Disembodied Rules versus Patterns in the Lexicon: Testing the Psychological Reality of Spanish Stress Rules
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DISEMBODIED RULES VERSUS PATTERNS IN THE LEXICON
Testing the Psychological Reality of Spanish Stress Rules*

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"However, we are not interested in just *any* kind of linguistic description that is compatible with data. We are concerned about that specific way (or those ways) of organizing linguistic knowledge that speakers actually use."
–*Per Linell* (1979:18)

"We believe that the results of these experiments suggest ... that the speakers make reference to the words in the lexicon, not to lexicon-independent rules, when making judgments of the kind we required of them."
–*John Ohala & Manjari Ohala* (1986:248)

This paper reports on an experiment carried out to test, or at least gain some insight into, the psychological reality of proposed rules for Spanish (non-verb) stress. Although talk of psychological reality seems to have fallen out of fashion in the 1980s, the issue is still relevant and important--not just "self-indulgent methodological agonizing," as one critic has referred to it--and much insight can be gained into the nature of language and its regularities by means of experimentation, an experiment being nothing other than an "observation under carefully controlled conditions" (Ohala 1987:207; cf. Ewen & Anderson 1986, Ohala & Jaeger 1986). The results of this experiment suggest that the stress of Spanish nouns and adjectives is not stored in the form of rules, in spite of being about 95% predictable. That is, speakers do not seem to make abstracted, or 'disembodied' generalizations about the regularities involved. This suggests that, although the linguist's rules are valid generalizations about the surface patterns or output, they aren't necessarily a good model of the internal 'mechanism' producing that output.

1. Rules and psychological reality

Although the use of rules as a device to represent phonological regularities did not start with Generative Phonology,[1] rules did take on a new dimension with the advent of this school of phonological analysis. They had a very central role in generative grammar from the beginning, both in syntax and in phonology,[2] and became the single mechanism to account for every ounce of regularity or redundancy, from low level, phonetic/allophonic variation to morphophonemic alternations. A consequence of this emphasis on rules to capture generalizations and regularities about the 'surface' phonological shape of forms was, among other things, "a change in phonology in the direction of much more abstract representations than those permitted within a theory which concentrated on biunique phonemics" (Anderson 1985:321). And the more abstract the representations became and the larger the number of regularities and subregularities to be explained by rules, the less regular these became, that is, the more they had to be supplemented by additional conditions on the application of the rules, leading to quite abstract representations.

The emphasis on rules in Generative Grammar was accompanied by a cognitive ("mentalist") framework which attributed psychological reality to the linguist's rules and other constructs. Thus, the individual speakers learning their language supposedly extracted the same generalizations as the linguist from the input utterances to which they were exposed, and the regularities obtained were stored in the form of rules into which abstract, fully idiosyncratic representations were 'fed' to produce the surface patterns of the language. Both the centrality of the interest in the psychological reality of linguistic description and the use of systems of rules to formalize these descriptions was quite revolutionary at the time. However, it was never quite clear exactly what the mental equivalents of the rules

and representations were to be. Soon it became clear, however, that the **process view** of rules, though perhaps plausible for low level phonetic alternations,[3] would not work for the increasingly abstract rules devised by generativists, nor for other constructs such as features,[4] rule ordering, and the cycle. The regularities that generative linguists in the 1960s extracted from the lexicon became increasingly less like anything speakers are likely to use or possess and this brought a reaction in the field, a 'psychological reality' backlash (cf. e.g. Kiparsky 1968, Derwing 1973, Hooper 1976).

Many linguists, wanting to 'have their cake and eat it too,' have adopted what Per Linell (1979) calls a "weak representationalist position," according to which not "every aspect or detail of the theory is assumed to be isomorphic to some psychological (or neurological) counterpart" (p. 11), but rather "the relationship between the theoretical grammar model and the speaker's internalized knowledge is more indirect" and "only *some* aspects of [the] theory mirror psychological structures" (p. 11). The weakest claim along these lines is that "only the *output* of the grammar relates to psychological reality, i.e. the strings generated are those which are judged as 'correct' by the speakers" (p. 12). Thus we should continue to do what linguists have always done and are good at, namely, look for and extract patterns and redundancies from the output/corpus. This attitude, according to Linell, is not really mentalistic at all, despite claims to the contrary, but rather merely formalistic.[5]

This is not to say that all modern phonologists would be in agreement with the cognitive framework or, if so, to similar degrees. Linell (1979) has a useful typology of linguists according to where they stand on the psychological reality issue. First, there are the **radical physicalists**, or radical behaviorists, for whom talk about the psychological reality of abstract concepts is nonsense. Next there are the **pessimists**, according to whom "[s]peakers are assumed to possess knowledge of their language, i.e. a grammar with a more or less specific organization which enables them to use their language correctly, but it is considered to be an unattainable goal to find out what properties these psychological structures have. Therefore, linguists should avoid these problems and do 'autonomous linguistics', i.e. establish linguistic generalizations by purely structural methods" (p. 4). As Linell observes, this is a respectable position, though not justified in our view. For another set of linguists, the **naive optimists**, mostly Chomsky and his followers, "speakers are assumed to have highly integrated and interindividually similar 'mental grammars'" (p. 5) organized around symbol manipulation. For them, "since many irrelevant factors intervene in performance the best way to determine mental grammars would then be to apply formal-linguistic methods in trying to investigate general and abstract conditions on linguistic structures" (p. 5).[6] According to Linell, "[i]n many respects, this kind of linguistics is an extreme form of structuralism or of 'autonomous linguistics,' i.e. a linguistics which refuses to utilize external evidence" (p. 5). Finally, the 'good guys' in Linell's typology are what he calls **moderate realists**. For them "speakers are assumed to have organized knowledge of their language in some specific ways," ways which can and must be sought by the investigator. But, he adds, "an investigation of psychological realities cannot be pursued with purely linguistic-structural methods. Instead, many types of 'external' evidence must be exploited... Also, one needs plausible 'metaphysical' assumptions about the nature of language, language acquisition and use, the properties of the mind, etc." (p. 5). It is in keeping with this approach that I will investigate the psychological implementation of Spanish stress patterns in this paper.

2. Some generativist rule accounts of Spanish stress

Before generativist accounts of Spanish stress, it was fairly uncontroversial that this stress was phonemic, and thus listed in the lexicon, since pairs and triplets of words that differ only in their stress pattern are not uncommon, e.g. *intérprete*, *'n.* interpreter,'

interpréte, '*v.* I/he/she interpret' (present subjunctive), *interpreté*, '*v.* I interpreted' (preterit indicative), or *bostézo*, '*n.* yawn', '*v.* I yawn,' and *bostezó*, '*v.* s/he yawned.' Generative phonologists, on the other hand, emphasized the great regularity and predictability of Spanish stress (as opposed to its partial idiosyncracy and occasional meaningfulness), especially in non-verb forms. Doublets and triplets always involve at most one noun and from one to three verb forms. Thus if verb and non-verb stress are accounted for differently, i.e. with different rules, one can very well say that stress in Spanish, at least non-verb stress, is quite predictable.

This yearning to see regularity everywhere led early generative phonologists working on Spanish to find (phonological) regularity in even the five percent of Spanish words with irregular stress, and, furthermore, to argue that there are "essentially valid arguments for stress assignment by the Latin stress rule," a rule "which, roughly, assigns stress to the penultimate syllable of polysyllabic words if that syllable is 'strong' (contains a tense vowel, or a lax vowel followed by two or more consonants) and to the antepenultimate syllable if the penultimate is 'weak' (contains a lax vowel followed by at most one consonant)" (Harris 1969:118; cf. (1) below). Never mind that Spanish shows no evidence of tense vs. lax vowels, other than perhaps some frozen reflexes, and that many more Spanish words are oxytonic than proparoxytonic; these 'minor' discrepancies could always be accounted for ("explained") by appealing to abstract segments (final vowels for words ending in a consonant, the vast majority of the 'surface' oxytonic words) and abstract features (tense vs. lax vowels). (For verb forms the story repeats itself, with the use of mechanisms that either mirror diachrony or are entirely *ad hoc*.)[7]

(1) $V \rightarrow [1\text{stress}] / \_\_ \left\{ \begin{array}{l} (\ C_0\ (\ \breve{V}\ C_0^1\ (L))\ V\ )\ C_0\ \#]_{N,A} \\ (\ ([\text{-perf}])\ C_0\ V)\ C_0\ \#]_V \end{array} \right\}$

The 1970s saw some complaints about Harris' fantastic accounts of Spanish stress. Stanley Whitley (1976), for instance, gave an insider's critique in which he faults Harris 1969 with overzealousness and argues that Spanish stress is distinctive, that Harris' account is excessively abstract (though Whitley's account is still rule oriented and not devoid of abstraction), and that, although it "appears to effect extensive savings in underlying representation,... the net effect is actually one of complication and a corresponding loss of adequacy and predictiveness" (p. 301).

Joan Hooper & Tracy Terrell (1976) put forth an account of Spanish stress from a Natural Generative Phonology perspective (cf. Hooper 1976), an attempt to put constraints on abstractness by specifying that (1) "the rules of the grammar are not extrinsically ordered," and that (2) "underlying phonological contrasts are limited to direct manifestations of surface forms." Thus, "the result is a grammar in which all the rules express true generalizations about surface forms" (p. 65). They espouse a separation between phonological rules (P-rules), or those that only have phonetic information in them, and morphophonological rules (MP-rules), which incorporate grammatical as well as phonological information.[8] Since, obviously, the Spanish stress rules do not qualify as P-rules (i.e. they are different for verb forms than for nouns and adjectives), they argue that "Spanish stress [is] morphologically determined in relation to the stem of the word" (p. 64). Concentrating on non-verb stress,[9] they show relative frequencies of patterns from a sampling from a dictionary, which clearly reveal what everybody knew, namely that the true ('surface') generalization about Spanish stress is that words that end in a consonant are oxytonic, whereas those that end in a vowel (*-V*) or plural *-s*[10] are paroxytonic:

(2) a. $[\ldots\ V\ C_0\ V\ (s)\ \#]_{N,A}$ Penultimate stress: ~95%; Final stress: ~4%
b. $[\ldots\ V\ C\ \#]_{N,A}$ Penultimate stress: ~4%; Final stress: ~95%

Hooper & Terrell's morphological solution for non-verb stress takes the final vowel in (2a)

type forms to be a thematic vowel, i.e. a vowel outside the stem (*/a/*, */o/*, or */e/*), e.g. *ventán-a(-s)*, 'window(s)', which is missing from the (2b) type forms, e.g. *jabón*, 'soap'. Thus the MP-rule which accounts for the stress of some 95% of Spanish words is the following:

(3) $V \rightarrow [+\text{stress}] / \_\_\_ C_0]_{STEM}$

In other words, the 'inflectional' vowel, if there is one, is ignored. This takes care of the vast majority of Spanish words, and the exceptions, which will be marked in the lexicon, are reduced to the following for Hooper & Terrell:

1. Paroxytonic words ending in a consonant (i.e. without a 'thematic' or 'class' vowel: (a) about 20 words ending in */-r/*, e.g. *cadáver*, 'corpse', *ámbar*, 'amber'; (b) about 15 words ending in */-il/*, e.g. *fácil*, 'easy'; (c) about 10 words ending in */-en/*, e.g. *crímen*, 'crime'; (d) 3 words in {-z} (= */θ/* or */s/*, depending on the dialect), e.g. *lápiz*, 'pencil'; and (e) 2 words in */-d/* (pronounced [d], [t], [θ], or zero, depending on the dialect), cf. *césped*, 'lawn', and *huésped*, 'guest'. All these words are 'accounted for' by means of a diacritic mark/feature on the final vowel.
2. Oxytonic words ending in a vowel: *-í* (7 ea.), *-ú* (5 ea.), *-á* (4 ea.), e.g. *mamá*, 'mom', *-ó* (2 ea.), e.g. *dominó*, 'domino', and *-é* (10 ea.), e.g. *café*, 'coffee'. These words are accounted for by making the final vowel part of the stem, i.e. not a 'thematic' vowel.
3. Proparoxytonic words ending in a consonant: only 3 words: *régimen*, 'regime', *espécimen*, 'specimen', and *ínterin*, 'meanwhile' (archaic).[11] These words are accounted for by labeling the last two vowels as unfit to receive stress.

Hooper & Terrell's account seems similar in spirit to later metrical ones which use the notion of extrametricality (cf. Harris 1983), and does a reasonable job of capturing the *surface* generalizations about the stress of Spanish non-verb forms.

Lest it be thought that all recent accounts of Spanish stress are rule oriented, I should mention a paper by Jeff Elman (1979) in which he argues against Harris' (1969) phonological penultimate stress rule on the basis of a variety of 'external' evidence: double plurals, loan words, psycholinguistic tests, and historical and dialectal change, and proposes that "in Spanish there are classes of words with distinctive stress patterns. Class membership might be determined on the basis of several factors; phonological shape is certainly not irrelevant, but may be secondary to morphological structure or semantic analysis" (p. 12). In other words, "Spanish noun and adjective stress is not governed by a single rule. It is the result of a complex process by which a word is assigned to a stress class" (p. 15). Thus, for him stress is stored in the words in the lexicon and word class is motivated by a variety of factors.

3. Testing the psychological reality of Spanish stress rules: the hypotheses

The generativists' claim (if we are to believe their stated concern with psychological reality) is thus that Spanish speakers make a (phonological or morphological) generalization about the surface stress patterns of the language and mark the exceptions somehow in the lexicon. It would be desirable not to credulously accept this assumption and to test whether this is in fact the case. The obvious alternative to pattern extraction, abstraction, or "disembodiment", would be that stress is simply stored with the words in the lexicon. Let us refer to this view as the **Patterns in the Lexicon** (PL) view, as opposed to the generativist or **Disembodied Rule** (DR) view. This possibility was already envisioned for instance by Chomsky when he said: "Phonology, as distinct from syntax, is a system that is essentially finite in scope. It would be possible, in principle, for the mapping from surface structure to phonetic representation to be simply memorized, case by case" (Chomsky 1967, pp. 126-7; cited in Derwing 1973, p. 123). The implications of the resolution of this controversy go beyond the issue of Spanish stress, for if a phonological phenomenon as

regular (but not automatic) as Spanish stress can be shown to be simply stored and not abstracted in the form of a rule by speakers this would have serious consequences for our view of phonology and its psychological implementation.

One particular area in which these two models, the DR model and the PL model, would seem to be making differing and testable predictions has to do with how speakers would react to new words presented to them in such a way that they would have to choose the appropriate stress pattern. Taking advantage of the fact that in capitalized script in Spanish stress is conventionally left unmarked, we can express the different predictions as follows:

HYPOTHESES/PREDICTIONS:
If speakers encounter a made-up word written in capital letters which they have never seen before, then:

* **DR model**: Since they have made a generalization of the type expressed in the stress rules, then they will use this generalization and assign stress accordingly.
* **PL model**: They will access the lexicon itself to assign stress to the new word using some sort of analogical process, and, when looking for a suitable pattern, they may be influenced for instance by
  i. the specific phonological shape of the word they are to assign stress to (rather than the general shape the rules say is relevant), or by
  ii. other non-phonological information about that word (that, again, the rule does not predict is relevant).

Major patterns		Minor patterns	
-a:	33.053%	-t,-d:	0.919%
-o:	26.390%	-i,-j:	1.670%
-e:	9.684%[1]	-V:	1.630%
-s:	6.593%[2]	Other:	1.159%
-r:	11.492%[3]	Total:	5.378%
-l:	2.554%		
-n:	4.856%		
Total:	94.622%		

Notes
1. Many are adverbs in *#mente*.
2. Not counting plurals (in *-(e)s*) and finite verb forms.
3. 71% of these are infinitival forms of verbs (*-{a,e,i}r*).

Table 1 Segments found in Spanish word endings. Not included: verb forms except infinitives (all in *-r*) and plurals (in [...V]-*s*, [...C]-*es*). Source: Faitelson-Weiser (DIASLE), p. 177.

A specific area where the two models are likely to make different predictions is one where phonological facts not present in the rule analyses are associated with a different stress pattern. I have in mind here, for instance, the fact that although paroxytonic words ending in a consonant (a limited number of consonants are available word finally in Spanish, see Table 1) are in general exceptional,[12] this is not true of words ending *-en*. As can be seen in Table 2, although the vast majority of words ending in *-n* are oxytonic, words in *-en* are around 62% paroxytonic, or around 50% if we discount some quite rare words. By words 'familiar to the author' I mean words that I thought, using a subjective criterion, were not exceedingly learned or archaic and thus were likely to be at least vaguely familiar to an educated speaker. These facts lend themselves to formulating the following corollaries to the hypotheses or predictions made above:

COROLLARIES (1):
If speakers encounter a new, written, made-up word ending in *-en*:

* **DR model**: they will follow the rule/generalization; thus, since the word ends in *-n* (a consonant), stress it on the final syllable.
* **PL model**: they will examine their mental lexicon for a suitable model/pattern there; thus they may be influenced by the fact that penultimate stress is a distinct possibility for words in *-en*.

	Total in dictionary		Familiar to the author	
	Penultimate	Final	Penultimate	Final
-an	15	338	1[1]	54[2]
-in	1	479	1[3]	62
-on	22	4,463	11[4]	n/c[5]
-un	0	25	0	6
-en	76	156	34[6]	21[7]

Notes (n/c: not computed; a high percentage)

1. *ránglan* (also *ranglán*, both rare). In DIASLE there are 3 additional borrowings from English: (?)*púlman*, (?)*bárman*, and *eslógan*.
2. In addition there are 4 monosyllabic words.
3. *esmóquin* ('smoking jacket'). DIASLE also has (?)*mítin* (~*mitín*), < *Eng.* meeting.
4. 5 somewhat rare paroxytonic words: *náilon*, *cánon*, *pláncton*, *néwton*, *cláxon*; and 6 quite rare proparoxytonic words: *épsilon*, *ómicron*, *hipérbaton*, *asíndeton*, *polisíndeton*, *rémington*. (DIASLE also has *Nélson* and (?)*bádmington*.)
5. 2,168 in *-ción* (mostly common deverbal nouns).
6. 32 are paroxytonic: of which 22 are **common** words: *órden*, *contraórden*, *desórden*, *imágen*, *orígen*, *aborígen*, *márgen*, *vírgen*, *álguien*, *pólen*, *certámen*, *exámen*, *sémen*, *hímen*, *crímen*, *dólmen*, *abdómen*, *Cármen*, *gérmen*, *volúmen*, *resúmen*, *jóven*; and 10 words are more ***rare***: *ligámen*, *vejámen*, *pelámen*, *velámen*, *dictámen*, *gravámen*, *albúmen*, *cacúmen*, *glúten*, *líquen*. 2 words are proparoxytonic: *espécimen*, *régimen*.
7. *Jaén*, *almacén*, *arcén*, *Almadén*, *Edén*, *andén*, *desdén*, *rehén*, *también* (Adv.), *recién* (Adv.), (?)*parisién* (~*parisino/a*), *Jerusalén*, *Matusalén*, *Belén*, *terraplén*, *amén*, *santiamén*, *harén*, *retén*, *sartén*, *sostén*, *vaivén*. (Also *arcén*).

Table 2 Number of words in *-Vn* and *-Ṽn*. Source: Bosque & Pérez Fernández.

Another 'semi-sub-regularity' of Spanish stress concerns words ending in *-ico* and *-ica* (*-ic{o,a}*). As can be seen in Table 3, the vast majority of words in *-ic{o,a}* have proparoxytonic (antepenultimate) stress, for they are historically forms containing the adjective forming suffix *-ic-* (which is stress-retracting in the rule accounts). However, a count of these words from Bosque & Pérez Fernández's reverse dictionary reveals that approximately 43% of the proparoxytonic words ending in *-ica* are either not analyzable at all (even to an educated native speaker) as consisting of a stem plus *-ic{o,a}*, or only partially analyzable (e.g. *síntesis* ~ *sintética*), and of these, about 76% are adjectives (e.g. *fanática*, *'f.* fanatic'), about 19% are both nouns and adjectives (e.g. *química*, *'a.* chemical', *'n.* chemistry'), and only about 5% could be only nouns (e.g. *república*, 'republic'). Also, there are a few paroxytonic words in *-ic{o,a}*. The question is: What is the generalization that native speakers extract from this lot of words? Could it be that speakers make a generalization having to do with the fact that most of these words are adjectives? Our two models could be said to make the following predictions about the relevance of word class information:

COROLLARIES (2):

If speakers encounter a new, written, made-up word ending in *-ic{o,a}* (not the suffix):

* **DR model**: they will follow the general rule; thus since there is no evidence for a stress retracting suffix and word class (N vs. A) information is not relevant for stress assignment, they will stress the word on the penultimate syllable.
* **PL model**: they will consult their mental lexicon in search for a similar pattern, and so word class information (N vs. A) may be one of the relevant factors. Thus they

	Total	Familiar	Compositional	Noncompositional
-$\acute{V}C_0$ica	1,743	663	358[1]	275[2]
-íca	53	12[3]	n/a	n/a
-$\acute{V}C_0$ico	1,837	n/c	n/c	n/c
-íco	68	7[4]	n/a	n/a
-icó	2[5]	1	n/a	n/a

Notes (n/a: not applicable; n/c: not computed)

1. **51** words in *-graf{o,ía}+ica*, e.g. *telegráfica* (cf. *telégrafo, telegrafía*) and **57** in *-log{o,ía}+ico*, e.g. *teológico* (cf. *teólogo, teología*).
2. **210 adjectives**, e.g. *láctica, semítica*; **14 nouns**, e.g. *república, encíclica, basílica, crónica, Verónica, fábrica, América, música, plática*; and **51 noun/adjective**, e.g. *química, técnica, clínica, lírica, táctica, política, ...*
3. **6 nouns**: *chíca, canica, Dominica, picapica, Federica, barrica*; **1 adjective**: *rica*; **5 noun/adjective** (colloquial & compositional): *quejica, roñica, marica, lloriça, acusica.* In addition the dictionary has 15 dialectal diminutives (in *-ic-* instead of *-it-*; all nouns and rare): *herbecica, tardecica, ternecica, fontecica, portecica, cieguecica, mañanica, vainica, bonica, risica, setica, chiquirritica, cinturica, borrica, botica.*
4. (4 are bisyllabic!) *hocico, zorcico, chico, mico, abanico, pico, rico.* An additional 13 are dialectal diminutives (in *-ic-* rather than *-it-*): *ternecico, cornecico, corpecico, ventecico, cieguecico, callandico, caballico, bonico, asnico, acerico, majaderico, Perico.*
5. (?)*calicó, Jericó.*

Table 3 Number of words in *-ico, -ica*. Source: Bosque & Pérez Fernández.

may be more likely to stress adjectives in *-ic{o,a}* on the antepenultimate syllable than they are nouns in *-ic{o,a}*, since most words in *-ic{o,a}* are adjectives.

4. The experiment

In order to test these different predictions about how native speakers would react to made-up words ending in *-n* and in *-ic{o,a}* they had not encountered before, a list of such words in context was designed. The words in *-n* that were used (6 pairs) can be seen in Table 4. The test words (1-6) end in *-en*, and the control words (7-12) end in a different vowel plus *n* (*-{a,i,o,u}n*). The results can be seen next to the words: 1 means final stress, 2 penultimate, and 3 antepenultimate. The 6 pairs of words in *-ic{o,a}* and their results can be seen in Table 5. Half of them had to be interpreted as adjectives in context (13-18, left column) and the other half as nouns (19-24, right column). The 24 sentences were randomized and then 12 sentences with real but rare Spanish words were interspersed every two words. These 12 'foil' words, with their results, can be seen in Table 6. Thirty six native speakers of Spanish[13] read the 36 sentences (see Appendix), which were presented in bound booklet form, with one sentence per page. The numbers in the columns labeled *S#* in Tables 4-6 stand for the order the word came in the test.

The results of the two tests can be seen comparatively in Figures 1 and 2, as well as in Tables 4 and 5. In short, he outcome of the *-en* test supports the PL model's prediction, with speakers stressing *-en* words with penultimate stress 43.5% of the time and with final stress 55.6% of the time (one word, CORUMEN, was given antepenultimate stress by two subjects), whereas the other words in *-n* were given final stress 96.8% of the time (χ^2 =8.289; significant, p > 0.01). As for the *-ic{o,a}* test, although the results point in the direction predicted by the PL model, the difference is not statistically significant (χ^2 =1.826; p > 0.2): Adjectives: Antepenultimate--83.3%, Penultimate--16.7%; Nouns:

	S#	-en	2	%	1	%		S#	other -Vn	2	%	1	%
1	(11)	BESOREN	8	22.2	28	77.8	7	(3)	SEBORAN	1	2.8	35	97.2
2	(23)	CORUMEN	23	63.9	11	30.6	8	(8)	PORUBON	0	0.0	36	100.0
3	(33)	PETABEN	4	11.1	32	88.9	9	(18)	PETAMIN	0	0.0	36	100.0
4	(17)	FADEN	21	58.3	15	41.7	10	(35)	TEDON	0	0.0	36	100.0
5	(36)	GORQUEN	12	33.3	24	66.7	11	(5)	SORQUIN	1	2.8	35	97.2
6	(14)	MERASEN	26	72.2	10	27.8	12	(20)	PERASUN	5	13.9	31	86.1
		Total	**94**	43.5	**120**	55.6			Total	**7**	3.2	**209**	96.8

Chi-square: **8.289**, $p > 0.01$ (significant)

Table 4 Made-up words in *-n* and their results. 1-6: *-en*; 7-12: *-{a,o,i,u}n*. S#: order of sentence containing the word in the test; CÓRUMEN: 2 ea. or 5.5%.

	S#	Adjectives	3	%	2	%		S#	Nouns	3	%	2	%
13	(29)	DRONICO	34	94.4	2	5.6	19	(15)	PROMICO	17	47.2	19	52.8
14	(2)	SEPAJICA	25	69.4	11	30.6	20	(24)	NERAJICA	15	41.7	21	58.3
15	(6)	MELICO	32	88.9	4	11.1	21	(30)	LEGICO	31	86.1	5	13.9
16	(21)	DARSICA	34	94.4	2	5.6	22	(26)	LARSICO	32	88.9	4	11.1
17	(32)	FELULICO	23	63.9	13	36.1	23	(9)	MESULICO	14	38.9	22	61.1
18	(12)	CLAPERICO	32	88.9	4	11.1	24	(27)	PRATERICO	28	77.8	8	22.2
		Total	**180**	83.3	**36**	16.7			Total	**137**	63.4	**79**	36.6

Chi-square: **1.826**, $p > 0.2$ (not significant)

Table 5 Made-up words in *-ic{o,a}* and results: 13-18: Adjectives, 19-24: Nouns.

	S#		3	2	1		S#		3	2	1
25	(1)	REOMETRO	24	12	0	31	(19)	PUSILANIME	36	0	0
26	(4)	SABICHOSO	0	36	0	32	(22)	ESCARAPELA	0	36	0
27	(7)	MORCON	0	1	35	33	(25)	MENJUNJE	0	36	0
28	(10)	MORDAGUERA	0	36	0	34	(28)	ARANDELA	2	34	0
29	(13)	PARLERO	0	36	0	35	(31)	ZAFANTE	0	36	0
30	(16)	PERVINCA	0	36	0	36	(34)	SUBILLA	2	34	0

Table 6 Real but rare 'foil' words used for padding in the test in positions 1, 4, 7,...

Antepenultimate--63.4%, Penultimate--36.6%.

5. Discussion

5.1. Analysis of the results. The result of the *-en* test shows that speakers treat words in *-en* differently from words in *-an*, *-in*, *-on*, and *-un*, *reflecting the actual patterns in the lexicon quite closely*. This result is incompatible with the hypothesis that speakers make an abstract generalization about Spanish stress, along the lines of Harris' or Hooper & Terrell's rule analyses, since these minor 'sub-patterns' do not in any way figure in the formulation of these rules. Furthermore, it is not easy to see how this minor pattern could be incorporated into an abstract generalization or rule that doesn't make direct reference to the lexicon, since the sub-pattern (paroxytonic words in *-en*) is **not categorical, but variable:**

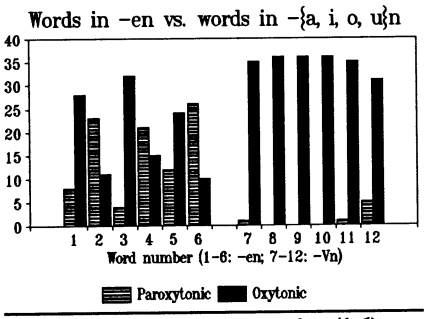

Figure 1 Test 1: *-en* words (1-6) vs. *-{a,e,o,u}n* words (7-12).

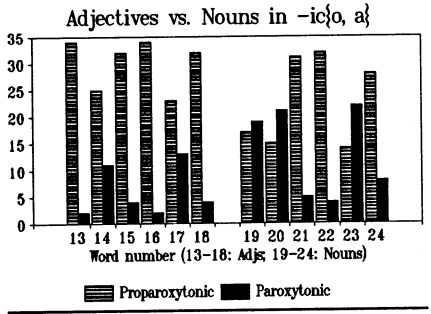

Figure 2 Test 2: *-ic{o,a}* adjectives (13-18) vs. *-ic{o,a}* nouns (19-24).

only about half of the words in -en *in the lexicon do not follow the oxytonic pattern for words in* -n. That is, there is no generalization one can make about the stress of words in *-en* (be it in terms of extrametricality or some other equivalent formalism), like the one possible for most words in *-n* (i.e. final stress).

The result of the second test (the *-ic{o,a}* test) fails to support the prediction that speakers treat nouns in *-ic{o,a}* differently from adjectives in *-ic{o,a}*. That is, although there is a difference which points in that direction, it is not large enough to be statistically significant. However, one thing the results reflect is that speakers treat words in *-ic{o,a}* very differently from other words ending in a vowel, i.e. they stress them overwhelmingly on the antepenultimate syllable instead of the penultimate one, in spite of the fact that these 'words' cannot possibly be analyzed as consisting of a stem plus the suffix *-ic-* plus a theme vowel. This is exactly what the PL model would have predicted. Although this was not part of the test, and control words in, say, *-ac{o,a}* and *-ec{o,a}* were not provided, it is very likely, and a question for further tests, that if they had been and the following corollaries proposed, the results would have been as predicted by the PL model:

COROLLARIES (3):
If speakers encounter a new, written, made-up word ending in *-ic{o,a}*:
* **DR** model: they will access the general rule/generalization and,
  i. If there is evidence for a suffix *-ic-* they will stress the word in the antepenultimate syllable.
  ii. If there is no evidence for a suffix *-ic-* they will follow the general pattern and since it ends in a vowel, they will stress the word on the penultimate syllable.
* **PL** model: they will consult the lexicon directly for a matching pattern, and, since a majority of unanalyzable words ending in *-ic{o,a}* have antepenultimate stress, they may, by analogy, assign this word antepenultimate stress.

5.2. Questions about the experiment. The whole idea of resolving theoretical questions by means of 'external' evidence in general, and experimentation in particular, is not a new one, but it is one that is not thought of very highly among generative phonologists, or at least not enough to put it into practice. I will not address the issue of the validity of experiments to settle theoretical questions, which I take for granted, and will concentrate on problems, or potential problems, with the experiment in order to better understand the variables involved and improving the tests for possible future runs.

One possible reaction to this test is to say that it didn't actually tap the subjects' 'implicit' (rule) knowledge of the patterns in the language and that they merely used some form of analogy, but not because they lack the rules. Although I address related aspects

of this question in the next section, I should say that I did expect this test to tap whatever is there to be tapped about speakers' knowledge of the stress patterns of Spanish. I do not see any reason, other than possible flaws with the experiment, why, if speakers have made an abstract generalization similar to the proposed stress rules for Spanish they would not use such knowledge in the context of this test.

Another issue is that, even if subjects did consult their mental lexicons when called to stress new words, there was no guarantee that they would look at certain features of segments (e.g. *-e-* vs. *-o-*), and if they did, of how many segments (e.g. *-en* vs. *-ten*). It turned out, however, that there was a rather good correlation between percentage of words ending in $-V_i n$ in the lexicon and the percentage of words in $-V_i n$ stressed like those words in the test. The possibility that a larger degree of similarity (more segments) would be relevant, say one more segment, such as the C_j in $-C_j V_i n$, would be compatible with the fact that *CORUMEN* (the test word in sentence 23) had a very high percentage of penultimate stress, since many of the real words in *-en* with penultimate stress also end in *-men*. This logic, however, doesn't help with the other cases.

A related problem is that there was no way of knowing beforehand whether the number of words having a certain subpattern would be a good indicator of the functional weight of such a pattern since we didn't know what the cognitive factors involved were. Some words could have had a higher functional weight due to their being more common, and this could have changed the results greatly. For instance, the fact that many of the oxytonic words in *-én* are proper nouns, unlike the words in the test, could have turned out to play a role. As far as I can see, however, no such factors turned out to be relevant.

An interesting fact that I can't account for is that not all words in a particular subgroup behaved the same way in the test. For instance, the most noticeable discrepancy in the *-ic{o,a}* test is that half of the nouns have very low scores (between 4 and 8%) for penultimate stress, whereas the other half have scores of around 20%. In fact, if we ignore the nouns with very low scores and their corresponding adjectives, the difference between nouns and adjectives in *-ic{o,a}* is statistically significant. Also, for the words in *-en* there are two words that were given predominantly final stress, whereas the other 4 were stressed on the penultimate syllable between 33 and 72% of the time. The reasons for this asymmetry are also not clear.

Finally I should mention that groups of words ending in a consonant other than *-n* in Spanish lend themselves to similar tests. For instance, although nouns and adjectives in *-r* are predominantly oxytonic, those in *-er* seem to be about 50% paroxytonic. Also, the percentage of paroxytonic words in *-il* is much higher than the percentage of words in a different vowel plus *-l*.

5.3. Rules vs. non-wasteful listing. As we have seen, the results of the *-en* test support the hypothesis that Spanish stress patterns are stored in the lexical entries themselves and that speakers do not have lexicon-independent abstracted generalizations about such stress patterns. The results of the *-ic{o,a}* test do not support the hypothesis that grammatical (word class) information, i.e. adjective vs. noun, is relevant for assigning stress to a new word in Spanish, although they point in that direction. Indirectly this test also suggests, however, as we saw in section 5, the same support of the hypothesis as the *-en* test. These results suggest that the surface patterns of a language, and in particular the abstract characterizations of those patterns made by linguists, are not necessarily isomorphic with the cognitive or mental structures that produce those patterns.

These results are bound to cause either concern, or, alternatively, denial, among linguists who are most deeply influenced by the **list vs. rule** metaphor of cognition which says something like: 'In description as well as in cognition, something is listed if it is totally

arbitrary and unpredictable; otherwise, it is predicted/abstracted by a rule.' It should be clear by now that such a model of human cognition is extremely naive and that the mind does not work in such a limited all-or-none fashion. This is not the first time that the assumption that all regularities in language are a sign of an abstract rule/generalization reached (implicitly) by the speaker has been challenged, and, as some have argued, in particular proponents of what Derwing & Skousen (1989) call 'analogical' models, just because something is listed it doesn't mean that the (lexical) redundancies are not taken advantage of by the cognitive system in storing, retrieving, etc., without having to resort to abstractions of any sort.

One area of phonology in which regularities have less often been attributed to abstract rule knowledge because of the difficulties involved is that of phonotactics or 'morpheme structure constraints'. Such constraints typically prove difficult to write as rules and thus to extract from the lexicon, although where possible linguists haven't hesitated to do so, as with Spanish *$_{\#}$*sC* and 'epenthetic' *e-* (cf. Harris 1969). John Ohala & Manjari Ohala (1986), however, carried out experiments which suggest that speakers consult the lexicon directly and not disembodied rules when making judgements about morpheme structure constraints.

Another study which supports lexical storage of redundancies is the one by David Rumelhart & James McClelland (1987), in which they look at the acquisition and storage of past tense forms of English verbs. In their paper they argue for a realistic model of cognition, grounded on the functioning of the brain, in which the regularities and redundancies of the stored forms are not stored there 'wastefully', but rather the patterns and subpatterns reinforce the storage networks and assist in the organization, storage, retrieval, access, etc. of the items. This model of the cognitive machine seems to me to be more realistic than the rule vs. list model, the latter being nothing but the linguist's useful tool, a simple initial hypothesis for "characterizing, at least approximately, what [speakers] will and will not say" (p. 195). Rumelhart and McClelland argue that rules are rather inadequate to account for human learning and actual use of language, which is much more probabilistic in nature, and which can tolerate enormous amounts of variability and idiosyncracy meshed with subregularities in the system.

Once we have a sophisticated storage model of this sort it is easy to see that creative or novel uses of a pattern may be accounted for by a sophisticated version of what has for a long time been known as analogy, at least until the notion was disparaged by generativists in favor of rules to account for novel uses of existing patterns. But analogy is not the caricature that generativists have made it to be (cf. Derwing & Skousen 1989). For instance Gustaf Stern, well before the era of modern linguistics, foresaw that analogy was more than the creation of a form on the basis of a single form (proportional or four-part analogy) but a rather more complex phenomenon: "A new formation is not necessarily made on the basis of an individual pattern. It is more likely to be guided by an abstract scheme..." (Stern 1965[1931]:211).

5.4. An alternative intermediate solution. Joan Bybee & Dan Slobin (1982) have argued for an alternative to storage and to 'rule regularity', namely 'schema regularity', as reflected in the morphophonemic alternations of English strong verbs, e.g. *keep~kept, leap~leapt, sleep~slept*. According to them, speakers do not treat such sub-regularities as rules, nor do they merely list them. Although they are "rote-learned and stored in the lexicon,"

> this does not prevent speakers from formulating generalizations about these forms. These generalizations are not in the form of rules that derive one thing from another by changing features. Thus we will not call them rules, but will rather refer to them as SCHEMAS. A SCHEMA is a statement that describes the phonological properties of a morphological class (in this case past tense). It does not relate a base form to

> a derived one, as a rule does, but describes only one class of forms (the product class, in terms used by Zager 1980). It is not a constraint which rigidly specifies what can and cannot occur, but is rather a much looser type of correlation, used in organizing and accessing the lexicon. (pp. 266-7)

One schema that they claim to have evidence for can be stated as either (4a) or (4b):

(4) a. A past-tense form may have the vowel [uw]

b. ...uw]$_{\text{VERB, PAST}}$

as in *drew, blew, flew*. Note "that the base forms of these verbs (*draw, blow, fly*) do not all have the same vowel, so the class cannot be defined in terms of the [phonological] input, nor can a rule be stated that changes a single base vowel into the vowel [uw]. Rather, what these verbs share is the single vowel in their past forms" (p. 267).

If we accept the existence of such a mental entity as the schema, i.e. an abstract (disembodied) statement of a regularity different than a rule, it might be argued that Spanish speakers have one such schema for words ending in *-en*, for instance, which overrides the general phonological rule and which says something like: 'Words ending in *-en* often have penultimate stress.' (Or, alternatively: 'The *-n* of words in *-en* is often extrametrical'.) Although to me this is more plausible than a rule account of such a semi-sub-regularity, I see no reason, on the basis of this test, to posit any such intermediate, abstract representation, rather than assuming that the lexicon is consulted directly.

This doesn't mean that schemas may not turn out to be relevant. I suspect, as more and more linguists do, that schemas, and not rules, are bound to be the best conceptual tool to capture all kinds of mental linguistic abstractions, from phonology, to syntax, to semantics. Schemas have the advantage of being much more flexible--unconstrained some might say--than rules, being rather like templates which characterize all kinds of patterns found in language, typically, but not exclusively, grammatical constructions, with all the relevant formal, semantic and pragmatic information associated with them (cf. Fillmore 1988, Fillmore, Kay & O'Connor 1988). Thus, it could be even argued, schemas are not an alternative to rules, but rather, rules are a special and more general type of schema.

6. Excursus: Parallel phenomena in syntax

Generative linguistics is based on the proposition that there are very general underlying principles, innate or otherwise universal, which can be violated only at a cost. Two classical examples of this are X-bar principles and grammatical relations. I think that our results in the area of phonology add force to those who argue for alternative ways of conceiving of these topics. I have in mind here in particular the notion of grammatical construction in Construction Grammar (cf. e.g. Fillmore, Kay & O'Connor 1988) and the notion of grammatical relations in Role and Reference Grammar (cf. Foley & Van Valin 1984).

According to X-bar syntax, there are general rules for the expansion of different types of phrases and sentences, or at least a few such types of expansion crosslinguistically. When a language is not consistent in some way, a special statement is made to this effect (notice the similarity to the notion of phonological rule). In Construction Grammar on the other hand the basic units of grammar are constructions, which go from the most general and underspecified to the very specific, which may be even partially filled in with lexical items, as well as with all the semantic and pragmatic information associated with the constructions. It is not that all constructions in a language have the same status, but they all do belong to the same type of objects. And, just as with the stored stress patterns, the inter-construction redundancies and regularities are not 'wastefully listed', but rather they reinforce each other while stored as separate patterns or schemas. Once this possibility is envisioned, all the appeal of the X-bar model disappears and can be seen for what it is,

namely, an interesting statement **about surface patterns**, not a reflection of internal mental representations.

Another possible parallel has to do with grammatical relations. In Role and Reference Grammar grammatical relations (actually the **pivot** grammatical relation, since there are no others) are not basic, universal categories that remain invariable from language to language or even from construction to construction within a language, which can be 'violated' in a language or in a construction at a cost. Rather grammatical relations reflect construction-specific neutralizations of semantic/functional distinctions for the purposes of syntax. In some languages, such as English, grammaticalized reflexes of this category are remarkably constant throughout most construction types, which makes it reasonable to call them *the* subject of English, but in other languages this is much less so. Although having to state what the pivot is for each construction may seem highly redundant, especially when it is typically highly predictable within a language and even crosslinguistically, this analysis is consistent with the claim that although redundancies may be listed in different places the cognitive system may still recognize them and make use of them.

7. Conclusion

The results of this experiment suggest that speakers of Spanish do not make absolute, abstract generalizations about stress patterns, which are then overridden by lexical specifications, for they do not seem to use any such generalization when encountering new words. Rather, the results suggest that speakers look at the lexicon directly for a suitable pattern, concentrating on the last few segments of a word, since the results mirror the patterns in the lexicon quite closely in their variable behavior. This would imply that, at least non-automatic phonological features of this kind perhaps should be assumed to reside in the lexicon and not in abstract rules disembodied from the lexicon. In other words, the linguist's abstract rule characterizations of surface linguistic patterns are not necessarily the best model for the internal cognitive mechanisms that produce those patterns.

APPENDIX

1. NECESITO UN NUEVO REOMETRO PARA MI AUTOMOVIL.
2. LA ESCENA MAS SEPAJICA DE ESA PELICULA ESTA AL FINAL.
3. DESCUBRIERON UN SEBORAN PREHISTORICO DENTRO DE UNA CUEVA.
4. MI TIO LUIS ERA UN CABALLERO BIEN SABICHOSO.
5. EL SORQUIN ES UN INSTRUMENTO QUE USABAN LOS CARPINTEROS.
6. EXPULSARON AL TRABAJADOR MAS MELICO DE LA FABRICA.
7. A LA LAVADORA LA LLAMAN MORCON EN PANAMA.
8. ANUNCIARON LA ENTRADA DE UN PORUBON EN LA ATMOSFERA.
9. ESTA MAÑANA ME TOME UN MESULICO PARA DESAYUNAR.
10. LA PROFESORA DE QUIMICA PILLO UNA MORDAGUERA MUY FUERTE.
11. EL LIQUIDO QUE SALE DE ESA GLANDULA SE LLAMA BESOREN.
12. SE MOSTRABA MUY CLAPERICO EL EMPLEADO AQUEL DIA.
13. VICTOR ES DEMASIADO PARLERO PARA MERECER ESE TRABAJO.
14. NO DEMOSTRARON QUE EL VIRUS MERASEN FUERA TRANSMISIBLE.
15. EXISTE UN PAJARO TROPICAL QUE SE LLAMA PROMICO.
16. UN ZAPATO PERVINCA UTILIZA BOTONES EN VEZ DE CORDONES.
17. ESTA MODA DE CALZADO ES DEMASIADO FADEN PARA MI GUSTO.
18. DIJERON QUE EL QUE TUVIERA UN PETAMIN QUE SE FUERA.
19. NO ENCONTRE LA PALABRA PUSILANIME EN MI DICCIONARIO.
20. EL PATRON ME MANDO QUE TRAJERA UN PERASUN METALICO.
21. LA MUJER QUE VINO A VERME ERA MUY DARSICA.
22. CADA VEZ QUE VEO A JUAN ME OFRECE UNA ESCARAPELA.
23. ¿A QUIEN SE LE OCURRIRIA TRAER UN CORUMEN TAN GRANDE?
24. MI HIJO QUIERE UNA NERAJICA PERO NO SE LA VOY A COMPRAR.
25. PRETENDIAN VENDER ESE MENJUNJE POR CINCUENTA PESOS.
26. EL GANADOR DE LA RIFA OBTENDRA UN LARSICO NUEVO.

27. MI TIA ANCIANA VIVE EN LA CALLE PRATERICO, NUMERO 88.
28. NO PUEDEN ARREGLAR EL TELEVISOR PORQUE FALTA UNA ARANDELA.
29. TENGO ENTENDIDO QUE JUAN ES UN HOMBRE MUY DRONICO.
30. MI AMIGA PREFIERE UN LEGICO QUE UN APARATO DE MUSICA.
31. EL CONTADOR INDICA QUE LA PROBETA ES DEMASIADO ZAFANTE.
32. ¿POR QUE SERA TAN FELULICO ESE CAMARERO?
33. ME DIJO EL DOCTOR QUE ME TOMARA UN PETABEN CADA NOCHE.
34. INVENTARON UNA SUBILLA QUE ES MUY EFICAZ CONTRA LA POLILLA.
35. PARA ABRIR LA CAJA FUERTE ERA NECESARIO UN TEDON.
36. AUN NO ME HAN MANDADO EL GORQUEN QUE PEDI HACE UN MES.

NOTES

*. I would like to thank John Ohala for the stimulating class on Methods of Phonological Analysis in the Spring of 1986 which led to the pilot study of the experiment reported on here (Aske 1987). For the present experiment I have benefited from comments from Mariscela Amador, Larry Hyman, Paul Kay, John Ohala, Dan Slobin, and María José Solé Sabater, advice which perhaps I should have followed more often than I did.

1. Early structuralists in the US, such as Boas and Bloomfield, as well as some European counterparts, and, of course, the legendary Indian grammarian Panini, had made use of rules and rule-like terminology in their linguistic descriptions.

2. cf. Chomsky's undergraduate thesis (1949) and Halle's (1959) *The Sound Pattern of Russian*.

3. It has been observed, however, that it is precisely the most basic, regular, and redundant phenomena that often provide the most central clues for identifying a phoneme in context, e.g. aspiration of voiceless obstruents and preceding vowel lengthening for final voiced obstruents in English.

4. Phonological features in Generative Phonology enjoy the same virtues and vices of rules. Features can be a great tool for capturing generalizations about what different speech sounds/segments/phonemes have in common, and for writing statements about phenomena associated with sounds sharing something in common. However, when they are turned into theoretical primes in terms of which phonological segments are defined, then probably a generalization is being missed about what speech and actual phonological systems are really like (cf. Ohala 1985).

5. One problem that I see with the weak position is that if rules are not in any way involved in production, then what are the psychological analogues of phonological derivations and the phonological cycle? In Generative phonology, unlike in Generative syntax, these mechanisms do not seem to have been disposed of or curtailed in any way.

6. This view fits well with Chomsky's content view of inborn linguistic structures, but is logically independent.

7. Harris (1975) is a reworking of Harris (1969) in which he stops using the tense/lax distinction, and shifts to a more honestly *ad hoc* feature [X]. Harris (1983) has an analysis of stress framed within the new theory of metrical phonology, which relies heavily on the notion of extrametricality and the existence of class vowels, or class markers (the final vowels of proparoxytones), which are marked in the lexicon (by convention) as extrametrical. Final consonants of proparoxytones which end in a consonant are also extrametrical, as is the penultimate vowel of proparoxytones. As far as I can see this extrametrical account is nothing but a (slightly modified) notational variant of Hooper & Terrell's morphological account, with even less convincing explanatory power.

8. Another type of 'rule' in NGP is the **via-rule**, a lexical rule proposed by Vennemann **1971**, which accounts for "putative alternations of the type *leche* and *lactar*, *noche* and *nocturno*" in Spanish (Hooper 1976, p. 17) (The rule, to the extent that speakers are aware of this correspondence, would be represented in the following way: kt ↔ č).

9. Hooper & Terrell claim that verb stress has a morphological function, i.e. "it is directly correlated with tense" (p. 79), and interesting though not totally convincing claim.
10. As they notice, "[t]he status of /s/ appears uncertain because /s/ marks the plural and pluralization has no effect upon the position of stress in nouns and adjectives." (p. 67) Furthermore, words that end in a consonant, the majority of which have final stress, in the plural have penultimate stress, since an 'epenthetical' /e/ is added to the /s/ (i.e. they make their plural in /-es/).
11. For many speakers the stress shifts in the plural when one more syllable is added, e.g. *regímenes*. The same is true for most speakers with *carácter*, which becomes *caractéres*.
12. The dictionary DIASLE contains quite a large number of rare non-native words absent from other inverse dictionaries, which may make minor patterns (e.g. words ending in an accented vowel) more prevalent than they really are in the vocabulary of the vast majority of speakers.
13. 20 speakers were tested by the author in Berkeley (most of them UC Berkeley graduate students and their spouses) (plus 2 who were disqualified because pages were skipped). Origin: Argentina, 8 ea.; Mexico, 6 ea.; Spanish State, 2 ea.; Chile, 1 ea.; Central America, 1 ea.; Peru, 1 ea.; Cuba, 1 ea. The other 16 (plus 2 more disqualified for the same reason) were tested by the author's associates in the Spanish State. Origin: Euskadi, 14 ea.; Catalonia, 1 ea.; Castile, 1 ea.

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