Linguistic Processing is Exemplar-Based

David Eddington
Brigham Young University

Abstract

In contrast to rule systems, analogy assumes massive storage of previously experienced linguistic material. Accordingly, linguistic processing involves access to and comparison with this database of stored instances. Computationally explicit models of analogy allow analogical models to be tested empirically. One such model is shown to be quite effective in predicting the gender of Spanish nouns given their phonological makeup, and in mirroring gender errors made by children. Dialectal differences in diminutive formation is also explored analogically. While rule models postulate differing underlying structures and constraint ranking, analogy accounts for the dialectal variants as due to differences in the diminutives that are stored in a speaker's mental lexicon. Morphology is the result of connections made between words that share semantic and phonological traits.

1. Introduction

Early generative approaches assumed that the lexicon contained only the minimal amount of information that could not be derived by general rules. It contained morphemes and not whole words. This meant that a great deal of processing had to be performed on the input. Some early researchers (e.g. Halle 1973, Jackendoff 1975) did suggest that all known words could be stored as whole entities in the mind, and some contemporary formal approaches are beginning to acknowledge the influence of fully formed lexical items (Benua 1995, Burzio 1996, Kenstowicz 1996, McCarthy & Prince 1994, Steriade 1999). Nevertheless, the majority of formal work still assumes that computation has the greatest role in processing, while the contents of the lexicon are secondary.

A number of language researchers have become disenchanted with models of language that espouse rule-based mechanisms as the principal mechanism of linguistic cognition. Due to the dissatisfaction with such models, several non rule-based models have been proposed (e.g. Bybee 1985, 1988, 1995, Goldsmith 1993, Lakoff 1993, Rumelhart & McClelland 1986, Stemberger 1994). The present paper explores analogy as a mechanism of language processing.

Studies in Hispanic and Lusophone Linguistics
Volume 2, Number 2
Fall 2009

2. Processing by exemplars

The idea that language is exemplar-based turns the storage versus processing paradigm on its head. It asserts that people go through life storing all of the linguistic input they receive in all of its redundant glory and with all of its messy, irrelevant detail. This means that speakers do not need to subconsciously find systematic correspondences and generalizations in the data, make rules or constraints out of them, then discard the input they are based on. Instead, the generalizations exist in the linguistic experiences they have stored in their long-term memory. Behavior that appears to be rule-based may be explained by assuming that people have recourse to their past experience that is stored in highly organized matrices in terms of similarity. In short, linguistic cognition entails enormous amounts of storage and little processing.

There is good evidence to suggest that most words are stored as wholes, not merely as combinations of morphemes (Alegre & Gordon 1999; Baayen, Dijkstra & Schreuder 1997, Butterworth 1983, Bybee 1985, 1988, 1995, 1998, Sereno & Jongman 1997, Stemberger 1994). Of course, this claim has not gone uncontested (e.g. Pinker & Prince 1988), and the debate continues. Nevertheless, psycholinguistic studies demonstrate that not only are words stored as types, but individual tokens of the same word may be stored in long-term memory (Kolers & Roediger 1984, Palmeri, Goldinger & Pisoni 1993, Boomershine 2006). Words also appear to be stored with all of the phonetic detail present in the speech signal, rather than in a form that has all redundant and irrelevant phonetic details abstracted away (Brown & MacNeill 1966, Burton 1990, Bybee 1994, 2001, Fougeron & Steriade 1997, Pisoni 1997).

2.1 Exemplar-based models

One advantage of assuming that language processing is exemplar based is that it lends itself to explicit empirical test. A number of computer algorithms have been devised to test the ability of exemplar theory to model cognitive processes (Daelemans, Zavrel, van der Sloot & van den Bosch 2001, Medin & Schaffer 1978, Nosofsky 1990, Pierrehumbert 2001, Riesbeck & Schank 1989). What these models have in common is that they use analogy to instances of stored linguistic experience in order to determine linguistic behavior.

Traditionally, analogy has been used to account for exceptional outcomes. That is, when an outcome does not obey the general rule, a form that is semantically or phonetically similar to the exceptional one is sought that is then said to influence the exceptional form in such a way that it does not develop according to the general process. What makes this sort of analogy suspicious is that it ultimately serves to patch up the inability of rules to derive all forms. In addition, no limits are set regarding what forms can serve as analogs nor on how similar two forms must be in order for analogy to become a factor. In contrast to the traditional notion of analogy, exemplar-based models assume that both regular and irregular forms are attributable to the analogical influence of other forms.

2.2 Analogical Modeling of Language

The present simulations were carried out using Analogical Modeling of Language (henceforth, AM; see Skousen 1989, 1992, 1995). In AM, two things are needed in order to predict forms: a database of fully specified words and a mechanism for searching and comparing those words. The behavior of the words most similar to the word in question generally predicts the behavior of the word in question, although the behavior of less similar words also has a small chance of applying.

Suppose that the task is to predict the nominal form of the verb *tentar* 'to tempt'. Would it be *tención, tentición, tensión,* or *tentación*? The algorithm finds all verbs that begin with /t/ and considers them together. It also compares all verbs with /e/ as the nucleus of the penult syllable. Other groupings contain the verbs beginning with /te/, /ten/, or /t/ and whose theme vowel is /a/, and so on until all possible groupings of all variables are considered. These groups, called *subcontexts*, are then inspected in order to calculate disagreements.

A disagreement occurs when not all of the verbs in the subcontexts bear the same relationship to their nominal form. For example, if the subcontext of verbs ending in *-tar* contained *representar* 'to represent' and *adoptar* 'to adopt' there would be a disagreement because the relationship between the verbs and their corresponding nominals is different. *Adoptar* takes the suffix *-ción* and loses the stem-final /t/ and stem vowel /a/, yielding *adopción*. *Representación,* on the other hand, maintains the stem vowel and /t/ of the verb. Under certain conditions (see Skousen 1989 for details), members of a subcontext containing disagreements will be eliminated from consideration. In this example, the algorithm specifies that verbs ending in *-tar* do not form a cohesive enough group from which to draw analogs on which the nominal form of *tentar* may be predicted. In general, a word with more in common with the given context exerts more analogical influence on the given context than a word that has less in common.

Once all the irrelevant subcontexts have been eliminated, the remaining verbs constitute the analogical set. The words from this set can then serve as analogical models for a given context. For the purposes of this example, let us assume that the analogical set for *tentar* contains only three items and that AM has calculated the extent of similarity (or predicted probability) of each as specified in (1).

(1)	A	*representar*	'to represent'	(*representación*)	50%
	A	*excitar*	'to excite'	(*excitación*)	30%
	B	*adoptar*	'to adopt'	(*adopción*)	20%

Notice that the first two verbs in the analogical set have the same sort of behavior/relationship (A) with regard to their nominal forms. According to Skousen (1989, p.82), there are two ways in which the contents of the analogical set can influence the outcome. The first is that a word can be randomly selected from among those in the analogical set and the outcome for that word can be applied to the given context. In this case, there is a 33% chance of choosing any one of the three words. Since two of them have the same behavior, the probability of behavior A is 66% (33+33). The second possibility is to determine which outcome is most frequent among the words in the set and assign that outcome to the given context. Since the probability of A is 80% (50+30) behavior A would apply.

One possible mechanism for nominalizing *tentar* can be conceived of as a sort of proportional analogy based on relationship A: *representar* is to *representación*, and *excitar* is to *excitación* as *tentar* is to __? One could assume that the process involves adding *-ación* to the stem *tent-*, or adding *-ción* to the stem plus theme vowel *tenta-*. Another possibility would be to assume the entire infinitive form is considered and that the final *-ar* has to be deleted and replaced by *-ación*. The point here is that the exact procedure speakers employ in order to modify the nominal of *tentar* so that it bears the same relationship that *represenatar* and *excitar* bear to their nominal forms is irrelevant as long as the output is the same. In fact, the exact mechanism may vary from one speaker to another.

3. An analogical simulation of Spanish gender assignment

The relationship between grammatical gender and phonological word shape has been approached from various points of view: pedagogy (Bergen 1978, Bull 1965, Teschner & Russell 1984), bilingualism (Clegg 1997, Poplack, Pousada & Sankoff 1982, Smead 2000, Zamora Munné & Béjar 1987), description (Natalicio 1983, Rosenblat 1952, Teschner 1983), generative linguistics (Harris 1991, Klein 1989), acquisition (Brisk 1976, Pérez-Pereira 1991), and dialectology (García-Albea, Sánchez-Casas & Igoa 1998). The data below demonstrate the sort of empirical findings that are manifest when gender assignment is assumed to be an analogical process.

3.1 Gender assignment according to analogy and rules

The first question to grapple with is how analogy compares with rule models. The extant generative analyses (e.g. Harris 1991, Klein 1989) are not useful for this purpose; they strive to describe gender in terms of a rule system that derives a word's final phoneme(s) given the word's inherent gender and a set of abstract assumptions about the word's underlying structure. In other words, they are not designed to predict a word's gender given its phonological properties. Bull's (1965) pedagogical rules serve as a more appropriate point of comparison. Based on an

extensive dictionary search, Bull concludes that most words ending in *-a, -d, -ción, -sión, -tis,* and *-sis* are feminine, while words ending in any other phoneme or combination of phonemes are masculine.

As a test set, I extracted all 2416 single gender nouns from the Juilland & Chang-Rodríguez (1964) frequency dictionary of Spanish (see Eddington 2002b for details). In order to be processed by AM's algorithm, the phonemes of the final syllable of each word were considered. In the analogical simulation, each word was treated as if its gender was unknown and gender assignment was based on analogy to similar words in the database. When Bull's rule was applied to these 2416 words a success rate of 95% was achieved.

Although both approaches performed equally on the database items, analogy was found to be superior in an experiment that involved assigning gender to unknown words. A group of 31 Spanish speakers was asked to determine the gender of 118 antiquated Spanish words that have fallen out of contemporary usage, such as *sorce* 'small mouse' and *bocacín* 'part of a wagon.' Bull's rules corresponded with the majority responses on 75% of the test words, while analogy correctly predicted 81% of them (Eddington 2002b).

3.2 Analogy and the acquisition of gender

Brisk (1976) noticed that children make more gender errors on feminine words than on masculine words. However, children whose abilities in Spanish were least developed made more errors that entailed giving masculine words feminine gender when compared with more advanced speakers. This sort of developmental phenomenon can be modeled by assuming that speakers with more advanced abilities have larger vocabularies.

I performed a series of analogical simulations using databases of varying sizes. The purpose of the simulations was to calculate the number of errors that would occur. The first step was to organize the database of 2416 words by descending order of token frequency and then to divide the database into ten data sets, each containing about 241 words. The first data set contained the 241 most frequent nouns. The second data set included all of the items in the first one, plus the next 241 most frequent words, and so on until the tenth data set comprised all 2416 items. This progression of data sets not only corresponds to the fact that language acquisition entails increasing the size of one's mental lexicon, but that more frequent words are learned first and less frequent words at a later stage. The gender of all of the 2416 items was predicted in each of the ten simulations. Comparing the number of errors on masculine and feminine nouns in the database is a valid procedure since there are almost identical numbers of masculine and feminine items (masc. N=1207; fem. N= 1209).

The outcome of the ten simulations is summarized in Figure 1. Errors on masculine nouns (masc. to fem.) outnumber those committed on feminine nouns in the simulations that used smaller data sets composed of high frequency words. However, once the database contained 2169 words, the number of errors on feminine nouns became slightly higher. This mirrors quite closely the acquisition data presented by Brisk. According to her, the split that is observed for more advanced speakers occurs because masculine nouns outnumber feminine nouns in children's vocabularies. While this may be true in her study, it does not explain the outcome of the simulations in which errors on feminine nouns outnumber errors on masculine nouns (2169 and 2416 items) where the percentages of masculine and feminine data set are roughly equal (2169: 51% masc. 49% fem.; 2416: 50% masc. 50% fem.). It is unclear how Bull's rules or any other rule-based model of gender could account for these data.

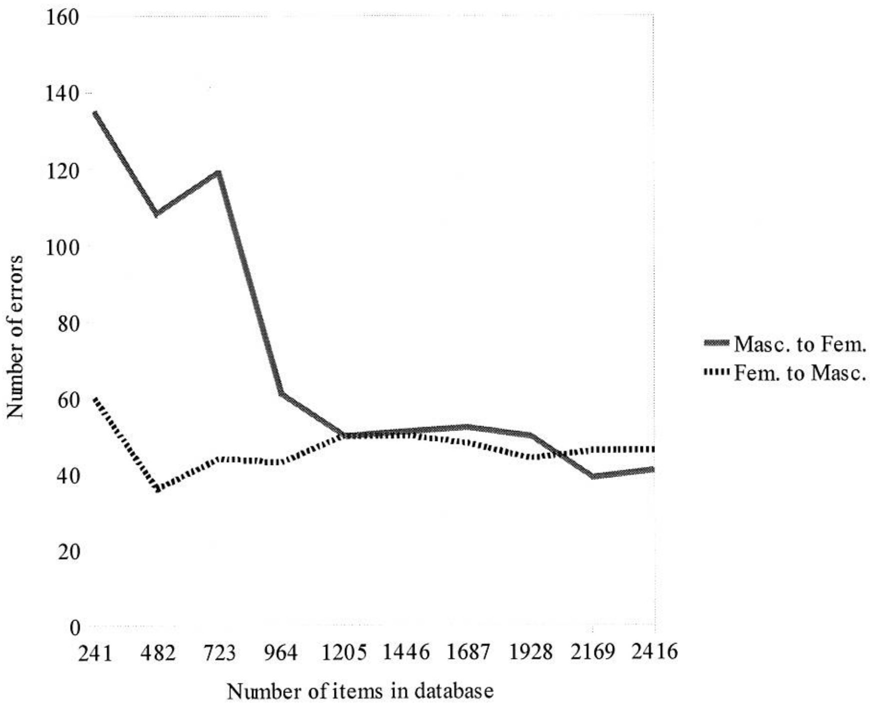

Figure 1. Errors on gender assignment by size of database.

3.3. Markedness and gender

According to generative theory, the masculine gender must be explicitly specified as the unmarked option. However, I suggest that the structure of the nouns themselves is responsible for establishing the masculine as the unmarked member. Plunkett & Marchman (1991) observe that unmarked or default status does not necessarily depend on numerical superiority. Instead, items belonging to the marked category tend to cluster in groups sharing many characteristics. Unmarked items, on the other hand, have less in common and tend to be spread out across contextual space. Bull's rules for gender assignment reflect this state of affairs; words ending in *-a, -d, -ción, -sión, -tis,* and *-sis* are feminine (marked), while words ending in any other phoneme(s) are masculine (unmarked). From an analogical perspective, what this means for gender is that a random throw of the dart onto a map of nouns organized according to phonological similarities has a much higher probability of landing in a neighborhood of masculine nouns, even if they do not dominate feminine nouns numerically. Analogy accounts for and identifies the unmarked member without having to specify that it is unmarked beforehand.

4. Accounting for dialectal differences through analogy

One issue that often arises in the linguistic literature is how to account for differences in dialects of the same language. I will use diminutive formation in Spanish to exemplify this. The allomorphs of *-ito/a* and their distribution have received a great deal of attention (Ambadiang 1997, Colina 2003, Crowhurst 1992, Elordieta & Carreira 1996, Harris 1994, Jaeggli 1980, Prieto 1992). There are essentially three allomorphs: *-ito/a, -cito/a,* and *-ecito/a*. They may attach to entire words (*animal* 'animal'> *animalito; pan* 'bread' > *panecito, pancito; grande* 'large' > *grandecita; tigre* 'tiger' > *tigrecito*) or to stems stripped of their final vowel (*tigre* > *tigrito; casa* 'house' > *casita*).

As can be seen, there is more than one way to form a diminutive for a number of words. In my previous corpus study of diminutives (Eddington 2002a), I searched several corpora totaling about 51 million words and identified about 2460 different diminutives. About 60 of these diminutives have alternative forms. For example, *viento* 'wind' has two possible diminutives, *vientecito* and *vientito*. The diminutive of proper name *Jorge* is attested as both *Jorgecito* and *Jorgito*. A great deal of variation is also found in words containing the diphthongs [je] and [we] in the final syllable of the stem. The diminutive of *hierro* 'iron' is either *hierrecito* or *hierrito*, while the diminutive of *muerto* 'dead' is either *muertecito* or *muertito*.

A number of formal mechanisms have been proposed to account for these sorts of dialectal variants. For example, Crowhurst (1992) utilizes resyllabification and syllabic templates, while Colina (2003) argues for differing constraint rankings. As I have argued elsewhere (Eddington 1996), formal mechanisms such as constraints may be excellent tools for describing linguistic phenomena, but their status as the actual mechanisms speakers use to process language is highly dubious. Analogy more closely captures actual performance mechanisms.

Using AM (Eddington 2002a), I predicted the diminutive formation of the 2460 base words found in the corpus search. When these words were treated as if their diminutive forms were previously unknown, 96% of them were given an attested diminutive form. I will use this database to show that dialectal differences in diminutive formation may be explained in terms of storage and analogy to stored base/diminutive sets. Consider a dialect in which diminutives containing [je] and [we] in the final syllable of their stems are of the sort *dientito* and *muertito*, in contrast to *dientecito* and *muertecito*.[1] Assume that every diminutive known by a speaker of this dialect is stored in his/her mind and is connected to the base word on which the diminutive is formed. Provided that the speaker is not having memory problems, s/he will use the same diminutive form the next time it is needed.

What is of greater interest is how the speaker will form the diminutive of a word whose diminutive form s/he has never heard or produced before. This may be simulated using the database from the previous study. One difficulty with the database is that it contains diminutives produced by speakers of many different dialects of Spanish. However, it may be altered to simulate the dialect in question. To this end, I modified the entries in the database so that every word with [je] and [we] in the stem of the base word took a diminutive of the type *dientito* and *muertito*. I then ran AM so that it predicted the diminutive of 21 words containing [je] and [we] that do not appear in the database. The 2460 words in the database were available as analogs. These results appear in Table 1 under Dialect A.[2]

In order to simulate a dialect, such as Peninsular Spanish, in which the diminutives of *diente* and *muerto* are *dientecito* and *muertecito*, rather than *dientito* and *muertito,* the database was revised to reflect this sort of relationship between base words and diminutives. A comparison of Dialects A and B in Table 1 clearly demonstrates that analogy can account for dialectal variation. Children who are raised speaking Dialect A produce diminutives of this type because they have access to the forms that already form part of their mental lexicon. They use these same forms to analogize on when the formation of a diminutive is required, and analogy will predict forms similar to those they already know.

The point I wish to make is that there is no need to postulate differences in constraint rankings, rule orderings, or the existence of diacritic features in order to account for dialectal differences in diminutive formation. Children simply learn the diminutives used in their community and those diminutives themselves are the models for subsequent diminutive formation.

	DIALECT A		DIALECT B	
BASE WORD	Prob. of *-ito*	Prob. of *-ecito*	Prob. of *-ito*	Prob. of *-ecito*
cuerdo	100	0	10.17	89.83
diestro	99.95	0	14.94	84.98
fuero	100	0	0.12	99.88
mueble	100	0	1.14	98.86
pienso	99.98	0	8.41	91.37
pliegue	99.99	0	3.50	96.48
riego	100	0	0.21	99.78
ruego	100	0	0.12	99.87
siervo	99.99	0.01	1.88	99.08
trueno	100	0	6.14	93.86
	Prob. of *-ita*	Prob. of *-ecita*	Prob. of *-ita*	Prob. of *-ecita*
cuelga	100	0	1.13	98.87
cuerda	100	0	9.21	90.61
fiebre	97.67	1.68	0.30	97.37
friega	100	0	16.97	82.98
huerta	100	0	6.97	92.86
niebla	100	0	0.25	99.75
nieve	92.09	7.70	0	92.09
prueba	100	0	1.10	98.90
suerte	96.12	1.11	0.33	95.69
sierva	100	0	0.65	99.30
tuerca	100	0	7.52	92.40

Table 1. Probabilities of variant forms in two simulated dialects.

5. Morphology in exemplar theory

According to exemplar theory, words are not parsed into morphemes, but stored as wholes. This is consistent with a number of models in which words are not stored as lone items, but as entities with complex networks of interconnections between each other (Bybee 1985, 1988, 1995, Drews & Zwisterlood 1995, Fowler, Napps & Feldman 1985, Grainger, Cole & Segui 1991, Lukatela, Carello & Turvey 1987). In particular, words belonging to families of morphological relatives are thought to be stored and linked to each other which allows the access of one member of the family to activate the other members (Feldman 1992, Lukatela, Gligorijevic, Kostic & Turvey 1980, Segui & Zubizarreta 1985). Presumably, two of the most important types of links between stored items are semantic and orthographic/phonological.

According to Bybee, "when a new morphologically complex word is learned, it forms connections with existing lexical material on the basis of its meaning and phonological shape. The word is not physically dismembered, but its parts are identified" (1988, p.127). In other words, morphemes can be viewed as interconnected patterns that exist between words that are both semantically and orthographically/phonologically similar.

Accordingly, *-a* may be considered a feminine morpheme because words ending in *-a* are connected based on that shared trait. At the same time, most of those words are also connected based on their feminine gender. There is no need to assume that *-a* is either added to a stem in the course of production, nor stripped off in word recognition. The morpheme *-a* is an identifiable unit even though it does not exist separately from the words that contain it.

6. Conclusions

There are a number of advantages to accounting for language processing via analogy. First, simulations may be performed that are empirically testable and robust. Analogy assumes only storage of known forms and the ability to find similarities and apply similar behavior. Second, it does not require speakers to glean generalizations from the data and formulate them into systems of rules or constraints. Some of these formal systems are extremely challenging for trained linguists to understand and devise, yet if taken as actual performance mechanisms they are assumed to be subconsciously arrived at by native speakers with no formal training in linguistic analysis.

Notes

* This paper is a revised and shortened version of Eddington (2004), Chapter 5.

1 Prieto (1992) suggests that Bolivian Spanish may be of this type, as does Crowhurst's (1992) data on Sonoran Mexican Spanish. Based on my own informal observations, the Spanish of the Canary Islands may also have this type of diminutives.

2 The results reported here differ somewhat from those reported in Eddington (2002a). The reason for this is that in the previous database, a word such as *muerto* was divided into variables in this manner: mu/er/t/o. The current database divides words in such a way that the members of a diphthong are kept together: m/ue/r/t/o.

References

Alegre, Maria & Peter Gordon. 1999. Frequency effects and the representational status of regular inflections. Journal of Memory and Language 40, 1-61.

Ambadiang, Théophile. 1997. Las bases morfológicas de la formación de diminutivos en español. Verba 24, 99-132.

Baayen, R. Harald, Ton Dijkstra, and Robert Schreuder. 1997. Singulars and plurals in Dutch: Evidence for a parallel dual-route model. Journal of Memory and Language 37, 94-117.

Benua, Laura. 1995. Identity effects in morphological truncation. Papers in Optimality Theory. University of Massachusetts Occasional Papers in Linguistics 18, 77-136.

Bergen, John J. 1978. A simplified approach for teaching the gender of Spanish nouns. Hispania 61, 865-876.

Boomershine, Amanda. 2006. Perceiving and processing dialectal variation in Spanish: An exemplar theory approach. In Timothy L. Face & Carol A. Klee (eds.), Selected proceedings of the 8th Hispanic Linguistic Symposium, 58-72. Somerville, MA: Cascadilla.

Brisk, María Estela. 1976. The acquisition of Spanish gender by first grade Spanish-speaking children. In Gary D. Keller, Richard V. Teschner & Silvia Viera (eds.), Bilingualism in the bicentennial and beyond, 143-160. New York: Bilingual Press.

Brown Roger & David McNeill. 1966. The 'tip of the tongue' phenomenon. Journal of Verbal Learning and Verbal Behavior 5, 325-337.

Bull, William E. 1965. Spanish for teachers: Applied linguistics. New York: Ronald Press.

Burton, Peter G. 1990. A search for explanation of the brain and learning: Elements of the synchronic interface between psychology and neurophysiology. Psychobiology 18, 119-161.

Burzio, Luigi. 1996. Surface constraints versus underlying representations. In Jacques Durand & Bernard Laks (eds.), Current trends in phonology: Models and methods, 97-112. Salford: European Studies Research Institute, University of Salford Publications.

Butterworth, Brian. 1983. Lexical representation. In Brian Butterworth (ed.), Language production, Vol. 2, 257-294. London: Academic Press.

Bybee, Joan. 1985. Morphology. Amsterdam: John Benjamins.

Bybee, Joan. 1988. Morphology as lexical organization. In Michael Hammond & Michael Noonan (eds.), Theoretical approaches to morphology, 119-141. San Diego, CA: Academic Press.

Bybee, Joan. 1994. A view of phonology from a cognitive and functional perspective. Cognitive Linguistics 5, 285-305.

Bybee, Joan. 1995. Regular morphology and the lexicon. Language and Cognitive Processes 10, 425-455.

Bybee, Joan. 1998. The emergent lexicon. In M. Catherine Gruber, Derrick Higgins, Kenneth S. Olson & Tamra Wysocki (eds.), Proceedings of the 34th annual meeting of the Chicago Linguistics Society, 421-435. Chicago: Chicago Linguistic Society.

Bybee, Joan 2001. Phonology and language use. Cambridge: Cambridge University Press.

Clegg, Jens. 1997. Native Spanish speaker intuition in gender assignment in English loan words. Manuscript, Brigham Young University.

Colina, Sonia. 2003. Diminutives in Spanish: A morpho-phonological account. Southwest Journal of Linguistics 22(2), 45-88.

Crowhurst, Megan J. 1992. Diminutives and augmentatives in Mexican Spanish: A prosodic analysis. Phonology 9, 221-253.

Daelemans, Walter, Jakub Zavrel, Ko van der Sloot, & Antal van den Bosch. 2001. TiMBL: Tilburg memory-based learner, version 4.1 reference guide: Induction of linguistic knowledge technical report 01-04. Tilburg: ILK Research Group, Tilburg University.

Drews, Etta & Pienie Zwisterlood. 1995. Morphological and orthographic similarity in visual word recognition. Journal of Experimental Psychology: Human Perception and Performance 21, 1098-1116.

Eddington, David. 1996. The psychological status of phonological analyses. Linguistica 31, 17-37.

Eddington, David. 2002a. Spanish diminutive formation without rules or constraints. Linguistics 40, 395-419.

Eddington, David. 2002b. Spanish gender assignment in an analogical framework. Journal of Quantitative Linguistics 9, 49-75.

Eddington, David. 2004. Spanish phonology and morphology. Amsterdam: John Benjamins.

Elordieta, Gorka & María M. Carreira. 1996. An optimality theoretic analysis of Spanish diminutives. In Lise M. Dobrin, Kora Singer & Lisa McNair (eds.), Proceedings of the Chicago Linguistic Society's 32nd meeting, 49-60. Chicago: Chicago Linguistic Society.

Feldman, Laurie B. 1992. Morphological relationships revealed through the repetition priming task. In Michael Noonan, Pamela Downing & Susan Lima (eds.), Linguistics and literacy, 239-254. Amsterdam: John Benjamins.

Fougeron, Cécile & Donca Steriade. 1997. Does deletion of French schwa lead to neutralization of lexical distinctions? In G. Kokkinakis, N. Fakotakis, and E. Dermatas (eds.), Proceedings of the 5th European Conference on Speech Communication and Technology, Vol. 7, 943-946. Rhodes: University of Patras.

Fowler, Carol A., Shirley E. Napps & Laurie Feldman. 1985. Relations among regular and irregular morphologically related words in the lexicon as revealed by repetition priming. Memory and Cognition 13, 241-255.

García-Albea, José E., Rosa M. Sánchez-Casas & José M. Igoa. 1998. The contribution of word form and meaning to language processing in Spanish: Some evidence from monolingual and bilingual studies. Syntax and Semantics 31, 183-209.

Goldsmith, John. 1993. Harmonic phonology. In John Goldsmith (ed.), The last phonological rule, 21-60. Chicago: University of Chicago Press.

Grainger, Jonathan, Pascale Cole & Juan Segui. 1991. Masked morphological priming in visual words recognition. Journal of Memory and Language 30, 370-384.

Halle, Morris. 1973. Prolegomena to a theory of word formation. Linguistic Inquiry 4, 3-16.

Harris, James W. 1991. The exponence of gender in Spanish. Linguistic Inquiry 22, 27-62.

Harris, James W. 1994. The OCP, prosodic morphology and Sonoran Spanish diminutives: A reply to Crowhurst. Phonology 11, 179-190.

Jackendoff, Ray. 1975. Morphological and semantic regularities in the lexicon. Language 51, 639-671.

Jaeggli, Osvaldo A. 1980. Spanish diminutives. In Frank Neussel Jr. (ed.), Contemporary studies in Romance languages: Eighth Annual Linguistics Symposium on Romance Languages, 145-158. Bloomington, IN: Indiana University Linguistics Club.

Juilland, Alphonse & Eugenio Chang-Rodríguez. 1964. Frequency dictionary of Spanish words. The Hague: Mouton.

Kenstowicz, Michael. 1996. Base-identity constraints and uniform exponence: Alternatives to cyclicity. In Jacques Durand & Bernard Laks (eds.), Current trends in phonology: Models and methods, 363-393. Salford: European Studies Research Institute, University of Salford Publications.

Klein, Philip W. 1989. Spanish 'gender' vowels and lexical representation. Hispanic Linguistics 3, 147-162.

Kolers, Paul A. & Henry L. Roediger. 1984. Procedures of mind. Journal of Verbal Learning and Verbal Behavior 23, 425-449.

Lakoff, George. 1993. Cognitive phonology. In John Goldsmith (ed.), The last phonological rule, 117-145. Chicago: University of Chicago Press.

Lukatela, Georgije, Clausia Carello & M.T. Turvey. 1987. Lexical representation of regular and irregular inflected nouns. Language and Cognitive Processes 2, 1-17.

Lukatela, Georgije, B. Gligorijevic, Aleksandar Kostic, and M.T. Turvey. 1980. Representation of inflected nouns in the internal lexicon. Memory and Cognition 8, 415-423.

McCarthy, John & Alan Prince. 1994. The emergence of the unmarked. Manuscript, University of Massachusetts, Amherst. [ROA 13, ruccs.rutgers.edu/roa.html]

Medin, Douglas L. & Marguerite M. Schaffer. 1978. Context theory of classification learning. Psychological Review 85, 207-238.

Natalicio, Diana. 1983. Native speaker intuitions as a basis for determining noun gender rules in Spanish. Southwest Journal of Linguistics 6, 49-55.

Nosofsky, Robert M. 1990. Relations between exemplar similarity and likelihood models of classification. Journal of Mathematical Psychology 34, 393-418.

Palmeri, Thomas J., Stephen D. Goldinger & David B. Pisoni. 1993. Episodic encoding of voice attributes and recognition memory for spoken words. Journal of Experimental Psychology: Learning, Memory, and Cognition 19, 309-328.

Pérez-Pereira, Miguel. 1991. The acquisition of gender: What Spanish children tell us. Journal of Child Language 18, 571-590.

Pierrehumbert, Janet. 2001. Exemplar dynamics: Word frequency, lenition, and contrast. In Joan Bybee & Paul Hopper (eds.), Frequency and the emergence of linguistic structure, 137-158. Amsterdam: John Benjamins.

Pinker, Steven & Alan Prince. 1988. On language and connectionism: Analysis of a parallel distributed processing model of language acquisition. Cognition 28, 73-193.

Pisoni, David. 1997. Some thoughts on 'normalization' in speech perception. In Keith Johnson & John W. Mullennix (eds.), Talker variability in speech processing, 9-32. San Diego, CA: Academic Press.

Plunkett, Kim & Virginia Marchman. 1991. U-shaped learning and frequency effects in a multi-layered perception. Cognition 38, 43-102.

Poplack, Shana, Alicia Pousada & David Sankoff. 1982. Un estudio comparativo de la asignación de género a préstamos nominales. In Orlando Alba (ed.), El español del caribe, 239-269. Santiago, Dominican Republic: Universidad Católica Madre y Maestro.

Prieto, Pilar. 1992. Morphophonology of the Spanish diminutive formation: A case for prosodic sensitivity. Hispanic Linguistics 5, 169-205.

Riesbeck, Chris K. & Roger S. Schank. 1989. Inside case-based reasoning. Hillsdale, NJ: Erlbaum.

Rosenblat, Angel. 1952. Género de los sustantivos en -e y en consonante. Estudios dedicados a Menéndez-Pidal, Vol. 3, 159-202. Madrid: Concejo Superior de Investigaciones Científicas.

Rumelhart, David E. & James L. McClelland. 1986. On learning the past tense of English verbs. In James L. Mc Clelland, David E. Rumelhart & the PDP Research Group (eds.), Parallel distributed processing, Vol. 2, 216-271. Cambridge, MA: MIT Press.

Segui, Juan & María Luisa Zubizarreta. 1985. Mental representation of morphologically complex words and lexical access. Linguistics 23, 759-774.

Sereno, Joan A. & Allard Jongman. 1997. Processing of English inflectional morphology. Memory and Cognition 25, 425-37.

Skousen, Royal. 1989. Analogical modeling of language. Dordrecht: Kluwer.

Skousen, Royal. 1992. Analogy and structure. Dordrecht: Kluwer.

Skousen, Royal. 1995. Analogy: A non-rule alternative to neural networks. Rivista di Linguistica 7, 213-232.

Smead, Robert N. 2000. On the assignment of gender to Chicano anglicisms: Processes and results. Bilingual Review 25, 277-297.

Stemberger, Joseph Paul. 1994. Rule-less morphology at the phonology-lexicon interface. In Susan D. Lima, Roberta L. Corrigan & Gregory K. Iverson (eds.), The reality of linguistic rules, 147-169. Amsterdam: John Benjamins.

Steriade, Donca. 1999. Lexical conservatism. In Linguistic Society of Korea (ed.), Linguistics in the morning calm, Vol. 4, 157-180. Hanshin: Linguistic Society of Korea.

Teschner, Richard V. 1983. Spanish gender revisited: -Z words as illustrating the need for expanded phonological and morphological analysis. Hispania 66, 252-256.

Teschner, Richard V. & William M. Russell. 1984. The gender patterns of Spanish nouns: An inverse dictionary-based analysis. Hispanic Linguistics 1, 115-132.

Zamora Munné, Juan C. & Eduardo Béjar. 1987. El género de los préstamos. Revista Española de Lingüística 17, 131-137.