Introduction. Beyond the Obvious: Do Second Language Learners Process Inflectional Morphology?

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Given that this special issue is devoted to the acquisition and processing of inflectional morphology by second language (L2) learners, the question in the title may appear redundant. However, recent research on first language (L1) and L2 morphological processing has challenged basic assumptions about the status of inflectional morphology in linguistic processing that had long been taken for granted. The present issue demonstrates how experimental paradigms and theoretical positions developed in L1 and L2 research result in a new synergy and advance our understanding of the complex mechanisms implicated in morphological processing.

The question as to whether L2 learners process inflectional morphology includes several smaller ones. First, does the morphological level exist in psycholinguistic terms, not just in linguistic descriptions? Second, assuming it exists, do L2 learners rely on the same mechanisms as L1 speakers when processing inflectional morphology? Third, what are the cognitive and environmental factors underlying L2 acquisition of inflectional morphology? The goal of this short introduction is to briefly review the main theoretical positions vis-à-vis inflectional morphology and to identify points of convergence between research on L1 and L2 morphological processing.

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Three points are relevant for the issue’s agenda. First, debates between the extreme positions expressed by the dual-system and single-system approaches to inflectional morphology, which hinge on a categorical distinction between regular and irregular inflection and a no less categorical interpretation of the role of frequency, have highlighted the strengths and weaknesses in both approaches. Apparently, more often than not, there is a continuum between regular and irregular processing. Second, crosslinguistic comparisons signal significant differences in the processing of inflection among languages ranging in morphological richness. Third, and crucially for this research, the discussions of purely SLA-driven issues in morphological processing, such as differences in early and late L2 learning, the role of L1 background, and the relative distance between L1 and L2, as well as the type of input received by L2 learners, are moving to the forefront.

Regular and Irregular Morphology: Two Systems or One?

Until the 1990s, the morphological level of processing postulated by most linguistic theories for some languages had been taken for granted by psycholinguists interested in how the mind works. To use some examples from inflection, based on this assumption, to generate the plural of the English word *rat* — *rats* — the speaker will compose an inflected word by adding the plural inflection to the stem: \{rat\} + {-s}. Similarly, the listener who hears such a morphologically complex word will understand its meaning by decomposing it into the stem \{rat\} and the plural inflection {-s} and will arrive at the meaning “more than one long-tailed rodent,” which, in turn, will bring forth a semantic association with an affectionate pet, a creature from the gutter, or the ingenious chef from the cartoon “Ratatouille.” If, indeed, this (de)composition is easy and automatic, then it makes sense to expect stems and inflections to be stored separately and to be assembled by combinatorial rules. This would be very cost-effective in terms of saving on storage space needed for all the inflected words. Such a procedure is not possible, however, for the plural of the word *mouse* {mouse}, with the irregular {mice}, which is formed by stem vowel change rather than the addition of the predictable regular {-s} affix. For such irregular formations, both the singular and the plural stem should be stored in the mental lexicon, as the plural is not decomposable.

This straightforward set of expectations was shattered by advances in connectionist modeling of neural networks, which simulated rulelike behavior, with the network generalizing phonological similarities among pairs of
uninflected and inflected words to new ones without any rules built into the model (Rumelhart & McClelland, 1986). Such models were able to generate English past tense verbs from their stems, both regular (e.g., *talk-talked*) and irregular (e.g., *bring-brought*). The rulelike behavior that could be inferred from the output of connectionist simulations was the result of associative patterning based on phonological similarities between the stem and inflected forms that were fed into the system during training.

The success of connectionist modeling together with the network theory led to the formulation of a single-system approach to morphological processing (Bybee, 1995; Elman et al., 1996; Seidenberg & Elman, 1999), according to which all inflected words, both regular and irregular, are processed by the single mechanism of associative patterning. The single-system approach postulates two kinds of associations—phonological and semantic—and obviates the need for a separate morphological level of representation and processing (Bybee, 1995). For example, a recent study using masked and cross-modal priming with varying interstimulus intervals claimed that the differences between regular and irregular English past tense verbs could be explained by the interaction of form (orthography or phonology) and meaning (semantics) factors, with the role of inflectional morphology not clearly defined (Kielar, Joanisse, & Hare, 2008).

The alternative, dual-system approach claims that regular inflected forms are processed by symbolic rule computation, whereas irregular inflected forms (as well as morphologically simple forms) are processed by associative patterning (Pinker, 1999; Pinker & Prince, 1994; Pinker & Ullman, 2002; Prasada & Pinker, 1993). The main testing tool used by the proponents of each approach is the frequency effect. The single-system approach predicts that both regular and irregular inflected verbs will show frequency effects. The dual-system approach predicts that only irregular, not regular, verbs will show frequency effects. The predictions by proponents of both approaches are based on the assumption that if an inflected word is stored in associative memory, it should show whole-word frequency effects. Conversely, if it is morphologically processed online, it will not show any whole-word effects but will show stem-cluster (lemma) frequency effects, given that the stem is part of all of the forms in the cluster, and is stored separately. Then whole-word frequency effects with stem-cluster frequency controlled should indicate that the word is stored. If the dual-system predictions are correct, they will distinguish between storage in irregular inflection and computation in regular inflection (the latter with no frequency effects).
English Past Tense Verbs: A Special Case?

The frequency effect has been extensively studied with English past tense verbs. Whereas irregular verbs typically show frequency effects, regular verbs show mixed results (see Alegre & Gordon, 1999, for a review). The frequency effect can be inferred from reaction times or accuracy scores in verb generation or lexical decision tasks. The reason why there is no agreement on whether regular past tense English verbs show frequency effects lies in part in methodological difficulties. In order to show that regular past tense verbs are sensitive to frequency, one needs to control for their cumulative (stem-cluster, or lemma) frequency, which obviously affects access speed, whether the word is inflected or not. If two verbs have the same cumulative lemma frequency but different surface (whole-word) frequencies and these differences are reflected in reaction times, this would be taken as proof that the inflected word forms are stored in memory. The problem, leading to controversial outcomes, is that it is almost impossible to produce lists of English irregular and regular verbs comparable in both lemma and surface frequency. Indeed, one cannot add the frequency of past tense irregular verb forms to the cumulative lemma frequency because the past tense form uses a different stem. To be consistent and not to bias counts, one should not include past tense frequencies in the cumulative frequency for regular verbs, but this is not justified either. In fact, this may lead to an absurd situation when past tense frequency for a given verb may be higher than its cumulative frequency (see Alegre & Gordon, 1999, for details). It is likely that these difficulties with balancing the frequencies in test materials have led to an “anti-frequency effect” in L1 and L2 English regular past tense verb generation (high-frequency verbs took longer to generate than low-frequency verbs) (Beck, 1997).²

Phonological similarity effects have also been used to prove that inflected words are stored in memory undecomposed. English irregular verbs form neighborhoods based on the phonological similarity of their stems and/or parallelism in past tense formation, such as sing-sang, ring-rang, or bring-brought, think-thought, buy-bought.³ The dual-system approach claims that English irregular, but not regular, past tense verbs will show phonological similarity effects (Prasada & Pinker, 1993; Ullman, 1999). Indeed, English speakers produced an irregular past tense for a nonce verb closely resembling an existing irregular verb but not for an irregular verb that was phonologically very different from irregular verbs. At the same time, regular past tense inflection was applied to any verb, regardless of its phonological composition (Prasada & Pinker, 1993).⁴
Numerous studies using a variety of experimental techniques have documented statistically significant differences in the processing of English regular and irregular past-tense verbs, in different populations of speakers, including individuals with speech deficits, such as patients with aphasia (Ullman et al., 2005), which supports the position of the dual-system approach. However, it is premature to generalize this conclusion to other languages. In English, verbs are divided into a large (high-type-frequency) regular default\textsuperscript{5} class and a small heterogeneous irregular class, with regularity, default status, and high type frequency blocked together. Thus, these may be the properties of the default and/or high-frequency pattern rather than regularity that underlie the differences. Additionally, even for English, a more graded system of regular, semiregular, and irregular inflection has been hypothesized (Basnight-Brown, Chen, Hue, Kostic, & Feldman, 2007).

**Regular and Irregular Inflection in Morphologically Rich Languages**

In languages with rich inflectional morphology, there is no sharp division between regular and irregular inflection but, rather, several inflectional patterns ranging in regularity, as shown in the priming experiments involving verb conjugation in Romance and Slavic languages (see, e.g., Orsolini & Marslen-Wilson, 1997, for Italian; Meunier & Marslen-Wilson, 2004, for French; Veríssimo & Clahsen, 2009, for Portuguese; De Diego Balaguer, Sebastián-Gallés, Diaz, & Rodríguez-Fornells, 2005, for Spanish; and Gor & Cook, this issue, for Russian). For languages with complex inflectional systems, the existence of a boundary between regular and irregular verbs and two different mechanisms subserving the processing of inflectional morphology, referred to as symbolic rule computation and associative patterning, or (de)composition and whole-word storage in associative memory, becomes a debated issue. Thus, numerous studies reported a dissociation between regular and irregular processing of verbal morphology in German (see, e.g., Clahsen, 1999, for a review); however, two recent studies claimed that both regular and irregular German inflected verbs are processed by a single system (Smolka, Komlósi, & Rösler, 2009; Smolka, Zwitserlood, & Rösler, 2007). Bowden, Gelfand, Sanz, and Ullman (this issue) do not support a categorical distinction between the default Class I (-ar) and nondefault Classes II/III for Spanish. The authors do not equate regularity/irregularity with class membership but rather with the absence/presence of stem changes in a particular inflected form in the paradigm. This is a step in
the direction of moving away from the regular/irregular distinction toward the issues of decomposability and stem allomorphy.

Several lines of inquiry partially reconcile the dual- and single-system positions and push research in a slightly different direction. These include different “hybrid” models combining computation and storage of inflected words, the main one being the dual-route model (Baayen, Dijkstra, & Schreuder, 1997), according to which both decomposition and whole-word access are activated simultaneously, and the fastest route wins the competition. Other proposals combine rule-based processing with the use of linguistic probabilities (Bod, Hay, & Jannedy, 2003; Gor, 2003, 2004; Yang, 2002). The usage-based theory (Langacker, 1987), relying on the notion of schemas, has been integrated within the single-system approach (see, e.g., Bybee, 1995; Dabrowska, 2008). However, it would be more accurate to interpret it as a combination of both dual- and single-system approaches. Indeed, schemas have a dual nature, combining the properties of rules, because they are abstractions of the occurring patterns, and also the properties of associative networks, being shaped by the input and dependent on input frequencies. Because more and more studies report a graded effect of regularity in languages with rich inflectional morphology, and even English (Basnight-Brown et al., 2007), the strong dual-system position loses its basis. These languages include Norwegian (Simonsen, 2000), Icelandic (Ragnasdóttir, Simonsen, & Plunkett, 1999), Italian (Orsolini & Marslen-Wilson, 1997), Spanish (De Diego Balaguer et al., 2005), Russian (Gor & Chernigovskaya, 2001, 2005), and Polish (Dabrowska, 2004). Yet, the view of the morphological level as redundant, adopted by single-system proponents, has been challenged by numerous studies demonstrating that morphological effects in word processing are different from form (orthographic or phonological, depending on the mode: visual or auditory) and semantic effects (see, e.g., Feldman & Soltano, 1999). An interesting recent proposal, although supporting the single-system view, claims that morphological relations are processed independently of form and meaning relatedness (Smolka et al., 2007, 2009). Remarkably, this conclusion was based on the studies of German prefixed verbs and participles, although German is typically analyzed within the dual-system approach and shows a dissociation of regular and irregular processing (e.g., Clahsen, 1999; Clahsen, Felser, Neubauer, Sato & Silva, this issue).

The research agenda exploring the categorical difference between regular and irregular morphological processing, which equates regularity with symbolic rule computation and irregularity with whole-word storage (Pinker, 1999), has motivated a new research direction. However, it has come to a standstill,
due to a number of factors. First, it has become obvious that a categorical regular/irregular distinction does not work for morphologically rich languages and, thus, cannot be treated as a universal property of morphological processing (see, e.g., Meunier & Marslen-Wilson, 2004; Gor & Cook, this issue). For such languages, to take Romance and Slavic languages as examples, the degree of regularity of a particular conjugational pattern (as in verb classes) is defined by the complexity and predictability of allomorphy and of the conjugational paradigm as a whole. Meunier and Marslen-Wilson acknowledged the predominance of studies supporting a regular/irregular distinction for English and German and hypothesized that this may be a property of West Germanic languages (2004, p. 575).

Second, even for English, the regular/irregular distinction remains controversial in the light of more recent data (e.g., Basnight-Brown et al., 2007).

Third, the predictive value of surface (whole-word) frequency effects with lemma frequency held constant is limited by methodological difficulties in measuring lemma (stem-cluster) frequency for the paradigms, which include irregular forms with complex allomorphy. Including and excluding such forms in the counts each has its problems. By including a form with a different stem in the counts, one is making an ad hoc decision that different stems are stored together. By excluding such forms, one ends up basing the counts on different sets of word forms for different verbs, thus creating a different bias. Additionally, given that many regularly inflected words show frequency effects, with the threshold for English of above six per million words (Alegre & Gordon, 1999), frequency effects cannot be reliably interpreted as proof of storage.7 With regard to L2 morphological processing, extra caution is needed when very low-frequency inflected forms are claimed to be stored undecomposed, because L2 learners have smaller mental lexicons than L1 speakers.

Fourth, the status of the default inflectional pattern has important consequences for the generation of inflected words. Indeed, numerous studies confirm that the default pattern is often chosen and generalized to other patterns, especially in dealing with novel verbs, a situation encountered even by advanced L2 speakers, due to their limited mental lexicon. For English past tense verbs, it is impossible to maintain the distinction between regular and default inflection.

Fifth, type frequency, or the size of the conjugational class has an impact on the choice of inflectional pattern in verb generation (Ellis, 2002), which is in conformity with the single-system approach (Bybee, 1995) and the rules and probabilities model (Gor, 2003, 2004). The role of type frequency is supported by the experimental data: High-type-frequency conjugational patterns are more readily used in novel verb processing (Gor & Chernigovskaya, 2001,
Gor

Do L2 Learners Process Inflectional Morphology?

2005). This psycholinguistic tendency to more readily apply high-frequency and hence highly probable patterns is in conflict with the Blocking Principle, according to which minor rules are applied before more general rules, and irregularly inflected stored forms are retrieved before regular computation is applied (Pinker, 1999).

Sixth, when a language has a developed inflectional paradigm, this has several implications (see Orsolini & Marslen-Wilson, 1997; also Bowden et al., this issue; Gor & Cook, this issue). The sets of inflections for a given paradigm are limited, and in case they are easily detachable from the stem, early automatic (de)composition is to be expected (Marslen-Wilson, 2007). In addition, typically, not all forms in the paradigm have irregular allomorphy. If some of them do, it is not obvious that the whole paradigm is treated as irregular, with all the inflected word forms stored undecomposed. Finally, it has been proposed that the inflectional paradigm is psycholinguistically real and influences the processing of individual inflected words (see Clahsen, Sonnenstuhl, Hadler, & Eisenbeiss, 2001).

Morphological Decomposition

More recently, the focus has shifted to the role of decomposition in storage and access of inflected forms. The research is concerned with how different language-specific factors, including the properties of inflection, the degree of stem allomorphy, complexity of the paradigm, decomposability, and type and token frequency, contribute to whole-word storage and access, as opposed to (de)composition. Numerous studies have demonstrated that decomposition of visually presented inflected, and even pseudo-inflected, words (e.g., "trade" as a pseudo-regular past tense of "tray") is early and automatic (see Marslen-Wilson, 2007, for a review). The same is true for derivational morphology for English (Marslen-Wilson, Bozic, & Randall, 2008) and other languages, such as Russian (Kazanina, Dukova-Zheleva, Geber, Kharlamov, & Tonciulescu, 2008).

Although the extreme opposite proposals, which include obligatory decomposition of all the inflected forms, whole-word storage and retrieval, as well as “intermediate” proposals combining decomposition and full listing, have coexisted for several decades (see Soveri, Lehtonen, & Laine, 2007, for a review), there is new evidence in favor of automatic decomposition of inflected forms. This evidence has been connected with the discovery of two different pathways in the brain: the dorsal pathway, linked to phonological decomposition, and the ventral pathway, linked to semantic processing (Hickock & Poeppel, 2004). It has been proposed that the dorsal path constitutes a decompositional
stream also responsible for morphological inflection (Marslen-Wilson & Tyler, 2007). Because these two pathways can function in parallel and relatively independently of each other, or, alternatively, only one of the two can be activated, depending on a set of conditions, they seem to provide a neural substrate for the dual-route approach (Baayen et al., 1997). Independent evidence of automatic morphological decomposition obtained in experiments using decomposable nonce words with easily detachable inflections is linked to the dorsal pathway (Marslen-Wilson & Tyler, 2007). If, indeed, inflected words can be stored and accessed both whole and decomposed, then there is no conflict between the data on automatic decomposition of inflected words (Marslen-Wilson & Tyler, 2007) and whole-word frequency effects, which, for English, were shown to appear above the six per million threshold (Alegre & Gordon, 1999). This reasonably low threshold implies that many regularly inflected words are stored undecomposed, a fact problematic for the dual-system approach, which makes provisions only for very high-frequency regularly inflected words to be stored. The vast majority of inflected words is claimed to be generated online by symbolic rule computation using stems and inflections that are stored separately.

L2 Acquisition and Processing of Inflectional Morphology

Inflectional morphology in L2 as evidenced in morphosyntax has attracted researchers’ attention since the so-called morpheme order studies (Bailey, Madden, & Krashen, 1974; Dulay & Burt, 1978; Larsen-Freeman, 1975, 1978) focused on the use of morphological markers in sentences produced by L2 learners with different L1 backgrounds. The clusters of free and bound morphemes that were shown to be acquired in a certain “natural” accuracy order, with small deviations, were obtained first in oral sentence production using picture elicitation (the Bilingual Syntax Measure). A somewhat modified sequence was observed in writing, most likely due to the fact that it was not performed in real time and allowed L2 learners to use metalinguistic knowledge to improve accuracy on some (those, like English plural, governed by simple rules), but not all, of the targeted morphemes (Larsen-Freeman, 1975). The inferences about acquisition orders were based on accuracy scores—in that case, suppliance in obligatory contexts. Several factors were invoked as responsible for a particular accuracy order, including input frequency, morpheme salience, and transparency of form-function mappings (Larsen-Freeman, 1978). A meta-analysis of the available studies performed much later identified a composite salience factor underlying the observed order (Goldschneider & DeKeyser, 2001).
Most of the questions raised in the late 1970s, when morpheme order studies were a prominent part of the SLA agenda, still have not received a full explanation. At the same time, important contributions have been made both to theory and experimental research on L2 processing of inflectional morphology. Morpheme order studies focused on a phenomenon that was uncontroversial and easy to observe, because it is omnipresent—namely, errors and omissions of morphological markers in L2 production in sentences (and beyond). The mechanisms underlying this morphosyntactic deficit pertain to at least two levels: (a) the realization that a marker is needed, given a certain sentence structure (such as gender agreement, number, and tense marking); and (b) generation of the inflected word form containing the appropriate marker. Only the latter level is involved in the generation of isolated word forms. Similarly, in comprehension, the interpretation of the inflected word within a sentence context and in isolation are based on different procedures. Thus, omission of morphological markers in L2 sentence production or insensitivity to them in sentence interpretation are potentially driven by two sets of difficulties. Studies focusing on how inflected words are stored and (de)composed are dealing with the second set.

Differences Between L1 and L2 Morphological Processing

Several positions support a difference between L1 and late L2 mechanisms that goes beyond the processing constraints. The latter include low working memory capacity, poor decoding, and inadequate processing speed in the L2 compared to the L1 (McDonald, 2006). Although there is agreement that all of these factors contribute to the processing difficulties experienced by L2 learners, three hypotheses about the nature of L2 morphological processing maintain that the processing constraints, alone, are insufficient to explain all of the observed differences in L1 and L2 treatment of inflectional morphology (see Clahsen et al., this issue; also Clahsen & Felser, 2006; Jiang, 2004, 2007; Ullman, 2001, 2006). All three hypotheses converge on the claim that L1 and L2 processing of inflected words are based on different mechanisms.

Clahsen and Felser (2006) put forward the shallow-structure hypothesis, according to which, in sentence processing, L2 learners rely less on syntactic cues and more on lexical and semantic information. They have extended this hypothesis to the processing of morphosyntax and also inflectional and derivational morphology out of context, not embedded in a sentence (Clahsen et al., this issue; also Neubauer & Clahsen, 2009; Silva & Clahsen, 2008). With respect to inflectional morphology, they claimed that L2 learners are less sensitive to morphological structure than L1 speakers and rely more on storage than morphological decomposition. The first indication came from an
event-related potential (ERP) study of German nonce participle generation by L1 speakers of Russian that revealed that L2 learners relied on decomposition less than native speakers (Hahne, Mueller, & Clahsen, 2006). Based largely on the results of masked priming experiments with L2 learners of English (L1 Chinese and German) and L2 learners of German (L1 Polish), Clahsen and Felser (2006) maintained that L2 learners do not take advantage of decomposition. No facilitation occurred for English regular past tense primes or German regularly inflected participle primes, but there was a facilitation for irregular participle primes. There are possible alternative explanations for the results of these masked priming experiments. It is possible that because masked priming is primarily form (orthographic) priming even in L1, due to very short exposure and the presence of the mask, and given that L2 learners are generally slow, they do not have time to fully decompose an inflected prime presented for 60 ms. Thus, L2 learners of English (L1 speakers of Chinese and German) showed facilitation in the identity condition (boil-BOIL) but not in the test condition (boiled-BOIL) (Silva & Clahsen, 2008, and Clahsen, Felsen, Neubauer, Sato, & Silva, this issue).

Second language learners of German (L1 speakers of Polish) showed partial facilitation for (irregular) -n participles as L1 speakers did, but unlike L1 speakers, did not take advantage of regularly inflected easily decomposable -t participle primes (Neubauer & Clahsen, 2009; Clahsen et al., this issue). It is not easy to see why L2 learners did not decompose the regularly inflected -t participles, but decomposed the -n participles and the first-person target forms that have the -e inflection. Another finding in need of explanation is the fact that the first-person verb targets preceded by regular participles took longer to be identified as words than the first-person targets preceded by irregular participles in all of the conditions, with the same tendency for L1 and L2 participants (Neubauer & Clahsen, 2009, p. 422). According to Portin and collaborators (Portin, Lehtonen, Harrer, et al., 2007; Portin, Lehtonen, & Laine, 2007; see also Gor & Cook, this issue, for discussion), longer reaction times (RTs) to inflected words compared to monomorphemic words within a group of L1 or L2 speakers should be interpreted as the processing costs associated with decomposition. However, this does not explain the results obtained by Neubauer and Clahsen (2009) because all of the inflected targets were decomposable. Additionally, the two studies by Portin and collaborators (Portin, Lehtonen, Harrer, et al., 2007; Portin, Lehtonen, & Laine, 2007) indicated that late L2 learners only store full-form representations of very high-frequency inflected words and use decomposition to process all other inflected words. Gradually, with more input and an increase in proficiency, they develop whole-word representations for
other inflected words. Essentially, the developmental trend in late L2 learners, according to Portin and collaborators, is opposite to what is suggested by the shallow-structure hypothesis (Clahsen & Felser, 2006).

The declarative/procedural model of late L2 processing of inflectional morphology is similar to the shallow-structure hypothesis, in that it expects late L2 learners to rely more on the declarative memory circuit and to store full-form representations of inflected words, because in late L2 learners, the procedural memory circuit is less efficient than in early learners (Ullman, 2001, see also Bowden et al., this issue; Morgan-Short, Sanz, Steinhauer, & Ullman, this issue; Gor & Cook, this issue, for discussion). The results reported by Portin and collaborators (Portin, Lehtonen, Harrer, et al., 2007; Portin, Lehtonen, & Laine, 2007) are thus not in agreement with the declarative/procedural model.

The shallow-structure hypothesis addressing both morphological and morphosyntactic phenomena and the declarative/procedural model addressing regular/irregular inflection in single words make similar predictions about the role of storage and decomposition in L2 learners. More data on L2 morphosyntactic processing in online experiments come from two studies dealing with morphological insensitivity of Chinese L1 speakers to the English plural {-s} marker (Jiang, 2004, 2007). In a self-paced reading task, Chinese L2 learners of English did not show sensitivity to the omission of the plural {-s} marker, although they showed sensitivity to violations in verb categorization. Based on these findings, Jiang (2007) proposed the idea of selective integration of linguistic knowledge and discussed the possible factors that contribute to integration of knowledge, with L1 transfer, perceptual salience (Goldschneider & DeKeyser, 2001), and input frequency not being responsible for the observed differences. It is possible that Chinese L1 speakers are insensitive to the omission of the plural {-s} marker because it is redundant from the point of view of sentence structure and is “invisible” not only because of its formal properties but rather because of its “limited” function. Such invisibility overrides any salience considerations and interacts with L1 transfer to produce a strong and persistent tendency in Chinese learners of English. Gender agreement, which presents difficulties for L2 learners who already have control of gender assignment, can also be considered a redundant category (see the studies by Kempe, Brooks, & Kharkhurin, this issue; Morgan-Short et al., this issue, devoted to L2 acquisition of gender marking and gender agreement). Overall, the observed pattern of ignoring morphosyntactic cues, especially when they are not functionally loaded, is in conformity with the shallow-structure hypothesis (Clahsen & Felser, 2006).

This introduction has reviewed some data that can be considered as evidence demonstrating that the morphological level is present in both L1 and
L2 processing of inflected words. In this sense, it is psycholinguistically real and cannot be reduced to the interaction of form (phonology or orthography) and meaning. Nonetheless, it is clear that L2 learners experience difficulties with processing inflectional morphology, are slow at decomposition in comprehension, and lack automatization of inflectional rules, which lead to errors in production. In single-word processing, these difficulties are purely decompositional, but at the phrase or sentence level, they involve morphosyntactic factors.

The shallow-structure hypothesis, in its general formulation, handles the observed L2 deficit, especially with regard to morphosyntax. At the same time, the precise claims of the shallow-structure hypothesis and the declarative/procedural model—namely, that late L2 learners rely on whole-word storage instead of decomposition—have been challenged by some studies. L2 learners of Swedish (L1 speakers of Finnish and Hungarian) developed whole-word representations, as reflected in decomposition costs in a visual lexical decision task, for high-frequency inflected words but not necessarily for lower frequency inflected words (Portin, Lehtonen, Harrer, et al., 2007; Portin, Lehtonen, & Laine, 2007). This implies that decomposition preceded whole-word storage in those late L2 learners. However, the finding that Chinese L1 speakers used whole-word representations in all of the frequency ranges highlights the importance of L1 background. The fact that early Swedish-Finnish bilinguals processed almost all inflected Finnish words by decomposition emphasizes the role of morphological structure in L2. Taken together, these findings indicate that both L1 and L2 play a role in the use of whole-word storage and decomposition.

The research on decomposition of Finnish and Swedish inflected words by late L2 learners documents a developmental tendency in the direction opposite the one predicted by the shallow-structure hypothesis and the declarative/procedural model: storage of full-form representations for the word forms highly frequent in the input before others. Is there indeed a conflict between the two sets of claims? Is it possible to see a point of convergence between them? First, the predictions of the shallow-structure hypothesis and the declarative/procedural model are correct for beginning L2 learners, who process L2 speech as unanalyzed chunks and rely heavily on stored representations. Yet, this processing mode is developmentally limited to the initial stages of L2 acquisition, corresponding to the novice level of proficiency on the ACTFL scale. Late L2 learners with intermediate-level proficiency have small mental lexicons and store only very high-frequency words, inflected or not. They do not have full-form representations for less frequent inflected words and, therefore, cannot revert to direct access of the stored forms instead of decomposition.
However, they have trouble with online decomposition of inflected words, due to slowness, and also fuzziness and lack of automatization of the inflectional rules.

Rather than stating that L2 learners rely on declarative memory and stored representations, it would be more accurate to suggest that L2 learners neither decompose nor store inflected words unless they are the most frequent ones. If the inflected word is highly frequent, it may, indeed, be stored and processed as a whole. For low-frequency words, stored inflected forms are unavailable to L2 learners before they reach high proficiency levels. Until then, L2 learners are likely to use the semantic mode of processing (possibly associated with the ventral stream in the brain) or decomposition that is slow and, overall, inefficient in real-time processing. In morphosyntactic processing, variable rules (often, with several interlanguage rules in competition), the tendency to ignore cognitively redundant information (e.g., in plural marking or gender agreement), and a general cognitive overload lead to shallow-structure processing and reliance on lexical meanings. Similarly, in word generation, L2 learners are slower and less accurate than L1 speakers when dealing with inflection, with errors involving not only the use of inappropriately marked word forms in a sentence but also word forms with morphological rules not properly applied and incorrect allomorphy. These inflected words with incorrect morphophonological rules, widely attested in the speech of L2 learners, must have been generated online rather than stored and retrieved.

The Present Issue: Factors in L2 Processing of Inflection

This special issue of *Language Learning* contains research articles that tackle the issue of L2 inflection from different theoretical perspectives and use different methodology. The six articles represent different theoretical approaches, including the dual-system approach (Clahsen et al.), the single-system approach (Murphy & Hayes), the declarative/procedural model, which is an extension of the dual-system approach (Bowden et al.; Kempe et al.; Morgan-Short et al.), and an approach postulating an interaction of rule-based and input-driven mechanisms (the rules and probabilities model; Gor & Cook). The selection of articles included in the thematic issue overcomes the constraints imposed by English past tense inflection, as several contributions are devoted to L2 acquisition and processing of languages with rich inflectional morphology: Spanish verb conjugation (Bowden et al.), Russian verb conjugation (Gor & Cook), and Russian gender agreement (Kempe et al.) by L1 learners of English. The experiment by Morgan-Short and collaborators used an artificial mini-language learned under highly controlled explicit and implicit training conditions. The
reported studies apply a variety of experimental designs and report online and offline behavioral and neurocognitive (event-related potentials, ERPs) data. Two studies dealing with verbal morphology use verb generation (Bowden et al.; Gor & Cook), and three studies use a lexical decision task, two with priming (Clahsen et al.; Gor & Cook) and one without (Murphy & Hayes). Other studies use ERPs (Morgan-Short et al.) as well as behavioral data, such as a speeded grammaticality judgment test (Clahsen et al.) and gender categorization tests (Kempe et al.).

These six articles are reviewed in two commentaries by prominent scholars representing two ends of the spectrum. Diane Larsen-Freeman has made contributions to research on L2 acquisition of grammatical morphology since its very beginnings at the time of the morpheme order studies. The team of Ruth De Diego Balaguer and Antoni Rodriguez-Fornells looks at the same set of articles from the perspective of neurolinguistics, going beyond the analysis of behavioral data into the underlying neurocognitive mechanisms and their localization in the brain.

To revisit the question in the title of this introduction, L2 learners do process inflectional morphology, but they are constrained by several linguistic and extralinguistic factors. Among those factors are the following:

- Morphological richness in L2, complexity and predictability of allomorphy (decomposability of inflected words), and of the inflectional paradigms;
- Properties of inflectional morphology in L1 (and the mere existence thereof); possibilities of L1 transfer;
- L2 proficiency level;
- Amount and properties of the input: early or late, explicit or implicit, auditory or visual, and so forth;
- Amount of exposure to L2 and practice;¹²
- Age of exposure: early or late L2 acquisitional profiles;
- Individual differences, primarily verbal working memory capacity.

The present issue sheds new light on some of these factors and the mechanisms underlying morphological processing in L2. Together with the two thoughtful commentaries, the articles in the issue provoke new sets of questions and outline a trajectory for future research. This research will continue to transcend the boundaries of inflectional morphology and provide answers to such fundamental questions as whether people operate with abstract symbolic rules in linguistic processing.

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Notes

1. The priming technique uses the lexical decision task format when the participant needs to decide whether the presented stimulus (the target) is a word or nonword. In priming experiments, the target is preceded by another word, a prime, to test whether properties of the prime can affect the reaction time to the target. The prime and the target can be presented visually or auditorily, and the prime is sometimes presented visually for a very short time, masked by a preceding or following string of symbols.

2. According to Smolka and collaborators (2007), similar difficulties with matching German regular and irregular past participles could have skewed the results in a lexical decision task with priming (Sonnenstuhl, Eisenbeiss, & Clahsen, 1999).

3. Different patterns of stem-past mappings in English irregular verbs were defined as source-oriented and product-oriented schemas (Bybee, 1995) and, alternatively, as minor abstract symbolic rules (Yang, 2002).

4. For English past tense verbs, factors beyond surface frequency and phonological similarity have been identified—for example, the type of irregular formation, such as the nesting stem (drawn-DRAW), as opposed to stem vowel change (ran-RUN), and semantic richness (Basnight-Brown et al., 2007).

5. Bybee (1995) defined default as the most open schema that is applied “when all else fails.”

6. The idea of the double nature of schemas was confirmed by Ronald Langacker (personal communication, Bordeaux, May 2005). Langacker, founder of cognitive grammar, has warned against the exclusionary fallacy of supporting either computation or storage (Langacker, 1987).

7. See also Neubauer and Clahsen (2009, p. 417) on difficulties in interpreting frequency effects as proof of storage or decomposition.

8. The most conclusive evidence emerging from neurocognitive studies of morphological processing is reviewed by Marslen-Wilson (2007) and in the commentary to the present issue by De Diego Balaguer and Rodriguez-Fornells. Accordingly, this introduction will mention neurocognitive data only in passing.

9. Participants in masked priming experiments typically do not consciously notice the masked prime and do not report seeing it.

10. The terms “regular” and “irregular” are used in reference to German participles not in a terminological sense but as shortcuts. For an in-depth analysis of their status, see the original articles.

11. It is not known which comparisons are statistically significant, but at least some of them are likely to reach the significance level.

12. See Gor and Long (2009) for data on the role of explicit instruction versus native input in L2 acquisition of Russian verbal morphology.
References

Alegre, M., & Gordon, P. (1999). Frequency effects and the representational status of 

Baayen, H., Dijkstra, T., & Schreuder, R. (1997). Singulars and plurals in Dutch: 
Evidence for a dual parallel route model. *Journal of Memory and Language, 37*, 
94–119.


Monolingual and bilingual recognition of regular and irregular English verbs: 
Sensitivity to form similarity varies with first language experience. *Journal of 
Memory and Language, 57*(1), 65–80.

Beck, M.-L. (1997). Regular verbs, past tense and frequency: Tracking down a 


Processes, 10*, 425–455.

Clahsen, H. (1999). Lexical entries and rules of language: A multidisciplinary study of 


paradigms in language processing and language disorders. *Transactions of the 


Dabrowska, E. (2008). The effects of frequency and neighborhood density of adult 
speakers’ productivity with Polish case inflections: An empirical test of usage-based 
approaches to morphology. *Journal of Memory and Language, 58*(4), 931– 
951.

De Diego Balaguer, R., Sebastián-Gallés, N., Diaz, B., & Rodriguez-Fornells, A. 
(2005). Morphological processing in early bilinguals: An ERP study of regular and 

acquisition. In E. M. Hatch (Ed.), *Second language acquisition: A book of readings* 

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


Gor, K. (2004). The rules and probabilities model of native and second language morphological processing. In L. Verbittskaya & T. Chernigovskaya (Eds.), *Theoretical problems of linguistics. Papers dedicated to 140 Anniversary of the Department of General Linguistics, St. Petersburg State University* (pp. 51–75). St. Petersburg, Russia: Philological Faculty of St. Petersburg State University Press.


