

# **Phonetic Cues to Phonological Acquisition: Evidence from L2 Syllabification**

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## **1. Introduction**

Cues, that is, those properties of the input which trigger acquisition, play a central role in all theories of language acquisition. It is thus somewhat surprising that relatively little research in either first (L1) or second (L2) language acquisition has focused on the elaboration of a theory of cues (but see e.g. Lightfoot 1989, Carroll 1999 for syntax; Dresher & Kaye 1990, Archibald 1994, Fikkert 1994 for phonology).

In this paper, I seek to contribute to the elaboration of such a theory of cues. Using data from a study of word-final syllabification (Steele 2000a), I argue that phonetic properties of the input serve as cues for parameter setting in the acquisition of syllabification. In the original study, English learners of French were tested on their syllabification of word-final liquid-obstruent, nasal-obstruent, and obstruent-liquid clusters via three elicited production tests. It was hypothesized that the early learners' syllabification of all three types of clusters would be consistent with their L1 grammar (i.e. Full Transfer; e.g. Schwartz & Sprouse 1994). While the prediction held for both the liquid-obstruent and nasal-obstruent clusters, it did not hold for the obstruent-liquid clusters. I argue here that the learners' non-L1-like syllabification of the obstruent-liquid forms does not constitute evidence against the Full Transfer hypothesis. Rather, the English learners had already reset parameters relevant to the syllabification of these clusters in the presence of positive evidence. Specifically, I contend that phonetic properties of the target forms, particularly liquid devoicing, served as cues for parameter resetting.

This paper is structured as follows. In §2, I briefly outline my assumptions concerning the nature of acquisition and the characteristics of good cues. The original experiment and relevant data is presented in §3. In §4, I evaluate the Full Transfer hypothesis. While I show that transfer alone cannot account for the obstruent-liquid forms, I nonetheless argue that the obstruent-liquid data do not constitute evidence against Full Transfer. Instead, I hypothesize that the English learners have reset parameters relevant to the syllabification of the obstruent-liquid clusters, specifically the parameter governing whether branching onsets at the right edge of words are licit, using phonetic evidence as cues. In §5, I forward evidence supporting this hypothesis. I conclude briefly in §6.

## 2. The Nature of Acquisition and Characteristics of Good Cues

The current research is conducted within the Principles and Parameters theory of generative grammar (Chomsky 1981). Within this theory, principles account for linguistic universals, or structures and properties observed in all languages, while parameters account for cross-linguistic variation. Acquisition consists of parameter setting in the presence of positive evidence containing good cues. Following Dresher & Kaye's (1990) cue-based model of the acquisition of metrical phonology, I assume that a good cue must be both appropriate and robust.<sup>1</sup> A cue is appropriate if it is in a principled relation with its parameter. For example, sonority is relevant to syllabification and, thus, an appropriate cue for a syllabification-related parameter may make reference to sonority (e.g. manner, voicing).<sup>2</sup> A cue is robust if it is not likely to be obscured by language-specific rules or exceptions.

## 3. Background Study

As mentioned above, the data under investigation come from a previous study (Steele 2000a), which investigated English learners' syllabification of French word-final liquid-obstruent, nasal-obstruent, and obstruent-liquid clusters. In the following sections, we will review this study, focusing particularly on the data from the learners' syllabification of the obstruent-liquid clusters; these data alone provide evidence for parameter resetting and for the role of phonetic cues in the earliest stages of phonological acquisition.

### 3.1. Structure under Investigation: Obstruent-Liquid Clusters

Both English and French permit word-final obstruent-liquid clusters, as illustrated by the English-French cognate *couple* 'couple' in Table 1 below.

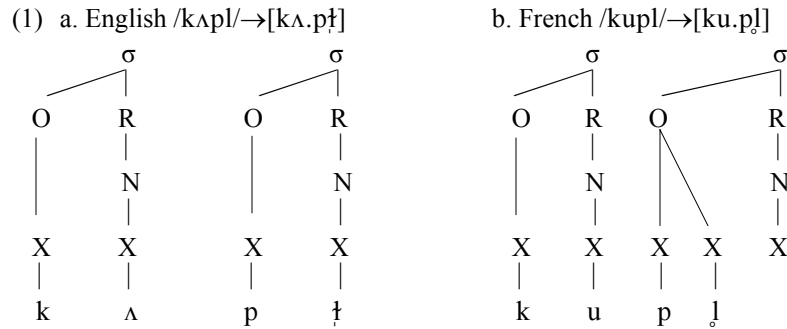
**Table 1. English and French Obstruent-Liquid Clusters**

	UR	SR
English (L1)	/kʌpl/	[kʌ.pʔ]
French (L2)	/kupl/	[ku.p <sub>2</sub> ]

Whereas the underlying representation (UR) of such clusters is identical in both languages, their surface realization (SR) differs. In English, the lateral of a word-final obstruent-liquid cluster is both syllabic and velarized. In contrast, in French, the lateral is devoiced and bears no secondary articulation.

### 3.1.1. Representation of English and French Obstruent-Liquid Clusters

I assume that L2 learners' linguistic knowledge includes abstract phonological representations (e.g. Broselow & Park 1995, Archibald 1998). The representations for the English and French obstruent-liquid clusters are in (1).



The differences in phonetic realization detailed in §3.1 reflect differences in the representation of these clusters. As shown in (1), in both English and French, the obstruent of a word-final obstruent-liquid cluster is syllabified as an onset. Note, however, that these onsets differ in one important respect. While the nuclear position following the /p/ of the English cluster is occupied by the liquid, the /p/ of the French cluster is syllabified in the onset of an empty-headed syllable (OEHS) (see esp. Charette 1991, Dell 1995). As concerns the liquids, the English liquid is syllabified within the nuclear position. Contrastingly, the French liquid is syllabified in the dependent position of the OEHS.

Within the Principles & Parameters framework, such differences in syllabification can be accounted for by differences in parameter settings. The parameter settings relevant to the syllabification of word-final obstruent-liquid clusters are given in Table 2.

**Table 2. Relevant Parameter Settings for Obstruent-Liquid Clusters**

	(1) OEHS		(2) SYLLABICITY	
	a. Possible	b. Branching	Vowels	Sonorant Consonants
English (L1)	✓	✗	✓	✓
French (L2)	✓	✓	✓	✗

The first parameter (1a) concerns the possibility of OEHS in a given language. In both English and French, OEHS are possible (e.g. Piggott 1999). The second parameter (1b) determines whether or not OEHS may branch. While OEHS are illicit in English, French allows such branching onsets. The third parameter (2) governs syllabicity, that is which classes of segments may be syllabified as

nuclei. French has the most restrictive setting, allowing only vowels to be syllabic. Contrastingly, in English, both vowels and sonorant consonants may be syllabic. In summary, the differences between English and French in the syllabification of obstruent-liquid clusters are related to differences in parameter settings, namely whether or not OEHS may branch (English: No, French: Yes) and whether sonorant consonants can be syllabic (English: Yes, French: No).

### 3.2. Subjects

Thirty-eight learners of French, all native speakers of (North) American English, as well as ten French Native Speaker controls, participated in the experiment. Relevant subject group characteristics are given in Table 3 below.

**Table 3. Subject Group**

Group	<i>n</i>	Average Age	Exposure to French
Novice	9	22	30 hours (2-3 weeks intensive instruction)
Beginner	7	19	36 hours (1 semester)
Intermediate	12	21	Beginning on average at 7 yrs of age
Advanced	10	24	Beginning on average at 11 yrs of age
Native Speaker	10	26	

### 3.3. Test Design

The learners were tested on their syllabification of the 50 word-final clusters (liquid-obstruent: *n*=12; nasal-obstruent: *n*=18; obstruent-liquid: *n*=20) given in Table 4. The clusters were controlled both for voicing and for place of articulation. All of the words on which the learners were tested were phonetically monosyllabic and monomorphemic/uninflected.

**Table 4. Cluster Bank**

	Liquid-Obstruent			Nasal-Obstruent <sup>3</sup>			Obstruent-Liquid		
	Lab	Cor	Dor	Lab	Cor	Dor	Lab	Cor	Dor
+vce	<i>courbe</i> <i>bulbe</i>	<i>corde</i> <i>tilde</i>	<i>orgue</i> <i>algue</i>	<i>bombe</i> <i>jambe</i> <i>rhombe</i>	<i>bonde</i> <i>dinde</i> <i>onde</i>	<i>gangue</i> <i>langue</i> <i>mangue</i>	<i>cible</i> <i>table</i> <i>ombre</i> <i>zèbre</i>	<i>cadre</i> <i>foudre</i>	<i>aigle</i> <i>sigle</i> <i>pagre</i> <i>tigre</i>
-vce	<i>carpe</i> <i>poulpe</i>	<i>porte</i> <i>volt</i>	<i>arc</i> <i>foulque</i>	<i>lampe</i> <i>tempe</i> <i>trompe</i>	<i>comte</i> <i>conte</i> <i>tente</i>	<i>banque</i> <i>conque</i> <i>scinque</i>	<i>couple</i> <i>temple</i> <i>câpre</i> <i>pourpre</i>	<i>huitre</i> <i>lettre</i>	<i>boucle</i> <i>socle</i> <i>ancre</i> <i>sacre</i>

Tokens were elicited using the three tasks described in Table 5. All learners took the same version of the test which included all 50 clusters, randomized into ten groups of five. All 50 clusters were tested in each of the three tasks.

**Table 5. Elicitation Tasks**

Task	Description
1 <sup>st</sup> 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 word aloud
2 <sup>nd</sup> 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 a small version of same images as in Repetition task; <i>Response:</i> subject reads each sentence aloud
3 <sup>rd</sup> 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 the images

### 3.4. Original Hypothesis: Full Transfer

As stated earlier, the original study set out to test the Full Transfer hypothesis (e.g. Schwartz & Sprouse 1994; Broselow & Finer 1991, Broselow & Park 1995, Archibald 1994, 1998 for phonology). Under this hypothesis, interlanguage grammars consist of principles and parameters provided by Universal Grammar (UG), with parameters set to the values of the learner's L1 at the earliest stage of acquisition. As concerns the obstruent-liquid clusters, it was hypothesized that early English learners would syllabify such clusters as onset-nuclear sequences, consistent with the L1 English parameter settings and representations in §3.1.

### 3.5. Results for Obstruent-Liquid Clusters

Each of the test sessions was recorded for subsequent transcription by the author. Transcriptions were then verified by one of two people, the first a native speaker of French, the second a professional linguist; both had previous experience in the transcription of experimental data. Once verified, the data were tallied. Individual and group means were then calculated.

As the Full Transfer hypothesis concerns initial state grammars, we will restrict our discussion to the Novice group who had the least amount of exposure to French; their grammars are arguably the most representative of true initial L2 grammars. The Novice learner data for the obstruent-liquid clusters are given in Table 6. Syllabification categories are based on surface order; 'C<sub>1</sub>'

refers to the obstruent, ‘C<sub>2</sub>’ to the liquid, ‘Del’ to the deletion of the segment specified, and ‘v’ to epenthesis of a vowel, most often [ə].

**Table 6. Novice Group’s Syllabification of Obstruent-Liquid Clusters**

<i>Task</i>	<i>n</i>	<i>Segmental Preservation</i>		<i>Consonant Deletion</i>			
		C <sub>1</sub> C <sub>2</sub>	C <sub>1</sub> C <sub>2</sub> v	Del C <sub>1</sub>	Del C <sub>1</sub> + v	Del C <sub>2</sub>	Del C <sub>2</sub> + v
Repetition	176	.31	.66			.02	.01
Reading	161	.24	.71			.03	.02
Naming	154	.18	.79			.03	

Note that in Table 6, preservation of ‘C<sub>2</sub>’ represents almost without exception a non-syllabic liquid. The Novice learners only realized a total of 6 of the 491 obstruent-liquid tokens (i.e. 1%) with a syllabic liquid (subject NF1: 3x [sib<sup>l</sup>], subject NF4: 1x [sib<sup>l</sup>]; subject NF9: 2x [tæb<sup>l</sup>]). The Novice learners’ preferred syllabification across tasks was ‘C<sub>1</sub>C<sub>2</sub>v’ (e.g. [kuplə]); that is, word-final obstruent-liquid clusters were most often syllabified as branching onsets via epenthesis. The second most common strategy was ‘C<sub>1</sub>C<sub>2</sub>’ (e.g. [kupl]); that is, word-final clusters were syllabified as branching OEHS.

#### 4. Hypothesis Evaluation

The Novice learners’ preferred syllabifications ‘C<sub>1</sub>C<sub>2</sub>v’ and ‘C<sub>1</sub>C<sub>2</sub>’ are inconsistent with transfer; their native English grammar would generate ‘C<sub>1</sub>C<sub>2</sub>’ forms in which the liquid is syllabic. Syllabifications of the form ‘C<sub>1</sub>C<sub>2</sub>v’ and ‘C<sub>1</sub>C<sub>2</sub>’ clearly show that the learners’ L2 grammar differs, at least in some aspects, from that of their L1. There are two possible explanations for such a fact. The first explanation is that the Full Transfer hypothesis is incorrect and that the Novice learners’ initial grammars differed from those of their L1. The second explanation is that Full Transfer is correct, but that the data in question are not representative of the initial state. Rather, the data in question are generated by grammars in which parameters relevant to the syllabification of the obstruent-liquid clusters have already been reset.

At this point, we face a dilemma. It would appear that the only way to determine which of the two explanations is correct is to determine whether or not the learners’ forms are generated by initial (i.e. transferred L1) grammars. However, as White (2000) clearly points out, such a task is highly problematic as one can always postulate the existence of an ‘earlier’ grammar. Fortunately, there is another way to determine which of the two explanations better accounts for the data. If one chooses to argue that the obstruent-liquid data constitute evidence against Full Transfer under the assumption that such data are generated by an initial state grammar, then one must provide an alternative theory of the initial state. Two such theories exist, the No Transfer and Partial Transfer hypotheses. As concerns the L2 acquisition of phonology, the No Transfer

hypothesis can be swiftly rejected; previous research on L2 phonology, including research on syllabification (e.g. Eckman 1986, Osburne 1996, Steele 2000b), has shown a strong role for the L1 grammar in the L2 acquisition of phonology. Moreover, the Novice learners' syllabification of the liquid-obstruent and nasal-obstruent clusters was highly consistent with the relevant parameter settings of their L1.<sup>4</sup> The only remaining alternative to Full Transfer is Partial Transfer. Under Partial Transfer, it is assumed that L2 learners transfer only some of the properties of the L1 into the interlanguage grammar. For example, in the acquisition of syntax, it has been proposed that learners transfer lexical but not functional categories (e.g. Vainikka and Young-Scholten 1994). Given the Novice learners' preferred forms 'C<sub>1</sub>C<sub>2</sub>v' (e.g. [kuplə]) and 'C<sub>1</sub>C<sub>2</sub>' (e.g. [kupl]), one could propose that, while the learners transferred the L1 parameter setting allowing for branching onsets (i.e. [pl] of [ku.plə]), they did not transfer the English setting of the syllabicity parameter (parameter (2) in Table 2). There is, however, a serious logical problem with such an argument. While No Transfer and Full Transfer assume that transfer is categorical, Partial Transfer requires that only some properties of the L1 are instantiated in the initial L2 grammar. Arguably, a learner must have some clear, non-arbitrary criterion for determining which properties and parameter settings transfer and which do not. While the distinction between lexical and functional categories might constitute such a criterion, the distinction between a parameter governing branching structures and a parameter governing syllabicity does not. A Partial Transfer account can forward no principled explanation for the asymmetry in the transfer of L1 parameter values that would be necessary to explain the English learners' syllabification of the obstruent-liquid clusters.

Lacking evidence to refute Full Transfer, we have no choice but to adopt the second explanation: the syllabifications are representative of a non-initial state grammar in which parameters have been reset in the presence of good cues. Evidence to support this explanation will be forwarded in the following section.

## **5. Parameter Resetting in the Presence of Phonetic Cues**

If we are to argue that the Novice learners have reset parameters relevant to the syllabification of the obstruent-liquid clusters using phonetic cues, we must determine which parameter(s) was/were reset and demonstrate that the learners' input contained good cues capable of triggering parameter resetting. Based on the learners' preferred forms 'C<sub>1</sub>C<sub>2</sub>v' and 'C<sub>1</sub>C<sub>2</sub>', I will argue that it is the branching OEHS parameter (Parameter (1b) in Table 2) that has been reset. I will then show that a phonetic property of the input, namely liquid devoicing, constitutes a good cue for the resetting of this parameter; such a proposal is in keeping with previous research that has shown that L2 learners use phonetic cues, both in the acquisition of target phonetic categories (e.g. Bohn & Flege 1990) and in the resetting of prosodic parameters (e.g. Broselow & Park 1995, Steele 2000b).

### 5.1. Resetting of the OEHS Parameter

In theory, the resetting of either the branching OEHS parameter or the syllabicity parameter could explain the absence of syllabic liquids in the Novice learners' syllabifications. If the learners were to reset the branching OEHS parameter to the French value, branching OEHS would then be possible. As a result, an underlying form such as /kʌpl/ would be syllabified as [kʌpl]; in such a form the liquid would be syllabified as the dependent member of a branching onset and, consequently, would not be syllabic. If the syllabicity parameter was reset, syllabic liquids, that is, English-like syllabifications (i.e. [kʌpl̩]), would become illicit. Clearly the resetting of either parameter could account for the absence of syllabic liquids in the learners' data. If the absence of syllabic liquids were the only relevant piece of evidence, we would not be able to determine which of the two parameters had been reset. However, the learners' preferred 'C<sub>1</sub>C<sub>2</sub>v' and 'C<sub>1</sub>C<sub>2</sub>' forms tell us more. Had the learners reset the syllabicity parameter and not reset the branching OEHS parameter, their grammars would have been able to generate forms such as 'C<sub>1</sub>C<sub>2</sub>v' (e.g. [kʌplə]) but crucially not forms like 'C<sub>1</sub>C<sub>2</sub>' containing branching OEHS. Indeed, a grammar which does not allow for branching OEHS *or* syllabic liquids could only syllabify an underlying form such as /kʌpl/ via epenthesis and could not generate the 'C<sub>1</sub>C<sub>2</sub>' forms attested in the data. Now consider the alternative case, where the learners had reset the parameter governing branching OEHS. Such a grammar could generate both the 'C<sub>1</sub>C<sub>2</sub>v' and 'C<sub>1</sub>C<sub>2</sub>' forms.<sup>5</sup> Thus, it must be the case that the learners have reset the parameter governing branching OEHS, and that the absence of syllabic liquids is due to the fact that branching OEHS are now possible in the learners' grammars.

### 5.2. Liquid Devoicing: A Good Cue for Branching OEHS

I will now argue that the relevant cue for the resetting of the branching OEHS parameter is the devoicing of the liquids in the target obstruent-liquid forms. Let us first consider the phonetic realization of liquids in both languages.

### 5.3. Phonetic Realization of English and French Liquids<sup>6</sup>

Both English and French have a phonemic contrast between lateral and rhotic liquids. The phonetic realization of these liquids in both languages is given in Table 8. Note that the English learners' native North American dialects all permit /r/ in coda position.

**Table 8. Phonetic Realization of English and French Liquids**

	/l/			/r/		
	Onset		Rhyme	Onset		Rhyme
	Following [-vce]	Else		Following [-vce]	Else	
English	[l̥]	[l]	[ɾ]	[r̥]	[r]	
French	[l̥]	[l]	[l̥]	[ʁ̥]	[ʁ]	

One aspect of the phonetic realization of English and French liquids is particularly important. As is arguably the unmarked case cross-linguistically, in both English and French, a liquid syllabified in the dependent position of a branching onset is devoiced when preceded by a voiceless stop (e.g. English *plant* /plænt/→[p̥lænt], French *plante* /plant/→[p̥lɑ̃t]). I argue that this devoicing is the phonetic cue to resetting of the branching OEHS parameter.

#### 5.4. Devoicing as a Cue in English Learners' Evaluation of French Laterals

I assume that the mechanisms used to interpret cues must be provided by UG. Under this assumption, innate knowledge concerning structural markedness would constitute a mechanism for interpreting cues. As mentioned above, cross-linguistically, the devoicing of the dependent member of a branching onset following a voiceless stop is arguably the unmarked case. Furthermore, devoiced nuclei are highly marked. Thus, if markedness guides acquisition (e.g. Jakobson 1941/68, Ingram 1978, Fikkert 1994, Demuth 1995, Gnanadesikan 1995 for L1 acquisition; Eckman 1977, 1991, Steele 2000a for L2 acquisition), an English learner should hypothesize, when confronted with the devoiced liquid of a form such as [kup̥], that the liquid is syllabified within the onset.

Let us now consider the parameter-resetting process. Based on transfer, an English learner will expect that the liquid of a word-final obstruent-liquid cluster can be syllabic and thus syllabified as a nucleus. The devoiced liquid of forms like [kup̥] is incompatible with such an expectation. As the transferred L1 parameter settings cannot generate the target form, the learner will proceed to reset parameters. Devoicing of the liquids will be interpreted by UG-provided knowledge concerning markedness, which will lead the learner to posit that the liquid is not rhyml but rather is syllabified in the dependent position of the branching onset. The learner will then conclude that the target grammar permits branching OEHS and extend the analysis to the syllabification of voiced clusters (e.g. /tabl/→[ ta.bl]). The branching OEHS parameter would be reset.<sup>7</sup>

#### 5.5. Evaluation of Cues

I have argued that the devoicing of the French liquid serves as a good cue for the resetting of the branching OEHS parameter. If devoicing is indeed a good cue, we would expect both criteria of appropriateness and robustness to be met;

such is the case. Sonority and syllabification are intimately related (e.g. Zec 1988, Clements 1990). If voicing is relevant to sonority, as I assume here, devoicing is thus an appropriate cue for the syllabicity parameter. The cue is also robust as devoicing is neither opaque, nor subject to language-particular rules or exceptions.

## 6. Conclusion

Three conclusions can be drawn from the present study. First, early grammars are clearly not characterized by transfer alone. The Novice learners of the present study, with less than 30 hours of exposure to the target language, had begun to restructure their interlanguage grammar. Second, phonetic cues can be good cues for phonological parameter resetting if they are appropriate and robust. Finally, L2 learners use phonetic cues present in the input for parameter resetting in the acquisition of syllabification; UG-provided knowledge, including markedness, serves as the mechanism that interprets cues present in the target forms.

## Endnotes

\* The ideas presented here have benefited greatly from commentary and discussion with Heather Goad. Nonetheless, any errors are my own. The research reported here was supported in part by SSHRCC Grant 410-98-0176 to L. White and N. Duffield and FCAR Grant 20001-ER-66973 to L. White et al.

1. Dresher & Kaye discuss robustness as a property of the learning theory as a whole. I assume that cues, as components of such a theory, must also be robust.
2. For arguments in favour of the role of voicing in sonority, see e.g. Steriade (1982), Blevins (1995), Kawasaki (1998).
3. The nasal of an underlying nasal-obstruent cluster is realized as nasalization on the preceding vowel (e.g. *bombe* 'bomb' /bomb/ → [bõb]).
4. See Steele (2000a) for a detailed discussion.
5. Admittedly, a grammar with this combination of parameter settings would not need to generate epenthetic forms. These forms, however, do not preclude the analysis proposed. The Native French speakers tested also produced both 'C<sub>1</sub>C<sub>2</sub>v' and 'C<sub>1</sub>C<sub>2</sub>' forms. I will assume that the Novice learners' 'C<sub>1</sub>C<sub>2</sub>v' forms reflect the input to which they were exposed.
6. French /ʁ/, while phonetically a fricative, patterns as a liquid.
7. It may be the case that there exists an implicational relationship whereby grammars allowing branching OEHS do not require syllabic sonorants. If this is indeed the case, the resetting of the branching OEHS parameter would in turn trigger the resetting of the syllabicity parameter.

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