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ULTIMATE ATTAINMENT IN INTERLANGUAGE GRAMMARS: A PROSODIC APPROACH[*]

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I Introduction

The ultimate attainment of L2 learners varies considerably; some learners achieve completely native-like performance – and arguably native-like competence– while others 'fossilize', their endstate competence and performance differing, often considerably, from native speakers of the L2. In this paper, we contrast two positions which argue that failure to achieve native-like competence reflects effects of L1 representations on the interlanguage grammar (ILG). These accounts differ as to whether non-native attainment reflects L1 syntactic or phonological properties. According to the Representational Deficit Hypothesis (RDH) (Hawkins and Chan, 1997; Hawkins, 2000, 2003; Hawkins and Liszka, 2003; Tsimpli, 2003), there is no (syntactic) parameter resetting in adult L2; consequently, speakers can never acquire functional categories or features that are required by the L2 but absent in the L1. In other words, there are permanent effects of L1 syntactic representations on the ILG. In contrast, we argue that it is transfer of L1 prosodic constraints that affects IL representations, with consequences for the production of inflectional morphology and function words, particularly during the course of development but also in the endstate. In this paper, we investigate the L2 acquisition of English tense morphology by Mandarin speakers; we show that Mandarin speakers have few problems in interpreting English tense appropriately and that their production of the morphology shows effects of stimulus type which is unexpected on syntactic accounts. We further argue that, while there are circumstances in which L2 speakers are able to adapt L1 prosodic structures in order to represent L2 functional morphology, there are certain situations where this will never be possible.

II Representational Deficit Hypothesis

According to the RDH, the only uninterpretable formal features that can be realized in the ILG are those that are represented in the L1. In the case of the feature [±past], the lack of overt tense morphology in Mandarin is taken to indicate a lack of the corresponding formal feature in that language. The prediction, therefore, is that Mandarin-speaking learners of English are unable to acquire [±past], leading to difficulties in realizing and interpreting tense morphology. The IL representation, then, is permanently defective in the sense that it lacks features required to appropriately represent the L2.

Investigating this hypothesis, Hawkins and Liszka (2003) report that, in oral production tasks, two Chinese-speaking subjects had greater difficulty realizing English *t/d* in regular past tense contexts (63% suppliance) than in the case of past participles (100% suppliance). Contra Lardiere (1998, 2003), they argue that the problem with tense cannot be attributed to a difficulty with final consonant clusters: although many inflected forms ends in clusters, the same subjects

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show a high degree of accuracy on final clusters in monomorphemic words (82% suppliance). Bayley (1996) reports similar findings from production data from 20 Mandarin-speaking learners of English; he finds 38% suppliance of *t/d* in past tense contexts, contrasted with 74% suppliance for past participles and 65% suppliance for cluster-final monomorphemic words. Hawkins and Liszka argue that it must be the morphosyntactic representation of Tense that is defective, since difficulties in production are specific to past tense. Past participles do not implicate tense; rather, they encode perfectivity (or passive), tense being realized on the associated auxiliary. Since Chinese overtly realizes perfective aspect, no problems are predicted with perfective use of past participles under the RDH.

If Chinese speakers are truly unable to represent [±past] in their English ILGs, another prediction of the RDH is that performance on regular and irregular past should be equally problematic. This prediction is not borne out: Hawkins and Liszka (2003) find that correct realization of irregulars is considerably higher than regulars (84% versus 63%), a result consistent with Bayley (1996) and Lardiere (2003) as well. Hawkins and Liszka suggest that irregular past forms are acquired as independent lexical items, and that they are conceptually associated with the meaning of past time, without having a morphosyntactic [+past] feature (see also Hawkins, 2000). As they point out, however, this leaves unexplained why learners do not treat regular past tense forms in the same manner.

There are some problems with Hawkins and Liszka's (2003) data. The data come from only two Chinese-speaking subjects, so it is not clear how generalizable the findings are. In addition, there are relatively few regular past tense contexts (n=40), comparable monomorphemic words (n=11) and regular past participles (n=10), so claims as to differences in behaviour across these three categories must be interpreted with caution. Furthermore, as we shall argue below, it is essential that stimuli of particular segmental and prosodic shapes be examined in order to determine whether the problem is indeed due to the absence of [±past] from the L1 or to issues relating to L1 phonological representations.

III The Prosodic Transfer Hypothesis

Languages differ as to how they prosodify functional material. This observation underlies the Prosodic Transfer Hypothesis (PTH), according to which L1 prosodic constraints restrict the types of representations that can be built in the L2, hence limiting IL production of inflectional morphology and function words (Goad, White and Steele, 2003; Goad and White, 2004).[1] Our original proposal was that L2 speakers are unable to construct prosodic representations required for the L2 if these representations are disallowed in the L1 (Goad, White and Steele, 2003). We showed that learners are unable to organize 3SG agreement into the structure required for target-like production in English, as the necessary licensing relation (adjunction to the Prosodic Word (PWd); see (2a.i) below) is lacking in Mandarin. Consequently, some learners in our experiment deleted agreement across the board; others used available L1 structures to represent English agreement in so far as this was possible, leading to prosodically-determined asymmetries in the contexts where the morphology appeared. An implication of this version of the PTH is that prosodic transfer should be persistent: endstate L2 competence should always be constrained by L1 prosodic representations. In other words, the RDH and this version of the PTH are in agreement that L1 effects are permanent, while differing as to the source of these effects.

[1] The PTH is concerned with the role that the L1 plays in the *production* of functional material in L2 outputs. On our view, L1 prosodic constraints do not act as a filter in comprehension which could prevent the establishment of the necessary syntactic representations in the L2 (see Goad and White, 2004).

In subsequent work, we showed that this position was too strong (Goad and White, 2004). In examining the productions of an advanced fossilized speaker of English whose L1 is Turkish, it became evident that some development in the prosodic domain is possible. Accordingly, we proposed that L1 structures can be 'minimally adapted' to accommodate the needs of the L2; structures appropriate for the L2 are possible under two conditions:

(1) a. when they can be built through combining L1 licensing relations;
    b. when they involve L1 structures being licensed in new positions.

This proposal was supported through a comparison of the suppliance of tense, agreement and plural morphology with suppliance of articles in the outputs of the L2 speaker under study. In the former case, it was possible to minimally adapt structures from the L1 (Turkish), so that appropriate prosodic representations could be built in the L2 (English) and rates of suppliance were high. In the case of articles, however, no such adaptation was possible, and problems remained persistent. In short, under the revised view, some reorganization of L1 licensing relations is possible, but representations that cannot be built from existing structures will be impossible to acquire, leading to fossilization for even the most proficient L2 speakers.

In this paper, we examine the acquisition of English tense and past participial morphology by Mandarin speakers and show that, contrary to the predictions of the RDH, both are equally acquirable. Through an examination of the phonetic detail of speakers' productions, we further show that the prosodic representation required for regular inflection in English can be built under condition (1a).

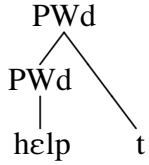
IV The prosodification of inflection

In earlier work, we argued that inflection is prosodified differently in English and Mandarin (Goad, White and Steele, 2003). In English, regular inflection (for both past tense and past participles) is adjoined to the PWd, as shown in (2a.i) for 'helped'; it is not incorporated into the PWd of the stem to which it attaches, as in the illicit (2a.ii). Irregular inflection, by contrast, is organized PWd-internally, whether it involves 'pseudo-inflection' as in 'kept' (2b.i) or ablaut as in 'won' (2b.ii).

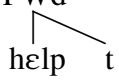
(2) English:

a. Regular inflection:

i.

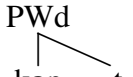


ii.



b. Irregular inflection:

i. Pseudo-inflection:



ii. Ablaut:

The proposal that regular inflection in English is adjoined follows from constraints that hold on PWd shape. Most languages, including English, do not permit three-position rhymes PWd-internally. For example, while words with two-position (VX) rhymes (X = C or V) like [hɛ̲l.pər] 'helper', [kæ̲p.tɪv] 'captive', [ba̲i.kər] 'biker' are well-formed, words with three-position (VXC) rhymes like *[kæ̲lp.tɪv] and *[ba̲ik.tər] are not. An extra consonant is, however, permitted PWd-finally in English (e.g., [hɛ̲lp] 'help', [æ̲pt] 'apt'). The addition of one more consonant, for a total of four positions, is only allowed in the case of inflection (e.g., [hɛ̲lpt] 'helped'); that is, there are no monomorphemic parallels (single PWds by definition) for words of this shape.[2] This

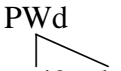
[2] There are a handful of exceptions, i.e., words where three positions are found PWd-internally (e.g., [ma̲un.tən] 'mountain') and four positions at the right edge (e.g., [tʃa̲ild] 'child').

asymmetry between single PWds and inflected forms is explained if inflection is organized outside the PWd of the stem to which it attaches.

In contrast to regulars, pseudo-inflected forms are always suffixed with [t], and suffixation triggers stem changes not observed with regulars: vowel shortening (e.g., *keep-kept*), obstruent devoicing (e.g., *leave-left*), and [d] deletion (e.g., *build-built*). Vowel shortening provides strong evidence for the PWd-internal analysis of [t] in (2b.i). Unlike regulars, pseudo-inflected forms cannot have a fourth position at the right edge. Instead, the attachment of [t] to a VXC# base triggers shortening ([kiːp]-[kɛpt]), in order to accommodate the inflection within the PWd of the stem ([kɛp-t]$_{PWd}$). As expected, there are monomorphemic words with this same profile (e.g., [ədɛpt]$_{PWd}$ 'adept').

In Mandarin, the only inflection that is overtly realized is aspect, and it is organized PWd-internally; see (3) (Goad, White and Steele, 2003; cf. also Yip, 1995: 490).[3] This corresponds to how pseudo-inflected irregulars are organized in English (see 2b.i). Adjunction to the PWd, (2a.i), appears to be absent from the Mandarin grammar.

(3) Mandarin inflection:



buy PERF 'bought already' (example from Duanmu, 2000: 81)

Evidence for (3) requires an examination of constraints on PWd shape in Mandarin. Native Mandarin PWds are largely limited to two syllables. The first syllable is bimoraic, stressed and tone-bearing (tones 1-4) (e.g., Yip, 1995; Duanmu, 2000). The following syllable is monomoraic, unstressed and does not bear contrastive tone (it is neutral-toned (tone 5) or acquires tone from the preceding syllable). Focusing on neutral tone, the latter observation holds of inflected forms like [mai3-lə5] in (3), as well as derived forms (e.g., [muu4-t^{h}o5]$_{PWd}$ wood-NOMINAL 'wood') and phonologically-restructured compounds (e.g., [[ʈʂ^{hw}ən1]$_{PWd}$ [t^{hj}an1]$_{PWd}$]$_{PWd}$ → [ʈʂ^{hw}ən1-t^{hj}ɑ̃5]$_{PWd}$) spring-day 'spring') (Duanmu, 2000). This suggests that both inflected and uninflected forms are prosodically represented in the same fashion and, thus, that inflection incorporates into the PWd of the stem to which it attaches, as in (3).

Stronger evidence for (3) comes from the prosodic shapes of inflected verb compounds in Mandarin. If these compounds involved conjoined PWds, inflection would have to be adjoined to enable it to have scope over the entire compound: [[[…]$_{PWd}$ […]$_{PWd}$]$_{PWd}$ inflec]$_{PWd}$. However, verb compounds do not appear to involve this structure. While resultatives and verb-object compounds can inflect (e.g., *ta1 dai4-shang4-le5 ta1-de5 mao4zi5* 3SG wear-ascend-PERF 3SG-GEN hat 'He/she put on his/her hat' (Li and Thompson, 1981: 60); and *kai1-hui4-le5* open-meeting-PERF 'the meeting started' (C. Qu, p.c.) respectively), both of these compound types must be phrasal, as the two constituents of the putative compound can be interrupted by other material, the former by the potential modality items *de* 'obtain' and *bu* 'not' and the latter by inflection. In other words, the two constituents must form entirely independent PWds, thereby avoiding the need for the adjunction structure in (2a.i). The third type of verb compound that can inflect is the parallel compound (e.g., *da3-sao3-le5 fang2-jian1* clean-sweep-PERF room 'Have cleaned the room' (C. Qu, p.c.)). These compounds, however, appear to form single PWds; the two constituents must be 'synonymous or signal the same type of predicative notion' (Li and Thompson, 1981: 68), as virtually all of them have arisen as Mandarin has changed from a language where most words were monosyllabic to one which prefers disyllabicity. When viewed

[3] Here, we refer to the three neutral-toned (tone 5) aspect markers (*le5* perfective, *zhe5* imperfective/durative, *guo5* experiential), as well as the delimitative which involves reduplication of the verb, the aspectual half of which is neutral-toned.

in cross-linguistic terms, a binarity constraint of this type can only hold of single PWds or of lower constituents, notably the foot.

In sum, in Mandarin, the prosodic shapes of inflected compounds and parallels in shape between uninflected and inflected words strongly suggest that this type of functional morphology is organized internal to the PWd, (3). In English, the absence of such parallels in the case of regular inflection instead indicates that inflection is adjoined, (2a.i).

V Predictions for Mandarin-English interlanguage

We now compare the predictions of the RDH and PTH concerning the acquirability of English tense and participial morphology by Mandarin speakers. Given the RDH's claim that [±past] is not acquirable, it predicts problems for past tense morphology but not for past participles, since the latter do not involve tense and the L1 grammar realizes perfective aspect. By contrast, the PTH expects performance on past tense and past participles to be similar, as the inflectional morphology is prosodified in the same way. Furthermore, the RDH predicts equally bad performance on regular and irregular inflection,[4] while the PTH predicts differences, due to differences in prosodification ((2a.i) versus (2b) above). In particular, performance on irregulars should be better than on regulars, as the PWd-internal structure required for the former is available in the L1 grammar (see (3)). Finally, the RDH makes no predictions based on stimulus shape, while the PTH predicts differences (see below).

Assuming that the adjunction structure required for regular English inflection is absent from Mandarin, the PTH predicts that suppliance of regular tense and past participial morphology will be depressed, at least at earlier stages in development. However, there are certain conditions under which a PWd-internal representation for inflection can be constructed, and in these contexts, suppliance rates are predicted to be higher for some speakers. For example, while (2a.i) is the appropriate representation for both 'short-stemmed' (VX-final) and 'long-stemmed' (VXC-final) regular stimuli (e.g., $[[\text{ræp}]_{\text{PWd}}\ \text{t}]_{\text{PWd}}$ 'wrapped' and $[[\text{hɛlp}]_{\text{PWd}}\ \text{t}]_{\text{PWd}}$ 'helped' respectively), a target-sounding output which circumvents adjunction can be produced for short-stemmed stimuli: the addition of [t/d] yields a string with only three positions at the right edge, generating a prosodically well-formed output with inflection incorporated into the PWd of the stem ($[\text{ræp-t}]_{\text{PWd}}$), one whose representation parallels that of the pseudo-inflected irregulars in (2b.i) ($[\text{kɛp-t}]_{\text{PWd}}$). In other words, higher rates of suppliance might be expected for regular short-stemmed stimuli than for long-stemmed stimuli; in the latter case, inflection cannot bypass adjunction,[5] unless the stem itself is shortened (e.g., $[[\text{hɛlp}]_{\text{PWd}}\ \text{t}]_{\text{PWd}} \rightarrow [\text{hɛp-t}]_{\text{PWd}}$).[6]

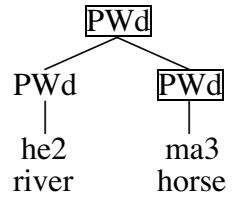
Later in development, suppliance of tense and past participial morphology is predicted to improve, provided that speakers can build the adjunction structure through minimally adapting L1 structures, and assigning the adapted representation to a new syntactic construction. For Mandarin speakers, combining L1 structures as in (1a) can yield adjunction. One component of the target representation is PWd dominating PWd (PWd-PWd), required for lexical compounds, as mentioned above; see (4a). The second component involves PWd directly dominating σ (PWd-σ) at the right edge, the structure required to prosodify three-syllable PWds which contain only one foot; see (4b). (Examples from Li and Thompson, 1981, pp. 49 and 32.)

[4] Recall, however, that Hawkins and Liszka (2003) admit that this prediction is not supported in their data.

[5] Not all speakers will show this pattern of behaviour, as it requires that they treat long- and short-stemmed regulars differently. Without adjunction, speakers who opt for a unified analysis of regular inflection will delete the inflection after short and long stems alike (see Goad, White and Steele, 2003).

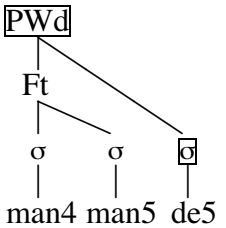
[6] It could be argued that performance on short-stemmed regulars will be better than performance on long-stemmed regulars for independent reasons, that the latter are articulatorily more difficult because they often have an additional consonant at the right edge. We return to this in section VII.2.a.

(4) a.



'hippopotamus'

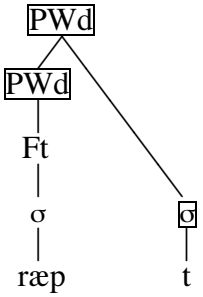
b.



'slowly'

The result will be the adjunction required for English tense and past participles, as shown by the more articulated structure in (5) for *wrapped:*

(5)



In the following sections, we turn to an experiment which was designed to test the predictions of the PTH for verbal inflection in Mandarin-English interlanguage.

VI Experiment

The PTH was tested through a combined sentence completion and production task. This methodology enables us to determine whether production of past and perfective morphology coincides with syntactic knowledge. That is, it allows us to determine whether omission of inflection is due to phonological constraints or whether it reflects a problem with the syntactic representation.

1 Subjects and procedure

Subjects were 10 intermediate level Mandarin-speaking learners of English and 9 native English-speaking controls.

On a computer screen, the beginning of a sentence was displayed, setting up a present, past or perfective context, followed by two endings (see Figure 1). While both endings are grammatical in isolation, one is strongly favoured by the context. The appropriate answer could not be selected by copying the tense/aspect of any verb in the lead-in phrase; some lead-ins had no verb at all (Figure 1a), while others had a verb in the lead-in which differed in tense/aspect from the appropriate answer (Figure 1b).

a. Present vs. past:

Last night after dinner…
○ you show me photos of your daughter.
○ you showed me photos of your daughter.

b. Present vs. perfective:

My parents can visit me today because…
○ I have cleaned my apartment.
○ I clean my apartment.

Figure 1 Sample stimuli

Subjects had 12 seconds to choose and memorize the ending they considered most appropriate to the context. Once they memorized their choice, they pressed a button (which registered their response); they then saw a blank screen and said their chosen ending aloud. The production data were taped on DAT recorders (SONY TCD-D100 and PCM-M1) and were narrowly transcribed by a native speaker of English with extensive training in phonetic transcription.

Stimuli included 103 verbs: 68 uninflected present vs. past (half with past as the intended answer; half with present) and 20 uninflected present vs. perfective (15 with perfective as the intended answer; 5 with present).[7,8] Test items were semi-randomized and presented in four blocks, with breaks between.

2 Construction of stimuli

Results from our earlier work revealed that, for some subjects, suppliance of inflection was tied to stem shape (Goad, White and Steele, 2003). Stimuli for this experiment were constructed to examine this issue more systematically. Table 1 summarizes the prosodic and morphological profiles of the stimuli involved. (See Appendix 1 for further details.)

Table 1 Prosodic and morphological shape of stimuli

	Regular				Irregular			
	Long stem (…VXC#)		Short stem (…VX#)		Pseudo-inflected		Ablaut	
Uninflected	'help'	$[hɛlp]_{PWd}$	'wrap'	$[ræp]_{PWd}$	'keep'	$[kiːp]_{PWd}$	'win'	$[wɪn]_{PWd}$
Target past/ perfective	'helped'	$[[hɛlp]_{PWd}$ t$]_{PWd}$	'wrapped'	$[[ræp]_{PWd}$ t$]_{PWd}$	'kept'	$[kɛp\text{-}t]_{PWd}$	'won'	$[wʌn]_{PWd}$

To test the effect of transferred prosodic constraints on the organization of inflection, regular stimuli were divided into two categories defined by the length of the stem-final string, VXC or VX, and pseudo-inflected irregulars were similarly-shaped to the short-stemmed regulars. To optimize cross-form comparison, the regular stimuli were all voiceless- or sonorant-final, to conform to how the stem surfaces in the pseudo-inflected forms, and all stimuli were phonetically monosyllabic, consistent with the vast majority of irregulars in English. Verb frequency was also controlled for, using the companion website for Leech, Rayson and Wilson (2001). In particular, regular verbs were paired with irregular verbs of approximately equal frequency, to rule out the possibility that any differential performance on regular versus irregular verbs might reflect frequency rather than prosodic effects (cf. Beck, 1997).

[7] There were also 15 3SG vs. past pairs, to control for the possibility of a response bias for uninflected forms (10 with 3SG as the intended answer; 5 with past).

[8] The original intention was to include a direct comparison between past and perfective but it proved impossible to construct enough stimuli where the contexts unambiguously favoured one interpretation over the other.

VII Results

1 Sentence completion task

Results from the sentence completion task are in Table 2. While the L2 speakers were less accurate than the native English controls, they were nevertheless successful in their choice of sentence completion, for both past tense and perfective. A two-way repeated measures ANOVA shows a significant main effect for group (f (1, 17) = 17.134, p < .001), no main effect for sentence type (present/past vs. present/perfective (f (1, 17) = 3.242, p < .0895), and no interaction (f (1, 17) = 3.164, p < .0931). Given their success in making appropriate choices for present versus past, these results suggest that the Mandarin speakers do indeed represent [±past] in their ILG, contrary to the claims of the RDH.[9]

Table 2 Mean accuracy in selecting appropriate completion

Sentence types	Mandarin speakers (n=10)	English controls (n=9)
Present vs. past (n=68)	83%	98%
Present vs. perfective (n=20)	77%	98%

2 Production task

In order to ensure that productions represent circumstances where the L2 speakers intended to produce past or perfective forms, production data from inappropriate responses in the sentence completion task have been excluded from the analysis; production data from 3SG vs. past contexts have also been excluded.[10] The data will be examined with three considerations in mind: (i) comparison of performance on past vs. perfective; (ii) comparison of performance on regular vs. irregular inflection; and (iii) asymmetries in patterns of behaviour within each of past and perfective.

Table 3 shows that suppliance rates for past and perfective morphology are high, for all four types of stimuli.[11] This finding is in contrast to our earlier work on agreement with Mandarin-speaking learners of English (Goad, White and Steele, 2003). This may, in part, reflect the type of task involved. The study in Goad, White and Steele involved picture description, where speakers' attention was not drawn to the experiment's focus on verbal inflection. In the current experiment, subjects read pairs of sentences with contrasting verbal morphology, which may have made them more inclined to realize the inflection. Nevertheless, important phonetic differences are observed between regularly-inflected and pseudo-inflected forms which reveal that adjunction has indeed been acquired (see sections VII.2.c-d).

[9] All stimuli in Table 2 involved choices between inflected and uninflected verbs. The high level of accuracy suggests that no response bias is implicated. Absence of a response bias is further supported by the results (84% accuracy) on items which contrasted 3SG and past tense (both inflected).

[10] The following stimuli have also been omitted: regular [t/d]-final stems, which take [əd] in the past/perfective (because they do not permit a direct comparison with irregulars); 'sell'-'sold', which patterns differently from other pseudo-inflected forms (true ablaut rather than vowel shortening and suffixation of [d] rather than [t]).

[11] The task included no stimuli which required ablaut in the perfective (see Appendix 1).

Table 3 Suppliance of past/perfective inflection in production

		Suppliance	Nonsuppliance	Other
Past	Short-stemmed regulars (n=102)	87%	11%	2%
	Long-stemmed regulars (n=41)	92%	7%	
	Pseudo-inflected irregulars (n=60)	93%	7%	
	Ablaut (n=49)	94%	6%	
Perfective	Short-stemmed regulars (n=42)	91%	7%	2%
	Long-stemmed regulars (n=34)	97%	3%	
	Pseudo-inflected irregulars (n=39)	94%	3%	3%

Chi-square tests show that none of the differences between past and perfective is statistically significant (short-stemmed regulars (χ^2 (1) = .441, $p < .5$); long-stemmed regulars (χ^2 (1) = .705, $p < .4$); pseudo-inflected (χ^2 (1) = .782, $p < .37$)). This is as predicted by the PTH, since these two morphemes are prosodified in the same fashion, but it is not expected under the RDH, which assumes that only [±past] will be defective in the Mandarin-English ILG. Indeed, there are no robust differences between past and perfective on any of the production measures examined; consequently, results for these two morphemes will be collapsed in all subsequent analyses.

a Has adjunction been acquired?

As shown in Table 3, performance on both short- and long-stemmed regulars is high and there is no asymmetry between regulars and irregulars. Overall, the contigency between suppliance of inflection and verb type (regular vs. irregular) is not significant ($p > .29$). One possibility, then, is that these L2 speakers have acquired the adjunction structure necessary for representing English inflection in target-like fashion.

Alternatively, inflected short-stemmed regulars could involve a PWd-internal representation for inflection (transferred from Mandarin), which would account for the observed parallel in performance between these forms and the pseudo-inflected forms (i.e., *wrapped* and *kept* would be prosodified identically: [ræp-t]$_{PWd}$, [kɛp-t]$_{PWd}$). Further, if the inflected long-stemmed regulars were shortened, the PWd-internal analysis could hold for them as well (e.g., [hɛp-t]$_{PWd}$ for target [[hɛlp]$_{PWd}$ t]$_{PWd}$ 'helped'), thereby explaining the parallel observed between these forms and short-stemmed regulars. Table 4 shows that shortening of long-stemmed regulars is, in fact, the predominant pattern.[12] Thus, despite high rates of suppliance of inflection (Table 3), one cannot definitively conclude that the morphology has been appropriately represented in the phonological ILG.

Table 4 Shortening in past/perfective inflected contexts

	Not shortened (VXC)	Shortened (VX)	Other
Long-stemmed regulars (n=77)	37%	62%	1%

[12] The stem-final consonant was virtually always retained, indicating that articulatory difficulty (due to clusters arising in inflected contexts) cannot account for shortening. For VVC+t/d ('cleaned', 'smiled', 'typed'), the vowel was shortened, through deletion or coalescense; for VCC+t/d, [l] (not [p]) was typically deleted from 'helped', and 'blinked' was never shortened. Comparing the results in Table 4 with short-stemmed VV+d ('died', 'tied', 'showed'), the pattern for the latter is the reverse: 31% shortened, 66% not shortened, 3% other. With one exception, shortening was restricted to 'showed'. While this and the shortening observed for 'cleaned' could reflect an inability to accurately perceive these vowels ([ou], [iː]) as long, the difference in the treatment of the true diphthong [ai] in long- and short-stemmed verbs instead suggests that shortening in the vast majority of cases is truly phonological (see further note 13).

However, further examination of the phonetic detail of learners' outputs convincingly suggests that the morphology has indeed been appropriately represented, such that both short- and long-stemmed regulars involve adjunction, while pseudo-inflected forms involve a stem-internal analysis.[13] We begin with the articulatory properties of the inflectional morpheme, which will set the scene for an examination of the preceding stem-final consonant.

b Articulatory properties of the inflectional morpheme

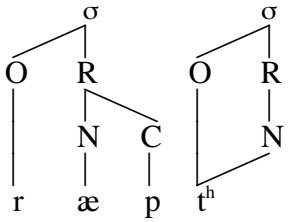
Table 5 provides information on the shape of the inflectional morpheme for all past and perfective stimuli where the inflection was supplied (n=292).[14] The most common pattern is for the inflection to be realized with a fortis (tense) release. This is especially true in the case of pseudo-inflection; indeed, the contigency between inflection type (regular vs. pseudo-inflection) and release (plain vs. fortis) is highly significant (χ^2 (1) = 15.896, $p < .0001$), suggesting that a representational difference holds between the two types of inflection (at the level of PWd structure; see note 18). Target-like release includes both non-fortis release and absence of release; as these are often in free variation in the target grammar, they will henceforth be collapsed as 'plain'.

Table 5 Shape of past/perfective inflection (when supplied)

	Target-like (plain) release	Fortis release	Epenthesis (after inflection)	Other
Short-stemmed regulars (n=127)	34%	50%	10%	6%
Long-stemmed regulars (n=72)	36%	49%	8%	7%
Pseudo-inflection (n=93)	16%	80%	3%	1%

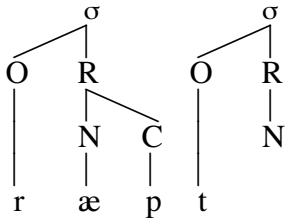
Fortis release optimally occurs when a stop is followed by a vowel, as the nucleus serves to support the release. Accordingly, we propose that inflectional morphemes with fortis release are syllabified as word-final onsets where the melodic content of the consonant has spread into the following empty nucleus. The resulting structure, which we refer to as 'Onset-Nuclear (ON) sharing' (Goad, 2002; Goad and Brannen, 2003), is shown in (6a); for convenience, the fortis consonant is transcribed as C^h (but see Laver (1994) on differences between this type of release and true aspiration). Most of the fortis consonants surfaced as voiceless, although some fortis [d] were also attested; both were realized with stronger bursts and greater than target-like duration.

(6) a. Favoured IL syllabification: ON sharing:



'wrapped'

b. Target syllabification: OEHS:



[13] If this is the case, then shortening of long-stemmed regulars must have nothing to do with the absence of adjunction and must instead be due to L1 syllable structure constraints. Note that Mandarin does not permit ...VXC# strings (e.g., Duanmu, 2000).

[14] 23 forms involved deletion of the inflection; 83% of these errors were attributed to four subjects, two of whom also commonly epenthesized after the inflection.

One might have expected a higher incidence of fortis release after stems ending in stops or obstruents more generally. For the three types of verbs in Table 5, we included near equal numbers of sonorant- and obstruent-final stimuli (see Appendix 1). Interestingly, fortis release was equally supplied after sonorants and obstruents, both within and across subjects, suggesting that it is not a phonetic strategy adopted to realize strings of articulatorily-difficult consonants but, instead, arises for structural reasons.

True vowel epenthesis provides another way to fill the empty nucleus in (6a), but Table 5 reveals that it was not commonly attested. While this type of output is less marked, it is also less favoured on faithfulness grounds; ON sharing, by contrast, sounds very close to target-like. Epenthesis is widely attested only in the outputs of three speakers (14%-38%), precisely those who show relatively low rates of fortis release (31%-36%; compare 53%-72% for the other seven subjects). The ILGs of these three subjects are closer to the L1 grammar which does not permit (6a).

The representation in (6a) contrasts with the target structure in (6b) where inflection is syllabified as the onset of an empty-headed syllable (OEHS). We reject the alternative analysis where the inflectional morpheme is syllabified as a coda. First, recall from (2a.i) that, in English, inflection is adjoined to the PWd of the stem to which it attaches: $[[\text{ræp}]_{\text{PWd}}\ \text{t}]_{\text{PWd}}$. Since it is not inside the lower PWd, it cannot be syllabified inside the rhyme of the stem-final syllable. More generally, however, final [t] must be an onset, regardless of the prosodic organization of inflection. Even after short stems, if [t] were a coda, the rhyme would be tri-positional which is impossible in most languages, including English and Mandarin. Thus, if (L2) speakers of English produce VCC# strings intact, the final consonant must be an onset, independent of its morphological status.[15]

Before turning to the propreties of stem-final consonants, we must address the question of where ON sharing comes from, as this type of structure is permitted neither in the L1 nor in the L2. In Goad (2002) and Goad and Brannen (2003), it is argued that this structure is the least marked way to syllabify word-final consonants (i.e., in languages where true vowel epenthesis does not apply). Yapese and European French employ this syllabification option for word-final consonants; it is commonly attested in the outputs of L1 learners of English, German and Québec French, although it is not permitted in these target languages; and it is frequently observed in the L2 outputs of learners of English whose L1s are Polish, Italian, Japanese and Mandarin, although it is similarly not permitted in these L1s.

Mandarin allows sonorant codas only. As discussed, a coda analysis is not available for inflection in English, and three-position rhymes are not permitted in either language. Accordingly, we would expect that once English inflection is reliably produced by Mandarin speakers, IL outputs should display true vowel epenthesis. As mentioned, this pattern is relatively common in the outputs of three subjects in our study. The next stage in development should be ON sharing; there is no change in syllabification, but the requirement that the nucleus be filled with melodic content must still be respected. The third and final stage should be one where inflection is syllabified as an OEHS. Again, there is no change in syllabification, but the constraint that nuclei be filled has been relaxed.

[15] We do not consider the possibility that final consonants in VCC# strings are extra-rhymal positions linked directly into higher prosodic structure. The parallels between CC# in uninflected contexts (e.g., [plænt] 'plant') and word-internal coda-onset clusters (e.g., [frænt<u></u>ɪk] 'frantic') are striking, a generalization that goes unexplained if final consonants in the former case are analysed as extra-rhymal instead of as onsets. For us, the difference between final consonants in uninflected and inflected contexts (in target English) arises at higher prosodic structure (e.g., $[(\text{plæn})_{\sigma}(\text{tØ})_{\sigma}]_{\text{PWd}}$ 'plant' vs. $[[(\text{plæn})_{\sigma}]_{\text{PWd}}(\text{dØ})_{\sigma}]_{\text{PWd}}$ 'planned').

c Articulatory properties of the stem-final consonant

As will be detailed below, ON sharing is not restricted to the inflection; fortis release is also present – under certain conditions – when the stem-final consonant is a stop. Through an examination of these conditions, we will conclude that the adjunction structure in (2a.i) has indeed been acquired by the Mandarin speakers under focus.

Table 6 shows the distribution of fortis versus plain stem-final stops (i.e., preceding inflection) for all regular and pseudo-inflected stimuli.[16,17] (Recall that all stem-final stop targets were voiceless.)

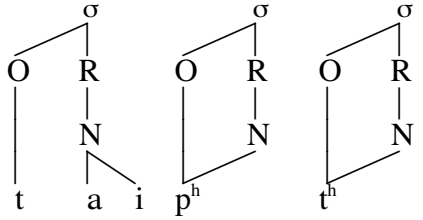
Table 6 Stem-final stops (past and perfective contexts)

Stem shape	Target-like (plain) release	Fortis release	Epenthesis (after stem-final C)	Deletion
Long stems (n=24)	21%	54%	25%	
Short stems and shortened long stems (n=86)	58%	34%	3%	5%
Pseudo-inflected stems (n=33)	73%	9%	3%	9%

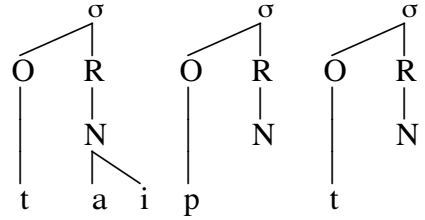
The number for long stems realized as long is small (n=24) because stems of this shape were frequently shortened (Table 4). One pattern is nevertheless robustly observed (54%): the stem-final stop is realized as fortis (e.g., [tai$\underline{p^h}\underline{t^h}$] 'typed'). The 21% of plain stem-final stops come from two subjects whose grammars are more target-like than the other subjects, while almost all cases of epenthesis come from one less advanced subject. Fortis release on the stem-final stop for long stems is entirely as expected. When the rhyme preceding the stem-final consonant is binary, there is no room in this syllable for the stem-final consonant without creating an illicit ternary rhyme. The stem-final consonant thus has no choice but to be syllabified in an independent syllable. As shown in (7a), in the ILGs in question, this segment is syllabified through ON sharing and is therefore realized as fortis. Compare the target representation in (7b) where the stem-final consonant is syllabified as an OEHS.

(7) Long stems:

a. IL syllabification:



b. Target syllabification:

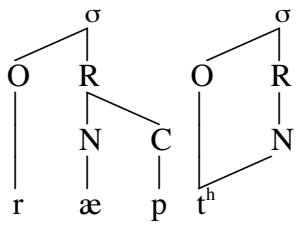


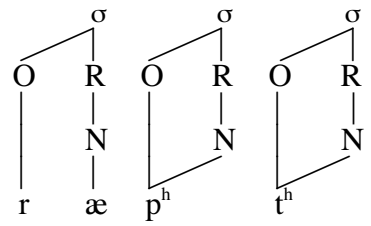
For the short(ened) stems in Table 6, two patterns of behaviour are observed. The stem-final consonant may appear as plain ([ræ$\underline{pt^h}$] 'wrapped'; [ta$\underline{pt^h}$] 'typed') or as fortis ([ræ$\underline{p^ht^h}$]; [ta$\underline{p^ht^h}$]), 34% versus 58% of the time. These findings correspond to the representations in (8a) and (8b), respectively.

[16] 60% of all epenthesis errors are due to one subject, and 71% of all deletion errors are due to another.

[17] The numbers for pseudo-inflected stems do not add up to 100%, as two forms have been excluded; these forms have a stem-final stop that is fortis, but the inflectional suffix has been deleted.

(8) Short stems and shortened long stems:

a. 

b. 

The absence of fortis release on the stem-final stop in (8a) suggests that this consonant is syllabified as a coda, as in the native English grammar (for short stems only (Goad, 2002); compare (6b) with (7b)). This representation requires demotion of the Mandarin constraint against obstruent codas. The representation in (8b), by contrast, avoids codas that are not permitted in the L1 grammar by syllabifying the stem-final consonant through ON sharing.

We now compare the short(ened) regular stems and the pseudo-inflected stems. As can be seen from Table 6, even though the two are segmentally parallel (short vowel+stop+inflection), the former is realized with a fortis or plain stem-final consonant, while the latter only surfaces with a plain stem-final consonant ([kɛpt^h], *[kɛp^{h}t^h] 'kept'). The contingency between inflection type (short(ened) regular vs. pseudo-inflected) and release (plain vs. fortis) is significant (χ^2 (1) = 6.591, $p < .01$).

d Adjunction has been acquired

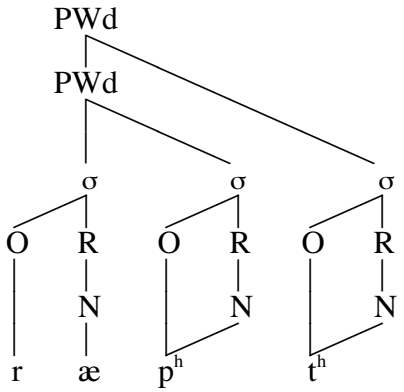
We have just observed that short(ened) regulars occur with either a fortis or plain stem-final consonant whereas pseudo-inflected forms surface only with a plain consonant. We propose that this is due to differences in higher prosodic structure: the L2 speakers have acquired the target representations for inflection; in the regulars, inflection is adjoined while *-t* in the pseudo-inflected forms is PWd-internal.

The explanation requires that we look at more elaborated representations, including both syllable and PWd structure. In (9a.i) and (9b.i), the stem-final stop is fortis; in (9a.ii) and (9b.ii), it is plain.

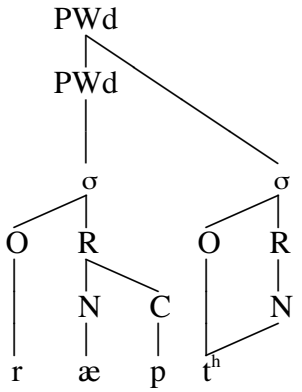
(9) L2 representations for stem-final stops in inflected contexts:

a. Short(ened) stems:

i. Expected (attested 34%):

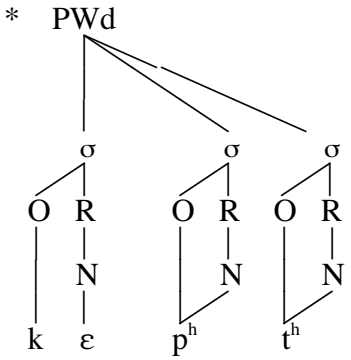


ii. Expected (attested 58%):

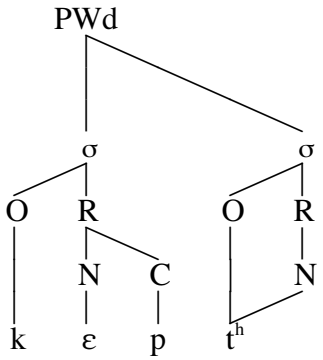


b. Pseudo-inflected stems:

i. Unexpected (attested 9%):



ii. Expected (attested 73%):



The crucial difference between the short(ened) regular and pseudo-inflected forms is that, in the latter case, the inflection is internal to the same domain (PWd) as the stem-final consonant (9b), consistent with the target representation (2b.i); whereas in the former case (9a), the inflection is adjoined, consistent with (2a.i), and so the consonants are separated by a domain boundary. Following in the spirit of the Empty Category Principle (ECP) from Government Phonology (informally expressed in (10)), we propose that adjacent instances of ON sharing (as in *[kɛp^{h}t^h]) are illicit where we interpret 'adjacent' as structurally contiguous within the lowest relevant domain (i.e., the PWd).

(10) Empty Category Principle (e.g., Kaye, 1990):
Adjacent syllables with empty nuclei are not permitted; empty nuclei must be licensed by a following segmentally-realized nucleus or by a domain edge.

The ECP regulates the distribution of syllables with empty nuclei. The parallel between such syllables and syllables involving ON sharing is that the nuclei in both are featurally impoverished. In the former, the nucleus is empty by definition; in the latter, it has acquired its segmental content from the preceding onset and so it contains no vocalic features. If we extend the ECP to the latter case, the result will be a universal ban against [...C^{h}C^h]$_{PWd}$ (as well as against [...CØCØ]$_{PWd}$) and this will be responsible for the lack of fortis release on stem-final consonants in pseudo-inflected forms.

In sum, the differential treatment of regular and pseudo-inflected forms with respect to fortis release on stem final consonants (Table 6) suggests that the L2 speakers are representing regular inflection differently from pseudo inflection, using adjunction only in the former case, as in the target grammar.[18]

[18] With the structures in (9), we can now return to the fact that fortis release is observed much more frequently on the inflection in pseudo-inflected forms than in regulars (Table 5). While both of these consonants are syllabified as onsets, the PWd structure differs in the two contexts, (9b.ii) vs. (9a). Indeed, the closest parallel for both syllable and PWd structure is between the inflection in pseudo-inflected forms (e.g., [(kɛp)$_σ$(t^h)$_σ$]$_{PWd}$ 'kept') and the stem-final consonant in long-stemmed regulars (e.g., [[(blɪŋ)$_σ$(k^h)$_σ$]$_{PWd}$ (t^h)$_σ$]$_{PWd}$ 'blinked'), both of which are syllabified as onsets at the right edge of the lower PWd. When we directly compare plain and fortis outputs for the underlined consonants in these two types of words (i.e., ignoring epenthesis and 'other'), the rate of fortis release is very similar, 83% and 72% respectively.

VIII Discussion

Our results argue against the RDH: there is no evidence of fossilization in the syntactic domain. Firstly, Mandarin-speaking learners of English proved to be very accurate in the sentence completion task, suggesting the presence of [±past] in the ILG. Secondly, there are no differences between past and perfective forms in production. Finally, although rates of suppliance of inflection were high, there are clear effects of stimulus type: long vs. short(ened) regulars and regulars vs. pseudo-inflected forms. Attention to fine phonetic detail has shed light on the prosodic representations used. The distribution of fortis release speaks to the syllabification of right-edge consonants and, most importantly, motivates a prosodic difference between regular inflection and pseudo inflection, the presence or absence of adjunction respectively.

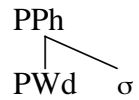
Compared to previous studies (Hawkins and Liszka, 2003; Goad, White and Steele, 2003), the Mandarin speakers under study were successful in accommodating L2 inflection. This is contrary to our original view (Goad, White and Steele, 2003) that Mandarin speakers would be permanently confined to a PWd-internal analysis of English inflection. Here, we have shown that they can build the adjunction structure required for English. That is, target-like prosodic representations are ultimately attainable for at least some functional material which is absent from the L1.

The prosodic category PWd is special in its ability to organize both lexical and functional material. This means that prosodic representations for lexical material in the L1 can be adapted to represent functional morphology in the interlanguage. In the case of English inflection, we argued that the necessary adjunction structure, (2a.i), can be built in the Mandarin-English ILG by combining existing representations from the L1: PWd-PWd, the structure required for organizing lexical compounds, (4a), and PWd-σ, the structure needed to prosodify three-syllable PWds, (4b). As most languages have compounding and permit syllables to link directly to the PWd in the case of lexical words longer than two syllables, learners from many L1s lacking adjunction should be in a position to build the structure required for English-type inflection.

Under our view, if the morphosyntactic representation of categories like Tense can be acquired, as our sentence completion data suggest, the phonological evidence available to learners (e.g., the attachment of regular inflection to long stems with no consequent shortening of the stem (section IV)) will lead to the construction of the appropriate prosodic representation in (2a.i), provided that both of the structures in (4) are available in the L1.

However, the PWd is not the only level of stucture which organizes functional material. In many languages, function words (e.g., articles in English) are organized higher in the prosodic tree, attaching directly to the phonological phrase (PPh), as in (11).

(11)



Lexical material cannot link directly to the PPh. Consequently, the PPh equivalents of (4a) and (4b), namely PPh-PPh and PPh-σ, only occur in languages that already allow functional material to link directly to the PPh. In other words, if a language permits PPh-σ, as in (11), the PWd-external syllable must be functional, while PPh-PPh only occurs in languages that allow recursion of clitics (e.g., French: [je [le [mange]$_{PWd}$]$_{PPh}$]$_{PPh}$ 'I it eat'). Hence, if an L1 grammar lacks the linking option in (11), the PTH predicts that appropriate prosodic representations will not be acquirable because such a representation cannot be built from existing L1 structures, unlike the adjunction structure in (2a.i).

In short, the PTH predicts that ultimate attainment will differ depending on whether the representation of functional morphology requires adjunction to the PWd or linking to the PPh. An appropriate L2 representation is much less likely to be achieved in the latter case, a claim that is supported by our earlier work on articles in the grammar of an endstate L2 speaker of English whose L1 is Turkish (Goad and White, 2004).

In conclusion, we have argued against the claim of the RDH that there is a permanent deficit in ILGs as far as representation of syntactic features like [±past] is concerned. Instead, we have suggested that, even if the L1 does not realize a particular feature, L2 speakers are able to acquire it. Nevertheless, we agree with the RDH that there are L1 effects on interlanguage representations. The PTH claims that learners are constrained by L1 prosodic representations, such that inflectional morphology requiring representations not instantiated in the L1 is initially problematic. We have proposed that appropriate representations can be built in certain circumstances, through combining licensing relations available from the L1 grammar. The results of our experiment suggest that these Mandarin-speaking learners of English were indeed able to acquire the adjunction structure needed for English, although this could only be determined from a fine-grained phonetic analysis of their outputs. At least in the case of PWd adjunction, then, native-like representations are attainable.

Appendix 1. Stimuli

Verb	Reg/Irreg	Stem length	Final segment before inflec	Contrasts examined (with targeted response)		
				pres/past	pres/perf	3SG/past
drip	reg-t	short	obstr	both	both	
wrap	reg-t	short	obstr	both		both
slip	reg-t	short	obstr	both	both	both
pick	reg-t	short	obstr	both		3SG
cook	reg-t	short	obstr	both		
stuff	reg-t	short	obstr		both	
laugh	reg-t	short	obstr	both		
plan	reg-d	short	son C	both		3SG
scan	reg-d	short	son C	both	both	
kill	reg-d	short	son C	both		
fill	reg-d	short	son C		both	3SG
die	reg-d	short	V	both		
tie	reg-d	short	V	both		
show	reg-d	short	V	both		
type	reg-t	long	obstr	both	perf	both
help	reg-t	long	obstr	both	perf	3SG
blink	reg-t	long	obstr	both	perf	both
clean	reg-d	long	son C	both	perf	3SG
smile	reg-d	long	son C	both	perf	both
rent	reg-ed		t/d	both		
plant	reg-ed		t/d	both		
melt	reg-ed		t/d	both		
load	reg-ed		t/d	both		
hide	ablaut		obstr	both		
ride	ablaut		obstr	both		
take	ablaut		obstr	both		
run	ablaut		son C	both		
win	ablaut		son C	both		
fall	ablaut		son C	both		
send	pseudo		son C	both		
spend	pseudo		son C	both	perf	
build	pseudo		son C	both	perf	
sell	pseudo		son C	both		
keep	pseudo		obstr	both	perf	
sleep	pseudo		obstr	both	perf	
leave	pseudo		obstr	both	perf	

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