ESSEX RESEARCH REPORTS IN LINGUISTICS

Volume 54

Contents

The Lexical Learning Hypothesis 1
Sonja Eisenbeiss

Linguistic and Metalinguistic Categories in Second Language Learning 5
Karen Roehr

The Perfective Past Tense in Greek Child Language 51
Stavroula Stavrakaki & Harald Clahsen

ESSEX RESEARCH REPORTS IN LINGUISTICS

Essex Research Reports in Linguistics present ongoing research activities of members of the Department of Language and Linguistics. The contents, form and distribution of the reports lie in the hands of the authors, and copyright remains with the author(s) of the reports as well. Most of the reports will subsequently appear in revised form as research articles in professional journals or in edited books.

We are happy to exchange *Essex Research Reports in Linguistics* for working papers (or other publications) in linguistics and related disciplines. If you require extra copies of earlier issues of *ERRL*, please contact one of the author(s) directly.

Sonja Eisenbeiss
Department of Language & Linguistics
University of Essex
Wivenhoe Park
Colchester C04, 3SQ
UK

Email: *seisen@essex.ac.uk*

URL: *http://www.essex.ac.uk/linguistics/wkpaps*

The Lexical Learning Hypothesis
(Lexicon Entry)

Sonja Eisenbeiss
(University of Essex)

Contact Addresss:
Department of Linguistics
University of Essex
Colchester, C04 3SQ, UK
seisen@essex.ac.uk

According to the Lexical Learning Hypothesis, children's grammatical development is incremental and driven by the learning of lexical elements (see Pinker 1984, Clahsen 1996, Eisenbeiss 2000, 2003, 2007 for overviews and references). This hypothesis was developed by proponents of *GENERATIVE GRAMMAR* in order to address the *POVERTY-OF-THE-STIMULUS ARGUMENT*: In order to produce and understand new sentences, children must generalize beyond individual input utterances. However, they do not have reliable access to systematic corrections that would allow them to reject incorrect generalizations about the target-language. Therefore, generative linguists have postulated an innate *LANGUAGE ACQUISITION DEVICE, UNIVERSAL GRAMMAR* (UG), that constrains children's hypothesis space. According to the *PRINCIPLES AND PARAMETERS THEORY*, UG contains (i) principles that constrain all grammatical representations and (ii) open parameters that provide a finite set of values, i.e. options from which learners can choose (Chomsky 1981). For instance, generative linguists assume that all sentences contain subjects, but that languages may differ with respect to the positioning of subjects and their overt realization (e.g. optional subjects in Italian versus obligatory subjects in English). In such a model, language acquisition only involves (i) setting parameters to their target values and (ii) acquiring the lexicon.

If one assumes such a powerful acquisition device, one must explain why children need several years to acquire their target grammar and initially produce non-target-

like sentences – e.g. subjectless sentences in English. Faced with this "developmental" problem, proponents of the Lexical Learning Hypothesis argue that UG is available from the onset of grammatical development, but in order to set parameters, children still need to learn the grammatical properties of the lexical elements associated with these parameters.

These assumptions are in line with lexicalist generative models: Initially, parameters referred to a heterogeneous set of linguistic properties, e.g. subject omissions, word order or morphological marking. However, cross-linguistic (parametric) variation is closely linked to lexical properties, in particular to properties of grammatical morphemes (see e.g. Manzini & Wexler 1987). For instance, Germanic languages with post-verbal negation exhibit a morphological distinction between 1st and 2nd person. Proponents of lexicalist models argue that this suggests a relationship between parameter values for word order and the *PERSON*-specifications of subject-verb-*AGREEMENT* markers. In recent generative models, such markers or function words (e.g. auxiliaries) are analyzed as realizations of functional categories which project to phrases just as the lexical categories VERB and NOUN. For instance, subject-verb-agreement markers are viewed as realizations of the functional category INFL (Chomsky 1986). Proponents of lexical learning regard functional categories as the only source of parametric variation (Chomsky 1989); and they argue that children should fix parameters and build up projections of functional categories by learning the properties of the lexical elements that encode the respective functional categories. Hence, one should find developmental correlations between the acquisitions of lexical items and the acquisition of the syntactic properties associated with the projections of the corresponding functional categories. Such correlations have been documented – for instance a correlation between the acquisition of the German subject-verb agreement paradigm and the target-like ordering of subjects, verbs and negation (Clahsen 1996). Moreover, if one assumes incremental phrase-structure building, one can explain developmental dissociations between realizations of different functional categories – for instance the observation that German children master the use of agreement markers associated with INFL, before they consistently produce complementizers, i.e. realizations of the functional category COMP.

However, children show even more complex dissociations (Eisenbeiss 2003): First, children start to realize different features of the same category at different points. For instance, for the category *CASE*, German children mark the nominative/accusative-

distinction before the accusative/dative-distinction. Second, children do not acquire all instantiations of the same features simultaneously. For example, German children show case distinctions on pronouns earlier than on articles. Third, children's realizations of functional categories show lexeme-specific restrictions. For instance, German children initially restrict the possessive *–s* to some familiar names (e.g. *Mamas* "mommy's").

These observations can be captured in feature-based, lexicalist versions of the Lexical Learning Hypothesis (see Eisenbeiss 2003, 2007 for discussion): In these models, cross-linguistic variation is not so much related to functional categories as such, but to their individual grammatical features (e.g. *TENSE*), which are stored in lexical entries for grammatical morphemes and project to phrases whenever these morphemes are combined. According to such models, children should be able to acquire individual features independently of one another, integrate them into lexical entries for individual lexical/morphological elements in an item-by-item fashion, and project each of these features into phrases when these elements are combined. Thus, whether a child's utterance involves a realization of a particular grammatical feature and the corresponding syntactic operations does not depend on a global parameter value. Rather, it depends on the individual lexical items that the child has acquired so far. Hence, developmental dissociations between individual lexical items and between individual features are expected. For instance, definite and indefinite articles are different lexical realizations of the functional category *DETERMINER* and German children acquire indefinite articles before definite articles. Similarly, when they start producing definite articles, German children use feminine forms correctly, but incorrectly combine masculine forms of articles with both masculine and neuter nouns. This suggests that German children acquire the [±FEMININE]-distinction before they instantiate the feature [±MASCULINE] that distinguishes masculines from neuters.

Thus, in sum, the Lexical Learning Hypothesis, i.e. the idea that syntactic development is driven by lexical development, can provide accounts for the incremental nature of syntactic development as well as for the observed correlations between lexical and syntactic development and the developmental dissociations that have been observed in children's grammatical development.

References

Chomsky, Noam. 1981. *Lectures on Government and Binding.* Dordrecht: Foris.

Chomsky, Noam. 1986. *Barriers.* Cambridge, MA: MIT Press.

Chomsky, Noam. 1989. "Some notes on economy of derivation and representation". *MIT Working Papers in Linguistics* 10. Cambridge, MA: MIT: 43-74.

Clahsen, Harald ed. 1996. *Generative Perspectives on Language Acquisition*. *Empirical Findings, Theoretical Considerations and Crosslinguistic Comparisons.* Amsterdam: Benjamins. With relevant contributions by Harald Clahsen, Sonja Eisenbeiss and Martina Penke; Jürgen Meisel and Maria-Jose Ezeizabarrena; Andrew Radford; Thomas Roeper.

Eisenbeiss, Sonja. 2000. "The acquisition of the Determiner Phrase in German child language." In *The Acquisition of Syntax: Studies in Comparative Developmental Linguistics*, edited Friedemann and Rizzi, 26-62. London: Longman.

Eisenbeiss, Sonja. 2003. *Merkmalsgesteuerter Grammatikerwerb. Eine Untersuchung zum Erwerb der Struktur und Flexion der Nominalphrase.* http://www.ub.uni-duesseldorf.de/home/etexte/diss/show?dissid=1185.

Eisenbeiss, Sonja. 2007. "Generative Approaches to Language Learning." To appear, *Linguistics*.

Manzini, Rita, and K. Wexler. 1987. Parameters, Binding Theory, and Learnability. *Linguistic Inquiry* 18 (July): 413-444.

Pinker, Steven. 1984. *Language Learnability and Language Development.* Cambridge, MA: Harvard University Press.

Linguistic and Metalinguistic Categories in Second Language Learning

Karen Roehr
(University of Essex)

Contact Addresss:
Department of Linguistics
University of Essex
Colchester, C04 3SQ, UK
kroehr@essex.ac.uk

Abstract

This paper discusses proposed characteristics of implicit linguistic and explicit metalinguistic knowledge representations as well as the properties of implicit and explicit processes believed to operate on these representations. In accordance with assumptions made in the usage-based approach to language and language acquisition, it is assumed that implicit linguistic knowledge is represented in terms of flexible and context-dependent categories which are subject to similarity-based processing. It is suggested that, by contrast, explicit metalinguistic knowledge is characterized by stable and discrete Aristotelian categories which subserve conscious, rule-based processing. The consequences of these differences in category structure and processing mechanisms for the usefulness or otherwise of metalinguistic knowledge in second language learning and performance are explored. Reference is made to existing empirical and theoretical research about the role of metalinguistic knowledge in second language acquisition, and specific empirical predictions arising out of the line of argument adopted in the current paper are put forward.

0. Introduction

This article is concerned with the role of metalinguistic knowledge, or explicit knowledge about language, in the area of second language acquisition (SLA). It is situated within a cognitive-functional approach to language and language learning, in the belief that our understanding of an essentially pedagogical notion – metalinguistic knowledge – may be enhanced if we consider this notion in terms of a specific linguistic theory, that is, the usage-based model of language. In this way, light can be shed on a concept which is of interest to second language (L2) teachers, adult language learners themselves, and last but certainly not least, applied linguists of all theoretical persuasions, including cognitive linguists with a pedagogical outlook (e.g. Achard & Niemeier, 2004; Boers & Lindstromberg, 2006).

In this paper, I argue that while implicit linguistic knowledge is characterized by exemplar-based categories, explicit metalinguistic knowledge relies on Aristotelian categories. Exemplar-based categories are flexible, highly contextualized, and subject to prototype effects, whereas Aristotelian categories are stable, discrete, and clearly delineated. These characteristics can be illustrated briefly with the help of the following examples (from Taylor, 2003): (1) *The Pope is a bachelor*. (2) *Her husband is an unrepentant bachelor*. [1] If the construction *bachelor* is considered in terms of Aristotelian category structure, i.e. if it is defined by means of primitive binary features such as +adult, +male, –married, etc., sentence (1) would be judged semantically acceptable, while sentence (2) would have to be regarded as semantically anomalous. Conversely, if the construction *bachelor* is considered in terms of exemplar-based category structure, categorization by means of primitive binary features no longer applies. Instead, specific attributes associated with the category [BACHELOR] can be perspectivized in accordance with the linguistic and cultural context provided by the sentences in which the construction appears, whereas other attributes may be filtered out. Thus, sentence (1) seems somewhat odd, since bachelorhood is taken for granted in a pope. Sentence (2), by contrast, is no longer anomalous, since certain behavioural attributes associated with the (idealized) prototype of an unmarried man are highlighted; at the same time, the attribute associated with the marital status of a prototypical bachelor is temporarily ignored.

In addition to positing qualitatively distinct category structures, I assume that the processing mechanisms operating on implicit linguistic and explicit metalinguistic

knowledge representations are qualitatively different. While implicit linguistic knowledge is stored in and retrieved from an associative network during parallel distributed, similarity-based processing, explicit metalinguistic knowledge is processed sequentially with the help of rule-based algorithms. I suggest that these distinctions between linguistic and metalinguistic knowledge representations and processes affect the way in which the two types of knowledge can be used in L2 learning and performance.

Indeed, it appears that the proposed conceptualization of linguistic and metalinguistic knowledge in terms of different category structures and associated differences in processing mechanisms can help explain available findings from the area of SLA which are indicative of both facilitative potential and apparent limitations of metalinguistic knowledge in L2 learning and performance. Moreover, if read in conjunction with existing research, the proposed conceptualization allows for the formulation of specific predictions about the use of metalinguistic knowledge in L2 learning, both at a general level and for particular types of language learners.

The article is organized as follows: Section 1 provides definitions of the main constructs under discussion, that is, explicit and implicit knowledge, explicit and implicit learning, pedagogical grammar, and metalinguistic knowledge. In Section 2, assumptions about the nature of implicit linguistic knowledge commonly made by researchers working in a usage-based paradigm are outlined. Section 3 contains a summary and evaluation of key empirical and theoretical research in relation to the role of explicit knowledge in language acquisition, with a strong emphasis on L2 learning. Section 4 puts forward the proposal which is at the core of the current paper, with the argument focusing on the contrasting category structures of implicit linguistic knowledge and explicit metalinguistic knowledge as well as differences in processing mechanisms associated with these. Section 5 details empirical predictions that emerge from the argument put forward in the current paper. Section 6 offers a brief conclusion.

1. Construct definitions

Explicit knowledge is defined as declarative knowledge that can be brought into awareness and that is potentially available for verbal report, while **implicit knowledge** is defined as knowledge that cannot be brought into awareness and cannot

be articulated (Anderson, 2005; Hulstijn, 2005). Accordingly, **explicit learning** refers to situations "when the learner has online awareness, formulating and testing conscious hypotheses in the course of learning". Conversely, **implicit learning** "describes when learning takes place without these processes; it is an unconscious process of induction resulting in intuitive knowledge that exceeds what can be expressed by learners" (N. Ellis, 1994: 38-39; see also N. Ellis, 1996; Hulstijn, 2005).

It is assumed that focused attention is a necessary requirement for bringing representations or processes into conscious awareness, i.e. for knowledge or learning to be explicit. In accordance with existing research, three separable but associated attentional sub-processes are assumed, that is, alertness, orientation, and detection (Schmidt, 2001; Tomlin & Villa, 1994). In this conceptualization of attention, alertness refers to an individual's general readiness to deal with incoming stimuli; orientation concerns the allocation of resources based on expectations about the particular class of incoming information; during detection, attention focuses on specific details. Detection is thought to require more attentional resources than alertness and orientation, and to enable higher-level processing (Robinson, 1995). Stimulus detection may occur with or without awareness. If coupled with awareness, stimulus detection is equivalent with noticing, which is defined as awareness in the sense of (momentary) subjective experience (Schmidt, 1990, 1993, 2001). Proponents of the so-called noticing hypothesis argue that noticing, or attention at the level of awareness, is required for L2 learning to take place.

It is worth noting that the concepts of attention, noticing, and awareness, as well as their application in SLA, remain controversial (for critical reviews, see, for instance, Robinson, 2003; Simard & Wong, 2001). Nevertheless, a working definition is needed to allow for a clear discussion. Thus, for the purpose of the present article, it is assumed that the fine line between focused attention in the sense of stimulus detection and focused attention in the sense of noticing can be regarded as the threshold of conscious awareness, that is, the point of interface between implicit and explicit processes and representations.

First and foremost, the present paper is concerned with the notion of metalinguistic knowledge. Metalinguistic knowledge is a specific type of explicit knowledge, that is, an individual's explicit knowledge about language. Accordingly, **L2 metalinguistic knowledge** is an individual's knowledge about the L2 they are attempting to learn. The term metalinguistic knowledge tends to be used in applied

linguistics research concentrating on L2 learning and teaching (e.g. Alderson, Clapham, & Steel, 1997; Bialystok, 1979; Elder & Manwaring, 2004), and it is closely related to applied linguists' conceptualization of pedagogical grammar (e.g. McDonough, 2002; Saporta, 1973; Towell, 2002). **Pedagogical grammar** has been described as "a cover term for any learner- or teacher-oriented description or presentation of foreign language rule complexes with the aim of promoting and guiding learning processes in the acquisition of that language" (Chalker, 1994: 34, quoting Dirven, 1990). It is worth noting that, in discussions of pedagogical grammar, the term grammar is used in a broad sense as referring to any aspect of language that can be described systematically; it is therefore not restricted to morphosyntactic phenomena.

In sum, the notion of metalinguistic knowledge is concerned with a learner's explicit mental representations, while the notion of pedagogical grammar is concerned with explicit written or oral descriptions of linguistic systematicities which can be presented to a learner as a source of information about the L2. Accordingly, a learner's metalinguistic knowledge may arise from encounters with pedagogical grammar, e.g. through textbooks and/or through exposure to rule-based or other types of form-focused instruction (R. Ellis, 2001; Sanz & Morgan-Short, 2005). By the same token, pedagogical grammar has arisen from the metalinguistic knowledge of applied linguists, L2 teachers, and materials designers. Thus, while the labels of metalinguistic knowledge and pedagogical grammar are used to denote, respectively, an individual's mental representations and written or oral instructional aids, the two notions are similar to the extent that they are both explicit by definition and that the latter can give rise to the former as well as vice versa.

As the argument presented in what follows is concerned with differences in category structure between explicit and implicit knowledge, the question of whether a learner's explicit knowledge has been derived 'bottom-up' through a process of analysis of the linguistic input or whether it has been acquired 'top-down' through formal study of grammar textbooks is not of immediate relevance. In other words, for the purpose of the current discussion, it does not matter whether explicit knowledge has arisen from implicit knowledge, e.g. when an L2 learner, perhaps after prolonged experience with the L2, discovers certain systematicities and arrives at a pedagogical grammar rule of their own, which is represented as metalinguistic knowledge and can be articulated, or whether explicit knowledge is assimilated from the environment,

e.g. when an L2 learner listens to a teacher's explanation drawing on a pedagogical grammar rule and memorizes this information as metalinguistic knowledge. In either scenario, the defining characteristics, including the internal category structure, of the metalinguistic knowledge held by the learner remain the same, as will become apparent in Section 4 below.

It is acknowledged that there may be pedagogically relevant differences between internally induced metalinguistic knowledge and metalinguistic knowledge gleaned from externally presented pedagogical grammar that are of practical interest to teachers and learners in the L2 classroom. I am not aware of any empirical research pertaining to this specific issue, but one could hypothesize, for instance, that pedagogical grammar rules presented to the learner are more accurate than metalinguistic knowledge induced 'bottom-up' by the learner him/herself, since the cumulative knowledge of the applied linguistics community is based on more extensive language experience than the average individual learner has been able to gather. Alternatively, one could hypothesize that metalinguistic knowledge derived by the learner him/herself is more relevant to the individual's L2 learning situation than one-size-fits-all pedagogical grammar rules acquired from a commercially produced textbook. These questions, though clearly interesting in themselves, do not impact on the theoretical argument put forward here, however.

Finally, it is worth noting that rule-based or other types of form-focused instruction occur not only in the L2 classroom, but also in the context of laboratory studies. Reports of such empirical studies as well as theoretical papers with a psycholinguistic orientation (e.g. DeKeyser, 2003; N. Ellis, 1993; Robinson, 1997) tend not to use the terms form-focused instruction, pedagogical grammar, or metalinguistic knowledge; instead, they refer more generally to explicit learning conditions and learners' explicit knowledge. However, explicit learning conditions drawing on learners' explicit knowledge typically require knowledge about the L2, i.e. metalinguistic knowledge. Hence, the notion of metalinguistic knowledge is of relevance to L2 learning and L2 teaching, as well as to psycholinguistically oriented and applied SLA research.

In the context of the present article, **metalinguistic knowledge** is defined as a learner's explicit or declarative knowledge about the syntactic, morphological, lexical, pragmatic, and phonological features of the L2. Metalinguistic knowledge includes explicit knowledge about categories as well as explicit knowledge about relations

between categories. (R. Ellis, 2004; Hu, 2002; Roehr, submitted). Metalinguistic knowledge can vary in terms of specificity and complexity, but it minimally involves either a schematic category or a relation between two categories, specific or schematic. Metalinguistic knowledge relies on Aristotelian categories, i.e. categories that are stable and discrete. These categories subserve sequential, rule-based processing.

In the following sections, these proposed characteristics of metalinguistic knowledge will be explained and exemplified. I will begin by comparing and contrasting the characteristics of explicit metalinguistic knowledge with the characteristics of implicit linguistic knowledge as conceptualized in the usage-based model of language.

2. Implicit linguistic knowledge in the usage-based model

Within the framework of cognitive-functional linguistics, the usage-based model makes several fundamental assumptions about the nature of language: First, interpersonal communication is seen as the main purpose of language. Second, language is believed to be shaped by our experience with the real world. Third, language ability is regarded as an integral part of general cognition. Fourth, all linguistic phenomena are explained by a unitary account, including morphology, syntax, semantics, and pragmatics. Hence, at the most general level, the usage-based model characterizes language as a quintessentially functional, input-driven phenomenon (e.g. Bybee & McClelland, 2005; Goldberg, 2003; Tomasello, 1998). Two specific theoretical consequences arising from these general premises are particularly relevant to the current discussion, namely, first, the process of categorization and the sensitivity of knowledge representations to context and prototype effects, and second, the notion of linguistic constructions as conventionalized form-meaning pairings varying along the parameters of specificity and complexity.

In the usage-based model, the representation and processing of language is understood in terms of general psychological mechanisms such as categorization and entrenchment, with the former underlying the latter. Entrenchment refers to the strengthening of memory traces through repeated activation. Categorization can be defined as a comparison between an established structural unit functioning as a

standard and an initially novel target structure (Langacker, 1999, 2000). In view of well-established empirical evidence from the area of cognitive psychology (Rosch & Lloyd, 1978; Rosch & Mervis, 1975), it is accepted that cognitive categories are subject to prototype effects, which are assumed to apply in equal measure to conceptual and linguistic knowledge (Dirven & Verspoor, 2004; Taylor, 2003; Tomasello, 2003). A prototype can be defined as the best example of a category, i.e. prototypical members of cognitive categories have the largest number of attributes in common with other members of the category and the smallest number of attributes which also occur with members of neighbouring categories. In terms of attributes, prototypical members are thus maximally distinct from the prototypical members of other categories. To illustrate by means of a well-known example, ROBIN or MAGPIE are prototypical members of the category [BIRD] for (British) speakers of English, while PENGUIN constitutes a marginal category member (Ungerer & Schmid, 1996).

Categorization is influenced by the frequency of exemplars in the input as well as by the recency and context of encounters with specific exemplars (N. Ellis, 2002a, 2002b). As the parameters of frequency, recency, and context interact, specific memory traces may be more or less entrenched and hence more or less salient and accessible for retrieval (Murphy, 2004). In addition, exemplars encountered in the input may be more or less similar to exemplars encountered previously. Accordingly, category membership is often a matter of degree and cannot normally be understood as a clear-cut yes/no distinction. It follows from this that category boundaries may be fuzzy, and that categories may merge into one another (Langacker, 1999, 2000).

Two theoretical approaches to categorization are compatible with the usage-based assumptions outlined in the previous paragraphs, that is, the prototype view and the exemplar view (Murphy, 2004). In its pure form, the prototype view holds that concepts are represented by schemas, i.e. structured representations of cognitive categories. Schemas contain information about both attributes and relations between attributes that characterize a certain category. Conversely, the exemplar view, in its pure form, posits that our mental representations never encompass an entire concept. Instead, an individual's concept of a category is the set of specific category members they can remember, and there is no summary representation. In this view, categorization is determined not only by the number of exemplars a person remembers, but also by the similarity of a new exemplar to exemplars already held in memory.

While the prototype and exemplar views may be incompatible in their pure forms, they share a sufficiently large number of characteristics to allow for a hybrid model to be formulated which includes both schema-based and exemplar-based representations (Abbot-Smith & Tomasello, 2006; Langacker, 2000). As a hybrid model is not only compatible with usage-based assumptions, but also particularly informative for accounts of language learning and use, it is adopted in the current paper.

According to the hybrid model, all learning is initially exemplar-based. As experience with the input grows and as repeated encounters with known exemplars gradually change our mental representations of these exemplars, it is believed that, ultimately, abstractions over instances are derived (Kemmer & Barlow, 2000; Taylor, 2002). These abstractions are in fact schemas. Schema formation can be defined as "the emergence of a structure through reinforcement of the commonality inherent in multiple experiences", while, at the same time, experiential facets which do not recur are filtered out. Correspondingly, a schema is "the commonality that emerges from distinct structures when one abstracts away from their points of difference by portraying them with lesser precision and specificity" (Langacker, 2000: 4).

To illustrate with the help of a linguistic example, a large number of encounters with specific utterances such as *I sent my mother a birthday card* and *Harry is sending his friend a parcel* lead to entrenchment, i.e. the strengthening of memory traces for the form-meaning associations constituting these constructions. Gradually, constructional subschemas such as *send*-[NP]-[NP] and finally the wholly general ditransitive schema [V]-[NP]-[NP] are abstracted. Entrenched constructions, both general and specific, are described as conventional units. Accordingly, a speaker's linguistic knowledge can be defined as "a structured inventory of conventional linguistic units" (Langacker, 2000: 8).

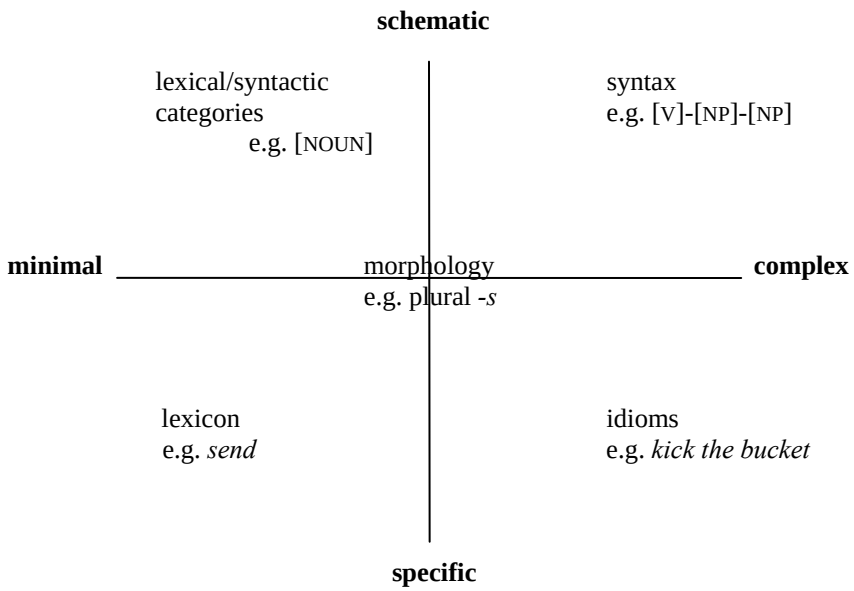
Crucially, the hybrid view argues that representations of specific exemplars can be retained alongside more general schemas subsuming these exemplars. Put differently, specific instantiations of constructions and constructional schemas at varying levels of abstraction exist alongside each other, so that the same linguistic patterns are potentially represented in multiple ways. Thus, linguistic knowledge is represented in a vast, redundantly organized, hierarchically structured network of form-meaning associations.

Conventional linguistic units, or constructions, are viewed as inherently symbolic (Kemmer & Barlow, 2000; Taylor, 2002), so that constructions at all levels of

abstraction are pairings of form and meaning (Goldberg, 2003: 219). Hence, even though a constructional schema at the highest level of abstraction such as the English ditransitive [V]-[NP]-[NP] no longer contains any specific lexical items, it is still endowed with constructional meaning. Accordingly, a construction is always more than the sum of its parts; beyond symbolizing the meanings and relations of its constituents, it has its own semantic profile (Langacker, 1991, 2000). For instance, at the most general level, the semantics of the English ditransitive schema [V]-[NP]-[NP] are captured by the notions of transfer and motion (Goldberg, 1995, 1999, 2003).

To reiterate, the unitary approach to language which characterizes the usage-based model is applied both at the level of cognition and at the level of linguistic structure itself. Hence, syntax, morphology, and the lexicon are all accounted for by the same system (Bates & Goodman, 2001; Langacker, 1991, 2000; Tomasello, 1998); they are regarded as differing in degree rather than as differing in kind. Syntax, morphology, and the lexicon are conceptualized as a graded continuum of conventional linguistic units, or constructions, varying along the parameters of specificity and complexity, as shown in Figure 1. [2]

Figure 1. Linguistic constructions in the specificity/complexity continuum



As Figure 1 indicates, schematic and complex constructions such as the ditransitive [V]-[NP]-[NP] occupy the area traditionally referred to as syntax. Words

such as *send* or *above* are both minimal and specific and occupy the area traditionally labelled lexicon. Morphemes such as English plural *–s* or regular past tense *–ed* are situated at the centre of the two clines, since instances of morphology are neither entirely specific nor entirely schematic; by the same token, they are neither truly minimal nor truly complex, but they are always bound. Lexical categories like [NOUN], [VERB], and [ADJECTIVE] are minimal but schematic, while idioms such as *kick the bucket* tend to be both complex and specific in that they allow for little variation. The example *kick the bucket* only permits verb inflection for person and tense, for instance, and thus ranges high on the specificity scale. At the same time, the construction *kick the bucket* can be considered as more complex than the constructions *send* or *above* because the latter cannot be broken down any further.

To summarize, the usage-based model assumes that categorization is a key mechanism in language representation, learning, and use. As linguistic knowledge is regarded as an integral part of cognition, it is accepted that both conceptual and linguistic categories are subject to context and prototype effects. Linguistic knowledge is conceptualized in terms of constructions, i.e. conventionalized form-meaning units varying along the parameters of specificity and complexity. Crucially, these assumptions underlie the usage-based account of **implicit** phenomena of language representation, acquisition, and use. The role of **explicit** phenomena, in particular as studied in the field of SLA, is the focus of the next section.

3. Explicit knowledge in language learning

The notion of explicit knowledge has consistently attracted the interest of researchers in the areas of SLA and applied linguistics more generally. Over the past two decades in particular, this interest has generated an impressive amount of both empirical and theoretical research. Depending on whether researchers take a primarily educational or a primarily psycholinguistic perspective, empirical studies have drawn on a variety of correlational and experimental research designs, investigating the relationship between L2 learners' linguistic proficiency and their metalinguistic knowledge, the role of explicit knowledge in instructed L2 learning, and the effects of implicit versus explicit learning conditions on the acquisition of selected L2 constructions.

The most uncontroversial cumulative finding resulting from this body of research has borne out the prediction that attention (in the sense of stimulus detection) is a

necessary condition for the learning of novel input (Doughty, 2003; N. Ellis, 2001, 2003; MacWhinney, 1997). Moreover, it has been found that form-focused instructional intervention is more effective than mere exposure to L2 input (Doughty, 2003; R. Ellis, 2001, 2002; Norris & Ortega, 2001). As it is the intended purpose of all types of form-focused instruction to direct learners' attention to relevant form-meaning associations in the linguistic input, this is not a surprising outcome.

Beyond the well-substantiated claim that attention in the sense of stimulus detection is a necessary requirement for input to become intake, the picture is much less clear. In other words, findings regarding the role of explicit knowledge, i.e. knowledge above the threshold of awareness, yield a more complex and sometimes even apparently contradictory pattern of evidence. As it is beyond the scope of this paper to present an exhaustive review of the large body of research that has been carried out in the preceding decades, the following summary is deliberately brief and focused exclusively on representative studies that are directly relevant to the current discussion (for more comprehensive recent reviews of the literature, see DeKeyser, 2003; R. Ellis, 2004). In particular, work which illustrates the sometimes contrasting nature of findings and conclusions as well as work which emphasizes the complex interplay of variables in language learning processes has been selected.

Empirical research concerned with metalinguistic knowledge in SLA has led to at least two results that highlight the potential benefits of explicit knowledge and learning. First, learners' metalinguistic knowledge and their L2 linguistic proficiency have been found to correlate positively and significantly, even though the strength of the relationship varies between studies, ranging from a moderate 0.3 to 0.5 (e.g. Alderson et al., 1997; Elder, Warren, Hajek, Manwaring, & Davies, 1999) to between 0.6 and 0.7 (Elder & Manwaring, 2004), and, reported most recently, up to 0.8 (Roehr, submitted). Thus, there is evidence for an overall association between higher levels of learner awareness, use of metalinguistic knowledge, and successful L2 performance (Leow, 1997; Nagata & Swisher, 1995; Rosa & O'Neill, 1999). Second, learners' use of metalinguistic knowledge when resolving form-focused L2 tasks has been found to be associated with consistent and systematic performance (Roehr, 2006; Roehr & Gánem, in preparation; Swain, 1998).

While these findings are indicative of a generally facilitative role for explicit knowledge about the L2, empirical evidence likewise demonstrates that use of metalinguistic knowledge by no means guarantees successful L2 performance. For

instance, Doughty (1991) found equal gains in performance across two experimental groups comprising 20 university-level learners of L2 English from various L1 backgrounds. Focusing on restrictive relative clauses (e.g. *I know the people who you talked with*), learners receiving meaning-oriented instruction with enhanced input and learners exposed to rule-oriented instruction with explicit explanation of the targeted L2 construction showed equal gains in performance – a finding which suggests that metalinguistic explanations may be unnecessary.

By the same token, Sanz and Morgan-Short (2004) found support for the null hypothesis that providing learners with explicit information about the targeted L2 construction either before or during exposure to input-based practice would not affect their ability to interpret and produce L2 sentences containing the targeted L2 construction, as long as learners received structured input aimed at focusing their attention appropriately. The study was carried out with 69 L1 English learners of L2 Spanish and concentrated on preverbal direct object pronouns. The researchers concluded that structured input practice which made linking form and meaning task-essential, as proposed in processing instruction (VanPatten, 1996, 2004), appeared to be sufficient for successful learning. Additional explicit information about the targeted L2 construction did not enhance participants' performance any further.

The ambivalent relationship between use of metalinguistic knowledge and successful L2 performance was likewise underlined by Green and Hecht (1992), Camps (2003) and Roehr (2006). Green and Hecht (1992) report a study with 300 L1 German learners of L2 English which targeted the use of various morphosyntactic features such as tense and word order. While successful metalinguistic rule formulation typically co-occurred with the successful correction of errors instantiating the rules in question, it was also found that successful error correction could be associated with the formulation of incorrect rules, or no rule knowledge at all.

In a study involving 74 L1 English learners of L2 Spanish focusing on third-person direct object pronouns, Camps (2003) collected both concurrent and retrospective verbal protocol data. He found that references to the targeted L2 construction co-occurred with accurate performance in 92% of cases; yet, no reference to the targeted L2 construction still co-occurred with accurate performance in 69% of cases. Thus, despite providing additional benefits in some cases, use of explicit knowledge appears to have been far from necessary.

Roehr (2006) studied retrospective verbal reports from ten L1 English learners of L2 German, which were obtained immediately after the completion of form-focused tasks targeting adjectival inflection. She found that although reported use of metalinguistic knowledge co-occurred more frequently with successful than with unsuccessful item resolution overall, fully correct use of metalinguistic knowledge still co-occurred with unsuccessful item resolution in 22% of cases. Along similar lines, anecdotal evidence from the L2 classroom suggests that, on occasion, learners may use their metalinguistic knowledge to override more appropriate intuitive responses based on implicit linguistic knowledge (Gabrielatos, 2004).

Theoretically oriented work concerned with metalinguistic knowledge has mainly sought to identify the defining characteristics of the concept of explicit knowledge as well as the facilitative potential of such knowledge in SLA. The most substantial contribution to establishing the defining characteristics of metalinguistic knowledge has arguably been made by R. Ellis (2004, 2005, 2006), according to whom explicit L2 knowledge is represented declaratively, characterized by conscious awareness, and verbalizable, as mentioned in the construct definition presented in Section 1 above. Moreover, explicit L2 knowledge is said to be learnable at any age, given sufficient cognitive maturity. As explicit knowledge is employed during controlled processing, it tends to be used when the learner is not under time pressure. Finally, it has been hypothesized that learners' explicit L2 knowledge may be more imprecise and more inaccurate than their implicit knowledge.

Research with a primarily theoretical outlook has further considered metalinguistic knowledge in terms of the categories and relations between categories that are represented explicitly, as well as the nature of the L2 constructions described by explicit categories and relations between categories. Typically, such research has conceptualized metalinguistic knowledge as knowledge of pedagogical grammar rules consisting of explicit descriptions of linguistic phenomena. It has been argued that metalinguistic descriptions may vary along several parameters, including complexity, scope, and reliability (DeKeyser, 1994; Hulstijn & de Graaff, 1994).

For instance, metalinguistic descriptions may refer to either prototypical or peripheral uses of a particular L2 construction (Hu, 2002). Moreover, the L2 construction described may itself vary in terms of complexity, perceptual salience, or communicative redundancy (Hulstijn & de Graaff, 1994). In view of this multifaceted interaction between the type of explicit description and the type of L2 construction

described, it is notoriously difficult to predict which kind of metalinguistic description is likely to be helpful to the L2 learner. Accordingly, positions have shifted somewhat over the years, with earlier work advocating fairly categorically either the teaching of more complex metalinguistic descriptions (Hulstijn & de Graaff, 1994), or the teaching of simpler rules (DeKeyser, 1994; Green & Hecht, 1992).

In recent years, researchers have adopted a more sophisticated line of argument. DeKeyser (2003) has highlighted the fact that the difficulty – and hence the potential usefulness – of metalinguistic descriptions is a complex function of a number of variables, including the characteristics of the description itself, the characteristics of the L2 construction being described (see also DeKeyser, 2005), and individual learner differences in aptitude.

Indeed, the fact that the relative usefulness of metalinguistic descriptions in L2 learning and performance is affected by a range of variables is to be expected, since language is necessarily learned and used by specific individuals in specific contexts. First and foremost, the role of metalinguistic knowledge in SLA is at least partially dependent upon a learner's current level of L2 proficiency (Butler, 2002; Camps, 2003; Sorace, 1985). Second, a learner's use of metalinguistic knowledge is likely to be subject to situation-specific variation, since both the targeted L2 construction(s) and the task requirements at hand play a part in determining whether and how metalinguistic knowledge is employed (R. Ellis, 2005; Hu, 2002; Klapper & Rees, 2003; Renou, 2000). Hence, timed tasks in general and oral task modalities in particular may prevent a learner from allocating sufficient attentional resources to controlled processing involving metalinguistic knowledge, whereas untimed tasks in general and written task modalities in particular may have the opposite effect, possibly encouraging the use of metalinguistic knowledge.

Third, the L1-L2 combination under investigation, paired with the relative typological distance between L1 and L2, may have a part to play (Elder & Manwaring, 2004). Fourth, length of prior exposure to L2 instruction and the type of instruction experienced have been shown to impact on a learner's level and use of metalinguistic knowledge (Elder et al., 1999; Roehr, submitted; Roehr & Gánem, in preparation). Finally, individual differences in cognitive and learning style, strategic preferences, and aptitude may influence a learner's use of metalinguistic knowledge (Collentine, 2000; DeKeyser, 2003; Roehr, 2005).

Most recently, existing work concerned with the role of explicit knowledge in SLA has been complemented by hypotheses about the nature of the representations and processes involved in the use of metalinguistic knowledge. Crucial to the current paper, both empirical findings and theoretical research suggest that explicit and implicit knowledge are separable constructs which are nonetheless engaged in interplay (N. Ellis, 1993, 2005; R. Ellis, 2005; Segalowitz, 2003). In other words, the so-called weak-interface position [3] allows for the possibility of explicit metalinguistic knowledge contributing indirectly to the acquisition of implicit linguistic knowledge, and vice versa. It has been argued that the two types of knowledge come together during conscious processing (for particularly readable reviews of the complex subject matter of consciousness, see Baddeley, 1997; Cattell, 2006). Moreover, when explicit knowledge is brought to bear on implicit knowledge and vice versa, enduring learning effects may result (N. Ellis & Larsen-Freeman, 2006).

The mechanism which is thought to enable conscious processing is called binding. During binding, a number of implicit representations in different modalities are activated simultaneously and integrated into a unified explicit representation that is held in a multimodal code in working memory (Bayne & Chalmers, 2003; Dienes & Perner, 2003; N. Ellis, 2005). We consciously experience this unified representation as a coherent episode. Put differently, the mechanism of binding, explained through the temporally synchronized firing of a number of neurons in different brain regions (Engel, 2003), accounts for how implicit representations subserve explicit representations.

With regard to explicit metalinguistic and implicit linguistic processing, it has been proposed that "implicit learning of language occurs during fluent comprehension and production. Explicit learning of language occurs in our conscious efforts to negotiate meaning and construct communication" (N. Ellis, 2005: 306). Thus, during fluent language use, the implicit system automatically processes input and produces output, with the individual's conscious self focused on the meaning rather than the form of the utterance. When comprehension or production difficulties arise, however, explicit processes take over. We focus our attention on linguistic form, and we notice patterns; moreover, we become aware of these patterns as unified, coherent representations. Such explicit representations can then be used as pattern recognition units for new stimuli in future usage events. In this way, conscious processing helps

consolidate new bindings, which are fed back to the brain regions responsible for implicit processing (N. Ellis, 2005).

Steered by the focus of our conscious processing, the repeated simultaneous activation of a range of implicit representations helps consolidate form-meaning associations, often to the extent that implicit learning on subsequent occasions of use becomes possible. Thus, as the various elements constituting a coherent form-meaning association are activated simultaneously during processing, they are bound together more tightly (N. Ellis, 2005). Crucially, however, it is not a question of the explicit representation 'turning into' an implicit representation. According to the weak-interface position, it is not the metalinguistic knowledge, e.g. in the form of an explicit description of a linguistic phenomenon, that 'becomes' implicit, but its instantiation, i.e. the sequences of language that the description is used to comprehend or to construct (R. Ellis, 2004: 238). [4]

The locus of conscious processing – metaphorically speaking – is working memory. Put differently, explicit knowledge is conceptualized as information that is selectively attended to, stored, and processed in working memory. Working memory refers to "the system or mechanism underlying the maintenance of task-relevant information during the performance of a cognitive task" (Shah & Miyake, 1999: 1). Thus, working memory allows for the temporary storage and manipulation of information which is being used during online cognitive operations such as language comprehension, learning, and reasoning (Baddeley, 2000; Baddeley & Logie, 1999). The so-called episodic buffer, a component of working memory, is capable of binding information from a variety of sources and holding such information in a multimodal code. Importantly, working memory is limited in capacity (Just & Carpenter, 1992; Miyake & Friedman, 1998), i.e. we can only attend to and hence be aware of so much information at any one time.

Clearly, the fact that limited working memory resources constrain explicit processing of language affects L2 and L1 in equal measure. It is well-established that individuals differ in the maximum amount of activation available to them, i.e. that individuals differ in terms of their working memory capacity (e.g. Daneman & Carpenter, 1980; Just & Carpenter, 1992; Miyake & Shah, 1999). Moreover, young children generally have smaller working memory capacity than cognitively mature adolescents and adults. In other words, beyond the issue of individual differences, working memory capacity increases in the course of an individual's development.

In L1 acquisition and use, the emergence of metalinguistic ability is closely associated with the development of literacy skills, that is, another dimension of linguistic competence which requires selective attention to language form (Birdsong, 1989; Gombert, 1992). As both metalinguistic ability and literacy skills rely on conscious processing drawing on working memory resources, a certain level of cognitive maturity which guarantees sufficient working memory capacity is required; hence, these abilities do not tend to develop until a child is between six and eight years of age.

Metalinguistic processes – whether concerned with L1 or L2 – are analogous to other higher-level mental operations that draw on working memory resources and thus require a certain level of cognitive maturity. Hence, the application of metalinguistic knowledge and the process of analytic reasoning as applied during general problem-solving appear to rely on the same basic mechanisms. Put differently, use of metalinguistic knowledge in language learning and performance can be regarded as analytic reasoning applied to the problem space of language; metalinguistic processing is problem-solving in the linguistic domain (Anderson, 1995, 1996; Butler, 2002; Hu, 2002).

In L1, a child may raise questions about form-meaning associations ('Why are there two names, *orange* and *tangerine*?'), comment on non-target-like utterances they have overheard (e.g. if another child mispronounces certain words), or objectify language ('Is *the* a word?'), thus not only demonstrating their ability to monitor language use, but also showing the first signs of what will eventually result in the ability to reason about language (examples adapted from Birdsong, 1989: 17; Karmiloff & Karmiloff-Smith, 2002: 80). In L2, use of metalinguistic knowledge can likewise be understood in terms of monitoring and reasoning based on hypothesis-testing operations (N. Ellis, 2005; Roehr, 2005), which are characteristic of a problem-solving approach. Thus, the cognitively mature L2 learner may deliberately analyze input in an attempt to comprehend an utterance ('What is the subject and what is the object in this sentence?'), or creatively construct output that is monitored for formal accuracy ('If I use a compound tense in this German clause, the first verb needs to be in second position and the second verb in final position.')

To summarize this section, available empirical evidence about the role of explicit knowledge in language learning and use bears out the theoretically motivated expectation that metalinguistic knowledge can have both benefits and limitations.

Whilst the facilitative effect of focused attention in the sense of stimulus detection is all but undisputed, determining the impact of higher levels of learner awareness and more explicit types of learner knowledge which go beyond focused attention in the sense of stimulus detection is less straightforward. On the one hand, L2 proficiency and metalinguistic knowledge have been found to correlate positively and significantly. Moreover, use of metalinguistic knowledge is typically associated with performance patterns characterized by consistency and systematicity. On the other hand, use of metalinguistic knowledge is by no means a guarantee of successful performance, and higher levels of learner awareness that reach beyond noticing may be unnecessary or possibly even unhelpful in certain situations.

In the area of theory, a recent position includes the proposal that explicit and implicit knowledge are separate and distinct, but can interact. Hence, explicit knowledge about language may contribute indirectly to the development of implicit knowledge of language, and vice versa. As explicit and implicit knowledge interface during conscious processing, and as such processing is subject to working memory constraints, use of metalinguistic knowledge in language learning and performance is likely to have not only benefits, but also certain limitations. On the one hand, conscious processing involving the higher-level mental faculty of analytic reasoning allows the cognitively mature individual to apply a problem-solving approach to language learning. On the other hand, conscious processing is constrained by limited working memory capacity and thus only permits the consideration of a restricted amount of information at any one time.

Finally, existing research acknowledges that the relative usefulness of metalinguistic knowledge can be expected to depend on a range of learner-internal and learner-external variables, including task modalities, the learner's level of L2 proficiency, their language learning experience, their cognitive abilities, and their stylistic orientation.

Whilst it is important to bear in mind that all these factors will differentially affect the role of metalinguistic knowledge in language learning and performance (see Section 5 below), it is argued here that, ceteris paribus and over and above these factors, another, more fundamental variable which goes beyond specific usage situations and individual learner differences is worthy of consideration: The contrasting category structures of implicit linguistic knowledge representations on the one hand and explicit metalinguistic knowledge representations on the other hand as

well as the different modes of implicit, associative processing and explicit, rule-based processing constitute the basic cognitive conditions in which language learning and performance take place. If taken into account, these phenomena not only help explain existing findings about the apparently ambivalent role of metalinguistic knowledge in L2 learning and use, but also permit us to formulate specific empirical predictions that can guide future research.

4. The representation and processing of implicit linguistic knowledge and explicit metalinguistic knowledge

As linguistic and metalinguistic knowledge pertain to the same cognitive domain – language – they can be expected to share certain characteristics. Specifically, it appears that linguistic constructions and metalinguistic descriptions vary along the same parameters, namely, specificity and complexity. The usage-based model assumes that linguistic constructions can be more or less specific as well as more or less complex (see Figure 1 above). By the same token, empirical evidence suggests that L2 learners' metalinguistic knowledge can be more or less specific and more or less complex (e.g. Roehr, 2005, 2006; Rosa & O'Neill, 1999).

For the purpose of illustration, one might imagine the case of an educated L1 English-speaking adult learner of L2 German and consider their metalinguistic knowledge which has mostly been derived from encounters with pedagogical grammar in the classroom and in textbooks. [5] Thus, a metalinguistic description which this learner is aware of can refer to specific instances, e.g. 'German *hin* expresses movement away from the speaker, while *her* expresses movement towards the speaker'. Alternatively, it can be entirely schematic and therefore involve no specific exemplars at all, e.g. 'a subordinating conjunction sends the finite verb to the end of the clause'. Both of these examples are additionally complex, i.e. they state relations between categories, and they can be broken down into their constituent parts and therefore require several mental manipulations during processing (DeKeyser, 2003; Stankov, 2003). However, a metalinguistic description can also be minimal, e.g. 'noun'. Various combinations of different levels of specificity and complexity seem possible – with the exception of both minimal and specific.

In fact, the joint characteristics of minimal and specific appear to be unique to lexical items, that is, linguistic constructions. By contrast, even entirely specific

metalinguistic descriptions containing no schematic categories such as 'German *ei* is pronounced like English *i*' or 'English *desk* means *Schreibtisch* in German' involve a relation between two specific instances and can therefore still be broken down into their constituent parts. By the same token, a minimal metalinguistic description such as 'noun', which cannot be broken down any further, is schematic rather than specific. Put differently, as soon as implicit linguistic knowledge is made explicit, i.e. when a metalinguistic knowledge representation is created (no matter by whom, whether an L2 learner, an applied linguist, or any other language user), it seems to take the form of either a schematic description ('noun'), or a proposition involving at least two categories and a relation between them.

It should be pointed out that this circumstance does not exclude statements about the lexicon from the realm of metalinguistic description and representation; quite to the contrary, semantic knowledge is perhaps the most obvious area of explicit knowledge about language, since it typically encompasses not only L2 metalinguistic knowledge, but also L1 metalinguistic knowledge. Indeed, we can glean metalinguistic knowledge about lexical items from any monolingual or bilingual dictionary. However, it is crucial to note that, when made explicit, semantic knowledge incorporates at least two categories and a relation between them, as exemplified by dictionary definitions of any description. Even the briefest listing of a synonym without further explanatory comment amounts to stating a relation between two categories ('X means Y'). Hence, one can argue that implicit knowledge of the meaning, function, and appropriate usage contexts of minimal and specific linguistic constructions such as lexical items is distinguishable from explicit knowledge about the meaning, function, and appropriate usage contexts of these constructions. This claim applies not only to implicit knowledge of and explicit knowledge about the lexicon, but also to all other areas of language.

Whilst metalinguistic knowledge is comparable with linguistic constructions in terms of the parameters of complexity and specificity, explicit metalinguistic knowledge differs qualitatively from implicit linguistic knowledge in the crucial respect of categorization, that is, one of the key cognitive phenomena underlying conceptual as well as linguistic representation and processing. As outlined in Section 2 above, the usage-based model assumes that cognitive categories, whether conceptual or linguistic, are flexible and context-dependent, sensitive to prototype effects, and have fuzzy boundaries.

By contrast, metalinguistic knowledge appears to be characterized by stable, discrete, and context-independent categories with clear-cut boundaries. Put differently, metalinguistic knowledge relies on what has alternately been labelled Aristotelian, categorical, classical, or scientific categorization (Anderson, 2005; Bod, Hay, & Jannedy, 2003; Taylor, 2003; Ungerer & Schmid, 1996). For instance, the metalinguistic category 'subordinating conjunction' is stable and clearly defined; in the case of German, it is instantiated by a certain number of exemplars, such as *weil* (because), *da* (as), *wenn* (if, when), etc. Although some instantiations occur more frequently than others, there are no better or worse category members; all subordinating conjunctions have equal status and are equally valid exemplars, regardless of context.

By the same token, the linguistic construction [NOUN] and the metalinguistic description 'noun' can be contrasted. As all linguistic constructions are form-meaning pairings, the linguistic construction [NOUN] is not devoid of semantic content. Even though it has no specific phonological instantiation, it has been abstracted over a large number of exemplars occurring in actual usage events (as exemplified in more detail for the English ditransitive construction in Section 2 above); accordingly, the linguistic construction [NOUN] is strongly associated with the semantics of its most frequent instantiations, such as lexical items denoting entities in the real world. Consequently, in the average user of English, the highly frequent and prototypical constructions *man*, *woman* and *house* can be expected to be more strongly associated with the schema [NOUN] than the relatively rare constructions *rumination* and *oxymoron*, or the dual-class words *brush* and *kiss*, for instance. Likewise, in the average user of German, *Fühlen* (the sensing/feeling) is likely to be a relatively marginal instantiation of the category [NOUN], compared with the more common instantiation *Gefühl* (sensation/feeling). The more marginal status of *Fühlen* can be attributed to the relative rarity of its nominal usage as well as its homophone *fühlen* (sense/feel), a prototypical verb. Thus, by dint of its association with various instantiations, their respective conceptual referents, and their usage contexts, the linguistic schema [NOUN] exhibits a category structure which is characterized by flexibility and context-dependency, and which takes into account prototype effects.

The metalinguistic description 'noun', on the other hand, relies on Aristotelian categorization. It may be defined by means of a discrete statement, e.g. as "a word … which can be used with an article" (Swan, 1995: xxv) or "a content word that can be

used to refer to a person, place, thing, quality, or action". [6] Metalinguistic categorization is based on clear yes/no distinctions; frequency distributions or contextual information are not taken into account, and prototype effects are filtered out. Thus, in metalinguistic terms, the constructions *man, woman, house, rumination*, *oxymoron, brush, kiss, Fühlen,* and *Gefühl* all have equal status as members of the Aristotelian category 'noun'.

Of course, use of Aristotelian categorization does not mean that we as language users are unaware of the potential shortcomings of such an approach. This awareness is also acknowledged in L2 instruction which draws on metalinguistic descriptions. Most L2 learners will be able to think of examples of pedagogical grammar rules that are qualified by frequency adverbs such as *usually, in general*, etc. Most L2 learners will likewise be familiar with statements about specific usage contexts as well as lists of exceptions to a rule that apparently have to be learned by rote. Finally, the realm of metalinguistic descriptions is not immune to prototype effects. For instance, descriptions of prototypical functions of a certain L2 form will occur more often than descriptions of less prototypical functions of the same form and will thus be more familiar to learners (Hu, 2002). However, it is argued here that these prototype effects only concern the presentation and/or our perception of metalinguistic descriptions; they do not seem to have any bearing on the internal category structure of explicit knowledge representations or the processing mechanisms operating on these representations, as explicated in the following.

As a matter of fact, in order to be of use, metalinguistic knowledge requires conditions of stability and discreteness; otherwise, it would be of little practical value (see also Swan, 1994). For metalinguistic knowledge to be informative, the user needs to decide categorically whether a specific linguistic construction is to be classified as a noun or not, otherwise a metalinguistic description such as 'the verb needs to agree in number with the preceding noun or pronoun' cannot be implemented. By the same token, the user needs to decide categorically whether a linguistic construction is a subordinate conjunction or not, otherwise a metalinguistic description such as 'in German, the finite verb appears at the end of a subordinate clause' cannot be employed.

To exemplify further, the metalinguistic description 'in English reported speech, the main verb of the sentence changes to the past tense when it is in the present tense in direct speech' applies in equal measure to all English utterances, unless it is

qualified by further statements about specific contexts, e.g. 'if something that is still true at the time of speaking is being reported, the main verb may remain in the present tense'. Further propositions are required to make explicit the formal and functional criteria of introducing reported speech by means of different verbs such as *say* and *tell*, to describe the formal and functional aspects of reported questions, and so forth (example adapted from Murphy, 1994). No matter how many statements are formulated, though, the user needs to be able to clearly assign category membership in each case in order to be able to apply the metalinguistic description, represented as metalinguistic knowledge, to a concrete linguistic construction. If we cannot decide categorically if something is a main verb, if something is direct speech, etc., we cannot bring to bear our explicit knowledge.

As a final example, consider a general, dictionary-style metalinguistic description pertaining to the constructions *desk* and *Schreibtisch* (desk), which is again necessarily stable and discrete. The statement that 'English *desk* means *Schreibtisch* in German' is posited as a context-independent proposition which does not take into account prototypicality or usage situations. In order to achieve a finer descriptive grain, additional propositions need to be formulated, e.g. 'in the context of English *check-in desk*, the word *Check-in-Schalter* needs to be used in German'. Conversely, the implicit linguistic knowledge of a proficient user of both English and German would accurately reflect the frequency distributions of the constructions *desk, Schreibtisch,* and *Schalter* in connection with the relevant referential meanings and suitable pragmatic contexts in which these constructions tend to appear.

The same principle applies to the internal structure of all metalinguistic categories and propositions about relations between categories that make up metalinguistic descriptions, regardless of whether these refer to lexico-semantic, morphosyntactic, phonological, or pragmatic phenomena: Aristotelian categories are needed to allow for the effective deployment of metalinguistic knowledge. To reiterate, if we cannot take clear-cut decisions about category membership, our metalinguistic knowledge is of little practical value in concrete usage situations.

The contrasting category structures of implicit linguistic and explicit metalinguistic representations can be expected to affect the processing mechanisms which operate on these representations during language learning and use. Indeed, implicit and explicit mental operations involving natural language appear to be

analogous with what is respectively termed similarity-based and rule-based processing in the field of cognitive psychology.

Similarity-based and rule-based processing have been studied in relation to categorization, reasoning, and artificial language learning, and experimental evidence for a qualitative distinction between the two processes is quite robust, though not uncontroversial. In accordance with the weak-interface position adopted in the current paper (see Section 3 above), I am in agreement with researchers who not only regard rule-based and similarity-based processing as separable and distinct, but also argue that the defining property of rule-based processing is its conscious nature (Cleeremans & Destrebecqz, 2005; Hampton, 2005; Smith, 2005). As mentioned previously, conscious awareness 'occurs' in working memory, a limited-capacity resource; as rule-based processes require executive attention and effort, they may exceed an individual's working memory capacity (Ashby & Casale, 2005; Bailey, 2005; Reber, 2005).

Empirical evidence indicates that rule-based processing is characterized by compositionality, productivity, systematicity, commitment, and a drive for consistency (Diesendruck, 2005; Pothos, 2005; Sloman, 2005). A set of operations is compositional when more complex representations can be built out of simpler components without a change in the meaning of the components. Productivity means that, in principle, there is no limit to the number of such new representations. An operation is systematic when it applies in the same way to a whole class of objects (Pothos, 2005). Rule-based processing entails commitment to specific kinds of information, while contextual variations are neglected (Diesendruck, 2005). The reason for this is that rule-based operations involve only a small subset of an object's properties which are selected for processing, while all other object dimensions are suppressed (Markman et al., 2005; Pothos, 2005). A strict match between an object's properties and the properties specified in the rule has to be achieved for rule-based processing to apply. Because of this, rule-based judgements are more consistent and more stable than similarity-based judgements (Diesendruck, 2005; Pothos, 2005). It should be immediately apparent that all these properties of rule-based processing are in keeping with the characteristics of Aristotelian category structure detailed and exemplified above in relation to metalinguistic knowledge, i.e. stability, discreteness, lack of flexibility, as well as selective and categorical decision-making.

The characteristics of rule-based processing can be contrasted with the characteristics of similarity-based processing. The latter involves a large number of an object's properties, which only need to be partially matched with the properties of existing representations to allow for successful categorization (Pothos, 2005). Moreover, and contrary to rule-based processing, similarity-based processing is flexible, dynamic, open, and susceptible to contextual variation (Diesendruck, 2005; Markman et al., 2005). Again, it should be apparent that the attributes of similarity-based processing identified in the field of cognitive psychology are fully consonant with the characteristics of implicit linguistic categories assumed in the usage-based model.

It is now possible to consider the empirical findings about the role of metalinguistic knowledge in language learning (see Section 3 above) in light of the proposed conceptualization of explicit metalinguistic representations and processes as opposed to implicit linguistic representations and processes. First, I have argued that linguistic and metalinguistic knowledge pertain to the same cognitive domain (language) and vary along the same parameters (specificity and complexity). These circumstances are consistent with the empirical finding that the two types of knowledge are positively correlated in L2 learners. At the same time, it is of course necessary to bear in mind that, considered on their own, correlations do not allow for direct conclusions to be drawn about cause-effect relationships, or indeed the directionality of such relationships.

Second, I have suggested that linguistic and metalinguistic knowledge differ qualitatively in terms of their internal category structure, with implicitly represented categories characterized by flexibility, fuzziness, and context-dependency, and explicitly represented categories showing the contrasting attributes of Aristotelian structure. This proposal is compatible with the existing claim that the two types of knowledge are separate and distinguishable constructs.

Third, research in cognitive psychology has revealed that rule-based processes, i.e. processes which operate on explicit knowledge representations, are characterized by compositionality, productivity, systematicity, commitment, and a drive for consistency. These characteristics are consonant with the empirical finding that use of metalinguistic knowledge is associated with consistent, systematic, and often successful L2 performance.

Fourth, rule-based processes are associated with stability and definite commitment to selected information, while flexibility and attention to contextual variation are absent. Furthermore, as rule-based processes require both attentional resources and effort, they are constrained by an individual's working memory capacity. These circumstances are in keeping with the empirical finding that use of metalinguistic knowledge does not guarantee successful L2 performance and may even be unhelpful in certain situations. Put differently, rule-based processes operating on Aristotelian categories may not only exceed an individual's working memory resources in a given situation, but may also fail to capture the intricacies of certain linguistic constructions in the first place, as exemplified below. [7]

In sum, it appears that the proposed conceptualization of explicit metalinguistic representations and rule-based processes can account for the benefits as well as the limitations of knowledge based on Aristotelian category structure. Such knowledge is at its best when it pertains to highly frequent and entirely systematic patterns whose usage is largely independent of context and may be described in terms of one or a few relations between categories. 'In English, an *-s* needs to be added to present tense verbs in the third person' is an example of a metalinguistic description instantiating metalinguistic knowledge of this kind. Conversely, metalinguistic knowledge is less useful, or perhaps even useless, when less frequent, more item-based constructions exhibiting complicated form-meaning relations need to be captured, since the required number of categories and propositions specifying relations between categories grows rapidly with every specific usage context that diverges from the regular pattern.

To exemplify, our implicit representations of the linguistic constructions *desk* and *Schreibtisch* (desk) include a wealth of information about appropriate pragmatic usage contexts of the linguistic forms based on cultural models relating to the meanings they symbolize. Accordingly, the implicit linguistic representations of a proficient user of English and German would include information about the suitability of the construction *desk* to describe an item of furniture commonly found in an office, as well as the place where you check in at an airport or see a bank clerk to open an account. Furthermore, the proficient user would hold information about the suitability of the construction *Schreibtisch* in the former scenario but not in the latter.

At the implicit level, this probabilistic information is represented in a vast network of associations subject to parallel distributed processing, i.e. non-conscious operations that are unaffected by the constraints of working memory and the cumbersome

propositional nature of explicit knowledge representations and processes. By contrast, the Aristotelian categories and relations of the relevant metalinguistic description require the formulation of a set of independent propositions that specify different usage situations, such as 'English *desk* is *Schreibtisch* in German'. 'However, if you want to say English *desk* in German and if the expression is used in the context of an airport or a bank, *Schalter* needs to be used', and so forth.

At the level of more schematic categories, the implicit linguistic knowledge of a proficient user of English and German would include not only the schema [CO-ORDINATING CONJUNCTION], but likewise instantiations of this schema, all of which are associated with a wealth of linguistic and conceptual context information. Accordingly, the fact that the German constructions *aber, jedoch, allein* and *sondern* may all be translated as English *but* would be complemented not only by information about the high frequency of *aber*, but also by knowledge of the specific syntactic properties of *jedoch*, the literary or archaic connotations of *allein*, the tendency of *sondern* to be used in contradicting a preceding negative, etc. However, the metalinguistic descriptions formulated in the previous sentence clearly show that, when made explicit, this information needs to be stated in terms of additional independent propositions based on stable and discrete categories.

This potentially explosive growth of propositions that would be required to make explicit representations applicable in different contexts has two detrimental consequences. First, it increases working memory load and thus renders metalinguistic knowledge proportionally more burdensome to process; and, second, it becomes less widely applicable. These potential drawbacks of explicit, rule-based processes apply in equal measure to the use of metalinguistic knowledge, i.e. reasoning about language, and reasoning in other cognitive domains: 'If there is white-grey smoke coming out of the kitchen oven where I have had fish cooking for the last three hours, then there is a fire' (example adapted from Pothos, 2005: 8) is obviously both harder to process and less useful than 'if there is smoke, then there is fire'. Unfortunately, the complexity, flexibility, and context-dependency of natural language means that general (and truthful) metalinguistic descriptions equivalent to the latter statement are inevitably rather rare.

5. Empirical predictions

In the preceding section, I have argued that the distinct category structures and processes which characterize explicit and implicit knowledge are consonant with existing findings in the area of SLA. Naturally, a retrospective explanatory account can only take us so far. However, the theoretical proposals I have put forward offer us further and arguably more important insights: They allow for the formulation of empirically testable predictions with regard to the role of metalinguistic knowledge in L2 learning. In what follows, five specific hypotheses which are intended to inform future research are presented.

(1) Linguistic constructions which are captured relatively easily by Aristotelian categories and relations between such categories will be easier to acquire explicitly than linguistic constructions which are not captured easily by Aristotelian categories and relations between such categories. Specifically, linguistic constructions which show comparatively systematic, stable, and context-independent usage patterns should be more amenable to explicit teaching and learning than linguistic constructions which do not show these usage patterns.

There is as yet very little existing research which has investigated the potential amenability of specific linguistic constructions to explicit L2 instruction drawing on metalinguistic descriptions, even though theoretically motivated predictions about the potential difficulties of simple versus complex metalinguistic rules were put forward more than a decade ago (e.g. DeKeyser, 1994; Hulstijn & de Graaff, 1994). Recent empirical findings suggest that L2 form-function mappings which can be described metalinguistically in conceptually simple terms and which refer to systematic usage patterns appear to pose the least explicit learning difficulty (R. Ellis, 2006; Roehr & Gánem, in preparation) and may therefore be particularly suitable for explicit teaching and learning. By contrast, L2 form-function mappings with less systematic usage patterns which require conceptually complex metalinguistic descriptions should pose greater explicit learning difficulty. In view of the small number of studies that have been conducted so far, further investigation of Hypothesis 1 is clearly required.

(2) Use of metalinguistic knowledge will differentially affect the fluency, accuracy, and complexity of L2 performance. Specifically, fluency may decrease, while accuracy and complexity may increase.

Existing research has shown that L2 learners' metalinguistic knowledge correlates positively with L2 proficiency – provided that the latter is operationalized by means of written rather than oral measures (e.g. Alderson et al., 1997; Elder et al., 1999; Renou, 2000). Given that the use of explicit knowledge requires controlled processing which is by definition slow and effortful compared with automatic, implicit operations, this finding is perfectly compatible with previous theoretical argumentation. However, whilst L2 proficiency has typically been operationalized via discrete-item tests of structural and lexical competence and/or via the 'four skills' of reading, writing, speaking, and listening, no study to date has investigated learners' use of metalinguistic knowledge in relation to the SLA-specific developmental measures of fluency, accuracy, and complexity (R. Ellis & Barkhuizen, 2005; Larsen-Freeman, 2006; Skehan, 1998) which cut across both oral and written performance.

In view of the fact that explicit, rule-based processing drawing on representations with Aristotelian category structure is subject to working memory constraints and thus relies on the selective allocation of attentional resources, one would expect that increased accuracy, for instance, can only be achieved at the expense of decreased complexity and fluency. Likewise, increased complexity can only be achieved at the expense of decreased accuracy and fluency, whereas increased fluency is unlikely to be achieved at all in association with high use of metalinguistic knowledge. Averaged across a group of learners, these predicted patterns should hold for both oral and written performance, although trade-off effects can be expected to be stronger in the case of oral performance, since the time pressures of online processing inevitably place even higher demands on working memory. To my knowledge, none of the performance patterns hypothesized here have been subjected to empirical enquiry yet.

(3) Use of metalinguistic knowledge will be related to cognitively based individual learner differences. Specifically, a learner's cognitive and learning style, language learning aptitude, and working memory capacity are likely to differentially affect their use of metalinguistic knowledge in L2 performance.

I have argued that metalinguistic knowledge representations exhibit Aristotelian category structure and that rule-based processing mechanisms operate on these representations. As mentioned previously, rule-based processing mechanisms are characteristic of analytic reasoning more generally, so that use of metalinguistic knowledge can be regarded as problem-solving in the linguistic domain. Accordingly,

individuals with an analytic stylistic orientation and large working memory capacity should be particularly adept at using metalinguistic knowledge.

While existing research has occasionally speculated on some of these issues (e.g. Collentine, 2000; DeKeyser, 2003), no study to date has probed the relationship between L2 learners' metalinguistic knowledge and their stylistic preferences (for recent work on cognitive and learning style in SLA more generally, see, for instance Ehrman & Leaver, 2003; Reid, 1998). As far as I am aware, only one study to date has directly investigated the interplay of L2 learners' metalinguistic knowledge, their language learning aptitude, and their working memory capacity (Roehr & Gánem, in preparation). Results indicate that learners' level of metalinguistic knowledge and their working memory capacity are unrelated, but that analytic components of language learning aptitude, i.e. components whose operationalization incorporates no purely memory-based or purely auditory elements, were positively correlated with learners' level of metalinguistic knowledge, with coefficients ranging from 0.46 to 0.66. In view of the shortage of available evidence, further research into the relationship between metalinguistic knowledge and cognitively based individual difference variables is needed.

(4) Use of metalinguistic knowledge and cognitively based individual differences will be related to learners' affective responses. Specifically, individuals with an analytic disposition who are likely to benefit from explicit learning and teaching drawing on metalinguistic knowledge will experience feelings of greater self-efficacy and will thus develop positive attitudes towards their L2 learning situation. By contrast, individuals with a non-analytic disposition who are likely to benefit less from explicit learning and teaching drawing on metalinguistic knowledge will experience greater anxiety and will thus develop negative attitudes towards their L2 learning situation.

To my knowledge, there is as yet no published research that has put these predictions to the test (but see Roehr, 2005 for some preliminary analyses based on a small number of cases; for work on the interaction of affect and cognition more generally, see, for instance, Schumann, 1998, 2004; Stevick, 1999). In view of Hypothesis 1 above, it is plausible to hypothesize that metalinguistic descriptions which pertain to linguistic constructions characterized by systematic and relatively context-independent usage patterns may be facilitative for any L2 learner, regardless of cognitively based individual differences. Such metalinguistic descriptions may

focus a learner's attention on aspects of the L2 input that might otherwise be ignored, thus leading to noticing, i.e. conscious processing just above the threshold of awareness, and all its associated benefits.

If, on the other hand, metalinguistic descriptions pertaining to linguistic constructions that pose more substantial explicit learning difficulty according to Hypothesis 1 are used, cognitively based individual learner differences should begin to matter. An analytically oriented individual may continue to benefit by moving beyond noticing towards understanding, thus relying on conscious processing at a high level of awareness (Schmidt, 1990, 1993, 2001). The achievement of understanding is likely to result in positive affective responses such as feelings of greater self-efficacy and enhanced self-confidence. A positive attitude towards the L2 learning situation may result, which would in turn encourage the learner to deliberately seek further exposure to the L2. In a learner with a different stylistic orientation, however, this upward dynamic could well be replaced by a downward spiral of failure to understand, feelings of anxiety and loss of control, a negative attitude towards the L2 learning situation, and, in the worst-case scenario, the eventual abandonment of L2 study. This hypothesized interaction of cognitive and affective variables can and should be put to the test.

(5) Use of metalinguistic knowledge in L2 learning will be related to L1 metalinguistic ability. Specifically, individuals who show strong metalinguistic ability and literacy skills in L1 development are likely to exhibit high levels of metalinguistic knowledge in L2.

With regard to metalinguistic knowledge in adult learners, the link between L1 and L2 skills has not been widely explored. Some studies have incorporated measures of L1 metalinguistic knowledge alongside tests of L2 metalinguistic knowledge (e.g. Alderson et al., 1997), or acknowledged the association between metalinguistic and literacy skills (e.g. Kemp, 2001). Furthermore, existing research has emphasized the link between L1 ability and aptitude for L2 learning (e.g. Sparks & Ganschow, 2001), or highlighted the fact that multilingual individuals generally show greater metalinguistic awareness (e.g. Jessner, 1999, 2006). Yet, I am not aware of any published study of cognitively mature learners which has directly focused on the relationship between L1 and L2 competence on the one hand and L1 and L2 metalinguistic knowledge on the other hand. If Hypotheses 3 and 4 are borne out, the

patterns of interplay between individual difference variables and metalinguistic knowledge can be expected to be similar in both L1 and L2.

6. Conclusion

In this paper, I have put forward a theoretically motivated and empirically grounded conceptualization of the construct of metalinguistic knowledge, or explicit knowledge about language, with specific reference to L2 learning. I have argued that explicit metalinguistic and implicit linguistic knowledge vary along the same parameters, specificity and complexity, but that they differ qualitatively in terms of their internal category structure and, accordingly, the processing mechanisms that operate on their representation in the human mind. In consonance with assumptions made in the usage-based approach to language, implicit knowledge is characterized by flexible and context-dependent categories with fuzzy boundaries. By contrast, explicit knowledge is represented in terms of Aristotelian categories with a stable, discrete, and context-independent structure.

In accordance with research in cognitive psychology, implicit knowledge is subject to similarity-based processing which is characterized by dynamicity, flexibility, and context-dependency. Conversely, explicit knowledge is subject to rule-based processing which is both conscious and controlled. Such processing is constrained by the capacity limits of working memory; it requires effort, selective attention, and commitment. Rule-based processing is further characterized by stability and consistency – properties that are achieved at the cost of flexibility and consideration of contextual and frequency information. Rule-based processing underlies analytic reasoning, whether in the linguistic or any other cognitive domain. Hence, use of metalinguistic knowledge can be understood as problem-solving applied to language.

The proposed attributes of implicit linguistic and explicit metalinguistic category structures and processes have been considered in relation to available research in the field of SLA, and a post-hoc account that is consistent with both the benefits and the limitations of metalinguistic knowledge as identified in existing research has been provided. Arising from the theoretical proposals put forward in the present paper, I have further formulated five specific predictions which, if confirmed, would identify the conditions under which metalinguistic knowledge is likely to be useful to the L2

learner. These predictions constitute empirically testable hypotheses which, it is hoped, will be addressed in future research.

Acknowledgements

I would like to thank Martin Atkinson, Bob Borsley, and Ewa Dabrowska for their helpful and constructive comments.

References

Abbot-Smith, K., & Tomasello, M. (2006). Exemplar-learning and schematization in a usage-based account of syntactic acquisition. *The Linguistic Review, 23*(3), 275-290.

Achard, M., & Niemeier, S. (Eds.). (2004). *Cognitive linguistics, second language acquisition, and foreign language teaching*. Berlin: Mouton de Gruyter.

Alderson, J. C., Clapham, C., & Steel, D. (1997). Metalinguistic knowledge, language aptitude and language proficiency. *Language Teaching Research, 1*, 93-121.

Anderson, J. R. (1995). *Learning and memory: An integrated approach*. New York, NY: John Wiley & Sons.

Anderson, J. R. (1996). *The architecture of cognition*. Mahwah, NJ: Erlbaum.

Anderson, J. R. (2005). *Cognitive psychology and its implications* (6th ed.). New York, NY: Worth Publishers.

Ashby, F. G., & Casale, M. B. (2005). Empirical dissociations between rule-based and similarity-based categorization. *Behavioral and Brain Sciences, 28*(1), 15-16.

Baddeley, A. D. (1997). *Human memory: Theory and practice*. Hove: Psychology Press.

Baddeley, A. D. (2000). The episodic buffer: A new component of working memory? *Trends in Cognitive Sciences, 4*(11), 417-423.

Baddeley, A. D., & Logie, R. H. (1999). Working memory: The multiple-component model. In A. Miyake & P. Shah (Eds.), *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 28-61). Cambridge: Cambridge University Press.

Bailey, T. M. (2005). Rules work on one representation; similarity compares two representations. *Behavioral and Brain Sciences, 28*(1), 16.

Bates, E. A., & Goodman, J. C. (2001). On the inseparability of grammar and the lexicon: Evidence from acquisition. In M. Tomasello & E. Bates (Eds.), *Language development* (pp. 134-162). Malden, MA: Blackwell.

Bayne, T., & Chalmers, D. J. (2003). What is the unity of consciousness? In A. Cleeremans (Ed.), *The unity of consciousness: Binding, integration, and dissociation* (pp. 23-58). Oxford: Oxford University Press.

Bialystok, E. (1979). Explicit and implicit judgements of L2 grammaticality. *Language Learning, 29*(1), 81-103.

Birdsong, D. (1989). *Metalinguistic performance and interlinguistic competence*. Berlin: Springer.

Bod, R., Hay, J., & Jannedy, S. (2003). Introduction. In R. Bod & J. Hay & S. Jannedy (Eds.), *Probabilistic linguistics* (pp. 1-10). Cambridge, MA: MIT Press.

Boers, F., & Lindstromberg, S. (2006). Cognitive linguistic applications in second and foreign language instruction: Rationale, proposals, and evaluation. In G. Kristiansen & M. Achard & R. Dirven & F. J. Ruiz de Mendoza Ibánez (Eds.), *Cognitive linguistics: Current applications and future perspectives* (pp. 305-355). Berlin: Mouton de Gruyter.

Butler, Y. G. (2002). Second language learners' theories on the use of English articles: An analysis of the metalinguistic knowledge used by Japanese students in acquiring the English article system. *Studies in Second Language Acquisition, 24*(3), 451-480.

Bybee, J. L., & 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.

Camps, J. (2003). Concurrent and retrospective verbal reports as tools to better understand the role of attention in second language tasks. *International Journal of Applied Linguistics, 13*(2), 201-221.

Cattell, R. (2006). *An introduction to mind, consciousness and language*. London: Continuum.

Chalker, S. (1994). Pedagogical grammar: Principles and problems. In M. Bygate & A. Tonkyn & E. Williams (Eds.), *Grammar and the language teacher* (pp. 31-44). New York, NY: Prentice Hall.

Cleeremans, A., & Destrebecqz, A. (2005). Real rules are conscious. *Behavioral and Brain Sciences, 28*(1), 19-20.

Collentine, J. (2000). Insights into the construction of grammatical knowledge provided by user-behavior tracking technologies. *Language Learning and Technology, 3*(2), 44-57.

Croft, W. (2001). *Radical construction grammar: Syntactic theory in typological perspective*. Oxford: Oxford University Press.

Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior, 19*, 450-466.

DeKeyser, R. M. (1994). How implicit can adult second language learning be? *AILA Review, 11*, 83-96.

DeKeyser, R. M. (2003). Implicit and explicit learning. In C. J. Doughty & M. H. Long (Eds.), *The handbook of second language acquisition* (pp. 313-348). Malden, MA: Blackwell.

DeKeyser, R. M. (2005). What makes learning second-language grammar difficult? A review of issues. *Language Learning, 55*(s1), 1-25.

Dienes, Z., & Perner, J. (2003). Unifying consciousness with explicit knowledge. In A. Cleeremans (Ed.), *The unity of consciousness: Binding, integration, and dissociation* (pp. 214-232). Oxford: Oxford University Press.

Diesendruck, G. (2005). "Commitment" distinguishes between rules and similarity: A developmental perspective. *Behavioral and Brain Sciences, 28*(1), 21-22.

Dirven, R., & Verspoor, M. (2004). *Cognitive exploration of language and linguistics* (2nd ed.). Amsterdam: John Benjamins.

Doughty, C. J. (1991). Second language instruction does make a difference: Evidence from an empirical study of SL relativization. *Studies in Second Language Acquisition, 13*, 431-469.

Doughty, C. J. (2003). Instructed SLA: Constraints, compensation, and enhancement. In C. J. Doughty & M. H. Long (Eds.), *The handbook of second language acquisition* (pp. 256-310). Malden, MA: Blackwell.

Ehrman, M. E., & Leaver, B. L. (2003). Cognitive style in the service of language learning. *System, 31*, 393-415.

Elder, C., & Manwaring, D. (2004). The relationship between metalinguistic knowledge and learning outcomes among undergraduate students of Chinese. *Language Awareness, 13*(3), 145-162.

Elder, C., Warren, J., Hajek, J., Manwaring, D., & Davies, A. (1999). Metalinguistic knowledge: How important is it in studying a language at university? *Australian Review of Applied Linguistics, 22*(1), 81-95.

Ellis, N. C. (1993). Rules and instances in foreign language learning: Interactions of explicit and implicit knowledge. *European Journal of Cognitive Psychology, 5*(3), 289-318.

Ellis, N. C. (1994). Consciousness in second language learning: Psychological perspectives on the role of conscious processes in vocabulary acquisition. *AILA Review, 11*, 37-56.

Ellis, N. C. (1996). Sequencing in SLA: Phonological memory, chunking, and points of order. *Studies in Second Language Acquisition, 18*, 91-126.

Ellis, N. C. (2001). Memory for language. In P. Robinson (Ed.), *Cognition and second language instruction* (pp. 33-68). Cambridge: Cambridge University Press.

Ellis, N. C. (2002a). Frequency effects in language processing: A review with implications for theories of implicit and explicit language acquisition. *Studies in Second Language Acquisition, 24*(2), 143-188.

Ellis, N. C. (2002b). Reflections on frequency effects in language processing. *Studies in Second Language Acquisition, 24*(2), 297-340.

Ellis, N. C. (2003). Constructions, chunking, and connectionism: The emergence of second language structure. In C. J. Doughty & M. H. Long (Eds.), *The handbook of second language acquisition* (pp. 63-103). Malden, MA: Blackwell.

Ellis, N. C. (2005). At the interface: Dynamic interactions of explicit and implicit language knowledge. *Studies in Second Language Acquisition, 27*(2), 305-352.

Ellis, N. C., & Larsen-Freeman, D. (2006). Language emergence: Implications for applied linguistics. *Applied Linguistics, 27*(4), 558-589.

Ellis, R. (2001). Introduction: Investigating form-focused instruction. *Language Learning, 51*(1), 1-46.

Ellis, R. (2002). Does form-focused instruction affect the acquisition of implicit knowledge? *Studies in Second Language Acquisition, 24*(2), 223-236.

Ellis, R. (2004). The definition and measurement of L2 explicit knowledge. *Language Learning, 54*(2), 227-275.

Ellis, R. (2005). Measuring implicit and explicit knowledge of a second language: A psychometric study. *Studies in Second Language Acquisition, 27*(2), 141-172.

Ellis, R. (2006). Modelling learning difficulty and second language proficiency: The differential contributions of implicit and explicit knowledge. *Applied Linguistics, 27*(3), 431-463.

Ellis, R., & Barkhuizen, G. (2005). *Analysing learner language*. Oxford: Oxford University Press.

Engel, A. K. (2003). Temporal binding and the neural correlates of consciousness. In A. Cleeremans (Ed.), *The unity of consciousness: Binding, integration, and dissociation* (pp. 132-152). Oxford: Oxford University Press.

Gabrielatos, C. (2004). *If-conditionals in ELT materials and the BNC: Corpus-based evaluation of pedagogical materials.* Paper presented at the Corpus Linguistics Research Group meeting on 26 April 2004, Lancaster University.

Goldberg, A. E. (1995). *Constructions: A construction grammar approach to argument structure*. Chicago: University of Chicago Press.

Goldberg, A. E. (1999). The emergence of the semantics of argument structure constructions. In B. MacWhinney (Ed.), *The emergence of language* (pp. 197-212). Mahwah, NJ: Erlbaum.

Goldberg, A. E. (2003). Constructions: A new theoretical approach to language. *Trends in Cognitive Sciences, 7*(5), 219-224.

Gombert, J. E. (1992). *Metalinguistic development*. Hemel Hempstead: Harvester.

Green, P. S., & Hecht, K. (1992). Implicit and explicit grammar: An empirical study. *Applied Linguistics, 13*(2), 168-184.

Hampton, J. A. (2005). Rules and similarity - a false dichotomy. *Behavioral and Brain Sciences, 28*(1), 26.

Hu, G. (2002). Psychological constraints on the utility of metalinguistic knowledge in second language production. *Studies in Second Language Acquisition, 24*(3), 347-386.

Hulstijn, J. H. (2005). Theoretical and empirical issues in the study of implicit and explicit second-language learning: Introduction. *Studies in Second Language Acquisition, 27*(2), 129-140.

Hulstijn, J. H., & de Graaff, R. (1994). Under what conditions does explicit knowledge of a second language facilitate the acquisition of implicit knowledge? A research proposal. *AILA Review, 11*, 97-112.

Jessner, U. (1999). Metalinguistic awareness in multilinguals: Cognitive aspects of third language learning. *Language Awareness, 8*(3&4), 201-209.

Jessner, U. (2006). *Linguistic awareness in multilinguals: English as a third language*. Edinburgh: Edinburgh University Press.

Johnson, K. (1996). *Language teaching and skill learning*. Oxford: Blackwell.

Just, M. A., & Carpenter, P. A. (1992). A capacity theory of comprehension: Individual differences in working memory. *Psychological Review, 99*(1), 122-149.

Karmiloff, K., & Karmiloff-Smith, A. (2002). *Pathways to language: From fetus to adolescent*. Cambridge, MA: Harvard University Press.

Kemmer, S., & Barlow, M. (2000). Introduction: A usage-based conception of language. In M. Barlow & S. Kemmer (Eds.), *Usage-based models of language* (pp. vii-xxviii). Stanford, CA: CSLI.

Kemp, C. (2001). *Metalinguistic awareness in multilinguals: Implicit and explicit grammatical awareness and its relationship with language experience and language attainment.* Unpublished PhD thesis, University of Edinburgh.

Klapper, J., & Rees, J. (2003). Reviewing the case for explicit grammar instruction in the university foreign language learning context. *Language Teaching Research, 7*(3), 285-314.

Krashen, S. D. (1981). *Second language acquisition and second language learning*. Oxford: Pergamon.

Krashen, S. D. (1985). *The input hypothesis: Issues and implications*. London: Longman.

Langacker, R. W. (1991). *Concept, image, and symbol: The cognitive basis of grammar*. Berlin: Mouton de Gruyter.

Langacker, R. W. (1999). *Grammar and conceptualization*. Berlin: Mouton de Gruyter.

Langacker, R. W. (2000). A dynamic usage-based model. In M. Barlow & S. Kemmer (Eds.), *Usage-based models of language* (pp. 1-64). Stanford, CA: CSLI.

Larsen-Freeman, D. (2006). The emergence of complexity, fluency, and accuracy in the oral and written production of five Chinese learners of English. *Applied Linguistics, 27*(4), 590-619.

Leow, R. P. (1997). Attention, awareness, and foreign language behavior. *Language Learning, 47*, 467-505.

MacWhinney, B. (1997). Implicit and explicit processes: Commentary. *Studies in Second Language Acquisition, 19*, 277-281.

Markman, A. B., Blok, S., Kom, K., Larkey, L., Narvaez, L. R., Stilwell, C. H., & Taylor, E. (2005). Digging beneath rules and similarity. *Behavioral and Brain Sciences, 28*(1), 29-30.

McDonough, S. (2002). *Applied linguistics in language education*. London: Arnold.

McLaughlin, B. (1995). Aptitude from an information-processing perspective. *Language Testing, 12*, 370-387.

Miyake, A., & Friedman, N. P. (1998). Individual differences in second language proficiency: Working memory as language aptitude. In A. F. Healy & L. E. Bourne (Eds.), *Foreign language learning: Psycholinguistic studies on training and retention* (pp. 339-364). Mahwah, NJ: Erlbaum.

Miyake, A., & Shah, P. (1999). Toward unified theories of working memory: Emerging general consensus, unresolved theoretical issues, and future research directions. In A. Miyake & P. Shah (Eds.), *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 442-481). Cambridge: Cambridge University Press.

Murphy, G. L. (2004). *The big book of concepts*. Cambridge, MA: MIT Press.

Murphy, R. (1994). *English grammar in use* (2nd ed.). Cambridge: Cambridge University Press.

Nagata, N., & Swisher, M. V. (1995). A study of consciousness-raising by computer: The effect of metalinguistic feedback on second language learning. *Foreign Language Annals, 28*(3), 337-347.

Norris, J. M., & Ortega, L. (2001). Does type of instruction make a difference? Substantive findings from a meta-analytic review. *Language Learning, 51*(1), 157-213.

Paradis, M. (2004). *A neurolinguistic theory of bilingualism*. Amsterdam: John Benjamins.

Pothos, E. M. (2005). The rules versus similarity distinction. *Behavioral and Brain Sciences, 28*(1), 1-49.

Reber, R. (2005). Rule versus similarity: Different in processing mode, not in representations. *Behavioral and Brain Sciences, 28*(1), 31-32.

Reid, J. M. (Ed.). (1998). *Understanding learning styles in the second language classroom*. Upper Saddle River, NJ: Prentice Hall Regents.

Renou, J. M. (2000). Learner accuracy and learner performance: The quest for a link. *Foreign Language Annals, 33*(2), 168-180.

Robinson, P. (1995). Review article: Attention, memory, and the "noticing" hypothesis. *Language Learning, 45*(2), 283-331.

Robinson, P. (1997). Generalizability and automaticity of second language learning under implicit, incidental, enhanced, and instructed conditions. *Studies in Second Language Acquisition, 19*, 223-247.

Robinson, P. (2003). Attention and memory during SLA. In C. J. Doughty & M. H. Long (Eds.), *The handbook of second language acquisition* (pp. 631-678). Malden, MA: Blackwell.

Roehr, K. (2005). *Metalinguistic knowledge in second language learning: An emergentist perspective.* Unpublished PhD thesis, Lancaster University.

Roehr, K. (2006). Metalinguistic knowledge in L2 task performance: A verbal protocol analysis. *Language Awareness, 15*(3), 180-198.

Roehr, K. (submitted). Metalinguistic knowledge and language-analytic ability in university-level L2 learners. *Applied Linguistics*.

Roehr, K., & Gánem, A. (in preparation). Metalinguistic knowledge in instructed second language learning: An individual difference variable. Unpublished manuscript, University of Essex.

Rosa, E., & O'Neill, M. D. (1999). Explicitness, intake, and the issue of awareness. *Studies in Second Language Acquisition, 21*, 511-556.

Rosch, E., & Lloyd, B. B. (Eds.). (1978). *Cognition and categorization*. Hillsdale, NJ: Erlbaum.

Rosch, E., & Mervis, C. B. (1975). Family resemblances: Studies in the internal structure of categories. *Cognitive Psychology, 7*, 573-605.

Sanz, C., & Morgan-Short, K. (2004). Positive evidence versus explicit rule presentation and explicit negative feedback: A computer-assisted study. *Language Learning, 54*(1), 35-78.

Sanz, C., & Morgan-Short, K. (2005). Explicitness in pedagogical interventions: Input, practice, and feedback. In C. Sanz (Ed.), *Mind and context in adult second language acquisition: Methods, theory, and practice* (pp. 234-263). Washington, DC: Georgetown University Press.

Saporta, S. (1973). Scientific grammars and pedagogical grammars. In J. P. B. Allen & P. Corder (Eds.), *The Edinburgh course in applied linguistics* (pp. 265-274). London: Oxford University Press.

Schmidt, R. W. (1990). The role of consciousness in SLA learning. *Applied Linguistics, 11*, 129-158.

Schmidt, R. W. (1993). Awareness and second language acquisition. *Annual Review of Applied Linguistics, 13*, 206-226.

Schmidt, R. W. (2001). Attention. In P. Robinson (Ed.), *Cognition and second language instruction* (pp. 3-32). Cambridge: Cambridge University Press.

Schumann, J. H. (1998). The neurobiology of affect in language. *Language Learning, 48*(s1), xi-341.

Schumann, J. H. (2004). The neurobiology of aptitude. In J. H. Schumann & S. E. Crowell & N. E. Jones & N. Lee & S. A. Schuchert & L. A. Wood (Eds.), *The neurobiology of learning: Perspectives from second language acquisition* (pp. 7-22). Mahwah, NJ: Erlbaum.

Segalowitz, N. (2003). Automaticity and second languages. In C. J. Doughty & M. H. Long (Eds.), *The handbook of second language acquisition* (pp. 382-408). Malden, MA: Blackwell.

Shah, P., & Miyake, A. (1999). Models of working memory: An introduction. In A. Miyake & P. Shah (Eds.), *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 1-27). Cambridge: Cambridge University Press.

Simard, D., & Wong, W. (2001). Alertness, orientation, and detection: The conceptualization of attentional functions in SLA. *Studies in Second Language Acquisition, 23*, 103-124.

Skehan, P. (1998). *A cognitive approach to language learning*. Oxford: Oxford University Press.

Sloman, S. (2005). Avoiding foolish consistency. *Behavioral and Brain Sciences, 28*(1), 33-34.

Smith, E. E. (2005). Rule and similarity as prototype concepts. *Behavioral and Brain Sciences, 28*(1), 34-35.

Sorace, A. (1985). Metalinguistic knowledge and language use in acquisition-poor environments. *Applied Linguistics, 6*(3), 239-254.

Sparks, R., & Ganschow, L. (2001). Aptitude for learning a foreign language. *Annual Review of Applied Linguistics, 21*, 90-111.

Stankov, L. (2003). Complexity in human intelligence. In R. J. Sternberg & J. Lautrey & T. I. Lubart (Eds.), *Models of intelligence: International perspectives* (pp. 27-42). Washington, DC: American Psychological Association.

Stevick, E. W. (1999). Affect in learning and memory: From alchemy to chemistry. In J. Arnold (Ed.), *Affect in language learning* (pp. 43-57). Cambridge: Cambridge University Press.

Swain, M. (1998). Focus on form through conscious reflection. In C. J. Doughty & J. Williams (Eds.), *Focus on form in classroom second language acquisition* (pp. 64-81). Cambridge: Cambridge University Press.

Swan, M. (1994). Design criteria for pedagogic language rules. In M. Bygate & A. Tonkyn & E. Williams (Eds.), *Grammar and the language teacher* (pp. 45-55). New York, NY: Prentice Hall.

Swan, M. (1995). *Practical English usage* (2nd ed.). Oxford: Oxford University Press.

Taylor, J. R. (2002). *Cognitive grammar*. Oxford: Oxford University Press.

Taylor, J. R. (2003). *Linguistic categorization* (3rd ed.). Oxford: Oxford University Press.

Tomasello, M. (1998). Introduction: A cognitive-functional perspective on language structure. In M. Tomasello (Ed.), *The new psychology of language: Cognitive and functional approaches to language structure* (Vol. 1, pp. vii-xxiii). Mahwah, NJ: Erlbaum.

Tomasello, M. (2003). *Constructing a language: A usage-based theory of language acquisition*. Cambridge, MA: Harvard University Press.

Tomlin, R. S., & Villa, V. (1994). Attention in cognitive science and second language acquisition. *Studies in Second Language Acquisition, 16*, 183-203.

Towell, R. (2002). Design of a pedagogical grammar. URL: http://www.lang.ltsn.ac.uk/resources/goodpractice.aspx?resourceid=410.

Ungerer, F., & Schmid, H.-J. (1996). *An introduction to cognitive linguistics*. London: Longman.

VanPatten, B. (1996). *Input processing and grammar instruction in second language acquisition*. Norwood, NJ: Ablex.

VanPatten, B. (Ed.). (2004). *Processing instruction: Theory, research, and commentary*. Mahwah, NJ: Erlbaum.

Notes

1 The following notation conventions are used: Schematic categories are shown in small capitals with square brackets, e.g. [BIRD]. Exemplars of conceptual categories are shown in small capitals, e.g. ROBIN. Specific linguistic constructions are shown in italics, e.g. *bachelor, unrepentant*, etc. Metalinguistic descriptions are shown in single inverted commas, e.g. '*da* sends the finite verb to the end of the clause'.

2 Langacker's (1991) terminology is employed throughout this article. Croft (2001) uses the terms "atomic" and "substantive" instead of "minimal" and "specific", respectively.

3 The weak-interface position can be contrasted with the non-interface position and the strong-interface position. The non-interface position contends not only that explicit and implicit knowledge are separate and distinct constructs, but also that they cannot engage in interplay (Krashen, 1981, 1985; Paradis, 2004). The strong-interface position maintains that explicit and implicit knowledge interact directly, and that explicit knowledge may be converted into implicit knowledge, e.g. through prolonged practice (DeKeyser, 1994; Johnson, 1996; McLaughlin, 1995). A review of these various positions can be found in R. Ellis (2005).

4 Current research into the interface between explicit and implicit knowledge does not yet offer any highly precise descriptions of the links between the level of the mind and the level of the brain. Likewise, researchers' understanding of the notion of consciousness is still incomplete. Therefore, what I present here are hypotheses that are compatible with existing empirical findings. While recognizing that further research is required, I regard these hypotheses both as sufficiently plausible to be given serious consideration and as sufficiently detailed to be incorporated into a coherent line of argument.

5 As mentioned previously, for the current discussion it does not matter whether an individual's metalinguistic knowledge has been derived internally or assimilated from external sources.

6 URL: http://wordnet.princeton.edu/perl/webwn, retrieved 16 April 2007, based on a keyword search for 'noun'.

7 This circumstance is consistent with the proposal that explicit knowledge about language may be more inaccurate and more imprecise than implicit knowledge (R. Ellis, 2004, 2005, 2006). While, at first glance, this hypothesis seems to be incompatible with the attributes of rule-based processing, it fits into the picture if the limitations of metalinguistic knowledge based on representations with Aristotelian category structure are taken into consideration.

The Perfective Past Tense in Greek Child Language

Stavroula Stavrakaki (University of Thessaloniki)

Harald Clahsen (University of Essex)

Contact Addresss of Corresponding Author:
Harald Clahsen
Department of Linguistics
University of Essex
Colchester, C04 3SQ, UK
harald@essex.ac.uk

ABSTRACT

This study examines the perfective past tense of Greek in an elicited production and an acceptability judgment task testing 35 adult native speakers and 164 children in six age groups (age range: 3;5 to 8;5) on both existing and novel verb stimuli. We found a striking contrast between sigmatic and non-sigmatic perfective past tense forms. Sigmatic forms (which have a segmentable perfective affix (-*s*-) in Greek) were widely generalized to different kinds of novel verbs in both children and adults and were overgeneralized to existing non-sigmatic verbs in children's productions. By contrast, non-sigmatic forms were only extended to novel verbs that were similar to existing non-sigmatic verbs, and overapplications of non-sigmatic forms to existing sigmatic verbs were extremely rare. We argue that these findings are consistent with dual-mechanism accounts of morphology.

1. Introduction

One crucial property of many inflectional processes is that they generalize to novel or unusual words. Adults make use of this to incorporate words from foreign languages, as for example in *I schlepped a shopping bag around Manhattan* or *Das Bloggen während der Arbeitszeit ist verboten* 'blogging during working hours is prohibited'. By applying inflectional processes a new word can easily be accommodated into another language; in the first case by applying *–ed* to a Yiddish/German word (*schleppen* 'to drag') and in the second case by applying the German *–en* to an English word. Children make use of the generalization properties of inflectional processes in overregularizations errors such as **beated* and **drawed* (Marcus, Pinker, Ullman et al. 1992: 148), in which *-ed* forms are applied to verbs that have irregular past-tense forms (*beat, drew*). These kinds of error have been extensively studied and have been taken as an indication that children do not just memorize and repeat forms found in the input but also make use of abstract rules of grammar (see e.g. Brown and Bellugi 1964, McNeill 1966).

Whilst the capacity for linguistic generalizations seems to be a core element of human knowledge of language, the mechanisms underlying generalization of inflectional processes are still subject to some controversy. Dual-mechanism morphology (see Clahsen 2006 for review) distinguishes between exemplar-based and rule-based generalization processes. The first one concerns generalization by analogy to novel words that are similar to existing ones and/or to the most common frequent exemplars. The second one concerns generalization based on abstract grammatical categories (e.g. 'V' or 'N') irrespective of any kind of analogy to exemplars. Whilst rule-based generalization applies elsewhere, i.e. even under circumstances in which similarity-driven analogy fails, for example to unusual sounding novel words, exemplar-based generalizations are sensitive to similarity and/or frequency patterns. An alternative view is represented by different kinds of single mechanism accounts according to which all word forms (including morphologically complex ones) employ the same representational and processing mechanisms (Rumelhart & McClelland 1986; Elman et al. 1996; Langacker 2000). In these accounts, all generalization processes are said to be exemplar-based. One important issue in the controversy between dual and single-mechanism accounts of the acquisition of morphology concerns the nature of overgeneralization errors. In the former, past tense errors such as **bring-ed* are interpreted in terms of overapplication of a regular *–ed* affixation

rule (Pinker & Ullman 2002), whereas in single-mechanism models these kinds of error are taken to reflect a generalization of a high-frequency pattern (McClelland & Patterson 2002).

In child language acquisition research over the past fifteen years, these predictions have been tested against different sets of data. However, much of this research has focused on just one inflectional system, the English past tense, and it remains to be seen whether contrasts between regular and irregular morphology in children's generalization errors that were found for the English past tense also hold cross-linguistically. It is true that acquisition researchers have begun to examine children's overgeneralizations in languages other than English, but the results are still scarce and mixed, and the controversy surrounding the nature of these generalization processes is far from settled. Some acquisition studies have provided support for dual-mechanism accounts reporting dissociations between regular and irregular forms in children's inflectional errors, parallel to those found for children's past-tense errors in English (see e.g. Clahsen & Rothweiler 1993 for German, Say & Clahsen 2002 for Italian, Clahsen, Aveledo & Roca 2002 for Spanish, Royle 2007 for French). Other studies, however, have not found any sharp regular/irregular contrast in children's inflectional errors and claimed to be more consistent with single-mechanism models (see e.g. Orsolini et al. 1998 for Italian, Laaha et al. 2006 for German, Dabrowska & Szczerbinski 2006 for Polish, Ragnarsdottir et al. 1999 for Icelandic and Norwegian, Marchman et al. 1997 for English). Clearly, more research is needed to determine the nature of generalization processes in children's inflectional errors from a cross-linguistic perspective.

The present study contributes new data and analyses to these issues by investigating the perfective past tense in Greek child language. The main purpose of our study is to describe the kinds of generalization processes Greek children employ in producing and judging perfective past tense forms and how these generalization processes change with age. To this end, we collected and analyzed an extensive data set. A total of 199 native speakers of Greek in different age groups were examined, using two experimental tasks (acceptability judgement and elicited production), and testing perfective past tense forms of both existing and novel verbs. The results from these data provide a detailed picture of the development of the perfective past tense in Greek child language.

2. Linguistic background: The perfective past tense in Greek

Modern Greek marks present, past, and future tense in the indicative mood (Holton et al. 1997). Tense marking is closely linked to the aspectual system, specifically to the distinction between perfective and imperfective aspect. The former is used when an action or an event is seen as completed while the latter is used when it is seen as in progress, habitual or repeated (Holton et al. 1997; Triandafillidis 1941). Consequently, Greek distinguishes between a perfective and an imperfective past tense. Both types of past-tense form have antepenultimate stress and are prefixed by a stressed augment *e-* when the verb stem is monosyllabic and starts with a consonant; compare, for example, the two perfective past-tense forms *efaga* 'I ate' and *halasa* 'I destroyed' of which only the former contains the augment *e-* (Holton et al. 1997; Triandafillidis 1941).

One important distinction amongst perfective past-tense forms is between sigmatic and non-sigmatic ones, the former are with *–s-* ('sigma' in the Greek alphabet) and the latter are without *–s-*. Sigmatic past-tense forms have been considered to be 'regular' in the sense that they involve a segmentable affix (*–s-*) paired with phonologically predictable stem changes; non-sigmatic past-tense forms, by contrast, exhibit properties typical of 'irregular' inflection in that they involve unsystematic and even suppletive stem changes and no segmentable (perfective past-tense) affix (for discussion see e.g. Ralli 1988, 2003; Terzi, Papapetropoulos & Kouvelas 2005; Tsapkini, Jarema, Kehayia 2001, 2002a, 2002b). Consider the following examples.

(1) a. graf-o, e-grap-s-a 'I write', I wrote'
b. lin-o, e-li-s-a 'I untie, I untied'
(2) a. plen-o, e-plin-a 'I wash, I washed'
b. zesten-o, zestan-a 'I warm, I warmed'
c. tro-o, efag-a 'I eat, I ate
(3) kouval-o, kouvali-s-a 'I carry, I carried'

The first two cases illustrated in (1) involve *–s-* affixation and predictable stem changes (Holten et al. 1997). If, for example, the unmarked (= present tense or imperfective) stem ends in a labial consonant, then the sigmatic perfective past-tense

form changes to *p-s-* (1a). If the unmarked stem ends in a vowel followed by /n/, then the stem-final consonant is deleted in the sigmatic perfective past-tense form (1b). The examples shown in (2) are forms without a segmentable perfective affix and idiosyncratic stems. Examples (2a) and (2b) illustrate unpredictable stem-vowel changes and example (2c) has a completely suppletive stem. In addition, there is a small number of verbs in which an idiosyncratic perfective stem is combined with the perfective past tense affx *–s-* (see (3)). These are comparable to so-called semi-regular or mixed verbs such as *kept, felt* etc. in English which also consist of a marked stem and the regular past-tense ending.

To determine frequency differences between the sigmatic and the non-sigmatic past tense, we performed a count of a relevant subset of the verb lemmas represented in a large corpus of 100.000.000 Greek words collected from the web (Neurosoft Language Tools; http://www.neurosoft.gr/aao/freq.zip). We excluded verbs that appeared in the passive voice, verbs that do not have distinct forms for the imperfective and the perfective past tense, and verbs with very low token frequencies (of < 40). This resulted in a total of 2,266 verb lemmas extracted from the Neurosoft corpus. We found that 2,119 of these take sigmatic and only 147 non-sigmatic past-tense forms. Thus, in terms of type frequencies, the sigmatic past tense clearly outnumbers the non-sigmatic one.

Summarizing, the sigmatic past tense is more frequent than the non-sigmatic one, sigmatic perfective past-tense forms are morphologically transparent (with a segmentable affix and systematic stem allomorphy), and possibly rule-based. Non-sigmatic perfective past-tense forms are morphologically less transparent, partly idiosyncratic, and possibly stored as exceptions in lexical memory. Given these contrasts, we would expect differences between sigmatic and non-sigmatic perfective past-tense forms in their generalization properties. For sigmatic forms we should find rule-based generalization effects, i.e., widespread generalization to novel verbs irrespective of phonological, orthographic or semantic similarity to existing words. In children's inflectional errors sigmatic forms should overgeneralize to non-sigmatic ones (in cases in which children fail to retrieve them from memory), whereas generalizations of non-sigmatic forms in cases in which sigmatic ones are required should be rare or non-existent. For non-sigmatic forms, on the other hand, we would expect neighbourhood or gang effects, i.e. memory-based generalizations depending

on the degree of similarity of a novel form to existing ones. The purpose of our study was to test these predictions.

3. Previous studies on the Greek perfective past tense

Stephany (1997) examining spontaneous speech data from four children aged 1;10 to 2;10 found that aspect marking emerges earlier (at the age of 1;10) than tense marking. According to Stephany, tense marking only emerges at 2;4 when the distinction between non-past and past imperfective forms appears. More recent studies of Greek child language have examined the interaction of aspect, tense, and telicity (Stephany & Voeikova 2003, Delidaki & Varlokosta 2003). However, the development of sigmatic and non-sigmatic past tense in Greek child language has not yet been studied.

Similarities and differences between sigmatic and non-sigmatic past tense forms have been examined in several neurolinguistic studies with aphasic and Parkinson's Disease patients. Kehayia & Jarema (1991) reported that the two non-fluent aphasic patients they tested showed lower performance on highly irregular past tense forms such as *troo, efaga* 'I eat, I ate' than on the sigmatic past tense, e.g. *grafo, egrapsa* 'I write, I wrote'. In addition, Tsapkini and colleagues presented several studies examining the performance of non-fluent patients on the Greek past tense (Tsapkini et al. 2001, Tsapkini et al. 2002a; Tsapkini et al. 2002b). Tsapkini et al. (2002a) found that the non-fluent patient they studied had more problems with the production of non-sigmatic perfective past-tense forms such as *pleno* - *eplina* 'I wash - I washed' than with sigmatic forms involving *–s-* suffixation. Tsapkini et al. (2001) reported that their non-fluent patient was impaired in producing perfective past tense forms that required both a stem change and *–s-* suffixation. Tsapkini et al. (2002b) presented data from on-line experiments with aphasic patients which revealed distinct priming patterns across the group of patients studied. One patient failed to show any priming effects for regular sigmatic forms such as *grafo* - *egrapsa* 'I write - I wrote' that do not involve any idiosyncratic stem changes but showed priming effects for non-sigmatic forms and for semi-regular forms such as *milo* - *milisa* 'I speak - I spoke'. On the other hand, the second patient did not show any priming effect for sigmatic forms but a priming effect for highly irregular suppletive forms (*plen* - *eplina*).

Terzi et al. (2005) tested twenty-five patients with Parkinson's disease (PD) and twenty-five normal controls on the production of sigmatic and non-sigmatic perfective

past tense forms. Whilst the PD patients performed worse than controls on both sigmatic and non-sigmatic forms, they produced more errors on verbs requiring non-sigmatic (n=40) than sigmatic forms (n=28). Moreover, there were substantial individual differences. For example, patient TA performed at chance on sigmatic forms whereas patients ED, ZS, and KT were at chance on non-sigmatic ones. Further investigation is required to determine whether these differences are correlated with the patients' cognitive profile.

Although the results from the studies mentioned above are not completely coherent (which might be due to individual differences between patients), several studies yielded distinct patterns of impairment for sigmatic and non-sigmatic perfective past tense formation in aphasia and PD, a finding that is consistent with the linguistic differences between sigmatic and non-sigmatic forms in Greek.

As pointed out above, however, nothing is known about the development of the perfective past tense in Greek child language and the kinds of inflectional errors Greek children produce. The present study is meant to fill this gap.

4. Method

We examined the sigmatic and non-sigmatic perfective past tense in Greek child language and a control group of adult native speakers testing both existing and novel verbs. The same set of materials was used for an elicited production task and (with an altered procedure) as an acceptability judgment task.

Participants

35 adults and 164 typically developing children of different age groups participated in one of the two tasks, none of whom took part in both the elicited production and the acceptability judgment task; see Table 1 for further participant information. All participants were native speakers of Greek living in urban and rural areas of Northern Greece (Ioannina and Thessaloniki and the rural areas around these places). All adult participants had been exposed to 3 to 18 years of education, except for one adult participant who was illiterate. All children attended Greek day nursery and primary schools at the time of testing. The experiments were performed by properly trained 3rd and 4th year undergraduate students of the Department of Speech and Language Therapy, Technological Educational Institute of Epirus (Ioannina) under the supervision of the first author.

Table 1: Number of participants, mean age (standard deviations), and number of female participants

	Elicited Production			Acceptability Judgment		
	Number	Age	Females	Number	Age	Females
AD (Adults)	10	24 (5.04)	5	25	36;6 (16.5)	17
CH-VIII (8-9-year olds)	12	8;5 (0.33)	7	12	8;5 (0.4)	6
CH-VII (7-8-year olds)	14	7;3 (0.34)	5	11	7;7 (0.31)	6
CH-VI (6-7-year olds)	16	6;4 (0.32)	9	13	6;5 (0.24)	6
CH-V (5-6-year olds)	14	5;4 (0.23)	9	18	5;7 (0.35)	9
CH-IV (4-5-year olds)	10	4;4 (0.33)	4	10	4;6 (0.21)	7
CH-III (3-4-year olds)	14	3;5 (0.23)	7	10	3;5 (0.34)	5

Materials

A total of 50 verbs were tested, 20 existing verbs, 20 rhyming novel verbs, and 10 non-rhymes (see Appendix A for a complete set of critical items). The existing verbs were divided into two conditions with 10 items each, a sigmatic and non-sigmatic one, depending on the required past-tense form.

The sigmatic condition included three subclasses (Holton et al. 1997, Ralli 1988):

- 3 verbs in which (in addition to the affix *-s-*) the past-tense form comprises a consonantal change in the coda of the stem, e.g. *graf-o*, *e-grap-s-a* 'I write, I wrote'
- 4 verbs in which (in addition to the perfective affix *-s-*) one or two stem-final consonants are deleted in the past tense, e.g. *lin-o, e-li-s-a* 'I untie, I untied'

- 3 verbs in which a marked perfective stem is combined with the affix *-s-*, e.g. *kouval-o, kouvali-s-a* 'I carry, I carried', where *kouvali-* is the perfective stem of *kouval-*

The non-sigmatic condition also included three subclasses (Holton et al., 1997; Ralli 1988):

- 3 verbs with a suppletive perfective past-tense form, e.g. *tro-o, e-fag-a* 'I eat, I ate'
- 4 verbs with stem-internal changes and the augment *e-*, e.g., *plen-o, e-plin-a* 'I wash, I washed'
- 3 verbs with stem-internal changes but without the augment *e-*, e.g. *zesten-o, zestan-a* 'I warmed, I warm.

The existing verbs in the sigmatic and the non-sigmatic conditions were matched as closely as possible in terms of their lemma frequencies and their (perfective past-tense) word-form frequencies. The lemma frequencies (shown in Table 2) were taken from the Neurosoft Language Tools and represent frequencies calculated as proportions of a total of 100.000.000 words. The word-form frequencies shown in Table 3 come from the Institute of Speech and Language Processing (ISLP) corpus (http://hnc.ilsp.gr/en/) and represent proportions out of the total number of word forms included in ISLP in ‰ (per thousand)[i]. The items in the sigmatic and non-sigmatic conditions of our experiment were matched both in terms of their mean lemma frequencies (Z=.682, p=.495) and their mean (past-tense) word-from frequencies (Z=.681, p=.296). Moreover, we attempted to match the items in the two conditions pairwise as closely as possible; see Tables 2 and 3.

Rhyming novel verbs differ from the existing ones in their onsets. For the existing verb *graf-i*, for example, we constructed the novel one *traf-i*. There were 20 novel rhymes in total, 10 rhyming with verbs of the sigmatic class and 10 with verbs of the non-sigmatic class; see Appendix A. Non-rhyming novel verbs (n=10) were constructed not to rhyme with any existing verb in the language but to be phonotactically legal words in Greek; see Appendix A for examples. An additional 10 filler items were included for which participants were asked to describe pictures depicting actions or objects

Table 2: Lemma Frequencies among 100.000.000 words for existing verbs

Sigmatic verbs	Lemma frequencies	Non-sigmatic verbs	Lemma frequencies
grafi	40664	vlepi	89169
Pefti	17708	ferni	23926
Kovi	5975	troi	6258
Halai	2030	pini	3907
Dini	1835	zesteni	654
tripai	1751	jerni	590
Kouvalai	1496	pleni	560
vafi	839	sperni	612
Plathi	590	ifeni	165
Lini	362	konteni	47

Table 3: Word frequencies (out of the 1000 most frequent word forms)

Sigmatic verbs	Word frequency	Non-sigmatic verbs	Word frequency
epese	0.0490	ide	0.0709
egrapse	0.0495	efere	0.0602
ekopse	0.0100	efage	0.0072
halase	0.0052	ipie	0.0026
elise	0.0042	ejire	0.0024
kouvalise	0.0009	espire	0.0009
tripise	0.0007	zestane	0.0003
evapse	0.0007	epline	0.0003
eplase	0.0009	ifane	0.0001
edise	0.0006	kontine	0.0001

Procedure

The linguistic materials described above were used for two experimental tasks, elicited productions and acceptability judgments. All participants were tested individually. Both tasks were preceded by a training session aiming to familiarize participants with the two tasks. Participants were told that they were going to see pictures showing people who live on earth and some other pictures showing people who live on a different planet and speak a strange language. The training session included 8 pictures (four used to introduce novel verbs and four for real verbs). In each of the main production and judgment experiments, participants were presented with pairs of two pictures each on one sheet of paper. The first picture (shown in the top half) depicted an ongoing activity (e.g. a child eating a cake), whereas the second picture (shown in the bottom half) showed that the activity presented in the first picture had been completed, e.g. an empty plate. There were 60 picture pairs, 50 for the critical items and 10 fillers, all presented in a pseudo-randomized order. The picture stimuli can be made available upon request; an example of a picture pair is shown in Appendix B.

Instructions given to participants differed between the two experimental tasks. In the *elicited production task*, the experimenter pointed to the first picture saying, for example, 'Here the child is eating a cake', and then she/he pointed to the second picture saying 'and what did the child do here?' Participants' responses were written down and tape-recorded for verification. Calculation of accuracy scores did not include (i) exact repetitions of one of the critical verbs and (ii) cases in which a participant produced an existing verb instead of one of the targeted novel ones.

In the *judgment task*, the experimenter pointed to the first picture and described the picture in the same way as in the production task. Two puppets, a boy and a girl called 'Giannis' and 'Maria' respectively, manipulated by the experimenter then provided one simple sentence each to describe the second picture. These two sentences contained different past-tense forms of the target verb but were otherwise identical. Participants were asked to choose between the two puppets' descriptions and encouraged to provide a third, alternative past-tense form if they did not find any of the past-tense forms provided acceptable. For existing verbs, one of the puppets provided the perfective past tense of the target verb while the other one gave a corresponding imperfective past-tense form of the same verb. For novel verbs, one puppet provided a sigmatic and the other a non-sigmatic perfective past-tense form;

see example in Appendix B. The order in which these forms were given was pseudo-randomized making sure that existing, novel and filler items appeared in a random order and that the order in which the puppets presented sigmatic and non-sigmatic forms was not predictable. The examiners recorded the children's preferences by ticking off the participants' chosen response on a prepared answer sheet.

5. Results

5.1 Elicited productions

Existing verbs

Table 4 shows mean percentages (and standard deviations) of the participants' responses in the two conditions. The three columns on the left refer to verbs that require sigmatic perfective past-tense forms in Greek, the three columns on the right to verbs that require non-sigmatic perfective past-tense forms. For each of these two conditions, Table 4 provides percentages of correct and incorrect elicited productions. Of the incorrect responses, we distinguish between overapplications of non-sigmatic forms in the sigmatic condition, overapplications of sigmatic forms in the non-sigmatic condition, and 'other' errors. All incorrect productions were subject to a separate error analysis (see below).

Consider first the accuracy scores (see the columns 'correct' in Table 4). Whilst the adult group had high correctness scores for both the sigmatic and the non-sigmatic condition, the children's scores for the non-sigmatic condition were lower than those for the sigmatic ones. The younger the children, the stronger was this contrast.

These observations were confirmed statistically. A 7x2 (Group x Condition (sigmatic vs. non-sigmatic)) ANOVA revealed significant effects of Group ($F(6, 83)=19.73$, $p<.001$) and Condition ($F(1, 83)=153.04$, $p<.001$), and an interaction between Group and Condition ($F(6, 83)=5.91$, $p<.001$). Pairwise comparisons using t-tests showed that all child groups performed significantly better on the sigmatic than the non-sigmatic conditions (CH-VIII: $t(11)=4.00$, $p<.05$, 3; CH-VII: $t(13)=4.49$, $p<.01$; CH-VI: $t(15)=5.01$, $p<.01$; CH-V: $t(13)=6.61$, $p<.01$; CH-IV: $t(9)=4.88$, $p<.01$; CH-III: $t(13)=6.83$, $p<.01$).

Table 4: Mean percentages (and standard deviations) for existing verbs

	SIGMATIC CONDITION			NON-SIGMATIC		
	Correct	Non-sigmatic	Other	Correct	Sigmatic	Other
AD	100	0	0	97	0	3
				(6.74)		(6.74)
CH-VIII	99.17	0.83	0	90	7.50	2.50
	(2.88)	(2.88)		(6)	(6.2)	(4.5)
CH-VII	100	0	0	77.85	18.57	3.58
	(.0)			(18.47)	(15.61)	(8.41)
CH-VI	93.12	1.25	5.62	73.75	18.13	8.12
	(9.46)	(3.41)	(8.13)	(16.68)	(15.15)	(8.34)
CH-V	87.14	0	12.86	63.15	27.48	9.37
	(15.89)		(15.89)	(16.55)	(11.69)	(13.85)
CH-IV	93	0	7	65	17	18
	(6.75)		(6.75)	(17.79)	(6.74)	(15.49)
CH-III	69.99	0.71	29.3	35.53	11.43	53.04
	(25.63)	(2.67)	(25.77)	(19.09)	(9.49)	(23.78)

Table 5: Child-adult comparisons of correctness scores for existing verbs

	Sigmatic condition	Non-sigmatic condition
AD vs. CH-VIII	t(20)=.91, p=.37	t (20)=2.57, p<.05
AD vs. CH-VII	Not applicable	t (17)=3.56, p<.05
AD vs. CH-VI	t (24)=2.9, p=.011	t (24)=4.96, p<.001
AD vs. CH-V	t (22)=3.03, p=.010	t (22)=6.89, p<.001
AD vs. CH-IV	t (18)=3.28, p=.010	t(18)=5.32, p<.001
AD vs. CH-III	t (22)=4.38, p=.001	t (22)=10.72, p<.001

Between-group comparisons (Table 5) showed that children aged 7 and above (i.e. groups CH-VIII and CH-VII) achieved adult-like correctness scores for the sigmatic condition, whilst the younger children had significantly lower accuracy scores for the sigmatic past tense than the adult group. Moreover, for the non-sigmatic condition children of all age groups performed significantly worse than the adult group. Taken together, these results indicate that the sigmatic perfective past tense is acquired earlier than the non-sigmatic one.

Table 6: Mean correctness scores (and standard deviations) for the three subclasses of sigmatic and non-sigmatic verbs

	SIGMATIC			NON-SIGMATIC		
	1ST subclass	2nd subclass	3rd subclass	1st subclass	2nd subclass	3rd subclass
AD	91 (28.46)	100 (.0)	100 (.0)	100 (.0)	100 (.0)	89.99 (22.49)
CH-VIII	100 (.0)	97.92 (7.2)	100 (.0)	100 (.0)	93.75 (11.3)	74.99 (15.07)
CH-VII	100 (.0)	100 (.0)	100 (.0)	95.24 (17.81)	75 (32.52)	64.28 (15.82)
CH-VI	89.58 (15.96)	93.75 (11.18)	95.83 (11.38)	95.83 (11.38)	57.81 (29.88)	72.91 (25)
CH-V	88.093 (21.11)	78.57 (25.67)	97.61 (8.91)	85.71 (21.54)	53.57 (21.61)	55.95 (24.11)
CH-IV	100 (.0)	87.5 (13.17)	93.33 (14)	86.66 (23.3)	65 (21.08)	43.33 (31.62)
CH-III	63.09 (40.39)	72.02 (24.59)	73.8 (29.75)	66.66 (36.98)	25.59 (19.73)	17.85 (23.07)

Further analysis of the accuracy scores revealed differences between the various subclasses of sigmatic and non-sigmatic verbs. Table 6 shows that the correctness scores in the third subclass of sigmatic verbs were overall higher than those for the other two subclasses. This could be due to the fact that the past-tense forms in the 3rd subclass have a more transparent structure than the other past-tense forms required in that they consist of a distinct perfective stem plus the –s suffix (e.g. *tripi-s-e* 'bored-3s') whereas the other forms require different kinds of stem changes. Likewise, the correctness scores for the first subclass of non-sigmatic verbs were overall higher than those for the other two subclasses. One reason for this could be that these verbs have suppletive past-tense forms and that they are considerably more frequent than the other non-sigmatic past tense forms tested (see Table 2 and 3).

Error analysis

The label 'Other' in Table 4 comprises the following kinds of error:

(4) imperfective past tense instead of the targeted perfective form:
…ekove (target: ekopse; present tense: kovo)
…cut-imperfective-aspect-past-3rd sg.

(5) perfective past tense of a different verb:
…teliose (target: egrapse; present tense: grafo)
…finish-perfective-past-3rd sg.

(6) incorrect stem of a sigmatic form
…plathise (target: eplase; present tense: plathi)
…made-3rd sg. (by hand)

(7) incorrect stem of a non-sigmatic form
…esprothe (target: espire; present tense: sperni)
…seeded-3rd sg.

Table 4 shows that errors of these kinds were mostly found for the youngest children. Stem errors such as those illustrated in (6) and (7) were rare. There were only eight cases such as (6) and five cases such as (7) in the whole data set, all of which came from the youngest children.

Table 4 shows that most of these errors occurred for verbs that required non-sigmatic forms. There were even three such errors in the adult group; all of them were

imperfective past tense forms. In cases in which a participant selected a different verb (which was often semantically related to the target verb, as in (5)), the corresponding past-tense form was correctly inflected. Hence, these cases do not represent morphological errors.

Table 4 also shows that the children (but not the adults) produced overapplications of sigmatic and non-sigmatic perfective past-tense forms. Consider the examples in (8) and (9):

(8) Overapplication of the sigmatic perfective past tense:

a. …ejerse (target: ejire; present tense: jern-i)
…bent-3rd sg.

b. …kontese (target: kontine, present tense: konten-i)
…shortened-3rd sg.

c. …eplise (target: epline, present tense plen-i)
…washed-3rd sg.

d. …esprise (target: espire, present tense: sperni
…seeded-3rd sg.

(9) Overapplication of the non-sigmatic perfective past tense
…eplan-e (target: eplas-e, present tense: plath-i)
…made-3rd sg. (by hand)

The distribution of overapplications showed a clear contrast between sigmatic and non-sigmatic forms. Whilst sigmatic forms were often overapplied with percentages ranging from 7.5% to more than 27%, non-sigmatic forms were hardly ever overapplied to existing sigmatic verbs. The mean overapplication rate for the sigmatic past-tense was 20%, 40 times higher than the one for the non-sigmatic past tense (= 0.005%)[ii]. Further analyses revealed that there were hardly any overapplications for verbs of the first non-sigmatic subclass, i.e. those that require suppletive past tense forms (see Table 7). Moreover, overapplications of the sigmatic form sometimes co-occurred with stem errors. In most of these (96 out of a total of 135 cases), the *–s-* affix of the perfective past tense was combined with the unmarked (present tense) stem of the verb, as for example in (8a) and (8b). In 21 cases, *–s-* was attached to a different marked stem of a given verb, as in (8c), and in 18 cases, the sigmatic suffix *-s-* was combined with a non-existing stem (8d).

Finally, the sigmatic past-tense overapplication rates shown in the penultimate column of Table 4 were not constant across the different age groups. The highest sigmatic past-tense overapplication rates were found in 4-to-7-year old children (17% to 27.48%), whereas in the youngest and in the oldest child groups they were considerably lower (7.5%, 11.43%). These differences are suggestive of a U-shaped trend in the development of sigmatic past-tense overapplications in Greek, similarly to what was found for the development of overregularizations in other languages (see e.g. Marcus et al. 1992 for English, and Clahsen et al. 2002 for Spanish).

Table 7: Sigmatic past tense forms (%) in the three subclasses of existing non-sigmatic verbs

	SIGMATIC PAST TENSE		
	1st subclass	2nd subclass	3rd subclass
AD	0	0	0
CH-VIII	0	6.25 (11.30)	16.66 (17.4)
CH-VII	0	21.43 (21.61)	33.33 (32.02)
CH-VI	0	25 (28.86)	27 (21.83)
CH-V	2.38 (8.90)	36.31 (18.66)	41.66 (19.33)
CH-IV	0	20 (19.72)	29.99 (18.92)
CH-III	0	10.71 (16.16)	23.81 (20.37)

Novel rhymes

Table 8 shows mean percentages (and standard deviations) of the participants' responses for rhyming novel verbs. The three columns on the left refer to verbs that rhymed with existing verbs that require sigmatic past-tense forms, the three columns on the right to verbs that rhymed with existing verbs that require non-sigmatic past-tense forms. For each of these two conditions, Table 8 provides a breakdown of the past-tense forms produced by the participants. 'Other' responses were imperfective past tense forms instead of the target perfective ones.

Table 8: Mean percentages (and standard deviations) for rhyming novel verbs

	SIGMATIC CONDITION			NON-SIGMATIC CONDITION		
	Sigmatic	Non-sigmatic	Other	Non-sigmatic	Sigmatic	Other
AD	92	1	7	20	73	7
	(11.35)	(3.16)	(9.48)	(11.54)	(14.94)	(10.59)
CH-VIII	87.50	4.17	8.33	11.02	70.65	18.33
	(12.88)	(6.68)	(9.37)	(12.56)	(22.27)	(17.49)
CH-VII	80	5	15	12.86	72.85	14.28
	(26.31)	(8.54)	(24.41)	(16.37)	(28.67)	(20.27)
CH-VI	80.32	3.39	16.29	4.62	80.28	15.10
	(23.67)	(5.29)	(23.88)	(8.17)	(25.79)	(22.2)
CH-V	71.78	1.43	26.78	3.3	87.95	8.75
	(33.25)	(3.63)	(32.2)	(5.44)	(19.36)	(18.77)
CH-IV	69.75	2.11	28.14	10.11	67.95	21.94
	(28.42)	(4.45)	(27.05)	(17)	(25.83)	(17.47)
CH-III	43.97	.0	56.03	2.78	52.63	44.59
	(40.12)	(.0)	(40.12)	(7.85)	(40.87)	(40.12)

In all participant groups, the most common responses were sigmatic past-tense forms, even for nonce verbs that rhyme with existing verbs taking non-sigmatic past-tense forms[iii]. Thus, the sigmatic past-tense generalizes outside its own similarity domain. For non-sigmatic forms, however, we can see an effect of rhyme similarity. Non-sigmatic forms are hardly ever used for verbs that rhyme with existing verbs taking sigmatic past-tense forms (range: 0% to 5%). Instead, non-sigmatic forms are largely confined to the non-sigmatic condition, i.e. to novel verbs that rhyme with existing non-sigmatic ones.

Table 8 also shows developmental changes. The percentages of sigmatic past tense responses gradually increase with age. For the two oldest child groups (CH-VIII & CH-VII) as well as for the adult group, the percentages of sigmatic forms are higher

in the sigmatic than in the non-sigmatic condition, whereas for the other child groups there is no such difference. The percentages of non-sigmatic forms in the non-sigmatic condition also increase with age from 2.78% in the youngest children to 20% in the adult group.

These observations are also confirmed statistically. A 7x2 (Group x Condition) ANOVA on the percentages of expected responses (i.e. sigmatic form/SIGMATIC CONDITION, non-sigmatic form/NON-SIGMATIC CONDITION) revealed significant effects of Group ($F(6, 77)=6.48$, $p<.0010$) and Condition ($F(1, 77)=326.83$, $p<.001$), but no interaction between Group and Condition ($F(6, 77)=1.33$, $p=.26$). The main effect of Group reflects the fact that the younger the children, the smaller the number of expected responses. Further between-group analyses using paired t-tests showed that children below the age of 5 produced significantly fewer sigmatic past-tense and children below the age of 7 fewer non-sigmatic forms than the adult group in the expected conditions[iv]. The main effect of Condition reflects the fact that all participant groups produced more sigmatic forms and less non-sigmatic ones than expected on the basis of rhyme similarity. Further within-group comparisons using paired t-tests confirmed that all participant groups produced significantly more sigmatic than non-sigmatic forms in the expected conditions (AD: $t (9)=15.43$, $p<.001$; CH-VIII: $t (11)=13.99$, $p<.001$; CH-VII: $t (13)=6.49$, $p<.001$; CH-VI: $t (15)=9.91$, $p<.001$, CH-V: $t (13)=8.09$, $p<.001$, CH-IV: $t (9)=4.31$, $p=.002$; CH-III: $t (7)=2.84$, $p=.025$).

Non-rhymes

Table 9 presents mean percentages (and standard deviations) of the participants' responses for novel verbs that did not rhyme with any existing verb. 'Other' responses were imperfective past tense forms used instead of the target perfective ones.

Table 9: Mean percentages and standard deviations for non-rhyming nonce verbs

	Sigmatic	Non-sigmatic	Other
AD	91 (11.97)	5 (5.27)	4 (9.67)
CH-VIII	80.83 (15.64)	10 (10.44)	9.17 (10.84)
CH-VII	76.67 (30.15)	8.17 (16.96)	15.16 (17.92)
CH-VI	77.10 (26.08)	5.27 (9.16)	17.63 (22.68)
CH-V	83.37 (16.77)	9.84 (10.55)	6.79 (12.65)
CH-IV	59.19 (24.98)	17.30 (17.63)	23.51 (17.33)
CH-III	39.48 (27.79)	9.24 (14.52)	51.28 (27.06)

In all participant groups, sigmatic past-tense forms were more commonly used for non-rhyming nonce verbs than for non-sigmatic ones[v]. Table 9 also shows that the use of sigmatic forms gradually increases with age. Pairwise comparisons of the adult group to the different child groups revealed that children aged 5 and above showed adult-like performance on the production of sigmatic forms for non-rhymes (CH-VIII: $t(20)=1.68$, $p=.11$; CH-VII: $t(22)=1.61$, $p=.13$; CH-VI: $t(24)=1.84$, $p=.08$; CH-V: $t(22)=1.23$, $p=.23$), whereas the two youngest child groups produced significantly fewer sigmatic responses than the adult group (CH-IV vs. AD: $t(18)=3.631$, $p<.01$; CH-III vs. AD: $t(16)=4.893$, $p<.01$).

Summarizing the results of the elicited production task, we found some striking asymmetries between sigmatic and non-sigmatic perfective past-tense forms in both children and adults. Whereas the children overgeneralized the sigmatic form to existing verbs that required non-sigmatic forms, non-sigmatic forms were (with a few exceptions) not extended to cases in which sigmatic forms were required. Moreover, the sigmatic past-tense was the most common response for novel verbs, even for those that were similar to existing verbs taking non-sigmatic past-tense forms. The sigmatic past tense was also clearly preferred for non-rhymes, i.e. in cases in which similarity-based generalizations were not possible. By contrast, non-sigmatic forms did not generalize outside their own similarity domain. Non-sigmatic forms of novel verbs were largely confined to those novel verbs that rhyme with existing non-sigmatic ones. These results indicate that the sigmatic perfective past-tense generalizes beyond

similarity and is used in cases in which access to exceptional (non-sigmatic) forms fails. The non-sigmatic past-tense, on the other hand, was found to be sensitive to (rhyme) similarity.

We also observed developmental changes from child to adult. Specifically, the development of the non-sigmatic past-tense was found to lag behind that of the sigmatic one. Children showed lower accuracy scores for the former than for the latter, and they underused non-sigmatic forms for novel verbs relative to adults. There were signs of U-shaped development for *–s-* overapplication rates, a finding that is familiar from other studies of the development of children's overregularizations. In the case of the perfective past tense in Greek, developmental changes seem to take place between the age of 4 and 5. Children aged 5 or above exhibit adult-like behavior in generalizing the sigmatic form to rhyming and non-rhyming novel verbs, and children aged 7 or above have the same high accuracy scores for existing sigmatic verbs as adults.

5.2 Acceptability judgments

Recall that for this experiment the same materials were used as for the elicited production task, but that for each item participants were confronted with two past-tense forms from which they had to choose which one sounded better.

Existing verbs

Table 10 shows mean percentages (and standard deviations) of correct and incorrect responses for existing verbs. A correct response is one in which the participant selected the sigmatic form for the sigmatic condition and the non-sigmatic one for the non-sigmatic condition. Although participants were told that they may provide a response different from one of the two offered, they never made use of this option. Consequently, the scores shown in Table 10 subtracted from 100% will yield the percentages of incorrect choices.

Table 10: Mean percentages (and standard deviations) of correct responses for existing verbs

CONDITION	SIGMATIC	NON-SIGMATIC
AD	100 (.00)	97.6 (5.97)
CH-VIII	97.5 (6.21)	94.16 (9.003)
CH-VII	95.45 (9.34)	87.27 (20.04)
CH-VI	83.85 (23.64)	84.61 (11.98)
CH-V	73.33 (18.47)	67.22 (22.96)
CH-IV	65 (10.8)	62 (18.14)
CH-III	52 (11.35)	51 (14.41)

The accuracy scores increase with age and are slightly higher for the sigmatic condition than for the non-sigmatic condition. These observations were confirmed by a 7x2 (Group x Condition) ANOVA which revealed main effects of Group (F (6,92)=26.44, p<.001) and Condition (F (1,92)=5.95, p<.05) but no interaction between Group and Condition (F (6,92)=.695, p>.1). The main effect of Group was further examined using paired t-tests to compare the adults' accuracy scores to those of the various child groups. These between-group comparisons showed that children aged 7 or above (i.e. CH-VIII and CH-VII) achieved adult-like correctness scores, whilst the younger children had significantly lower accuracy scores in both conditions[vi]. To further explore the main effect of Condition, within-group comparisons were performed using paired t-tests. These analyses showed that the differences in the accuracy scores of the sigmatic and the non-sigmatic condition were not significant in any participant group (all p's>.1) except for the 5-to-6-year olds who had a significantly higher correctness score on the sigmatic than the non-sigmatic condition (t(17)=2.27 p<.05). Finally, to determine whether the accuracy scores differed from chance level, we compared the individual scores to 50% using t-tests. These analyses revealed that children below the age of 5 (i.e. CH-IV and CH-III) performed at chance level for existing non-sigmatic verbs and the 3-to-4-year olds for existing sigmatic verbs[vii].

Further analysis revealed slightly higher accuracy scores in the 3rd sigmatic subclass (relative to other sigmatic subclasses) as well as in the 1st non-sigmatic subclass (relative to other non-sigmatic subclasses) in most participant groups (see Table 11), similarly to what was found in the production task.

Table 11: Mean correctness scores (and standard deviations) for the three subclasses of sigmatic and non-sigmatic verbs

	SIGMATIC			NON-SIGMATIC		
	1ST subclass	2nd subclass	3rd subclass	1st subclass	2nd subclass	3rd subclass
AD	100 (.0)	100 (.0)	100 (.0)	98.67 (6.67)	99 (5)	94.67 (15.75)
CH-VIII	100 (.0)	97.92 (7.2)	94.45 (12.97)	100 (.0)	93.75 (15.53)	88.89 (16.41)
CH-VII	96.97 (10)	95.45 (10.11)	93.94 (20.1)	81.82 (31.14)	93.18 (16.16)	81.82 (22.9)
CH-VI	84.61 (25.8)	80.76 (27.29)	87.18 (21.68)	94.87 (12.51)	82.69 (18.77)	76.92 (21.013)
CH-V	72.22 (20.61)	70.83 (27.45)	77.78 (28)	66.66 (37.92)	72.22 (22.5)	61 (41.63)
CH-IV	60 (26.29)	65 (17.48)	70 (24.59)	59.99 (30.63)	65 (17.48)	60 (37.84)
CH-III	49.99 (23.57)	47.5 (21.88)	60 (21.08)	60 (30.63)	45 (22.97)	50 (36)

Novel rhymes

Table 12 presents the percentages of rhyme-based choices in the two experimental conditions, i.e. a sigmatic form in the sigmatic condition and a non-sigmatic form in the non-sigmatic Condition. There were no 'other' responses.

Table 12: Mean percentages (and standard deviations) for novel rhymes

CONDITION	SIGMATIC	NON-SIGMATIC
AD	92.4 (13.93)	27.5 (15.62)
CH-VIII	94.17 (7.92)	33.33 (11.55)
CH-VII	77.27 (12.7)	40.91 (17.58)
CH-VI	74.61 (19.83)	43.08 (18.88)
CH-V	61.11 (23.73)	45.56 (15.8)
CH-IV	57 (14.94)	45 (16.49)
CH-III	53 (10.59)	40 (14.9)

Table 12 shows that all participant groups had a preference for choosing the sigmatic past-tense even in the non-sigmatic condition. This preference increased with age. Moreover, for novel verbs that rhymed with existing non-sigmatic ones, all participant groups were more likely to choose a non-sigmatic form than for novel verbs that rhymed with existing sigmatic ones. Thus, whilst sigmatic past-tense forms were widely preferred for novel verbs, the choice of non-sigmatic forms was affected by rhyme similarity.

A 7x2 (Group x Condition) ANOVA on the percentages shown in Table 12 revealed main effects of Group ($F(6,92)=4.70$, $p<.001$) and Condition ($F(1,92)=148.84$, $p<.001$) and a significant interaction between Group and Condition ($F(6,92)=11.58$, $p<.001$) reflecting the gradual increase of sigmatic choices with age. Additional analyses[viii] revealed that for children aged 5 and below (i.e. CH-V, CH-IV and CH-III) the percentages of expected choices were at chance level for the sigmatic condition, whereas for the adult group and the older children they were different from chance. For the non-sigmatic condition, only the performance of the adult group and the oldest children was different from chance.

These results show that adults prefer sigmatic forms for nonce verbs, even for those that rhyme with existing non-sigmatic ones, whereas non-sigmatic forms rarely generalize outside their own similarity domain. In contrast to that, children below the age of 5 do not yet have a clear preference for either past-tense form. The use of the sigmatic past-tense as a default form for nonce verbs develops from the age of 5 onwards with gradually increasing scores for sigmatic forms, and non-sigmatic forms being more and more restricted to the non-sigmatic condition.

Non-rhymes

Table 13 presents mean percentages (and standard deviations) of sigmatic choices for novel verbs that did not rhyme with any existing verb. In all the remaining responses participants chose the non-sigmatic form. There were no 'other' responses.

Table 13: Mean percentages (and standard deviations) of sigmatic choices for non-rhyming nonce verbs

	SIGMATIC
AD	92 (10.4)
CH-VIII	91.66 (11.93)
CH-VII	80.90 (10.44)
CH-VI	66.92 (19.31)
CH-V	67.22 (23.46)
CH-IV	45 (9.71)
CH-III	54 (14.29)

These data show that adults and children aged 5 or above prefer sigmatic forms for novel verbs that have no or little similarity to existing verbs and that the percentages of sigmatic choices gradually increase between the age of 5 and adulthood. By contrast, children below the age of 5 do not seem to have a clear preference.

A one-way ANOVA revealed a main effect of Group confirming that the groups' mean scores for sigmatic past tense forms of non-rhyming nonce verbs were significantly different (F (6,98)=18.47, p<.001). Additional comparisons (with chance

level set at 50%) revealed that the scores for sigmatic forms in Table 13 were significantly above chance level in the adult group as well as in children aged 5 or above (AD: t (24)=-20.17, p<.001; CH-VIII: t (11)=12.09, p<.001; CH-VII: t (10)=-9.82, p<.001; CH-VI: t (12)=3.16, p=<.05; CH-V: t (17)=3.11, p<.05), whereas the younger children's scores did not differ from chance level (CH-IV: t (9)=1.62 p=.14; CH-III: t (9)=.89, p=.40).

Summarizing the results of the judgment task, we found that sigmatic perfective past-tense were preferred for novel verbs including non-rhymes and novel verbs that rhymed with existing non-sigmatic verbs. Non-sigmatic forms, on the other hand, were more common for novel verbs that rhymed with existing non-sigmatic verbs than with those that were similar to existing sigmatic ones. These contrasts confirm the different generalization properties of the two perfective past-tense forms seen in the elicited production task suggesting that whilst generalizations of non-sigmatic forms are similarity-based, the sigmatic perfective past tense generalizes widely even outside its own similarity domain. We also found developmental changes in the acceptability judgments. Three and four-year olds performed at chance level for existing sigmatic and non-sigmatic verbs and for rhyming novel verbs in both the sigmatic and the non-sigmatic condition. These children also did not seem to have any clear preference for non-rhymes. By contrast, children aged 5 or above showed the same preferences as adults, and with increasing age their scores gradually approached those of the adult group.

6. Discussion

The most important findings of the present study are the contrasts in how sigmatic and non-sigmatic perfective past-tense forms generalize to novel verbs. In the following, we will first discuss the nature of these generalization processes and then the developmental changes from child to adult.

The generalization properties of the perfective past tense in Greek

Our main findings can be summarized in four points:

(10) a. Sigmatic forms were preferred for non-rhyming novel verbs.
b. Sigmatic forms were preferred for novel verbs that rhyme with existing non-sigmatic verbs.

c. Children often overapplied sigmatic forms to existing non-sigmatic verbs, whereas overapplications of non-sigmatic forms to existing sigmatic verbs were extremely rare.
d. Generalizations of non-sigmatic forms were most common for novel verbs that are similar to existing non-sigmatic verbs.

The form that is used for non-rhymes may be regarded as a default which applies when analogical (similarity-based) generalizations to existing items fail. (10a) shows that in Greek the sigmatic perfective past tense has this function. For novel verbs that did not rhyme with existing Greek verbs, all participant groups preferred sigmatic forms over non-sigmatic ones in the elicited production task. In the judgment task, this was the case for participants aged 5 or above.

Sigmatic forms were also preferred for novel verbs that belong to a different similarity cluster (10b). This preference was seen in the production task for all age groups and in the judgment task for participants aged 5 or above. Notice that the opposite pattern does not hold, that is, non-sigmatic forms were rarely chosen for novel verbs that are similar to existing sigmatic verbs. This contrast confirms the default function of the sigmatic perfective past tense in Greek.

In contrast to the adult participants, children of all age groups produced overapplication errors on existing verbs, and the distribution of these errors showed the asymmetry mentioned in (10c). These data show that in cases in which children fail to retrieve the correct non-sigmatic perfective past tense they produce a sigmatic form, another finding that supports the default nature of the sigmatic perfective past tense.

As mentioned in (10d), non-sigmatic forms also generalized to novel verbs, albeit under different circumstances than sigmatic forms. In the production task, both children and adults were most likely to use a non-sigmatic form for novel items that were similar to existing non-sigmatic verbs. In the judgment task, non-sigmatic choices were more common for novel non-sigmatic than for novel sigmatic rhymes in adults and in children above the age of 5. These results show that generalizations of non-sigmatic forms are more restricted than those of sigmatic forms and sensitive to a novel verb's similarity to existing forms.

From the perspective of dual-mechanism morphology, one may account for the findings in (10) by assuming that the grammar of Greek contains a general rule that

attaches *–s-* to a verbal stem to form the sigmatic perfective past tense and that non-sigmatic perfective past tense forms are listed in memory. The different generalization properties of sigmatic and non-sigmatic forms can be explained in terms of this simple distinction. If sigmatic forms are based on a general rule (Add *–s-*), then this rule may generalize freely to any verbal stem (unless it is blocked by a lexical entry containing a non-sigmatic form). Consequently, the sigmatic perfective past tense functions as a default form in generalization processes which is used when access to stored perfective past-tense forms is not possible (10a) or fails (10b). Children's overapplication errors (10c) can also be explained in these terms. Overapplications such as *ejerse* (see (8a)) are due to the child applying the *–s-* perfective past-tense rule in cases in which the lexical entry for the non-sigmatic word form (*ejir-e* 'bent-3rd sg.') is not yet available, and they disappear once the child can reliably retrieve the correct exceptional form. Consequently, *-s-* overapplication errors decrease with age. Generalizations of non-sigmatic forms, on the other hand, were similarity-based (10d). This finding is consistent with the idea that non-sigmatic perfective past-tense forms are stored in lexical memory hence allowing for analogical generalizations. In this way, dual-mechanism morphology provides a straightforward account for the different generalization properties of sigmatic and non-sigmatic forms in Greek.

Alternatively, one may try and explain the findings in (10) from the perspective of associative single-mechanism models such as the kinds of connectionist models proposed for the English past tense and other inflectional systems (see McClelland & Patterson 2002 for review). These models do not posit any kind of morphological operations or rules for inflected word forms but, instead, claim that all inflected word forms are stored in memory in the same way as uninflected word forms, in terms of associative links between phonological and semantic codes. Sigmatic forms are more frequent in Greek than non-sigmatic ones. Thus, in a connectionist network of this system, the link weights to the phonological and semantic features defining sigmatic forms would probably be stronger than those to non-sigmatic forms. This may lead the network to output sigmatic forms for novel items that are dissimilar to any stored forms (10a) and to even overwhelm the relatively weaker weights to existing non-sigmatic forms, as in the case of novel rhymes (10b) and in children's overapplication errors (10c). From this perspective, the generalization properties of the sigmatic perfective past tense would essentially be a consequence of its higher type frequency relative to the number of verbs that take non-sigmatic forms.

On the other hand, it is hard to see how a model of this kind could at the same time account for the similarity-based generalizations that were found for non-sigmatic forms (10d), because a single-mechanism model that normally applies the most frequent pattern to novel verbs will always do so and will not suddenly rely on a less frequent pattern for a particular subclass of novel verbs. It seems then that a single-mechanism account only provides a partial account for our findings. To be sure, however, the generalization properties of sigmatic and non-sigmatic forms need to be simulated in an implemented connectionist model of the Greek perfective past-tense, a model that is currently not available.

Developmental aspects

The present study provides a rich source of data on how inflectional generalization processes emerge over time. Whilst we saw the same (sigmatic versus non-sigmatic) dissociation in all age groups of children as in the adult group, statistical analyses of the data revealed that only the 7-to-8-year old children achieved adult-like scores in the various conditions. Consider the following summary:

(11) a. 3-4 year olds: reduced levels of generalization of both sigmatic and non-sigmatic forms

b. 5-6 years olds: generalizations of sigmatic forms adult-like; reduced levels for non-sigmatic forms

c. 7-8 years olds: adult-like levels of generalization of both sigmatic and non-sigmatic forms

In the production task, the two youngest child groups had significantly lower scores than the adult group for generalizations of both sigmatic and non-sigmatic forms in all novel verb conditions, and in the judgment task they performed at chance level on novel verbs. The two intermediate age groups of 5-to-6-year-old children achieved adult-like scores in the production task and above-chance levels of performance in the judgment task, but only for generalizations of sigmatic forms. For non-sigmatic forms, the 5-to-6-year-olds performed significantly below adult levels. Only the two oldest age groups of children represented in our sample exhibited adult-level scores in generalizing sigmatic and non-sigmatic forms to novel verbs.

These findings are perhaps surprising in that it seems to take a long time until adult-level performance is reached. Could this mean that productive inflectional processes of the adult language are unproductive in young children and only become productive in late childhood? Consider children's overapplication errors of sigmatic forms with respect to this question. Such errors represented 11.43% (for the 3-year-olds) and 17% (for the 4-year-olds) of the total responses to existing non-sigmatic verbs, rates that are in line with children's overapplication rates of regular inflections in elicited speech reported in the literature (Clahsen et al. 2002: 606). These types of error were found for the three subclasses of non-sigmatic verbs and were not restricted to particular lexical items. Whilst most of the overapplication errors of sigmatic forms were combinations of the perfective past-tense affix *–s-* with the unmarked (present tense) stem of the verb, there was also a considerable number of cases in which *–s-* was attached to a different marked stem of a given verb (n=21) and cases in which *–s-*was combined with a non-existing stem form (n=18); see examples in (8) above. Instances of these different kinds of overapplication errors were found in 3-to-4-year old children indicating that at this age, children are already capable of manipulating stems and inflectional endings separately. Furthermore, the production data show that even the youngest children prefer to use sigmatic forms for rhyming and non-rhyming novel verbs. It is true that the scores are lower than for adults, but the pattern is the same as for adults, with sigmatic forms of novel verbs clearly outnumbering non-sigmatic ones. Thus, even the youngest children we tested were able to use the sigmatic perfective past tense productively to create word forms that are not attested in the input.

A related question is why in the judgment task, 3-to-4-year olds performed at chance level in most conditions. We suggest that this is due to the particular demands of the judgment task which required two very similar verb forms to be stored in working memory and subsequently to be matched to a picture. Chance performance in this task could result from children focussing on whether the picture contents fitted with the verb's meaning rather than with its inflectional form. Note also that even for existing sigmatic verbs, the 3-year-old children performed at chance level in the judgment task, even though they were able to correctly produce the sigmatic perfective past tense form of the same verbs with a mean accuracy score of almost 70% (see Table 4). We conclude that the younger children's low levels of

performance in the judgement task are most probably task effects and do not reflect any lack of grammatical knowledge.

A developmental delay was, however, found for non-sigmatic perfective past tense formation. Adult-like levels of generalizations were achieved later for non-sigmatic than for sigmatic forms. Likewise, the correctness scores on existing verbs were significantly lower for non-sigmatic than for sigmatic verbs in all age groups of children, another indication of a developmental delay for non-sigmatic perfective past tense formation. Most probably, this delay is a consequence of non-sigmatic forms having to be learned on an item-by-item basis over an extended period of time.

7. Conclusion

We presented a detailed and large-scale investigation of the development of the perfective past tense in Greek. Our focus was on how children and adults generalize different kinds of inflected forms to novel verbs and how these generalization processes change over time. The data came from acceptability judgments and elicited productions testing 35 adult native speakers of Greek and 164 Greek-speaking children in six age groups on both existing and novel verbs.

Our main finding was a dissociation between sigmatic and non-sigmatic forms in both the adult and the child data. Sigmatic forms showed generalization properties that are characteristic of regular defaults. They were preferred for non-rhymes and for novel verbs in general, even for those that are similar to existing non-sigmatic ones. Children produced overapplication errors using sigmatic forms. Non-sigmatic forms, on the other hand, exhibited analogical generalization properties and were only extended to novel verbs that were similar to existing non-sigmatic verbs. The data also provided a detailed picture of the development of perfective past tense formation. In particular, we found that whilst the use of non-sigmatic forms was developmentally delayed relative to sigmatic ones, the contrast between the generalization properties of the two kinds of perfective past tense inflection was basically the same for children and adults. We proposed a dual-mechanism account for these findings arguing that the sigmatic perfective past tense involves a morphological rule and that non-sigmatic forms are stored in lexical memory.

Acknowledgments

We thank Claudia Felser for helpful comments on a first version of this paper, Anna Anastasiadi for discussions on verb morphology in Greek, and Giorgos Orfanos for letting us have access to the Neurosoft corpus. We are also grateful to Nikoletta Dalatsi and Eleni Vletsi for helping us with counting verb lemmas from the Neurosoft corpus. Many thanks go to the undergraduate students of the Dept. of Speech and Language Therapy at the Technological Educational Institute of Epirus in Ioannina who collected the data for the present study (as part of their training) under the supervision of the first author.

References

Brown, R. and Bellugi, U. (1964). Three processes in the child's acquisition of syntax. Harvard Educational Review 34, 133-151.

Clahsen, H. (2006). Dual-mechanism morphology. In: K. Brown (ed.), Encyclopedia of language and linguistics. 2nd edition. Elsevier: Oxford, Vol. 4, pp.1-5.

Clahsen, H. & Rothweiler, M. (1993). Inflectional rules in children's grammars: evidence from the development of participles in German. Yearbook of Morphology 1992, 1-34.

Clahsen, H., Aveledo, F. & Roca, I. (2002). The development of regular and irregular verb inflection in Spanish child language. Journal of Child Language 29, 591-622.

Dabrowska, E. & Szczerbinski, M. (2006). Polish children's productivity with case marking: The role of regularity type frequency and phonological diversity. Journal of Child Language 33, 559-597.

Delidaki, S. & Varlokosta, S. (2003). Testing the aspect first hypothesis: A preliminary investigation into the comprehension of tense in child Greek. ZAS Papers in Linguistics 29, 73-84.

Elman, J., Bates, L., Johnson, M., Karmiloff-Smith, A., Parisi, D. & Plunkett, K. (1996). Rethinking innateness. Cambridge, Mass.: MIT Press.

Holton, D., Mackridge, P. & Phillipaki-Warburton, I. (1997). Greek: A comprehensive grammar of the modern language. London: Routlege.

Kehayia, E. & Jarema, G. (1991). On agrammatism in Greek. Neurolinguistik 35, 47-61.

Lahha, S., Ravid, D., Korecky-Kröll, K., Laaha, G. & Dressler, W. U. (2006). Early noun plurals in German: regularity productivity or default? Journal of Child Language 33, 271-302.

Langacker, R. (2000). Grammar and conceptualization. Berlin, New York: de Gruyter.

Marchman, V. A., Plunkett, K., & Goodman, J. (1997). Overregularization in English plural and past tense inflectional morphology: A response to Marcus (1995). Journal of Child Language 24, 767-779.

Marcus, G. F., Pinker, S., Ullman, M. T., Hollander, M., Rosen, T. J. and Xu, F. (1992). Overregularization in language acquisition. Monographs of the Society for Research in Child Development 57. Serial No. 228. Chicago, IL: University of Chicago Press.

McClelland, J.L. and Patterson, K. (2002). Rules or connections in past-tense inflections: What does the evidence rule out? Trends in Cognitive Sciences 6, 465–472.

McNeill, D. (1966). Developmental psycholinguistics. In: F. Smith and G. Miller (eds.), The genesis of language: a psycholinguistic approach. Cambridge, MA: MIT Press, pp.18-84.

Orsolini, M., Fanari, R., & Bowles, H. (1998). Acquiring regular and irregular inflection in a language with verb classes. Language & Cognitive Processes 13, 425-464.

Pinker, S. & Ullman, M (2002). The past and future of the past tense. Trends in Cognitive Sciences 6, 456-462.

Ragnarsdottir, H., Simonsen, H. G., & Plunkett, K. (1999). The acquisition of past tense morphology in Icelandic and Norwegian children: An experimental study. Journal of Child Language 26, 577-618.

Ralli, A. (1988). Eléments de la morphologie du grec moderne: la structure du verbe. Unpublished Ph.D. dissertation, University of Montreal.

Ralli, A. (2003). Morphology in Greek Linguistics: The state of the art. Journal of Greek Linguistics 4, 77-129.

Royle, P. (2007). Variable effects of morphology and frequency on inflection patterns in French preschoolers. The Mental Lexicon 2, 103-125.

Rumelhart, D. E. and McClelland, J. L. (1986). On learning the past tenses of English verbs. Implicit rules or parallel distributed processing? In D. E. Rumelhart, J. L.

McClelland and the PDP Research Group (eds), Parallel Distributed Processing: explorations in the Microstructure of Cognition. Vol.2. Cambridge, MA: MIT Press, pp. 216–271.

Say, T. & Clahsen, H. (2002). Words, rules and stems in the Italian mental lexicon. In S. Nooteboom, F. Weerman & F. Wijnen (eds.), Storage and computation in the language faculty. Dordrecht: Kluwer, pp.93-129.

Stephany, U. (1997). The acquisition of Greek. In D. Slobin (ed.), The crosslinguistic study of language acquisition. Vol 4. Hillsdale, NJ: Erlbaum Press, pp. 183-303.

Stephany, U. & Voeikova, M. (2003). On the early development of aspect in Greek and Russian child language: A comparative analysis. ZAS Papers in Linguistics 29, 211–224.

Terzi, A., Papapetropoulos, S. & Kouvelas, E. (2005). Past tense formation and comprehension of passive sentences in Parkinson's disease: Evidence from Greek. Brain and Language 94, 297-303.

Tsapkini, K., Jarema, G. & Kehayia, E. (2001). Manifestations of morphological impairments in Greek aphasia: A case study. Journal of Neurolinguistics 14, 281-296.

Tsapkini, K., Jarema, G. & Kehayia, E. (2002a). A morphological processing deficit in verbs but not in nouns: a case study in a highly inflected language. Journal of Neurolinguistics 15, 265-288.

Tsapkini, K., Jarema, G. & Kehayia, E. (2002b). The role of verbal morphology in aphasia during lexical access: Evidence from Greek. In E. Fava (ed.), Clinical linguistics and phonetics: Theory and applications in speech pathology and therapy. Amsterdam/Philadephia: John Benjamins, pp. 299-314.

Triandafillidis, M. (1941). Neoellniki grammatiki (The Modern Greek grammar). Athens: OESV.

Appendix A

EXISTING VERBS

1st subclass – Sigmatic past tense

grafo - egrapsa (I write - I wrote), *kovo – ekopsa* (I cut - I cut), *vafo - evapsa* (I paint - I painted)

2nd subclass– Sigmatic past tense

lino – elisa (I untie - I untied), *pefto - epesa* (I fall - I fell), *dino - edisa* (I dress - I dressed), *platho - eplasa* (I make by hand - I made by hand)

3rd subclass – Sigmatic past tense

tripo - tripisa (I bore - I bored), *kouvalo - kouvalisa* (I carry - I carried), *halo - halasa* (I spoil - I spoiled)

1st subclass - Non-sigmatic past tense

troo - efaga (I eat - I ate), *pino - ipia* (I drink - I drank), *vlepo - ida* (I see - I saw)

2nd subclass - Non-sigmatic past tense

pleno - eplina (I wash - I washed), *sperno - espira* (I seed - I seeded), *ferno - efera* (I bring - I brought), *jerno - ejira* (I bend - I bent)

3rd subclass- Non-sigmatic past tense

zesteno - zestana (I warm - I warmed), *ifeno - ifana* (I weave - I wove), *konteno - kontina* (I shorten - I shortened)

NOVEL VERBS

Sigmatic rhymes: 1st subclass: *trafo, lovo, mafo*

2nd subclass: *vino, tefto, bino, pratho*

3rd subclass: *kripo, jalo, nouvalo*

Non-sigmatic rhymes: 1st subclass: *proo, rino, flepo*

2nd subclass: *fleno, skerno, lerno, verno*

3rd subclass: *kesteno, pifeno, lonteno*

Non-rhymes: *stoutho, kepratho, strelotho, hrokejo, goutheno, klouho, taprino, pnekefo, fapino, kirovo*

Appendix B

To koritsi	bini	to luludi’
The-girl-nom	novel verb	the-flower-acc

Maria: To koritsi ebane to luludi
The-girl-ebane-non-sigmatic-the-flower

Giannis: To koritsi ebise to luludi
The-girl-ebise-sigmatic-the-flower

Notes

[i] The word-form frequencies in the ISLP corpus are regularly updated, and the ones shown in Table 3 were taken on March 24, 2007.

[ii] Following Marcus et al. (1992), we calculated overapplication rates as the proportion of tokens of sigmatic (or non-sigmatic) forms that were overapplications. The sigmatic past-tense overregularization rate was calculated as in (a) and the one for the non-sigmatic past tense as in (b):

(a) Tokens of overapplied sigmatic forms/Tokens of overapplied sigmatic forms PLUS tokens of correct non-sigmatic forms

(b) Tokens of overapplied non-sigmatic forms/Tokens of overapplied non-sigmatic forms PLUS tokens of correct sigmatic forms

[iii] In some cases, the sigmatic forms of the novel verbs produced by the children contained stem simplifications, which were not further analyzed, for example, *edipse* (expected response: *edrapse*: present tense: *drafi*). There were 38 such errors, most of which were produced by the 3-to-5-year old children (n=29).

[iv] The t-test results comparing the means of the adult group to those of the various child groups were as follows:

Sigmatic form in sigmatic condition: CH-VIII: t(20)=.86, p=.4; CH-VII t(22)=1.52, p=.15; CH-VI: t(24)=1.69, p=.11; CH-V: t(22)=2.11, p=.050; CH-IV: t(18)=2.29, p=.034; CH-III: t(16)=3.28, p=.011;

Non-sigmatic form in non-sigmatic condition: CH-VIII: t(20)=1.73, p=.099; CH-VII: t(22)=1.18 , p=.25; CH-VI: t(24)=3.98, p=.001; CH-V: t(22)=4.25, p=.001; CH-IV: t(18)=1.52, p=.15 ; CH-III: t(16)=3.59, p=.002

[v] Again, as in the case of novel rhymes, the children produced some sigmatic forms that contained stem simplifications, for example, *tapi<u>s</u>e* or *pami<u>s</u>e* for the present

tense stimulus *taprini* (expected response: taprise). There were 74 such cases in the whole dataset, most of which came from the 3-to-5-year old children (n=57).

[vi] The t-test results comparing the means of the adult group to those of the various child groups were as follows:

Sigmatic form in sigmatic condition: CH-VIII: t(35)=1.39, p>.1; CH-VII: t(34)=1.61, p>.1; CH-VI: t(36)=2.46, p<.05; CH-V: t(41)=6.13, p<.001; CH-IV: t(33)=10.23, p<.001; CH-III: t(33)=13.37, p<.001;

Non-sigmatic form in non-sigmatic condition: CH-VIII: t(35)=1.38, p>.1; CH-VII: t(34)=1.68, p>.1; CH-VI: t(36)=3.68, p<.05; CH-V: t(41)=5.48, p<.001; CH-IV: t(33)=6.01, p<.001; CH-III: t(33)=9.84, p<.001

[vii] The t-test results comparing the correctness scores to chance level (= 50%) were as follows:

Sigmatic: AD: Not applicable; CH-VIII: t(11)=-26.47 p<.001; CH-VII: t(10)=-16.13 p<.001; CH-VI: t(12)=-5.16 p<.001; CH-V: t(17)=-5.359 p<.001; CH-IV: t(9)=-.4.39 p=.002; CH-III: t(9)=-.557 p=.591;

Non-sigmatic: AD: t (24)==-39.85 p<.001; CH-VIII: t(11)=-16.99 p<.001; CH-VII: t(10)=-6.167 p<.001; CH-VI: t (12)=-10.41 p<.001; CH-V: t(17)=-3.183 p=.005; CH-IV: t(9)=-2.092 p=.066; CH-III: t(9)=-.218 p=.832

[viii] The t-test results comparing the percentages of sigmatic forms in the sigmatic condition and those of sigmatic forms in the non-sigmatic condition to chance level (= 50%) were as follows:

Sigmatic: AD: t (24)=-15.22 p<.001; CH-VIII: t(11)=-19.29 p<.001; CH-VII: t(10)=-7.11 p<.001; CH-VI: t (12)=-4.47 p=.001; CH-V: t(17)=-1.98 =.063; CH-IV: t(9)=-1.48 p=.17; CH-III: t(9)=-.896 p=.394

Non-sigmatic: AD: t(24)=7.17 p<.001; CH-VIII: t (11)=5 p<.001; CH-VII:

t(10)=1.715 p=.117; CH-VI: t (12)=1.322 p=.211; CH-V: t(17)=1.193 p=.249; CH-IV: t(9)=.958 p=.363; CH-III: t(9)= 2.12 p=.063

The following volumes of ESSEX RESEARCH REPORTS IN LINGUISTICS have appeared since 2000:

53:2007	*Special Issue: Martin Atkinson – The Minimalist Muse, edited by Andrew Radford, with a Dedication and Curriculum Vitae for Richard Martin Atkinson*	
-/-	*Doug Arnold*	*DOP-based models for richer grammatical frameworks*
-/-	*Robert D. Borsley*	*Hang on again! Are we 'on the right track'?*
-/-	*Harald Clahsen*	*Psycholinguistic perspectives on grammatical representations*
-/-	*Claudia Felser and David Britain*	*Deconstructing what with absolutes*
-/-	*Roger Hawkins*	*Emergent and innate sources of knowledge in the early L2 acquisitionof English verbal morphology*
-/-	*Andrew Radford*	*Split projections, percolation, syncretism and interrogative auxiliary inversion*
-/-	*Louisa Sadler*	*Agreement features, indeterminacy and disagreement*
-/-	*Andrew Spencer*	*The possessum-agreement construction or 'Does Albanian have a genitive case?'*
52:2006	*Gabriela Adela Gánem Gutiérrez*	*Microgenesis,* method *and* object*: a study of collaborative activity in a Spanish as a foreign language classroom*
-/-	*Gabriela Adela Gánem Gutiérrez*	*Sociocultural Theory and its application to CALL: A study of the computer and its relevance as a mediational tool in the processes of collaborative activity*
51:2006	Mikako Sato, Claudia Felser	*Sensitivity to Semantic and Morphosyntactic Violations in L2 Sentence Processing: Evidence from Speeded Grammaticality Judgments*
-/-	Karen Roehr	*Metalinguistic Knowledge and Language-analytic Ability in University-level L2 Learners*
50:2006	Jürgen Bohnemeyer, Sonja Eisenbeiss, Bhuvana Narasimhan	*Ways to go: Methodological considerations in Whorfian studies on motion events*
-/-	Karen Roehr	*Theorizing L2 Metalinguistic Knowledge*
49:2006	Martin Atkinson	*On What There Is (and Might Not Be)*

-/-	Bob Borsley	*Syntactic and Lexical Approaches to Unbounded Dependencies*
-/-	Harald Clahsen	*Chomskyan Syntactic Theory and Language Disorders*
48:2006	Matthew Baerman	*The Location of Deponency*
-/-	Daniel Harbour	*On the Unity of 'Number' in Semantics and Morphology*
-/-	Ana R. Luís and Ryo Otoguro	*Mismatch Phenomena from an LFG Perspective*
-/-	Ana R. Luís and Andrew Spencer	*Udi Clitics*
-/-	Kathleen Neubauer and Harald Clahsen	*Inflection and Derivation in a Second Language*
-/-	Gergana Popova	*Integrating Nominalisations into a Generalised PFM*
47:2004	Robert D. Borsley	*On the Nature of Welsh VSO Clauses*
-/-	Beatriz Mariz Maia de Paiva	*Exploring the Relationships between Theories of Second Language Acquisition and Relevance Theory*
-/-	Rebecca Clift	*Discovering Order*
46:2004	Harald Clahsen	*Linguistic Perspectives on Morphological Processing*
-/-	Melanie Ring and Harald Clahsen	*Distinct Patterns of Language Impairment in Down Syndrome and Williams Syndrome: The case of syntactic chains*
-/-	Michaela Wenzlaff and Harald Clahsen	*Finiteness and Verb-Second in German Agrammatism*
45:2003	Hahne, A., Mueller, J. and H. Clahsen	*Second language learners' processing of inflected words: Behavioral and ERP evidence for storage and decomposition*
-/-	Marinis, T., Roberts, L., Felser, C. and H. Clahsen	*Gaps in second language sentence processing*
44:2003	Johnson, W. and D. Britain	*L vocalisation as a natural phenomenon*
-/-	Matsumoto, K. and D. Britain	*Contact and obsolescens in a diaspora variety of Japanese: The case of Palau in Micronesia*
43:2003	Clahsen, H., M. Ring and C. Temple	*Lexical and morphological skills in English-speaking children with Williams Syndrome*
-/-	Wenzlaff, M. and H. Clahsen	*Tense and agreement in German agrammatism*

-/-	Clahsen, H., M. Hadler and H. Weyerts	*Frequency effects in children's and adults' production of inflected words*
-/-	Papadopoulou, D. and H. Clahsen	*The role of lexical and contextual information in parsing ambiguous sentences in Greek*
41:2002	Britain, D.	*The British History of New Zealand English?*
-/-	Britain, D.	*Phoenix from the ashes?: The death, contact and birth of dialects in England*
-/-	Britain, D.	*Surviving 'Estuary English': Innovation diffusion, koineisation and local dialect differentiation in the English Fenland*
40:2002	Felser, C., L. Roberts, R. Gross and T. Marinis	*The processing of ambiguous sentences by first and second language learners of English*
-/-	Clahsen, H., I. Sonnenstuhl and J. Blevins	*Derivational morphology in the German mental lexicon: A dual mechanism account*
39:2002	Marinis, T.	*Acquiring the left periphery of the Modern Greek DP*
-/-	Marinis, T.	*Subject-object asymmetry in the acquisition of the definite article in Modern Greek*
-/-	Papadopoulou, D. and H. Clahsen	*Parsing strategies in L1 and L2 sentence processing: a study of relative clause attachment in Greek*
38:2001	Britain, D.	*Dialect contact and past BE in the English Fens*
-/-	Britain, D.	*If A changes to B, make sure that A exists: A case study on the dialect origins of New Zealand English*
-/-	Matsumoto, K. and D. Britain	*Conservative and innovative behaviour by female speakers in a multilingual Micronesian society*
37:2001	Atkinson, M.	*Defective intervention effects, die!*
-/-	Atkinson, M.	*Putting the X on TH/EX*
-/-	Felser, C.	*Wh-copying, phases, and successive cyclicity*
36:2001	Clahsen, H. and C. Temple	*Words and Rules in Children with Williams Syndrome*
-/-	Radford, A. and E. Ramos	*Case, Agreement and EPP: Evidence from an English-speaking child with SLI*
35:2001	Patrick, P.	*The speech community*
-/-	Figueroa, E. and P. Patrick	*The meaning of kiss-teeth*
34:2000	Atkinson, M.	*Minimalist visions*
-/-	Radford, A.	*Children in search of perfection: Towards a*

		minimalist model of acquisition
-/-	Hawkins, R.	*Persistent selective fossilisation in second language acquisition and the optimal design of the language faculty*
-/-	Atkinson, M.	*Uninterpretable feature deletion and phases*
-/-	Felser, C.	*Wh-expletives and secondary predication: German partial wh-movement reconsidered*
-/-	Borsley, R.D.	*What do 'prepositional complementisers' do?*
-/-	Clahsen, H., I. Sonnenstuhl, M. Hadler and S. Eisenbeiss	*Morphological paradigms in language processing and language disorders*
33:2000	Radford, A.	*Minimalism: Descriptive perspectives*
32:2000	Clift, R.	*Stance-taking in reported speech*
-/-	McDonough, J. and S. McDonough	*Composing in a foreign language: an insider-outsider perspective*
-/-	Arnold, D.	*Corpus access for beginners: the W3Corpora project*
-/-	Patrick, P. and S. Buell	*Competing creole transcripts on trial*
31:2000	Weyerts, H., M. Penke, T. F. Muente, H.-J. Heinze and H. Clahsen	*Word order in sentence processing: An experimental study of verb placement in German*
-/-	Nakano, Y., C. Felser and H. Clahsen	*Antecedent priming at trace positions in Japanese long-distance scrambling.*
30:2000	Al-Wer, E.	*Education as a speaker variable in Arabic variationist studies*
-/-	Al-Wer, E.	*Jordanian and Palestinian dialects in contact: vowel raising in Amman*
-/-	Al-Wer, E.	*Perspectives on two Arabic emphatic sounds: A merger or an artificial split?*
-/-	Cook, V.	*The innateness of a Universal Grammar principle in L2 users of English*
29:2000	Matsumoto, K. and D. Britain	*Hegemonic diglossia and pickled radish: symbolic domination and resistance in the trilingual Republic of Talau*
	Britain, D.	*The difference that space makes: an evaluation of the application of human geographic thought in*

		sociolinguistic dialectology
28:2000	Britain, D. and A. Sudbury	*There's sheep and there's penguins: 'Drift' and the use of singular verb forms of BE in plural existential clauses in New Zealand and Falkland Island English*