione formale dei costituenti» (Iacobini 2004: 110)[52].

Having said that, it is certainly the case that for many of the prefixed verbs with a bound stem an identifiable meaning cannot be found («la maggiore opacità si ha di norma in parole formate con prefissi non più produttivi e basi che non sono parole autonome» Iacobini 2004: 109[53]).

Yet, the issue of recognizability may have not to do solely with meaning: as Iacobini points out, the likelihood for a complex word to be parsed is higher when the word forms part of a systematic series, i.e., in this case, when there is a great number of words sharing the same stem. When we compare suffixed and prefixed bound stems, we observe that the size of morphological families of the latter seems to be much larger than those of the former[54]. If we exclude subsequent stages of derivation, we usually find two or three suffixed derivatives exhibiting the same bound stem. Prefixed verbs with bound stems exhibit greater variation in terms of the number of relatives sharing the same bound stem, reaching up to 10 for the stem *-durre*, for instance (*abdurre* 'to abduct', *addurre* 'to adduce', *condurre* 'to conduct', *dedurre* 'to deduce', *indurre* 'to induce', *introdurre* 'to insert', *ridurre* 'to reduce', *sedurre* 'to seduce', *tradurre* 'to translate', *trasdurre* 'to transduce'). Interestingly, however, it does not seem that a higher number of prefixed verbs containing the same stem contributes to the emergence of a constant semantic value for that same stem, but it could potentially contribute to the emergence of a morphemic element, following Aronoff (1976), even if no common semantics is found.

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[52] [In order to obtain full semantic compositionality, we should have an autonomous base and a productive prefix, but since semantic transparency is a gradual notion, speakers might be able to identify the meaning and the constituents of a morphologically complex word at different levels (from hypotheses about the global meaning, to meaning assignment to only one of the constituents or to its simple identification), even when words contain unproductive prefixes and non-autonomous bases or formal alterations have taken place].

[53] [Maximal opacity is usually found in words with prefixes that are no longer productive and bases that are not autonomous words].

[54] Indeed, this does not come as a surprise since typically such prefixed forms derive from Latin, where verbal prefixation was highly productive.

Another interesting fact about prefixed verbs containing a bound stem concerns the nature of the prefixes involved. For full semantic compositionality to be obtained, both the base and the affix should be transparent and productive. As Iacobini highlights, the distinction between words derived on the basis of productive word formation processes and inherited words does not necessarily coincide with the distinction between words with productive and non-productive prefixes, nor with the one between autonomous and non-autonomous bases. Therefore, besides words of Italian formation with free stems and productive prefixes (*rivendere* 'to resell', *disfare* 'to undo') and inherited words with bound stems and non-productive prefixes (*secernere* 'to secrete', *segregare* 'to seclude'), we can observe intermediate cases such as: i) words derived through productive Italian word formation processes with no longer productive prefixes and a free stem (*sorvolare* 'to fly over', *travolgere* 'to carry away'); ii) inherited words with a bound stem and a productive prefix (*rimanere* 'to remain', *risolvere* 'to resolve'); iii) inherited words with productive prefixes and free stems (*decolorare* 'to bleach', *riscrivere* 'to rewrite'), synchronically indistinguishable from words derived through productive word formation processes (Iacobini 2004: 109-110).

Productivity, on the other hand, may not always coincide with semantic transparency: even if the prefix *ri-*, for example, in its expression of iterative meaning, has high productivity, in words that have become lexicalized this semantic value may no longer be evident. While lexicalization can occur for words with both free and bound stems (e.g., *ribellare* 'to rebel' from Latin *rebellāre*, originally 'to fight again', where *-bellare* is a bound stem and *riparare* 'to repair' from Latin *reparāre* 'to obtain again', where *parare* is a free stem), it goes without saying that the phenomenon is probably far more widespread for bound stems, which by definition are lexicalized relics of a stem no longer occurring in the language. On the other hand, there are some prefixes for which the meaning might still be recognizable to speakers (*contra-*, with the meaning of 'against' or *fra-*, which has the meaning of 'in between'), even if they are no longer productive.

Finally, non-productive prefixes with a non-identifiable meaning are still likely to be perceived as morphemic constituents when the bases they occur with also occur with a number of other prefixes. The Latin prefix *ob-*, for example, is not a

productive prefix in Italian, nor has it any identifiable meaning, but it could be recognized because many of the stems with which it occurs also appear with other prefixes (both with bound stems such as in *occludere* 'to occlude', *concludere* 'to conclude', *precludere* 'to preclude', *includere* 'to include' and free stems such as in *ottenere* 'to obtain', *contenere* 'to contain', *trattenere* 'to detain', *detenere* 'to hold'). Moreover, the fact that the same prefix occurs with other (free and bound) stems (*occorrere* 'to be necessary', *omettere* 'to omit', *opporre* 'to object', *occludere* 'to occlude', *opprimere* 'to oppress') will also likely boost its representational strength. Crucially, in turn, the emergence of *ob-* as a prefix contributes to the emergence of the bound stems with which it occurs.

A paradigmatic view of the lexicon is advantageous in such cases: if we were to consider solely the combination of morphemes, the mere occurrence of *ob-* with a free stem may be sufficient for the prefix to emerge as such, given that a free stem already holds a morphemic status. On the other hand, the combination of *ob-* with a bound stem would hardly be interpreted as resulting in a complex word, since the bound stem itself would have little strength. The fact that other prefixes can be substituted thus should contribute to both the emergence of the bound stem itself and of those non-productive prefixes which would no longer be perceived as such otherwise. Therefore, in such complex words, non-productive affixes and bound stems seem to be mutually motivated by their participation in systematic series.

Summing up, it is legitimate to wonder whether words with bound stems will be somewhat more problematic to be recognized as complex and be processed as such. Dimensions along which such a problematic nature may be modulated, however, can vary greatly depending on i) shared semantics ii) number of words in which the stem is present iii) nature of the affixes involved. In the present work, we will try to explore the first of these dimensions, but implications with regard to the other two will necessarily be worth considering.

5.3 – Usage-based perspectives on bound stems

Bound stems, by definition, pose a problem for morphological theories that are strictly morpheme-based and that consider the morpheme as the smallest meaningful unit, given the lack of an identifiable meaning inherently entailed by

stems which have no lexical existence on their own. We have already discussed that Aronoff has criticized this traditional notion in favour of a theory based on words in which it is sufficient that speakers are able to isolate and recognize an element to perceive it as a morpheme. Indeed, a word-based approach seems to be more adequate to give an account of how such stems may be represented in the mental lexicon. More specifically, models assuming paradigmatic relations among words encounter little difficulty in accounting for stems which are bound, in that, crucially, they describe word internal complexity in terms of generalizations arising on the basis of relationships among words. Specifically, the mental lexicon posited by such models is structured not only by the relationship between a derived word and its base, but crucially, also by the relationships between derived words exhibiting the same degree of internal complexity. For these reasons, we adhere to such a theoretical framework and consider in the next sections how bound stems can be accounted for in the models we have discussed so far.

5.3.1 – Network Model

Bybee specifically treats the problem posed by baseless words in her Network Model. As we have seen, in her account, morphological relatedness is determined by semantic and phonological associations. If we consider cases of semantically consistent baseless words (e.g., *religione – religioso* 'religion – religious'), it is rather straightforward that no difference should be observed in the degree of relatedness exhibited by such words and derivatives with free stems (e.g., *giornalismo – giornalista* 'journalism – journalist'). Indeed, in a word-based view of the lexicon there is no need for base autonomy in order to appreciate morphological relationships.

The issue becomes obviously more complicated when it comes to baseless words with no meaning relationship. In such cases, it is still possible to posit the existence of paradigmatic relationships among all the complex words containing, for instance, *-durre,* but these should only be based on formal associations established among them. Such relationships will be much stronger than those among words overlapping formally, where no affix can be identified. As we have discussed above, their occurrence with an element which can be identified as an affix can

potentially increase the stem's perceptibility, therefore, formal relationships between words in *-durre* should be stronger than those between, e.g., words ending with *-dere*, such as *ridere* 'to laugh', *ardere* 'to burn', *credere* 'to believe', *chiedere* 'to ask', where no consistent association can be formed for the parts preceding this 'pseudostem'. Moreover, the higher the number of words containing a bound stem, the higher should be the likelihood for it to emerge.

There is yet another factor which could potentially boost awareness of such semantically empty bound stems, i.e., their morphophonological behavior in deriving complex words such as nominalizations, observed by Aronoff (1976). Much in the same vein, although not from a rule-based perspective, Bybee's Network Model suggests a way in which such stems could be represented in the lexicon. In her model, units such as *-ceive* hold a specific status, since their existence is likely to emerge because of their occurrence in more than one word (in combination with other affixes). A first set of phonological associations is established on the basis of formal similarities in the mental lexicon. In addition, words containing these stems establish phonological and semantic connections with all their derived forms (in the specific example considered, *deceive – deception*, *receive – reception*). These, in turn, create phonological associations among each other (*deception*, *reception*, *conception*), so that a complex network of relations is realized among bases and derivatives («*deceive* is related to *deception* and *receive* to *reception* by both semantic and phonological connections. *Deceive* and *receive* are connected phonologically and by the fact that they are both verbs. Similarly, *deception* and *reception* are related phonologically and by the fact that they are both nominalizations» Bybee 1988: 128). Much like in English, similar morphophonological alterations are commonly found in Italian prefixed baseless verbs (e.g., *dedurre – deduzione* 'to deduce – deduction'; *produrre – produzione* 'to produce – production'; *tradurre – traduzione* 'to translate – transalation').

Clearly, however, it is legitimate to wonder whether such types of double paradigmatic relationships are sufficient in order for speakers to perceive some degree of morphological relatedness among words participating in such schemas and, if so, to what extent this happens. On the one hand, according to the predictions of the Network Model, overall, «a minor pattern of which most speakers probably

are aware» (Bybee & Beckner 2010: 838) is likely to emerge: «Is *-ceive* a morpheme? The answer is no, because it has no identifiable meaning. However, some speakers might still be aware that *-ceive* recurs in verbs and furthermore alternates with *-cep-* before *-tion* in nouns» (Bybee 2001: 24-25).
On the other hand, we have discussed above (§ 3.2.1) how semantic associations seem to have a more dominant role in determining morphological relatedness. It could be therefore plausible that, due to the lack of a strong semantic connection, speakers might not be able to appreciate such a relatedness anymore.

5.3.2 – Construction Morphology

In Booij's Construction Morphology the issue of baseless derivations is extensively discussed (see Booij 2010 and especially the recent Booij & Audring to appear) and fully developed within a theory of constructional schemas. Word complexity can be argued for in such derivatives on the basis of (potential) multiple schemas. On the one hand, across 'baseless' words such as *altruism*, *autism*, *baptism*, *pacifism*, a generalization (a constructional schema) can be formulated on the basis of the shared semantic categories that they can express via the suffix *-ism*:

$[x - ism]_{Ni} \leftrightarrow [\text{PHENOMENON, IDEOLOGY, DISPOSITION, } \ldots]_i$ (Booij 2010: 30)

In other terms, we can relate words ending with the suffix *-ism* and identify a common semantics conveyed by them, even if the semantics of the first part is still opaque: «the meaning of complex words can better be defined over the entire word than over their individual morphemes» (Booij & Audring to appear).
On the other hand, relationships between two or more sets of words derived from the same base word are also established. In the example of nouns in *-ism*, a relationship also emerges with the derived words with the same stem and the suffix *-ist*, which is often utilized to denote a person involved in some kind of disposition or ability Y (a variable associated with the specific nature of the phenomenon under consideration) and alternates frequently with the same bases with which *-ism* occurs (as in *altruism – altruist*, *autism – autist*, *baptism – baptist*, *pacifism – pacifist*). Therefore, a paradigmatic relationship between the schema for words in *-ism* and

those in *-ist* can be established by way of what is called a second-order schema in CxM:

$< [x - ism]_{Ni} \leftrightarrow SEM_i > \approx < [x - ist]_{Nj} \leftrightarrow [\text{person with property Y related to } SEM_i]_j >$

(Booij 2010: 33)[55]

Such schemas can express the parallelism between words with the same degree of internal complexity, i.e., in this case, between two derived words. Crucially, it is of little importance whether the stems in these words are bound or free, as long as the semantics expressed by the relationship is preserved. In Booij's words, «Even though they have no corresponding base word, the meaning of one member of a pair can be defined in terms of that of the other member […] in a schema-based analysis, it suffices to state the precise semantic correlation between two classes of words with the same degree of morphological complexity» (Booij 2010: 29). In other terms, word internal complexity emerges as a consequence of such systematic paradigmatic relationships between sets of words. It follows, of course, that the semantic transparency of the word formation schema should be a prerequisite for such correlations to establish and render the schema salient. Many of the suffixed words containing bound stems we have considered above (§ 5.2.1) fit well into both the schemas considered: very rich series such as the one between alternating *-nte* and *-nza* would emerge according to both (i.e., they receive multiple motivation; see Booij & Audring to appear).

For those suffixed words which cannot so easily be fitted in such a second-order schema (or rather, whose second-order schema's representational strength is not reinforced by many members), we could still recognize word-internal complexity as a consequence of participation in a schema established on the basis of words containing the same affix. Therefore, even instances of bound stems occurring in only one derivative may receive partial motivation (e.g., the above-considered *potabile* participates in the morphological schema for $[x - bile]_{Vi}$). Importantly, in the model, complex words need not be necessarily fully motivated (as would be the

[55] The symbol ≈ is used to indicate a paradigmatic relationship between two constructional schemas.

case for derivatives with free bases) in order to be perceived as complex. Different degrees of motivation can be attributed to them based on the number of schemas they participate in.

A problem remains, however, with those baseless words in which no meaning can be identified, neither on the basis of other words containing the same stem (e.g., *consistere* 'to consist', *resistere* 'to resist', *assistere* 'to assist'), nor on the basis of other words containing the same affix (e.g., *consistere* 'to consist', *condurre* 'to conduct', *condividere* 'to share', *confondere* 'to confound'). We can certainly hypothesize certain syntactic features of the bound stems on the basis of the affixes they combine with, but intuitions about the lexical meaning of the base would be hard to develop. Booij's approach also considers of course the relevance of their shared morphological behavior (i.e., in this case the above-cited alterations they exhibit in nominalizations), but how these might be viewed as pertaining to a morphological schema based on correspondences of form and meaning is rather difficult considering the high degree of lexicalization exhibited by them. Indeed, such derivatives do not appear to be easily captured even within schemas based on paradigmatic relationships.

5.4 – Previous studies on the processing of bound stems

The issue of the processing of bound stems has been previously investigated in the field of L1 processing, though mainly with reference to English (but see, e.g., Giraudo & Voga 2016)[56], from different perspectives and using different methodologies. Before considering the rationale for the experiments here presented, let us briefly review the main findings so far emerged in the field of L1 processing[57]. The study by Taft & Forster (1975), which has already been discussed extensively above, was specifically dedicated to this issue. In this study, decision times for bound stems presented in isolation (i.e., a stimulus which should be rejected since

[56] See also the series of experiments presented in Burani (1990); Burani, Laudanna & Cermele (1992); Chialant & Burani (1992), which focus on the specific issue of prefixed verbs with bound stems in Italian as revealed by production tasks. Given the different domains of investigation, we do not discuss extensively such studies here.

[57] To our knowledge, no study has investigated yet this issue in the field of L2 processing.

it is not a real word, e.g., *juvenate*) and for non-words which are not stems (e.g., *pertoire*) were compared. Interestingly, participants were faster in rejecting the *pertoire*-type than the *juvenate*-type. Moreover, their reaction times for bound stems were longer when they were presented with the same stimuli combined with a prefix (e.g., non-words such as *dejuvenate* and *depertoire*). Such results were taken as evidence of the fact that bound stems are indeed represented independently in the lexicon and laid the foundation for the model of lexical access based on affix stripping and access to a word through its stem, which has been discussed above. Further confirmation of the results of this study came later with subsequent elaboration by Taft (1979) and Taft (1994)[58]. In particular, Taft (1979) found that the frequency of the bound stem of a prefixed word affects latencies when the surface frequency of the stimuli is matched.

Another body of research on the processing of bound stems is constituted by priming experiments. The study by Stanners, Neiser & Painton (1979) first focused on this issue by using a long-lag priming experiment. In their experiments, words such as *progress* were reliably primed both by relatives such as *regress* and by their bound stems presented in isolation (e.g., *-gress*). Moreover, comparable effects were obtained for words with free stems (e.g., *true – untrue*), suggesting similar processing mechanisms for bound and free stems[59].

The study by Marslen-Wilson et al. (1994) (see also § 3.4 for their experiments on phonological and orthographic transparency) investigated the topic using a cross-modal design, where primes are presented auditorily followed by the visual presentation of targets. Their series of experiments on semantic transparency,

[58] In this study, the author conceded that the stimuli used in the Taft & Forster's study might have been poorly controlled and proposes the same experiments with better controlled items. Results confirm the findings of the previous study, although Taft here proposes an interactive-activation version of the prefix-stripping model, in which affixes are not stripped, but access occurs via the stem nonetheless.

[59] Similar findings were found in a primed auditory lexical decision task by Emmorey (1989), in which facilitation effects for pairs such as *conceive – deceive* emerged. See, however, discussion in Marslen-Wilson et al. (1994), suggesting that these effects might have been partly due to phonological similarities.

include, amongst others, one concentrating on the priming effects produced by prefixed words sharing a semantically empty bound stem (e.g., *submit – permit*). Data obtained from this experiment reveal no facilitation effect in this condition, which contrasted with the findings of the previous experiment in the same study (exp. 4), in which it was found that prefixed free stems such as *unfasten – refasten* strongly primed each other. Crucially, the difference between the two types of pairs lied in their semantic transparency, which is therefore claimed to be a prerequisite for priming by the authors. Set into a framework based on semantically-driven decomposition, the conclusion drawn by the authors is that semantically opaque bound stems have no representational status on their own and that words containing them would be as a matter of fact perceived as monomorphemic. Recognition of distributional regularities (the fact that *-mit* is combined with several prefixes) is explicitly ruled out as a factor sufficient to render such words perceived as morphologically related (Marslen-Wilson et al. 1994: 24).

More recently, the issue of the representation of bound stems has been investigated through the use of the masked priming paradigm in a number of studies. Forster & Azuma (2000), considering prefixed bound stems, found the same amount of facilitation triggered by free stem (*happy – unhappy*) and bound stem (*survive – revive*) primes. However, the RTs in these two conditions did not differ from the ones obtained in the orthographic control condition (*shallow – follow*) and reliable effects (i.e., different from the orthographic ones) were only obtained when increasing the SOA from 50 ms to 68 ms. Moreover, interestingly, the difference between bound stem priming and orthographic priming failed to reach significance in the item analysis even at longer SOAs. Closer data inspection led the authors to find that stem productivity (defined by them as the number of affixes which can combine with a given bound stem)[60] is a variable affecting priming effects, given that after excluding pairs with a small family size (two members), priming induced by bound stems became significantly greater than that triggered by orthographic

[60] The authors claim that their measure corresponds to the measure for morphological family size. However, it is not clear whether or not they included subsequent stages of derivations (in their example, they cite all words formed with *-rupt* and a prefix, which would seem to exclude, for example, *abruptly*).

relatives. One of the strongest claim made by the authors is that, not only the relative freedom of the stem does not affect priming effects, but also semantic opacity, which characterized their bound stem primes as opposed to the ones with free stems[61], is not a factor impairing morphological relatedness among forms. While such results seem to be at odds with those of the Marslen-Wilson et al. study, it is worth remarking that cross-modal priming is supposed to depict later stages of access, in which semantics could come into play inhibiting facilitation among forms which do not share meaning.

Two more studies conducted on English further revealed some aspects of the early stages of processing of bound stems by means of a masked priming task. Taft & Kougious (2004) concentrated on bound stems retaining a constancy of meaning (e.g., *virus – viral*) and compared the priming effects for such pairs to those triggered by pairs which were only phonologically or orthographically related (*future – futile*; *saliva – salad*) and by semantically related ones (*pursue – follow*). Based on the fact that priming was only observed for the bound stem condition, the authors claim that semantic transparency is a key determinant for facilitation to occur. While such findings would seem to contradict those by Forster & Azuma (2000), it should be highlighted that no semantically empty bound stem condition was taken into consideration. Orthographic pairs, such as *future – futile*, while superficially comparable to semantically empty bound stem pairs, are by no means similar to morphologically structured items such as *permit – submit*, in which, as discussed extensively, a stem might be recognized by virtue of its appearance with other affixes. On the other hand, it is true that in this study the authors refer generically to *virus – viral* as sharing initial orthographic units rather than as bound stems[62].

[61] While this seems true for many of their stimuli, more strongly related pairs such as *survive – revive* were also included.

[62] Elsewhere in the study (Taft & Kougious 2004: 11), these subunits are referred to as 'bound morphemes'. It appears not entirely clear whether the aim was to investigate bound stems or only pairs with a shared semantics which have initial overlapping orthography. Confusion is added by the fact that the entire set of items used is not presented and in the examples provided by the authors some words could be more properly labelled as bound stems, given their occurrences with affixes, while for some others this would be more dubious.

While no insights into the role of semantic relatedness emerged in the study by Pastizzo & Feldman (2004), since apparently no selection on the basis of semantic criteria was made in the construction of their set of critical targets, interesting results come from this study with regard to the comparison between the processing of free and that of bound stems. Interestingly, the priming effects they found in the morphologically related condition were robust both for free and bound stem primes when compared to the unrelated condition. However, when such effects were assessed relative to the orthographic condition, a significant tendency towards greater facilitation for free stem primes emerged. The authors explain such findings in terms of the greater semantic mismatch existing between free stems (which usually have a well-defined semantics) and their orthographic relatives, as opposed to the lesser distance between the latter and bound stems, which are often devoid of a clear meaning. An additional variable that was considered in this study is the size of the morphological family of the stems considered. A significant positive correlation between this variable and bound stem morphological facilitation was found, i.e., morphological facilitation was greater for bound stem targets with large as compared to small morphological families. Differently from what observed in the study by Forster & Azuma (2000), however, no such correlation was found when the size count took into consideration only relatives composed of a given bound stem and the prefixes combining with them. Furthermore, morphological family size was not found to be correlated with the facilitation effect found for prefixed forms sharing a free stem, which would seem to point to the existence of some more subtle differences between bound and free stem processing.

We conclude this review with the recent study on French presented by Giraudo & Voga (2016), who contributed to the analysis of bound stem processing by going deeper into the issue of their representational status. Specifically, their interest was set on demonstrating that, although derived words sharing a bound stem can give rise to facilitation effects, this is not due to activation of an independently represented bound stem. The results from their series of experiments confirmed their thesis in that priming between bound stem derivatives was significantly larger compared to both orthographic controls and bound stems presented in isolation (e.g., *terr-* used as a prime for *terrible*, 'terrible'). Such findings would therefore

locate morphological effects at a more central level rather than positing access via a morphemic unit (e.g., *terr-* in their example).

5.5 – Bound stems in the psychological models

While keeping in mind that most part of the findings descripted above comes from studies conducted on English, a few points about the representational status of bound stems can be made. A clear tendency emerging from these studies is that words containing bound stems are perceived as morphologically structured. Both lexical decisions and priming studies highlight this fact since such morphemic units were found to play a role in determining latencies and facilitation effects among pairs sharing them. Such results are, therefore, clearly incompatible with full-listing views assuming no morphological structure at any level. On the other hand, as has been repeatedly pointed out by supporters of different theoretical frameworks (Taft & Forster 1975: 645; Taft 1994: 291; Burani 1990: 109), no clear answer can be formulated concerning the nature of access units. The results seem to be both compatible with sub-lexical accounts, which posit a lower morphemic level where morphemes would be represented and supra-lexical approaches, where words are organized according to morphological families and series, although this level is located above whole-word access units. The only study which seems to be informative to this regard is Giraudo & Voga (2016), which demonstrates that facilitation effects between bound stems presented in isolation and words containing them are smaller than those observed between bound stem derived pairs. This should seemingly rule out the possibility that access proceeds via stems, as equivalent facilitation effects should have been observed otherwise. If we assume priming to reflect pre-activation of a shared stem, there is no reason why prior presentation of the isolated stem should not activate the same stem when presented embedded in a word. Although of course further cross-linguistic confirmation would be needed to verify this claim, this seems a solid attempt to answer the research question presented above. On the other hand, facilitation coming from priming studies where bound stems were not semantically transparent are somewhat at odds with this interpretation, which supports a semantically-based organization of morphological families. It is worth remarking at this point that the studies here

cited considered either prefixed or suffixed bound stems, therefore, there is a possibility that contradictory results originate as a consequence of considering aspects of affixation which might differ from each other (see § 1.3.3.3). On the other hand, the issue of the role of semantic transparency bears some interest on its own, as there is still a possibility that, although located higher above the level of whole-word forms, the morphological organization posited by supra-lexical accounts might be based not solely on meaning, but also on other factors enhancing the salience of morphemic units within the word (e.g., the productivity of a schema, i.e., the number of combinations of stem + possible affixes or the fact that certain morphophonological changes of the stem are shared in derived nominalizations across words presenting that stem).

5.6 – Rationale for experiments 3 & 4

After these preliminaries, we propose here to concentrate on the issue of bound stem processing taking separately into consideration prefixed and suffixed stems, given the different characteristics they appear to have in Italian.

A first general question pertains to whether derivatives with free and bound stems can induce similar facilitation effects in a masked priming experiment. Given the scarcity of studies investigating languages other than English, we propose to verify this claim in Italian, in which the phenomenon is largely found. To this aim, we compare the priming effects induced by both free and bound stem derivatives. The issue of bound stem processing is further developed by testing semantically opaque stems, in order to understand whether semantics can be disposed of at early stages of processing or not. Since sub-lexical approaches posit priming effects to arise at early stages of processing irrespective of shared semantics, facilitation should be observed with prefixed bound stem stimuli, despite their lack of shared meaning.

Caution will be needed with the interpretation of results, given that, as we have discussed, the semantic characteristics of bound stems tend to coincide with different affix types, namely, opaqueness with prefixation and transparency with suffixation. Potential differing patterns of results might, therefore, be interpreted on the basis of either affixal differences or semantic factors. For this reason, exploitation of prefixed and suffixed derived words with free stems in both

experiments will be crucial for the understanding of how the effects of these two aspects of processing might be disentangled. On the other hand, if no such differences emerge, we can safely conclude that neither stem type, affix type nor semantics affect processing.

As far as L2 processing is concerned, the present study proposes to investigate the issue of bound stem processing for the first time. The research fits into the more general question relating to the existence of potential differences between the mechanisms underlying L1 and L2 processing. A further development is constituted by the fact that bound stems seem particularly interesting to provide insights about the relative contribution of form to morphological processing in non-native speakers. For a start, bound stems might be less easily perceived, given that they can never appear in isolation as autonomous words. The association of a stable meaning even for those suffixed stems in which semantics can be predicted on the basis of second-order schemas (§ 5.3.2) might be less straightforward for L2 speakers, should schemas for them be underdeveloped due to smaller vocabulary size. On the other hand, stronger reliance on form might translate into priming effects arising among words presenting semantically empty stems, where formal overlap might be enough to trigger facilitation. In order to evaluate whether such potential effects are due to overreliance on form or the result of a process of picking up regularities in the L2 input, the comparison with L1 performances and, crucially, the effects induced by simple orthographic controls will be determining. The study, therefore, aims at providing deeper insights into the question how form and morphology might be disentangled in L2 processing.

Chapter 6 – Experiments 3 & 4

Experiments 3 and 4 focus on the processing of words with bound stems. Both kinds of bound stems discussed in the previous section will be explored, albeit presented separately in two different experiments. Given the prevalence of semantically opaque bound stems in prefixed verbs as opposed to semantically more interpretable stems in suffixed derived words, we chose to explore the two separately from each other, as claims about the existence of potential asymmetries between prefixation and suffixation cannot be easily dismissed on the basis of the existing data (see § 1.3.3.3). Keeping in mind that direct comparisons between the two cannot be drawn, the first general aim of both experiments is to observe whether primes containing both bound and free stems trigger significant morphological facilitation on the recognition of targets sharing the same stems. Even if no recognizable constituent can be isolated in words with bound stems, we can anticipate that, if words are indeed organized in terms of paradigmatic morphological series, we should be able to observe morphological priming, at least when consistent semantics is provided. Within the theoretical framework discussed above, connections among words are formed without the need for decomposition into constituent parts, and shared parts which hold a constant relation between form and meaning should be meaningful enough to emerge even if they cannot occur in isolation.

The peculiarity inherently present in bound stems forced us to use derived words as primes and targets, given that presenting bound stems in isolation would mean presenting non-words[63]. This choice should not be problematic since Giraudo & Grainger (2001) clearly demonstrated that facilitation effects arise even when both primes and targets are derivatives. The same criterion has been applied to free stems, in order to make sure that we are dealing with comparable effects.

A further step into the understanding of bound stem processing is represented by Experiment 4, which is concentrated on the processing of bound stems which are

[63] This choice is, however, possible even when dealing with words, presenting for example bound stems in isolation: not as targets on which lexical decision must be performed, but as primes; see, e.g., experiments 2 and 3 of the study by Giraudo & Voga (2016).

opaque in their semantics. We investigate whether such bound stems are able to trigger morphological facilitation despite their semantic emptiness and whether this effect can be truly conceived as morphological or cannot be distinguished from formal effects.

6.1 – Experiment 3

6.1.1 – Stimuli and design

In Experiment 3, we concentrated on suffixed words containing bound stems which are semantically interpretable on the basis of other words they appear in. As we have anticipated, the design for this experiment features derived words for both primes and targets in the morphological condition (e.g., *terrore – terribile* 'terror – terrible'). 36 suffixed words containing bound stems were selected as targets for the bound stem set. In order to ensure that the chosen design does not affect priming patterns, we also added a free stem set, with derived primes and targets sharing the same free stem (e.g., *giornalista – giornalismo* 'journalist – journalism'). Four priming conditions were included in the experiment: identity, morphological, orthographic, and unrelated. The design of Experiment 3 is summarized in the table below:

CONDITION	FREE STEM	BOUND STEM
Identity	giornalismo/GIORNALISMO 'journalism/JOURNALISM'	terrore/TERRORE 'terror/TERROR'
Morphological	giornalista/GIORNALISMO 'journalist/JOURNALISM'	terribile/TERRORE 'terrible/TERROR'
Orthographic	giocare/GIORNALISMO '(to) play/JOURNALISM	terrazza/TERRORE 'terrace/TERROR'
Unrelated	edificio/GIORNALISMO 'building/JOURNALISM'	recita/TERRORE 'performance/TERROR'

Table 17 – Experimental design of experiment 3

Some criteria were followed in the selection of items to be used as critical items. Firstly, given that the design required two suffixed words with the same stem, we had to discard those bound stems which only appear in one word (e.g., *pernicioso*

'pernicious'), since at least two members of the same morphological family were needed. With this regard, a clarification is necessary: we did not consider the whole morphological families of words, but only those members in which the root coincides with the base of derivation. In other terms, we did not consider *terribilmente* ('terribly') as a candidate for either the prime or the target since its base of derivation (*terribile*) is not bound. Therefore, we only chose those words where we are left with a bound morpheme when removing the suffix (*terr-ibile*). Another criterion at the basis of the selection of materials was connected to the semantic relatedness between the prime-target pairs. In the vast majority of cases the meaning of the shared bound stem is fairly constant in suffixed words, probably due to the fact that many of them are noun-adjective (such as the above mentioned *terrore – terribile* example) pairs. However, cases of semantic opacity are to be found even in suffixed bound stems, such as in the pair *collettivo – collezione* ('collective – collection'), in which, although the two words derive from the same Latin stem *collĭgere*, only a vague semantic association can be established. Such instances of weaker semantic connections were excluded from this first experiment with bound stems.

As for the free stem set, we selected 36 suffixed word pairs sharing the same free stem (e.g., *giornalismo – giornalista*, 'journalism – journalist'), trying, when possible, to use the same range and numbers of suffixes of the bound stem set. Two additional sets of 72 (36 + 36) orthographic and unrelated items were also selected. All primes were matched for frequency and length, with frequency being given priority (t-tests between frequency values indicated no significant differences: bound stem set: morphological – orthographic: $t(35) = 0.33$, $p = .738$; morphological – unrelated: $t(35) = .18$, $p = .856$; free stem set: morphological – orthographic: $t(35) = 0.89$, $p = .375$; morphological – unrelated: $t(35) = -0.58$, $p = .562$). Mean values are indicated in Table 18:

	Overall	
Prime type	**Frequency**	**Length**
Identity	3.87 (0.56)	9.1 (1.6)
Morphological	3.67 (0.53)	8.8 (1.6)

Orthographic	3.63 (0.52)	7.9 (1.5)
Unrelated	3.68 (0.48)	7.8 (1.3)
	Bound stem set	
Prime type	**Frequency**	**Length**
Identity	3.78 (0.53)	8.5 (1.4)
Morphological	3.61 (0.55)	8.3 (1.4)
Orthographic	3.57 (0.58)	7.4 (1.4)
Unrelated	3.60 (0.52)	7.4 (1.1)
	Free stem set	
Prime type	**Frequency**	**Length**
Identity	3.95 (0.58)	9.7 (1.7)
Morphological	3.73 (0.51)	9.4 (1.6)
Orthographic	3.68 (0.45)	8.3 (1.5)
Unrelated	3.76 (0.42)	8.1 (1.5)

Table 18 - Experiment 3: mean item frequency and length values (SD in brackets)

Finally, 72 non-word prime-target pairs were created using a combination of a non-existing stems + existing suffixes (*grafalico – grafalismo*). For each target, the correspondent identity, orthographic and unrelated primes were created, in order to have overall four lists with 144 targets (72 words + 72 non-words) each.

6.1.2 – Method

6.1.2.1 – Participants

47 native speakers of Italian, aged from 23 to 36 years (mean age: 26.6) and 35 learners of Italian[64], aged from 24 to 37 (mean age: 27.6), who were living in Italy at the time of testing, participated in the experiment on a voluntary basis. They all had normal or corrected-to-normal vision and a high-school or university educational background. The proficiency level of non-native participants was self-assessed (proficiency levels ranging from B2 to C1 of the Common European

[64] As with the previous experiments, participants had different L1 backgrounds: French (7), Spanish (5), English (3), German (6), Bulgarian (2), Romanian (6), Russian (6).

Framework for Languages) with ratings given on: written production, oral production, listening and reading comprehension. None of the ratings on single abilities was below B2 (Vantage). Participants were recruited among students at the University of Verona (where non-native students need to have at least a B2 certificate to be enrolled) or in private schools of Italian in Italy (in upper-intermediate or advanced courses). None of the L2 participants reported being bilingual.

6.1.2.2 – Procedure

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 144 items in two blocks.

6.1.3 – Results

6.1.3.1 – L1: results and data analysis

Data were cleaned considering accuracy rates for participants and items: since all participants and items showed accuracy rates higher than the established (70%), none of them was excluded at this stage. Incorrect responses and timeouts were removed (1.95%) and only correct responses to word trials were analysed. RTs that were two standard deviations above or below the mean were treated as outliers and consequently removed (4.40%). Remaining data were entered into by-subject and by-items ANOVAs, with Prime Type and Stem Type as within-participants factors in the subject analysis and Prime Type as within- and Stem Type as between-participant factors in the item analysis.

The analysis of reaction times showed a significant main effect of Prime Type ($F1(3,138) = 21.85$, $p < .0001$, $F2(3,210) = 16.43$, $p < .0001$). Stem Type, on the other hand, had no significant main effect ($Fs < 1$) and neither did the interaction of Prime by Stem Type ($Fs < 1$). Average RTs for each set (free and bound) are indicated below:

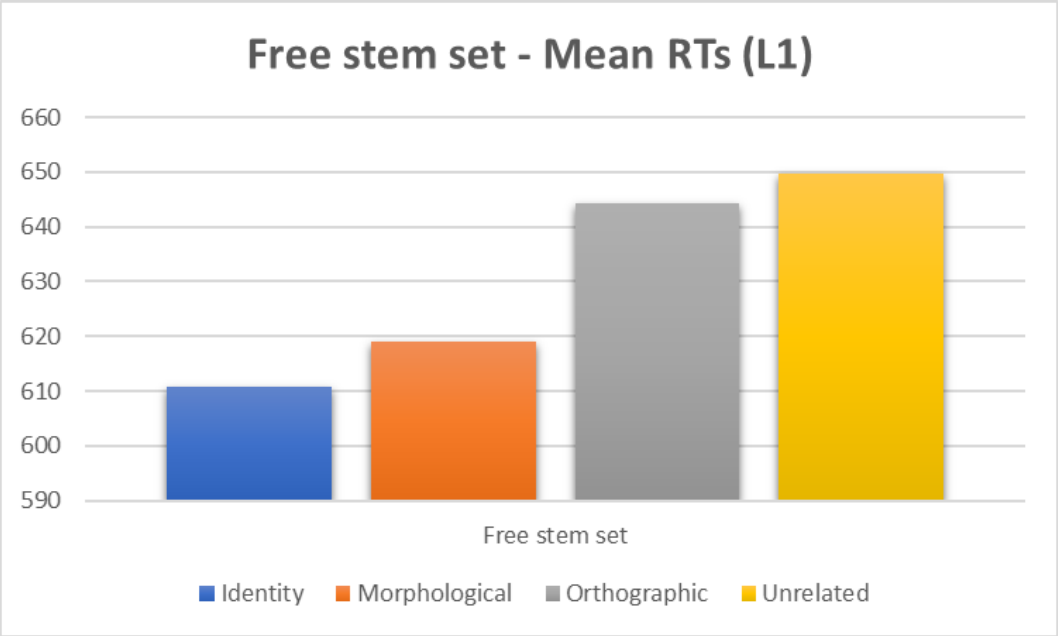

Figure 10 – Experiment 3: mean reaction times for the free stem set (L1)

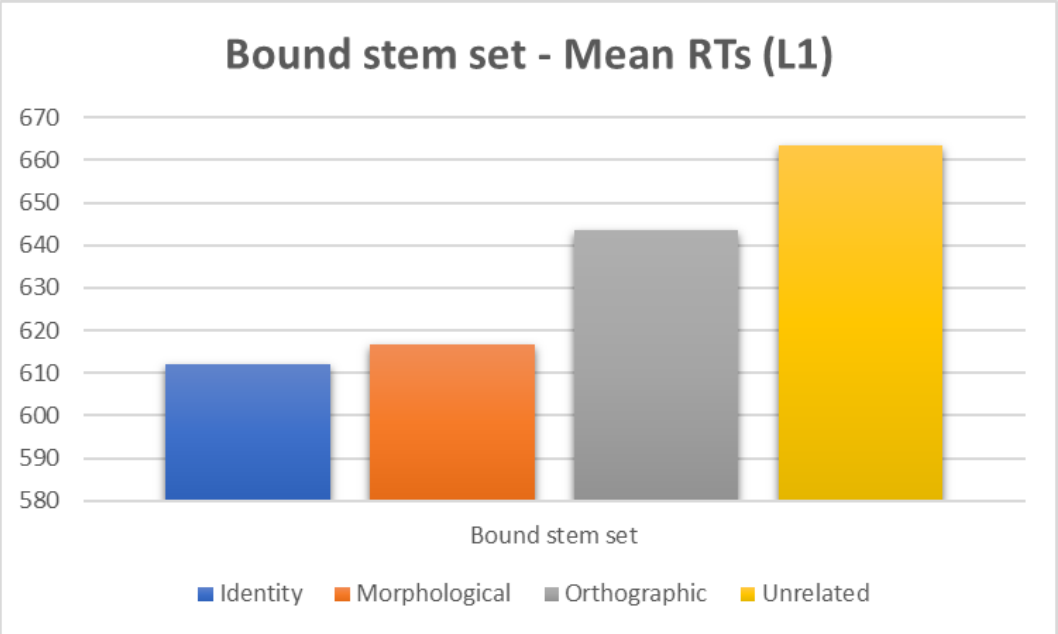

Figure 11 - Experiment 3: mean reaction times for the bound stem set (L1)

Prime Type interacted partially with Stem Type (free stem: $F1(3,138) = 8.49$, $p < .0001$; $F2(3,105) = 7.66$, $p < .001$; bound stem: $F1(3,138) = 21.82$, $p < .0001$; $F2(3,105) = 8.83$, $p < .0001$). Planned comparisons indicated a significant facilitation effect of identity primes on the recognition of the targets, relative to both the unrelated and the orthographic baselines, in both the free (unrelated $F1(1,46) = 30.94$, $p < .0001$; $F2(1,35) = 17.86$, $p < .01$; orthographic: $F1(1,46) = 10.67$, $p < .01$; $F2(1,35) = 7.06$, $p < .05$) and the bound stem set (unrelated $F1(1,46) = 55.23$, $p < .0001$; $F2(1,35) = 20.04$, $p < .0001$; orthographic: $F1(1,46) = 18.93$, $p < .0001$; $F2(1,35) = 7.21$, $p < .05$). Moreover, morphological primes were found to facilitate target recognition in both sets, i.e., independent of stem type. The effect was significantly different from that induced by unrelated (free stem set: $F1(1,46) = 12.07$, $p < .01$; $F2(1,35) = 12.91$, $p < .01$; bound stem set: $F1(1,46) = 41.15$, $p < .0001$; $F2(1,35) = 16.58$, $p < .01$) and orthographic primes (free stem set: $F1(1,46) = 6.14$, $p < .05$; $F2(1,35) = 5.92$, $p < .05$; bound stem set: $F1(1,46) = 12.13$, $p < .01$; $F2(1,35) = 10.43$, $p < .01$).

Net priming effects and significant effects are showed in the table below:

	Prime type	**RTs**	**SD**	**U-I**	**U-M**	**O-M**
Bound stem set terribile – terrore 'terrible – terror'	Identity	612	111	51*	46*	26*
	Morphological	617	110			
	Orthographic	643	118			
	Unrelated	663	106			
Free stem set giornalista – giornalismo 'journalist – journalism'	Identity	611	114	39*	31*	25*
	Morphological	619	109			
	Orthographic	644	132			
	Unrelated	650	112			

Table 19 – Experiment 3: mean reaction times, standard deviations, and net priming effects (L1): *= p < .05.

Given that errors were too few, they were not submitted to statistical analysis. Error rates per condition are summarized in Table 20:

	Prime type	**Error rate**
Bound stem set terribile – terrore 'terrible – terror'	Identity	2.8%
	Morphological	1.9%
	Orthographic	3.3%
	Unrelated	3.1%
Free stem set giornalista – giornalismo 'journalist – journalism'	Identity	0.7%
	Morphological	0.2%
	Orthographic	1.7%
	Unrelated	1.9%

Table 20 – Experiment 3: Error rates per condition (L1)

From the data obtained in this experiment we can draw two main conclusions on native morphological processing: firstly, morphological facilitation effects appear to be quite robust even across paradigms. As was hinted before, even if expected, this result could not be taken for granted based on existing data on Italian. The fact that morphological effects arise between derived prime-target items could point towards an organization of the lexicon which does not necessarily entail only a derivational relationship between base and suffixed word. Secondly, derived words sharing bound stems also appear to be organized along the same lines, given that significant morphological effects were triggered for this set of prime-target items too. This fact further contributes to our knowledge of the morphological organization of the lexicon in that it highlights that there is no need for an isolable morphological element in order to perceive morphological relationships among

words. This further reinforces our belief that base-derivative directionality is not necessarily the only means of organizing words on morphological grounds and provides psychological plausibility for the existence of schemas arising on the basis of derived words.

6.1.3.2 – L2: data analysis and results

In the L2 sample, data cleaning following the procedure described above resulted in the exclusion of five participants, due to accuracy rates falling overall below 70%. Incorrect responses and timeouts (4.4%) were removed and only correct word responses were submitted to analysis. Data points which were two standard deviations above or below the mean reaction time per participant were also excluded (4.68%).

The analysis of reaction times showed a significant main effect of Prime Type ($F1(3,87) = 6.79$, $p < .01$, $F2(3,210) = 7.73$, $p < .0001$). Stem Type had no significant main effect ($Fs < 1$) and neither did the interaction of Prime by Stem Type ($Fs < 1$). Average RTs for each set are indicated in figures 12 and 13:

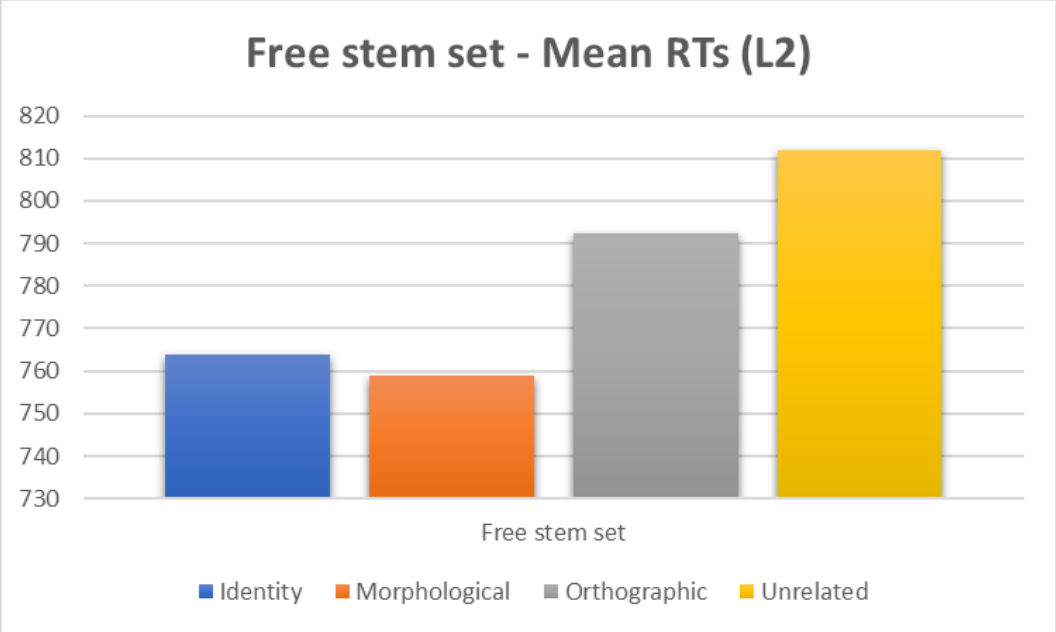

Figure 12 – Experiment 3: mean reaction times for the free stem set (L2)

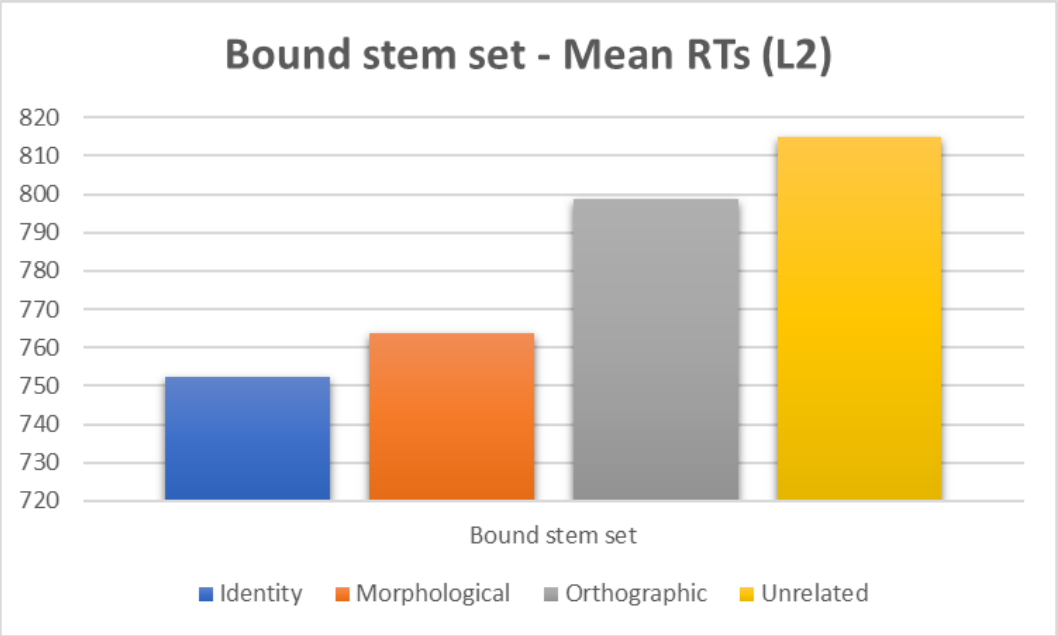

Figure 13 – Experiment 3: mean reaction times for the bound stem set (L2)

Prime Type interacted partially with Stem Type (free stem: $F1(3,87) = 4.50$, $p < .01$; marginally significant in the item analysis, $F2(3,105) = 2.57$, $p = .06$; bound stem: $F1(3,87) = 4.64$, $p < .01$; $F2(3,105) = 5.80$, $p < .01$). In both sets, identity primes triggered faster reaction times compared to the unrelated control condition (free stem set: $F1(1,29) = 6.22$, $p < .05$; $F2(1,35) = 5.61$, $p < .05$; bound stem set: $F1(1,29) = 10.09$, $p < .01$; $F2(1,35) = 12.81$, $p < .01$). Planned comparisons revealed, moreover, a significant effect of morphological primes relative to the unrelated baseline (free stem set: $F1(1,29) = 9.45$, $p < .01$; $F2(1,35) = 5.22$, $p < .05$; bound stem set: $F1(1,29) = 5.97$, $p < .05$; $F2(1,35) = 9.85$, $p < .01$). The effect induced by morphological primes on the recognition of their targets was, however, significant compared to the orthographic baseline only in the free stem set and only by participants ($F1(1,29) = 4.79$, $p < .05$; $F2(1,35) = 2.35$, $p > .10$). While the effects of the orthographic primes did not differ significantly from those registered after the presentation of unrelated primes ($Fs < 1$), they were neither significantly different from those yielded by morphological primes in the bound stem set ($F1(1,29) = 2.75$, $p > .10$; $F2(1,35) = 3.48$; $p > .05$), possibly suggesting that the latter were more likely due to shared form rather than truly perceived morphological relatedness. Net priming effects and significant differences are indicated below:

	Prime type	RTs	SD	U-I	U-M	O-M
Bound stem set terribile – terrore 'terrible – terror'	Identity	752	146	63*	51*	35
	Morphological	764	168			
	Orthographic	799	179			
	Unrelated	815	180			
Free stem set giornalista – giornalismo 'journalist – journalism'	Identity	764	171	48*	53*	34*
	Morphological	759	169			
	Orthographic	793	169			
	Unrelated	812	198			

Table 21 – Experiment 3: mean reaction times, standard deviations, and net priming effects (L2): *= p < .05.

The analysis of error rates (on which an arcsine transformation was performed prior to analysis) highlighted a significant main effect of Prime Type ($F1(3,87) = 2.47$, $p = .06$; $F2(3,210) = 2.70$, $p < .05$). Detailed inspection of partial interactions revealed that the effect of Prime Type was significant in the bound stem set ($F1(3,87) = 2.77$, $p < .05$; marginally significant in the item analysis, $F2(3,105) = 2.15$, $p = .09$), where the identity condition induced fewer errors with respect to the orthographic ($F1(1,29) = 4.56$, $p < .05$; nearly significant in the item analysis, $F2(1,35) = 3.82$, $p = .05$) and the unrelated (($F1(1,29) = 6.63$, $p < .05$; $F2(1,35) = 4.51$, $p < .05$) conditions. Error rates (in raw percentages) per condition are given in Table 22:

	Prime type	Error rate
Bound stem set terribile – terrore	Identity	2.6%
	Morphological	3.7%

'terrible – terror'	Orthographic	6.3%
	Unrelated	6.7%
Free stem set giornalista – giornalismo 'journalist – journalism'	Identity	4.1%
	Morphological	2.6%
	Orthographic	5.9%
	Unrelated	3.7%

Table 22 – Experiment 3: error rates per condition (L2)

The data for L2 speakers cannot be satisfyingly interpreted within the perspective depicted above for native speakers. For a start, the failure to obtain significant morphological effects with bound stem prime-target pairs relative to the orthographic control condition cannot fully support the hypothesis that morphological paradigms drive lexical organization in non-native mental lexicon. While priming was significant relative to the unrelated baseline, the non-significant difference between the morphological and the orthographic condition could likely indicate that this facilitation effect was actually determined by the orthographic similarity between morphological primes and targets. Even if orthographic primes failed to trigger significant facilitation effects as compared to the unrelated primes, the difficulty to match the degree of orthographic overlap (i.e., the overlap between morphological primes and targets and that between orthographic primes and targets) in a language like Italian could explain why we only observed priming with morphological primes. In other words, morphological primes could have benefited from maximal orthographic overlap with the targets rather than from their morphological nature. On the other hand, the fact that a significant effect was observed relative to the orthographic condition in the free stem set could be hinting at a more relevant role for the isolability of the stem in non-native processing. To elaborate, a possible explanation for the present data could view isolable stems as more salient elements in second language processing. Words with bound stems, on the other hand, could be more perceived as only orthographically similar words and not be viewed as having an internal morphological structure.

6.2 – Experiment 4

6.2.1 – Design and selection of materials

Experiment 4 investigated further the processing of words containing bound stems, expanding its scope to the exploration of those stems in which a recognizable semantics is lacking, even on the basis of other words in which the same stem is contained. As we have discussed above (§ 5.2.2), the majority of such semantically empty bound stems can be found in Italian in prefixed verbs and, therefore, critical items were selected from this domain of derivation. As was done with Experiment 3, a set of prime-target pairs sharing a free stem was also added, to make sure we can interpret results correctly. This seemed even more necessary in this experiment, since the vast majority of studies on morphological processing is conducted on suffixation rather than prefixation, and consequently, we could not safely assume that two prefixed verbs would prime each other even in less opaque conditions, i.e., when the stem can also freely occur in isolation and is more semantically interpretable. The experimental design is summarized in the table below:

CONDITION	FREE STEM	BOUND STEM
Identity	rivedere/RIVEDERE ‘(to) see again/(TO) SEE AGAIN’	resistere/RESISTERE ‘(to) resist/(TO) RESIST’
Morphological	prevedere/RIVEDERE ‘(to) foretell/(TO) SEE AGAIN’	consistere/RESISTERE ‘(to) consist/(TO) RESIST’
Orthographic	scendere/RIVEDERE ‘(to) go down/(TO) SEE AGAIN’	smettere/RESISTERE ‘(to) stop/(TO) RESIST’
Unrelated	stabilire/RIVEDERE ‘(to) establish/(TO) SEE AGAIN’	tracciare/RESISTERE ‘to trace/(TO) RESIST’

Table 23 – Design of Experiment 4

The materials comprise 36 prefixed prime-target pairs containing a bound stem (*consistere – resistere*, 'to consist – to resist') and 36 prefixed prime-target pairs containing a free stem (*rifare – disfare*, 'to do again – to undo').

In the selection of the prefixed verbs sharing a bound stem, we only included those verbs where the semantics of the lexical root was not preserved, so as to ensure that no stable association of meaning between the members of the pair was possible. Therefore, we did not include opposites such as *intricare – districare* ('to entangle – to disentangle'), in which the meaning of *-tricare* can be inferred from its presence in a pair of antonyms. On the other hand, the reverse was done for the free stem set, where we strived to select only those pairs where the semantic nucleus remained stable. In this regard, it is necessary to clarify that this did not always coincide with perfect semantic compositionality of the prefix-base combination. Even if this was sought for, it was not always possible to find verbs where both the base and the prefix were semantically transparent. This issue is intimately tied to the concept of productivity, i.e., the likelihood to create new words with a given element. While prefix transparency is acknowledged to be linked to its degree of productivity (Iacobini 2004), it is not always the case that the combination of a productive prefix and a transparent base results in a semantically transparent derivative, as was discussed in § 5.2.2. For instance, it is somewhat hard to recognize the temporal meaning of the productive prefix *pre-* in *prescrivere* ('to prescribe'). On the other hand, the meaning of the verb *esportare* ('to export') seems to be compositionally clearer despite the presence of the unproductive prefix *ex-*. In other terms, the global semantic transparency of a word may not necessarily go hand in hand with either prefix transparency or productivity[65]. Since in this experiment we do not aim at

[65] «All'interno dei prefissi non produttivi ce ne sono alcuni il cui significato è conosciuto dai parlanti o facilmente ricavabile dalle parole in cui compare (es. *contra-, estro-, fra-),* per altri è possibile individuare un gruppo di parole in cui il prefisso esprime un significato identificabile (si pensi al valore locativo "attraverso" di *per-* in *percorrere, percutaneo, perforare)* mentre l'apporto semantico del prefisso nelle altre parole non è sistematizzabile in modo coerente (cfr. *perdere, perdonare, persuadere).* Vi sono poi altri prefissi a cui non è possibile attribuire un significato costante in sincronia a partire dalle parole in cui compaiono (es. *ob-*, cfr. *occludere, occorrere, offrire, opporre, osservare, ottenere),* ma che possono essere riconosciuti grazie all'esistenza di verbi che hanno le stesse basi e diversi prefissi (cfr. *concludere / precludere, concorrere / decorrere, comporre /*

making any specific claim about the perception of prefixes, but we instead focus on the base, we decided to favour the semantic transparency of the latter.

Each target was paired with its correspondent identity, orthographic and unrelated primes, in order to have four experimental lists with 72 target verbs (36+36), preceded by one of the primes in the four conditions. Differently from the previous experiments, orthographic primes were here matched to their targets by ensuring that the overlap occurred in the final part of the word, as was the case with morphologically related prime-target pairs. As in all of the above experiments priority was given to matching for frequency (t-tests between frequency values indicated no significant differences, except for the unrelated mean frequency in the bound stem set, that differed significantly from the mean frequency of morphological primes: bound stem set: morphological – orthographic: $t(35) = -0.81$, $p = .423$; morphological – unrelated: $t(35) = -2.92$, $p = .006$; free stem set: morphological – orthographic: $t(35) = 0.85$, $p = .398$; morphological – unrelated: $t(35) = 1.40$, $p = .170$) and length was controlled too, so that primes differed of a maximum of two letters whenever possible, as summarized in the table below:

	Overall	
Prime type	**Frequency**	**Length**
Identity	3.58 (0.61)	9.2 (1.3)

deporre, conservare / riservare, contenere / trattenere)» (Iacobini 2004: 110). [Among non-productive prefixes there are some whose meaning is known by speakers or can be easily inferred from the words in which they appear (e.g., *contra-*, *estro-*, *fra-*), for others it is possible to find groups of words in which the prefix conveys an identifiable meaning (consider the locative value "through" of *per-* found in *percorrere* 'to walk along', *percutaneo* 'percutaneous', *perforare* 'to pierce'), while its semantics cannot be consistently systematized in other words (see *perdere* 'to lose', *perdonare* 'to forgive', *persuadere* 'to persuade'). There are also other prefixes for which a constant meaning cannot be found synchronically on the basis of the words in which they appear (e.g., *ob-*, see *occludere* 'to obstruct', *occorrere* 'to be necessary', *offrire* 'to offer', *opporre* 'to oppose', *osservare* 'to observe', *ottenere* 'to obtain'), but can be recognized because of other verbs sharing the same bases and different prefixes (see *concludere*/*precludere* 'to conclude/to preclude', *concorrere*/*decorrere* 'to concur/to take effect', *comporre*/*deporre* 'to compose/to lay down', *conservare*/*riservare* 'to conserve/to reserve', *contenere*/*trattenere* 'to contain/to keep').]

Morphological	3.34 (0.61)	9.1 (1.3)
Orthographic	3.34 (0.59)	8.3 (1.4)
Unrelated	3.36 (0.58)	8.3 (1.1)
	Bound stem set	
Prime type	**Frequency**	**Length**
Identity	3.81 (0.59)	9.1 (1.2)
Morphological	3.38 (0.49)	8.8 (1)
Orthographic	3.43 (0.47)	8.3 (1.3)
Unrelated	3.45 (0.48)	8.2 (1.1)
	Free stem set	
Prime type	**Frequency**	**Length**
Identity	3.35 (0.55)	9.3 (1.5)
Morphological	3.30 (0.72)	9.3 (1.5)
Orthographic	3.24 (0.68)	8.2 (1.6)
Unrelated	3.26 (0.65)	8.4 (1.1)

Table 24 – Experiment 4: mean item frequency and length values (SD in brackets)

Finally, 72 non-word prime-target pairs were created using a combination of a non-existing roots + existing prefixes (e.g., *confisiare – refisiare*). For each target, the corresponding identity, orthographic and unrelated primes were created, in order to have overall four lists with 144 targets (72 words + 72 non-words) each.

6.2.2 – Method

6.2.2.1 – Participants

The same population participating in Experiment 3 also took part in this experiment.

6.2.2.2 – Procedure

The procedure was exactly the same of Experiment 3. Since the same participants participated in both studies, they were offered a long break between the two. No previously presented item was repeated in this experiment.

6.2.3 – L1: Data analysis and results

Data were cleaned considering accuracy rates for participants and items: since all participants and items showed accuracy rates higher than 70%, none of them was excluded. Incorrect responses and timeouts were removed (2.45% of data points) and only correct responses to word trials were analysed. RTs that were two standard deviations above or below the mean were treated as outliers and consequently removed (4.67%). Remaining data were entered into by-subject and by-items ANOVAs, with Prime Type and Stem Type as within-participants factors in the subject analysis and Prime Type as within- and Stem Type as between-participant factors in the item analysis.

The main effect of Prime Type was significant ($F1(3,138) = 10.70$, $p < .0001$, $F2(3,210) = 9.19$, $p < .0001$) and so was that of Stem Type ($F1(1,46) = 31.69$, $p < .0001$; marginally significant in the item analysis, $F2(1,70) = 3.86$, $p = .05$). Overall, verbs containing a bound stem were responded to faster (669 ms vs 694 ms), as could be expected given that they were on average more frequent than those of the other set. The interaction of the two factors was not significant ($F1(3,138) = 1.07$, $p > .10$; $F2(3,210) = 0.80$, $p > .10$). Average RTs for each set (free and bound) are indicated in figures 14 and 15:

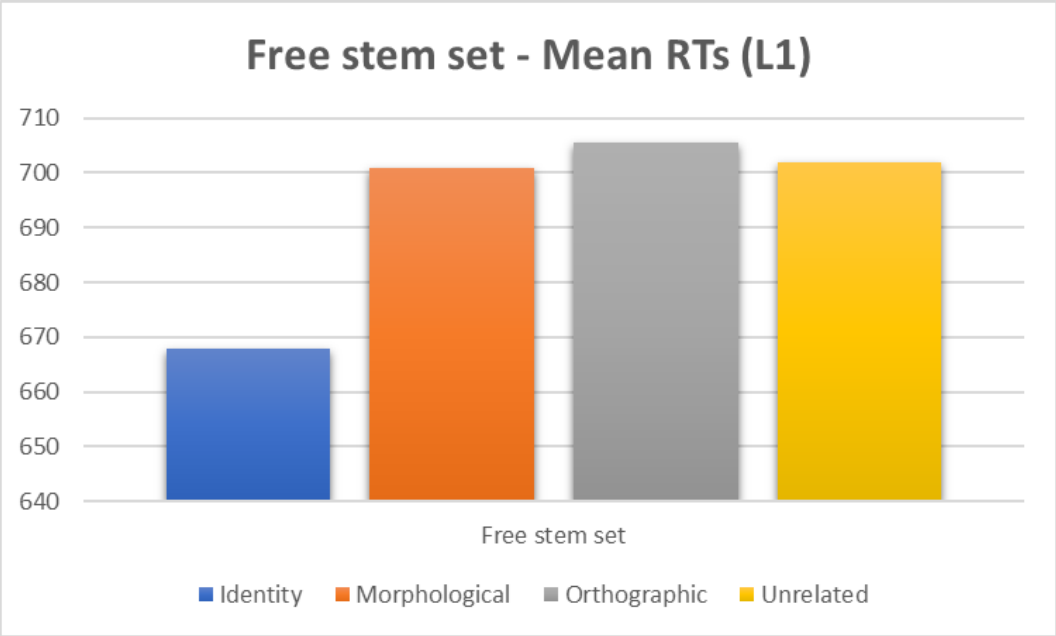

Figure 14 – Experiment 4: mean reaction times for the free stem set (L1)

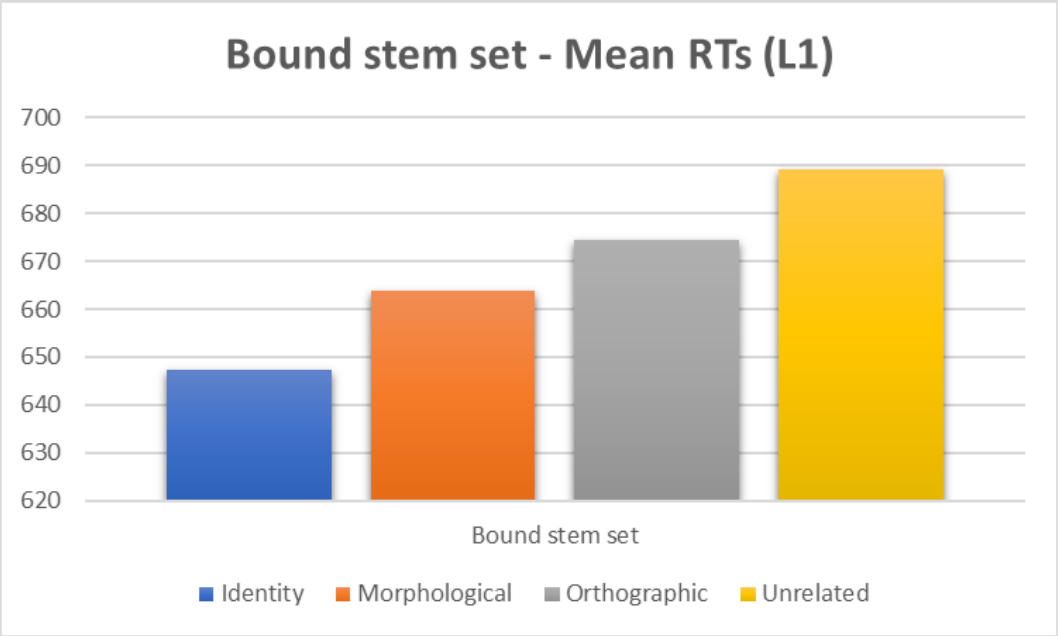

Figure 15 – Experiment 4: mean reaction times for the bound stem set (L1)

Prime Type interacted partially with Stem Type (free stem: $F1(3,138) = 5.09$, $p < .01$; $F2(3,105) = 4.07$, $p < .01$; bound stem: $F1(3,138) = 6.76$, $p < .001$; $F2(3,105) = 6.21$, $p < .001$). Planned comparisons were run for the two stem types (free and bound). In the free stem set, the identity condition triggered fastest responses and this effect was significant relative to the unrelated ($F1(1,46) = 9.00$, $p < .01$; $F2(1,35) = 8.71$, $p < .01$) and the orthographic baseline ($F1(1,46) = 9.38$, $p < .01$; $F2(1,35) = 6.85$, $p < .05$). Moreover, reaction times in this condition were also faster than those in the morphological condition ($F1(1,46) = 13.16$, $p < .01$; $F2(1,35) = 6.98$, $p < .05$). Response times after presentation of morphological primes were not significantly different from either the unrelated or the orthographic condition (all $Fs < 1$), and neither did those in the orthographic condition relative to the unrelated condition ($F < 1$). Planned comparisons for the bound stem set show a slightly different picture for this level of Stem Type. Identity primes triggered fastest latencies also in this set, relative to the unrelated ($F1(1,46) = 17.52$, $p < .01$; $F2(1,35) = 14.70$, $p < .01$) and the orthographic condition ($F1(1,46) = 12.06$, $p < .01$; $F2(1,35) = 6.79$, $p < .05$). The effect was also marginally significant compared to that of the morphological condition ($F1(1,46) = 2.97$, $p = 0.9$; $F2(1,35) = 3.15$, $p = 0.8$). Morphological primes, on the other hand, triggered significantly faster responses compared to the unrelated condition ($F1(1,46) = 5.46$, $p < .05$; $F2(1,35)$

= 6.65, p < .05), while they failed to do so relative to the orthographic baseline (F1(1,46) = 1.30, p > .10; F2(1,35) = 2.22, p > .10). Net priming effects and significant differences are indicated in the table below:

	Prime type	RTs	SD	U-I	U-M	O-M
Bound stem set consistere – resistere '(to) consist – (to) resist'	Identity	647	108	42*	25*	11
	Morphological	664	113			
	Orthographic	674	106			
	Unrelated	689	108			
Free stem set prevedere – rivedere '(to) foretell – (to) see again'	Identity	668	124	34*	1	5
	Morphological	701	119			
	Orthographic	706	114			
	Unrelated	702	115			

Table 25 - Experiment 4: mean reaction times, standard deviations, and net priming effects (L1); *= p < .05.

Errors were not submitted to statistical analysis because of their low number. Error rates are given in Table 26:

	Prime type	Error rate
Bound stem set consistere – resistere '(to) consist – (to) resist'	Identity	1.1%
	Morphological	0.9%
	Orthographic	3.1%
	Unrelated	2.7%

Free stem set prevedere – rivedere '(to) foretell – (to) see again'	Identity	1.3%
	Morphological	3.1%
	Orthographic	3.6%
	Unrelated	2.7%

Table 26 – Experiment 4: error rates per condition (L1)

While the focus of this study was on the processing of bound stems, it was somewhat surprising to find no morphological effect in the set composed of words containing free stems. As was mentioned before, it is worth noticing, however, that masked priming studies on morphological processing have mainly concentrated on suffixation rather than prefixation. Moreover, the most common design in such studies consists in the presentation of derived prime stimuli and base targets, or (seldom) the reverse design, but it is rarely the case that two prefixed words are presented as both primes and targets (but see the studies by Marslen-Wilson et al. 1994; Meunier & Segui 2002 with a cross-modal design and Pastizzo & Feldman 2004 with a visual masked priming). We wonder therefore whether the failure to find a facilitation effect with prefixed free stem verbs might be due to the peculiarity of the design we used. Before entering into the details of such an explanation, however, the possibility that some inherent characteristics of the items selected for the experiment might have played a role in the observed results must be taken into consideration. Following the path indicated by the studies by Forster & Azuma (2000) and Pastizzo & Feldman (2004), which highlighted the effects of morphological family size, we checked our data relative to this variable. Specifically, we limited our count to all the possible prefix-root combinations that simple verbs can go into. The correlation test between this count and the net priming effect of each prime-target pair in the item analysis highlighted an interesting result concerning free stem data: a significant negative correlation was found between the number of possible base verb-prefix combinations and the size of net priming effects triggered by morphological primes, both relative to the orthographic ($r = -0.48$; $p < .01$) and the unrelated ($r = -0.37$, $p < .05$) baselines. Notably, no such correlations were found in the bound stem set (in line with the findings of Pastizzo

& Feldman 2004). If we consider only free stems with a small family size, a numerical facilitation of 24 ms emerges relative to the unrelated condition and a significant +27 ms effect ($p < .05$) is observed relative to the orthographic baseline. The implications of such observations, which might at first sight seem puzzling, will be discussed thoroughly in § 6.3.1.

As for verbs with bound stems, the presence of a significant facilitation relative to the unrelated baseline is certainly relevant and in line with the results of previous studies on the topic. However, it must be noted that such an effect did not significantly differ from that triggered by the orthographic condition. The findings of Experiment 3, therefore, were not paralleled here, because distinguishing morphological from orthographic effects was not possible in Experiment 4. Such results seem to point thus towards the possibility that the observed effects were actually due to the formal similarity between morphological primes and targets rather than a morphological relationship *per se*.

6.2.4 – L2: Data analysis and results

As for L2 data, cleaning procedures led to the exclusion of five participants (the same excluded in the previous experiment), due to accuracy rates falling overall below 70%. Incorrect responses and timeouts (4.53%) were removed and only correct word responses were submitted to analysis. Data points which were two standard deviations above or below the mean reaction time per participant were also excluded (3.98%).

The main effect of Prime Type was significant ($F1(3,87) = 7.69$, $p < .01$, $F2(3,210) = 5.81$, $p < .01$) and so was that of Stem Type ($F1(1,29) = 46.23$, $p < .0001$; $F2(1,70) = 9.49$, $p < .01$). Overall, as with native speakers, verbs containing a bound stem were responded to faster (856 ms vs 909 ms). The interaction of the two factors was not significant ($F1(3,87) = 1.77$, $p > .10$; but it approached significance in the item analysis, $F2(3,210) = 2.44$, $p = .07$). Average RTs for the two separate sets are indicated in figures 16 and 17:

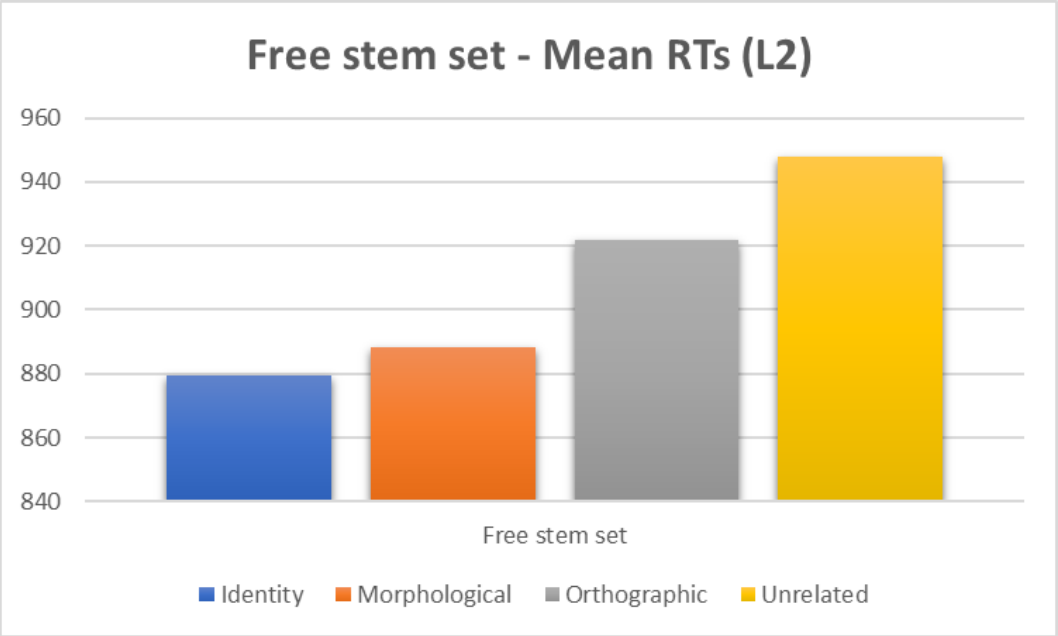

Figure 16 - Experiment 4: mean reaction times for the free stem set (L2)

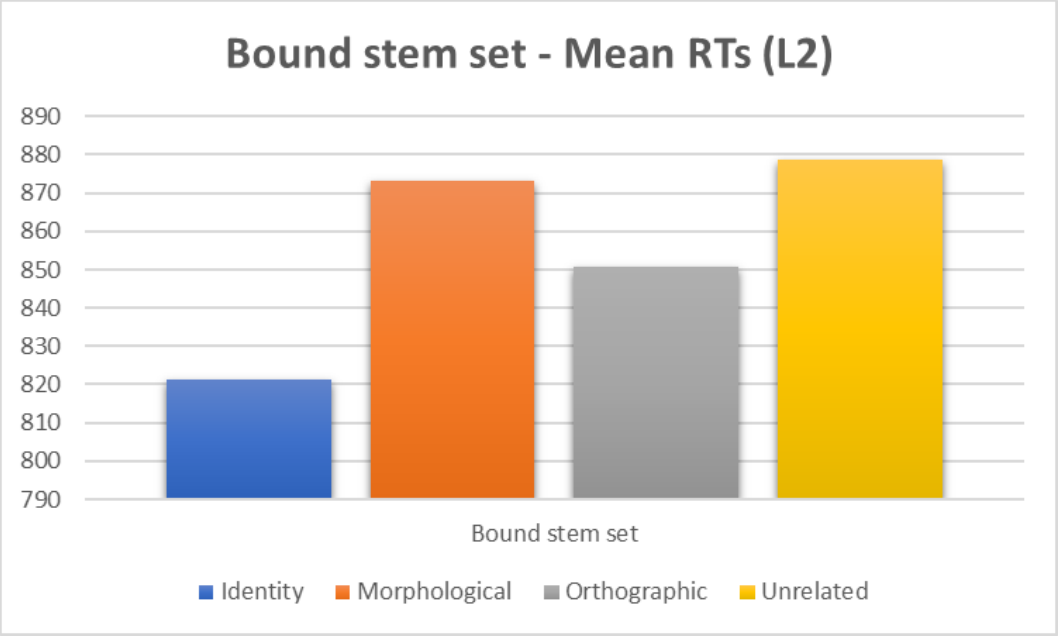

Figure 17 - Experiment 4: mean reaction times for the bound stem set (L2)

Prime Type was found to interact partially with Stem Type (free stem: $F1(3,87) = 4.27$, $p < .01$; $F2(3,105) = 4.68$, $p < .01$; bound stem: $F1(3,87) = 5.11$, $p < .01$; $F2(3,105) = 3.44$, $p < .05$). Planned comparisons showed that in the free stem set, the identity condition triggered fastest reaction times as compared to those induced by unrelated items ($F1(1,29) = 9.21$, $p < .01$; $F2(1,35) = 14.23$, $p < .01$). Morphological primes also induced a significant facilitation effect relative to this

baseline (F1(1,29) = 5.79, p < .05; F2(1,35) = 8.51, p < .01). However, such effects seem most likely to be formal given that no significant difference existed in the subject analysis between this condition and the orthographic one, while a tendency was observed in the item analysis (F1(1,29) = 2.76, p > .10; F2(1,35) = 3.99, p = .05). Reaction times after orthographic primes, on the other hand, despite showing a numerical trend (+26 ms), did not differ significantly from the unrelated baseline (F1(1,29) = 1.63, p > .10; F2(1,35) = 1.48, p > .10).

As for the bound stem set, a different pattern of effects emerged: identity primes induced facilitation which was significant against the unrelated condition (F1(1,29) = 10.92, p < .01; F2(1,35) = 6.53, p < .05), as in the free stem set, but also compared to the morphological condition, for which reaction times were slower (F1(1,29) = 8.65, p < .01; F2(1,35) = 9.98, p < .01). In this condition, moreover, response times did not differ significantly neither from those in the unrelated (F1(1,29) = 0.10, p > .10; F2(1,35) = 0.00, p > .10), nor from those induced by the orthographic condition (F1(1,29) = 1.86, p > .10; F2(1,35) = 1.95, p > .10).

Net priming effects and significant differences are showed in Table 27:

	Prime type	**RTs**	**SD**	**U-I**	**U-M**	**O-M**
Bound stem set consistere – resistere ‘(to) consist – (to) resist’	Identity	821	234	57*	5	-22
	Morphological	873	250			
	Orthographic	851	200			
	Unrelated	879	244			
Free stem set prevedere – rivedere ‘(to) foretell – (to) see again’	Identity	879	231	69*	60*	34
	Morphological	888	235			
	Orthographic	922	247			
	Unrelated	948	273			

Table 27 – Experiment 4: mean reaction times, standard deviations, and net priming effects (L2); *= p < .05.

The analysis of errors (on whose proportions an arcsine transformation was performed prior to analysis) revealed a significant effect of Stem Type ($F1(1,29) = 9.06$, $p < .01$; nearly significant in the item analysis, $F2(1,70) = 2.88$, $p = .09$), while the effect of Prime was not fully reliable (marginally significant in the subject analysis and not significant in the item analysis, $F1(3,87) = 2.45$; $p = .07$; $F2 < 1$) and neither was the interaction of the two factors (all $Fs < 1$). Overall, there were fewer errors in the bound stem set (3.52% vs 5.56%). Error rates (in raw percentages) are given in the table below:

	Prime type	**Error rate**
Bound stem set consistere – resistere '(to) consist – (to) resist'	Identity	2.6%
	Morphological	3.3%
	Orthographic	3%
	Unrelated	5.2%
Free stem set prevedere – rivedere '(to) foretell – (to) see again'	Identity	4.4%
	Morphological	5.6%
	Orthographic	7.4%
	Unrelated	4.8%

Table 28 - Experiment 4: error rates per condition (L2)

The results of non-native speakers reveal an opposite trend when compared to those of native participants: prefixed free stem primes appeared to facilitate the recognition of their targets relative to the unrelated baseline. However, consistent with what observed for native speakers, reaction times in the morphological condition did not differ significantly from those registered in the orthographic

condition, suggesting that the effect was possibly due to the formal overlap between primes and targets. Bound stem primes, on the other hand, clearly failed to facilitate target recognition. While the inconsistencies between such results and those found with native speakers will be discussed in the next section, it is important to highlight here that these results are in line with those of Experiment 3 and, taken together, seem to reveal that lack of base autonomy might play a more relevant role for non-native speakers of Italian.

6.3 – General Discussion

6.3.1 – Native processing of bound stems

Experiments 3 & 4 were aimed at exploring how different stem types might influence the way morphologically complex words are processed. Specifically, according to our underlying hypothesis, if words are organized along the dimension of morphological schemas which are abstracted on the basis of connections among them, the fact that a stem is not isolable should not be perceived as problematic for processing. This is at least predicted to be the case when a common semantic core is identifiable on the basis of other words retaining the same stem with an associated meaning. Crucially, such a common nucleus of meaning, in bound stems, can only emerge because of the holistic properties of words that share that same stem, given the non-lexicality of the stem in isolation. On such grounds, equivalent facilitation effects were expected to occur between derivatives sharing free and bound stems, the more so if we consider the abstract nature of the units contained at the supra-lexical level, in which (lack of) base autonomy is not relevant. Having said that, we acknowledged that it could also be the case that words with bound stems might be perceived as morphologically related by virtue of other characteristics, such as their combinability with other salient morphological units, i.e., affixes, or the common morphonological alterations they often exhibit in derivations. To understand whether indeed semantic relatedness is not the determining factor, Experiment 4 was designed, where derivatives with semantically opaque stems were used as critical materials.

The results of the first of such experiments are clear-cut for native speakers: similar facilitation effects were observed when derivatives containing either a free or a

bound stem were presented as primes for derived targets sharing the same stem. Importantly, such effects were significantly different from those yielded by both unrelated and orthographically related primes, suggesting that facilitation did not stem from mere orthographic similarities. These findings appear to be in line with the majority of studies discussed in § 5.4, which found that complex words containing bound stems can facilitate each other in word recognition tasks. The data of this experiment, moreover, fully meet the expectations of the above-cited model, where facilitation effects arise from morphological organization superimposed by an abstract higher level.

It could be argued, however, that this is not necessarily the case and that bound stems could be stored independently at a lower sub-lexical level. In a strictly decompositional view, morphological parsing would operate independent of shared meaning, as long as words display at least a superficial morphological structure. It could be the case, therefore, that the effects we observed were simply due to this fact. The study by Giraudo & Voga (2016) rejected this hypothesis, at least for French, as we have seen (§ 5.4), through the use of pseudowords represented by bound stems presented in isolation. This issue was further investigated here in Experiment 4: crucially, an observed morphological facilitation in this experiment would have been hard to reconcile with our hypothesis about the organization of the lexicon, given that no semantic linkage can be identified in word pairs such as *resistere* – *consistere* 'to resist – to consist'. On the other hand, a potential facilitation effect triggered by bound stem derivatives in this experiment would not necessarily entail a semantically-blind decomposition. There is a possibility that bound stems might be perceived as morphologically salient units because of their capability to combine with other affixes. On the other hand, shared morphophonological changes could also be a candidate for the emergence of the stem. Despite reducing the role of semantics in morphological organization, such a possibility would not necessarily be explained within a decompositional framework, but would certainly highlight a more relevant role for form, intended not only as the ortho-phonological shape of a word, but also its morpho-syntactic properties (as intended in Booij 2010: 5).

At first sight, the data obtained from this second experiment on bound stems do not seem to support discarding the role of semantics. Even though facilitation was observed relative to an unrelated baseline, reaction times yielded in the morphological condition did not differ significantly from those triggered by the orthographic condition. This seems to suggest that facilitation was stemming primarily from the orthographic similarity with the target. Importantly, sub-lexical approaches predict that only morphologically structured stimuli will be decomposed, while words in which we cannot isolate a stem and an affix should produce significantly less priming. Related to this point, it is worth mentioning the fact that, although we were dealing with very different items across the experiments (suffixed words in Experiment 3 and prefixed words in Experiment 4), the fact that reaction times after morphological primes differed significantly from those after orthographic primes in Experiment 3 seems to further confirm the orthographic nature of the effect observed in Experiment 4. To elaborate, the degree of formal overlap of both morphological and orthographic prime-target pairs was matched across the two experiments, so that bound stem items in the two studies showed the same degree of overlap (0.71 in both experiments, $t = -0.26$, $p = .791$) and so did orthographic primes and their bound stem targets (0.49 in Exp. 3 and 0.53 in Exp. 4, $t = 1.93$, $p = .057$). Given the similar amount of formal overlap between primes and targets in the two experiments, it seems that the morphological effects of Experiment 3 cannot be ascribed to the advantage shown by morphological primes (in terms of similarity with their targets) with respect to the orthographic baseline. If that were the case, we should have observed a similar effect in Experiment 4, given the comparability of matching across the two experiments.

Moreover, the literature on word recognition has shown that word onsets are perceptually more salient than word endings (see Cutler, Hawkins & Gilligan 1985 for review) and, as a consequence, orthographic overlap in final position (as was the case in the prime-target words of Experiment 4) should facilitate less in orthographically only related prime-target pairs. Within this view, the orthographic baseline of Experiment 3 (where overlap is word-initial) should have had even more chance to trigger facilitation and consequently should have worked better as a control condition relative to the same condition in Experiment 4 (where overlap

was word-final). To clarify, in Experiment 4, an advantage in the effects determined by morphological primes relative to their orthographic control condition should have been even more easily produced, if additional factors besides form were involved (that is, if bound stems were recognized by virtue of their morphological characteristics). On such grounds, it may be the case then that, other things being equal, lack of shared semantics could qualify as a candidate for the absence of truly morphological effects in Experiment 4. Along these lines, morphological schemas might indeed be more salient when semantics is identifiable, as hypothesized above. However, the puzzling patterns of (absent) facilitation that emerged for prefixed free stems should warn us against drawing too hasty conclusions. Indeed, the inclusion of a free stem set of prefixed words was meant precisely to rule out the possibility that any difference between the facilitation effects found in Experiments 3 and 4 could be ascribed to properties pertaining to the affixation processes involved. Evidently, the present data cannot exclude such a possibility and force us to look deeper into the issue of the asymmetry between prefixation and suffixation. This is not the first study to contemplate the hypothesis of the existence of such a differential treatment of prefixation and suffixation: we have mentioned in Chapter 1 how some works on morphological processing had previously raised the issue. The differences between the two processes from a theoretical point of view have been pointed out in several studies (for Italian see, e.g., Montermini 2008) and might as well be reflected in processing. We will here consider how this may occur from the point of view of their differing characteristics as to position, functional role, and semantic implications.

The first general observation that can be made is that, if processing proceeds from left to right, prefixes should be encountered earlier than suffixes in lexical access. One of the possible interpretations of the supposed left-to-right processing direction is set within the framework of semantically-blind affix stripping models (e.g., Taft & Forster 1975). Along this line of interpretation, prefixed words might have failed to prime their relatives because of the cost associated to the prefix-stripping operation, which would delay access to the base. Even if theoretically possible, it is not necessarily the case, however, that left-to-right processing should automatically imply affix-stripping, as has been pointed out by several studies focusing on prefix-

suffix asymmetries (e.g., Segui & Zubizarreta 1985; Feldman & Larabee 2001; Meunier & Segui 2002; Giraudo & Grainger 2003). Meunier & Segui (2002) maintain the claim, for example, that suffixed and prefixed words are processed differently because of their sequential organization: morphemic decomposition would operate for both types of words, but at different stages of word identification. Specifically, for suffixed words access would proceed through the stem, following the natural order imposed by left-to-right processing. Access to the stem would provide immediate access to the semantic information related to it, and therefore to the morphological relatives sharing that same stem. Prefixed words, on the other hand, would be decomposed 'post-lexically', i.e., after access has occurred. Part of their interpretation is motivated by the fact that they found different patterns of priming with suffixed and prefixed words exhibiting allomorphy. Specifically, no priming was observed with suffixed words in this condition (e.g., *sourd – surdité*). Accordingly, they argue that allomorphs activate phonologically abstract shared lexical representations and this selection process inhibits all other forms. Since no such inhibition was observed for allomorphic prefixed words, they hypothesize that decomposition does not occur at early stages and therefore no inhibitory effect arises. While we cannot provide data with regard to the processing of allomorphic prefixed words in Italian and, more in general, an integrated discussion of the results of all the experiments presented here will follow later, the fact that we did not observe such inhibitory effects with allomorphic suffixed words seems to contradict this interpretation. Moreover, while we agree that no decompositional process should necessarily operate on prefixed words, we do not see convincing reasons why such a decomposition should occur for suffixed words.

Most importantly, with regard to the data presented here the different positional organization of prefixed and suffixed words should be taken into account. We have shown that, under certain circumstances, the presence of an affix before the base does not impede priming effects to emerge. The fact that this occurred when we only considered prefixed words with a small number of prefix-base combinations seems to be irreconcilable with a view where the presence of an affix necessarily delays access to the base. If this were the case, there should be no condition where priming arises. Such facts are also confirmed by the fact that, cross-linguistically,

the configuration prefixed prime – stem target and its reverse have been usually found to trigger priming effects across different priming modalities (see, for example, Marslen-Wilson et al. 1994; Feldman & Larabee 2001; Grainger, Colé & Segui 1991). Rather, we should focus on the specific conditions under which priming may be lacking. While the prefixed-prefixed configuration has been less investigated, especially under masked conditions, we must acknowledge that the fact that no effect was observed in the present study contrasts with those studies which did find facilitation (with the masked priming methodology: Grainger, Colé & Segui 1991; Pastizzo & Feldman 2004; Giraudo & Voga 2013). Facilitation deriving from cross-modal tasks (Marslen-Wilson 1994 et al.; Feldman & Larabee 2001; Meunier & Segui 2002) might be less complicated to explain, in that differential results across priming modalities often occur and are usually interpreted either in terms of the different stages of lexical access (early phases *versus* more central stages) and/or modality-specific properties (see, e.g., Feldman & Larabee 2001). On the other hand, the reasons for the divergence of results under masked priming conditions should be explored more carefully, taking into consideration those differences which are relevant to the prefix-suffix diversity other than mere position.

Among the most relevant of such differences, the fact that prefixes in most cases do not change the syntactic category of the base they attach to[66], while suffixes generally do so, is notoriously an element which has drawn the attention of linguists: prefixes would typically provide semantic adjunction to the meaning of the lexical root. Moreover, phonological differences underlie prefixation and suffixation, rendering the prefix a more autonomous element: prefixes most commonly do not integrate prosodically with their base (i.e., the base does not undergo resyllabification), while this is usually the case with suffixes. In general, many studies have drawn the attention to the fact that prefixes are, to a certain extent, closer to prepositions and to autonomous lexical units than suffixes are, both

[66] See Montermini (2008) for a discussion of anomalous cases in Italian and other European languages (e.g., the phenomenon of parasynthesis if interpreted as a case of prefixation, Montermini 2008: 189).

syntactically and semantically[67]. On such grounds, there is a possibility that prefixes emerge as abstract units at a supra-lexical level of morphological organization. Indeed, while proponents of the supra-lexical model usually generically refer to abstract base lexemes as the units driving morphological organization, the possibility that some affixes could also be represented at this interface (as emergent units capturing the systematic correspondences between form and meaning related to a given affix) is suggested by Giraudo & Voga (2016). Thus, the nature of prefixes might have played a role in our patterns of results.

There are two intertwined dimensions along which the presence of prefixes might have affected priming patterns. On the one hand, a sort of inhibition might have surfaced: if prefixes are contained at a supra-lexical level, the presentation of a prefixed stimulus should activate its corresponding prefix unit, which in turn would contact all words containing that same affix (with the same form-meaning correlation). Given the relatively more autonomous role of prefixes compared to suffixes, it might be the case that they are perceived as units similar to lexical bases at the processing level (see also Giraudo & Grainger 2003, concerning the fact that prefixes have a more predominantly compositional character and add meaning in a similar way to what two bases do in compounding). This fact is even more prominent when combined with the supposed left-to-right processing direction discussed above. While mere position is not, in our view, sufficient to explain the asymmetry observed in processing between the two different types of affixes, this factor, together with the hypothesized inhibition effect, might explain the results we obtained. In other words, one possibility is that, when encountering before what is perceived as a salient unit, all the representations connected with that unit might be (additionally) activated. That this could be the case, is corroborated by the results of prefix priming studies, e.g., those studies where prefixed words sharing the same prefix, but not the same base (e.g., *refasten – redo*), facilitate each other (Chateau,

[67] This is not to say that prefixes and prepositions (and adverbs) should be considered as a unitary class. On the contrary, there are several criteria that have been proposed to distinguish the two (see Iacobini 1999; Sgroi 2007; Montermini 2008). The difficulty to set clear-cut boundaries is, however, widely acknowledged (at least in Italian), which points to the fact that they do share some common properties.

Knudsen & Jared 2001; Giraudo & Grainger 2003). Interestingly, analogous suffix priming failed to emerge in the literature (Giraudo & Grainger 2003; Giraudo & Dal Maso 2016a, but see Duñabeitia, Perea & Carreiras 2008 for effects with pseudo-words as primes). Importantly, however, it should be stressed that it is probably not the case that independent activation of the semantics of the prefix as such occurs (in a sort of semantic inhibition determined by the presence of the prefix *per se*, i.e., used as a semantically informed access unit, see, e.g., the account by Marslen-Wilson et al. 1994). The results emerging from our experiment with prefixed bound stems do not support such a view. If prefixes had an independently activated meaning, it would be difficult to explain why we observed an effect relative to the unrelated baseline. We should have instead expected an inhibition process to be at work. In this case, there might have been no inhibition simply because prefixes in such baseless derivations have no transparent, nor reconstructible meaning. Importantly, consistent with what advocated so far, the meaning of a prefix would only emerge in its relationship with the holistic properties of the derivative. Since there is no way of knowing whether an initial word string is a prefix until the word has been accessed, it would be the constructional schema in which the word participates that activates affix interpretation. In this light, it could be explained why this potential inhibition was not observed with prefixed bound stem pairs such as *consistere* – *resistere* 'to consist – to resist'. No comitative and iterative meanings (respectively, the prototypical meanings of prefixation schemas for *con-* and *re-*) are present in these two words.

Related to this point is the so-called prefix-likelihood (or conversely prefix confusability) discussed by Laudanna & Burani (1995), i.e., the likelihood for a given orthographic string to be a prefix (calculated as the ratio between word types in which that same string occurs as an affix and word types in which it does not). From our perspective, it might be equally relevant to consider not only prefix likelihood, but also its degree of semantic consistency across the word types in which the prefix occurs (recall, e.g., the findings by Bertram, Schreuder & Baayen (2000) on the ambiguous Dutch suffix *-er* and the possibility for this ambiguity to affect processing, discussed in § 1.3.2.3.). Importantly, as we have discussed in

Chapter 5, prefixes are highly heterogeneous as to the semantics they convey, not primarily the number of different meanings they can carry, but rather for their degree of lexicalization and, consequently, opacification.

This brings us to the second point about the way in which prefixes might have played a role in the processing of our experimental materials. As mentioned above, prefixes may modify the overall semantics of the derived word in which they appear contributing to the meaning of the base. With verbs, especially, they may evoke a whole range of new meanings typically very distant from the base. Concerning this issue, it should be noted that verbal prefixation is not particularly productive in modern Italian (Iacobini 2004), although prefixed verbs are numerous. A vast number of prefixed verbs derive from the inherited stratum of the language, i.e., they were already prefixed in Latin. While some of them are still perfectly compositional in their meaning from the synchronic point of view, a natural consequence of long permanence in the language is lexicalization: «la lessicalizzazione è naturalmente strettamente legata a questo parametro: più una parola è utilizzata a lungo più essa presenta la tendenza ad avere un significato opaco» [lexicalization is naturally strictly related to this parameter: the more a word is utilized the more it will have an opaque meaning] (Montermini 2008: 161). In other terms, while a base is still identifiable and transparent if considered on its own, the semantics expressed by this base and by a complex word containing that same base might be very distant from each other[68]. As a result, we might have large families, intended as combinations of all the possible prefixes occurring with a base verb, which, instead of producing the well-known facilitatory effect, might slow down activation by virtue of inhibitory links among relatives which compete for activation. For instance, words such as *promettere* 'promise', *permettere* 'permit',

[68] «Vi sono parole che erano già prefissate in latino e che hanno seguito un percorso di trasformazione semantica diverso da quello delle loro basi. In queste parole è ancora possibile identificare una base che fonologicamente corrisponde a una parola italiana, ma si è incapaci di mettere direttamente in relazione il significato di questa base con il significato della parola complessa» [There are words which were already prefixed in Latin and which underwent a different semantic evolution from that of their bases. In these words, it is still possible to identify a base which coincides phonologically with an Italian word, but we cannot directly relate the meaning of this base to that of the complex word] (Montermini 2008: 161-162).

and *ammettere* 'admit', though technically belonging to the same morphological family, might be perceived as being closer to orthographic neighbours (i.e., words which differ from each other in one letter and/or phoneme), given their high degree of formal overlap but little shared meaning. As such, they would not activate the same supra-lexical unit, given that this activation is supposed to reflect a systematic form-meaning correspondence. This could explain why, when we remove prime-target pairs with large families, where semantic drift is more likely to have occurred (in the specific case under investigation, i.e., prefixed verbs), priming effects tend to resurface. Such a view of the facilitatory and inhibitory connections among words would be compatible with a model where the lexical environment could be determinant in affecting processing times (in terms of competition or facilitation arising among words), which goes beyond the presented prime-target pairs of stimuli. Similar effects are expected in the supra-lexical model of word recognition: the recent study by Voga & Giraudo (2009) (see also discussion in Giraudo & Voga 2014) has focused the attention on the role played by synagonists and antagonists in the mental lexicon. The former can be referred to as all the words which send facilitatory patterns of activation to related words (semantically transparent members of the same morphological family), while with the latter term the authors refer to words such as orthographic neighbours and pseudo-family size members[69], which can slow down processing times by virtue of the inhibitory competition enhanced by them. Along this line, words like *promettere*, *permettere* and *ammettere* might be perceived as very little related, despite their belonging to the same morphological family.

The two explanations above discussed need not be mutually exclusive, even if they might appear so. Indeed, they may operate jointly: prefixed words might activate all words sharing that prefix, if semantically consistent, besides all the words sharing the same base (which is normally predicted to facilitate processing). At the same time, words that contain the same base but are semantically very distant from each other as for their holistic meaning, might be affected by inhibitory links at the

[69] With this term, they refer to pseudo-relatives that contain a string which might be superficially perceived as the same stem, not necessarily followed by an affix-like ending (e.g., *portons* 'we carry' would have as pseudo-relatives words like *portier* 'porter', but also *portrait* 'portrait').

word level (and not be contacted from the supra-lexical level), which would cancel out the beneficial effects coming from semantically consistent words. Prefixed bound stem words, on the other hand, would be paradoxically less inhibited given that no prefix unit at the supra-lexical level (and in turn, all its related words) is activated. However, the supposed explanation may not need to apply specifically to prefixation as opposed to suffixation. Indeed, the crucial point here seems to be the productivity and consequently the semantic transparency of the word-formation schema involved (though with the provisos discussed in § 5.2.2 about the relationship between the two variables), rather than the type of affixation considered. In the specific case of prefixed verbs, the two may go hand in hand, given the substantial decrease in productivity of verbal prefixation in Modern Italian (as opposed to its vitality in Latin, see Iacobini 2005) and the survival of many prefixed forms which have lost motivation.

Similarly, stem autonomy may not be a sufficient condition to perceive relationships among words. If we consider words such as *confondere* 'to confound' and *consegnare* 'to hand in', in which we may recognize a complex structure, it could be argued that they might be far less motivated than words such as *condividere* 'to share' and *convivere* 'to live together'. In terms of CxM, the latter should participate in multiple schemas (at least a prefixation schema and an output-oriented schema), while the former fit difficultly into any of them. Specifically, the internal complexity of words such as *confondere* would not receive motivation neither on the basis of their base *fondere* ('to melt'), nor on the basis of words sharing the same prefix such as *consegnare* 'to hand in'. The situation for such lexicalized verbs might be overall not much dissimilar from that of baseless prefixed verbs such as *consistere* 'to consist' and *condurre* 'to conduct'. Similar observations have been made by Aronoff (1976) concerning English verbs (namely, prefixations of *stand* and *take*; Aronoff 1976: 14) such as *understand*, *withstand*, *undertake*, *partake*, in which again the only motivating factor seems to be formal, i.e., the fact that they show the same variant in the past tense form (*understood*, *withstood*, *undertook*, *partook*).

To conclude, if we consider jointly the results of Experiments 3 & 4, we find no evidence of the fact that bound and free stems are processed differently, in line with

what previously has been found for other languages, and importantly, also for Italian (although in production tasks, as in the studies by Burani 1990, Chialant & Burani 1992 and Burani, Laudanna & Cermele 1992). While evidence in favour of similar treatment clearly emerged in Experiment 3, the results of Experiment 4 were more difficult to interpret and suggest an asymmetry between prefixation and suffixation. This asymmetry might be understood in terms of productivity and not necessarily linked to the free/bound dichotomy. In this experiment, the absence of truly morphological facilitation in the bound stem set cannot be solely related to the absence of shared semantics displayed by bound stems, but can be linked to a differential treatment of prefixation involving also free stems. While speculations on the possible reasons for such a difference were presented, future research should take into account the characteristics of prefixes not only from the quantitative point of view, but also from the perspective of their semantic relationship with the base.

6.3.2 – Non-native processing of bound stems

Before proceeding to discuss the results of non-native bound stem processing, it is worth mentioning that, to our knowledge, no other study on second language morphological processing has investigated this issue. Therefore, although some predictions were formulated for non-native results, no previous frame of reference was available with respect to this specific issue. Very broadly, the main aim was to compare native and non-native treatment of bound stem stimuli. More specifically, we anticipated that if form plays a more relevant role in second language processing, we will expect facilitatory effects to arise even in cases where the semantics of the stem is completely opaque. Of course, the pattern of results that emerged for native speakers leads us to take a more cautious approach and to reframe some of the underlying assumptions. Given the absence of morphological effects in native processing of free prefixed verbs, we will need to explore thoroughly the possible factors which might have favoured priming in non-native speakers.

The first general observation that can be made from a global overview of the results of both the experiments is that there seem to be some difficulties arising when derived words with bound stems are presented, be they suffixed or prefixed. The

data of Experiment 3 show that morphological priming arises when words like *giornalista* 'journalist' are presented prior to stimuli such as *giornalismo* 'journalism'. Reaction times in this condition significantly differed from those in the unrelated and orthographic conditions, suggesting the morphological nature of the observed facilitation. However, words such as *terrore* 'terror' were primed efficiently by relatives containing the same stem (*terribile* 'terrible'), but this effect, contrarily to what observed with native speakers, was only significant relative to the unrelated baseline. Orthographic effects cannot therefore be explicitly ruled out for non-native speakers, for whom evidently formal similarity may play a major role in the processing of bound stems.

Experiment 4 was to a certain degree consistent with the described pattern of effects: once again, bound stem prime-target pairs did not facilitate each other, the more so in that no effect emerged relative to either the orthographic (as in Exp. 3), or the unrelated baseline. Interestingly, prefixed free stem derivatives produced a significant effect, which was supposedly mainly orthographic (given the non-significant difference with the form control condition).

Two considerations are worth mentioning here. Firstly, the patterns of facilitation for free stems differed across the experiments, with orthographic effects arising for prefixed words, but not for suffixed ones. Secondly, and surprisingly, the fact that at least an orthographically-mediated effect emerged in non-native processing of free prefixed stems contrasts with the results obtained with native speakers, where we hypothesized the observed lack of effects to be a by-product of competition in the mental lexicon.

Following the explanation outlined above, we concentrate on the two most striking asymmetries with respect to native data, namely, facilitation only for free stems (*versus* free and bound in Experiment 3) and facilitation (although probably orthographically determined) for free prefixed verbs (*versus* absence of an effect).

As for the first point, our data seem to point towards a situation where the psychological reality of morphological organization for non-native speakers might be grounded primarily on elements which are freely occurring in the language. Notwithstanding our discussion about the psychological plausibility of second-order schemas for native speakers, it is undeniable that free stems could more likely

be perceived as more salient units, given their lexical autonomy. Within the usage-based perspective adopted in this work, we have seen that a unit may come to be perceived as salient for the speaker, besides by virtue of surface frequency, also as a result of its participation in an open schema. While quantitative data related to this aspect were not available (nor would have probably shed much light on the issue considering the range of root-affix combinations which were utilized in the present experiments), we hypothesized that for native speakers priming effects arise in fact as a consequence of bound stems emerging as meaningful units by virtue of their occurrence in a range of complex words. Crucially, in such a model, there is in principle no difference between bases that can occur in isolation *versus* those which cannot, given that common semantics, provided by both morphological family members and the semantics of a schema, contributes to their salience. Such claims should probably be weakened for non-native speakers, or at least, cannot find full confirmation in our results. In general, facilitation between derived words (*giornalista – giornalismo*) is an encouraging outcome, which could point to the fact that processing does not necessarily imply base-to-derivative directionality. However, a process of decomposition could also be at work. Even if we cannot come to a conclusion on this point for non-native speakers, it is worth highlighting that there is in principle no need to reject the idea of a morphological organization of the lexicon for non-native speakers too, even if it could be different from the native organization. Therefore, claims about substantial differences between native and non-native speakers should be reconsidered given that L2 speakers do indeed show morphological facilitation effects, at least in the most transparent conditions. Whether the *locus* of such morphological effects differs is an empirical question which can hardly be verified, since theoretical positions disagree also as far as native processing is concerned.

Turning to the second issue mentioned above, we should now ask why native speakers are inhibited (if our hypothesis is valid) by free stem derivatives, while non-native participants were clearly not. To be fair, it is worth underlining that no real inhibition effect was observed in the data of native speakers, but one of the possible explanations is that both inhibition and facilitation were at work, resulting in a null effect. A possible reason for the different patterns found in non-native

speakers might be the existence of the above-mentioned base-to-derivative processing bias. In this light, access could be hypothesised to operate mainly via the root which would be accessed necessarily first, and the related words would be activated on the basis of consistently related base meaning. Following this line of reasoning, prefixes (but also affixes in general) might play a more marginal role compared to native processing.

Importantly, however, access does not seem to be semantically blind, as demonstrated by the fact that priming effects failed to emerge when the base had no recognizable meaning (i.e., in prefixed bound stems). Thus, it may not be necessary to posit an L2 version of sub-lexical models. Indeed, instead of assuming that access operates via the base, we could consider what it takes for a unit to emerge as such at a higher level of morphological organization. Based on the findings here reported, it seems that stem integrity could be one of such constraints.

With respect to the issue of form-related properties, which was the main topic under investigation, a few additional remarks need to be made. Firstly, there are some effects which are best accounted for in terms of form similarities between morphological primes, as demonstrated by the non-significant differences between this condition and the orthographic condition found in both experiments. This was the case in Experiment 3 with suffixed bound stems, which were evidently unable to trigger purely morphological priming. Such a state of affairs could lead us to believe that bound stem derivatives are perceived as more similar to the class of monomorphemic words. In Experiment 4, no effects were observed with bound stem pairs and an effect which was significant against the unrelated baseline, but not the orthographic one, emerged for prefixed free stems.

A word of caution is necessary, however, in our view, before interpreting such effects as purely orthographic. Given that prefixed bound stem and free stem derivatives were matched across sets in terms of the amount of orthographic overlap (and so were orthographic primes between each other across sets), if form was the only determinant for facilitation we should have registered a similar effect for both sets. In other words, *resistere* should have primed *consistere* as *prevedere* primed *rivedere*. Failure to do so suggests there is certainly a more relevant role for formal similarity, but crucially this factor does not provide us with the whole picture.

Indeed, if we consider the results of both experiments, we find a pattern of effects which is stronger for freely occurring stems which keep their meaning constant, and weaker (actually absent) for bound elements in which no consistent semantic clue can be perceived. Interestingly, questionable cases are represented by bound (therefore, possibly less salient) stems where meaning could be inferred on the basis of other words and by free stems found in prefixed verbs, which posed problems even for native speakers. While explanation for the orthographic effects of the latter would first necessitate further research in L1 processing (in order to single out factors playing a role in native mechanisms), results for the former might suggest an ongoing learning process and progressive integration of the dimensions of morphological organization in the target language.

While the implications of such observations will be considered thoroughly in the next chapter, in a joint discussion of all the experiments presented here, it is worth highlighting that, related to this point, the presence of truly morphological effects for free stems in Experiment 3 should warn us against drawing strong conclusions about a supposedly exclusive role of form (as proposed by Heyer & Clahsen 2015).

Chapter 7: Concluding remarks: an integrated perspective

After having discussed separately the results of the experiments here presented, we conclude with a summary of the most important points emerging from this work and the proposal of an integrated perspective which could account globally for the evidence found. Even though we concentrated on different morphological phenomena, they can both shed light on the role of form in native and non-native processing, and on the implications that this factor has on a view of the mental lexicon.

7.1 – The organization of the native mental lexicon

Previous studies focusing on morphological processing in Italian have mainly concentrated on inflection and on the manipulation of frequency variables, in an effort to understand whether morphology drives, as in other languages, the organization of the mental lexicon (see Burani 2006 for a review). Leaving aside the fact that the specific model of access proposed by many such studies (the AAM) differs from the one we have supported here (while both acknowledge the role of morphology), the present work, using a different methodology, has further confirmed the reality of processing effects of morphological relationships among words. Specifically, given the little attention dedicated so far for this language to the role played by form during morphological processing, we concentrated here on this variable, with the aim of providing a more nuanced picture of how morphological relationships are established among words. The findings that emerged from experiments conducted through masked primed lexical decision tasks have highlighted the following major points:

i) morphological relationships appear to be solid even when formal disruptions of the stem intervene;
ii) stem autonomy does not affect the way complex words are processed;
iii) prefixation was found to differ from suffixation.

Such findings are in accordance with the majority of studies conducted on native morphological processing in other languages. While major differences were found with respect to the issue of allomorphy under masked priming conditions, only few

studies considered this aspect with this specific methodology. The most striking difference was observed with respect to the study by Orfanidou, Davis & Marslen-Wilson (2011). While our overall interpretation differs from the one proposed by these authors (see § 3.4), it is worth highlighting that it is not necessarily the case that our data contradict those obtained in that study. One likely reason for the difference between the outcomes of the two studies might pertain to language-specific variables: in other words, given that one concentrated on Greek and the other on Italian, we cannot exclude the possibility that the morphological organization of the two languages differ in some respects. While we do not see clear reasons why this should be the case, given that both languages are fairly transparent in their orthographic systems and have a quite rich morphological system, this explanation cannot be completely ruled out. Another potential reason might be related to the differences exhibited by the two studies as for their experimental protocol: although both studies made use of a masked priming methodology, different prime durations were used, i.e., 66 ms in the present work *versus* 42 ms in the Orfanidou et al. study. An alternative proposal could take into consideration the time-course of morphological priming effects. In other words, it may be the case that the two studies reflect different windows on early phases of lexical access. It is indeed true that the effects of form usually appear to emerge quite early in studies of visual word recognition. Even though morphological effects have been found even for very brief prime durations (see, e.g., the study by Giraudo & Grainger 2001, which finds effects as early as 43ms), the possibility that such effects are relatively weaker and less tolerant to orthographic/phonological alterations might still represent a possibility to be further verified.

On the other hand, results pertaining to bound stem processing have partially confirmed the results of previous studies investigating this topic with the same methodology. Both bound and free stem derivatives turned out to produce significant morphological effects, as found by the studies discussed in § 5.4. However, we could confirm these results only as far as words containing transparent bound stems were concerned. While vagueness of meaning can be thought of as a characteristic of bound stems in general (as seems to be implied by most studies on the topic), we could not confirm the existence of (truly) morphological effects when

such stems were more markedly opaque in meaning. On the other hand, the fact that even prefixed free stems failed to trigger facilitation led us to consider the hypothesis that, more than a bound *versus* free dichotomy, an underlying asymmetry between prefixation and suffixation, grounded in turn on issues related to productivity, might have played a role. While such a claim should be verified by means of a direct comparison between prefixed and suffixed words (i.e., by presenting the same target preceded by both a prefixed and a suffixed morphological relative), the fact that such an asymmetry has been found in studies on other languages might corroborate the hypothesis of the existence of underlying processing differences, which should be investigated thoroughly. Lack of facilitation in the prefixed bound set may therefore not be necessarily linked to base autonomy, even though, in this particular experiment, lexicalization characterized words with bound stems. The possibility of lexicalization in turn is certainly not a prerogative of prefixation (as opposed to suffixation), but it is more likely to occur in words existing in the language for a very long time and whose components are not productive anymore, as it is the case for many prefixed verbs in Italian. From this point of view, an interesting development would be to consider productive *versus* non-productive prefixation schemas, expanding the scope beyond verbal derivations, to the investigation of nominal and adjectival prefixation.

Taking into consideration the results of the four experiments presented here together, in our view, they can be best accounted for in a model which must be word-based rather than morpheme-based. The results of all the experiments indeed converge to indicate that such a model should be tolerant to ortho-phonological changes, a characteristic which is more adequately accommodated in models which do not need obligatory decomposition in morphemes. That words should be the privileged units of access is further confirmed by the fact that lack of base autonomy was found not to impede recognition among related morphological words. Within a framework based on morphological schemas, semantically consistent bound stems will receive multiple motivation, at least from second-order schemas and affixal schemas. From this perspective, it is not surprising to observe morphological effects even for such baseless words. Even though facilitation effects could still be interpreted as the result of a decompositional process extracting a common bound

stem which would later speed up activation on subsequent presentations, the fact that such an effect failed to occur with prefixed bound stems (which were semantically empty) undermines seriously an account which predicts semantically-blind parsing.

All in all, the data we have presented here, while still to be explained in some respects, are consistent with the view of a hierarchically structured lexicon, such as the one proposed by Booij (2010) and supported here. In line with this model, the fact that words can participate in multiple schemas may account for some of the processing differences observed.

7.2 - The organization of non-native mental lexicon

A general discussion of the data of non-native speakers should start from the observation that for such speakers we are still in the process of understanding whether morphology effectively plays a role in driving lexical organization. Therefore, the choice of a specific model of access is still rather dangerous and would probably be unwarranted at this time. Rather, the debate should be focused on whether any observable difference with respect to the results found for native speakers can be interpreted in the light of those accounts which support the existence of fundamental differences between the two groups or, on the contrary, can be ascribed to alternatives variables.

In this work, since no hypothesis on language background was made, we will not consider the role of such a variable, even though we acknowledge that it should not be neglected. Indeed, it is worth noticing that the heterogeneous language background of the learners who took part in the experiments might have influenced our results. This could explain the emergence of numerical effects which were not significant, as was the case in Experiments 3 and 4. In these experiments, 35 ms and 34 ms (respectively) facilitation effects for morphological primes relative to the orthographic baseline in the bound stem sets resulted to be non-significant. Specifically, in Experiment 3 the absence of significance in the subject analysis, but a tendency to significance in the item analysis ($p = .07$), is remarkable and may find an explanation when we consider the large variability of our L2 data. Moreover, heterogeneity of language backgrounds might have played a role with regard to

participants' word knowledge and consequently have affected their performances. Namely, because many of the items used in our experiments have Latin antecedents, it is clear that participants with a Romance language as L1 (in our case, Spanish, French, Portuguese and Romanian) might have benefited from the presence of cognates in their first language. Similarly, learners with English L1 might have had advantages as well, given that many of such items have cognates in this language too.

Similarly, we can make no specific claim on the role of proficiency, at least not from a developmental point of view, given that we did not differentiate participants on the basis of different stages of acquisition, but chose to investigate an advanced level only. Of course, speculations could be made on whether such a level represented a likely end-state of acquisition for L2 speakers (but this is unlikely to be so).

The main focus of this study was instead the investigation of the role of form, which has been recently proposed as an explaining factor in L2 processing. An overview of the main results of the experiments conducted with non-native speakers point towards a role for this variable. While native speakers were found to be facilitated by both allomorphic and transparent primes, such an effect was not replicated by the results for L2 speakers, whose recognition times were only found to be primed effectively when transparent morphological primes were presented. Likewise, a more predominant role for the formal aspects of words was found in the experiments focused on bound stems, where subjects appeared to show more sensitivity to the fact that the base was autonomous, an aspect which was not critical for native speakers.

That form affects non-native processing in a more relevant way appears to be clear on the basis of the summarized results and is overall in line with previous findings on other L2 languages (Diependaele et al. 2011; Basnight-Brown et al. 2007; Heyer & Clahsen 2015). The fact that form might be the first clue to the identification of relationships among words during language acquisition is not surprising, at least not from a usage-based perspective, as we have discussed in § 2.1.3. However, the present results highlight that, differently from what has been proposed in the study by Heyer & Clahsen (2015), the observed facilitation effects are not to be intended

as due to formal overlap only. Indeed, the fact that in the most transparent conditions morphological facilitation was significantly different from orthographic facilitation should lead us to reconsider such a strong claim, at least for what concerns L2 Italian.

While developmental progress was not directly investigated, the alternative proposal made by Feldman et al. (2010) can integrate better the results of this study: L2 speakers might in fact start out as being (only) driven by form, while progressively abandoning such an overreliance when they become more proficient. Within this perspective, the advanced level we considered in this study might reflect a stage in acquisition where speakers are starting to perceive morphological relationships *per se* and not only as related to formal overlap.

In Chapter 2 we discussed proposals which posit different processing mechanisms operating for native and non-native speakers (Ullman's DP model and Clahsen's SSH). Concerning this issue, we should first keep in mind that, while certain speculations on the results of masked priming experiments have been made in previous studies on morphological processing, there is no clear way in which morphological priming effects can be said to reflect a difference between declarative and procedural systems, reflecting respectively lexical and morphemic access routes. In our view, it is unwarranted to consider morphological priming effects as derived from morphemic combination, since they could be the consequences of both abstractions and lexical connections among words. More in general, we maintain that there is no need to posit an either/or distinction between the two possibilities, and relating morphological effects as revealed by masked priming methodologies to one or the other is, in our view, unjustified.

If we were to interpret morphological effects along the lines of a declarative/procedural distinction, one would be tempted to believe that only rule-based processes operating from base to derivative are relevant in second language processing. Indeed, one possible interpretation of our results is to see morphemic parsing operating where segmentation is possible, i.e., in formally transparent derivatives and free stem derivatives. For non-native speakers, it could be the case that decomposition drives access and that, upon failing to recognize a (bound) stem in the lexicon, processing would be slowed down. The fact that we did not find any

effect for allomorphic primes would seemingly corroborate this hypothesis. It is important to highlight that even if we were to ascribe to such a view, the claim that morphology plays no role in second language processing is still not tenable. Globally, within accounts positing a dichotomy between declarative and procedural mechanisms, it is surprising to observe no effects with allomorphic relatives, given that they are supposed to be processed through lexical connections and reliance on such means should be enhanced in such models (as posited, for instance, by Clahsen and colleagues).

Alternatively, we could see processing by second language speakers as relying on the same mechanisms operating in native speakers. Crucially, both connections among words and schemas abstracting from them could be at work in both native and non-native speakers. The diverging results that have emerged might be deriving not from fundamental differences between these two groups, but simply from an underdevelopment of morphological schemas in non-native speakers. Indeed, an assumption made by Construction Morphology is that abstraction of schemas will likely differ among speakers: «it is not necessarily the case that all language users make the same subgeneralizations. Schemas are based on lexical knowledge, and this type of knowledge varies from speaker to speaker. Hence, speakers may also differ in the number and types of schemas that they deduce from their lexical knowledge» (Booij 2010: 89). From this point of view, it is only natural that second language speakers might have reduced development of schemas relative to native speakers, given that they prototypically have reduced lexical knowledge. It may then be the case that the failure to observe facilitation effects with allomorphic primes depends on the fact that, for learners, opaque words are less strongly (or not at all) fitted into a morphological schema[70]. From the psychological point of view, within the supra-lexical model, which in our view best reflects constructionist accounts, this would translate in patterns of activation coming only from related forms at the whole-word level, but no activation coming from the higher level of supra-lexical units. Similarly, bound stems might be units not salient enough for non-native speakers, differently from what we have seen for native speakers. The

[70] In addition, the overall lower frequency of allomorphic primes in Experiment 1 might have reduced the priming effects, if the words used as primes were not part of the learners' competence.

fact that second-order schemas might be less easily discovered seems to account well for the results we have found.

That reduced lexical knowledge affects patterns of morphological priming has been indeed previously demonstrated by a study by Andrews & Lo (2013). Interestingly, they found that speakers with reduced competence in spelling and vocabulary were more affected by the orthographic shape of primes and targets in a masked priming experiment: poor readers were found to be primed with both *worker – work* and *corner – corn* pairs, i.e., by morphological and pseudo-morphological primes. On the other hand, speakers with higher lexical skills were found to be strongly primed by the former and only little by the latter. Similarly, orthography was found to be a relevant factor for speakers with reduced lexical knowledge in the study by Andrews & Hersch (2010): specifically, while good spellers showed inhibition for words with high density neighbourhoods, poorer spellers appeared to be facilitated rather than inhibited in this condition.

Further evidence supporting such claims comes from studies on reading development, in which has been shown that children may have additional difficulties in recognizing the relationship between a base and a derived form when the former is not included in its entirety in the latter. The study conducted by Carlisle, Stone & Katz (2001) demonstrated that young readers with and without reading difficulties take longer to respond (in an unprimed lexical decision task) and to name English words containing a phonological alteration (stress shift, as in *major – majority*). Similarly, the study by Schiff, Raveh & Kahta (2008) revealed that Hebrew children are influenced by form overlap between primes and targets in a primed naming task. When naming targets, children benefited from primes but only when the former overlapped totally with the latter.

Partial confirmation of such results come from the study by Quémart & Casilis (2014), which revealed different patterns of masked priming (with a SOA of 60 ms) between children learning to read French and adults. Crucially, when the prime exhibited some kind of phonological or orthographic shift in the base (e.g., only phonological, as in *bergerie – berger* 'sheepfold – shepherd' or both phonological and orthographic as in *soigneux – soin* 'careful – care'), children's reaction times did not significantly differ from latencies in an orthographic condition (e.g., *fourmi*

– *four* ‘ant – oven’). However, at longer SOAs (250 ms), no effect of orthographic and phonological shifts in the base was found. Moreover, contrary to the results of the study by Carlisle, Stone & Katz (2001), adult participants were primed by all morphological primes, irrespective of allomorphic variation and prime duration.

Orthographic alteration of the base also affected the performances of Spanish young readers with and without reading deficits in the study by Lázaro, García & Burani (2015). In both a definition task (in which participants were asked to provide a definition for a derived word presented as target stimulus) and a lexical decision task, children performed worse when presented with stimuli involving phonological/orthographic alteration[71].

Taken together, such findings seem to corroborate the hypothesis supporting the importance of the recognition of the base, which seems to be a particularly salient element in cases of reduced lexical exposure. Crucially, when base recognition is impaired, morphological schemas might be less developed.

In the specific field of L2 morphological processing, moreover, further support for the hypothesis that schemas might be less developed in L2 speakers comes from the study by Dal Maso & Giraudo (2014), who observed, in native and non-native speakers, different degrees of sensitivity to the distributional characteristics of affixes in Italian, namely to their productivity (§ 2.2.2.1). Accordingly, this highlights how more productive morphological schemas might be more salient for non-native speakers who «similarly to native speakers, […] are sensitive to morphological information, but they integrate it progressively through L2 learning» (Dal Maso & Giraudo 2014: 333).

7.3 – Conclusions

The present work has focused on morphological processing in native and non-native speakers of Italian. Since questions pertaining to the mechanisms underlying lexical access and the *locus* of morphological organization are still very much open to

[71] It should be noted that the two tasks involved different kinds of alterations. In the definition task, derived words differed from their bases because of diphthongization (e.g., *dentista* ‘dentist’, which derives from *diente* ‘tooth’); in the lexical decision task, adjustments such as vowel deletion (e.g., *obrero* ‘worker’ whose base is *obra* ‘work’) were taken into consideration.

debate, the study has aimed at contributing to it by investigating the role of form-related variables.

The first part of this dissertation has focused on providing the necessary theoretical and experimental background on the main issues characterizing research on lexical access and the role of morphology in both the L1 and the L2 domains. Chapter 1 has been therefore devoted to the presentation of the relevant linguistic and psycholinguistic theoretical background, along with a comprehensive review of psycholinguistic experimental research in the domain of native morphological processing. The linguistic theoretical framework within which this work is set (paradigmatic approaches to morphology, and especially the Network Model and Construction Morphology) was presented and its main tenets sketched out.

Chapter 2 has been designed to mirror the structure of the previous section, concentrating specifically on the domain of second language acquisition. At the beginning of the chapter, we have presented the opposition found in this field as to whether the same processing mechanisms would be available to native and non-native speakers of a language. Recent experimental evidence in the field of non-native processing has been reviewed and the main subjects of debate considered.

The second part of this work has concentrated on the specific case-studies selected to investigate the role of form, namely, on the phenomena of allomorphy and bound stems in derivation. Chapter 3 has provided a brief introduction to the former and specified how the phenomenon is accounted for in the chosen linguistic framework. Moreover, a review of the main experimental findings has been outlined and the relevant predictions made by psycholinguistic models explained, along with the specific rationale for the first two experiments.

These were presented in Chapter 4, with a detailed description of the stimuli selection phase opening the chapter. Results for native speakers have basically confirmed the pattern of morphological effects found in other languages, suggesting that ortho-phonological variations in the lexical root of derived words does not hinder speakers' perception of morphological relationships in the lexicon. On the other hand, non-native speakers exhibited differing patterns of effects for allomorphic relationships. An important finding, however, emerged in Experiment 1, where learners were found to be facilitated in the recognition of base words by

prior presentation of formally transparent items. Given the existence of recent proposals that L2 learners would exclusively rely on form during processing, we highlight that such findings should lead to reconsider such strong positions, while acknowledging that form might play a more relevant role than in L1 processing. The results of Experiment 2, on the other hand, leave open the possibility that learners could more strongly perceive a relationship between nominalizations in *-tura* and *-zione* and a (supposedly) preferred base form, i.e., the participial stem. The possibility that factors other than form might produce such a preference should be further investigated.

Chapter 5 focused on the second phenomenon under investigation here, i.e., bound stems. After having provided a basic definition, an overview of the phenomenon in Italian was outlined, with observations pertaining to both the domains of prefixation and suffixation. We then explained how such stems are treated in the Network Model and in Construction Morphology, before reviewing the main psycholinguistic findings related to them. Finally, the predictions of psychological models and the rationale for the subsequent two experiments were presented.

Chapter 6 was devoted to the presentation of the design and data of such experiments. Interesting results emerged in that semantically consistent bound stem derivations were found to prime each other with native speakers, but the same population was not (morphologically) primed by semantically empty bound stems derivatives. However, lack of facilitation with prefixed verbs sharing a semantically consistent free stem seems to cast some doubts on how we should interpret such findings. Hypotheses concerning potential asymmetries between prefixation and suffixation, the role of prefixes, and lexicalization phenomena have been put forward. It goes without saying, however, that such hypotheses need further empirical validation. Non-native speakers, on the other hand, appeared to be sensitive to the characteristic under investigation, i.e., stem autonomy. Specifically, they were only facilitated by pairs of words containing freely occurring stems.

Chapter 7 integrated the findings obtained in the four experiments, proposing that a supra-lexical model of morphological organization, reflecting a model of the lexicon such as the one posited by CxM, can best account for the observed effects, in both L1 and L2. Specifically, while learners would be indeed more influenced

by form-related characteristics of the words, an account in which morphological organization emerges on the basis of form-meaning systematic correspondences has the potential of explaining the findings of the present work.

To conclude, while the role of form is still a subject of discussion in the domain of native processing, the results here presented are globally in line with the findings emerging from other languages highlighting the strength of morphological relationships, and add to the existing body of psycholinguistic evidence for Italian, which in the past has been mostly focused on inflection. For what concerns L2 morphological processing, on the other hand, such a variable is currently at the centre of debate in the field of second language acquisition, which has received increasing attention in recent years. While many questions related to this factor and its potential interplay with other aspects (such as age of acquisition and frequency of exposure) are still awaiting an answer, new evidence for the role of morphology in the L2 lexicon has been provided.

REFERENCES

Anderson, S. (1992). *A-morphous morphology*. New York: Cambridge University Press.

Andrews, S. & Hersch, J. (2010). Lexical precision in skilled readers: Individual differences in masked neighbor priming. *Journal of Experimental Psychology: General*, *139*(2), 299–318.

Andrews, S. & Lo, S. (2013). Is morphological priming stronger for transparent than opaque words? It depends on individual differences in spelling and vocabulary. *Journal of Memory and Language*, *68*(3), 279–296.

Aronoff, M. (1976). *Word formation in generative grammar*. Cambridge, MA: MIT Press.

Aronoff, M. & Fudeman, K. (2005). *What is morphology?* Oxford: Blackwell.

Baayen, H. R. (2014). Experimental and psycholinguistic approaches to studying derivation. *Handbook of Derivational Morphology*, 95–117.

Baayen, H. R., Dijkstra, T. & Schreuder, R. (1997). Singulars and plurals in Dutch: Evidence for a parallel dual-route model. *Journal of Memory and Language*, *37*(1), 94–117.

Baayen, H. R., Lieber, R. & Schreuder, R. (1997). The morphological complexity of simplex nouns. *Linguistics*, *35*, 861–877.

Baayen, H. R., Milin, P., Đurđević, D. F., Hendrix, P. & Marelli, M. (2011). An amorphous model for morphological processing in visual comprehension based on naive discriminative learning. *Psychological Review*, *118*(3), 438–481.

Baayen, H. R., Milin, P. & Ramscar, M. (2016). Frequency in lexical processing. *Aphasiology*, *30*(11), 1174–1220.

Baayen, H. R. & Moscoso del Prado Martín, F. (2005). Semantic density and past-tense formation in three Germanic languages. *Language*, *81*(3), 666–698.

Baayen, H. R., Tweedie, F. J. & Schreuder, R. (2002). The subjects as a simple random effect fallacy: Subject variability and morphological family effects in the mental lexicon. *Brain and Language*, *81*, 55–65.

Balota, D. A., Cortese, M. J., Sergent-Marshall, S. D., Spieler, D. H. & Yap, M. J. (2004). Visual Word Recognition of Single-Syllable Words. *Journal of Experimental Psychology: General*, *133*(2), 283–316.

Banfi, E. & Bernini, G. (2003). Il verbo. In A. Giacalone Ramat (Ed.), *Verso l'italiano* (pp. 70–115). Roma: Carocci.

Baroni, M., Bernardini, S., Ferraresi, A. & Zanchetta, E. (2009). The WaCky wide web: a collection of very large linguistically processed web-crawled corpora. *Language Resources and Evaluation*, *43*(3), 209–226.

Basnight-Brown, D. M., Chen, L., Hua, S., Kostić, A. & Feldman, L. B. (2007). Monolingual and bilingual recognition of regular and irregular English verbs: Sensitivity to form similarity varies with first language experience. *Journal of Memory and Language*, *57*(1), 65–80.

Beauvillain, C. (1996). The integration of morphological and whole-word form information during eye fixations on prefixed and suffixed words. *Journal of Memory and Language*, *35*, 801–820.

Beckner, C., Blythe, R., Bybee, J., Christiansen, M. H., Croft, W., Ellis, N. C., Schoenemann, T. (2009). Language is a complex adaptive system: Position paper. *Language Learning*, *59*(s1), 1–26.

Bertram, R., Baayen, H. R. & Schreuder, R. (2000). Effects of Family Size for Complex Words. *Journal of Memory and Language*, *42*(3), 390–405.

Bertram, R., Laine, M. & Karvinen, K. (1999). The interplay of word formation type, affixal homonymy, and productivity in lexical processing: Evidence from a morphologically rich language. *Journal of Psycholinguistic Research*, *28*, 213–226.

Bertram, R., Schreuder, R. & Baayen, H. R. (2000). The balance of storage and computation in morphological processing: The role of word formation type, affixal homonymy, and productivity. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *26*(2), 489–511.

Birdsong, D. (1999). *Second language acquisition and the Critical Period Hypothesis*. Mahwah, NJ: Lawrence Erlbaum Associates.

Birdsong, D. (2006). Age and second language acquisition and processing: a selective overview. *Language Learning*, *56*, 9–49.

Bisetto, A. (1999). Il suffisso -tore. In A. Bisetto (Ed.), *Studi di morfologia teorica dell'italiano* (pp. 43–74). Padova: Unipress.

Bloomfield, L. (1933). *Language*. New York: Holt.

Booij, G. (2000). Morphology and phonology. In G. Booij, C. Lehmann & M. Joachim (Eds.), *Morphology. An International Handbook on Inflection and Word-formation. Vol. 1* (pp. 335–343). Berlin; New York: De Gruyter Mouton.

Booij, G. (2005). *The grammar of words: an introduction to linguistic morphology*. Oxford; New York: Oxford University Press.

Booij, G. (2010). *Construction Morphology*. Oxford: Oxford University Press.

Booij, G. (2015). Word-formation in construction grammar. In P. O. Müller, I. Ohnheiser, S. Olsen & F. Rainer (Eds.), *Word Formation. An International Handbook of the Languages of Europe. Vol. 1* (pp. 188–202). Berlin; New York: De Gruyter Mouton.

Booij, G. (2017). Inheritance and motivation in Construction Morphology. In N. Gisborne & A. Hippisley (Eds.), *Defaults in morphological theory* (pp. 18–39). Oxford: Oxford University Press.

Booij, G. & Audring, J. (to appear). Partial motivation, multiple motivation: the role of output schemas in morphology. In G. Booij (Ed.), *The construction of words. Advances in Construction Morphology*. Dordrecht: Springer.

Booij, G. & Van der Veer, B. (2015). Allomorphy in OT: the Italian mobile diphthongs. In E. Bonet, M.-R. Lloret & J. Mascaró (Eds.), *Understanding allomorphy: perspectives from Optimality Theory* (pp. 45–69). London: Equinox.

Bosch, S. & Clahsen, H. (2015). Accessing morphosyntactic information in L1 and L2 word recognition: A masked priming study. In E. Grillo & K. Jepson (Eds.), *BUCLD 39: Proceedings of BUCLD 39* (Vol. 1, pp. 101–112). Somerville, MA: Cascadilla Press.

Brysbaert, M. & New, B. (2009). Moving beyond Kučera and Francis: A critical evaluation of current word frequency norms and the introduction of a new and improved word frequency measure for American English. *Behavior Research Methods*, *41*(4), 977–990.

Burani, C. (1990). The lexical representation of prefixed words. *Acta Linguistica Hungarica*, *40*(1–2), 95–114.

Burani, C. (2006). Morfologia: i processi. In A. Laudanna & M. Voghera (Eds.), *Il linguaggio. Strutture linguistiche e processi cognitivi* (pp. 112–129). Bari: Editori Laterza.

Burani, C. & Caramazza, A. (1987). Representation and processing of derived words. *Language and Cognitive Processes*, *2*(3–4), 217–227.

Burani, C., Dovetto, F. M., Thornton, A. M. & Laudanna, A. (1997). Accessing and naming suffixed pseudo-words. In G. Booij & J. van Marle (Eds.), *Yearbook of Morphology1996* (pp. 55–72). Dordrecht: Kluwer.

Burani, C. & Laudanna, A. (1992). Units of representation of derived words in the lexicon. In R. Frost & L. Katz (Eds.), *Orthography, phonology, morphology, and meaning*. (pp. 361–376). Amsterdam: North-Holland.

Burani, C. & Laudanna, A. (2003). Morpheme-based lexical reading: Evidence from pseudo-word naming. In E. M. H. Assink & D. Sandra (Eds.), *Reading complex words: Cross-language studies* (pp. 241–264). Dordrecht: Kluwer.

Burani, C., Laudanna, A. & Cermele, A. (1992). Errors on prefixed verbal forms: Effects of root type and number of prefixed related forms. *Rivista Di Linguistica*, *4*, 273–295.

Burani, C., Salmaso, D. & Caramazza, A. (1984). Morphological structure and lexical access. *Visible Language*, *18*(4), 348–358.

Burani, C. & Thornton, A. M. (2003). The interplay of root, suffix and whole-word frequency in processing derived words. In H. R. Baayen & R. Schreuder (Eds.), *Morphological structure in language processing* (pp. 157–208). Berlin: Mouton de Gruyter.

Burgess, C. & Livesay, K. (1998). The effect of corpus size in predicting reaction time in a basic word recognition task: Moving on from Kučera and Francis. *Behavior Research Methods, Instruments & Computers*, *30*, 272–277.

Bybee, J. (1988). Morphology as lexical organization. In M. Hammond & M. Noonan (Eds.), *Theoretical morphology* (pp. 119–141). San Diego: Academic Press.

Bybee, J. (1995). Regular morphology and the lexicon. *Language and Cognitive Processes*, *10*, 425–455.

Bybee, J. (2010). *Language, Usage and Cognition.* Leiden: Cambridge University Press.

Bybee, J. L. (1985). *Morphology: a study of the relation between meaning and form*. Amsterdam; Philadelphia: J. Benjamins.

Bybee, J. L. (2001). *Phonology and language use*. Cambridge, [England]; New York: Cambridge University Press.

Bybee, J. L. & Beckner, C. (2010). Usage-based Theory. In B. Heine & H. Narrog (Eds.), *The Oxford Handbook of Linguistic Analysis.* (pp. 827–856). Oxford: Oxford University Press.

Bybee, J. & McClelland, J. L. (2005). Alternatives to the combinatorial paradigm of linguistic theory based on domain general principles of human cognition. *The Linguistic Review*, *22*(2–4), 381–410.

Caramazza, A., Laudanna, A. & Romani, C. (1988). Lexical access and inflectional morphology. *Cognition*, *28*(3), 297–332.

Carlisle, J.F., Stone, C.A. & Katz, L.A. (2001). The effects of phonological transparency on reading derived words. *Annals of Dyslexia*, 51, 249–274.

Carstairs, A. (1987). *Allomorphy in inflexion*. London: Croom Helm.

Carstairs, A. (1988). Some implications of phonologically conditioned suppletion. In G. Booij & J. van Marle (Eds.), *Yearbook of Morphology 1988* (pp. 63–94). Dordrecht: Kluwer.

Chateau, D., Knudsen, E. V. & Jared, D. (2002). Masked Priming of Prefixes and the Influence of Spelling–Meaning Consistency. *Brain and Language*, *81*(1–3), 587–600.

Chialant, D. & Burani, C. (1992). Errors on prefixed verbal forms: Effects of root type and prefix type. *Rivista Di Linguistica*, *4*, 297–317.

Chomsky, N. (1981). *Lectures on government and binding*. Dordrecht: Foris.

Chomsky, N. (1995). *The minimalist program*. Cambridge, MA: MIT Press.

Chomsky, N. & Halle, M. (1968). *The sound pattern of English*. New York: Harper & Row.

Clahsen, H. (1999). Lexical entries and rules of language: A multidisciplinary study of German inflection. *Behavioral and Brain Sciences*, *22*(6), 991–1013.

Clahsen, H. & Felser, C. (2006). Grammatical processing in language learners. *Applied Psycholinguistics*, *27*(01), 3–42.

Clahsen, H. & Felser, C. (2017). Some notes on the shallow structure hypothesis. *Studies in Second Language Acquisition*, 1–14.

Clahsen, H., Felser, C., Neubauer, K., Sato, M. & Silva, R. (2010). Morphological structure in native and nonnative language processing. *Language Learning*, *60*(1), 21–43.

Clahsen, H. & Neubauer, K. (2010). Morphology, frequency, and the processing of derived words in native and non-native speakers. *Lingua*, *120*(11), 2627–2637.

Clahsen, H., Sonnenstuhl, I. & Blevins, J. P. (2003). Derivational morphology in the German mental lexicon: A dual mechanism account. In H. R. Baayen & R. Schreuder (Eds.), *Morphological structure in language processing* (pp. 125–155). Berlin: Mouton de Gruyter.

Clahsen, H. & Veríssimo, J. (2016). Investigating grammatical processing in bilinguals: The case of morphological priming. *Linguistic Approaches to Bilingualism*, *6*(5), 685–698.

Colé, P., Beauvillain, C. & Segui, J. (1989). On the representation and processing of prefixed and suffixed derived words: A differential frequency effect. *Journal of Memory and Language*, *28*, 1–13.

Colombo, L. & Burani, C. (2002). The influence of age of acquisition, root frequency and context availability in processing nouns and verbs. *Brain and Language*, *81*, 398–411.

Coltheart, M. (1987). Functionalist architecture of the language processing system. In M. Coltheart, G. Sartori & R. Job (Eds.), *The Cognitive Neuropsychology of Language*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Coltheart, M., Curtis, B., Atkins, P. & Haller, M. (1993). Models of reading aloud: Dual-route and parallel-distributed-processing approaches. *Psychological Review*, *100*, 589–608.

Coughlin, C. E. & Tremblay, A. (2015). Morphological decomposition in native and non-native French speakers. *Bilingualism: Language and Cognition, 18*(03), 524–542.

Crepaldi, D., Rastle, K., Coltheart, M. & Nickels, L. (2010). 'Fell' primes 'fall', but does 'bell' prime 'ball'? Masked priming with irregularly-inflected primes. *Journal of Memory and Language, 63*(1), 83–99.

Dahl, Ö. (1985). *Tense and aspect systems*. Oxford: Blackwell.

Dal Maso, S. & Giraudo, H. (2014). Morphological processing in L2 Italian: Evidence from a masked priming study. *Lingvisticae Investigationes*, *37*(2), 322–337.

Davis, C. J. & Bowers, J. S. (2006). Contrasting five different theories of letter position coding: Evidence from orthographic similarity effects. *Journal of Experimental Psychology: Human Perception and Performance*, *32*(3), 535–557.

De Jong, N. H., Feldman, L. B., Schreuder, R., Pastizzo, M. J. & Baayen, H. R. (2002). The processing and representation of Dutch and English compounds: Peripheral morphological and central orthographic effects. *Brain and Language*, *81*, 555–567.

De Jong, N. H., Schreuder, R. & Baayen, H. R. (2000). The morphological family size effect and morphology. *Language and Cognitive Processes*, *15*(4–5), 329–365.

DeKeyser, R. M. (2000). The robustness of critical period effects in second language acquisition. *Studies in Second Language Acquisition*, *22*(4), 499–533.

Diependaele, K., Duñabeitia, J. A., Morris, J. & Keuleers, E. (2011). Fast morphological effects in first and second language word recognition. *Journal of Memory and Language*, *64*(4), 344–358.

Diependaele, K., Grainger, J. & Sandra, D. (2012). Derivational morphology and skilled reading: An empirical overview. In M. Spivey, K. McRae & M. Joanisse (Eds.), *The Cambridge Handbook of Psycholinguistics.* (pp. 311–332). Cambridge: Cambridge University Press.

Diependaele, K., Sandra, D. & Grainger, J. (2005). Masked cross-modal morphological priming: Unravelling morpho-orthographic and morpho-semantic influences in early word recognition. *Language and Cognitive Processes*, *20*(1–2), 75–114.

Diependaele, K., Sandra, D. & Grainger, J. (2009). Semantic transparency and masked morphological priming: The case of prefixed words. *Memory & Cognition*, *37*(6), 895–908.

Dijkstra, T. & Van Heuven, W. J. B. (1998). The BIA model of bilingual word recognition. In J. Grainger & A. M. Jacobs (Eds.), *Localist Connectionist Approaches to Human Cognition* (pp. 198–225). Mahwah, NJ: Lawrence Erlbaum Associates.

Dijkstra, T. & Van Heuven, W. J. B. (2002). The architecture of the bilingual word recognition system: From identification to decision. *Bilingualism: Language and Cognition*, *5*(3), 175–197.

Domínguez, A., Cuetos, F. & Segui, J. (2000). Morphological processing in word recognition: A review with particular reference to Spanish data. *Psicológica*, *21*(2).

Dörnyei, Z. (2009). *The psychology of second language acquisition*. Oxford: Oxford University Press.

Dressler, W. U. (1985). On the predictiveness of Natural Morphology. *Journal of Linguistics*, *21*(2), 321–337.

Dressler, W. U. (1987). Word-formation as a part of natural morphology. In W. U. Dressler, W. Mayerthaler, O. Panagl & W. U. Wurzel (Eds.), *Leitmotifs in Natural Morphology* (pp. 99–126). Amsterdam; Philadelphia: John Benjamins.

Dressler, W. U. (2005). Word-formation in natural morphology. In P. Štekauer & R. Lieber (Eds.), *Handbook of Word-Formation* (pp. 267–284). Dordrecht: Springer.

Dressler, W. U. (2015). Allomorphy. In P. O. Müller, I. Ohnheiser, S. Olsen & F. Rainer (Eds.), *Word-Formation: An International Handbook of the Languages of Europe. Vol. 1* (pp. 500–515). Berlin; New York: De Gruyter Mouton.

Drews, E. & Zwitserlood, P. (1995). Morphological and orthographic similarity in visual word recognition. *Journal of Experimental Psychology: Human Perception and Performance*, *21*(5), 1098–1116.

Dulay, H. C. & Burt, M. K. (1978). Some remarks on creativity in language acquisition. In W. C. Ritchie (Ed.), *Second language acquisition research: Issues and implications* (pp. 65–89). New York: Academic Press.

Duñabeitia, J. A., Perea, M. & Carreiras, M. (2008). Does darkness lead to happiness? Masked suffix priming effects. *Language and Cognitive Processes*, *23*(7–8), 1002–1020.

Ellis, N. C. (2006). Selective Attention and Transfer Phenomena in L2 Acquisition: Contingency, Cue Competition, Salience, Interference, Overshadowing, Blocking, and Perceptual Learning. *Applied Linguistics*, *27*(2), 164–194.

Ellis, N. C. & Wulff, S. (2015). Usage-based approaches to SLA. In B. VanPatten & J. Williams (Eds.), *Theories in Second Language Acquisition: An Introduction* (pp. 75–93). New York: Routledge/Taylor and Francis Group.

Emmorey, K. D. (1989). Auditory morphological priming in the lexicon. *Language and Cognitive Processes*, *4*, 73–92.

Feldman, L. B., Barac-Cikoja, D. & Kostić, A. (2002). Semantic aspects of morphological processing: Transparency effects in Serbian. *Memory & Cognition*, *30*(4), 629–636.

Feldman, L. B. & Fowler, C. A. (1987). The inflected noun system in Serbian: lexical representation of morphological structure. *Memory & Cognition*, *15*(1), 1–12.

Feldman, L. B., Kostić, A., Basnight-Brown, D. M., Durđević, D. F. & Pastizzo, M. J. (2010). Morphological facilitation for regular and irregular verb formations in native and non-native speakers: Little evidence for two distinct mechanisms. *Bilingualism: Language and Cognition*, *13*(02), 119–135.

Feldman, L. B. & Larabee, J. (2001). Morphological facilitation following prefixed but not suffixed words: Lexical architecture or modality-specific processes? *Journal of Experimental Psychology: Human Perception and Performance*, *27*, 680–691.

Feldman, L. B., Milin, P., Cho, K. W., Moscoso del Prado Martín, F. & O'Connor, P. A. (2015). Must analysis of meaning follow analysis of form? A time course analysis. *Frontiers in Human Neuroscience*, *9*.

Feldman, L. B., O'Connor, P. A. & Moscoso del Prado Martín, F. (2009). Early morphological processing is morphosemantic and not simply morpho-orthographic: A violation of form-then-meaning accounts of word recognition. *Psychonomic Bulletin & Review*, *16*(4), 684–691.

Feldman, L. B. & Soltano, E. G. (1999). Morphological Priming: The Role of Prime Duration, Semantic Transparency, and Affix Position. *Brain and Language*, *68*(1–2), 33–39.

Feldman, L. B. & Weber, K. (2012). Morphological processing: A comparison of graded and categorical accounts. In J. S. Adelman (Ed.), *Visual Word Recognition. Volume 2. Meaning and Context, Individuals and Development* (pp. 3–23). Hove: Psychology Press.

Ferrand, L. & Grainger, J. (1994). Effects of orthography are independent of phonology in masked form priming. *Quarterly Journal of Experimental Psychology*, *47A*, 365–382.

Foote, R. (2015). The storage and processing of morphologically complex words in L2 Spanish. *Studies in Second Language Acquisition*, 1–33.

Ford, M. A., Davis, M. H. & Marslen-Wilson, W. D. (2010). Derivational morphology and base morpheme frequency. *Journal of Memory and Language*, *63*(1), 117–130.

Forster, K. I. (1999). The microgenesis of priming effects in lexical access. *Brain and Language*, *68*, 5–15.

Forster, K. I. & Azuma, T. (2000). Masked priming for prefixed words with bound stems: Does submit prime permit? *Language and Cognitive Processes*, *15*(4–5), 539–561.

Forster, K. I. & Davis, C. (1984). Repetition priming and frequency attenuation in lexical access. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *10*(4), 680–698.

Forster, K. I., Davis, C., Schoknecht, C. & Carter, R. (1987). Masked priming with graphemically related forms: repetition or partial activation? *Quarterly Journal of Experimental Psychology Section A: Human Experimental Psychology*, *39*(2), 211–251.

Forster, K. I. & Forster, J. C. (2003). DMDX: A Windows display program with millisecond accuracy. *Behavior Research Methods, Instruments & Computers*, *35*(1), 116–124.

Fowler, C. A., Napps, S. E. & Feldman, L. B. (1985). Relations among regular and irregular morphologically related words in the lexicon as revealed by repetition priming. *Memory & Cognition*, *13*(3), 241–255.

Frauenfelder, U. H. & Schreuder, R. (1992). Constraining psycholinguistic models of morphological processing and representation: The role of productivity. In G. Booij & J. van Marle (Eds.), *Yearbook of Morphology 1991* (pp. 165–183). Dordrecht: Kluwer.

Frost, R., Deutsch, A. & Forster, K. I. (2000). Decomposing morphologically complex words in a nonlinear morphology. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *26*(3), 751–765.

Gaeta, L. (2004). Nomi d'azione. In M. Grossmann & F. Rainer (Eds.), *La formazione delle parole in italiano* (pp. 314–350). Tübingen: Niemeyer.

Gass, S. M., Spinner, P. & Behney, J. (Eds.). (2018). *Salience in second language acquisition*. New York: Routledge.

Gernsbacher, M. A. (1984). Resolving 20 years of inconsistent interactions between lexical familiarity and orthography, concreteness, and polysemy. *Journal of Experimental Psychology: General*, *113*(2), 256–281.

Giacalone Ramat, A. (2002). How do learners acquire the classical three categories of temporality? Evidence from L2 Italian. In M. R. Salaberry & Y. Shirai (Eds.), *Description and Explanation in the L2 Acquisition of Tense–Aspect Morphology* (pp. 221–248). Amsterdam: John Benjamins.

Giraudo, H. & Dal Maso, S. (2016a). *Bad data in psycholinguistic research on morphological processing*. Presented at the Workshop 'Dealing with bad data in linguistic theory' at the Meertens Institute, Amsterdam (The Netherlands), March 17-18, 2016.

Giraudo, H. & Dal Maso, S. (2016b). Suffix perceptual salience in morphological masked priming. *Lingue e Linguaggio, 15*(1), 85–106.

Giraudo, H. & Grainger, J. (2000). Effects of prime word frequency and cumulative root frequency in masked morphological priming. *Language and Cognitive Processes, 15*(4–5), 421–444.

Giraudo, H. & Grainger, J. (2001). Priming complex words: Evidence for supralexical representation of morphology. *Psychonomic Bulletin & Review, 8*(1), 127–131.

Giraudo, H. & Grainger, J. (2003). On the role of derivational affixes in recognizing complex words: Evidence from masked priming. In H. R. Baayen & R. Schreuder (Eds.), *Morphological structure in language processing* (pp. 209–232). Berlin: Mouton de Gruyter.

Giraudo, H. & Orihuela, K. (2015). Visual word recognition of morphologically complex words: Effects of prime word and root frequency. In V. Pirrelli, C. Marzi & M. Ferro (Eds.), *Proceedings of the NetWordS Final Conference, Pisa, March 30-April 1, 2015* (pp. 128–131). published at http://ceur-ws.org.

Giraudo, H. & Voga, M. (2013). Prefix units within the mental lexicon. In N. Hathout, F. Montermini & J. Tseng (Eds.), *Morphology in Toulouse. Selected Proceedings of Décembrettes 8* (pp. 61–68). München: Lincom Europa.

Giraudo, H. & Voga, M. (2014). Measuring morphology: the tip of the iceberg? A retrospective on 10 years of morphological processing. *Cahiers de Grammaire*.

Giraudo, H. & Voga, M. (2016). Words matter more than morphemes: An investigation of masked priming effects with complex words and non-words. *Italian Journal of Linguistics, 28*(1), 49–77.

Goldschneider, J. M. & DeKeyser, R. M. (2001). Explaining the "Natural Order of L2 Morpheme Acquisition" in English: A Meta-analysis of multiple determinants. *Language Learning, 51*(1), 1–50.

Gonnerman, L. M., Seidenberg, M. S. & Andersen, E. S. (2007). Graded semantic and phonological similarity effects in priming: Evidence for a distributed connectionist approach to morphology. *Journal of Experimental Psychology: General*, *136*(2), 323–345.

Gor, K. & Cook, S. (2010). Nonnative processing of verbal morphology: In search of regularity. *Language Learning*, *60*(1), 88–126.

Gor, K. & Jackson, S. (2013). Morphological decomposition and lexical access in a native and second language: A nesting doll effect. *Language and Cognitive Processes*, *28*(7), 1065–1091.

Grainger, J., Colé, P. & Segui, J. (1991). Masked morphological priming in visual word recognition. *Journal of Memory and Language*, *30*, 370–384.

Grainger, J., Kiyonaga, K. & Holcomb, P. J. (2006). The Time Course of Orthographic and Phonological Code Activation. *Psychological Science*, *17*(12), 1021–1026.

Grossmann, M. & Rainer, F. (Eds.). (2004). *La formazione delle parole in italiano*. Tübingen: M. Niemeyer.

Hakuta, K., Bialystok, E. & Wiley, E. (2003). Critical Evidence: A test of the Critical-Period Hypothesis for Second-Language Acquisition. *Psychological Science*, *14*(1), 31–38.

Halle, M. & Marantz, A. (1993). Distributed Morphology and the Pieces of Inflection. In K. Hale & S. J. Keyser (Eds.), *The View from Building 20* (pp. 111–176). Cambridge: MIT Press.

Haspelmath, M. (2002). *Understanding morphology*. London: Arnold.

Heyer, V. & Clahsen, H. (2015). Late bilinguals see a scan in scanner AND in scandal: dissecting formal overlap from morphological priming in the processing of derived words. *Bilingualism: Language and Cognition*, *18*(03), 543–550.

Heyer, V. & Kornishova, D. (2017). Semantic transparency affects morphological priming…eventually. *The Quarterly Journal of Experimental Psychology*. DOI: 10.1080/17470218.2017.1310915.

Holmes, V. M. & O'Regan, J. (1992). Reading derivationally affixed French words. *Language and Cognitive Processes*, *7*(2), 163–192.

Iacobini, C. (1999). I prefissi dell'italiano. In P. Benincà, A. Mioni & L. Vanelli (Eds.), *Atti del XXXI congresso della Società di Linguistica Italiana (Padova, 25-27 settembre 1997)* (pp. 369–399). Roma: Bulzoni.

Iacobini, C. (2004). Prefissazione. In M. Grossmann & F. Rainer (Eds.), *La formazione delle parole in italiano* (pp. 97–163). Tübingen: Niemeyer.

Iacobini, C. (2005). I verbi italiani come base di derivazione prefissale. In *La formazione delle parole* (pp. 289–307). Roma: Bulzoni.

Jackendoff, R. (1975). Morphological and Semantic Regularities in the Lexicon. *Language*, *51*(3), 639–671.

Jacob, G., Fleischhauer, E. & Clahsen, H. (2013). Allomorphy and affixation in morphological processing: a cross-modal priming study with late bilinguals. *Bilingualism: Language and Cognition*, *16*(4), 924–933.

Jacob, G., Heyer, V. & Veríssimo, J. (2017). Aiming at the same target: A masked priming study directly comparing derivation and inflection in the second language. *International Journal of Bilingualism*. DOI: 10.1177/1367006916688333.

Jarema, G. & Libben, G. (2007). Introduction: Matters of Definition and Core Perspectives. In *The Mental Lexicon: Core Perspectives* (pp. 1–6). Amsterdam: Elsevier.

Juffs, A. (2001). Psycholinguistically oriented second language research. *Annual Review of Applied Linguistics*, *21*, 207–220.

Kirkici, B. & Clahsen, H. (2013). Inflection and derivation in native and non-native language processing: Masked priming experiments on Turkish. *Bilingualism: Language and Cognition*, *16*(04), 776–791.

Krause, H., Bosch, S. & Clahsen, H. (2015). Morphosyntax in the bilingual mental lexicon. *Studies in Second Language Acquisition*, *37*(04), 597–621.

Kroll, J. F. & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations. *Journal of Memory and Language*, *33*, 149–174.

Kučera, H. & Francis, W. (1967). *Computational analysis of presentday American English*. Providence, RI: Brown University Press.

Kuperman, V., Bertram, R. & Baayen, R. H. (2010). Processing trade-offs in the reading of Dutch derived words. *Journal of Memory and Language*, *62*(2), 83–97.

Kuperman, V., Schreuder, R., Bertram, R. & Baayen, H. R. (2009). Reading of polymorphemic Dutch compounds: Towards a multiple route model of lexical processing. *Journal of Experimental Psychology: Human Perception and Performance*, *35*, 876–895.

Langacker, R. (1987). *Foundations of cognitive grammar. Theoretical prerequisites.* (Vol. 1). Stanford, CA: Stanford University Press.

Laudanna, A. & Burani, C. (1986). Effetti di ripetizione e priming su forme verbali morfologicamente collegate. *Giornale Italiano Di Psicologia*, *13*, 123–139.

Laudanna, A. & Burani, C. (1995). Distributional properties of derivational affixes: Implications for processing. In L. B. Feldman (Ed.), *Morphological aspects of language processing* (pp. 345–364). Hillsdale, NJ: Lawrence Erlbaum Associates.

Laudanna, A., Burani, C. & Cermele, A. (1994). Prefixes as processing units. *Language and Cognitive Processes*, *9*(3), 295–316.

Laudanna, A., Voghera, M. & Gazzellini, S. (2002). Lexical representations of written nouns and verbs in Italian. *Brain and Language*, *81*, 250–263.

Lázaro, M. (2012). The Effects of Base Frequency and Affix Productivity in Spanish. *The Spanish Journal of Psychology*, *15*(02), 505–512.

Lázaro, M., García, L. & Burani, C. (2015). How orthographic transparency affects morphological processing in young readers with and without reading disability. *Scandinavian Journal of Psychology*, *56*, 498–507.

Lázaro, M., Sainz, J. & Illera, V. (2015). The role of derivative suffix productivity in the visual word recognition of complex words. *Psicológica*, *36*(2), 165–184.

Lehtonen, M. & Laine, M. (2003). How word frequency affects morphological processing in monolinguals and bilinguals. *Bilingualism: Language and Cognition*, *6*(3), 213–225.

Lehtonen, M., Niska, H., Wande, E., Niemi, J. & Laine, M. (2006). Recognition of Inflected Words in a Morphologically Limited Language: Frequency Effects in Monolinguals and Bilinguals. *Journal of Psycholinguistic Research*, *35*(2), 121–146.

Lenneberg, E. H. (1967). *Biological Foundations of Language*. New York: Wiley.

Libben, G. (2015). Word-formation in psycholinguistics and neurocognitive research. In P. O. Müller, I. Ohnheiser, S. Olsen & F. Rainer (Eds.), *Word Formation. An International Handbook of the Languages of Europe.* (Vol. 1, pp. 203–216). Berlin; New York: De Gruyter Mouton.

Ling, C. X. & Marinov, M. (1994). A symbolic model of the nonconscious acquisition of information. *Cognitive Science*, *18*(4), 595–621.

Longtin, C.-M., Segui, J. & Hallé, P. A. (2003). Morphological priming without morphological relationship. *Language and Cognitive Processes*, *18*(3), 313–334.

Lüdeling, A. & De Jong, N. H. (2002). German particle verbs and word formation. In N. Dehé, R. Jackendoff, A. McIntyre & S. Urban (Eds.), *Explorations in Verb-Particle Constructions* (pp. 315–333). Berlin: Mouton de Gruyter.

Lukatela, G., Gligorijevic, B., Kostic, A. & Turvey, M. T. (1980). Representation of inflected nouns in the internal lexicon. *Memory & Cognition*, *8*(5), 415–423.

MacWhinney, B. (1997). Second language acquisition and the competition model. In A. M. B. de Groot & J. F. Kroll (Eds.), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 113–142). Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.

Manelis, L. & Tharp, D. A. (1977). The processing of affixed words. *Memory & Cognition*, *5*(6), 690–695.

Marangolo, P., Incoccia, C., Pizzamiglio, L., Sabatini, U., Castriota-Scanderbeg, A. & Burani, C. (2003). The right hemisphere involvement in the processing of morphologically derived words. *Journal of Cognitive Neuroscience*, *15*(3), 364–371.

Marangolo, P., Piras, F. Galati, G. & Burani, C. (2006). Functional anatomy of derivational morphology, *Cortex*, *42*, 1093–1106.

Marchand, H. (1969). *The Categories and Types of Present-Day English Word-Formation. A Synchronic-Diachronic Approach*. München: Beck.

Marslen-Wilson, W. D. (1999). Abstractness and combination: the morphemic lexicon. In S. Garrod & M. J. Pickering (Eds.), *Language processing* (pp. 101–109). Hove: Psychology Press.

Marslen-Wilson, W. D., Ford, M., Older, L. & Zhou, X. (1996). The combinatorial lexicon: priming derivational affixes. In *Proceedings of the 18th Annual Conference of the Cognitive Science Society* (pp. 223–227). La Jolla, CA: Lawrence Erlbaum Associates.

Marslen-Wilson, W. D., Hare, M. & Older, L. (1995). *Priming and blocking in the mental lexicon: The English past tense*. Presented at the Meeting of the Experimental Psychology Society, London, January.

Marslen-Wilson, W., Tyler, L. K., Waksler, R. & Older, L. (1994). Morphology and meaning in the English mental lexicon. *Psychological Review*, *101*(1), 3–33.

McClelland, J. L. & Bybee, J. L. (2007). The gradience of gradience: a reply to Jackendoff. *The Linguistic Review*, *24*(4), 437–455.

McCormick, S. F., Brysbaert, M. & Rastle, K. (2009). Is morphological decomposition limited to low-frequency words? *The Quarterly Journal of Experimental Psychology*, *62*(9), 1706–1715.

McCormick, S. F., Rastle, K. & Davis, M. H. (2008). Is there a 'fete' in 'fetish'? Effects of orthographic opacity on morpho-orthographic segmentation in visual word recognition. *Journal of Memory and Language*, *58*, 307–326.

McDonald, J. (2006). Beyond the critical period: Processing-based explanations for poor grammaticality judgment performance by late second language learners. *Journal of Memory and Language*, *55*, 381–401.

McQueen, J. M. & Cutler, A. (1998). Morphology in word recognition. In A. Zwicky & A. Spencer (Eds.), *The handbook of morphology*. (pp. 406–427). Oxford: Blackwell.

Melloni, C. (2006). Logical polysemy in word formation: E and R suffixes. *Lingue e Linguaggio*, *2*, 281–308.

Meunier, F. & Marslen-Wilson, W. D. (2004). Regularity and irregularity in French verb inflection. *Language and Cognitive Processes*, *19*, 561–580.

Meunier, F. & Segui, J. (2002). Cross-Modal Morphological Priming in French. *Brain and Language*, *81*(1–3), 89–102.

Milin, P., Feldman, L. B., Ramscar, M., Hendrix, P. & Baayen, R. H. (2017). Discrimination in lexical decision. *PloS One*, *12*(2).

Milin, P., Smolka, E. & Feldman, L. B. (2017). Models of Lexical Access and Morphological Processing. In E. M. Fernández & H. S. Cairns (Eds.), *The Handbook of Psycholinguistics* (pp. 240–268). Hoboken, NJ, USA: John Wiley & Sons, Inc.

Montermini, F. (2008). *Il lato sinistro della morfologia*. Milano: Franco Angeli.

Moscoso del Prado Martín, F., Bertram, R., Häikiö, T., Schreuder, R. & Baayen, R. H. (2004). Morphological family size in a morphologically rich language: the case of Finnish compared with Dutch and Hebrew. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *30*(6), 1271–1278.

Murrell, G. A. & Morton, J. (1974). Word recognition and morphemic structure. *Journal of Experimental Psychology*, *102*(6), 963–968.

Napps, S. E. (1989). Morphemic relationships in the lexicon: Are they distinct from semantic and formal relationships? *Memory & Cognition*, *17*(6), 729–739.

Nefs, H. T., Assink, E. M. H. & Knuijt, P. P. N. A. (2003). Effects of Sublexical Frequency and Meaning in Prefixed Words. In E. M. H. Assink & D. Sandra (Eds.), *Reading complex words: Cross-language studies* (pp. 191–219). Dordrecht: Kluwer.

Neubauer, K. & Clahsen, H. (2009). Decomposition of inflected words in a second language. *Studies in Second Language Acquisition*, *31*(03), 403–435.

Nida, E. A. (1948). The identification of morphemes. *Language*, *24*, 414–441.

Niswander, E., Pollatsek, A. & Rayner, K. (2000). The processing of derived and inflected words during reading. *Language and Cognitive Processes*, *15*(4), 389–420.

Niswander-Klement, E. & Pollatsek, A. (2006). The effects of root frequency, word frequency, and length on the processing of prefixed English words during reading. *Memory & Cognition*, *34*(3), 685–702.

Obler, L. K. & Goral, M. (2007). Bilingual lexica. In G. Jarema & G. Libben (Eds.), *The Mental Lexicon: Core Perspectives* (pp. 185–205). Oxford: Elsevier.

Orfanidou, E., Davis, M. H. & Marslen-Wilson, W. D. (2011). Orthographic and semantic opacity in masked and delayed priming: Evidence from Greek. *Language and Cognitive Processes*, *26*(4–6), 530–557.

Orsolini, M. & Marslen-Wilson, W. (1997). Universals in morphological representation: Evidence from Italian. *Language and Cognitive Processes*, *12*(1), 1–47.

Pastizzo, M. J. & Feldman, L. B. (2002). Discrepancies between orthographic and unrelated baselines in masked priming undermine a decompositional account of morphological facilitation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *28*(1), 244–249.

Pastizzo, M. J. & Feldman, L. B. (2004). Morphological processing: A comparison between free and bound stem facilitation. *Brain and Language*, *90*(1–3), 31–39.

Perani, D. & Abutalebi, J. (2005). The neural basis of first and second language processing. *Current Opinion in Neurobiology*, *15*(2), 202–206.

Perani, D., Abutalebi, J., Paulesu, E., Brambati, S., Scifo, P., Cappa, S. F. & Fazio, F. (2003). The role of age of acquisition and language usage in early, high-proficient bilinguals: An fMRI study during verbal fluency. *Human Brain Mapping*, *19*(3), 170–182.

Pinker, S. (1991). Rules of language. *Science*, *253*(5019), 530–535.

Pinker, S. (1994). *The language instinct*. New York: William Morrow.

Pinker, S. (1999). *Words and rules: The ingredients of language*. New York: Basic Books.

Plaut, D. C. & Gonnerman, L. M. (2000). Are non-semantic morphological effects incompatible with a distributed connectionist approach to lexical processing? *Language and Cognitive Processes*, *15*(4–5), 445–485.

Portin, M., Lehtonen, M., Harrer, G., Wande, E., Niemi, J. & Laine, M. (2008). L1 effects on the processing of inflected nouns in L2. *Acta Psychologica*, *128*(3), 452–465.

Portin, M., Lehtonen, M. & Laine, M. (2007). Processing of inflected nouns in late bilinguals. *Applied Psycholinguistics*, *28*(01), 135–156.

Quémart, P. & Casalis, S. (2014). Effects of phonological and orthographic shifts on children's processing of written morphology: a time-course study. *Scientific studies of reading*, *18*, 363–382.

Rastle, K. & Davis, M. H. (2008). Morphological decomposition based on the analysis of orthography. *Language and Cognitive Processes*, *23*(7–8), 942–971.

Rastle, K., Davis, M. H., Marslen-Wilson, W. D. & Tyler, L. K. (2000). Morphological and semantic effects in visual word recognition: A time-course study. *Language and Cognitive Processes*, *15*(4–5), 507–537.

Rastle, K., Davis, M. H. & New, B. (2004). The broth in my brother's brothel: Morpho-orthographic segmentation in visual word recognition. *Psychonomic Bulletin & Review*, *11*(6), 1090–1098.

Rumelhart, D. E. & McClelland, J. L. (1986). On learning the past tenses of English verbs. In J. L. McClelland, D. E. Rumelhart & PDP Research Group (Eds.), *Parallel Distributed Processing: Explorations in the Microstructures of Cognition. Vol. 2* (pp. 216–271). Cambridge, MA: Bradford/MIT Press.

Sánchez-Casas, R., Igoa, J. M. & García-Albea, J. E. (2003). On the representation of inflections and derivations: Data from Spanish. *Journal of Psycholinguistic Research*, *32*(6), 621–668.

Sánchez-Gutiérrez, C.H., Mailhot, H., Deacon S.H. & Wilson, M.A. (2017). MorphoLex: A derivational morphological database for 70,000 English words. *Behavior Research Methods*. DOI: 10.3758/s13428-017-0981-8.

Scalise, S. (1983). *Morfologia lessicale*. Padova: Clesp.

Scalise, S. (1990). *Morfologia e lessico*. Bologna: Il Mulino.

Scarborough, D., Cortese, C. & Scarborough, H. (1977). Frequency and repetition effects in lexical memory. *Journal of Experimental Psychology: Human Perception and Performance*, *3*, 1–17.

Schacter, D. L. & Tulving, E. (Eds.). (1994). *Memory systems 1994*. Cambridge, MA: MIT Press.

Schiff, R., Raveh, M. & Kahta, S. (2007). The developing mental lexicon: evidence from morphological priming of irregular Hebrew forms. *Reading and Writing*, *21*, 719–743.

Schmid, H.-J. (2015). The scope of word-formation research. In P. O. Müller, I. Ohnheiser, S. Olsen & F. Rainer (Eds.), *Word-Formation. An International Handbook of the Languages of Europe. Vol. 1* (pp. 1–21). Berlin; New York: De Gruyter Mouton.

Schreuder, R. & Baayen, H. R. (1994). Prefix-stripping re-revisited. *Journal of Memory and Language*, *33*, 357–375.

Schreuder, R. & Baayen, H. R. (1995). Modeling morphological processing. In L. B. Feldman (Ed.), *Morphological aspects of language processing* (pp. 131–154). Hillsdale, NJ: Lawrence Erlbaum Associates.

Schreuder, R. & Baayen, R. H. (1997). How complex simplex words can be. *Journal of Memory and Language*, *37*(1), 118–139.

Schreuder, R., Burani, C. & Baayen, R. H. (2003). Parsing and Semantic Opacity. In E. M. H. Assink & D. Sandra (Eds.), *Reading Complex Words* (Vol. 22, pp. 159–189). Boston, MA: Springer US.

Segui, J. & Zubizarreta, M.-L. (1985). Mental representation of morphologically complex words and lexical access. *Linguistics*, *23*(5), 759–774.

Seidenberg, M. S. & Gonnerman, L. M. (2000). Explaining derivational morphology as the convergence of codes. *Trends in Cognitive Sciences*, *4*(9), 353–361.

Selkirk, E. (1982). *The Syntax of Words*. Cambridge, MA: MIT Press.

Sereno, J. A. & Jongman, A. (1997). Processing of English inflectional morphology. *Memory & Cognition*, *25*(4), 425–437.

Sgroi, S. C. (2007). Termini-chiave della Wortbildung polisemici e contraddittori e nuove proposte di definizione. A proposito di prefisso, confisso, parasintetico, poliremática. In D. Poli (Ed.), *Lessicologia e metalinguaggio. Vol. II* (pp. 557–677). Roma: Il Calamo.

Shanks, D. R. (1995). *The psychology of associative learning*. Cambridge; New York: Cambridge University Press.

Silva, R. & Clahsen, H. (2008). Morphologically complex words in L1 and L2 processing: Evidence from masked priming experiments in English. *Bilingualism: Language and Cognition*, *11*(02), 245–260.

Silveri, M.C., Traficante, D., Lo Monaco, M.R., Iori, L., Sarchioni, F. & Burani, C. (2018). Word selection processing in Parkinson's disease: when nouns are more difficult than verbs. *Cortex*, *100*, 8–20.

Singleton, D. (1999). *Exploring the second language mental lexicon*. Cambridge: Cambridge University Press.

Smolka, E., Zwitserlood, P. & Rösler, F. (2007). Stem access in regular and irregular inflection: Evidence from German participles. *Journal of Memory and Language*, *57*(3), 325–347.

Smolka, E., Komlósi, S. & Rösler, F. (2009). When semantics means less than morphology: the processing of German prefixed verbs. *Language and cognitive processes*, *24*(3), 337–375.

Sonnenstuhl, I., Eisenbeiss, S. & Clahsen, H. (1999). Morphological priming in the German mental lexicon. *Cognition, 72*, 203–236.

Stanners, R., Neiser, J., Hernon, W. & Hall, R. (1979). Memory representation for morphologically related words. *Journal of Verbal Learning and Verbal Behavior*, *8*, 399–412.

Stanners, R., Neiser, J. & Painton, S. (1979). Memory representation for prefixed words. *Journal of Verbal Learning and Verbal Behavior*, *18*, 733–743.

Taft, M. (1979). Recognition of affixed words and the word frequency effect. *Memory & Cognition*, *7*(4), 263–272.

Taft, M. (1994). Interactive-activation as a framework for understanding morphological processing. *Language and Cognitive Processes*, *9*(3), 271–294.

Taft, M. & Forster, K. I. (1975). Lexical storage and retrieval of prefixed words. *Journal of Verbal Learning and Verbal Behavior, 15*, 638–647.

Taft, M. & Kougious, P. (2004). The processing of morpheme-like units in monomorphemic words. *Brain and Language*, *90*(1–3), 9–16.

Tekavčić, P. (1968). Sull'analisi morfematica di un tipo di derivati italiani: Il problema dei cosiddetti interfissi. *Studia Romanica et Anglica Zagrabiensia, 25–26*, 69–85.

Thornton, A. M. (1990). Sui deverbali italiani in -mento e -zione. *Archivio Glottologico Italiano*, *75*(2), 169–207.

Thornton, A. M. (1991). Sui deverbali italiani in -mento e -zione (II). *Archivio Glottologico Italiano*, *76*, 79–102.

Thornton, A. M. (2005). *Morfologia*. Roma: Carocci.

Thornton, A. M. (2015). Paradigmatically determined allomorphy: the "participial stem" from Latin to Italian. In P. O. Müller, I. Ohnheiser, S. Olsen & F. Rainer (Eds.), *Word-Formation. An International Handbook of the Languages of Europe. Vol. 1* (pp. 780–802). Berlin; New York: Mouton de Gruyter.

Traficante, D. & Burani, C. (2003). Visual processing of Italian verbs and adjectives: The role of inflectional family size. In R. H. Baayen & R. Schreuder (Eds.), *Morphological structure in language processing* (pp. 45–64). Berlin: Mouton de Gruyter.

Ullman, M. T. (2001a). A neurocognitive perspective on language: The declarative/procedural model. *Nature Reviews. Neuroscience*, *2*(10), 717–726.

Ullman, M. T. (2001b). The neural basis of lexicon and grammar in first and second language: The declarative/procedural model. *Bilingualism: Language and Cognition*, *4*(2), 105–122.

Ullman, M. T. (2004). Contributions of memory circuits to language: the declarative/procedural model. *Cognition*, *92*(1–2), 231–270.

Ullman, M. T. (2005). A cognitive neuroscience perspective on second language acquisition: The declarative/procedural model. *Mind and Context in Adult Second Language Acquisition*, *11*(2), 141–178.

Van Heuven, W. J., Mandera, P., Keuleers, E. & Brysbaert, M. (2014). SUBTLEX-UK: A new and improved word frequency database for British English. *The Quarterly Journal of Experimental Psychology*, *67*(6), 1176–1190.

Veríssimo, J., Heyer, V., Jacob, G. & Clahsen, H. (2017). Selective Effects of Age of Acquisition on Morphological Priming: Evidence for a Sensitive Period. *Language Acquisition*, Advance online publication. DOI: 10.1080/10489223.2017.1346104.

Voga, M., Anastassiadis-Symeonidis, A. & Giraudo, H. (2014). Does morphology play a role in L2 processing? Two masked priming experiments with Greek speakers of ESL. *Lingvisticae Investigationes*, *37*(2), 338–352.

Voga, M. & Giraudo, H. (2009). Pseudo-family size influences the processing of French inflections: Evidence in favor of a supra-lexical account. In F. Montermini, G. Boyé & J. Tseng (Eds.), *Selected Proceedings of the 5th Décembrettes: Morphology in Toulouse* (pp. 148–155). Somerville MA: Cascadilla Proceedings Project.

Voga, M. & Grainger, J. (2004). Masked morphological priming with varying degrees of form overlap: Evidence from Greek verbs. *Current Psychology Letters*, *13*(2).

Zeno, S. M., Ivens, S. H., Millard, R. T. & Duvvuri, R. (1995). *The educator's word frequency guide*. Brewster, NY: Touchstone Applied Science.

Zevin, J. D. & Seidenberg, M. S. (2002). Age of acquisition effects in word reading and other tasks. *Journal of Memory and Language*, *47*, 1–29.

APPENDIX A – Critical items used in the experiments

Experiment 1

ALLOMORPHIC SET							
Identity		**Morphological**		**Orthographic**		**Unrelated**	
raggio	ray	radioso	bright	raggiro	scam	alterno	alternate
fuoco	fire	focoso	fiery	fuorché	except	balordo	foolish
lavoro	work	laborioso	wearisome	lavagna	blackboard	testardo	stubborn
scuola	school	scolastico	scholastic	scultura	sculpture	contrario	contrary
nave	ship	nautico	nautical	nausea	nausea	bizzarro	bizarre
nozze	wedding	nuziale	bridal	nozione	notion	gonfio	swollen
uovo	egg	ovale	oval	uvetta	raisin	audace	daring
ghiaccio	ice	glaciale	glacial	ghiaia	gravel	bugiardo	liar
fiore	flower	floreale	floral	fiocco	flake	osceno	obscene
pioggia	rain	pluviale	pluvial	pioppo	poplar	gracile	frail
maestro	master	magistrale	masterly	maestà	majesty	consueto	usual
fiume	river	fluviale	fluvial	fiutare	to sniff	robusto	sturdy
ruotare	to rotate	rotazione	rotation	rumore	noise	interprete	interpreter
buono	good	bontà	goodness	bunker	bunker	sella	saddle
nuovo	new	novità	novelty	nuotare	to swim	moglie	wife
pianeta	planet	planetario	planetary	pianoforte	piano	asciutto	dry
pianta	plant	plantare	plantar	pialla	plane	scapolo	bachelor
memoria	memory	mnemonico	mnemonic	membrana	membrane	astemio	teetotal
diavolo	devil	diabolico	diabolic	diacono	deacon	soffice	fluffy
despota	despot	dispotico	despotic	desolato	desolate	randagio	stray
degno	worthy	dignità	dignity	degustare	to taste	nucleo	core
secco	dry	siccità	drought	secchio	bucket	brivido	shiver
lieto	happy	letizia	happiness	lievito	yeast	freccia	arrow

madre	mother	materno	maternal	madia	cupboard	fluido	fluid
ragione	reason	razionale	rational	raggiungere	to reach	sottile	thin
cucina	kitchen	culinario	culinary	cuccia	kennel	scaltro	shrewd
oro	gold	aureo	golden	oracolo	oracle	rapace	predatory
orecchio	ear	auricolare	auricular	orefice	goldsmith	piccante	spicy
dieci	ten	decina	around ten	dieta	diet	maglia	shirt
bagno	bath	balneare	bathing	bagaglio	baggage	limpido	clean
suonare	to play	sonata	sonata	suocero	father-in-law	ruscello	stream
mese	month	mensile	monthly	mestiere	job	attento	careful
legno	wood	ligneo	wooden	legenda	legend	acerbo	unripe
cervello	brain	cerebrale	cerebral	cerchio	circle	massiccio	solido
lago	lake	lacustre	lacustrine	lagna	whining	ghiotto	greedy
occhio	eye	oculare	ocular	occulto	occult	storto	crooked
specchio	mirror	speculare	specular	spezzare	to break	arretrato	backward
isola	island	insulare	insular	insolente	insolent	fasullo	phoney
capello	hair	capigliatura	hair	caparra	deposit	scoiattolo	squirrel
bue	ox	bovino	cattle	bucare	to hole	quieto	quiet
TRANSPARENT SET							
Identity		**Morphological**		**Orthographic**		**Unrelated**	
coraggio	bravery	coraggioso	brave	corallo	coral	morbido	soft
danno	harm	dannoso	harmful	danzare	to dance	sterile	sterile
gioco	play	giocoso	playful	giostra	carousel	profugo	refugee
mare	sea	marino	marine	marchio	brand	preciso	precise
architetto	architect	architettura	architecture	archivio	archive	calendario	calendar
dialetto	dialect	dialettale	dialectal	diagramma	diagram	meschino	petty
artigiano	craftsman	artigianale	craft	artefice	maker	selvaggio	wild
autunno	autumn	autunnale	autumnal	autografo	autograph	sciocco	fool
foresta	forest	forestale	forest	formula	formula	sinistro	left
inferno	hell	infernale	infernal	infermiere	nurse	smarrito	lost
posta	post	postale	postal	posteriore	back	urbano	urban

genio	genius	geniale	ingenious	generoso	generous	remoto	remote
colosso	colossus	colossale	colossal	colomba	dove	atroce	atrocious
inverno	winter	invernale	wintry	inventario	inventory	discreto	discreet
muscolo	muscle	muscolare	muscular	muschio	musk	crudele	cruel
spettacolo	show	spettacolare	spectacular	spegnere	to switch off	tranquillo	quiet
laguna	lagoon	lagunare	lagoonal	laggiù	over there	marcio	rotten
polo	pole	polare	polar	polacco	Polish	biondo	blonde
rettangolo	rectangle	rettangolare	rectangular	rettile	reptile	arrabbiato	angry
osso	bone	osseo	bony	ossequio	deference	barbaro	barbarous
rosa	pink	roseo	rosy	rosolia	rubella	snello	slender
giovane	young	giovanile	youthful	giovedì	Thursday	stabile	stable
stella	star	stellare	stellar	stereo	stereo	tremendo	terrible
armare	to arm	armata	army	armonia	harmony	flusso	flow
linea	line	lineare	linear	lingotto	ingot	supremo	supreme
venti	twenty	ventina	around twenty	ventaglio	fan	tabacco	tobacco
banca	bank	bancario	banking	bandiera	flag	delicato	delicate
milione	million	milionario	millionaire	millimetro	millimetre	squisito	delicious
furbo	smart	furbizia	craftiness	furgone	van	docile	docile
atleta	athlete	atletico	athletic	atlante	atlas	mediocre	mediocre
magnete	magnet	magnetico	magnetic	magnate	tycoon	precario	precarious
metallo	metal	metallico	metallic	meticcio	hybrid	attraente	attractive
panorama	panorama	panoramico	panoramic	pannolino	diaper	schietto	frank
speciale	special	specialistico	specialized	spedire	to send	intrigante	intriguing
campo	field	campestre	rural	campana	bell	arancione	orange
assurdo	absurd	assurdità	absurdity	assedio	siege	tassello	wedge
umido	humid	umidità	humidity	umore	humour	grotta	cave
sereno	serene	serenità	serenity	serata	night	mostro	monster
profondo	deep	profondità	depth	professore	professor	sportello	door
adorare	to adore	adorazione	adoration	adoperare	to use	portafogli	wallet

Experiment 2

ALLOMORPHIC SET									
Identity		**Past Participle**		**Infinitive**		**Ortographic**		**Unrelated**	
copertura	coverage	coperto	covered	coprire	to cover	coppa	cup	spendere	to spend
apertura	opening	aperto	open	aprire	to open	aperitivo	aperitif	tenere	to hold
lettura	reading	letto	read	leggere	to read	letale	lethal	seguire	to follow
rottura	break	rotto	broken	rompere	to break	rotondo	round	fumare	to smoke
scrittura	writing	scritto	written	scrivere	to write	scrupolo	scruple	entrare	to enter
sepoltura	burial	sepolto	buried	seppellire	to bury	separare	to divide	piovere	to rain
cottura	cooking	cotto	cooked	cuocere	to cook	cotone	cotton	durare	to last
tintura	dyeing	tinto	dye	tingere	to dye	tintinnio	clink	cascare	to fall
frittura	frying	fritto	fried	friggere	to fry	frizzante	frizzy	peccare	to sin
decisione	decision	deciso	decided	decidere	to decide	decennio	decade	giocare	to play
esplosione	explosion	esploso	exploded	esplodere	to explode	esplorare	to explore	mescolare	to mix
impressione	impression	impresso	impressed	imprimere	to impress	imprevisto	unexpected	meritare	to deserve
discussione	discussion	discusso	discussed	discutere	to discuss	discarica	dump	chiamare	to call
divisione	division	diviso	divided	dividere	to divide	divano	sofa	fuggire	to escape
confusione	confusion	confuso	confused	confondere	to confuse	conforto	comfort	buttare	to throw
espressione	expression	espresso	express	esprimere	to express	esperto	expert	cambiare	to change
connessione	connection	connesso	connected	connettere	to connect	connubio	union	ingannare	to deceive
conclusione	conclusion	concluso	concluded	concludere	to conclude	concetto	concept	stabilire	to establish
invasione	invasion	invaso	invaded	invadere	to invade	invalido	invalid	guarire	to heal
illusione	illusion	illuso	deluded	illudere	to delude	illustre	illustrious	condire	to season
fusione	fusion	fuso	fused	fondere	to fuse	fusto	stem	calare	to lower
delusione	disappointment	deluso	disappointed	deludere	to disappoint	delizia	delight	rovinato	spoiled
uccisione	killing	ucciso	killed	uccidere	to kill	uccello	bird	segnato	marked

evasione	evasion	evaso	evaded	evadere	to evade	evaporare	to evaporate	salato	salty
incisione	engraving	inciso	engraved	incidere	to engrave	incinta	pregnant	stimato	valued
espulsione	expulsion	espulso	expelled	espellere	to expel	espandere	to expand	bagnato	wet
concessione	granting	concesso	granted	concedere	to grant	concerto	concert	invitato	invited
diffusione	spreading	diffuso	spread	diffondere	to spread	differente	different	limitato	limited
oppressione	oppression	oppresso	oppressed	opprimere	to oppress	opposto	opposite	ricamato	embroidered
compressione	compression	compresso	compressed	comprimere	to compress	comprensorio	district	saporito	tasty
persuasione	persuasion	persuaso	persuaded	persuadere	to persuade	persiano	Persian	stordito	stunned
condivisione	sharing	condiviso	shared	condividere	to share	condono	remission	garantito	guaranteed
esclusione	exclusion	escluso	excluded	escludere	to exclude	escursione	excursion	occupato	busy
dispersione	dispersion	disperso	dispersed	disperdere	to disperse	dispari	odd	schiacciato	crushed
soppressione	suppression	soppresso	soppressed	sopprimere	to suppress	sopportare	to bear	tracciato	tracked
infusione	infusion	infuso	infused	infondere	to infuse	infame	infamous	bollito	boiled
erosione	erosion	eroso	eroded	erodere	to erode	errare	to wander	rasato	shaven
derisione	derision	deriso	derided	deridere	to deride	deragliare	to run off the rails	barrato	crossed
scissione	splitting	scisso	split	scindere	to split	sciroppo	syrup	stonato	out of tune
inclusione	inclusion	incluso	included	includere	to include	inchiostro	ink	favorito	favourite
TRANSPARENT SET									
Identity		**Past Participle**		**Infinitive**		**Ortographic**		**Unrelated**	
fornitura	supply	fornito	supplied	fornire	to supply	fornace	furnace	aiutare	to help
spaccatura	breaking	spaccato	broken	spaccare	to break	spaccio	trading	tradire	to betray
cucitura	sewing	cucito	sewed	cucire	to sew	cucciolo	puppy	sudare	to sweat
saldatura	welding	saldato	welded	saldare	to weld	salsiccia	sausage	abortire	to abort
spazzatura	rubbish	spazzato	swept	spazzare	to sweep	spaventare	to frighten	esaurire	to exhaust
verniciatura	painting	verniciato	painted	verniciare	to paint	verme	worm	occorrere	to be necessary

bocciatura	failure	bocciato	failed	bocciare	to fail	boccata	mouthful	stendere	to stretch
forzatura	straining	forzato	strained	forzare	to strain	formulare	to formulate	fallire	to fail
pulitura	cleaning	pulito	cleaned	pulire	to clean	pulmino	minibus	gettare	to throw
operazione	operation	operato	operated	operare	to operate	opinione	opinion	morire	to die
registrazione	registration	registrato	registered	registrare	to register	regina	queen	definire	to define
violazione	violation	violato	violated	violare	to violate	violino	violin	scadere	to expire
osservazione	observation	osservato	observed	osservare	to observe	ossessione	obsession	difendere	to defend
combinazione	combination	combinato	combined	combinare	to combine	combattere	to fight	stringere	to tighten
creazione	creation	creato	created	creare	to create	credito	credit	rendere	to render
dimostrazione	demonstration	dimostrato	demonstrated	dimostrare	to demonstrate	dimensione	dimension	ricevere	to receive
liberazione	release	liberato	released	liberare	to release	libreria	bookshop	tacere	to be silent
complicazione	complication	complicato	complicated	complicare	to complicate	compleanno	birthday	assorbire	to absorb
recitazione	recitation	recitato	recited	recitare	to recite	recipiente	container	stupire	to surprise
distribuzione	distribution	distribuito	distributed	distribuire	to distribute	distrarre	to distract	stimolare	to stimulate
rivelazione	revelation	rivelato	revealed	rivelare	to reveal	rivale	rival	detenuto	inmate
umiliazione	humiliation	umiliato	humiliated	umiliare	to humiliate	umano	human	ritirato	retired
decorazione	decoration	decorato	decorated	decorare	to decorate	decollo	take off	pregiato	precious
riparazione	reparation	riparato	repaired	riparare	to repair	ripassare	to pass again	targato	labelled
agitazione	agitation	agitato	agitated	agitare	to agitate	agile	agile	profumato	perfumed
deviazione	deviation	deviato	deviated	deviare	to deviate	devoto	devoted	ostinato	obstinate
affermazione	affirmation	affermato	affirmed	affermare	to affirm	affetto	affection	riservato	reserved
abitazione	habitation	abitato	inhabited	abitare	to inhabit	abisso	abyss	sposato	married
attivazione	activation	attivato	activated	attivare	to activate	attimo	moment	ordinato	tidy
ammirazione	admiration	ammirato	admired	ammirare	to admire	amministrare	administration	datato	dated
mutazione	change	mutato	changed	mutare	to change	mutande	underpants	errato	wrong
celebrazione	celebration	celebrato	celebrated	celebrare	to celebrate	celeste	celestial	tirato	tight
esitazione	hesitation	esitato	hesitated	esitare	to hesitate	esibire	to exhibit	dannato	damned

installazione	installation	installato	installed	installare	to install	instabile	unstable	controllato	controlled
implicazione	implication	implicato	implied	implicare	to imply	implorare	to implore	drogato	drugged
sparizione	disappearance	sparito	disappeared	sparire	to disappear	spargere	to scatter	coltivato	cultivated
esagerazione	exaggeration	esagerato	exaggerated	esagerare	to exaggerate	esaltare	to exalt	pentito	repentant
diminuzione	decrease	diminuito	decreased	diminuire	to decrease	dimissione	resignation	tagliato	cut
premiazione	award	premiato	awarded	premiare	to award	premura	hurry	gradito	welcome
misurazione	measuring	misurato	measured	misurare	to measure	misero	unhappy	scatenato	unrestrained

Experiment 3

BOUND STEM SET							
Identity		**Morphological**		**Orthographic**		**Unrelated**	
adolescenza	adolescence	adolescente	adolescent	adorare	to adore	triangolo	triangle
antagonismo	antagonism	antagonista	antagonist	antenato	ancestor	discoteca	discotheque
assenza	absence	assente	absent	assegno	check	esplicito	explicit
capiente	capacious	capienza	capacity	capillare	capillary	osceno	obscene
cinismo	cynicism	cinico	cynical	cinghia	strap	funebre	funeral
clemente	merciful	clemenza	mercifulness	clericale	clerical	svizzero	Swiss
coerenza	coherence	coerente	coherent	coercizione	coercion	triste	sad
cognizione	cognition	cognitivo	cognitive	cognato	brother-in-law	illustre	famous
consulente	consultant	consulenza	consultancy	consegna	delivery	sinistro	left
decente	decent	decenza	decency	decesso	decease	mediocre	mediocre
demenza	dementia	demente	demented	demonio	devil	testardo	stubborn
diligente	diligent	diligenza	diligence	dilagare	to flood	bulgaro	Bulgarian
efficiente	efficient	efficienza	efficiency	effettivo	effective	peggiore	worse
eleganza	elegance	elegante	elegant	elementare	elementary	comodo	comfortable
carenza	lack	carente	lacking	carezza	caress	atroce	atrocious
fanatismo	fanaticism	fanatico	fanatic	fantasia	fantasy	saporito	tasty
fazione	faction	fazioso	factious	fazzoletto	handkerchief	castano	chestnut
fragranza	fragrance	fragrante	fragrant	fragola	strawberry	scaltro	clever
frequenza	frequency	frequente	frequent	fregare	to rub	attento	careful
intelligenza	intelligence	intelligente	intelligent	intenso	intense	originario	native
ispezione	inspection	ispettore	inspector	ispirare	to inspire	tappeto	rug
aviazione	aviation	aviatore	aviator	avido	avid	fasullo	fake
reticente	reticent	reticenza	reticence	retata	roundup	anguria	watermelon
orazione	prayer	oratore	orator	orario	timetable	agnello	lamb
orribile	horrible	orrore	horror	oroscopo	horoscope	burro	butter
pazienza	patience	paziente	patient	pazzia	madness	corretto	right

imminente	imminent	imminenza	imminence	immigrato	immigrant	ombrello	umbrella
pittura	painting	pittore	painter	pitone	python	vergogna	shame
questura	police station	questore	chief of police	quiete	quietness	scommessa	bet
scultura	sculpture	scultore	sculptor	scudetto	shield	cintura	belt
suggestione	suggestion	suggestivo	suggesting	suggello	seal	precario	precarious
terribile	terrible	terrore	terror	terrazza	terrace	recita	play
turismo	tourism	turista	tourist	turno	turn	augurio	wish
pallido	pale	pallore	paleness	paletta	spatula	trapano	drill
squallido	dreary	squallore	dreariness	squalo	shark	focaccia	focaccia
candido	candid	candore	candour	cancro	cancer	ospizio	hospice
FREE STEM SET							
Identity		**Morphological**		**Orthographic**		**Unrelated**	
accoglienza	welcome	accogliente	welcoming	acconto	deposit	selvaggio	wild
apparente	apparent	apparenza	appearance	apparato	apparatus	supremo	supreme
appartenenza	belonging	appartenente	belonging to	apparecchio	device	posteriore	rear
negazione	negation	negativo	negative	negozio	shop	estremo	extreme
concorrente	competitor	concorrenza	competition	concordato	agreement	prospettiva	perspective
aderente	adherent	aderenza	adherence	adeguare	to adjust	superfluo	superfluous
supplenza	supply teaching	supplente	supply teacher	supposta	suppository	caverna	cave
convenienza	convenience	conveniente	convenient	convento	convent	innamorato	in love
credente	believer	credenza	belief	crepuscolo	dusk	equivoco	misunderstanding
dipendenza	addiction	dipendente	addicted	dipinto	painting	attentato	attempt
eccellente	excellent	eccellenza	excellence	eccessivo	excessive	parallelo	parallel
esigenza	demand	esigente	demanding	esilio	exile	idiota	idiot
pendenza	slope	pendente	pendent	pentola	pot	tenero	tender
giornalismo	journalism	giornalista	journalist	giocare	to play	edificio	building
ottimismo	optimism	ottimista	optimist	ottone	brass	neonato	new-born
alcolismo	alcoholism	alcolico	alcohol	alchimia	alchemy	innocuo	harmless
patriottismo	patriotism	patriottico	patriotic	pattuglia	patrol	vagabondo	tramp
magnetismo	magnetism	magnetico	magnetic	magnolia	magnolia	complice	accomplice

splendido	splendid	splendore	splendour	sprecare	to waste	poltrona	armchair
fervido	fervid	fervore	fervour	fermento	ferment	schiuma	foam
ambizione	ambition	ambizioso	ambitious	ambiguo	ambiguous	delirio	delirium
comunicazione	communication	comunicativo	communicative	comandare	to command	sotterraneo	underground
punizione	punishment	punitivo	punitive	pungere	to sting	acerbo	unripe
urgente	urgent	urgenza	urgency	urbano	urban	profondo	deep
saldatura	welding	saldatore	welder	salsiccia	sausage	dispetto	spite
fornitura	supply	fornitore	supplier	formaggio	cheese	ossigeno	oxygen
osservazione	observation	osservatore	observer	ossessione	obsession	colonnello	colonel
provocazione	provocation	provocatore	provoker	proverbio	proverb	lucchetto	padlock
consumazione	consumption	consumatore	consumer	consapevole	aware	entusiasmo	enthusiasm
conservazione	conservation	conservatore	conservative	consigliare	to advise	passeggero	passenger
abbondanza	abundance	abbondante	abundant	abbonamento	subscription	discreto	discreet
distanza	distance	distante	distant	distratto	absent-minded	violento	violent
ignoranza	ignorance	ignorante	ignorant	ignobile	ignoble	ubriaco	drunk
delinquente	delinquent	delinquenza	delinquency	delineare	to delineate	scintilla	spark
mancanza	absence	mancante	absent	mancino	left-handed	ostile	hostile
eroismo	heroism	eroico	heroic	erogare	to allocate	miope	myopic

Experiment 4

BOUND STEM SET							
Identity		**Morphological**		**Orthographic**		**Unrelated**	
tradurre	to translate	dedurre	to deduce	esporre	to expose	cessare	to cease
resistere	to resist	consistere	to consist	smettere	to stop	tracciare	to track
interferire	to interfere	preferire	to prefer	aderire	to adhere	offendere	to offend
aggredire	to attack	progredire	to progress	benedire	to bless	scorgere	to spot
contribuire	to contribute	distribuire	to distribute	diminuire	to decrease	recuperare	to rescue
ripetere	to repeat	competere	to compete	commettere	to commit	suscitare	to arouse
confessare	to confess	professare	to profess	lessare	to boil	ubbidire	to obey
costruire	to build	istruire	to teach	diluire	to dilute	stimare	to estimate
decidere	to decide	incidere	to engrave	accadere	to happen	subire	to suffer
declinare	to decline	inclinare	to incline	pattinare	to skate	arrostire	to roast
concludere	to conclude	includere	to include	accendere	to switch on	stampare	to print
prorogare	to extend	erogare	to deliver	impiegare	to use	tacere	to be silent
restituire	to bring back	istituire	to establish	influire	to affect	destinare	to assign
esprimere	to express	comprimere	to compress	temere	to fear	bilanciare	to balance
dirigere	to direct	erigere	to erect	porgere	to hand	esaurire	to exhaust
esibire	to exhibit	proibire	to prohibit	assorbire	to absorb	privare	to deprive
obiettare	to object	proiettare	to project	precipitare	to precipitate	partorire	to give birth to
rinunciare	to give up	denunciare	to denounce	lanciare	to throw	nascondere	to hide
suggerire	to suggest	digerire	to digest	alleggerire	to lighten	seminare	to seed
intercettare	to intercept	accettare	to accept	ascoltare	to listen	favorire	to favour
avvertire	to warn	divertire	to amuse	abortire	to miscarry	scivolare	to slide
esplorare	to explore	implorare	to implore	colorare	to colour	gradire	to appreciate
imputare	to impute	disputare	to dispute	meritare	to deserve	fondere	to melt
discutere	to discuss	incutere	to inspire	mietere	to reap	vaccinare	to vaccinate
distinguere	to distinguish	estinguere	extinguish	delinquere	to commit a crime	tamponare	to bump into

deludere	to disappoint	alludere	to allude	ardere	to burn	mentire	to lie
replicare	to reply	complicare	to complicate	pubblicare	to publish	demolire	to demolish
soccombere	to succumb	incombere	to impend	corrompere	to corrupt	fruttare	to yield
devolvere	to devolve	evolvere	to evolve	piovere	to rain	centrare	to centre
impedire	to prevent	spedire	to send	custodire	to guard	gridare	to scream
considerare	to consider	desiderare	to desire	esagerare	to exaggerate	eleggere	to elect
ricattare	to blackmail	scattare	to snap	spaventare	to scare	dipingere	to paint
provocare	to provoke	convocare	to convoke	soffocare	to choke	stringere	to tighten
esultare	to exult	insultare	to insult	piantare	to plant	dimagrire	to lose weight
dedicare	to dedicate	predicare	to preach	marcare	to mark	bollire	to boil
inserire	to insert	asserire	to declare	fiorire	to flourish	pilotare	to pilot
FREE STEM SET							
Identity		**Morphological**		**Orthographic**		**Unrelated**	
smuovere	to move	rimuovere	to remove	dovere	to have to	ospitare	to host
rivedere	to see again	prevedere	to forecast	scendere	to go down	stabilire	to establish
sparlare	to talk behind someone's back	riparlare	to talk again	dondolare	to swing	fucilare	to shoot
deformare	to deform	riformare	to reform	sistemare	to fix	fallire	to fail
riscrivere	to rewrite	trascrivere	to transcribe	piovere	to rain	indovinare	to guess
disfare	to undo	rifare	to do again	trionfare	to triumph	spegnere	to switch off
emettere	to emit	immettere	to introduce	riscuotere	to collect	invidiare	to envy
esportare	to export	importare	to import	dubitare	to doubt	stupire	to astound
trattenere	to hold	sostenere	to hold up	rimanere	to remain	eliminare	to eliminate
sbattere	to beat	abbattere	to knock down	scuotere	to shake	combinare	to combine
ricaricare	to reload	scaricare	to download	giudicare	to judge	colpire	to hit
proseguire	to continue	inseguire	to pursue	intuire	to guess	rovinare	to ruin
ritagliare	to cut out	intagliare	to carve	sbadigliare	to yawn	flettere	to bend
sorridere	to smile	deridere	to deride	radere	to shave	detestare	to loath
collegare	to link	slegare	to untie	frugare	to rummage	spandere	to spill

smontare	to disassemble	rimontare	to reassemble	sabotare	to sabotage	marcire	to rot
convivere	to live together	rivivere	to live again	ricevere	to receive	alterare	to alter
avvolgere	to roll up	stravolgere	to twist	fingere	to pretend	disturbare	to disturb
condividere	to share	suddividere	to subdivide	tendere	to tend	paragonare	to compare
coordinare	to coordinate	subordinare	to subordinate	confezionare	to pack	espellere	to expel
disdire	to retract	predire	to predict	esordire	to start off	mischiare	to blend
aggirare	to go round	rigirare	to twist round	stirare	to press	smarrire	to lose
svoltare	to turn	rivoltare	to turn again	multare	to fine	mungere	to milk
congiungere	to join	aggiungere	to add	spingere	to push	mostrare	to show
impiantare	to implant	trapiantare	to transplant	ambientare	to set	eccellere	to excel
ricominciare	to restart	incominciare	to start	schiacciare	to crush	spartire	to divide
ricreare	to recreate	procreare	to procreate	ideare	to design	friggere	to fry
distorcere	to distort	storcere	to twist	giacere	to lay	arredare	to furnish
disattivare	to deactivate	riattivare	to reactivate	giovare	to profit	applaudire	to applaud
sottrarre	to subtract	estrarre	to extract	redarre	to write	guarire	to heal
scoprire	to discover	ricoprire	to cover	nutrire	to feed	catturare	to catch
reagire	to react	interagire	to interact	fuggire	to escape	indossare	to wear
reinstallare	to reinstall	disinstallare	to uninstall	strangolare	to strangle	inghiottire	to swallow
disconoscere	to disown	riconoscere	to recognize	convincere	to convince	cominciare	to start
rivendere	to resell	svendere	to sell off	pendere	to lean	tritare	to mince
disabilitare	to disable	riabilitare	to re-enable	brevettare	to patent	scolpire	to sculpt