CHAPTER 49

TEACHING IMPLICATIONS OF L2 PHONOLOGY RESEARCH

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ABSTRACT

This chapter discusses the implications of recent second language acquisition research in the field of phonology for second language teachers, including the question of whether adult second language learners can trigger a new phonological structure that is not present in the first language. I will look at processes of Chinese and Japanese learners of English acquiring the [l]/[r] contrast, and then will follow this up by looking at the implications of Matthew's work on Japanese learners being instructed in acquiring a variety of English sounds and how phonological theory explains their results. Work by Atkey on the acquisition of Czech palatal sounds will also be described to illustrate the conditions under which people can perceive new sounds. The chapter will conclude with a list of the implications for second language teachers of recent research in phonology.

INTRODUCTION

One of the traditional preoccupations of the field of second language acquisition (SLA) research has been to understand the nature of second language grammars and the factors that influence the development of those grammars. While this is a wide-ranging area of interest, my emphasis here will be on the common patterns found and the nature of the mental representation of second language grammars, in particular their phonological aspects. English language teachers are also concerned with what their students come to know about English and why they may find learning some aspects of the language easy while other aspects are difficult. What I propose to do in this paper is to bring together these two worlds of research, although I will not have much to say about variation in the attainment of individual learners.

BASIC QUESTIONS

What Is Phonology?

The first question that must be addressed is 'What is phonology?' Phonology has to do with the rules and patterns of sounds in a language. The discipline of linguistics is concerned with describing what people know when they know a language. This knowledge is very complex, and largely unconscious. By unconscious, we mean that if native speakers of English are asked why the sentence 'Who do you think that

arrived?' is ill-formed, they tend not to be able to identify the source of the violation. We may have been taught the grammatical bells and whistles of a particular language (e.g., don't end a sentence with a preposition; don't use *task* as a verb) but these "rules" are usually *prescriptive* (imposing on the speaker) rather than *descriptive* of what speakers actually do.

The sound system of a language is just as complex as the *syntax* (or sentence structure) and our knowledge of it is also largely unconscious. Again, we may be taught certain rules of pronunciation (which are often sociolinguistic rules) such as "say, *running* not *runnin*." But when asked to produce rules about English pronunciation that we have not been taught, we often are caught short. Why can the words *city* and *pretty* be pronounced with a d-like sound for the *t* ([sɪDi], [prɪDi]) but the word *attack* cannot (*[əDæk])?

When we know a language, we know very complex, abstract things about the combinations of sounds. One model of phonological structure is shown in Figure 1. This figure illustrates that an English word such as *backlog* has a rich linguistic structure at a variety of levels. In this chapter, we will focus primarily on *features* (e.g., [±voice]), *segments*, and *syllables* (represented by σ) but will virtually ignore *moras* (represented by μ) and *feet* (e.g. *iambic* or *troachaic*)).

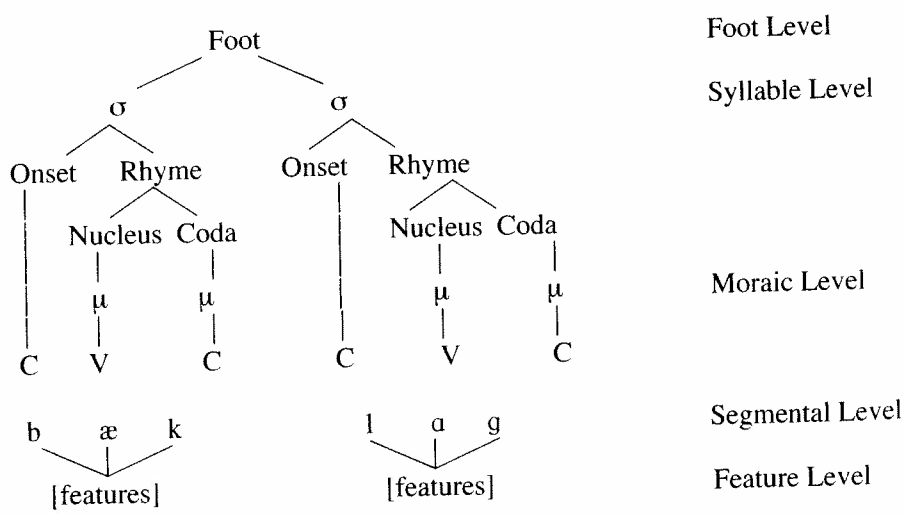


Figure 1. Levels of Phonological Structure

The segmental level may well be the most intuitively obvious. We know that words are made up of small units that we know as sounds or *segments* (a useful cover term that groups together consonants and vowels). We also know that segments can be grouped together to form syllables. The rules of syllable structure can vary from language to language, so that a Japanese speaker having to learn to pronounce the English word *strengths* may have difficulty, just as an English speaker learning to pronounce the Polish word *wybaczyc* may also have trouble.

Finally, we know that segments are not the smallest possible unit of analysis. They are more like molecules while the *features* below them are like atoms. We tend to have less conscious knowledge of the behavior of features, but consider the following example: English has a negative prefix *in-* that is often described as a negative prefix as in the word *in-tolerant*. However, note that the prefix can take a slightly different form in words like *im-possible*. There is a predictable pattern; it is not the case that we have a prefix *in-* that is used with some arbitrary set of words and a prefix *im-* that is used with some other arbitrary set of words. We find the variant with an [m] when the root of the word begins with a sound made with the lips (e.g. [m, b, p]) as in *im-perfect, im-mobile* and *im-balance*. The final consonant of the prefix is always a nasal consonant but it changes its *place of articulation* from *alveolar* to *labial*. Therefore, these terms (like *alveolar* and *labial*) are like the atoms that make up the molecules of the segments. A consonant can be broken down into smaller units like *voiced, nasal, labial, sibilant*, and so on. Later in the chapter we will see how these features affect second language learners.

Full Transfer/Full Access?

A broad issue concerning the nature of interlanguage (IL) grammars has been raised by White (2000) under the rubric of the *full transfer/full access* question. Essentially, this question seeks to address two basic concerns about a learner's grammar: What elements of it transfer from the L1 to the L2, and what can the learner do when attempting to learn structures that are absent from the first language? The term *full transfer* identifies a position that assumes that L2 learners will transfer *all* elements of their L1 grammar into their initial IL grammar. If your L1 has stress, you will start by trying to find stress in your L2. If your L1 has gender, you will start by trying to find gender in your L2. If your L1 has a voicing contrast, you will start by trying to find a voicing contrast in your L2. Of course, the IL grammar may change over time, but the question of full transfer refers primarily to the initial assumptions made by the learner.

The question of *full access* refers to whether or not adult second language learners' grammars are constrained by principles of *universal grammar*. Universal grammar (UG) is a linguistic theory that assumes that all human languages share certain basic structural properties in their grammatical design. UG captures the idea that there are possible human grammars and impossible human grammars. That is to say, there are some things that no human language does. This is relevant to L2 learners when we look at the nature of their IL grammars. Are those grammars subject to the same universal laws as other languages such French and Swahili and English? How would we know? Imagine the following kinds of thought experiments: First, let's imagine a subject whose first language is a tonal language like Chinese, and that subject is trying to learn a language like English, which is not a tonal language but rather a stress-timed language. Will the IL grammar that he or she sets up be governed by the universal principles we know govern the stress systems of the world's natural languages? Of course, this is an empirical question. A second thought experiment that might be relevant to this question is to think how a second language learner will fare when attempting to learn new structures. Imagine the subject trying to learn something that is not found in the L1. It could be an [l]/[r]

contrast, or gender, or optitive case. We could assume that if the learners had access to UG, they would know that those structures were part of the human linguistic arsenal. If their only source of knowledge is their L1 (and not UG), then they will not be able to automatically trigger linguistic knowledge that is not found in their L1. We will return to both these questions throughout the chapter.

Can Adult L2 Learners Acquire a New Language?

Many people are probably familiar with this general question in the literature on the critical period hypothesis (e.g., Birdsong, 1999; Harley, 1986; Scovel, 1988, 1995). In spite of the attention devoted to this topic, the question of whether proficient users of an L2 actually have knowledge or competence that is indistinguishable from native speakers had not been satisfactorily addressed. Coppieters (1987) looked at highly proficient second language learners and argued that none of them performed within the range of native speakers (acknowledging, of course, that native speakers will vary on their test performance too). Birdsong (1992) replicated this study (with modifications) and argued that some of his highly proficient L2 subjects *did* perform within the range of native speakers. White and Genesee (1996) looked at just this question in the domain of syntax. They looked at knowledge of facts about the movement of Wh-words in questions, the syntactic details of which do not concern us here. Consider these sample sentences:

*Who$_i$ did Mary meet the man who saw t$_i$?
*What$_i$ was a dish of t$_i$ cooked by Mary?

The principles governing syntactic movement are abstract and complex, and not taught in any second language class. Note that the semantics of the situation are fine. A man saw someone and Mary met this man. We want to ask a question about the someone that the man saw. This is a logically possible scenario but it is blocked by the rules of English syntax. Similarly, note that the syntax allows to move Wh-words in structures which seem very similar. For example, 'When did Mary meet the man who left?' is grammatical while 'Who did Marry meet the man who saw?' is ungrammatical. Native speakers' grammars capture this distinction. Therefore, the question of whether second language learners can arrive at knowledge of these principles that is within the range of knowledge we see in native speakers is an interesting question. White and Genesee (1996) looked at 89 subjects aged 16-66 who were interviewed extensively in English. Samples of their speech were evaluated by two judges for pronunciation, morphology, syntax, vocabulary, fluency, and overall impression of nativelike-ness. Each dimension was assessed on a 9 cm line, as shown in Figure 2.

Non-native _____ Native

Figure 2. Assessing Nativelike Proficiency

Each judge had to mark the line and the marks were measured to within the nearest half-centimeter, resulting in an 18-point scale.

Individuals who received scores of 17 or 18 on all scales by both judges were classified as *near-native* speakers. Forty-five of the original 89 subjects fell into this category. Subjects were given grammaticality judgment tasks (on a computer screen) and a pencil and paper question formation task. The subjects were compared to a control group of native speakers for both the accuracy and speed of their judgments, and to see if they produced grammaticality violations in their question formation. There were no significant differences between the native speakers and the near-native speakers with respect to their grammaticality judgments, their response times, or their question production. This was true even for those subjects who received their first intensive exposure to the L2 after the age of 16. In short, the near-natives performed just like the natives with respect to accuracy and speed on the grammaticality judgment tasks. This experiment demonstrates that the ultimate attainment of second language learners can be native-like.

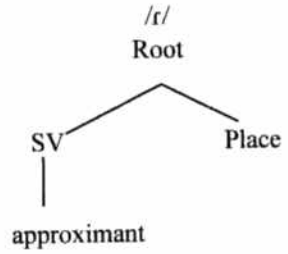
Is this true of phonology as well? There have been a number of studies in Nijmegen, Holland, that have investigated this question. Bongaerts and his colleagues have argued that there are some late learners of a L2 who can achieve native-like pronunciation in both instructed and uninstructed settings. Bongaerts (1999) suggests that those people who did achieve native-like pronunciation all received intensive training in both the production and perception of the target language sounds. Bongaerts, Mennen, and van der Silk (2000) looked at uninstructed learners of Dutch as a second language. All speakers (both non-native speakers and native speaker controls) read 10 sentences out loud (e.g., *Alle exemplaren van de dichtbundel zijn uit de handle genomen.*). The samples were rated by 21 native speakers of Dutch (11 were teachers of Dutch) on a 5-point scale ranging from *very strong accent* to *no foreign accent*. The native speakers of Dutch were given ratings from 4.00 to 4.91 (mean: 4.73), while the non-native speakers were given ratings from 1.70 to 4.59 (mean: 3.50). While the mean scores of the two groups were significantly different, there were some non-native subjects who were assessed within the native speaker range.

THE ACQUISITION OF SEGMENTS

Brown (2000) looked at the acquisition of English /l/ and /r/ by speakers of Japanese and Mandarin Chinese (neither of which contrasts /l/ and /r/ phonemically). The Japanese situation is illustrated in Figure 3, and is explicitly contrasted with the representations for English. Note that SV stands for sonorant voice, a feature used by phonologists to capture the fact that typologically voicing behaves differently on sonorants than on obsturents.

[l] and [ɾ] are allophones of a single phoneme. This phoneme may appear only in a simple onset in Japanese. Mandarin Chinese also lacks the contrast, hence the structure is the same as shown in Figure 3 for Japanese speakers. If the segment is taken to be the level of explanation, then we might predict that both Mandarin and Japanese speakers should be unable to acoustically discriminate /l/ from /r/ (given their L1 feature geometries). The graph (see Figure 4) shows the overall performance of the subjects on the auditory discrimination task to test the subjects' discrimination of English /l/ and /r/.

(a) Japanese



(b) English

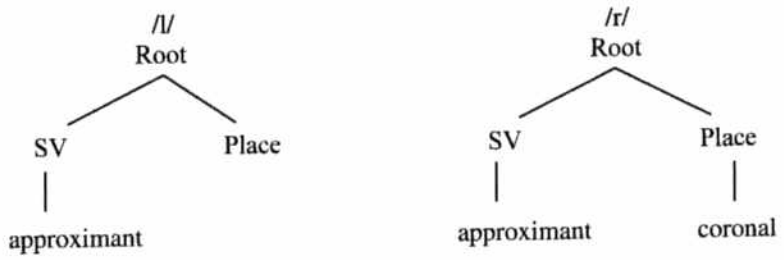


Figure 3. Cross-Linguistic Liquid Structure

In general, the Japanese speakers were unable to discriminate /l/ from /r/ both acoustically and phonologically in a lexical choice task, whereas the Chinese speakers discriminated the contrast in both tasks. The initial hypothesis that speakers of both languages would be unable to perceive the /l/ and /r/ distinction because one of the members of the contrast is an L1 phoneme is not supported by the Chinese subjects. So, what aspect of the L1 could be accounting for this difference? Brown (2000) suggests that a speaker may be able to perceive a non-native contrast if the feature that distinguishes the two segments is present in the L1 feature geometry, even if the feature is not utilized for the contrast in question. It is the coronal feature (that is, the sounds made with the tip of the tongue) that distinguishes /l/ from /r/. Chinese requires the coronal node for some features but Japanese does not. The inventories are given in Table 1.

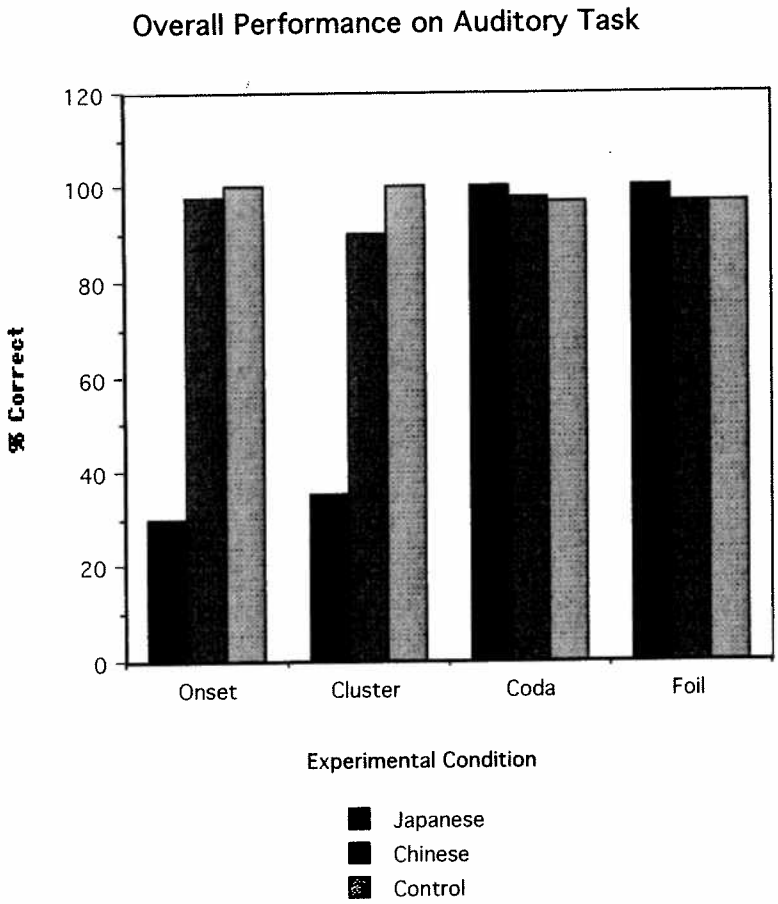


Figure 4. Overall Performance on Auditory Discrimination Task

Regardless, then, of the liquid inventory, the Chinese speaker will have a representation for the feature [coronal] somewhere in the phonological inventory (i.e., to contrast alveolar from post-alveolar segments shown in the box). The Japanese inventory, on the other hand, does not contrast any coronal phonemes and will, therefore lack a coronal node. Thus, Brown concludes that L2 speakers cannot build representations for segments that require features not present in their L1. They can, however, combine the features of their L1 in new ways to yield new segments.

Matthews (1997) investigated whether training can influence the perception of non-native contrasts. He looked at the well-known case of Japanese learners acquiring the [l]/[r] contrast. Many studies have shown that Japanese subjects can have difficulty in learning to perceive this contrast, which is not found in their L1. Matthews also tested other contrasts not found in Japanese such as ([b]/[v]; [s]/[θ]; [f]/[θ]. This focus on perceptual ability is important as it can be argued that perceptual studies are a better window onto linguistic competence as production tasks have many other factors involved (e.g., motor control).

Table 1. Japanese vs Chinese Phonemic Inventory

(a) Japanese Phonemic Inventory

p	t	k	ʔ
b	d	g	
	s		h
m	n	ŋ	
	ɾ		
w	y		

(b) Mandarin Chinese Phonemic Inventory

p	t		k
	ts	tṣ	
	s	ṣ	h
		ẓ	
m	n		ŋ
	l		
w	y		

Matthews' (1997) study comprised one group of students who received training and one who did not. The training took place once a week for 5 weeks. Each training session included training on all five of the sounds which are not found in Japanese: [f], [v], [l], [r] and [θ]. The subjects received no perceptual training or model pronunciations, but, rather, explicit instruction in the articulation of the five segments. During testing, the subjects heard stimulus pairs (drawn from familiar vocabulary) and had to indicate whether the words were the same or different. Over time, there was significant improvement in their perception of the [b]/[v] and [f]/[θ] contrasts but no significant change in their perception of [p]/[b], [s]/[f], or [l]/[r]. Thus, this training regimen caused improvement in some contrasts but not others. There was no improvement on [l]/[r] but there was improvement on [f]/[θ]. What could be causing the difference? Matthews, like Brown (2000), argues that the source of the behavior lies in the feature geometry. If the L1 utilizes the appropriate feature for a new contrast, then new contrasts can be acquired. To take just one example, Japanese lacks a [v] but contains the necessary features to build one.

Perception of New Segments

A similar example can be found in the work of Atkey (2001) who looked at English speakers acquiring palatal stops in Czech. While English has stops made at the lips ([p]/[b]), *alveolar ridge* ([t]/[d]), and *velum* ([k]/[g]), Czech has the *labial*, *alveolar*, and *palatal* stops ([c ɟ]). The feature required to make the distinction between alveolar and palatal stops is [posterior]. The relevant Czech sounds are given in Table 2.

Table 2. Alveolar versus Palatal Stops in Czech

Alveolar /t/, /d/	Palatal /c/, /ɟ/
Root | Coronal	Root | Coronal | [posterior]

English makes use of the feature [posterior] to distinguish alveolar and palatal fricatives, as shown in Table 3.

Table 3. Coronal contrasts in English

/s/ Alveolar	/ʃ/ Alveo-palatal	/θ/ Dental
root | coronal	root | coronal [posterior]	root | coronal [distributed]

The perception results shown in Table 4 demonstrate that the adult subjects (all native speakers of English acquiring Czech as a foreign language) Atkey (2001) looked at were able to perceive the alveolar/palatal distinction very accurately.

Table 4. Percentage of Palatal Stop Tokens Perceived Correctly by Native-Speakers of English

Position	ML (0;3)	JD (0;5)	AD (0;11)	SW (0;11)	JA (1;0)	RK (10;0)
Initial	70	90	80	85	80	95
Medial	70	70	80	90	85	90
Final	20	30	50	70	70	80

THE ACQUISITION OF SYLLABLES

Let us turn now to another example of hierarchical structure at a higher level: the syllable. A common model of syllable structure is shown in Figure 5:

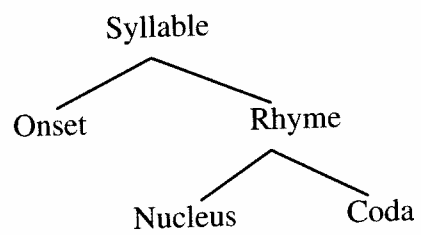


Figure 5. Syllable Structure

The languages of the world vary according to such things as whether syllabic nodes can branch. Some languages (e.g., Japanese) do not allow branching onsets or codas. Again, we can see the benefit of these types of models when it comes to the full transfer/full access issues. If we assume full transfer, then what the learner will be transferring will be the allowable syllable structures of the L1. Ignoring some complexities, let us assume for a particular L1 that all syllables must be CV or CVC. More complex syllables such as CCVCC are not allowed. A common phenomenon in L2 learning involves modifying an L2 word so that it fits the L1 syllable structure. Consider the words shown in Table 5 spoken by someone whose L1 is Arabic (adapted from Broselow, 1988):

Table 5. L2 Syllabification of English words by Arabic speakers

English target	Non-native speaker's version
plant	pilanti
Fred	Fired
translate	tiransilet

Arabic does not allow branching onsets or codas, so an English word like *plant* cannot be mapped onto a single Arabic syllable. As this example helps to show, we can explain why Arabic speakers pronounce English words in the way that they do by investigating the principles of syllabification in the L1. Especially at the beginning levels of proficiency, the structure of the IL is influenced by the structure of the L1. This would suggest that learners are clearly transferring the L1 principles of syllabification.

This raises the question of what learners do when they are faced with a situation where the mental representation of the structure of the L1 is not appropriate for the structure of the input perceived in the L2. Can they acquire new structures at the syllabic level? And do they have access to UG properties of syllable structure?

Clusters

Most of the consonant clusters in the worlds' languages obey what is known as the *sonority sequencing generalization* (shown in Figure 6) which captures the fact that the nucleus of a syllable is the most sonorous element and sonority diminishes towards the edges:

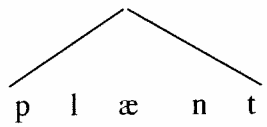


Figure 6. The Sonority Sequencing Generalization

There are, however, sequences of consonants that violate this generalization, and they tend to involve the phoneme /s/. In English, some s-clusters violate sonority sequencing (e.g., *st* since the fricative [s] is more sonorous than the stop [t]) while some do not (e.g., *sn* where the fricative [s] is less sonorous than the nasal [n]). The analysis of the structure of s-clusters is a complex and problematic area of phonological theory, so the details will not be elaborated here. Many researchers argue that [s] is what is known as *extrasyllabic*. In other words, [s] is not really part of the syllable, but somehow outside it. However, L2 learners are aware of this. Carlisle (1997) looked at how Spanish speakers deal with English onset clusters. He notes that three-consonant clusters are changed significantly more often than two-consonant clusters. Carlisle (1991) in a study on two-segment onsets, found that Spanish speakers modified onsets that violated the sonority sequencing generalization (e.g., st-) significantly more often than they did those that did not (e.g., sn-). They would, for example, be more likely to say [e]*stop* than [e]*snow*. Broselow (1988) also showed that Arabic speakers treat s-clusters that violate the sonority sequencing generalization differently than those that do not, as shown in Table 6.

Table 6. L2 Repairs of Consonant clusters

Needs a heading	Another heading here
sweater -> [siwɛtər]	study -> [istadi]
slide -> [silayd]	ski -> [iski]

Singh (1985) demonstrates the same pattern for Hindi speakers (see Table 7).

Table 7. L2 repairs of consonant clusters

Needs a heading	Another heading here
fruit -> [fɪrut]	school -> [ɪskul]
please -> [pɪliz]	spelling -> [ɪspɛliŋ]

Samarajiwa and Abeysekera (1964) show the same pattern by native speakers of Sinhalese speaking Sanskrit, as shown in Table 8.

Table 8. L2 repairs of consonant clusters

Sanskrit target pronuncitation	Pronunciation by Sinhalese speakers	English translation
Tyage	[tiyage]	*gift*
sriyavə	[siriyavə]	*grace*
stri	[istiri]	*woman*

These data suggest that L2 learners have full access to the principles of sonority sequencing, regardless of their L1 experience. The work of Broselow and Finer (1991) and Eckman and Iverson (1993) also clearly demonstrate that syllable structure can be changed in L2 learning. People can learn to pronounce new clusters that are not found in their L1. This means that even though a structure may be lacking from the L1, second language learners are able to acquire that structure, and to set up IL grammars that are constrained by the principles of universal grammar.

Perception of Clusters

Up to now, we have focused on the production data from subjects who are producing consonant clusters, and, as we have noted, sometimes modifying them. A related question that arises in this field has to do with these subjects perception of consonant clusters. Dehaene-Lambertz, Dupoux, and Gout (2000) have reported on both behavioral and *electrophysicological data* (i.e., data resulting from monitoring the electrical activity in a subject's brain during the processing of language) that argue that when second language learners are listening to linguistic items they are also modifying the consonant clusters. The relevant experiment looked at native speakers of French and Japanese. French allows consonant cluster quite freely across syllable boundaries while Japanese breaks up clusters with an epenthetic vowel. An example

of this can be seen when Japanese borrows a word from another language. English *baseball* [beysbal] is pronounced something like [beysubaru] where the consonantal sequence *sb* is broken up by an epenthetic [u]. The question that Dehaene-Lambertz, Dupoux, and Gout address is whether Japanese subjects when listening to sequences like *gm* or *sb* will hear an epenthetic vowel. The results of their paper show that they do. The implications of this are that second language learners who break up consonant clusters by inserting a vowel may not be doing this as a late production routine but rather as a result of deep processes influenced by their first language.

CONCLUSIONS

So, where are we now? We have seen that at a variety of levels—segmental and syllabic—learners transfer their L1 phonological representations: full transfer. What about full access? Most of the studies that I have referred to suggest that the representations that the learners set up do not violate UG. Learners can change their existing representations given exposure to the target language, but can they trigger completely new structure? That evidence appears to be a little more mixed.

There are a number of conclusion and implications of this research for English language teachers and teaching. Firstly, phonological knowledge is abstract and complex. There is still a tendency to think of L2 phonology as being synonymous with pronunciation by focusing on the production of consonants, vowels, stress, etc. The literature reveals, however, that learners' behavior (both production and perception) is governed by the nature of their abstract phonological representations. This does not mean that L2 teachers need to become theoretical phonologists but rather need to be sensitive to the fact that, like syntax and morphology and semantics, phonology is a subtle cognitive system. Full access to UG means that new sounds can be acquired. Just because a certain sound is not found in the student's first language does not mean that they are doomed to never master the production or perception of that sound. Research has shown that learners have access to another source of knowledge beyond the structure of their first language. All human languages share a base of common building blocks that can be re-deployed to acquire new sounds. Full transfer means that subtle complexity will be transferred from the L1. For example, if your L1 allows coda consonants but only a certain class of coda consonants , then this is what will initially transfer to learning the L2. However, this in not necessarily the final state of the learner's grammar. Teachers cannot be lulled into believing stereotypical generalizations about a particular language

Secondly, a number of studies show that L2 learners can acquire linguistic competence that is indistinguishable from native speakers in terms of accuracy and response time (White & Genesee, 1996). In other words, L2 learners can successfully acquire a second language. Late L2 learners (both instructed and uninstructed) can achieve pronunciation that falls within the range of native speakers (Bongaerts, Mennen, & van der Silk, 2000). Pronunciation is not just a matter of motor ability. As we have said before, phonology is a symbolic system; just like any other area of knowledge, it can be acquired. New contrasts can be acquired if the L1 utilizes the necessary *features* (Brown, 2000; Matthews, 1997). Teachers need to be

aware that just because a student lacks a particular *sound* in their L1 does not mean that they lack the building blocks to acquire new sounds.

Finally, the research demonstrates that explicit instruction can help with L2 phonological development, but won't always do so (Matthews, 1997). Instruction requires emphasis on perception and production. The literature on which method of instruction is the best is notoriously incomplete. We do not know which methods or techniques work for which learners of which languages. Nonetheless, if instruction takes place which provides the learners with opportunities to both produce and perceive the sounds in question and to be exposed to metalinguistic information about the sounds to be learned, then this is likely to be an environment that will be useful to the most learners.

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International Handbook of English Language Teaching

Part II

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Springer