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# **Metrical Phonology and the Acquisition of L2 Stress<sup>1</sup>**

John Archibald  
*The University of Calgary*

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## **Domain of Inquiry**

Most parameter-related research has taken place in the area of syntax. Flynn (1987) looked at the head-initial/head-final parameter; Phinney (1987) looked at pro-drop; White (1985) looked at subadjacency; etc. There has been little done in the area of phonology with the notable exception of Drescher and Kaye 1990 (see also Ioup and Weinberger 1987 and Mairs 1989).

## **The Acquisition of Stress Project**

The study I shall be describing in this paper is part of a larger project known as the Acquisition of Stress Project (ASP). The ASP is designed to investigate the acquisition of English stress patterns by adult, non-native speakers of English. Specifically, the behaviour of learners from three different language types (with respect to stress) is being studied: Spanish, Hungarian, and Polish.

The ASP has four major objectives:

- To come to a better understanding of when the first language (L1) will transfer to the second language (L2).
- To collect some empirical evidence relevant to deductive theories of language acquisition.
- To investigate the pedagogic implications of this deductive view of language learning.
- To gather some data relevant to the Continuity Assumption in language acquisition research (cf. Pinker 1984).

### Why Stress?

It makes sense to investigate stress within this framework for three main reasons:

- A well-developed theory of stress within a parametric framework exists — that is metrical phonology.
- It may help us to predict what linguistic features will be transferred from L1 to L2.
- Accentual systems can be studied in relative independence of other aspects of grammar.

### English Stress

English verbs and unsuffixed adjectives exhibit some interesting properties. These words receive final stress if they end in a string of at least two consonants or a syllable having a long vowel, and otherwise penultimate stress (Hayes 1981). Examples are shown in (1).

- (1) **robust<sup>2</sup> common**  
**overt illicit**

Hayes' interpretation of this fact is that word-final consonants are extrametrical (invisible to stress assignment). This reflects the quantity-sensitive nature of English stress: branching rimes are stressed while non-branching rimes are not.

Many suffixed adjectives behave differently than unsuffixed ones, in that they follow the same pattern as regular nouns. Typically they are the ones that end with -al, -ous, -ant, -ent, and -ive, as shown in (2).

- (2) **municipal magnanimous**  
**significant innocent**  
**primitive**

Here we note that adjectival suffixes become extrametrical in final position. The exceptions to this rule are the suffixes -ic and -id which are almost always given penultimate stress, as if they were monomorphemic. Examples are given in (3).

- (3) **intrepid economic**

One suffix that appears to be quantity insensitive is the -ate suffix which

always places stress two syllables to its left, as in (4).

- (4) **designate** articulate  
 confis**cate** **concentrate**

### The Cycle

English stress applies cyclically. That is, it applies to the internal bracketed domains of derived words before applying to the word as a whole, as the examples in (5) show.

- (5)       3 4 1  
 [indent] ation from **indent**  
           3 0 1  
 [compensat] ion from **compensate**

### Spanish Stress

There is no such thing as an irregularly stressed verb form in Spanish (Harris 1983). Information regarding non-verb stress must be supplied in the lexicon; segmental representation and morphological characterization are necessary but not sufficient to determine word stress. However, stress placement is not totally free due to residual effects of the Latin stress rule (like English). Two points are of interest here:

- Stress must fall on one of the last three syllables of the word. Although **atapama** and **atapama** are well-formed hypothetical words, **\*atapama** is not.
- Antepenultimate stress is impossible if the penult is a closed syllable. Hypothetical **atapamba** and **atapamba** are well-formed but **\*atapamba** is not (nor **\*atapamba**).

Although stress may appear on any of the last three syllables not all probabilities are equally likely. The following two generalizations are noted:

- Penultimate stress is unmarked in vowel final words:

Unmarked: **pistola**, **perdida**, **sabana**

Marked: **epistola**, **perdida**, **sabana**, **Panama**

- Final stress is unmarked in consonant-final words:

Unmarked: **civil**, **merced**, **altar**

Marked: **movil**, **cesped**, **ambar**

Stress assignment in Spanish is non-cyclic with the exception of two suffixes: -mente adverbs and the -ito diminutive.

### **The Study**

This pilot study was designed to investigate a proposed parameter of quantity-sensitivity (cf. Dresher and Kaye 1990). I assigned two tasks to seven native speakers of Spanish. In the first task the subject was asked to read a list of fifty English words out loud into a tape recorder. Later I transcribed where each subject placed the stress on the word. The second task was a perception test in which the subjects listened to a native speaker pronounce each of the words twice from a tape. After a training session, their task was to mark which syllable they perceived the stress to be on. The perception task was conducted second in order that the production task not be influenced.

### **Why A Production Task?**

Some of the research studies (e.g. White 1985) rely on grammaticality judgement tests in order to investigate the learners' parameter settings. Thus, the subjects' ability to perceive violations in the target language data is equated with their having acquired the L2 parameter setting. The study of stress seems particularly amenable to teasing apart production and perception variables. In this study, I hope to show that even though the learners are able to perceive the correct stress in the L2, their production may still be influenced by the L1. Therefore, we cannot infer actual parameter settings from perception data alone.

### **The Words**

The following classes of words were presented to the subjects (with the words in random order):

Class 1. Anecdote, interface, kindergarten, undertow.

Since Spanish stress assignment does not allow antepenultimate stress when the penult is closed, we would predict that these words would be difficult for Spanish speakers if they are transferring their L1 metrical rules.

Class 2. Data, study, era, into, money.

The unmarked stress pattern for vowel-final words is penultimate. We would predict that these words would be produced correctly.

Class 3. Apply, construe, ago, supply, below.

Final stress is the marked stress pattern for vowel-final words. Thus these words might be more difficult for Spanish speakers to produce.

Class 4. Explain, retrieve, afford, control.

Final stress is the unmarked pattern for Spanish consonant-final words. Thus, we would predict few problems with these words.

Class 5. Central, basis, reason, mountain, vowel, utmost.

Penultimate stress is the marked pattern for Spanish consonant-final words. Perhaps these words will cause problems for the Spanish speakers.

Class 6. Currently, secondary, stresslessness, relationship, frequency.

These derived forms were tested to see if the same constraint as in Class #1 applies to derived forms (for the most part Spanish stress assignment is non-cyclic.)

Class 7. Cannonball, overboard, undermine, sabertooth, basketball.

These words were tested in order to see if compounds exhibit the same constraint as in Class #1.

Class 8a. Robust, overt, collect.

English verbs and unsuffixed adjectives receive final stress if they end in a consonant cluster. It would be predicted that Spanish speakers would have difficulty with this.

Class 8b. Common, illicit.

English verbs and unsuffixed adjectives receive penultimate stress in other cases.

Class 9. Municipal, significant, magnanimous, innocent, primitive.

Many English adjectival suffixes are extrametrical. Spanish speakers may have difficulty acquiring this.

Class 10. Economic, intrepid.

The two exceptional suffixes are -ic and -id (which draw the stress to the immediately preceding syllable).

Class 11. Designate, confiscate, articulate, concentrate.

The -ate suffix in English is quantity-insensitive. The stress is always placed two syllables to the left of the suffix. It is predicted that Spanish speakers will have difficulty with this quantity-insensitivity.

### The Results

First of all, let me say that we should only view this as a pilot study as there are only seven subjects. However, as each class of words has approximately five members, our sample size is not that bad.

### Production versus Perception

The chart in (6) illustrates the breakdown of production versus perception errors:

- (6) Total number of tokens (50 words X 7 subjects): 350  
 Production errors: 94 (27%)  
 Perception errors: 63 (18%)

While this is not as large a difference as might have been expected, I think it can be explained when we look at the individual results, shown in (7).

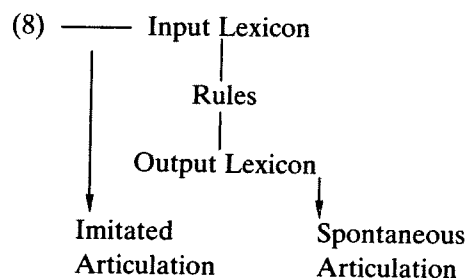
(7) Subject #	% Production error	% Perception error
1	26%	4%
2	10%	1%
3	18%	3%
4	15%	0%
5	18%	20%
6	13%	21%
7	8%	16%

The first four subjects show a marked difference between their production and perception error rates. The final three subjects show, surprisingly I think, that they make more perception than production errors. Solely on

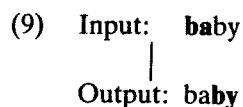
the basis of the interview session, I would say that these students seemed to be lower in overall proficiency than the first four students, even though the number of production errors was about the same. Perhaps beginning students are less able to perceive differences in stress; they are still filtering the English through a Spanish sound system. The more advanced students are able to perceive the differences but are not yet able to put it into practice consistently.

### Two Lexicons

Menn (1983) presents an interesting model which can be used to describe children's phonological knowledge. This is summarized in (8).



This two-lexicon model allows us to explain learners who are able to perceive distinctions that they are unable to make. The input lexicon stores a recognition form; the output lexicon stores a production form. Thus, if the learner, at a certain stage, is able to perceive which syllable is stressed in target speech but is unable to produce the word correctly, we would say there is a mismatch between the form stored in the input lexicon and the form stored in the output lexicon, as, for example, in (9).



Note also the prediction that sometimes the output lexicon can be bypassed and a form uttered that comes directly from the input lexicon.

Menn's model might help us to explain the difference in behaviour of the students. The first four subjects have a fairly accurate input representation but their output representation is still influenced by L1 metrical struc-

tures. Subjects 5, 6, and 7, though, have still not developed an adequate input representation, so the production and perception forms are influenced by L1 and the error rates are more equal. Assuming that subjects 5, 6, and 7 are beginning students, these results support Menn's claim that the input representation is the first to normalize, with the output lexicon lagging behind.

It should also be noted that perception errors affected more words than production errors (36 versus 29) and that fewer people made mistakes on the same word. That is to say that in the production data there were fifteen words that three or more people made a mistake on. In the perception data, there were only five words that three or more people made a mistake on. Perhaps then, the production data is more reflective of the L1 interference.

Let us now look at the production mistakes in more detail in the chart in (10).

(10) Class	Percent error
1 (heavy penult):	71%
8a (final CC):	67%
10 (-ate suffix):	57%
11 (-ic and -id):	29%
9 ([+ex] suffixes):	23%
7 (compounds):	20%
3 (marked V-final):	17%
5 (marked C-final):	17%
6 (derived forms):	14%
4 (unmarked C-final):	14%
2 (unmarked V-final):	0%
8b (unmarked adj.):	0%

Generally speaking, this chart shows the kind of progression that we would expect to see. Class 1 words, which violate the Spanish stress assignment rules, are problematic. Class 8 words show that the subjects have not yet acquired the English constraint which gives final stress to words like robust and overt.<sup>3</sup> Class 10 words indicate that the Spanish speakers do have trouble with quantity-insensitive suffixes like -ate. They also have difficulty with adjectival suffixes whether they be extrametrical or fixed-stress giving. The subjects had problems with English compound stress too.

Considering the markedness factors, we note that there is some indication that production of marked forms may be slightly more difficult. Harris



(1983) who made these markedness claims does not give any information as to the frequencies of these phonological forms in Spanish. It is interesting to note, however, the radical difference in behaviour between Class 1 and Class 6 words shown in (11).

(11) Class 1	Class 6
anecdote	currently
interface	secondary
kindergarten	stresslessness
undertow	relationship
	frequency
% errors: 71%	% errors: 14%

Both classes are examples of words which receive antepenultimate stress when the penult is closed, which violates Spanish stress-assignment rules. Class 6 words, though, seem to cause very few problems. No one made any mistakes on *stresslessness* or *relationship*; one person made a mistake on *currently*; and two people made mistakes on *secondary* and *frequency*. This would seem to indicate that the Spanish speakers have determined (at some level) that English stress assignment is cyclic.

Table 1 shows all the words with production errors and the number of subjects who erred.

Table 1. Production Mistakes Ranked

anecdote (7)	overboard (2)
robust (6)	municipal (2)
designate (6)	intrepid (2)
interface (4)	economic (2)
interface (2)	secondary (1)
construe (6)	secondary (1)
mountain (6)	frequency (2)
overt (5)	cannonball (1)
confiscate (3)	cannonball (1)
confiscate (1)	innocent (1)
undertow (4)	innocent (1)
concentrate (3)	undermine (2)
concentrate (1)	currently (1)
kindergarten (3)	afford (1)
articulate (3)	magnanimous (1)
collect (3)	sabertooth (1)
retrieve (3)	
significant (3)	

Quantity-sensitivity violations explain some of the most common mistakes: anecdote (7), robust (6), interface (6), overt (5), undertow (4), kindergarten (3), and collect (3).

Markedness violations are also explanatory. Several common mistakes resulted from the assignment of the unmarked stress pattern incorrectly: construe (6), mountain (6), concentrate (4), confiscate (4), and articulate (3).

These twelve words, then, account for 80% of the errors. Thus, quantity-sensitivity and markedness violations are definite sources of error.

### **Conclusion**

The results of this study seem to indicate that Spanish speakers are transferring the metrical parameters of their L1 into the L2. The question is then: how will these parameters be reset?

I think that one of the most useful sources of information for the learner will be the mismatch between production and perception. Hyams (1987) talks of triggering data which is inconsistent with the current grammar and forces a resetting of a parameter. I think it is reasonable to assume that if the learner is not able to perceive native-speaker stress placement correctly, then this input will not act as triggering data. This seemed to be the case with the three lower level subjects in this study. However, once perception ability improves then some data will become available as triggering data due to the mismatch between perception and production.

I believe that this kind of study also has interesting implications for the idea that a single utterance will force the resetting of a parameter. This is obviously not the case in the above data. Often, performance variability is explained by referring to other cognitive processes involved in performance (Crain 1987). Yet, in this type of study of phonology I think it would be questionable to say that it involves the same degree of higher cognitive processes. And we have seen that there is quite a difference between the production and the perception.

Finally, I suggest that this study shows us that we must be wary of inferring parameter settings from perception results alone. The mismatch of production and perception may be crucial in making the triggering data available as intake to the learner. We must still address the question of what drives the change in the input representation. For example, could

there be some sort of threshold or critical point at which the input representation will change? Right now we have no answers. However, the study of metrical parameters seems particularly well-suited to investigating many of the questions.

### Notes

1. I would like to thank Elan Dresher, Susanne Carroll, Merrill Swain, and Birgit Harley for their comments on earlier drafts of this paper.
2. A syllable in bold face indicates a stressed syllable.
3. This is counter-evidence to Mairs' (1989) Marked Rime Hypothesis, as I understand it. For Spanish speakers to be getting these words wrong, they must be marking the whole coda as extrametrical. If only the final consonants are extrametrical, we would predict correct stress. For more on this, see Archibald, forthcoming.

### References

- Archibald, J. Forthcoming. "The Learnability of Metrical Parameters". To appear *International Review of Applied Linguistics*.
- Crain, S. 1987. "How grammars help language learners." *University of Connecticut Working Papers in Linguistics*.
- Dresher, E. and J. Kaye 1990. "A Computational Learning Model for Metrical Phonology". *Cognition* 34.137-195.
- Flynn, S. 1987. *A Parameter Setting Model of Second Language Acquisition*. Dordrecht: D. Reidel Publishing Company.
- Harris, J. 1983. *Syllable Structure and Stress in Spanish*. Cambridge, MA: MIT Press.
- Hayes, B. 1981. *A Metrical Theory of Stress Rules*. Massachusetts Institute of Technology doctoral dissertation.
- Hyams, N. 1987. "The theory of parameters and syntactic development." Roper and Williams 1987.1-22.
- Ioup, G. and S. Weinberger, eds. 1987. *Interlanguage Phonology*. Rowley, MA: Newbury House.
- Mairs, Jane. 1989. "Stress Assignment in Interlanguage Phonology: An Analysis of the Stress System of Spanish Speakers Learning English". *Linguistic Perspectives on Second Language Acquisition* ed. by S. Gass and J. Schachter, 260-283. Cambridge: Cambridge University Press.
- Menn, L. 1983. "Development of articulatory, phonetic, and phonological capabilities." *Language Production, volume 2* ed. by B. Butterworth. New York: Academic Press.
- Phinney, M. 1987. "The pro-drop parameter in second language acquisition." Roper & Williams 1987.221-238.

- Pinker, S. 1984. *Language Learnability and Language Development*. Cambridge, MA: Harvard University Press.
- Roeper, T. and E. Williams, eds. 1987. *Parameter Setting*. Dordrecht: D. Reidel Publishing Company.
- White, L. 1985. "The acquisition of parameterized grammars: subjacency in second language acquisition." *Second Language Research* 1.1-17.

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Edited by

*Fred R. Eckman*

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