Goad, H. & L. White (2024) The syntax-phonology interface. In T. Ionin, S. Montrul & R. Slabakova (eds) *The Routledge handbook of second language acquisition, morphosyntax, and semantics*. London: Routledge, pp. 531-54.

Chapter 37
The Syntax-Phonology Interface

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Abstract

This chapter addresses the syntax-phonology interface and its effects on second language (L2) acquisition, highlighting the importance of taking phonology into account when considering learners' non-target behavior. The syntax-phonology interface is shown to have implications for the acquisition of functional morphology and for aspects of clause-level syntax. In the functional domain, it is suggested that failure to acquire and/or use the L2 grammar in a native-like manner often reflects difficulties arising at this interface, rather than being attributable to phonology or syntax alone. Differences in how inflection and function words are prosodified in the native language and the L2 are shown to impact the realization of functional morphology. Studies of prosodic effects on production of inflection (tense, agreement, plural) and function words (articles) are reviewed. Clause-level syntax is also considered (relative clause ambiguity resolution, pronoun interpretation), with a focus on how prosodic factors such as stress, pause and constituent length can influence interpretation. The need for experiments to include aural presentation of stimuli as well as phonologically-controlled stimuli is emphasized, in order to attribute non-target behavior to the appropriate components of the grammar or to the interface between them.

Keywords: Prosodic structure, inflection, function words, relative clauses, pronoun interpretation

The Syntax-Phonology Interface

1. Introduction

In generative linguistic theory, the grammatical domain is considered to be modular: it consists of autonomous components, including the lexicon, syntactic component, semantic component, and phonological component (Chomsky & Lasnik, 1977). The grammar is structured such that the syntactic component generates expressions that are interpreted by the grammar-internal components of phonology (PF) and semantics (LF) (Chomsky, 1995), as well as by grammar-external domains such as discourse. A mapping between different components or domains implies an interface, or point of interaction, between them.

In second language (L2) research, there has been considerable interest in interfaces and the acquisition challenges attributable to them. For example, problems integrating material at the syntax-lexicon interface (e.g., Lardiere, 2000; Prévost & White, 2000), the syntax-semantics interface (e.g., Ionin et al., 2004), and the morphology-semantics interface (e.g., Slabakova, 2019) have been argued to underlie the seemingly intractable difficulties that L2ers have with functional morphology. Problems at the syntax-discourse interface have been argued to underlie difficulties that L2ers have with pronoun interpretation (e.g., Belletti et al., 2007; Sorace & Filiaci, 2006).

In this paper, we consider the syntax-phonology interface in L2. This interface has been less well studied, despite the significant body of research that has been devoted to it in native speaker grammars (see section 3.1). We will suggest that failure to acquire and/or use the L2 grammar in a native-like manner often reflects difficulties arising at this interface, resulting in phonological effects on both morphosyntax and clause-level syntax. Our goal is to highlight the importance of taking phonology into account when considering sources of explanation for non-target-like behavior in L2 (morpho)syntax.

2. Description of the Linguistic Phenomenon

When learners are faced with a morphosyntactic element that is not overtly expressed in their first language (L1), they must make adjustments to one or more components of the grammar (functional syntax, phonology) as well as to the interface between these components, notably, how the morphosyntactic element is prosodically represented. Taking tense as an example, as far as the core syntactic component is concerned, when L2ers from a language like Mandarin without overt tense marking are exposed to a language like English, they must determine that English requires the feature [past] to be overtly expressed, unlike in the L1 grammar. As for the core phonological component, to appropriately produce past tense morphology in English, Mandarin speakers must adjust their L1 grammar to accommodate coronal stops ([t/d]) and consonant clusters in word-final position.

Turning to the interface between these components, Mandarin speakers must discover that strings at the right edge of monomorphemic words are subject to different constraints from inflected words in English. For example, while monomorphemic [bænd] ‘band’ and inflected [bænd] ‘banned’ are superficially alike, the segment expressing past tense does not require place agreement with a preceding nasal, unlike in monomorphemic words; thus, [bæŋd] ‘banged’ is well-formed as an inflected form, but monomorphemic words ending in [ŋd] are illicit. Such differences indicate that English inflection is prosodically organized differently from the final

segments in monomorphemic words. In Mandarin, inflection (aspect only) is not represented in the same manner as it is in English. This can lead Mandarin speakers to omit tense marking in English, even if L1 constraints on core components of the grammar (e.g., functional structure, syllable structure) have been overcome.

In the case of clause-level syntax, one challenge is ambiguity resolution, as covert structural differences generated by the syntax must be identified. Relative clause (RC) constructions provide a case in point. In the English sentence: *Someone shot the servant of the actress who was on the balcony*, the RC (*who was on the balcony*) can modify either the first noun (NP1: *servant*), referred to as high attachment (HA), or the second noun (NP2: *actress*), known as low attachment (LA).

Languages differ in their preferred interpretation (Fodor, 2002; Jun, 2003), as well as in the strength of this preference; English, for example, has a weak preference for LA, while Spanish has a stronger preference for HA (e.g., Bergmann et al., 2008; Cuetos & Mitchell, 1988). Languages also differ in their default prosody, which correlates with their preference for LA or HA (Jun, 2003). Finally, phrasing can be impacted by rhythmic factors (Fodor, 1998; Gee & Grosjean, 1983) and speech rate (Jun, 2003). The challenge for L2 learners is to detect and appropriately interpret the prosodic cues to constituency in spoken language, given the contexts in which potentially ambiguous sentences are uttered.

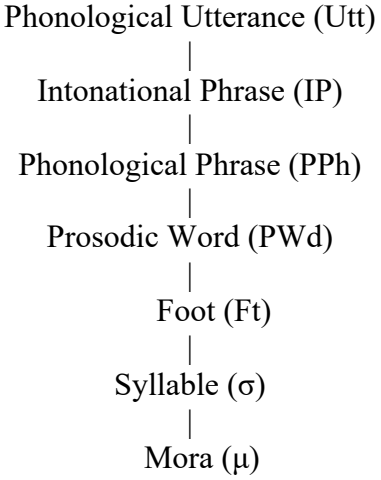
In sum, the linguistic phenomena described above illustrate how the syntax-phonology interface has implications for different aspects of the grammar and, as we detail below, for acquisition.

3. Theory and Background

3.1. Theoretical Analyses

A body of work at the syntax-phonology interface in native speaker grammars has observed that phonological activity is sensitive to prosodic domains that are mapped from – though not necessarily isomorphic with – syntactic domains (Chomsky & Halle, 1968). This observation forms the core of Prosodic Phonology (Hayes, 1989; McCarthy & Prince, 1995; Nespor & Vogel, 1986; Selkirk, 1978, 1986), which posits that sentences, which typically form Phonological Utterances (Utt), are organized into prosodic domains like those in (1).

(1)



Prosodic Phonology will be central to our discussion of the syntax-phonology interface in L2 (section 3.2), in part because there are robust differences in phonological profile depending on the functional versus lexical status of morphemes and words (Nespor & Vogel, 1986; Peperkamp, 1997; Selkirk, 1996). To illustrate, in most languages, a lexical word must meet a minimal size requirement to be a well-formed prosodic word (PWd) (McCarthy & Prince, 1995). English respects this constraint: lexical words cannot be smaller than a bimoraic foot: $(\mu\mu)_{Ft}$, as shown in (2a). Articles, however, do not satisfy this constraint, suggesting that they do not form PWds. Rather, they are clitics, organized directly by the Phonological Phrase (PPh) that contains their lexical host, shown in (2b) (Selkirk, 1996). Consistent with this representation, articles are not stressed.

(2) a. $[(\text{pí}_{\mu}\text{t}_{\mu})_{Ft}]_{PWd}$
‘pit’

$[(\text{pí}_{\mu}\text{ti}_{\mu})_{Ft}]_{PWd}$
‘pity’

*$[(\text{pí}_{\mu})_{Ft}]_{PWd}$

b. $[\text{ə}_{\mu}\ [(\text{pí}_{\mu}\text{ti}_{\mu})_{Ft}]_{PWd}]_{PPh}$
‘a pity’

Functional elements are prosodified in different ways, reflected, in part, in their phonological behavior (Selkirk, 1996). Further, the same morphosyntactic element can be prosodified in different ways across languages (e.g., Zec, 2005). For example, articles are often phonological clitics but they differ in how closely bound they are to their hosts. In English, articles are *free clitics*; they link directly to PPh (Selkirk, 1996), as shown in (3a). As a result, an adjective can appear between the clitic and noun. In Turkish, indefinite *bir*, which has been analyzed by some researchers as an article (e.g., Kornfilt, 1997), is an *affixal clitic*: it is adjoined to the PWd of the nominal host (Goad & White, 2009), as shown in (3b). Consequently, the clitic-noun sequence cannot be interrupted by an adjective.

Turning briefly to inflection, in English, inflectional morphology is organized as an affixal clitic, but in Mandarin, it appears inside the PWd of its host, as an *internal clitic* (Goad & White, 2006; Goad et al., 2003); see (4a-b).

(3) Articles:

a. English: Free clitic:
$[\text{ə}\ [\text{gʊd}]_{PWd}\ [\text{bʊk}]_{PWd}]_{PPh}$
a good book
‘a good book’

b. Turkish: Affixal clitic:
$[[\text{iyi}]_{PWd}\ [\text{bir}\ [\text{kitap}]_{PWd}]_{PWd}]_{PPh}$
good a book
‘a good book’

(4) Inflection:

a. English: Affixal clitic:
$[[\text{bæŋ}]_{PWd}\ \text{d}]_{PWd}$
bang PAST
‘banged’

b. Mandarin: Internal clitic:
$[\text{bɑŋ}_{1}\ \text{lə}_{0}]_{PWd}$
help PERF
‘helped’

Concerning the interface between clause-level syntax and phonology, syntactic ambiguity is resolved at PF, via prosodic cues to phrasing. Consider the syntactic representations for the RC constructions discussed earlier: the RC is either attached low, embedded within the complex NP, as in (5a); or it is attached high, as a sister to the NP that contains both nouns, (6a). The relevant prosodic domain for resolving the ambiguity is the Intonational Phrase (IP), the right edge of which is marked by a boundary tone, final lengthening, and often a pause (Jun, 2003). Jun (2003) shows that when an IP boundary follows NP1, as in (5b.i), or when the sentence is produced with default prosody (no boundary after NP1 or NP2), as in (5b.ii), the sentence is judged by English speakers to involve LA.[1] In contrast, when an IP boundary follows NP2, as in (6b), the sentence is judged to involve HA.

(5) Low attachment:
   a. Syntactic phrasing:
      Someone shot [$_{NP}$ the servant$_i$ of the actress$_j$ [$_{RC}$ who$_j$ was on the balcony]]
   b. Phonological phrasing:
      i. [Someone shot the servant$_i$]$_{IP}$ [of the actress$_j$ who$_j$ was on the balcony]$_{IP}$
      ii. [… the servant$_i$ of the actress$_j$ who$_j$ …]$_{IP}$

(6) High attachment:
   a. Syntactic phrasing:
      Someone shot [$_{NP}$ the servant$_i$ of the actress$_j$] [$_{RC}$ who$_i$ was on the balcony]
   b. Phonological phrasing:
      [Someone shot the servant$_i$ of the actress$_j$]$_{IP}$ [who$_i$ was on the balcony]$_{IP}$

In sum, prosodic domains allow for principled expression of morphosyntactic differences between lexical words and function words, as well as between different kinds of functional morphemes. They also allow for expression of syntactic differences between the interpretations of ambiguous sentences. As we shall see, these differences can be critical in accounting for the behavior of L2 learners.

3.2. Relevant SLA Theories

In SLA research, difficulties with many of the constructions we examine from the syntax-phonology interface have been explored from the perspective of other interfaces. In the case of the syntax-lexicon interface, apparent problems with L2 morphology have been attributed to lexical retrieval or mapping problems of various kinds (e.g., Lardiere, 2000; Prévost & White, 2000). In the case of the syntax-discourse interface, issues relating to interpretation have been shown to arise even in near-native speakers (e.g., Belletti et al., 2007; Sorace & Filiaci, 2006). In both cases, it has been argued that properties pertaining to interfaces are subject to more persistent difficulties or are harder to acquire than properties relating to non-interface domains, such as core syntax.

This same conclusion was arrived at for the syntax-phonology interface, beginning with research in variationist sociolinguistics (Bayley, 1996; Wolfram & Hatfield, 1984). This work focuses on the intersection of *t/d* deletion and past tense inflection in English. Native speakers variably delete *t/d* from the right edge of words, but deletion is disfavored when *t/d* marks tense.

Surprisingly, both Vietnamese- (Wolfram & Hatfield, 1984) and Mandarin-speaking (Bayley, 1996) learners of English show the opposite pattern: higher *t/d* deletion rates in past tense contexts than in monomorphemic words. These researchers propose that the challenge for learners lies in their need to acquire an obligatory morphosyntactic rule for past tense marking along with a variable phonological rule for *t/d* deletion, with the latter including conditions that curb its application in inflectionally complex words.

Although Wolfram and Hatfield (1984) and Bayley (1996) propose that integrating material at the syntax-phonology interface is the source of the acquisition problem under study, their account is confined to explaining L2ers' behavior when syntax and phonology collide: inflection that is marked with *t/d* involves the same segments implicated in *t/d* deletion.

The Prosodic Transfer Hypothesis (PTH) (Goad & White, 2004; Goad et al., 2003; see Goad & White, 2019, for a review) is broader in scope. The PTH proposes that integrating material at the syntax-phonology interface is a source of acquisition problems, particularly relating to inflection, rather than such problems being attributable to the syntax alone (e.g., claims for the absence of tense; Hawkins & Liszka, 2003) or to the phonology alone (e.g., stemming from the absence of clusters or phonotactic complexity at the right edge of words; Lardiere, 2003; Young, 1991) (see section 6.1).

At the core of the PTH is the theory of Prosodic Phonology (section 3.1): transfer of L1 prosodic representations impacts the realization of functional morphology in the interlanguage grammar. L2 prosodic representations which are disallowed in the L1 are particularly challenging to acquire. As a result, even when L2 morphosyntax can be demonstrated to have been acquired and correctly represented, the transfer of L1 prosodic constraints may make it difficult for learners to produce functional morphology in a target-like manner. In other words, the interface between syntax (appropriate for L2) and prosody (constrained by L1) leads to non-target production (omission, variable suppliance of inflection tied to phonological context, infelicitous stressing of function words, etc.; see section 6), such that it looks as if learners have not acquired the L2-appropriate morphosyntax when, in fact, they have.

4. Methodological Approaches

We briefly address three issues relating to methodology that arise when investigating the syntax-phonology interface. The first concerns the need for aurally-presented stimuli. In section 3.1, we mentioned that prosodic cues to phrasing can resolve syntactic ambiguity. Most studies in sentence interpretation, however, employ written stimuli. Although Fodor (2002) proposes that readers impose a default prosody when responding to written stimuli, we cannot actually tell what prosody readers assume (default or otherwise) and, in the case of L2ers, we also do not know whether their default prosody reflects the L1 or the L2. For this reason, it is essential to use aural stimuli where the researcher can control the prosody and thus, ideally, the expected interpretation.

The second issue concerns the fact that, at the syntax-phonology interface, it is not just the phonology that needs to be assessed but also the syntax. If one relies on oral production data alone, omission of inflection may be seen, potentially misleadingly, as a reflection of defective syntax (see, e.g., Lardiere, 2000, and Prévost & White, 2000, for discussion). Thus, it will often be appropriate to rely on a combined task or multiple tasks.

For example, Goad and White (2006) investigate past tense inflection in Mandarin-speaking learners of English. As mentioned, tense is not morphologically expressed in Mandarin.

Regular English tense and participles (e.g., *cleaned, have cleaned*) share the same prosodic representation ([[kliːn]$_{PWd}$ d]$_{PWd}$), so both should be impacted if prosodic transfer is implicated. In contrast, Hawkins and Liszka's (2003) proposal for defective tense predicts problems only with tense. Goad and White's experiment included a sentence completion task, where a written lead-in provided a context for completion and participants had to choose which completion was appropriate. This provided a baseline for their morphosyntactic knowledge. Participants then memorized what they had chosen and were subsequently required to produce it without orthographic input, allowing for an analysis of the prosodic factors influencing their productions. A similar two-pronged task designed to assess syntactic and phonological knowledge of tense was employed by Cabrelli Amaro et al. (2018) for Mandarin, Spanish, and Japanese learners of English.

The final issue relating to methodology concerns the phonological shape of stimuli (e.g., length and segmental profile of word-final rhymes). Whether one is dealing with comprehension or production, stimuli need to be carefully controlled, depending on the precise phenomena to be investigated and the hypotheses as to how syntax, phonology, and prosodic structure intersect. Spontaneous production data are usually insufficient, since the relevant properties cannot be controlled for. Instead, elicited production may be required.

Consider, for example, Austin et al. (2022) who examine prosodic transfer effects in Korean speakers' productions of English agreement morphology. Korean does not mark agreement and Austin et al. show that the affixal clitic representation required for English is not employed elsewhere in the language. Tense, on the other hand, is overtly realized as an internal clitic: [mʌk-ʌss]$_{PWd}$ 'eat'-PAST. If the PWd-internal representation for tense is transferred into the interlanguage grammar, learners should variably inflect stems, depending on their shape (see section 6.1). Accordingly, the verbs employed by Austin et al. control for rhyme length, namely short stems (VC-final; e.g., [tæp] 'tap') versus long stems (VCC-final; e.g., [slʌmp] 'slump'). Monomorphemic items that are segmentally parallel in shape to short-stemmed inflected forms (e.g., [læps] 'lapse'; cf. [tæps] 'taps') were also included, since the former are, by definition, single PWds. Austin et al. report asymmetries in suppliance of agreement on short and long stems (in favor of short stems), supporting redeployment of the L1 representation for tense to represent agreement in the L2. Further, final [s/z] was produced more robustly in monomorphemic parallels, which suggests that the locus of the problem is prosodic transfer (syntax-phonology interface, affecting only inflected forms), rather than phonotactic transfer (core phonology, affecting uninflected and inflected forms alike).

5. Studies from Other Learner Contexts

The relationship between phonology and syntax has long been discussed in L1 acquisition research, with variable production of functional morphology tied to prosodic context (see Demuth, 2014, for a review). While the literature does not explicitly probe children's prosodic representations of inflection, some findings suggest that prosodic differences between inflected forms and monomorphemic parallels may be implicated in the patterns displayed. For example, Song et al. (2013) observe that two-year-old English acquirers produce final clusters differently in plurals and monomorphemic parallels (*rocks* vs. *box*), leading the authors to propose that the main articulatory targets of the clusters in these words are distinct, inflectional /s/ in the former case and stem-final /k/ in the latter. In later work, Demuth (2014) suggests that this may indicate that children understand that inflection is not prosodified in the same manner as

right-edge consonants in monomorphemic words, building on Selkirk (1996) and Goad et al. (2003).

Prosodic representation may also be implicated in the results of Marshall and van der Lely (2006) on tense morphology in the productions of English-speaking children with SLI. Suppliance of *-ed* was much higher with inflected verbs ending in a phonotactically legal cluster (i.e., also found in monomorphemic words; e.g., [pækt] 'packed', cf. [fækt] 'fact') than with verbs ending in an illegal cluster (e.g., [hʌgd] 'hugged'). This may suggest that the children employ a PWd-internal representation for inflection, which is only possible when the inflected form could be a well-formed monomorphemic word (i.e., [pæk-t]$_{PWd}$, parallel to [fækt]$_{PWd}$).

As for function words, Gerken and McIntosh (1993) observe that two-year-old acquirers of English have some understanding of distributional constraints on articles, even when they fail to produce them spontaneously. Gerken (1996) attributes omission to prosodic factors, demonstrating that children's production of articles is higher when the article follows a monosyllabic verb (e.g., *kicks*) than when it follows a bisyllabic verb, with stress on the penult (e.g., *catches*). Gerken proposes that the article can be incorporated into a binary left-headed foot in the former case: (kícks the)$_{Ft}$ (píg)$_{Ft}$, but that it is stranded outside the foot in the latter case: (cátches)$_{Ft}$ the (píg)$_{Ft}$. Demuth and McCullough (2009) find the same pattern in spontaneous production data from four out of five English-learning children. The remaining child stressed articles, thereby allowing the article to form its own PWd, a pattern similar to one adopted by some L2ers (see section 6.2).

In sum, children face challenges with functional morphology that stem from prosodic limitations on their developing grammars. As we shall see below, the difficulties faced by L2ers are similar.

6. Critical Review of SLA Studies

We first consider studies that propose phonological accounts for difficulties that L2ers experience with the production of inflectional morphology and function words. We then consider prosodic effects on sentence interpretation in L2 acquisition and use.

6.1. Inflection

Problems with the production of L2 inflectional morphology are well documented (see Zobl & Liceras, 1994, for a summary). Target-like suppliance is variable, with omission reported to be the most commonly observed error. Omission can persist, even when other measures indicate that learners have attained a high level of proficiency in the L2, including target-like syntax (e.g., Lardiere, 1998, 2000; White, 2003). For many inflectional morphemes in English (the most commonly examined L2), protracted omission is somewhat surprising, as the contexts calling for past tense and plural marking are frequent in the input, and agreement and plural morphology are both marked by a perceptually salient consonant ([s/z]). Moreover, classroom learners are explicitly taught contexts for the marking of inflection in English (e.g., Cabrelli Amaro et al., 2018). In the absence of faulty syntax, other explanations for omission must be sought.

We focus on studies that reveal phonological patterns in the contexts where functional morphology fails to be supplied, considering two sources of phonological effects. The first is the phonology proper: low suppliance of inflection stems from a problem at the level of syllable

structure, which thereby impacts production of both inflected and similarly-shaped non-inflected forms. In other words, the phonology impinges on morphosyntax without implicating an interface. The second is the syntax-phonology interface: low suppliance of inflection stems from the unavailability of the prosodic representation required for inflectional morphology in the L2.

Lardiere (2003) provides a phonological account of production data from Patty, a fluent L2 English speaker whose L1s are Mandarin and Hokkien. Patty's suppliance of tense and agreement morphology on lexical verbs is low (less than 6% for agreement and regular past). Lardiere proposes that omission of inflection is due to transfer of an L1 constraint against clusters, which Patty regularly fails to produce at the right edge of both monomorphemic words and inflected verbs.

An account along these lines was challenged by Hawkins and Liszka (2003), who observe that omission of past tense *t/d* is much higher than omission of *t/d* from clusters in monomorphemic words in Chinese-speaking learners of English (data from Bayley, 1996, and Liszka, 2002). Hawkins and Liszka argue that this supports a syntactic deficit over a phonological deficit: according to them, the uninterpretable feature [*u*past] is absent from the interlanguage grammar of Chinese learners of English.

Divergent results such as these may suggest that phonology is not the appropriate place to seek explanations for learners' problems with inflection. We contend, though, that the solution lies at the syntax-phonology interface. According to the PTH, the manner in which inflectional morphology is prosodically represented in the L1 grammar impacts the ability to produce certain forms in the L2. To exemplify, Goad et al. (2003) and Goad and White (2006) argue that Mandarin and English differ in the way that inflection is prosodically organized: in Mandarin, it is represented as an internal clitic, whereas in English, it is an affixal clitic, shown earlier in (4). One consequence of the latter is that inflection is insensitive to the length of the rhyme in the final syllable to which it attaches, namely, short (VC-final; e.g., [[lʊk]$_{PWd}$ s]$_{PWd}$ 'looks') or long (VVC/VCC-final; e.g., [[haɪk]$_{PWd}$ s]$_{PWd}$ 'hikes', [[θɪŋk]$_{PWd}$ s]$_{PWd}$ 'thinks'). We discuss the significance of this below.

In an experiment targeting English agreement, Goad et al. (2003) found two patterns of production by Mandarin speakers. The first group showed variable suppliance of inflection, tied to stem length. Learners produced agreement morphology on average 68% of the time after short stems but only 9% after long stems. Although not target-like for English, inflection could be organized PWd-internally after short stems (i.e., [lʊks]$_{PWd}$ 'looks'), using the representation that is available from the Mandarin grammar. As expected from this, suppliance of clusters at the right edge of monomorphemic words which, by definition, employ the same representation (e.g., [fæks]$_{PWd}$ 'fax') was similar (68%).

The second pattern of behavior was across-the-board deletion of inflection. Learners in this group were sensitive to the need for a unified analysis of English inflection (i.e., one representation for stems of all shapes). However, since their L1 grammar does not permit inflection to be adjoined to the PWd, as required for English, inflection was deleted in all contexts, in contrast to clusters in monomorphemic forms (57% target-like). In short, the productions of L2 learners in both groups were constrained by the prosodic representation for inflection available in the L1 grammar.

Similar findings have been reported in the nominal domain. Here, we focus on omission errors in the production of English plural inflection by Korean and Mandarin speakers. There are complex syntactic/semantic conditions under which the morphemes used to express plurality in Korean and Mandarin (*-tul* and *-men*, respectively) can appear; both languages are more

restricted than English (see, e.g., Hwang & Lardiere, 2013, for Korean; Li, 1999, for Mandarin; and Su, 2019, for comparison of the two languages). As with tense and agreement morphology, plural is often omitted in the L2 English of Korean and Mandarin speakers. An obvious source for omission is syntactic mismatches between the L1 and target grammars. However, Lardiere (2009) finds that Mandarin-speaking learners who have overcome L1 syntactic constraints on plural marking continue to omit plural from obligatory contexts in the L2. This leads us to ask whether the difficulty may, instead, lie at the syntax-phonology interface.

Austin et al. (2022) explore this question. In addition to agreement morphology, they examine prosodic transfer effects in Korean learners' production of English plural morphology. Asymmetries between short and long stems are observed in L2ers' plural outputs (again, showing greater accuracy with short stems), supporting transfer of the L1 PWd-internal representation for tense for use in plural constructions in the L2.

In sum, we have considered two phonological alternatives for the difficulties that learners experience with the production of inflection, one which attributes the problem to the phonology proper, and the other to the syntax-phonology interface. We have suggested that the second kind of account provides a better explanation of learner output.

We turn next to function words where, in addition to errors of omission, we find errors of commission, some of which, again, motivate locating the problem at the interface between phonology and syntax.

6.2. Function Words

A wide literature has documented the types of difficulties that learners face with articles when their L1 grammar lacks them (see contributions to García-Mayo & Hawkins, 2009). As with inflection, omission is the most common pattern observed, and such errors have been attributed to challenges at multiple levels of the grammar: semantics (e.g., Huebner, 1985; Ionin et al., 2004), syntax (e.g., Trenkic, 2007), as well as to the grammar interfacing with discourse/pragmatics (e.g., Robertson, 2000; Trenkic, 2007).

Alongside omission, we observe substitutions: one article for another (primarily definite for indefinite; Ionin et al., 2004), demonstratives and numerals for definite and indefinite articles (Goad & White, 2008; Robertson, 2000), and stressed articles for unstressed (Snape & Kupisch, 2010; Ueyama, 2000). While phonology plays no role in accounting for substitution of one article for the other, it may be implicated in the other types of substitution: stressed articles, demonstratives and numerals all form independent PWds; this representation provides learners with a way to circumvent the free clitic representation required for articles in English (see (3a)), if the latter is not available in the L1 grammar.

Goad and White (2009) argue that this is the case for Turkish. Indefinite constructions in Turkish optionally contain *bir* which, when unstressed, is interpreted as the indefinite article and, when stressed, is interpreted as the numeral *one* (Kornfilt, 1997). Word order differences in DPs with adjectives indicate that unstressed *bir* does not employ the same representation as English articles (compare (3a) and (3b)). The canonical word order for Turkish is determiner + adjective + noun (e.g., *bír iyi kitap* 'one good book'), but unstressed *bir* (*bĭr*) must follow the adjective (e.g., *iyi bĭr kitap,* good a book, 'a good book'), indicating that it must prefix onto the noun that it modifies (as an affixal clitic): [[iyi]$_{PWd}$ [bĭr [kitap]$_{PWd}$]$_{PWd}$]$_{PPh}$. In English, where adjectives have no impact on the location of articles in the DP, articles are organized higher in the structure: [ə [gʊd]$_{PWd}$ [bʊk]$_{PWd}$]$_{PPh}$.

Goad and White (2009) used a story telling task to explore Turkish speakers' productions of English articles. The following patterns were robustly observed, especially in DPs with adjectives: omission of articles; stressing of articles; and insertion of pauses or fillers immediately after articles, which interrupts the prosodic structure of phrases, thereby avoiding the target representation.

In sum, Turkish speakers' production of English function words is constrained by L1 prosodic structure. As was the case for inflectional morphology, this results in the inability to produce target-sounding (unstressed) articles in certain phonologically-defined contexts.

6.3. Clause-level Syntax

So far, our examination of the syntax-phonology interface has considered how L1-based prosodic representations are implicated in problems that learners display with L2 functional morphology. Prosody also affects higher levels of structure, with interpretive consequences, at least for native speakers (e.g., Jun 2003). However, prosodic effects on sentence interpretation in L2 have been relatively little studied, with some exceptions discussed below.

We consider two areas where prosody has been argued to impinge on sentence interpretation: relative clauses and pronoun interpretation. In both cases, structures that are potentially ambiguous can be disambiguated by means of prosody (section 3.1).

6.3.1. Relative Clause Ambiguity

In research on relative clause attachment, the emphasis has been on ambiguous sentences like (5)-(6) above, where the RC can refer to either NP1 or NP2. As mentioned, there are crosslinguistic differences as to which interpretation is preferred: HA languages (e.g., Spanish, French) prefer NP1; LA languages (e.g., English, Basque) prefer NP2. Numerous studies have investigated the situation where the L1 and L2 differ in their attachment preferences, mostly using reading tasks (e.g., Dussias, 2003; Fernández, 2002; Frenck-Mestre & Pynte, 1997).

Few studies have explored whether L2ers use prosody for disambiguation, in interpretation or in production. Concerning interpretation, two exceptions are Dekydtspotter et al. (2008) on English-speaking learners of French and Goad et al. (2021) on Spanish-speaking learners of English. Both studies manipulated constituent length and position of the prosodic break, as these have been shown to affect native speaker judgments (Fodor, 2002; Jun, 2003). For example, in a sentence like (7) (from Dekydtspotter et al.), a longer relative clause (with *au centre-ville*) prefers HA, in contrast to a shorter RC (without *au centre-ville*); in addition, a break after NP1 (*secrétaire*) favors LA while a break after NP2 (*psychologue*) favors HA.

(7) Nous adorons le secretaire du psychologue qui se promène (au centre-ville).
we adore the secretary of.the psychologist who SE walks in.the center-town
'We adore the secretary of the psychologist who is taking a walk (downtown).'

Dekydtspotter et al. found no effect for RC length, nor for position of the break. However, one-third of participants, with higher proficiency in the L2, did show sensitivity to the break (see Liljestrand Fultz, 2007). Goad et al. found that both position of the break and constituent length had a significant effect on attachment preference, the latter to a lesser extent.

Turning to production, de la Cruz-Pavía and Elordieta (2015) observed that L1 Basque speakers who are highly proficient in Spanish favored HA in sentences produced with default prosody, like native speakers; however, they produced significantly fewer breaks after NP2 (especially before longer RCs) and a high proportion of sentences with unexpected pitch contours. Fernández (2005) reported that bilingual Spanish-English speakers, regardless of language dominance, marked prosodic breaks differently in their two languages, but neither pattern was exactly like that of monolinguals.

Taken together, these studies suggest that L2ers can come to understand that there is a relationship between prosody and syntax; specifically, that when a sentence is pronounced in a particular way, this favors a particular syntax, and hence a particular interpretation. They may, however, fail to achieve native-like prosody in production.

6.3.2. Pronoun Interpretation

A topic on which there has been considerable research at the syntax-discourse interface is pronoun interpretation in null subject languages like Italian. Native speakers prefer null pronouns to take subject antecedents and overt pronouns to take object antecedents (e.g., Carminati, 2002), as seen in (8) (indices reflect preferred interpretations).

(8) Monica$_i$ ha telefonato a Claudia$_j$ quando Ø$_i$/lei$_j$ era in ufficio.
Monica has telephoned to Claudia when she was in office
'Monica phoned Claudia when (she) was in the office.'

L2ers' interpretations have been shown to differ somewhat from those of native speakers. In their examination of L2 Italian, Belletti et al. (2007) and Sorace and Filiaci (2006) argue that difficulties arise from L2ers not being able to fully integrate syntactic and discourse properties of the L2, such that they choose subject antecedents for overt pronouns to a greater extent than do native speakers.

Stimuli in earlier experiments have not been presented auditorily, but their results may have been influenced by silent prosody, which participants assign in reading (Fodor, 2002). In this case, it could involve assignment of contrastive stress to an overt pronoun, which can lead to an 'overturning' effect, that is, to an increase in subject antecedents, as shown in (9).

(9) Monica$_i$ ha telefonato a Claudia quando LEI$_i$ era in ufficio.
Monica has telephoned to Claudia when SHE was in office
'Monica phoned Claudia when SHE was in the office.'

White et al. (2022) experimentally probe this in English learners of Italian. By manipulating prosody, they observe that changes can result in the expectedness of the antecedent, namely, a decrease in choice of object antecedents when the pronoun is stressed.

Gargiulo and Tronnier's (2020) study on L1 attrition of Italian under L2 Swedish influence shows that production of the same structures is impacted by prosody: the longer the attriters had been living in Sweden, the less they used the prosodic prominence patterns of L1 Italian. Instead, L2 Swedish patterns predominated. Once again, such results suggest that it is important to include consideration of the syntax-prosody interface when examining sentence interpretation.

To summarize, a number of different syntactic and/or morphological problems exhibited by L2 learners receive an explanation when prosody is taken into consideration. Prosodic transfer at the level of the PWd and PPh influences the acquisition of inflection and function words. Clause-level prosody has consequences for sentence interpretation.

7. Open Questions and Future Directions

Most of the research on the syntax-phonology interface in L2 has addressed issues relating to the production of functional morphology. There has been little examination of whether and how L1 prosodic structure constrains L2ers' comprehension. Lieberman (2012) hypothesized that if the L1 grammar lacks the appropriate representation for inflection, learners may either fail to comprehend the inflection altogether or use whatever structure they can transfer from the L1, leading to comprehension failure in certain circumstances and success in others. He examined interpretation of 3SG agreement in French- and Spanish-speaking learners of English. Assuming that both L1s organize agreement as an internal clitic, he shows that English agreement is more accurately comprehended after short stems than after long stems, parallel to the differences in production discussed earlier. These findings, however, are preliminary and much more needs to be done to investigate the extent to which prosodic factors constrain comprehension.

At the clausal level, the issue is, perhaps, the opposite. That is, while some research has addressed issues of interpretation attributable to the syntax-phonology interface, less is known about production in this context.

Finally, like L2 research in general, most of the work on the syntax-phonology interface has involved English as the L2 (but see, e.g., Jin et al., 2009, for functional morphology in L2 Norwegian; Dekydtspotter et al., 2008, and de la Cruz-Pavía & Elordieta, 2015, for clause-level prosody in L2 Romance). While several languages have been investigated as L1s, to appropriately evaluate the challenges that learners face at this interface, a range of L2s must be considered.

8. Conclusion

In conclusion, the syntax-phonology interface has been somewhat neglected in the L2 literature. Recent research has suggested that consideration of this interface has the potential to explain aspects of L2ers' behavior that have previously been attributed to syntactic or phonological problems or to problems at other interfaces, particularly the syntax-lexicon and syntax-discourse interfaces. As we have shown, some difficulties with inflectional morphology and function words can be accounted for in terms of transfer of L1 prosodic structure; at the clausal level, presumed problems with ambiguity resolution are explained, in part, once prosodic factors are taken into consideration.

Notes

[1] In (5b.ii), some text has been elided because there may be an IP boundary in a location other than after NP1 or NP2, consistent with Gee and Grosjean's (1983) observation that longer sentences tend to be phrased as two domains.

Acknowledgements

Thanks to John Archibald for helpful comments. This work was supported by grants from the Social Sciences and Humanities Research Council of Canada and Fonds de recherche du Québec-Société et culture.

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