THE LEARNABILITY OF ENGLISH METRICAL PARAMETERS BY ADULT SPANISH SPEAKERS

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OVERVIEW

In this paper I outline the results of a study done on adult speakers of Spanish learning English. First, I present some relevant facts about English and Spanish stress assignment. Then I list the words which were given to the Spanish subjects, and the reasons underlying the choices. The results of this study are discussed in terms of such things as the proper domain for extrametricality, and the transfer of L1 extrametricality markings. I conclude with some data from acquisition of stress in L1 (Spanish and English).

SPANISH STRESS

The relevant facts about Spanish stress are taken from Harris (1983). There is no such thing as an irregularly stressed verb form in Spanish. 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 *atápama* and *atapáma* are well-formed hypothetical words. **átapama* is not.
- Antepenultimate stress is impossible if the penult is a closed syllable. Hypothetical *atapámba* and *atapambá* are well-formed but **atápamba* is not (nor **átapambá*).

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: *ptstóla, perdída, sabána*
  Marked: *epí stola, pérdida, sábana, Panamá*

- Final stress is unmarked in consonant-final words:

  Unmarked: *civíl, mercéd, altár*
  Marked: *móvil, césped, ámbar*

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

Table 1 shows the metrical parameter settings for Spanish (based on Dresher and Kaye, 1990):

P1:	The word is strong on the	[Right]
P2:	Feet are	[Binary]
P3:	Feet are built from the	[Right]
P4:	Feet are strong on the	[Left]
P5:	Feet are Quantity-sensitive	[Yes]
P6:	Feet are QS to the	[Rime]
P8A:	There is an extrametrical syllable	[Yes]
P8:	It is extrametrical on the	[Right]

Table 1. Spanish Metrical Parameter Settings

ENGLISH STRESS

Chomsky and Halle (1968) noted the difference between syllables with branching and non-branching rhymes, as indicated below:

Cánada agénda

where we see that in a large class of nouns, the antepenult is stressed when the penult has a non-branching rhyme, and the penult is stressed otherwise. Thus, word stress in English is *quantity-sensitive* – main stress is assigned to a syllable with a branching rhyme.

Let's also look at stress patterns in unsuffixed adjectives. We note the two patterns seen below:

sólid	absúrd
méllow	robúst
cértain	diréct

where we note that adjectives which end in a consonant cluster receive final stress while adjectives which end in a single consonant receive penultimate stress. I will follow Hayes' (1980/81) explanation of this pattern: that word-final consonants are *extrametrical* (or invisible to stress assignment). Thus, the generalization that branching rhymes are stressed is maintained.

ENGLISH AND SPANISH METRICAL PARAMETERS

Table 2 illustrates that English and Spanish parameter settings are, for our purposes, identical:

		English	*Spanish*
P1:	The word is strong on the	[Right]	[Right]
P2:	Feet are	[Binary]	[Binary]
P3:	Feet are built from the	[Right]	[Right]
P4:	Feet are strong on the	[Left]	[Left]
P5:	Feet are Quantity-sensitive	[Yes]	[Yes]
P6:	Feet are QS to the	[Rime]	[Rime]
P8A:	There is an extrametrical syllable	[Yes]	[Yes]
P8:	It is extrametrical on the	[Right]	[Right]

Table 2. English and Spanish Metrical Parameter Settings

THE STUDY

Let me quickly summarize the study I will be discussing. In this study, 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.

Subsequent testing revealed that the method of marking stress did not affect the performance of the subjects. A number of native speakers of English were given different tests (some having to place a mark to indicate perceived stress, some having to circle a syllable, and some having to underline. I also administered tests which referred to letters as opposed

to syllables.) A one-factor ANOVA run on the tests and scores determined that the method of marking did not significantly change the performance of the subjects ($F=1.139$, $p=.3618$). These tests also showed native speakers ability to perform these tasks satisfactorily. The method of scoring that I used was to assign a score of 1 if the subject placed stress correctly and a score of 2 if stress was placed incorrectly. Thus, on a ten-item test, a score of 10 would indicate all correct and score of 20 would indicate all incorrect. For all tests administered to the native speakers, the mean score was 11.028, standard deviation was 1.715, and standard error was .286. The test also appears to be a reliable test of a learner's competence. On two separate days I administered the same 20-item test to two groups of native speakers of English (with approximately 90% overlap in the two populations). Therefore all correct would be assigned a score of 20, while all incorrect would be assigned a score of 40. On the first trial the mean score was 22.455, standard deviation was 3.584, standard error was .483. On the second trial the mean score was 21.51, standard deviation was 2.416, and standard error was .345. On both trials the mode was 20. Clearly, this shows the test to be reliable.

THE WORDS

The following classes of words were presented to the seven Spanish-speaking subjects (with the words in random order). The explanations are taken from Harris (1983):

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 if they are transferring their L1 settings.

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. We might expect that these words would 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 these words.

Class 8b. *Common, illicit.*

English verbs and unsuffixed adjectivies 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.

RESULTS

Production versus Perception

Table 3 illustrates the breakdown of production versus perception errors:

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

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%

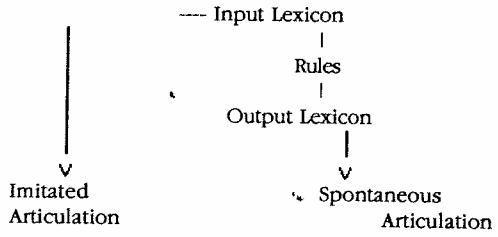
Table 3. Production versus perception errors.

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. This has been suggested in works such as Polivanov (1931).

Two Lexicons

Menn's (1983) two-lexicon model, presented below:



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. For example:

Input: báby
|
Output: babý

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 structures. 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 Table 4:

Class 1 (heavy penult):	71% error
Class 8a (final CC):	67%
Class 10 (*-ate* suffix):	57%
Class 11 (*-ic* and *-id*):	29%
Class 9 ([+ ex] suffixes):	23%
Class 7 (compounds):	20%

Class 3 (marked V-final):	17%
Class 5 (marked C-final):	17%
Class 6 (derived forms):	14%
Class 4 (unmarked C-final):	14%
Class 2 (unmarked V-final):	0%
Class 8b (unmarked adj.):	0%

Table 4. Ranking of production errors by class.

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*. 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. It is interesting to note, however, the radical difference in behaviour between Class 1 and Class 6 words:

Class 1	**Class 6**
anecdote	currently
interface	secondary
kindergarten	stresslessness
undertow	relationship
	frequency
% errors: 71%	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 subject made a mistake on *currently*; and two subjects 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 (i.e. they treat derived words differently than non-derived forms).

The following chart indicates all the words with their production errors and the number of subjects who erred:

Production Mistakes Ranked

anécdote (7)

róbust (6)
desígnate (6)
interfáce (4)
intérface (2)
cónstrue (6)
mountáin (6)

óvert (5)

confíscate (1)
confiscáte (3)
undertów (4)
concentráte (3)
concéntrate (1)

kindergárten (3)
articuláte (3)
cóllect (3)
rétrieve (3)
sígnificant (3)

overbóard (2)
múnicipal (2)
intrepíd (2)
ecónomic (2)
secondáry (1)
secóndary (1)
frequéncy (2)
cannónball (1)
cannonbáll (1)
innocént (1)
innócent (1)
undermíne (2)

currently (1)
áfford (1)
magnanímous (1)
sabertóoth (1)

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 also help to explain the error patterns. Several common mistakes resulted from the assignation 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.

EXTRAMETRICALITY

What I want to consider in more depth now is the notion of extrametricality in both L1 and L2 acquisition. First of all let's look at L2 acquisition. According to Harris (1983), it is extrametricality which leads to marked stress patterns. The way that marked stress is indicated in the lexicon is as "extrametricality of the rightmost rime segment in the derivational stem."[1] Roca (1988) disagrees with the assignation of the derivational stem as the appropriate domain, but interestingly, I think that the errors that learners made provide us with some evidence in this area as we shall see.

Remember that, as we have seen, the Spanish speakers behaved markedly differently on classes 1 and 6 – words with the same segmental structure (*anecdote*, *interface* etc., vs. *frequency*, *currently*, etc.) where the penult is heavy. We noted that the learners had less difficulty with the derived forms than with the non-derived forms. This suggests two things:

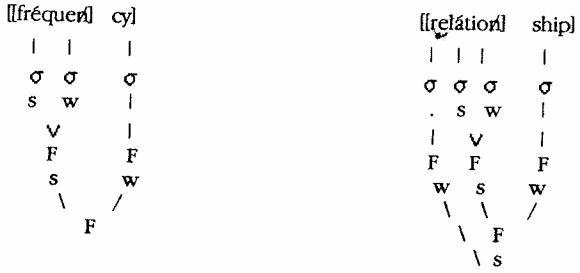
1) that they were aware of the internal structure of the word

and

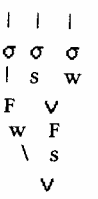
2) that the derivational stem is the appropriate domain for the application of extrametricality.

For if the word were the proper domain we would expect the heavy penults to be stressed in words like *frequency*, *relationship*, etc. For example,

However, if we assume that the derivational stem is the appropriate domain, we can explain the findings. The codas of the penults are extrametrical (as they are part of the final rime elements in the derivational stem) and thus would not be stressed. Subjects who did this also showed evidence of having determined that English stress assignment is cyclic. These items would be represented as follows:



This would not affect the penult in a non-derived form like *anecdote* where the 't' is extrametrical and correctly predicts the erroneous stress pattern [anécdote] which was produced by many subjects, as the following structure indicates:



This seems to be an area where second language acquisition facts can inform linguistic theory.

Now, for Spanish speakers to figure out English stress then, they would have to determine two things:

1) what the derivational stem is
2) which elements are marked as extrametrical in the lexicon.

TRANSFER OF EXTRAMETRICALITY

There is evidence that the L1 (in this case Spanish) extrametrical markings get transferred. Consider the word "cannibal" in Spanish, *canîbal*. The underlying representation must be:

[kaní bal]

where the final consonant is extrametrical. Otherwise we would get the unmarked stress pattern [kanibál]. When asked to produce this word in English, [kaní bal] was elicited in informal research sessions. The lexical marking of extrametricality seems to have been transferred into English. There is no evidence that when dealing with a marked parameter setting the learners switch back to an unmarked setting. This supports White's (1985) position that parameter settings transfer, and contradicts Mazurkewich (1984) who claims that learners revert to a default setting. Now this, of course, is a cognate, and it could be claimed that this is just a simple case of transfer. However, I do not think it is trivial for us to be as explicit as we can be as to what exactly is transferring. This gives us some information as to what elements of the lexical representation do transfer. If there is extrametricality marked in the learner's lexicon then this will transfer.

But what of a non-cognate? What if the learner did not know the word? Would she assume an extrametrical final consonant or not? I tested this informally by asking the same subject who produced [kaní bal] to pronounce several "words" in English, which were actually nonsense syllables. The subject was told they were actual English words. The subject did not seem to assume that the final consonant was extrametrical (i.e. did not assume a marked Spanish representation) when she produced the forms below:

lánifer, grúmabel, hálosen, and pótular

The pattern is not the same as [kaní bal]. Nor, however, was it the unmarked Spanish pattern of [kanibál]; she didn't produce *lanífer, grumabél, halosén*, or *potulár*. Rather, she seemed to have correctly applied English stress rules to a representation which (after Hayes 1980) has the final syllable of nouns as extrametrical. This subject, an advanced learner, seems to have the extrametricality facts of English nouns correct.

CONSONANT EXTRAMETRICALITY

Something else that Hayes brought to light was how extrametricality affected verbs and unsuffixed adjectives; they receive final stress if they end in an consonant cluster, otherwise they receive penultimate stress (class 8, #'s 15 & 16):

robúst, ovért cómmon, illícit

Remember that Hayes' explanation of this is that word-final consonants are extrametrical.

We noted that several subjects made mistakes on verbs and unsuffixed adjectives with consonant extrametricality. Why should this be the case if Spanish speakers have final extrametricality too? Remember that in Spanish, the unmarked stress pattern for C-final words is final:

e.g. paréd

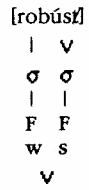
If the Spanish speakers are transferring this we would expect:

robúst, ovért

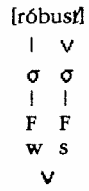
Instead, we found people producing:

róbust, óvert

Why? If we assume that they are treating the whole coda as extrametrical then this can be explained. If just the final segment of the rime was extrametrical then we would derive:



If the whole coda is extrametrical then we derive:



This makes sense when we consider that, in Spanish, complex codas are relatively rare. They are restricted mostly to a few proper names like *Guttart, Tlant*, and a few common nouns like *vals*. Spanish speakers acquiring the rules of English stress assignment would have to learn that a *part* of a complex coda could be labelled extrametrical. This is an argument for the constituency of the coda.

THE DOMAIN OF EXTRAMETRICALITY

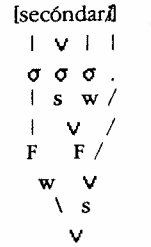
The class 6 words (*currently, secondary, stresslessness, relationship, frequency*) give us some evidence as to the proper domain in which to apply extrametricality marking. Harris (1983) claims that the domain for extrametricality in Spanish is the derivational stem. Most of the subjects in this study did not make mistakes on these words. In fact, no one made any mistakes on the words *stresslessness* and *relationship*. This indicates that they have no problem with the cyclic nature of English stress.

However, in one of the problematic words, two different error patterns emerged:

secondáry and secóndary

This can be explained when we look at the domain of extrametricality. One subject seems to be unaware of the internal structure of the English word.[2]

We could posit the underlying representation:



where the final rime segment of the (for the learner) derivational stem is marked extrametrical. On the other hand, the other subject is aware of the internal structure of the word and is assuming the underlying representation:

where the whole coda of the final rime of the derivational stem is marked extrametrical. Thus we can explain the two error patterns produced.

THE LEARNABILITY OF EXTRAMETRICALITY

In this section I would like to address extrametricality from the perspective of learnability. How would learners determine whether the language they were learning had extrametricality or not? That is to say, how would they determine what the proper setting of extrametricality parameter is?

We can begin by noting that the Subset Principle[3] (Wexler and Manzini 1987) cannot apply here as the Subset Condition[4] they proposed is not met. This is because the two possible parameter settings of the extrametricality parameter do not yield languages which are in a subset relation to each other. If Spanish had no extrametricality ([–extrametrical]) we would always find penultimate stress (assuming left-headed feet). If it had obligatory extrametricality ([+ extrametrical]) we would always find antepenultimate stress. The situation is a little more complex as we have extrametricality in both Spanish and English that is sensitive to the grammatical category (i.e. works differently on nouns and verbs, etc.). Thus, the subset principle makes no clear predictions regarding our second language learners.

What about first language acquisition? We can find a certain amount of evidence in the first language acquisition literature to support the claim that the initial setting is [–extrametrical].

Before discussing some Spanish data, let me briefly present some data from English. Klein (1984) looked at the acquisition of English stress in L1. From her data it looks as if the children (approximately two years old) in her study have a setting of [–extrametrical]. For many of her subjects, a closed, word-final syllable in the input representation[5] is stressed. These word-final consonants are not always produced, as indicated below:

Item	*Possible Input Representation*	*Output Representation*
broken	[bró kin]	[bó kín]
corner	[kʌ́rnʌr]	[kʌ́ nʌ́]
paper	[pépʌr]	[pé pʌ́]

Whereas open word-final syllables tend to be unstressed:

Item	*Possible Input Representation*	*Output Representation*
doggie	[dó gi]	[gó gi]
frisbee	[fríz bi]	[fí zi]
horsie	[hʌ́rsi]	[ʌ́ti]
monkey	[mʌ́n ki]	[mʌ́ ki]
penny	[pé ni]	[pé ni]

The data here, I would say are merely suggestive, not conclusive as there is certainly variation amongst tokens and subjects in Klein's study.

ACQUISITION OF SPANISH STRESS IN L1

Hochberg (1988) presents some interesting data on L1 acquisition of stress in Spanish which, again, sheds some light on the initial setting of the extrametricality parameter. She cites some evidence from studies by Montes Giraldo (1971, 1976). Montes Giraldo gives Examples of adult forms and their realization by child learners, shown below:

Adult Form	*Child Form*
cáscara	kakála
estómago	tomágo
lámpara	pampála
fósforo	popúlo
hipopótamo	popotámo

The children are shifting, what in adult Spanish are antepenultimate stresses, to the penult. This follows from the assumption that they do not have any extrametrical segments. Extrametricality is needed to produce the adult antepenultimate stress. For example:

The child's representation would be (ignoring possible segmental differences):

Once again, the data seems to support the claim that the initial setting of the Extrametricality parameter is [–extrametrical].[6]

CONCLUSION

In spite of the small scale of this pilot study, I think that the results reported in this paper allow us to make certain claims. The first is that the transfer of L1 extrametricality markings can help us to explain certain L2 errors. The second is that we saw no evidence of the learners resetting their parameters to a default setting (in this case [–extrametrical]. There is also

tentative evidence from both English and Spanish to support the claim that the initial setting for the learner's extrametricality parameter is [–extrametrical].

We must also address the question of how these parameters will 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 think 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 (Craine 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 think 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 (as Dresher and Kaye suggest) 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.

Research of this kind shows clearly how crucial it is that we begin to examine the complex interaction of segmental and suprasegmental phonology in terms of language development.

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NOTES

1 The derivational stem is the part of the word to which affixes are attached.
2 In some respects this is speculation, as I conducted no independent tests to determine whether the subjects were, in fact, consciously aware of the internal structure of the words. Their behaviour is, however, consistent with this interpretation.

3 The learning function maps the input data to that value of a parameter which generates a language:
(a) compatible with the input data; and
(b) smallest among the languages compatible with the input data (Wexler and Manzini, page 61).

4 For every parameter p and every two values i, j of p, the languages generated under the two values of the parameter are one a subset of the other, that is, $L(p(i)) \supseteq L(p(j))$ or $L(p(j)) \supseteq L(p(i))$, (Wexler and Manzini, page 60).

5 In the following hypothesized input representations, no claims are being made as to the segmental structure or nature of the representation beyond the presence or absence of the final consonant.

6 Creider (personal communication) has cited an error he heard on a TVO broadcast on February 22, 1990, originating in Spain where a Spanish child responding to the question *¿Cual es la profesión de tu padre?*, said *Mi padre es fotográfo*, where the correct adult pronunciation would be *fotógrafo*. This also seems to support the above claims.

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