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FROM PHONEMIC DIFFERENCES TO CONSTRAINT RANKINGS

Research on Second Language Phonology

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This article surveys the development of second language (L2) phonology over the last 40–50 years. Research in this area has grown from analyzing learners' errors in terms of Contrastive Analysis to proposals explaining L2 sound patterns in terms of constraints on interlanguage grammar. Although native language transfer has endured as one source of learner constraints, researchers have, over the years, shown the necessity of phonological universals in explaining L2 phonologies. More recently, L2 phonologists have provided insightful analyses through constraint-based grammars within the framework of Optimality Theory.

The study of second language (L2) phonology attempts to explain the pronunciation patterns of adult L2 learners. The main direction that the overwhelming majority of explanations have taken, at least for the last few decades, has been to show that L2 learners construct mental grammars that are constrained by general and independently motivated principles. The sound patterns of L2 learners are the way they are, in other words, because they could not be otherwise, given the nature of the constraints on L2 phonologies. From the middle

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of the last century, research in this area has looked for these constraints in two major areas: in the learners' first language (L1), and in universal properties of natural language phonologies.

In the 1950s and 1960s, work in L2 phonology dealt with pronunciation errors explained on the basis of phonemic substitutions and nontargetlike distributions of allophones (Hammerly, 1982; Lado, 1957; Stockwell & Bowen, 1965). The rise of generative phonology over the next few decades saw the use of distinctive features, underlying representations, rules, and derivations as a way of accounting for L2 utterances (Eckman, 1981a, 1981b; Ritchie, 1968). As nonlinear proposals made their way into phonological theory, prosodic hierarchies (Zampini, 1997), metrical grids (Archibald, 1993a, 1993b, 1993c; James, 1986), and Feature Geometry (Brown, 1998, 2000) were invoked as explanatory principles in L2 phonology. Recently, as many theoretical phonologists have turned from rule-driven to constraint-based approaches to phonological analyses, there have been studies explaining L2 pronunciation in terms of constraint rankings and rerankings in the learner's interlanguage (Broselow, Chen, & Wang, 1998; Hancin-Bhatt, 2000; Hancin-Bhatt & Bhatt, 1997; McCarthy, 2002; Prince & Smolensky, 1993).

The purpose of this paper is to outline and review some of the significant work in L2 phonology that has explored these topics over the last few decades. During this time, one of the important overarching themes that has recurred in virtually all frameworks has been the reporting and explanation of L2 phonological patterns that are not directly attributable either to the learner's L1 or L2 but are attested in the phonologies of other languages of the world. Indeed, it is this kind of evidence that purports to show the fundamental properties involved in the acquisition of L2 phonology.

The remainder of the article is structured as follows. I begin the discussion with the role of the L1 as a constraint on an L2 learner's pronunciation. I then consider proposals that focus on both differences and similarities between the L1 and L2 in the area of production as well as perception. The next section turns to the use of universals as explanatory principles in L2 phonology, and here we will see that there is necessarily some overlap between this section and the preceding one, as research on the role of universals in L2 grammars has often included the influence of the learner's L1. The first topic in this section on universals is the development of the construct *learner language* and its importance in redirecting the major focus of research on L2 phonology. This is followed by a discussion of the particular approaches to universals, including markedness and Universal Grammar (UG). In the case of the latter, I consider work utilizing parametric settings involving both segments and the assignment of stress. I then discuss the role of variation in L2 phonology and conclude with a discussion of Optimality Theory (OT).

The following section begins with the early theoretical proposals and empirical work on the role of differences and similarities between the L1 and L2 in explaining L2 pronunciation.

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INFLUENCE OF THE NATIVE LANGUAGE

Differences and Similarities between the L1 and L2

L1 influence on the acquisition of L2 pronunciation has never been seriously contested by researchers in SLA theory. Although there has been debate over whether the L1 has a significant role to play in the acquisition of L2 syntax (Dulay & Burt, 1972, 1973; Flynn, 1987), it has been widely accepted that the learner's L1 influences the acquisition of L2 phonology, even by those who doubt L1 influence in the area of syntax. Thus, Dulay and Burt (1974) stated, "most of the valid [contrastive analysis] evidence is phonological" (p. 105). Likewise, Richards (1971) claimed that "studies of second language acquisition have tended to imply that contrastive analysis may be most predictive at the level of phonology, and least predictive at the syntactic level" (p. 204). Finally, a study by Ioup (1984) showed that native speakers (NSs) of English can identify different groups of nonnative speakers on the basis of pronunciation but are not able to do so reliably on the basis of only written or syntactic evidence.

Some of the earliest research on the role of the L2 learner's L1 in accounting for pronunciation errors dates from the middle of the last century. This work was carried out within the context of the Contrastive Analysis Hypothesis (CAH), which claimed that L1-L2 differences and L1 transfer were paramount in explaining L2 speech, as the following quotes from Lado (1957) attest.

> We assume that the student who comes in contact with a foreign language will find some features of it quite easy and others extremely difficult. Those elements that are similar to his native language will be simple for him, and those elements that are different will be difficult. (p. 2)

> We have ample evidence that when learning a foreign language we tend to transfer our entire language system in the process. (p. 11)

During this era, a phonological analysis consisted of an account of the phonemes of the language in question and the distribution of the allophones of those phonemes. It is not surprising, then, that L2 pronunciation errors were explained in terms of a comparison of the phonemes and their distribution within the L1 and L2. Although phonemes figured prominently in the predictions of the CAH, a large role was also played by allophones. Lado's (1957) proposals addressed the question of what constituted maximum phonological difficulty, and allophonic differences between the L1 and L2 were important in his predictions. For Lado, the greatest difficulty lay in the learner assigning two or more allophones in the L1 to different phonemes in the L2. An example—the one used by Lado—involved the sounds [d] and [ð], which are allophones of /d/ in Spanish but which contrast in English. Lado claimed that assigning the allophones [d] and [ð] to separate phonemes in English by a learner whose L1 is Spanish constituted maximum learning difficulty.

An important contribution to this area of research was made by Stockwell and Bowen (1965), who expanded and refined the predictions of the CAH by

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invoking notions from American Structural linguistics and behavioral psychology (Hockett, 1955). Stockwell and Bowen compared the L1 and L2 in question in terms of whether any given sound was "optional," "obligatory," or "null" in either language. A null sound was one that did not occur in the language. A phoneme was designated as an optional sound in the sense that the distribution of phonemes in a language is not predictable on the basis of the surrounding phonological context. An allophone, on the other hand, was labeled as obligatory by the authors because allophones are environmentally conditioned. Comparing the optional, obligatory, and null elements of the L1 to the optional, obligatory, and null segments of the L2 and excluding the situation in which a sound was null in both the L1 and L2, Stockwell and Bowen constructed an eight-level hierarchy of difficulty. In this hierarchy, maximum phonological difficulty was predicted to arise from a learner having to acquire a L2 allophone that was null in the L1.

The claims made by Lado (1957) and Stockwell and Bowen (1965) were based on anecdotal evidence, as no systematically gathered data was reported in either work. However, there was sufficient empirical work on the role of L1 influence in L2 pronunciation to make it clear that at least some aspects of L2 pronunciation could be explained via attribution to the learner's L1. To cite a few examples, Suter (1976) measured 61 adult learners of English from four L1 backgrounds—Arabic, Japanese, Persian, and Thai—on 20 variables related to pronunciation accuracy. The subjects' pronunciation was rated by 14 NSs of English. The results showed that among the factors that correlated with pronunciation accuracy was the speaker's L1. Along similar lines, Ioup (1984) showed that English NSs can identify different groups of nonnatives on the basis of pronunciation and that pronunciation was a much more reliable indicator of L1 background than either written or syntactic evidence. Finally, Hammerly (1982) was able to support empirically some of the earlier claims about the difficulty associated with learning L1 allophones. In his study, utterances were elicited from 62 English-speaking learners of Spanish using several tasks. Analysis of the results showed that, of the six most problematic areas of pronunciation, the top three involved allophones. The greatest difficulty for Hammerly's subjects was the suppression of L1 allophones in pronouncing the L2; the second area of difficulty was producing L1 allophones with a different distribution in the L2, and the third most difficult aspect was the pronunciation of a L2 allophone that did not exist in the L1.

There were a number of other studies within the CAH framework that did not use English as the L2. Redard (1973) compared Italian with 11 other languages and used the CAH to predict pronunciation difficulties for NSs of Italian learning those languages. Anan (1981, as cited in Major, 2001) did a study of NSs of Japanese learning French, and Tomaszyk (1980) looked at the acquisition of Polish by NSs of English.

Although the majority of work on L2 pronunciation during this time was done within the framework of the CAH and attempted to explain L2 phonological difficulty on the basis of differences between the L1 and L2, there was

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also a school of thought that based the explanation of pronunciation problems on similarities between the L1 and L2.

Wode (1976, 1978, 1983a, 1983b) proposed the Crucial Similarity Measure (CSM) as a basis for L1 transfer. The CSM claims that there are identifiable similarity requirements that must obtain, at least in the mind of the L2 learner, for the L1 to interfere with the acquisition of the L2. Young-Scholten (1985) conducted a study to test Wode's CSM and found that it could account for a number of phonological and morphological errors to a greater degree than could the CAH. Similarly, Oller and Ziahosseiny (1970) pursued the idea that similarities between the writing systems of the L1 and L2 were the cause of difficulty because, according to their proposal, similar items were more likely to cause confusion, whereas differences were likely to be more salient.

Phonetic similarity is also a key concept in other important work on the role of perception in L2 phonology—specifically, studies of "equivalence classification" in the work of Flege (1986, 1987). Flege claimed that L2 sounds that are "equivalent" or "similar" to L1 sounds are difficult to acquire because the learner perceives the L2 sounds as being the same as the L1 sounds and therefore does not establish a new phonetic category for the L2 sounds. On the other hand, according to Flege, learners set up new phonetic categories for sounds that are perceived as different. This research is discussed in more detail later, in the context of Flege's (1995) Speech Learning Model (SLM). One problem with all of the work basing an explanation for L2 pronunciation on similarities or equivalences is that no one has as yet been able to make precise what the criteria are for determining similarity or equivalence (Rochet, 1995).

Finally, the demise of the major claims of the CAH was brought about by a body of work that, although it set out to find support for the hypothesis, actually found that the role of developmental processes—patterns often found in L1 acquisition—played a more significant role in the explanation of L2 sound patterns than did L1-L2 differences. For example, studies by Kohler (1971) and Nemser (1971b) showed that many L2 substitutions were not due to L1 transfer. Johannsson (1973) studied 20 L2 learners of Swedish from eight different L1 backgrounds: Czech, Danish, Finnish, Greek, Hungarian, Polish, Portuguese, and Serbo-Croatian. Her results showed that, although many of the errors were predictable by the CAH, others were explainable in terms of articulation ease.

To summarize briefly, research within the CAH paradigm, at least insofar as production was concerned, showed that, although L1 influence had a role to play in explaining L2 pronunciation errors, the influence of the L1 could explain only a portion of the errors. It became clear that other principles were necessary to explain difficulty that could not be directly related to L1-L2 differences. Over the years, a number of proposals have been made to account for facts that are not subsumed under the CAH, and I will consider some of these in the sections that follow. Before turning to these, however, I will first briefly review the role of the L1 insofar as perception is concerned.

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Perception

A plausible explanation for L2 learners' difficulty with L2 sounds that are different from those of the learners' L1 is that the L2 sounds in question could not be accurately perceived. This explanation is certainly reasonable on the face of it, the conventional wisdom being that, at least for child L1 acquisition, children's perception of phonemic contrasts always developed prior to their production of that contrast (Ingram, 1976; Menyuk, 1977; Smith, 1973). If the learners cannot perceive the L2 sounds correctly, the argument goes, then the learners will not be able to successfully produce those sounds.

One of the earliest challenges to this position came from Briere's (1966) study, which looked at the ability of English speakers to produce and perceive non-English sounds. One of his unexpected results was that production of the target sounds in question generally preceded accurate perception of those sounds. Briere's study, although groundbreaking, was limited to the analysis of only a few words (between four and six) each from Arabic, French, and Vietnamese. A stronger challenge to the tenet that perception of a sound must precede its successful, systematic production came in work by Goto (1971), in which he studied the ability of Japanese learners of English living in Japan to distinguish /r/ and /l/, a contrast that does not exist in Japanese. The results of the study showed that the production ability of Goto's Japanese subjects in making the /r/-/l/ contrast exceeded their perception ability, even for their own utterances. These subjects, in other words, could produce the contrast more accurately than they could perceive it.

Sheldon and Strange (1982) replicated and extended the work of Goto (1971) in a study of the perception and production of the English /r/-/l/ contrast by six Japanese students at the University of Minnesota. The subjects were presented the test words on cards containing both the citation form of the word and the word used in a sentence. The test words contrasted /r/ and /l/ in four environments: initially, intervocalically, finally, and in an initial consonant cluster. Each subject read the word on the card in isolation and also read the sentence containing the word. The subjects' responses were recorded and the citation forms were rerecorded and arranged as a perception test, which was administered to the Japanese subjects and to four NSs of English. Each subject was also tested on the productions of the other subjects. The results of the Sheldon and Strange study corroborated with those of Goto in that the Japanese subjects were less accurate in perceiving the contrast than they were in producing it.

These results clearly render the relationship between phonological perception and production anything but straightforward. How does one reconcile the finding from child language acquisition that perception of a contrast must precede its production, with the results from Briere (1966), Goto (1971), and Sheldon and Strange (1982), in which learners' production of a contrast outstripped their ability to perceive it? Based on this research, it would seem that all four logical possibilities can be realized: A contrast can be perceived

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but not produced; it can be produced but not perceived; it can be neither perceived nor produced; and it can be both perceived and produced. Moreover, the L2 research findings seem to run directly counter to the intuitive notion that, unless a learner can perceive a contrast, the learner will be unable to produce the contrast.

The resolution, it seems, lies in the fact that the L2 subjects in all of the above-mentioned studies received written input on the contrasts in question. Subjects did not have to hear the difference between, for example, /r/ and /l/, to know that they had to produce this contrast; they could discern that a contrast existed between /r/ and /l/ from the spelling of the words. The L2 learner, on receiving the written cues, may well have been able to produce distinct corresponding pronunciations that could be detected by NSs, yet the L2 learners themselves might still have been unable to perceive the contrast between the two sounds. Therefore, in language acquisition by preliterate children, it can still be maintained that perception of a contrast will precede its successful production; however, in SLA, if the learner is provided with written access to the contrast, or at least with some nonauditory way to discern the distinction, it is possible that the production of a contrast precedes its production.

An anonymous *SSLA* reviewer suggested that, although spelling does facilitate the encoding and recognition of a sound, there must have been some level of aural comprehension or else subjects could not have accurately produced it. The reviewer went on to state that telling a person how to produce a sound is not enough to elicit an accurate production of the sound. However, this appears not to be the case, at least for some of the subjects in the Sheldon and Strange (1982) study, as the authors stated: "Some of our subjects reported that they had been taught to pronounce American /r/ and /l/ by explicit reference to articulatory parameters rather than to auditory cues" (p. 254).

Having suggested a mechanism whereby the production of a L2 contrast by an L2 learner may precede its systematic production, I now turn to the role of perception in the explanation of L2 phonology in general. Several models pertaining to crosslinguistic speech perception have been proposed. The Perceptual Assimilation Model (PAM) has been put forth by Best (1993, 1994, 1995); the Feature Competition Model (FCM) has been proposed by Hancin-Bhatt (1994); Brown (1998, 2000) has suggested an approach based on Feature Geometry; and Flege (1995) has formulated his SLM.

Best's (1993, 1994, 1995) PAM accounts for a learner's perception of nonnative sounds in terms of the phonological system of the L1. The articulatory characteristics of the sounds in question determine the extent to which they will be assimilated to the phonetic categories of the native system. How closely a nonnative sound can be assimilated determines whether the learner will be able to perceive any contrast involved.

The FCM by Hancin-Bhatt (1994) bases its predictions on the notion of feature prominence. Evidence of prominence is determined on the basis of per-

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ception instead of production. Which features are prominent in a given language are decided on the basis of which features can be left unspecified in the phonological representation. The idea behind underspecification is that segments are represented structurally only to the extent necessary to contrast them from all other segments in the language. The model claims that features that are used more frequently in the learner's L1 will have a greater role to play in how learners perceive L2 sounds than will features that are less frequent. Hancin-Bhatt's model provides an algorithm for computing feature prominence within a given phonological inventory, which, in turn, generates a number of empirically testable hypotheses.

More recently, Brown (1998, 2000) has proposed a model of speech perception that is also based on the idea of underspecification (Archangeli, 1988; Avery & Rice, 1989) and on the construct of Feature Geometry (Clements, 1985; Sagey, 1986). It follows from underspecification principles that redundant properties of sounds are not represented underlyingly, and complete specification of segments results from phonetic implementation. Feature Geometry is a system of representing segments in which phonological features are not unordered bundles of properties, as proposed in Chomsky and Halle (1968), but are instead structured hierarchically so that some features are dependent on others. Brown's proposal is that L1 phonological structure is set up by the child learner respecting the hierarchy of features provided by UG. Feature structure is postulated only to the extent that contrasts require it. This structure of features determines the phonetic and phonemic categories into which speakers assign sound segments. In SLA, learners perceive the L2 sounds through the categories of the L1 phonological structure. These categories in turn constrain which nonnative sounds can be correctly perceived and which sounds the learner can successfully produce. This model has been tested on the acquisition of several English contrasts by NSs of Japanese, Korean, and Mandarin.

The model of speech perception and production that has been most influential for L2 pronunciation is the SLM (Flege, 1995), which is the focus of the following discussion. This model consists of four postulates in (1) and seven hypotheses in (2). The postulates and hypotheses of the SLM are the culmination of some 15 years of rigorous phonetic research by Flege and others on the perception and production of L2 sounds and contrasts by adult L2 learners.

(1) Postulates of the SLM
- P1: The mechanisms and processes used in learning the L1 sound system, including category formation, remain intact over the life span and can be applied to L2 learning.
- P2: Language-specific aspects of speech sounds are specified in long-term memory representations called phonetic categories.
- P3: Phonetic categories established in childhood for L1 sounds evolve over the life span to reflect the properties of all L1 or L2 phones identified as a realization of each category.

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P4: Bilinguals strive to maintain contrast between L1 and L2 phonetic categories, which exist in a common phonological space.

(2) Hypotheses of the SLM
- H1: Sounds in the L1 and L2 are related perceptually to one another at a position-sensitive allophonic level, rather than at a more abstract phonemic level.
- H2: A new phonetic category can be established for an L2 sound that differs phonetically from the closest L1 sound if bilinguals discern at least some of the phonetic differences between the L1 and the L2 sounds.
- H3: The greater the perceived phonetic dissimilarity between an L2 sound and the closest L1 sound, the more likely it is that phonetic differences between the sounds will be discerned.
- H4: The likelihood of phonetic differences between L1 and L2 sounds, and between L2 sounds that are noncontrastive in the L1, being discerned decreases as AOL [age of learning] increases.
- H5: Category formation for an L2 sound may be blocked by the mechanism of equivalence classification. When this happens, a single phonetic category will be used to process perceptually linked L1 and L2 sounds (diaphones). Eventually the diaphones will resemble one another in production.
- H6: The phonetic category established for L2 sounds by a bilingual may differ from a monolingual's if: (a) the bilingual's category is "deflected" away from an L1 category to maintain phonetic contrast between categories in a common L1-L2 phonological space; or (b) the bilingual's representation is based on different features, or feature weights, than a monolingual's.
- H7: The production of a sound eventually corresponds to the properties represented in its phonetic category representation.

According to the SLM, L2 learners perceive L2 sounds in terms of the phonetic categories established in the L1 sound system. Using a process of equivalence classification, L2 learners can establish new phonetic categories for L2 sounds that are different from sounds in the L1, and learners retain the ability to establish new categories throughout their life span although their acuity in doing so may diminish as their age of arrival in the L2 environment increases. To cite just a few examples of this work, Flege (1980) showed that NSs of Saudi Arabic learning English produced L2 voiced and voiceless stops with many of the same phonetic dimension found in Arabic. Despite this carryover, these learners were able to approximate some of the English norms for the sounds in question. Flege (1981) tested the "phonological translation hypothesis," which maintains that accents may persist even though adult L2 learners have been successful in acquiring the L2 phonemic inventory because, according to the hypothesis, the pronunciation of the L2 is based on pairs of corresponding sounds. The results of this and other work have shown that some of the phonetic dimensions of the learners' productions of the L2 sounds are intermediate between those of the L1 and the L2. Flege and Eefting (1987) showed that NSs of Dutch—which has unaspirated rather than aspirated voiceless stops—were aware of the acoustic differences in these sounds between English and Dutch. Moreover, the authors' subjects produced English stops with corresponding differences although the amount of the differences correlated with the learner's proficiency. These results suggest that the subjects were able to

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establish new phonetic categories for the English stops, pointing to the conclusion that L2 learners do not lose the ability to produce the requisite L2 sounds. Flege (1987) took this position explicitly and reaffirmed it more recently in Flege and Liu (2001).

Now, before I discuss the claims of the SLM, it would be useful to consider first three categories into which we can place hypotheses according to their relative strength and explanatory power. The weakest hypotheses are those that simply license a state of affairs in that they predict the possibility for something to occur. This type of hypothesis is difficult to test, because it takes only one instance of what the hypothesis allows to support it, whereas to falsify it, one would have to show that what is asserted never occurred. Of course, the problem with this is that one could never know whether enough time had elapsed to allow the licensed phenomenon to occur. A stronger hypothesis type predicts tendencies; it claims that certain facts or states of affairs are likely to obtain. This type of hypothesis is tested by determining whether, over a reasonable sampling space, the predicted state of affairs is more likely to occur than not to occur. The strongest type of hypothesis, and therefore the type that is most interesting, is one that claims that it is necessary for the predicted state of affairs to hold. Such hypotheses are stronger because they are easier to test; they are easier to test because they contain few or no qualifications or conditions and make clear assertions about which facts must obtain and which must not.

Only two of the hypotheses in the Flege (1995) version of the SLM fall into the category of strong hypotheses. Hypothesis 1 in (2) asserts that sounds in the L1 and L2 are perceptually related to each other at the phonetic rather than the phonemic level. One consequence of this claim is that the sounds in question should not contrast with each other but instead should be in mutually exclusive environments or vary freely. Flege cited as evidence for this claim the finding in Strange (1992) that Japanese L1 learners of English can more accurately perceive and produce the English /r/-/l/ contrast word finally than word initially. Hypothesis 7 in (2) is the other hypothesis in the SLM that could fall into the strong category. It contains a bit of a hedge with the word "eventually," but if we grant that time is not of the essence in testing this hypothesis, then it predicts that the phonetic properties of the sound produced by the L2 learner will correspond to the same phonetic properties as the category perceived by the learner.

The other five of the SLM hypotheses in (2) are not strong hypotheses but fall into the category of either licensing certain events or predicting the likelihood, but not necessity, of a state of affairs. Hypotheses 2 and 5 fall into the category of licensing events, and hypotheses 3, 4, and 6 predict only the likelihood of certain phenomena. For example, hypothesis 2 states only that there is the possibility that a new phonetic category will be established under certain conditions. Apparently, this is the intended force of the hypothesis because Flege (1995) stated, "bilinguals *sometimes* [italics added] establish a new phonetic category representation for sounds in the L2" (p. 240). If a hypothesis

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predicts that a set of facts will obtain sometimes, then it is merely licensing those facts. Hypotheses 5 and 6 both contain the modal "may" in their statement, and this also seems to be the intent of the claim, at least for hypothesis 6, as Flege stated, "[Hypothesis 6] is based on the observation that in the vowel system of languages, vowels *tend* [italics added] to disperse so as to maintain sufficient auditory contrast" (p. 242).

In more recent work on the SLM, some of the hypotheses have been restated into a stronger form. In MacKay, Flege, Piske, and Schirru (2001), the authors restated hypothesis 5 as the following: "The Speech Learning Model . . . proposes that category formation for an L2 speech sound *will be* [italics added] blocked if it is perceptually 'equated' with an L1 speech sound" (p. 516). Along the same lines, McAllister, Flege, and Piske (2002) seemed to recognize explicitly the weaker nature of the original hypothesis and restated it in a stronger form.

> This hypothesis was implied in Flege's speech learning model . . . (1995), one of the current models of L2 speech acquisition, and states that L2 phonetic category formation may be blocked by a mismatch in the phonetic features used to signal contrast in the L1 and L2. The hypothesis could be stated explicitly as follows: L2 features not used to signal phonological contrast in the L1 will be difficult to perceive for the L2 learner, and this difficulty will be reflected in the learner's production of the contrast based on this feature. (p. 230)

Thus, it seems clear that work on the SLM continues, and attempts to make its hypotheses stronger are ongoing.

To sum up this section, research in L2 phonology has considered the role of the L1 from the standpoint of both differences and similarities with respect to the L2 and in the medium of production as well as perception. It has been shown that several concrete proposals for models to analyze learners' perception of L2 sounds have been made and that studies to test these proposals continue up to the present.

Two important ideas had their beginning in work on the CAH and have recurred over the years in research on L2 phonology. The first is the claim that, although some L2 pronunciation errors are attributable to the learner's L1, many are not but are instead the result of developmental errors that reflect the construction of a new linguistic system. The second is the notion that not only differences but also similarities between the L1 and L2 can cause learning problems. Both of these two ideas have remained alive in L2 phonology and have a place in the some recent proposals involving universal principles, to which we now turn.

INFLUENCE OF UNIVERSAL PRINCIPLES

The other major domain in which researchers have looked for constraints on L2 phonology has been linguistic universals, interpreted in the broadest sense.

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In this section, I consider first the postulation of the concept of a "learner language," or "interlanguage," in the area of phonology and then turn to the discussion of research using markedness to explain facts about L2 pronunciation. Following that discussion, I take a look at some of the work employing principles of UG, including prosodic hierarchies, metrical grids, and Feature Geometry (Archibald, 1998a, 1998b). This is followed by a brief consideration of variability. The paper concludes with a discussion of some recent proposals within the framework of OT.

Interlanguage

One of the key developments in SLA theory in general, and in L2 phonology in particular, has been the construct of a *learner language*. This concept was proposed independently by three different scholars and labeled "idiosyncratic dialect" by Corder (1971), "approximative system" by Nemser (1971a), and "interlanguage" by Selinker (1972). The idea behind this notion is that L2 learners construct their own version of the L2. According to this view, SLA becomes the construction of a mental grammar—the learner language—based on input from the L2. The value of this construct is that it has allowed researchers to propose answers to questions that could not even be asked previously. With the concept *interlanguage* (the term that has endured), it is not only possible but also reasonable to raise the question of whether interlanguage (IL) grammars are similar in important ways to L1 grammars. It is this question that has underlain many, if not most, of the research programs in L2 phonology over the last few decades and on which I focus in the following sections.

The three researchers who proposed the idea of a learner language did not present any empirical evidence in support of it but motivated their proposals on theoretical grounds. The crucial argument for the postulation of an IL, however, is an empirical one. It requires providing evidence of what is acknowledged to be the most interesting of L2 data—namely, a pattern of utterances that does not derive from L1 transfer (because the L1 does not evidence the regularity in question) or whose systematicity cannot be tied to L2 input (because the L2 does not exhibit the relevant pattern, either). In other words, neither the L1 nor the L2 can explain the observed systematicity, but, as with all regularities, an explanation is required. Therefore, a principle or rule of some other system—namely, the IL system—must be hypothesized to explain the observed regularity.

An example of this kind of evidence in phonology is reported in Eckman (1981a, 1981b), in which it was argued that speakers from four different L1 backgrounds—Cantonese, Japanese, Mandarin, and Spanish—performed differently on a common L1-L2 difference: voiced obstruents in codas. The subjects compensated for the difficulty of voiced obstruent codas either by adding a vowel after the obstruent (through a rule of paragoge) or by devoicing the offending obstruent via a rule of word-final devoicing. The determining factor

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for which rule was motivated for the respective IL grammars was hypothesized to be whether the subject's L1 allowed obstruents in syllable codas. Japanese and Mandarin do not allow coda obstruents, and consequently subjects from these L1 backgrounds were more likely to add a vowel at the end of the L2 word, whereas Cantonese and Spanish do allow some obstruents in codas, and subjects from these L1 backgrounds devoiced the final consonant in the L2 word.

These results had two interesting implications for the notion of IL. First, the devoicing rules that were motivated for the ILs of the Spanish and Cantonese subjects were justified on the basis of morphemic alternations in the IL data. These devoicing rules, however, are not motivated either for the grammar of English (because English has a voice contrast in codas) or for the two L1s (because neither exhibits the alternations that would necessitate the postulation of such a rule). Spanish, in fact, has word-final voiced obstruents ([lißertað] *libertad* "liberty"), which would militate against a devoicing rule, and Cantonese has only voiceless obstruents, which excludes the possibility of medial voiced obstruents that could alternate with final voiceless obstruents.[1] This is an important point. If ILs are considered to be (natural) languages (Adjemian, 1976), then the analysis of IL grammars must be carried out in the same way as are the analyses of L1 grammars. In the case at hand, an L2 learner of English producing words with final voiceless obstruents, as shown in (3), where those words in the L2 are pronounced with corresponding voiced obstruents, does not in and of itself motivate a devoicing rule for the IL grammar.

(3)	IL form	L2 form	Gloss
	[rɛt]	[rɛd]	"red"
	[tæk]	[tæg]	"tag"

Such a rule would be a description of the relationship of the IL pronunciations to the L2 words but would not represent a rule of the IL grammar. What would motivate a rule of devoicing for the IL grammar would be the existence of forms such as those in (4), which, alongside those in (3), exhibit an alternation between word-final voiceless obstruents and word-medial voiced obstruents.[2]

(4)	IL form	L2 form	Gloss
	[rɛdər]	[rɛdər]	"redder"
	[tægiŋ]	[tægiŋ]	"tagging"

The existence of such a morphophonemic alternation would, on the one hand, justify postulating the lexical representations /rɛd/ for "red" and /tæg/ for "tag," and, on the other hand, motivate positing the rule of final devoicing. Had we attested the IL data in (5) instead of the forms in (4), there would have been no motivation for postulating /rɛd/ and /tæg/ as lexical representations; instead

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we would have had evidence to postulate /rɛt/ and /tæk/, in which case no IL devoicing rule could have been defended.

(5)	IL form	L2 form	Gloss
	[rɛtər]	[rɛdər]	"redder"
	[tækiŋ]	[tægɪŋ]	"tagging"

This point has at times been missed in the L2 phonological literature. For example, Edge (1991), in replicating Eckman (1981a, 1981b), raised several valid methodological points but failed to provide the necessary alternations motivating a rule of devoicing, thereby vitiating many of her arguments.

Additional phonological evidence for the necessity of postulating the concept of IL comes from studies such as Altenberg and Vago (1983) for Hungarian-speaking learners of English and by Eckman (1984) for English-learning NSs of Farsi. In both cases it was shown that the L2 learners in question regularly devoiced word-final obstruents, something that is not motivated by the English facts, nor is such a pattern defensible either for Hungarian or Farsi because both languages have a word-final voice contrast in obstruents. In both cases, one would expect that the learners would be able to produce L2 voice contrasts successfully by virtue of the contrast existing in the L1. This was not the case. However, what is especially interesting in this instance is that the resultant IL grammars evidenced a rule that is found in the grammars of many other languages. These data thus represent an example of an IL pattern that is not attributable to either L1 transfer or L2 input but is attested in other languages of the world.

Finally, with respect to Eckman (1981a, 1981b), it was argued that the IL rule that was motivated for the IL grammars of the Japanese and Mandarin speakers—that is, a rule of final vowel epenthesis or paragoge—was not found in the grammars of other known languages. It was further argued that the explanation for this could lie in the kind of language-contact situation arising in SLA. More specifically, the IL grammars, because of the influence of the L1, could contain a surface constraint against word-final obstruents, but on the basis of the L2 input, the IL grammars could at the same time contain lexical representations with final voiced obstruents. This situation would necessitate some mechanism to resolve the "clash" between the voiced obstruent in the coda of the lexical representation and the surface constraint against final voiced obstruents. This kind of discrepancy between underlying and surface representations would not arise in L1 acquisition, because the language contact leading to the conflict between the surface constraint and the underlying representation would be absent; rules of paragoge, therefore, would not be found in L1 grammars.[3]

To summarize, the concept of IL led explicitly to the possibility that L2 patterns could emerge that were independent of both the L1 and L2. This development allowed L2 researchers to question whether IL grammars obeyed universal principles, an idea that has underlain many of the research programs

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in L2 phonology over the last few decades. I begin the discussion of this question with a look at syllable structure and then proceed to the concept of markedness.

Syllable Structure

The syllable has been one of the most fertile domains for the investigation of L2 phonology. Studies of L2 syllable structure were among the earliest in L2 phonology to report IL patterns not directly attributable to either the L1 or L2 but attested in other languages. Most of the longitudinal studies in L2 phonology have focused on the development of syllables, and many of the proposals regarding the nature and magnitude of factors affecting variability in pronunciation have come from work on L2 syllables. The discussion of variation will be postponed to a later section; I turn now to the other findings.

There seem to be several good reasons for the syllable being a particularly viable domain for L2 research. First, the construct of the syllable itself, along with its structure, is relatively uncontroversial among phonologists. It is generally agreed that syllables consist of two main parts—an onset and a rhyme, with the rhyme being further subdivided into a nucleus and coda (Blevins, 1995; Kahn, 1980). Second, there exist a number of robust, crosslinguistic generalizations that describe the ways in which languages differ widely, yet systematically, in the kinds of syllable structure they exhibit (Greenberg, 1978). All languages appear to have syllables consisting of a single onset consonant followed by a vowel (open syllables). Other languages evince much more complex syllables, allowing up to four consonants in the onset (e.g., Polish) and five consonants in the coda (e.g., German and Swedish). Yet, despite the relative complexity of these onsets and codas, there are principles and empirical generalizations that describe the systematicity of syllable structure. Finally, the learner strategies for modifying L2 syllable types have in general been a clear indication of L2 learners' progress, which has made syllables the focus of several longitudinal studies.

L2 phonologists have been able to exploit the systematic, crosslinguistic differences in syllable structure by studying language-contact situations in which the L1 and L2 have contrasted sharply in their allowable syllable types. The ensuing analyses of the L2 utterances have then been brought to bear on a number of questions and issues in L2 phonology, including the role of L1 transfer and language universals.

L1 transfer was shown to constrain L2 syllable structure in an interesting way by Broselow (1983). The author showed that the different pattern of errors involving English onset clusters made by speakers of Egyptian Arabic, on the one hand, and by speakers of Iraqi Arabic, on the other hand, can be explained in terms of the epenthesis rules in the respective L1s. Broselow's data showed that, although speakers of Egyptian Arabic generally broke up onset clusters by epenthesizing a vowel between the consonants, speakers of

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Iraqi Arabic inserted the epenthetic vowel initially, before the consonant cluster.

Other studies have shown that universals of syllable structure also have an explanatory role to play. Tarone (1976, 1978) was one of the first researchers to argue for the syllable as the domain of L2 phonological analysis and one of the first to appeal to the universality of open syllables as a constraint on the IL phonology. Tarone (1980) conducted an empirical study using subjects from three L1 backgrounds—Cantonese, Korean, and Portuguese—in a research design intended to sort out the effects of L1 transfer and language universals as constraints on the IL grammar. She argued that many of the subjects' errors could not be explained on the basis of transfer, because the learners erred on syllable types that the L1 allowed, yet the modifications to the L2 codas suggested the learners' preference for open syllables. Tarone's work was replicated and extended by Hodne (1985) using Polish-speaking learners of English. Polish is similar to English in that it allows many complex codas, which eliminates L1 transfer as an explanation for many errors involving coda simplification.

The syllable is also the structure on which the most longitudinal research on L2 phonology has been carried out, much of it using NSs of Vietnamese, a language that is much more restrictive relative to English in the kinds of syllables it allows. Sato (1984) conducted one such study of two Vietnamese-speaking brothers, ages 10 and 12 years, eliciting utterances exclusively through spontaneous conversations. Despite the fact that Vietnamese allows only consonant-glide clusters in onsets and permits only singleton codas, Sato's data contained numerous tokens of syllable-initial and syllable-final consonant clusters. In many cases the subjects' difficulty with the clusters was reflected not in terms of vowel epenthesis (i.e., creating an open syllable) but in terms of reducing the clusters in question or changing the features of one or both of the segments involved. Thus, biliteral clusters were often reduced to single consonants, and voiced obstruents in the clusters were often devoiced. Although Sato's data do not reflect a learner preference for open syllables, they do show a modification in the direction of producing simpler structures. Another longitudinal study, by Osburne (1996), looked at the development of English codas by a single Vietnamese subject using data elicited 6 years apart. Osburne's results supported Sato's findings by showing that the rule of cluster reduction was highly systematic and was influenced by the L1 syllable structure. More recently, Hansen (2004) carried out a yearlong study of two Vietnamese learners of English, mapping the development of onsets and codas as a function of several linguistic and contextual factors.

One of the questions raised by these longitudinal studies was whether the development of L2 syllable structure is linear. Some recent work has addressed this question. Hansen (2001) investigated the acquisition of syllable codas by Mandarin-speaking learners of English, collecting data in two elicitations 6 months apart. Hansen's study posed several research questions, including: which constraints affect the acquisition of codas, which syllable-modification

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strategies learners employ when confronting complex codas, and how the factors governing the strategies vary and change over time. One of Hansen's important findings is that coda development over time was U-shaped rather than linear. Learners' errors were frequent initially, decreased in the early stages, and then increased subsequently. This U-shaped development for syllables was supported by Abrahamsson (2003) in a study on the acquisition of Swedish codas, also by NSs of Mandarin. Abrahamsson's data were collected at 3- to 5-week intervals over a 10-month period. One explanation proposed for the U-shaped development is that the subjects may tend to pay less attention to form as their fluency increases and as their ability to control a more casual style of speaking develops.

To summarize briefly, investigations of L2 syllable structure provided some of the earliest evidence of the interaction of L1 transfer and universal principles acting as constraints on the IL grammar. A number of the generalizations that were invoked in this work were principles of markedness, to which I now turn.

Markedness

Markedness was pioneered by the Prague School of Linguistics in the theories of Trubetzkoy (1939) and Jakobson (1941). The idea behind markedness is that binary oppositions between certain linguistic representations (e.g., voiced and voiceless obstruents or open and closed syllables) are not simply polar opposites but that one member of the opposition is assumed to be privileged in that it has wider distribution, both across languages and within a language. To assign the term "unmarked" to this privileged member is a way of giving it special status and indicating that it is considered to be, in some definable way, simpler, more basic, and more natural than the less widely occurring member of the opposition, which is designated as being "marked."

Over the decades since the inception of markedness, a number of different approaches to, and definitions of, this construct have been proposed, including the presence of overt morphological marking, the inclusion of certain features, occurrence in the environment when neutralization occurs, the amount of evidence required for acquisition by child learners, and the frequency of occurrence across the world's languages. (For further discussion, see Battistella, 1990, and Moravcsik & Wirth, 1986.) The last notion—distribution among the languages of the world, where there is a unidirectional implicational relationship between the occurrence of the members of the opposition—is known as typological markedness and was developed extensively in the work of Greenberg (1976) and can be defined as follows.[4]

> A structure X is typologically marked relative to another structure, Y, (and Y is typologically unmarked relative to X) if every language that has X also has Y, but every language that has Y does not necessarily have X. (Gundel, Houlihan, & Sanders, 1986, p. 108)

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Under this view, typological markedness is a relationship between linguistic structures or representations across the world's languages, and markedness is taken to be a property of the construction or representation itself.

In the area of L2 phonology, two hypotheses have been based on using the construct of typological markedness: the Markedness Differential Hypothesis (MDH; Eckman, 1977), and the Structural Conformity Hypothesis (SCH; Eckman, 1991). I will consider each in turn.

The MDH, stated as follows, is an extension of the CAH and claimed that typological markedness must be incorporated into the CAH as a measure of relative difficulty in SLA.

(6) Markedness Differential Hypothesis
The areas of difficulty that a language learner will have can be predicted such that:
a. Those areas of the target language that differ from the native language and are more marked than the native language will be difficult;
b. The relative degree of difficulty of the areas of difference of target language that are more marked than the native language will correspond to the relative degree of markedness;
c. Those areas of the target language that are different from the native language but are not more marked than the native language will not be difficult. (Eckman, 1977, p. 321)

Whereas the CAH attempted to explain L2 learning difficulty only on the basis of differences between the L1 and L2, the claim behind the MDH is that L1-L2 differences were necessary for such an explanation, but they were not sufficient, and therefore it was necessary to incorporate typological markedness into the hypothesis. The MDH asserts that, within the areas of difference between the L1 and L2, marked structures are more difficult than the corresponding unmarked structures.

Two testable implications follow immediately from the MDH. First, not all L1-L2 differences will cause systematic difficulty: Differing structures where there is no markedness relationship involved are not predicted to be difficult. Second, certain aspects of a given L2 will cause different degrees of difficulty for learners of different L1 backgrounds. Along similar lines, there should be "directionality of difficulty" involved in some language-contact situations. For example, two learners from different L1 backgrounds, each acquiring the same L2, are predicted not to experience equal difficulty with the same L2 structure, even though that structure may represent a difference in the L2, if there are different degrees of markedness between the L2 construction and the corresponding structures in the respective L1s. Likewise, two speakers of different languages, each acquiring the other's language, may not experience equal difficulty with the same different structures because of differing levels of markedness. If the structures to be acquired by one of the learners are more marked than those facing the other learner, then more difficulty is predicted for the learner encountering the more marked structures. None of these predictions

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necessarily follows from the CAH because the CAH, unlike the MDH, does not incorporate an independent measure of difficulty.

A number of studies have addressed the claims of the MDH, showing that typological markedness is a reliable predictor of difficulty, that there are cases where the directionality of difficulty involved in a language-contact situation follows the predictions of the MDH, and that the relative degree of difficulty corresponds to the relative degree of markedness. Space limitations allow review of a few such studies, leaving only the possibility of brief citations for some of the others. Moulton (1962) stated that the difference between German and English with respect to voice contrasts in syllable codas caused more difficulty for German speakers learning English than it did for English speakers learning German. This example was discussed within the context of the MDH in Eckman (1977), where it was argued that this asymmetry resulted from the German learners having to acquire a relatively more marked structure, a voice contrast in codas, compared to what the English-speaking learners of German had to acquire. Final devoicing in IL grammars has also been looked at from a markedness standpoint by Major and Faudree (1996) and Yavas (1994).

Anderson (1987) showed that different amounts of difficulty were encountered by learners from diverse L1 backgrounds learning a given L2. Anderson's study analyzed the learning of onset and coda clusters in English for subjects from three L1 backgrounds: Egyptian Arabic, Mandarin Chinese, and Amoy Chinese. The results supported the MDH in that the performance of the Chinese-speaking subjects was less targetlike than that of the Arabic-speaking subjects on coda clusters, and the difference in performance correlated with the degree of markedness. Additionally, marked final clusters caused more errors than the marked initial clusters. Stockman and Pluut (1992) reported findings that the authors claimed are at least in part counter to those of Anderson. Testing six Mandarin-speaking subjects, the authors found that the position of the contrast did not in all cases determine the difficulty. In some cases the phonetic features of the segment were most important, as in the case of a velar nasal, [ŋ], which causes more difficulty in onset position than in coda position. However, the findings of both Anderson and Stockman and Pluut are consistent with the MDH, because velar nasals are more marked in onset position than in coda position, because languages that have velar nasals in onsets also have them in codas but not vice versa (Ladefoged, 2001; Maddieson, 1984).

Other work has addressed different predictions of the MDH. Carlisle (1991) reported evidence showing that learners' performance on different L2 structures can be explained only by invoking the markedness relationships that exist among the structures in question. In this study, the author analyzed the production of complex onsets in English by NSs of Spanish, using a reading task. Because the elicitation task involved the subjects' producing an oral text, the number of different environments for inserting the epenthetic vowel was increased by taking into account the final segments in the preceding word. The findings showed that the subjects modified the complex onsets by inserting an epenthetic vowel and that the likelihood of a given onset type being

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modified was a function of the relative degree of markedness of two factors: the cluster in question and the preceding sounds. Another example of this kind of evidence for the MDH comes from a study by Benson (1988), in which she tested the performance of Vietnamese speakers on a number of onset and coda clusters in English. The data were elicited using a reading-list task in which the subjects produced single words. The results were in conformity with the predictions of the MDH. The subjects' performance on the syllable-final clusters was in accord with the hypothesis, although the scores on the syllable-onset clusters exhibited ceiling effects due to the relatively high proficiency of the subjects.

The other hypothesis that invoked typological markedness, or at least the generalizations underlying markedness principles, is the SCH:

(7) The Structural Conformity Hypothesis
The universal generalizations that hold for primary languages hold also for interlanguages. (Eckman, 1991, p. 24)

The primary motivation for the SCH, as argued in Eckman (1996), is an L2 pattern in which the structures adhere to markedness principles but the constructions in question are not in an area of difference between the L1 and L2. Because the pattern does not arise in an area of L1-L2 difference, it is not explained by the MDH, even though such patterns seem to fall under the spirit, if not the letter, of the MDH. One way to address this shortcoming was to eliminate L1-L2 differences as a criterion for invoking markedness to explain the facts. Essentially, then, the SCH is the result of stripping L1-L2 differences from the statement of the MDH. If we can assume that a learner will perform better on less marked structures relative to more marked structures, then the MDH can be seen as a special case of the SCH—namely, the case in which universal generalizations are obeyed by the IL in question—and the structures for which the generalizations hold are ones in which the L1 and L2 differ.

The kind of evidence that has been adduced in support of the SCH is an IL pattern that is neither nativelike nor targetlike but nevertheless obeys the kinds of universal patterns found in some of the world's languages. This kind of data has been reported in Eckman (1991), Carlisle (1997, 1998), and Eckman and Iverson (1994), to cite just a few. Each of these studies considered the case of consonant clusters in onsets or codas, where the L2 allowed both a greater number of clusters, as well as more marked clusters, than did the L1. In Eckman, the data were obtained using several elicitation tasks—including a free-conversation interview—from 11 ESL learners (4 speakers each of Japanese and Korean and 3 speakers of Cantonese). The speakers' performance was analyzed using an 80%-threshold criterion to determine whether a given cluster type was part of a subject's IL grammar. This determination was then used to test the SCH using several universal generalizations about the co-occurrence of consonant cluster types in a language. Out of over 500 such tests, the hypothesis was shown to hold in all but five cases. The studies by Carlisle

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also tested the occurrence of consonant clusters but in the IL grammars of Spanish-speaking learners of English. The specific hypotheses tested by Carlisle predicted that more marked clusters would be modified by the learners more frequently than related clusters that were less marked. Carlisle's studies supported the hypothesis in each case and also were consistent with the findings of Eckman but had the additional advantage of showing the operation of the SCH without imposing a criterial threshold on the data. Finally, Eckman and Iverson analyzed English complex codas as produced in free conversation by NSs of Japanese, Korean, and Cantonese, none of which allow complex codas. The findings showed that the learners had more errors on the more marked codas, with the consequence that the respective IL grammars had the more marked cluster type only if it also exhibited the less marked type. A common thread running through these studies supporting the SCH is that the IL grammars contain cluster types that are more complex than those allowed by the L1 but not as complex as those required by the L2. In this respect, the IL grammars fall between the L1 and L2, but always in a way that is in conformity with universal generalizations.

So far in this section, I have discussed two hypotheses in L2 phonology that incorporate markedness. A related hypothesis is the Similarity Differential Rate Hypothesis (SDRH) formulated by Major and Kim (1996). The SDRH reprises the idea from earlier work by Wode (1976) and Flege's SLM (1995) that dissimilar sounds may in some sense be easier than sounds that are similar to those in the L1. The hypothesis then blends this notion with markedness. The SDRH claims that dissimilar structures are acquired more quickly than similar structures and that markedness is a mediating factor. According to the hypothesis, "rate of acquisition" is the basis for explaining many L2 pronunciation errors, not "difficulty," as is stated in the CAH or the MDH. The primary argument for this claim is that the learning situation for beginning learners can run counter to that for advanced learners: Similar sounds are easier for beginners, because they can employ L1 transfer, but advanced learners often find sounds that are different to be more problematic (Major & Kim).

To illustrate the thrust of the hypothesis, and using Major's hypothetical illustration, if L1x is a representation in the L1, and $L2x_d$ is a dissimilar structure in the L2, and $L2x_s$ is a similar structure in the L2, then the hypothesis predicts that $L2x_d$ will be acquired faster than $L2x_s$. Moreover, if a markedness relationship is involved, then the rate is slowed. The SRDH is supported by the findings of Major and Kim (1996), in which they studied Korean learners of English on the acquisition of /ʤ/, a similar sound, and /ʒ/, a dissimilar sound. The results showed that both the beginning and advanced learners did better on the similar sound than on the dissimilar sound. However, a comparison of the rate of acquisition showed that the dissimilar sound was actually acquired at a faster rate than the similar sound.

Major (1997) tested the hypothesis further by considering acquisition results from a variety of L1 backgrounds, including Russian, Haitian Creole, Korean, and Japanese. Support for the SDRH also derived from a longitudinal study of

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Japanese learners of English by Riney and Flege (1998) and from work by Riney and Takagi (1999). Additionally, Major cited ways in which the SDRH addresses the issue of a criterial threshold for acquisition. Studies often set a seemingly arbitrary level of performance as a measure of whether a structure has been acquired. Major pointed out that the SDRH, by focusing on rate of acquisition instead of on difficulty, eliminates the need for such a threshold.

Although the SDRH makes a number of interesting predictions and seems to obviate the need for a sometimes-arbitrary threshold of acquisition, the trade-off seems to be that it still remains unclear how the notions "similar" and "dissimilar" are defined under the SDRH, just as this has been under other proposals previously discussed that have invoked similarity and dissimilarity as a factor in explaining L2 pronunciation (Rochet, 1995).

To sum up this section, it has been shown that typological markedness has played a significant role in the explanation of various facts about L2 phonology. However, one problem with this approach to markedness is that historically it has not been naturally incorporated into any theory of phonology; instead it has always seemed to be lurking on the fringes as something that had to be recognized and reckoned with but not directly incorporated into a theory. This issue is further addressed when I take up OT.

The Ontogeny Model and the Ontogeny Phylogeny Model

An important model of L2 pronunciation that also employs phonological universals is the Ontogeny Model (OM), developed in work by Major (1986, 1987). This approach has been modified over the years and has evolved into the Ontogeny Phylogeny Model (Major, 2001). The OM claims that, in the explanation of L2 sound substitutions, there is an interesting relationship between those substitutions being explainable on the basis of L1 transfer and those accounted for on the basis of L2 development. Moreover, the OM posits that the roles that these two explanation types have to play change over time and as the speaking situation moves from a less formal context to a more formal environment. More specifically, the OM claims that L2 sound substitutions due to L1 transfer decrease over time—that is, as the learner progresses—and that a similar situation occurs as the speaking situation becomes more formal. By the same token, developmental processes at first increase over time and as formality increases; they then decrease later. The results of Major (1994) supported the claims of the OM with respect to chronology but did not support the predictions made with respect to style.

Major (2001) revised the OM into the Ontogeny Phylogeny Model (OPM). Under the OPM, an IL grammar is viewed as a composite system consisting of three parts: the L1, the L2, and universals. Perhaps a better way to view this is that certain aspects of the IL grammar can be explained either on the basis of the learner's L1 or input from the L2 or on the basis of universal generalizations. Major (p. 85) also cited several interesting corollaries that follow from

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the claims of the OPM if one also takes into account the SDRH. In sum, first the OM, and later the OPM, are attempts to reconcile the influence of the L1, the L2, and universal properties on the development of IL grammars.

To summarize, it has been argued on several grounds that markedness principles constrain IL phonologies. L2 phonological patterns generally obey the implicational generalizations that have been postulated for L1 grammars. It has also been proposed that it is more fruitful for hypotheses to make predictions about rate of acquisition than about difficulty, as the former is a better indicator of learner progress than is the latter. In the next section, I consider work supporting the claim that principles of UG act to constrain L2 pronunciation.

Universal Grammar

In this section, I consider some proposals that have been made within the context of phonological theory and UG. Within the UG framework, crosslinguistic variation follows from grammars having differing parametric settings. One of the interesting findings in this area, just as in the other domains previously considered, is evidence that IL grammars are systematic in a way that is not predictable from either the L1 or the L2 but is nevertheless within the limits of variation allowed by UG. I consider two cases of such parametric variation: one involving segments and the other involving stress placement. I then conclude this subsection by considering other work on the prosodic features of stress and tone.

Parameters. One of the earliest studies in L2 phonology to utilize a parameter of UG as an explanatory principle was Broselow and Finer (1991). This study invoked the Minimal Sonority Distance (MSD) parameter to explain the performance of 24 Korean and 8 Japanese learners of English on the production of onset clusters. The MSD uses the Sonority Index (SI) from Selkirk (1982), which assigns a numerical value to relevant segment types according to the segment's sonority—the greater the sonority of the segment, the greater the value assigned by the SI. The SI is shown in (8), with sonority increasing from left to right on the scale, and the corresponding values assigned are shown in (9).

(8) Sonority Index (Selkirk, 1982)
Stops < Fricatives < Nasals < Liquids < Glides

(9)

Segment class	Value
Stops	1
Fricatives	2
Nasals	3
Liquids	4
Glides	5

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The idea is that the MSD parameter characterizes the systematic variation found in the kinds of onsets allowed crosslinguistically. This is accomplished by the MSD parameter specifying for any given language the minimal difference that must exist between the segment classes for any complex onset type to be allowed by the language in question. This minimal difference is computed by subtracting the value of one segment class from that of the other, co-occurring segment class. If the resulting value is equal to or greater than the value specified by the MSD for that language, then the onset cluster is allowed; if the resulting value is less than that number, the cluster is disallowed.

Consider some concrete examples. If a language has an MSD value of 5, that language allows no onset clusters because 5 is greater than the largest possible difference on the SI, which is 4. Alternatively, if a language has an MSD value of 4, then that language allows onset clusters consisting of stops plus glides. This is because stops have an SI of 1 and glides have an SI of 5, and the resulting difference is 4, which is equal to or less than the MSD value of 4 set for the language in this example. A language that had an MSD value of 3 would allow stop-glide, stop-liquid, and fricative-glide onsets because the difference between the sonority values of each of those pairs of consonant types is equal to or less than 3.

Broselow and Finer (1991) claimed that Korean and Japanese allowed only stop-glide onset clusters, and therefore, the MSD parameter value for these languages was 4. Because English allows fricative-stop clusters in onsets, its MSD parameter value must be no more than 1. The point and the interest of the Broselow and Finer study was the claim that their subjects did not simply transfer the value of the MSD parameter of the L1 to the IL, nor did they evidence targetlike values of this parameter. Rather, the authors argued, the subjects ended up somewhere in between the L1 and L2 settings, providing another instance in which IL grammars obey the same principles as L1 grammars.

Another study that provides evidence of this phenomenon is Pater (1997), which involves the acquisition of English stress patterns by NSs of French. Using a methodology employing nonce words, Pater found that his subjects misset the values for the parameters of word headedness and directionality. Rather than transferring the L1 values for these parameters or setting the IL values to be the same as those of the L2, the subjects set the values in a way that was neither nativelike nor targetlike. Participants in the study had no difficulty with the parameters of foot size and foot headedness, findings that are consistent with research on L1 acquisition. Studies by Fikkert (1994) and Hochberg (1988, as cited in Pater, 1997), both on L1 acquisition, support the claim that these two parameters are set early in the child's language development. Pater's subjects misset the word-headedness and directionality parameters but in a way that was nevertheless allowed by UG. Pater also reported a similar finding for speakers of Brazilian Portuguese learning English in the work of Baptista (1989).

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Prosody. Stress has been the most studied aspect of L2 prosodic structure. In addition to the above investigations showing the role of UG parameters in the SLA of stress, there has also been work attesting to the affect of L1 transfer. Thus, the findings have turned out to be similar to the results seen in other L2 phonological domains—namely, the L1 plays a significant role in determining IL stress, and at times the learners have constructed an IL stress system that derives from neither the L1 nor the L2.

The acquisition of stress patterns has been studied extensively by Archibald (1993a, 1993b, 1993c, 1995, 1997). In a study of phrasal stress by one Hungarian-speaking and one Polish-speaking learner of English, Archibald (1997) found that his subjects transferred the metrical parameters of their L1 to the IL grammar. Mairs (1989) reported results that accord with those of Archibald. She also found that the L1 has an affect on acquiring L2 stress patterns. Mairs studied the English stress patterns of 23 ESL learners, eliciting data through several different tasks. She investigated whether the L2 pattern of stress assignment was a result of L1 transfer, knowledge of the acquired English stress system, or universal tendencies of stress assignment. For Mairs, the term *universal tendencies* referred to a simplicity metric that gauges some rules to be simpler than others. She concluded that all of the IL stress patterns could be accounted for by the L2 stress system, given certain assumptions and provisos—in particular, the assumption that L2 learners fail to apply rules to rhymes that are highly marked in their L1. L2 learners do not, according to Mairs's findings, restructure L2 syllables to be in line with the L1. Rather the effect of the L1 is to place constraints on how certain rules apply in the IL. The author argued that Metrical Theory was necessary for the explanation of her results and that an equally insightful account would not have been available in a linear approach to phonology.

The acquisition of L2 prosody has also been investigated as a function of syllable structure. Anderson-Hsieh, Johnson, and Koehler (1992) investigated the relationship between the judgments of nonnative pronunciation by raters of SPEAK tests and the actual pronunciation deviance in the segments, prosody, and syllable structure. Data were gathered from 60 subjects, and the deviance was correlated with the ratings from SPEAK tests. Although all aspects showed a significant influence on pronunciation, the prosodic variable had the strongest effect and was always significantly related to the global ratings.

More recently, Young-Scholten and Archibald (2000) reviewed a wide range of studies on the SLA of syllable structure, taking into account numerous factors that bear on the acquisition of L2 syllables, such as prosodic development, typology, and sonority. The authors concluded that the acquisition of syllable structure is influenced both by universal principles of prosodic structure and by properties of the L1 syllable structure.

The effect of tone and of intonation in the L2 as perceived by L2 learners has been studied by Leather (1987) and Rintell (1984). In a tonal-labeling task, Leather found that NSs of two nontone languages—English and Dutch—could locate the crossover point in Chinese at roughly the same spot as NSs only

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after a significant amount of exemplification and then much less categorically than NSs. Rintell used a test involving judgments of the emotional tone of the conversation and found that speakers of Chinese (a tone language) had difficulty discerning emotional states of English speakers, whereas speakers of Spanish and Arabic had better success.

Zampini (1997) studied the acquisition of Spanish spirantization by NSs of English. Zampini showed that the L1 rule must be formulated in terms of the prosodic hierarchy with the domain being the intonational phrase. However, she found that the spirantization rule of her subjects applied in a more restrictive domain. In testing 32 subjects in a reading and conversational task, she found that most of L2 learners' spirantization was word internal and occurred in the domain of the clitic group. The learners' word-initial spirantization, on the other hand, had a domain of the phonological word, which suggested that parameters are reset in stages, beginning with the most restrictive setting.

Having discussed some of the work showing the influence of UG principles and parameters in both segmental and suprasegmental features, I turn now to the topic of variability.

Variability

The significance of within-speaker variability in L2 phonology was recognized at least as far back as the mid 1970s in the work of W. Dickerson (1976, 1977) and L. Dickerson (1975), and there has been considerable attention paid to this topic over the years. There are several reasons why the study of variation in L2 phonology is important, besides the fact that intraspeaker variability exists and therefore should be taken into account. In fact, one could argue, as most generative grammarians do, that simply the existence of variation does not in and of itself constitute convincing evidence to consider it part of the domain of study. It could be considered scientifically justifiable to abstract away from variability because variation may well be a function of factors that lie outside a speaker's linguistic competence (Gregg, 1990). Compelling motivation for the inclusion of variability in L2 phonological studies derives from its theoretical importance. Analyses of intraspeaker variation in pronunciation as a function of social variables (e.g., style or gender), as a consequence of the speaking context (e.g., situational formality or elicitation task), or as a result of linguistic factors (e.g., linguistic context or grammatical function) are important because these analyses shed light on the process of acquiring L2 phonology. In this section, I consider some of the factors that have been shown to bear on phonological variability in SLA.

The work of W. Dickerson (1976, 1977) and L. Dickerson (1975) reported longitudinal studies of the acquisition of the English /r/-/l/ contrast by NSs of Japanese. Their findings were couched in the framework of Variable Rules, following Labov (1969). The importance of this proposal by the Dickersons was that it had implications for acquisition, given that Labov's claim was that

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the mechanism for language change lay in the inherent variability of a grammar as depicted by variable rules. Language change over time, in the case of a primary language, would correspond to language learning in the case of an IL.

Social factors shown to be relevant within the sociolinguistic literature on primary languages were also brought to bear on the study of L2 pronunciation. One of the major issues in this context was the extent to which social factors impinged on the performance of the L2 learner. Schmidt (1977) was one of the first to argue for the importance of style variables in L2 phonology. In an empirical study on NSs of Egyptian Arabic learning English, Schmidt showed that the L2 learners varied their pronunciations of English interdental fricatives as a function of speech style and that within a given style the frequency of L2 substitutions in questions was a reflection of the learner's performance in the L1 (Arabic) at a comparable style level. Similar results have been reported by Beebe (1980), who conducted a study of 25 NSs of Thai on the pronunciation of "R," which for Beebe denoted a sociolinguistic variable that was realized phonetically as a flap, a trill, or a lateral continuant. Beebe found that, although her subjects' pronunciation varied according to style, the IL grammar was affected by different systems. For final R, performance was affected more in the formal tasks by the L2 system, English, and on initial R, performance was affected more, again in the formal tasks, but by the L1, not the L2. In more recent work, the relationship between IL variation and style has been shown to be even more complex. Lin (2001) showed that the claim that pronunciations are more targetlike in formal styles seems to hold for simplex codas but not for codas containing clusters. Rather, what varies in complex codas according to style is the particular simplification strategy employed, with the use of epenthesis increasing as the style became more formal.

Another factor that has been shown to affect L2 pronunciation is the nature of the elicitation task. Among the first researchers to report this kind of systematic variation was Tarone (1980), whose study was discussed previously. Sato (1985), in a study of a Vietnamese-speaker learner of English, found that coda clusters varied much more as a function of the task than singleton codas. Weinberger (1987) tested several hypotheses concerning coda simplification as a function of task formality, phonological context, and linguistic context. He analyzed the cluster simplification strategies employed by four NSs of Mandarin learning English. Based on the results, Weinberger was able to draw several conclusions. The first was that devoicing is a simplification strategy. The second was that the rate of simplification—that is, the rate of error—increased as the length of the coda increased, although there was no correlation between length of coda and whether a deletion or an epenthesis strategy was employed. Finally, the data showed that context was a factor: The ratio of epenthesis to deletion increased according to the linguistic task, such that the ratio was higher in connected discourse than it was in the reading of lists or single-word elicitations.

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Linguistic and grammatical context have also been determined to be factors affecting pronunciation variability. In addition to the work by Weinberger (1987), Tropf (1987) analyzed the structure of onsets and codas in the L2 German of 11 NSs of Spanish. The data were gathered during informal conversations held in the homes of the subjects. Tropf found that, in both onsets and codas, his subjects tended to omit stops rather than fricatives and that the frequency of omission varied as a function of the linguistic context and discourse domain. The more sonorant a segment was, the more likely it was to be maintained in an onset or coda. Grammatical context was found to be important by Saunders (1987), who analyzed the speech of Japanese NSs learning English. The focus of the study was clusters formed by the attachment of the sibilant [z] to verbs and nouns, as in the case of third-person-singular morphemes, plurals, and possessives. In comparison to a native control group, Saunders found that his subjects were more likely to omit the [z] from verbs than from nouns and, further, that omissions were greater in words with initial consonant clusters.

Grammatical context has also been shown to be a factor in predicting variation in more recent work. Hansen (2001), using a statistical program in her analysis, found that grammatical context was one of the conditions affecting the acquisition of English codas by her Mandarin subjects. In a similar vein, Abrahamsson (2003) found that coda segments were less likely to be absent in the pronunciation of his Mandarin learners of Swedish if the segment was a morpheme—that is, if the segment had semantic content.

In sum, a number of researchers have been able to make clear that the findings of sociolinguistic studies of primary languages have important implications for the study of L2 pronunciation. I conclude with a discussion of some recent developments in phonological theory, in the form of OT, that have made their way into L2 phonology.

Optimality Theory

In this section, I reprise the question raised earlier whether markedness principles can be naturally incorporated into a theory of language—a question that has arisen from time to time over the years within the SLA literature (Flynn, 1987; White, 1987, 1989). Until recently, phonological theories have had difficulty incorporating markedness principles and generalizations in any natural way. Although there seems to have been recognition over the decades that markedness generalizations are an important component of phonological theory, markedness principles appear to have been little more than appendages tacked on to the theory, almost as an afterthought. In fact, in one of the major phonological works in the last few decades, *The sound pattern of English* (Chomsky & Halle, 1968), markedness is treated in the very last chapter of the book, under the heading of "Epilogue and Prologue."

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To date, the only phonological theory—with the possible exception of Natural Phonology (Stampe, 1979)—to explicitly and intrinsically incorporate markedness is OT (Prince & Smolensky, 1993), to which I now turn.

The most significant difference between a grammar within OT and grammars within other metatheories is the way in which well-formedness is described. In non-OT grammars, which are rule based, grammaticality is characterized by constructing a set of rules, which, if adhered to, will yield well-formed utterances. Deviance is described by showing that ungrammatical representations violate at least one of the principles of the grammar. Within OT, on the other hand, grammars consist of a universal set of constraints instead of rules. A good way to conceive of the constraints is as criteria for well-formedness. Given that no language can satisfy all of these criteria, it is assumed that some of the constraints will conflict with each other. Thus, the constraints are violable, and conflicts are resolved by ranking the constraints in cases of conflict. Grammars of particular languages result from different rankings of the universal constraints.

From the stipulation that all constraints are universal and that grammars differ only in the particular ranking of the universal constraints, the theory makes the claim that well-formedness criteria do not differ from language to language; rather, what varies across languages is how these criteria are applied—that is, how they are ranked. OT is thus inherently a theory of typology: Any ranking of the universal constraints should yield a grammar of a language, and any grammar of a language should conform to one of the possible rankings of the constraints.

Moreover, given that the goal of a grammar is to specify all and only the well-formed utterances in the language, or in the case of phonologies, all the well-formed pronunciations, OT grammars and rule-based grammars accomplish this aim differently. Rule-based grammars begin with the lexical representation of an utterance and execute a derivation, by applying the appropriate rules to the lexical representation, making the changes specified by the rules, producing intermediate representations to which other rules are applied, and continuing until all of the applicable rules have been brought to bear, and the output is specified. The well-formed utterances of the language are predicted to be all and only those that can be successfully derived using the rules of the grammar. An ill-formed, or ungrammatical, utterance is characterized by showing that its derivation violates one or more of the rules of the grammar. On the other hand, the constraints of an OT grammar are violable; no single utterance can satisfy all of the universal set of criteria for well-formedness. Within OT, therefore, grammaticality is not characterized on the basis of whether an utterance violates one or more of the constraints; instead, the grammaticality of an utterance is determined by an optimization procedure whereby well-formed utterances are those that conform to the highest ranked constraints in the grammar.

This leads to the third important feature of OT—that the set of universal constraints is divided into two categories, faithfulness constraints and mark-

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edness constraints. Interestingly, this division has been cited as corresponding, roughly and respectively, to the notions contrast and articulatory ease (Gundel et al., 1986). The important point, from our perspective, is that, within OT, markedness is incorporated as a basic tenet of the theory.

In recent years, there have been a few studies on L2 phonology done within an OT framework. Hancin-Bhatt and Bhatt (1997) reprised and extended the Broselow and Finer (1991) study of the acquisition of English complex onsets by NSs of Japanese and Korean. The authors advanced the Broselow and Finer study by analyzing subjects from two L1 backgrounds (Spanish and Japanese) that differ in the onsets and codas allowed. Because Spanish allows some complex onsets and codas, whereas neither Japanese nor Korean does, Hancin-Bhatt and Bhatt argued that this allowed them to test for the effects of transfer. The authors concluded that OT gives a superior account of the data because it characterizes the differences between Japanese and Spanish solely in terms of the ranking of the same constraints and that the theory made clear the language-particular differences that were the basis for the pronunciation errors.

Broselow et al. (1998) illustrated that the simplification strategies used to modify English codas by NSs of Mandarin could be explained as the emergence of the unmarked. The emergence of the unmarked (or tetu) is claimed by McCarthy (2002) to be one of the hallmarks of OT. The phenomenon can be described as follows. Within OT, a grammar of a language is a particular ranking of the universal constraints. The utterances of any given language are generally characterized by the more highly ranked constraints; low-ranked constraints are, by definition, not determinant in the vast majority of evaluations. However, a fundamental tenet of OT is that such low-ranked constraints are still part of the grammar of the language. Evidence for this is that, in some cases, the outcome of an evaluation is that the higher ranked constraints are not decisive. The evaluation of candidates in this case continues by appealing to the lower ranked constraints. When a low-ranked constraint, usually a markedness constraint that is generally not decisive in a language comes to be the determining constraint in an evaluation, the candidate that surfaces as optimal is referred to as the emergence of the unmarked.

Broselow et al. (1998) also pointed out that OT provides a ready explanation for the source of L2 patterns that are attributable to neither the L1 nor the L2. Within OT, all grammars are assumed to contain all constraints; the source of the novel L2 patterns is the "emergence" of a constraint in the IL that is ranked low in both the L1 and L2.

In a recent study of the acquisition of English codas by NSs of Thai, Hancin-Bhatt (2000) showed that the IL patterns produced by her subjects could be successfully accounted for through constraint rerankings in which the relevant constraints reorder themselves in a systematic and predictable way.

Finally, Lombardi (2003) argued for an OT approach to the classical problem of "differential substitution," whereby learners of L2 English substitute either [t] or [s] for [θ], depending on their L1 background. Lombardi claimed that the substitution of [t] is primary in the sense that this is the substitution

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that children use. This substitution is, in other words, the unmarked case. Therefore, Lombardi argued, learners who substitute a fricative are showing an effect from the L1. Lombardi's proposal to account for this differential substitution was to adopt a particular formulation of the constraints on faithfulness to manner of articulation. By analyzing this constraint into its components and ranking these components separately, Lombardi was able to predict which phonological aspects of an L1 will result in learners' substituting a fricative instead of a stop.

OT offers an interesting and perhaps promising framework in which research on L2 phonology can be carried out. In particular, OT is inherently a theory of language typology, and it explicitly incorporates markedness, which has been involved in the explanation of some aspects of L2 phonology.

CONCLUSION

In this survey of L2 phonology over the last few decades, we have seen several themes emerge and recur, even as our understanding of sound systems in general and IL phonology in particular has increased. L1 influence has always been, and still is, a factor in explaining L2 pronunciation. In the days of Contrastive Analysis, it was paramount, and it has remained important even into recent accounts formulated within OT. Universals have also, over the years, played a significant role, whether in the form of developmental processes, markedness generalizations, principles of UG, or the emergence of the unmarked. Finally, one of the most interesting phenomena in SLA, including L2 phonology, is a pattern that is independent of both the L1 and L2 but is nevertheless attested in other human languages. OT, with its claim that all constraints are universal, has the potential to provide an explanation for the source of such L2 patterns.

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NOTES

1. One of the anonymous *SSLA* reviewers suggested that the Cantonese facts could also be accounted for using L1 transfer because Cantonese has voiceless but not voiced obstruents in codas. Although it is true that the substitutions of voiceless obstruents in codas by the Cantonese subjects could be attributed to L1 transfer, the fact that these word-final voiceless obstruents systematically alternated with intervocalic voiced obstruents, thereby motivating a devoicing rule, could not be accounted for by L1 transfer. This is true because Cantonese does not have voiced obstruents intervocalically, does not exhibit an alternation between medial voiced and final voiceless obstruents, and therefore provides no motivation for a devoicing rule.

2. One of the anonymous *SSLA* reviewers asked whether one could ever postulate a devoicing rule in the absence of the alternations. Perhaps the best way to respond is to say that it is unsound practice to postulate any construct without proper motivation. What motivates a devoicing rule, in this case, is the systematic occurrence of final voiceless obstruents in the face of evidence that the corresponding underlying representations are voiced. The alternations provide evidence of the voiced

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underlying representations. Thus, a devoicing rule would be motivated in the absence of alternations only if there were other evidence that the relevant underlying representations were voiced.

3. One of the anonymous *SSLA* reviewers pointed out that many languages (e.g., Japanese, Mandarin, and Portuguese) epenthesize word-final vowels as part of loan phonology and raised the question of whether loan phonology was part of the grammar or whether it should be considered a special case of SLA. Three points are relevant here. First, it seems that loan phonology should not be considered as a special case of SLA because the speaker in this situation is speaking the L1, not the L2. Second, the points raised in note 2 are pertinent. To the best of my knowledge, in loan phonology, the alternations that would motivate a rule of word-final epenthesis (paragoge) are not present. Thus, there appears to be no motivation for a derivational rule of word-final epenthesis, as opposed to, say, a strategy for lexicalizing borrowed words. Finally, in nonderivational, constraint-based frameworks, the question of whether such a rule is motivated as part of the grammar would be moot.

4. An anonymous *SSLA* reviewer suggested that it might be useful, along with the implicational definition of markedness, to characterize markedness in terms of "popularity." Some phenomena are more common across the world's languages and therefore could be described as less marked without there being an implicational relationship. This is, I believe, an open, empirical question. The central liquid, [ɹ], that occurs in North American English is less frequent crosslinguistically than either the alveolar trill [r] or the uvular trill [ʁ] (Maddieson, 1984). Moreover, there is no implicational relationship that exists among any of these liquids. Thus, the MDH, which employs the implicational definition of markedness, predicts a difference in the nature of the difficulty involved in L2 learners' acquiring the various r-sounds compared to, say, phenomena that are more or less marked in the implicational sense.

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