

0 Introduction

Much linguistic research has focused on interlanguage (IL) deletion and epenthesis, most often within a typological framework (e.g. Eckman 1977, 1986, 1991, Eckman & Iverson 1993, Carlisle 1998). While typological analyses are generally descriptively and predictively adequate, they arguably have three important weaknesses. First, typological accounts have little to say about the nature of L2 learners' grammatical knowledge (Archibald 1988a). If interlanguages are natural linguistic systems (e.g. Corder 1967, Selinker 1972, Adjemian 1976), and linguistic research seeks to model the grammatical systems which underlie natural languages, the failure of typological accounts to characterize L2 learners' grammatical knowledge must be seen as problematic. Second, typological analyses have tended to adopt a linear conception of syllable structure. In light of research in non-linear phonology which has highlighted differences between linear strings and hierarchical phonological representation, including potentially different representations of word-final consonants (e.g. Piggott 1999, Goad & Brannen 2000), it would seem desirable to examine IL epenthesis and deletion phenomenon within a more fully articulated theory of syllable structure. Finally, while generally descriptively and predictively adequate, typological accounts lack explanatory power (e.g. Cairns & Feinstein 1982, Archibald 1998b, Steele 2000); indeed, they offer no principled explanation or motivation for IL deletion and epenthesis phenomena.

In this paper, I advance a representationally-based account of L2 learners' modification of target language syllable structure. The data presented come from a pilot study designed to test Mandarin learners' syllabification of French word-final liquid-obstruent and obstruent-liquid clusters. I hypothesize that IL deletion and epenthesis are related to structural differences in representation between the IL (i.e. transferred L1) and target grammars (e.g. Broselow & Park 1995, Archibald & Vanderweide 1996). More specifically, L2 learners modify target language syllabifications when the target representation requires prosodic licensing (e.g. Itô 1986, Goldsmith 1990) options not present in the IL grammar. Whether a learner deletes or epenthesizes depends on several factors, including the importance of segmental preservation between underlying and surface representations, and constraints on word shape.

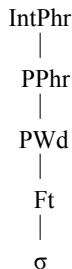
1 Syllabification of Word-Final CC Clusters

The present analysis is set in the Principles and Parameters framework of Universal Grammar (UG) (Chomsky 1981). Within this framework, linguistic principles account for structures attested in all languages, while cross-linguistic variation results from differences in parameter settings. In the following sections, I propose the principles relevant to word-final syllabification.

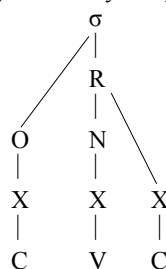
1.1 Prosodic Constituency and Licensing

It is widely accepted that UG provides a universal set of prosodic constituents, which include the Syllable (Φ), the Foot (Ft), the Prosodic Word (PWd), and the Prosodic (PPhr) and Intonational Phrases (IntPhr). These constituents are organized into the Prosodic Hierarchy (e.g. Selkirk 1980, McCarthy & Prince 1990), as illustrated in (1a). Syllables too are constructed from a set of universal constituents. I adopt Onset-Rhyme theory (e.g. Halle & Vergnaud 1978, Selkirk 1982) where syllable constituents, namely the Onset (O), Rhyme (R), and Nucleus (N),¹ are hierarchically organized as illustrated in (1b) below.

(1) a. Prosodic Hierarchy



b. Onset-Rhyme Theory of Syllable Structure



Furthermore, all phonological constituents are interrelated through the mechanism of Prosodic Licensing (2).

(2) PROSODIC LICENSING (cf. Itô 1986:2)

All phonological units must be prosodically licensed, i.e., belong to higher prosodic structure.

¹ Following Government Phonology (e.g. Kaye, Lowenstamm & Vergnaud 1990, Kaye 1990), I do not recognize the coda as a formal constituent. I will, however, use the term 'coda' informally to refer to post-nuclear rhymal consonants.

1.2 Constraints on Syllable Structure

Along with the set of phonological constituents and the mechanism of Prosodic Licensing, UG also provides principles governing constituent size and head-dependent relationships within syllable constituents, as well as constraints on sonority profile. As concerns constituent size, I adopt the view that phonological constituents are maximally binary; this is formalized in the Binary Theorem (e.g. Kaye 1990, Hayes 1991) in (3).

(3) BINARY THEOREM

Prosodic constituents² are maximally binary.

One direct consequence of constituent binarity is that only one post-vocalic consonant can be licensed within the rhyme (i.e. codas can not branch). Were a coda to branch, the rhyme would be ternary.

As concerns headedness, I assume that any syllable constituent minimally consists of a head and maximally consists of a head and its dependent. Furthermore, following Kaye, Lowenstamm & Vergnaud (1990), I assume that syllable constituents are universally left-headed.

Finally, I recognize the role of sonority in determining syllable wellformedness as formalized in the Sonority Sequencing Generalization (e.g. Selkirk 1984) and Syllable Contact Law (e.g. Vennemann 1972, Kaye, Lowenstamm & Vergnaud 1990) in (4). The relative sonority of segments is determined by the Sonority Hierarchy in (5).

(4) SONORITY SEQUENCING GENERALIZATION & SYLLABLE CONTACT LAW

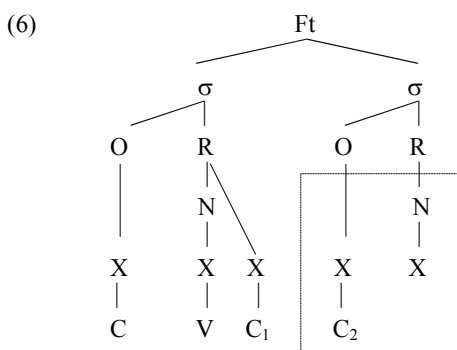
A string CVC₁C₂V will be syllabified as CV.C₁C₂V where sonority C₁<C₂ and as CVC₁.C₂V where sonority C₁∃C₂ (modulo language-specific constraints).

(5) SONORITY HIERARCHY (e.g. Clements 1990)

obstruent < nasal < liquid < glide < vowel

1.3 Representations of French Word-Final Liquid-Obstruent & Obstruent-Liquid Clusters

In this section, I will forward the representations for the target language clusters on which the learners were tested. Before doing so, I will need to discuss one further representational matter. To this point, our discussion of syllable structure has focused on prosodic constituents and segments; no mention has been made of the intervening timing tier represented with Xs in (1b). This tier consists of positions into which segmental material is organised. These slots play an important role in the representation of contour segments (e.g. affricates, prenasalized stops), long vowels and geminate consonants. If one adopts the view that such positions exist independently of the segmental content which they dominate, the possibility arises of having a timing position in the absence of phonetic content. Indeed, I assume that UG allows for the construction of syllables whose head (nucleus) is phonetically unrealized (on empty-headed syllables see Kaye 1990, McCarthy & Prince 1990, Piggott 1999, among others). As concerns word-final syllabification, the possibility of onsets of empty-headed syllables (OEHS) allows for two potential syllabifications of word-final consonants, either as codas or as OEHS.³ The representation of a final consonant syllabified as an OEHS is given in (6).



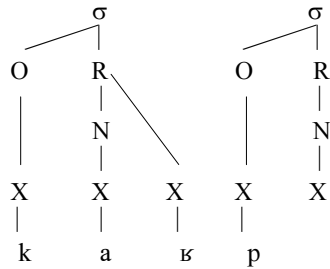
In the present study, Mandarin learners were tested on their syllabification of French word-final liquid-obstruent⁴ (e.g. *carpe* ‘carp’ /kaʁp/→[kaʁ.p]) and obstruent-liquid clusters (e.g. *lettre* ‘letter’ /lɛtʁ/→[lɛ.tʁ]). The representations for both types of clusters are given in (7) below.

² The Binarity Theorem holds only for prosodic constituents below the level of the Prosodic Word. For example, Prosodic Words may consist of multiple feet.

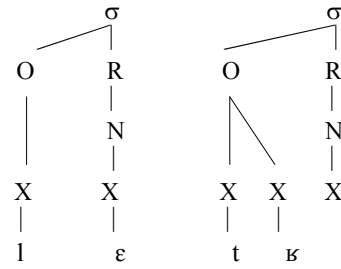
³ Languages will vary parametrically as to whether they permit OEHS. In the unmarked case, final consonants are syllabified as OEHS (e.g. Piggott 1999, Goad & Brannen 2000).

⁴ French /ʁ/, while phonetically realized as the uvular fricative [ʁ], patterns phonologically as a liquid. [ʁ] is also a segment in Mandarin.

(7) a. Liquid-Obstruent (e.g. [kaʁ.p])



b. Obstruent-Liquid (e.g. [lɛ.tʁ])



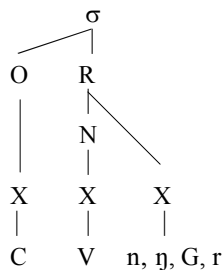
In the case of the liquid-obstruent cluster in (7a), the liquid is syllabified within the rhyme as a coda. Binarity (3) precludes syllabifying the obstruent within the rhyme; as French allows for OEHS (e.g. Charette 1991, Dell 1995, Piggott 1999), the final consonant of the cluster is syllabified as such. Note that the sonority and phonotactic properties of French liquid-obstruent clusters support the representation proposed in (7a). The decreasing sonority profile of word-final sequences such as [ʁp] parallels that of indisputable word-internal coda-onset sequences (e.g. *serpent* ‘snake’ [sɛʁ.pɑ̃]). Moreover, this decreasing sonority profile is the preferred coda-onset profile cross-linguistically.

The syllabification of the obstruent-liquid cluster (7b) differs from that of the liquid-obstruent cluster. This is not surprising given its mirror image (i.e. increasing) sonority profile. In French, word-final obstruent-liquid clusters are syllabified as branching OEHS (e.g. Charette 1991, Dell 1995, Piggott 1999). Once again, the sonority and phonotactic characteristics of these clusters support the representation given here. The Sonority Sequencing Generalization (4) requires that clusters with an increasing sonority profile be syllabified as a branching onset in the absence of language-specific phonotactic restrictions. Thus, the increasing sonority profile of French obstruent-liquid clusters is compatible with onset syllabification. Furthermore, all word-final obstruent-liquid clusters are possible word-initial and word-medial onsets (Dell 1995; e.g. *train* ‘train’ [tʁɛ̃], *controverse* ‘controversy’ [kɑ̃.tʁo.vɛʁ.s], *lettre* ‘letter’ [lɛ.tʁ]).

1.4 Mandarin Syllable and Word Structure

Mandarin, the learners’ L1, has a relatively simple syllable structure compared to that of French. Two characteristics of Mandarin syllable structure interest us in particular. First, consonant clusters are prohibited both word-initially and word-finally. Stated in terms of licensing, in Mandarin, an onset can license a head but not a dependent. Furthermore, OEHS are not permitted at all. Second, the Mandarin coda is a weak licenser, which is restricted to licensing glides, the nasals /n, ŋ/, and the approximant /r/.⁵ These two characteristics are illustrated in (8).

(8)



To this point, we have only discussed constraints on syllable shape. Languages can also place constraints on Prosodic Word shape, with such constraints usually making reference to word minimality or maximality. For example, in English, the minimal Prosodic Word is a bimoraic foot (e.g. [gɛt] but *[gɛ]). Following Yip (1994), I assume that the minimal Prosodic Word in Mandarin is not a bimoraic foot but rather a bimoraic syllable, with codas being moraic. Note that PWd minimality is not satisfied by two monomoraic syllables.⁶ Furthermore, as is the case in Chinese in general, Mandarin words tend towards monosyllabicity (Yip 1994:300).

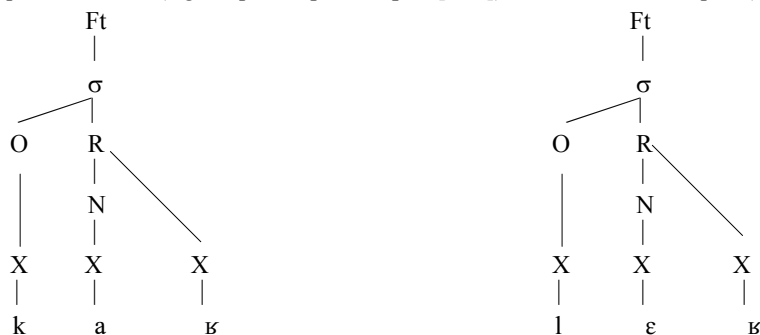
1.5 Hypothesized Forms for Mandarin Learners of French

Having outlined the differences in prosodic licensing options and word shape between Mandarin and French, we are now in a position to formulate specific hypotheses concerning Mandarin learners’ syllabification of French word-final liquid-obstruent and obstruent-liquid clusters. The predicted forms are given in (9).

⁵ /r/-final forms result from affixation only (e.g. Cheng 1966, Wiese 1986, Yip 1992).

⁶ Yip (p.c.)

- (9) a. Liquid-Obstruent (e.g. *carpe* ‘carp’ /kɑ̃p/→[kɑ̃]) b. Obstruent-Liquid (e.g. *lettre* ‘letter’ /lɛtʁ/→[lɛʁ])



Note that I assume that learners will treat /lC/ and /Cɹ/ forms in the same fashion as /rC/ and /Cr/ words (e.g. *bulbe* ‘bulb’ /bylb/→[byl] and *table* ‘table’ /tabl/→[tal]) even though the two liquids are not contrastive in Mandarin. Indeed, /l/ and /r/ tend to pattern together as concerns their syllabification cross-linguistically. For the purposes of the present analysis, the exact realization of the liquid as [l] or [ʁ] is of no consequence.

Both forms in (9) above result from the deletion of the obstruent. Deletion should be preferred over epenthesis. Epenthesis would create bisyllabic words (e.g. /kɑ̃p/→[kɑ̃.pə] and /lɛtʁ/→[lɛ.təʁ]). However, as stated in §1.4, Mandarin words tend towards monosyllabicity. While multisyllabic words are possible in Mandarin, they generally involve processes such as reduplication and compounding. I assume that learners will recognize that the French target forms are monomorphemic words and will consequently realize them as monosyllabic. In short, I hypothesize that complete segmental preservation is not possible given constraints on PwD shape in the learners’ L1 grammar.

Consequently, learners must resort to deletion. Deletion of the liquid would result in the surface forms [kap] and [let] respectively. Such forms present two serious problems. First, Mandarin does not permit word-final obstruents. Second, even were word-final obstruents permitted, both forms would be subminimal words as obstruents are not moraic in Mandarin.⁷

In §1.3, we saw that UG provides two possibilities for the syllabification of word-final obstruents, either as codas or as OEHS. Neither licensing option is available in the learners’ IL grammar. In order to avoid syllabifying the obstruent as a coda, the learners might delete the liquid and then epenthesize a vowel (e.g. [ka.pə] and [lɛ.tə]). Deletion of the liquid followed by epenthesis is not viable either as such forms would still be subminimal. Thus, rather than deleting the liquid, the learners will delete the obstruent and produce forms such as [kɑ̃] and [lɛʁ]. Such forms meet the constraint on PwD minimality, respect the preference for monosyllabic words, and are possible as concerns the types of segments that can be licensed in coda position in Mandarin.

In summary, learners will resort to deleting the obstruent resulting in forms such as [kɑ̃] and [lɛʁ]. Segmental preservation will be sacrificed to some extent in order to satisfy constraints on PwD shape and coda licensing.

2 Experiment

The general hypotheses outlined in the Introduction as well as the specific hypotheses presented immediately above were tested via the production experiment outlined in the following sections.

2.1 Experimental Group

The experimental group consisted of 5 native speakers of Mandarin whose average age was 30. None of the learners reported any knowledge of French prior to their arrival in Canada 4 months before the experiment. At the time of testing, the subjects had been enrolled for 3-4 weeks in an intensive French course at the Université du Québec à Montréal. The course, taught by a native speaker, consisted of 25 hours/week of formal instruction in the target language. Finally, the subjects reported little to no exposure or use of French outside of the classroom. Thus, it can be safely assumed that their primary input was the 75-100 hours of standardized French experienced within the classroom.

2.2 Test

The test consisted of two parts, a short grammar test and an oral production test. The grammar test, the Université Laval *Test de français langue seconde*, was given as an objective measure of the subjects’ proficiency in French. The scores obtained were comparable to those of the beginner English learners tested using the same instrument in Steele (2000). The elicited production test was designed to test the learners’ syllabification of the clusters under study. Fifty words in total were tested, including 12 liquid-obstruent clusters, 20 obstruent-liquid clusters, and 18 nasal-obstruent clusters. For the purposes of the present study, the nasal-obstruent clusters served as fillers. The clusters were controlled for voicing and place of articulation as shown in Table 1.

⁷ Even in Chinese dialects with obstruent codas such as Cantonese, obstruents are not necessarily moraic (Yip, p.c.).

	Liquid-Obstruent			Nasal-Obstruent			Obstruent-Liquid		
	Lab	Cor	Dors	Lab	Cor	Dors	Lab	Cor	Dors
Voiced	<i>courbe bulbe</i>	<i>corde tilde</i>	<i>orgue algue</i>	<i>bombe jambe rhombe</i>	<i>bonde dinde onde</i>	<i>gangue langue mangue</i>	<i>cible table ombre zèbre</i>	<i>cadre foudre</i>	<i>aigle sigle pagre tigre</i>
Voiceless	<i>carpe poulpe</i>	<i>porte volt</i>	<i>arc foulque</i>	<i>lampe tempe trompe</i>	<i>comte conte tente</i>	<i>banque conque scinque</i>	<i>couple temple câpre pourpre</i>	<i>huitre lettre</i>	<i>boucle socle ancre sacre</i>

Table 1. Cluster bank

The 50 words were divided into 10 groups of 5 words each. For each group of 5 words, the subjects completed the 3 tasks given in the order in Table 2 below. All of the subjects took the same version of the test.

Task	Description
1 st Task: Repetition	<i>Stimuli:</i> word and corresponding image are presented visually; recording of word is simultaneously presented twice aurally through headphones; <i>Response:</i> subject repeats the word aloud
2 nd Task: Reading	<i>Stimuli:</i> a sheet of five sentences is presented where each sentence contains one target word; words occur both phrase-medially and phrase-finally and are accompanied by small version of same images given in Repetition task; <i>Response:</i> subject reads each sentence aloud
3 rd Task: Naming	<i>Stimuli:</i> subject is presented with same images as in Repetition task, minus labels, and asked <i>Qu'est-ce que c'est?</i> ('What is this?'); <i>Response:</i> subject names images

Table 2. Task design

Both the grammar and production tasks were administered individually by the author. The production tasks were recorded with a Marantz tape recorder for subsequent transcription.

3 Data

Each of the testing sessions was first transcribed by the author. Transcription was restricted to the 12 liquid-obstruent and 20 obstruent-liquid clusters in each of the tasks. The transcriptions were then verified with the help of a professional linguist trained in phonetics. Cases where the two transcribers could not agree were excluded. Finally, the tokens were coded in terms of the categories in Tables 3 and 4, with the categories being based on linear surface order.

The data presented in the following sections comes from the Naming Task only. This data is arguably the most representative of the learners' underlying competence for two reasons. First, the memory component of the Naming task makes rote memorization and chunking of the forms, a potential confounding factor in the Repetition task, less likely. Second, the Naming task is less likely to be affected by orthography-influenced pronunciations (cf. Young-Scholten 1995) than the Reading Task.

3.1 Liquid-Obstruent Clusters

The data from the Naming task for the word-final liquid-obstruent clusters (e.g. Target [kaɹp]) is given below.

Subject	n	Segmental Preservation				Deletion				Metathesis	
		Target-like		C ₁ vC ₂	C ₁ vC ₂ v	Del C ₁	Del C ₁ + v	Del C ₂	DelC ₁ C ₂	C ₂ C ₁	C ₂ C ₁ v
C ₁ C ₂	C ₁ C ₂ v										
NF7C	9		.11	.11		.33	.33	.11			
NF3C	6		.17			.50	.33				
NF4C	6		.17			.33	.17		.33		
NF6C	9	.11	.11		.33	.22				.11	.11
NF2C	7	.29				.29				.43	
<i>Average</i>		.08	.11	.03	.08	.32	.16	.03	.05	.11	.03

Table 3. Learners' syllabification of word-final liquid-obstruent clusters

Liquid substitutions were not counted as errors. Three characteristics of the data merit comment. First, only 19% of the learners' syllabifications were target-like (i.e. C_1C_2); for that matter, the ten native controls tested syllabified the liquid-obstruent clusters as expected (i.e. C_1C_2 [kaʁ.p]: 55%) or with a final epenthetic vowel (i.e. C_1C_2v [kaʁ.pə]: 45%). Note that such forms differ only in whether or not the head of the second syllable is phonetically realized. Second, the learners' preferred syllabification means unexpectedly involved deletion of the liquid C_1 (Del C_1 [kap]: 32%, Del C_1+v [kapə]: 16%, Total: 48%). Finally, there were almost no cases (8%) where the learners deleted the obstruent C_2 while preserving the liquid (i.e. /kaʁp/→[kaʁ]), contrary to the hypothesis forwarded in §1.5.

3.2 Obstruent-Liquid Clusters

The subjects' syllabification of the obstruent-liquid clusters (e.g. Target [lɛtʁ]) is given in Table 4.

Subject	n	Segmental Preservation				Deletion				Metathesis	
		Target-like		C_1vC_2	C_1vC_2v	Del C_1	Del C_2	Del $C_2 + v$	Del C_1C_2	C_2C_1	$C_2C_1 v$
		C_1C_2	C_1C_2v								
NF4C	14		.14				.50	.36			
NF2C	16	.06	.63				.19	.13			
NF7C	15	.07	.27	.20	.13		.20	.13			
NF6C	17	.18	.59				.06			.18	
NF3C	12	.50	.42					.08			
Average		.15	.42	.04	.03		.19	.14		.04	

Table 4. Learners' syllabification of word-final obstruent-liquid clusters

In contrast to the liquid-obstruent clusters, in the case of the obstruent-liquid clusters more than half of the learners' syllabifications were native-like and involved branching onsets (C_1C_2 [lɛtʁ]: 15%, $C_1C_2 + v$ [lɛtʁə]: 42%, Total: 57%); the native speaker controls syllabified the obstruent-liquid clusters once again as expected (i.e. C_1C_2 : 35%), sometimes using epenthesis (i.e. C_1C_2v : 65%). However, as was the case with the liquid-obstruent clusters, one-third of the Mandarin learners' syllabifications involved deletion of the liquid (Del C_2 [lɛt]: 19%, Del $C_2 + v$ [lɛtə]: 14%, Total: 33%). Finally, there were no cases of the syllabifications predicted in §1.5 (i.e. Del C_1).

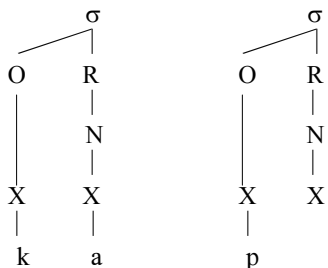
4 Analysis

We have seen that the Mandarin learners of French often deleted the liquid in syllabifying both the liquid-obstruent (i.e. [kap]) and obstruent-liquid (i.e. [lɛt]) clusters. We have also observed that, while their syllabification of obstruent-liquid clusters was native-like in just over half of all cases, their syllabification of liquid-obstruent clusters was native-like in only 20% of all cases. I will now propose a representationally-based account of these facts.

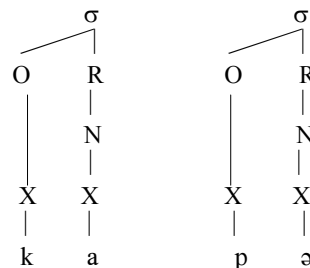
4.1 Liquid-Obstruent Clusters

The learners' preferred syllabification of the liquid-obstruent clusters involved deletion of the liquid (i.e. Del C_1 or Del $C_1 + v$). The representations I propose are given in (10) below.

(10)a. Del C_1 (i.e. [kap])



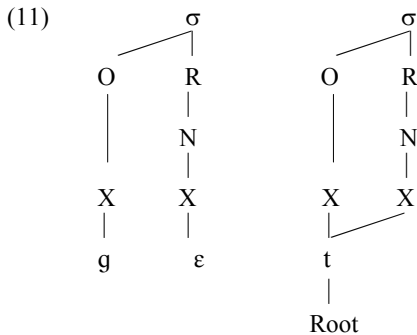
b. Del $C_1 + v$ (i.e. [kapə])



As stated in §3.1, these two representations differ only in whether or not the nucleus of the second syllable is spelled out. The question arises as to why the word-final obstruent in (10a) is represented as an OEHS, and not as a coda. The evidence for the OEHS representation of the final obstruents comes from their release properties: for both the liquid-obstruent and obstruent-liquid clusters, the learners (heavily) aspirated the word-final obstruent (Subject 1: 89.1%; Subject 2: 97.6%; Subject 3: 92.7%; Subject 4: 100%; Subject 5: 92.7%; Average: 94.0%). For example, a liquid-

obstruent target form such as [kɑp] was not produced as [kap] but rather as [kap^h], and an obstruent-liquid target form such as [lɛtʁ] was realized as [lɛt^h] in those cases where the liquid was deleted (i.e. Del C₂ in Table 4).

Heyer (1986) similarly reports that Mandarin learners of English ‘hyperaspirated’ word-final voiceless stops. Thus, the aspiration observed in the present study is most likely not an artefact of the task. Rather, following Goad & Brannen’s (2000) proposal for child English, I assume that the word-final aspiration is a consequence of the learners’ representation of the final obstruent as an onset, not a coda. Cross-linguistically word-final consonants are arguably syllabified as OEHS in the unmarked case (Piggott 1991, Goad & Brannen 2000).⁸ Furthermore, syllabifying the final obstruent as an onset allows the learner to avoid the marked coda representation while being faithful to the obstruent. Goad & Brannen forward such an analysis for a stage in child phonology where obstruent-final forms are characterized by four properties: lengthening of the preceding vowel, post-vocalic pause, final aspiration, and homorganic nasal release. These authors propose that all four of these properties result from the children’s syllabification of the final stops as shown in (11).



The vowel lengthening and post-vocalic pause are the direct consequence of the first syllable [gε] being open. Final aspiration and homorganic nasal release are the phonetic interpretation of a consonant released into the nucleus. I assume that the Mandarin learners in the present study are representing final obstruents in the same fashion.

While a form such as [ka.p^h] may be wellformed as concerns segmental licensing, it would seem to be ill formed as concerns PWd minimality. Recall from §1.4 that the minimal word in Mandarin is a bimoraic syllable and that a word consisting of two monomoraic syllables is subminimal. Neither syllable in a form like [ka.p^h], or, for that matter, any syllable lacking a long vowel or coda consonant, satisfies PWd minimality. I do not assume that learners are analyzing the target vowels as bimoraic (i.e. long) as French has no vowel length contrasts. There is consequently no evidence for vowel length in the input to which the learners are exposed. Rather, I propose that the learners have reformulated the minimal word constraint in their IL grammar. Such a possibility seems entirely logical given that French is a language where there is no evidence for the mora as the relevant unit for foot construction. Indeed, in French, stress always falls on the final (non-schwa) syllable. Such a fact can be formalized by stating that a non-iterative iamb is constructed at the right edge (e.g. Charette 1991).⁹ Thus, a Mandarin learner of French could correctly assume that moras are irrelevant to foot shape in French and that a PWd minimality constraint, if it exists, must be formulated differently. Cross-linguistically, languages require minimal words to be either bimoraic or bisyllabic. I hypothesize that the Mandarin learners, in the absence of evidence for the role of the mora in French, have assumed that the minimal word in French is bisyllabic. Such a hypothesis would be consistent with learners producing bisyllabic forms like [ka.p^h] and [ka.pə], where in the former the final aspirate occupies the nucleus as well as the onset (11).

Thus, while the surface form in (11) is not completely segmentally faithful to the target form, the obstruent is nonetheless preserved and the form meets the reformulated word minimality constraint in the learners’ IL grammar. To this point, no principled reason has been advanced to explain why the obstruent, and not the liquid, is preserved, as was predicted in §1.5. The preservation of the obstruent over the liquid cannot be phonetically motivated. While it is true that the /l/-/r/ distinction of languages like French and English is notoriously difficult for second language learners whose L1 phonemic inventory does not contain the contrast, French [ʁ] is also a segment in Mandarin (see note 6). Thus, the learners’ deletion of the liquid in word-final clusters cannot be related to articulatory difficulty. An alternative phonetic explanation is that the learners are preserving the least sonorous segment. Such an explanation is not implausible as child learners of many languages reduce onset clusters via deletion of the more sonorous segment (e.g. Fikkert 1994, Gnanadesikan 1995). However, while a sonority-based account of the deletion would make sense were the clusters word-initial, this explanation cannot hold for word-final clusters. Cross-linguistically, the best codas are

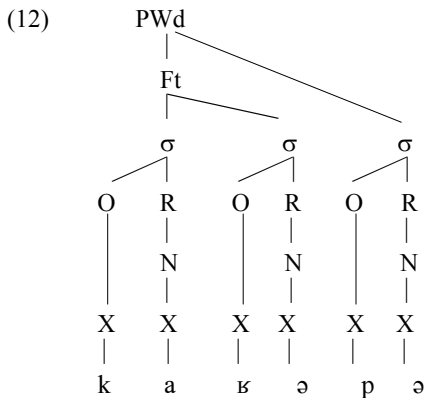
⁸ Note that the representation forwarded by Goad & Brannen in (11) differs slightly from that of an OEHS. However, I will assume that the representation is nonetheless unmarked.

⁹ Note that OEHS and syllables containing schwa cannot be in the head position of the foot. Thus, the footing of a word such as *révolte* ‘revolt’ /revɔlt/ must be (re¹vɔl)t or (re¹vɔl)tə, but critically not *(re(vɔl)tə). In such cases, the foot is constructed with the head (i.e. stress) being located one syllable from the right edge.

sonorants. If sonority were the relevant factor in determining which member of the cluster deletes, learners should delete the obstruent and not the liquid, as the latter has a better coda profile. For that matter, the only codas permitted in the learners' L1 are sonorants, as mentioned above.

Once again, I propose that the explanation for the preservation of the obstruent over the liquid is best understood with reference to representation. Recall from §1.2 that all phonological constituents must consist of a head. Moreover, syllable constituents are universally left-headed. Based on the representations in (7), it is the obstruent which occupies a head position (i.e. of the OEHS) in both liquid-obstruent and obstruent-liquid clusters. Contrastingly, in both types of clusters the liquid is in a dependent position, i.e. the dependent position of the rhyme in a liquid-obstruent cluster and the dependent position of the branching OEHS in the obstruent-liquid cluster. I contend that the learners' deletion is motivated by head preservation. The learners' grammars recognize the head status of the obstruent and consequently preserve it. It has similarly been argued (Goad & Rose to appear) that head preservation plays an important role in the L1 acquisition of branching onsets.

Let us now consider the learners' disfavoured outputs. It has often been suggested that, whereas the L1 acquisition of phonology is characterized by deletion, epenthesis typifies L2 phonological acquisition (e.g. Weinberger 1994). If it is indeed the case that epenthesis is common in L2 acquisition, we should expect that a Mandarin learner of French will resort to epenthesis in order to syllabify complex clusters, particularly when they occur word-finally. On the assumption that beginner Mandarin learners' IL grammar does not allow for the licensing of obstruent codas or OEHS, the target form [kaɛp] might surface as [ka.ɛə.pə]. Such a form would allow for complete segmental preservation and would respect the syllable structure of the learners' IL grammar. If L2 learners seek to preserve segmental content where possible (Steele 2000), epenthesis should indeed be highly favoured. However, as shown in Table 4, only 1 of the 5 learners produced any such forms. In order to understand why epenthesis was not more prevalent, consider the representation of a form like [ka.ɛə.pə] given below.

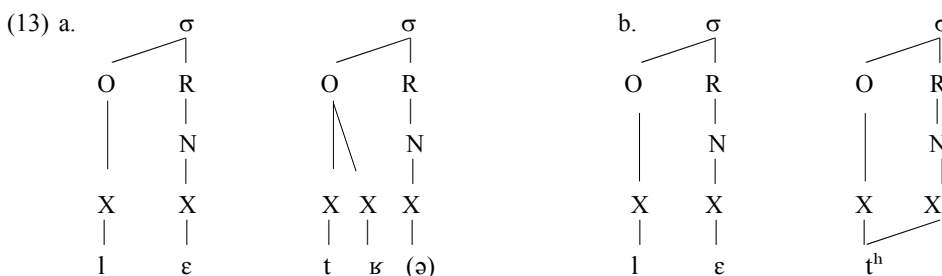


While the representation above respects Mandarin syllable structure, a form like [ka.ɛə.pə] is ill formed as concerns licensing. Given that binarity precludes the construction of a ternary foot, the third syllable must be indirectly licensed by the PWd. Yet such a licensing option is unavailable in the learners' IL grammar. A second problem with such a form concerns headship. Under a strict interpretation of head preservation, not only must heads be preserved, but segments licensed as dependents in the target form should not be syllabified as heads in the learner's surface form. Yet the form in (12) places the liquid [ɛ], which is syllabified in the dependent position of the rhyme in the target representation in (7a), into a head position.

In summary, a representation such as that in (12) requires a licensing option absent from the learners' IL grammar, and violates head preservation. Both the favoured and disfavoured syllabifications attest to the importance of the wellformedness of representations, where deletion may be permitted in order to satisfy constraints on Ft/PWd shape.

4.2 Obstruent-Liquid Clusters

The learners' preferred syllabifications of the obstruent-liquid clusters are given in (13). While the form in (13b) is identical to that of the liquid-obstruent cluster in (11), the form in (13a) differs in two important ways. First, the forms [ɛ.tɛ] or [ɛ.tɛə] represented in (13a) involve a branching onset. The presence of branching onsets in the surface forms of beginner Mandarin learners of French is highly surprising based on the L1 grammar. There thus appears to be an asymmetry between complex onsets and codas in the learners' IL grammar, with the former being acquired more readily. What is perhaps even more interesting is that 57% of their surface forms (i.e. Table 5 - C₁C₂ [ɛ.tɛ]: 15%; C₁C₂v [ɛ.tɛə]: 42%) were native-like. In both representations, codas are avoided, and the constraint on headship, as well as the reformulated PWd minimality constraint, are respected.



5 Conclusion

This paper has demonstrated that a representationally-based account of IL deletion and epenthesis achieves explanatory adequacy in a way not possible with typological accounts; L2 learners' grammars can best be understood in terms of abstract, hierarchical representations. It was demonstrated that deletion and epenthesis occur when differences in the wellformedness of representations exist between the learners' L1 and the target grammar. As concerns word-final syllabification, the differences are directly related to the types of Prosodic Licensing permitted in the IL grammar. The beginner Mandarin learners studied here deleted segments when such segments could not be properly licensed. The choice of deletion over epenthesis (contra e.g. Weinberger 1994) was motivated by a constraint on maximal Prosodic Word size. The choice of which segment to delete was also related to representation; as is the case in L1 acquisition, the Mandarin learners preserved constituent heads where possible. As concerns the order and difficulty of acquisition of new prosodic structure, it would seem that new licensing options are acquired more readily with constituents lower on the Prosodic Hierarchy; branching onsets (13a) were acquired before indirectly licensed syllables (12). Finally, transfer alone could not explain learners' syllabifications. Coda syllabification was highly disfavoured, in spite of the presence of liquid codas in the learners' L1 (8). The absence of codas was attributed to other constraints on representation.

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