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Phonological Transformations in Spanish–Speaking Aphasics

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Thirty-seven aphasic patients whose native language is Spanish were divided into four groups: (1) Broca's, (2) Wernicke's, (3) Conduction, and (4) Anomia. Phonological errors produced on repetition and object-naming tasks were analyzed in terms of type of transformation and degree of similarity between target and errors in terms of shared distinctive features. Segmental transformations were of the following types: (1) pure substitution, (2) pure addition, (3) deletion, (4) reduplicative addition (doublet creation)—anticipatory (right to left) or perseverative (left to right), (5) reduplicative substitution (doublet creation)—anticipatory or perseverative, and (6) mutual exchanges. Pure substitutions were the most prevalent, exchanges, the least. Some error types were found to differentiate significantly between aphasic populations. We suggest that different mechanisms may underlie the same error type for different aphasic populations.

The phonological paraphasias of brain-damaged patients have been the subject of numerous investigations and analyses (e.g., Alajouanine, Ombredane, & Durand, 1939; Jakobson, 1956; Luria, 1966, 1976, 1983; Lecours & Lhermitte, 1969; Blumstein, 1973, 1981; Blumstein, Cooper, Goodglass, Statlender, & Gottlieb, 1980; Trost & Canter, 1974; Buck-

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ingham, 1981, 1986; Buckingham & Kertesz, 1974, 1976; Ardila, 1984; Kohn, 1984). Nevertheless, there is no general agreement with the interpretation and characterization of phonemic errors in aphasia.

Luria (1966, 1976) proposes different paraphasic mechanisms for distinct aphasic groups, reasoning that phonemic errors will arise differentially according to lesion extent and localization. In Wernicke's aphasia, for example, the errors rest at the phonological level and stem from disturbances in the appreciation of distinctive feature contrasts of the underlying linguistic system. On the other hand, in Conduction aphasia (or afferent motor aphasia, as Luria called it),[5] the more or less simultaneous bundle of articulatory commands (the articuleme) necessary for the production of sounds types is "loosened up" or altered in some way, such that much confusion arises proprioceptively in terms of manner and place of articulation. In Broca's aphasia (or motor efferent aphasia in Luria's terms), the mechanism is inertial in nature and inhibits the smooth

[5]Conduction aphasia has always been one of the most problematical aphasic syndromes. It is usually defined as an aphasia characterized by relatively fluent spontaneous language, good comprehension, poor repetition, with the presence of phonemic paraphasias (e.g., Green & Howes, 1977; Benson, 1979; Kertesz, 1979, 1985). The sine qua non of the syndrome, however, is the repetition defect. Nevertheless, this defect has been explained in different ways. The oldest and most frequent account has been in terms of disconnection (e.g., Wernicke, 1874; Geschwind, 1965; Damasio & Damasio, 1983). One could consider that there are distinct mechanisms underlying repetition defects, resting at different levels of linguistic production for the act of repetition (repetition can involve short or long syllable strings; automatized, serial sequences or nonsense sequences; isolated words, phrases, or sentences). The possibility of several different mechanisms, each of which is capable of giving rise to deficient repetition, has led to the postulation of different forms of Conduction aphasia: efferent/afferent (Kertesz, 1979, 1985), or repetition/reproduction (e.g., Kinsbourne, 1972; Shallice & Warrington, 1977; Caplan, Vanier & Baker, 1986). The efferent/repetition type involves the phonemic organization/representation of words and correlates with parietal lobe damage, while the afferent/reproduction involves short-term verbal memory, affects the repetition of large stretches of material, and arises from temporal lobe damage (e.g., Caramazza, Basili, Koller, & Brandt, 1981). Luria (1966, 1976) also claims that what has been referred as Conduction aphasia is in reality two different types of linguistic defect. He uses the term *afferent motor aphasia,* and here he has in mind the parietal type mentioned above. Luria considers this to involve a defect in the ability to analyze, manipulate, or otherwise appreciate the featural composition of sound types (*articulemes* in his terminology). He notes that this is a type of apraxia—although a more fluent one than the frontal lobe limb-kinetic apraxia. Luria's second type of Conduction aphasia, related to our temporal lobe type, is also secondary to temporal lobe lesions and is characterized as an acoustic/amnesic aphasia. In our investigation we considered only the first form of Conduction aphasia—motor-afferent aphasia, which for the sake of ease we have labeled Conduction motor aphasia, and this we divided from Broca's motor aphasia.

and fluent transitions between segments, which in turn leads to the perseveration of segments and often to cluster reduction and syllable simplification. Inertial asynchronies affect the articulatory dynamics in ways that clearly alter the acoustic information in the spoken messages, and this subsequently leads hearers to falsely identify intended phonemes of the patient (Buckingham, 1986). In sum, there could be at least three distinct mechanisms producing phonemic errors in these three patient populations. The identity of the phonemes exists exclusively in the minds of the hearers, not in the production of the aphasics.

Luria's distinctions, however, have been subject to a great polemic. Blumstein (1973) made the startling claims that when one analyses a corpus of phonemic errors in the spontaneous speech of Broca's, Wernicke's, and Conduction aphasia, one finds similar distribution patterns (e.g., all have more substitutions, fewer deletions, even fewer transpositions), and one also finds that errors and targets differ usually by only one feature. The *number* of errors in each category differ, however, Broca's had a larger total than the other groups; Wernicke's had the smallest (Blumstein et al., 1980).

Blumstein, Baker, and Goodglass (1977) found several disruptions with the phonemic discriminations such as /p/ versus /b/ in Wernicke's aphasics, but they pointed out that those difficulties with phonological recognition did not correlate with deficits in comprehension. This point has been made by several other investigators (e.g., Assal, 1974; Gainotti, Caltagirone, & Ibba, 1975). Moreover, it has been shown that in all types of aphasia there exist at least some defects in language perception—deficits different in nature from those found in typical posterior aphasias (Boller, Kim, & Mack, 1977). Kertesz (1985) notes that categorical phonemic perception can be preserved in Wernicke's aphasia and that consequently there is little correlation between phonemic perception and general defects in comprehension. In his analysis of neologistic jargon, Buckingham (1977) considers various mechanisms that could be logically responsible for neologisms; a neologism could be the result of a phonemic transformation applied to a word already incorrectly selected. Both Luria (1976) and Brown (1972) place much emphasis on the two-stage account for a neologism. Phonemic paraphasia may also give rise to the production of neologisms, and most taxonomies of segmental paraphasias agree that there are substitutions, deletions, additions, and linear transpositions (anticipatory and perseverative).

Buckingham (1981, 1986) proposes at least two separate mechanisms that produce phonological errors—one mechanism that is basically at work in anterior aphasias and another that is principally at work in posterior aphasias. In anterior aphasics there is a phonetic level breakdown (variously called things such as kinetic apraxia of speech, motor-afferent aphasia, and the like) that alters articulation in such ways that acoustic cues are altered, leading hearers to falsely identify phonemes as intended by the aphasic. VOT errors are the clearest instance of this in Broca's aphasia. Faulty higher-level phonological programming is the source of difficulty in phonemic manipulation for the posterior aphasics. The mechanism here is prephonetic, and thus, output is a more fluent one. There may, however, be some more subtle motoric asynchronies in the posterior group, and these asynchronies may be altering acoustic cues as well and may be the source for at least reported paradigmatic phonemic substitutions in Wernicke's aphasia (Buckingham, 1986). One would therefore predict different error profiles in these two groups of aphasics.

Lecours (1975) and Nespoulous and Lecours (1983) have recently made some refinements on a taxonomy, parts of which have been proposed before, which is used to characterize aphasic errors in terms of the levels at which they occur: feature, phoneme, morpheme, lexeme, syntagma, and discourse (these last two are considered narrative paraphasias). They then propose an analysis of phonemic paraphasias based upon the following: (1) Paradigmatic distance (seen also in Lecours & Lhermitte, 1969)—this embraces the number of features not shared between the target and the error. (2) Index of formal similarity—this comprises the number of shared phonemes among the target word form and the error word form and the number of shared phonemes that also share equivalent syllabic slots in both words forms. (3) Specific transforming processes involve (a) substitution: one or more different segments are replaced by different segments. These should be substitutions that have no contextual source; i.e., they should be purely paradigmatic. That is, here we must rule out linear transpositions of segments somewhere in the near context; (b) deletion: one or more segments are omitted; (c) addition of a new segment that does not appear somewhere in the near context—that is, this addition is a "no-source" addition; (4) displacement: one or more segments are moved to another position; (5) if the displacement does not substitute for another segment and if it is not deleted from its original target position, then it is called a "reduplicative" addition; (6) if the displacement substitutes for another segment and if it is not deleted from its original target position, then it is called "reduplicative" substitution. Note that we cannot have reduplication unless the segment that is displaced is not deleted from its target position. This, of course, is how "doublets" are created. A word may be phonologically transformed by more than one of these processes, which, of course, is precisely what Lecours and Lhermitte (1969) proposed with a slightly less ornate error taxonomy. Also, again note that all movement errors may proceed from left to right (perseverative) or from right to left (anticipatory).

In this study we proposed the hypothesis that it is possible to find differences in the characteristics of the phonological paraphasias produced by distinct aphasic populations, and that these distinctions correspond to different error mechanisms for each group. This, of course, is what Luria (1966, 1976, 1983) proposed. As we mentioned above, there seems to be little agreement on this point—especially since the publication of Blumstein (1973).

In our study we would like to analyze this issue, using data from phonemic paraphasias in Spanish-speaking aphasic subjects. To study aphasia in different languages is highly relevant in order to differentiate between universal language and specific characteristics. There has been little published in mainstream literature on aphasia in native speakers of Spanish, and there are relatively few systematic analyses of aphasic breakdowns in Spanish language. There are numerous studies of aphasia in English, French, Italian, German, and Russian, and a few in Japanese, Chinese, Thai, and Hindi. But outside of these languages, there has been little or nothing reported. Nevertheless, each language possesses its own phonological, lexical, and grammatical subtleties (e.g., Tables I and II.). Cross-language comparisons of aphasic errors enrich our understanding of the basic mechanisms that underlie those errors.

METHOD

Subjects

Thirty-seven aphasic patients were studied (23 males, 14 females), with an average age of 50.5 years (range 21–74) and an average of 5 years of formal education (range 2–17). All subjects were right-handed and came from the Neurological Institute of Colombia, the Central Military Hospital, and the National Center for Rehabilitation ("Teleton"). Thirty-five of the subjects had an aphasia of vascular origin; one presented with a tumor and one with head trauma. All subjects were monolingual speakers of Spanish.

Average time postonset for our population was 1.5 years (range from 5 months to 8 years). All the patients had received speech therapy for

Table I. Phonological System of the Spanish Spoken in Colombia[a]

	Labials		Dentals		Alveolars		Palatals		Velars	
	Vl	Vd	Vl	Vd	Vl	Vd	Vl	Vd	Vl	Vd
Stops	p	b	t	d					k	g
Affricates							tʃ(č)			
Nasals		m				n		ɲ(ñ)		
Flap								/r/		
Trill								/ṙ/		
Fricatives	f				s				x	
Laterals						l		(ḷ)		

[a]There are 17 consonantal phonemes (the voiced, lateral palatal /l^y/, noted by the symbol /ḷ/ in our system, is found in some scattered regions, but in general, this pheneme is dropping out of the language). The phoneme /x/ (voiceless, velar fricative) is lowering articulatorily into the glottal region. The voiced, oral stop phonemes /b/, /d/, and /g/ have very weakly articulated fricative allophones in intervocalic position that are slowly vocalizing to the point of not being fully recognized as fricatives, but often only as highly sonorant approximants. There are five simple vowel phonemes at cardinal points: /a/, /e/, /i/, /u/, and /o/. [y] and [w] function as semiconsonants when they are the nontonic left member of diphthongs such as [tyene] and [kwatro], while they funcion as semivowels when they are the nontonic right member of diphthongs such as [peyne] and [kawsa]. The [y] and [w] function as full consonants when they occur alone with no contiguous consonant such as [yeso] and [weso] (spelled "yeso" and "hueso"), where they serve as phonemes and are distinguished from [peso], [beso], etc. In the present analysis we used a "broad" phonetic transcription, specifying roughly the phonemic units only.

approximately 2 to 3 hours per week for an average period of 8.35 months (range 6–13).

Aphasia diagnosis was carried out in the neuropsychological unit at each institution. The patients were classified into four groups: (1) Broca's aphasia (10 patients), (2) Wernicke's aphasia (8 patients), (3) Conduction aphasia (9 patients), and (4) Anomia (10 patients). Within and across

Table II. Analysis of the Distinctive Features in Spanish[a]

	o	a	e	u	i	ḷ	l	r	ṙ	g	x	k	ɲ	y	s	t	m	b	f	p	n	d	θ	t
Vocalic/nonvocalic	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Consonantal/ nonconsonantal	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Dense /diffuse	+	+	+	-	-	+	-			+	+	+	+	+	+	+	+	-	-	-	-	-	-	-
Grave/compact	+	+	-	+	-					+	+	+	-	-	-	-	+	+	+	+	-	-	-	-
Nasal/oral										-	-	-	+	-	-	-	+	-	-	-	+	-	-	-
Continuant/obstruent						+	+	-	-		+	-			+	-			+	-			+	-
Voiced/voiceless								+	-	+	-	-		+	-	-		+	-	-		+	-	-

[a]From Alarcos (1965).

each group there were no significant differences in sex, age, time postonset, educational level, or amount of speech therapy. We eliminated patients from this study who presented with mixed symptomatology or with a global aphasia. For some comparisons, only two main groups of aphasics were distinguished: Motor (Broca's and Conduction), and Sensory (Wernicke's and Anomia).

Materials

Three different tasks were used in this study: (1) Spontaneous language sample: the patient was asked to talk about his/her disease. (2) Repetition of words: 48 words were selected, all of which were nouns of the canonical pattern CVCVCV with penultimate stress. Each word was presented once, and all responses were transcribed. (3) Naming: 20 pictures of typical objects, animal, and vegetables were used. The phonological structure of the target words was of a graded complexity and included various syllable types: V, CV, VC, CVV, CCV, CVC.

Each of the three tasks was administered independently at one sitting per task. Each task took approximately 15 minutes. The same examiner administered all tasks, and all responses were recorded for subsequent analysis. The first task (spontaneous speaking) was only used in order to further specify the actual characteristics of the aphasia, and to establish rapport. Phonological analysis of the phonemic transformations, however, was restricted to the responses from the repetition and naming tasks. We found that the language samples taken from spontaneous speech were quite different between groups and even within each group, so comparison would have been difficult using those data. Responses from the standard types of repetition and naming tasks were easier to compare.

Analysis of the Data

For our analysis we used the model proposed by Lecours (1975). The following criteria were included: (1) mechanisms involved in phonological transformation (substitution, addition, deletion, reduplicative addition, reduplicative substitution, exchanges); (2) paradigmatic distance: in the case of substitutions (pure—no source—substitution or exchange type substitutions where the substituting phoneme comes from the immediate context) we calculated the number of distinctive features shared by the target and the error phonemes; and (3) type of feature opposition involved (according to the feature system developed in Jakobson, Fant, & Halle, 1961, which was adapted for Spanish by

Alarcos, 1965) vocalic/consonantal, dense/diffuse, grave/compact, oral/nasal, obstruent/sonorant, voiced/voiceless (see Table II). This system was selected because of being the most broadly used and applied in Spanish linguistics, however, we are conscious that sometimes it can be confusing and questionable its application.

We did not consider verbal paraphasias, and when these were produced by the patient, the examiner asked for another name. If the patient could not name the picture, the examiner went on to the next picture. Nor did we consider phonetic errors. Nevertheless, there is always the possibility that in some cases phonetic alterations in articulation will lead to the perception of phonemic category substitutions by the hearer (Buckingham, 1986). In our transcriptions, we took the utmost of care in ruling out phonetic aberrations as the source of phonemic substitutions. This represents a problem only for the so-called no-source, purely paradigmatic phonemic substitutions. Tables III and IV list some examples of our errors.

RESULTS

A total of 744 paraphasias constituted the database we analyzed. There was an average of 20.11 paraphasias per patient and 0.296 paraphasias per situation (48 words to repeat and 20 pictures to name).

Table V contains the obtained results. We immediately note that the majority of paraphasias were produced by the Conduction aphasics (330), followed by Broca's aphasia, with the smallest number being produced by the Anomics. These paraphasias were 2.6 times more frequent in the repetition task than in the naming task. In the Conduction aphasics each paraphasia involved an average of 1.46 phonological changes (features); for Broca's patients the average was 1.6; Wernicke, 1.52; and Anomia, 1.35. The maximum number of paraphasias was produced in Conduction aphasia on the repetition task, while the minimum number was observed with Anomics on naming.

Table VI lists the error mechanisms involved in the phonemic transformations we found in our subjects. For every group, the maximally utilized error type was substitution, while the least used was exchange. Nevertheless, there were several interesting differences in the way the errors were distributed. Substitutions were proportionally fewer in Motor aphasias, as compared with the Sensory groups ($X^2 = 6.70$, $df = 1$, $p < .01$). On the other hand, the Conduction aphasics had a larger

Table III. Examples of Mechanisms Utilized in the Phonemic Paraphasias Produced During Repetition

Stimulus	Response			
		Substitution Sounds	Nonshared features	Feature distance
Bocina /bosina/	/gosina/	/b/x/g/	Dense/diffuse	1
Manada /manađa/	/magađa/	/n/x/γ/	Dense/diffuse Grave/compact Nasal/oral	3
Pirata /pirata/	/birata/	/p/x/b/	Voiced/voiceless	1
		Addition Sound added		
Pequeño /pekeɲo/	/pwekeɲo/	/w/		
Resina /resina/	/tresina/	/t/		
Casino /kasino/	/karsino/	/r/		
		Deletion Sound deleted		
Tocino /tosino/	/osino/	/t/		
Marina /marina/	/maina/	/r/		
Cabeza /kaβesa/	/aβesa/	/k/		
		Reduplicative addition Duplicated sound		
Tarima /tarima/	/trarima/	/r/	(anticipation)	
Ceniza /senisa/	/senisya/	/y/	(perseveration)	
Salina /salina/	/saylina/	/y/	(anticipation)	
		Reduplicative substitution Sound	Nonshared features	Feature distance
Pomada /pomađa/	/popađa/	/m/x/p/	Nasal/oral Voiced/voiceless	2
Sonido /sonido/	/soniso/	/đ/x/s/	Dense/diffuse Voiced/voiceless	2
Meseta /meseta/	/mesata/	/e/x/a/	Grave/compact	1
		Exchange Sounds exchanged		
Sotana /sotana/	/tosana/	/s/, /t/		
Bocado /bokađo/	/dokaβo/	/b/, /d/		
Tarima /tarima/	/tamira/	/r/, /m/		

Table IV. Examples of Errors in Naming

Stimulus	Response	Sound	Mechanism	Features	Feature distance
Maleta /maleta/	/paleta/	/m/x/p/	Substitution	Nasal/oral Voiced/voiceless	2
Caballo /kaβajo/	/kapar̉o/	/β/x/p̣/ / j/x/r/	Substitution Substitution	Voiced/voiceless Continuant/obstruent	2
Martillo /martijo/	/martinjo/	/n/	Addition		
Zanahoria /sanaorya/	/sanaβorya/	/β/	Addition		
Peinilla /peynija/	/penija/	/y/	Deletion		
Bombillo /bombijo/	/boβijo/	/m/	Deletion		
Escalera /eskalera/	/eskaslera/	/s/	Reduplicative addition		
Zahanoria /sanaorya/	/sananorya/	/n/	Reduplicative addition		
Lapiz /lapis/	/papis/	/l/x/p/	Reduplicative substitution	Vocalic/nonvocalic Continuant/obstruent	2
Tenedor /tenedor/	/tededor/	/n/x/đ/	Reduplicative substitution	Nasal/oral	1
Telefono /telefono/	/telenofo/	/n/,/f/	Exchange		
Rosa /ṙosa/	/soṙa/	/s/,/ṙ/	Exchange		

number of reduplicative substitutions. Deletion as an error type significantly distinguished the Motor aphasias (Broca's and Conduction) from the Sensory aphasias (Wernicke's and Anomia) ($X^2 = 12.6$, $df = 1$, $p < .01$). Addition was more frequent in Sensory aphasics.

For all aphasic groups, the phonological transformations involved very small paradigmatic distances (differed in few features) in the majority of instances. Paradigmatic distances between target and error of three or more distinctive features constituted no more than 10% of the substitutions (Table VII).

Table V. Number of Paraphasias for the Four Groups of Aphasics Under Analysis[a]

	Repetition	Naming	Total
Broca's	192(296)	86(149)	278(445)
Wernicke's	76(106)	29(54)	105(160)
Conduction	244(354)	86(129)	330(483)
Anomic	27(33)	4(9)	31(42)
Total	539(789)	205(341)	744(1130)

[a]We have placed the total number of phonological changes for each group according to task in parentheses.

Table VIII illustrates the features shared between error and target phonemes. The most frequent feature switch was [dense/diffuse], although the distribution of this switch was similar for each aphasic group in the study. The feature switch [grave/compact] did, however, significantly distinguish among the Motor and Sensory aphasias ($X^2 = 8.80$, $df = 1, p < .01$), that feature pair confusion being significantly greater in Sensory aphasias.

Subsequently, we analyzed all the segmental confusions found in

Table VI. Relative Frequency of Error Types for the Phonemic Paraphasias Produced by Our Four Groups of Aphasics, in the Repetition (R) and Naming (N) Tasks[a]

	Broca	Wernicke	Conduction	Anomic	Total
Substitution	R 205	78	206	29	518
	N 73	36	48	4	161
	(62.47)	(71.25)	(52.59)	(78.57)	(60.09)
Addition	R 12	7	9	0	28
	N 11	3	9	2	25
	(5.17)	(6.25)	(3.72)	(4.76)	(4.70)
Deletion	R 41	8	71	0	120
	N 51	12	50	1	114
	(20.67)	(12.50)	(25.05)	(2.38)	(20.70)
Reduplicative addition	R 8	1	11	0	20
	N 2	1	2	0	5
	(2.25)	(1.25)	(2.70)	(0.00)	(2.21)
Reduplicative substitution	R 26	11	54	4	95
	N 8	2	19	0	29
	(7.64)	(8.12)	(15.11)	(9.52)	(10.97)
Exchange	R 4	1	3	0	7
	N 4	0	1	2	7
	(1.80)	(0.62)	(0.83)	(4.76)	(1.24)

[a]The percentages of error types, as compared with all others, are shown in parentheses.

Table VII. Paradigmatic (Feature) Distance Between Error and Target Phonemes in Our Aphasic Population[a]

	Low	Mid	High
Broca's	57.74	33.55	8.71
Wernicke's	58.03	33.93	7.14
Conduction	60.22	30.25	9.52
Anomic	77.78	22.22	0.00

[a]Our figures constitute three degrees of distance: *low* (one distinctive feature difference), *mid* (two distinctive feature differences), and *high* (three or more distinctive features differences). These percentages are based on the total number of substitutions.

our population, and we classified them into five groups: (1) switches in manner of articulation, (2) switches in place of articulation, (3) switches in manner and place, (4) switches in the feature [± voice] for the stops only, and (5) vocalic switches. Table IX presents the results of this analysis.

Switches in manner of articulation appeared significantly greater in the Motor aphasia group ($X^2 = 8.07$, $df = 1$, $p < .01$). Moreover, within those two populations, manner switches were significantly greater in the Conduction group than in the Broca's aphasics. Switches in place of articulation were increased only in Anomics.

[± voice] changes among the stop phonemes revealed a very interesting pattern. In absolute terms, the Motor aphasic group had twice as many of these as the Sensory group (27 and 14, respectively), but for the Sensory aphasics these switches represented twice as great a percentage of their total error when compared with the Motor group (4.23% of the total in the Motor group, and 8.54% of the total in the

Table VIII. Feature Differences Between Error and Target Phonemes in Our Aphasic Groups[a]

	Broca	Wernicke	Conduction	Anomic	Average
Dense/diffuse	30.00	29.21	25.58	23.25	27.82
Grave/compact	15.90	24.72	18.72	30.23	18.13
Nasal/oral	15.44	11.24	17.37	23.25	15.94
Continuant/obstruent	10.74	9.55	11.20	6.98	10.62
Voiced/voiceless	10.07	11.80	10.40	6.98	10.38
Vocalic/nonvocalic	17.90	13.48	18.34	9.30	17.11

[a]Percentages are based on the total number for each group.

Table IX. Types of Phonological Changes (Articulation-Based) Found in Our Groups of Aphasics[a]

	Broca	Wernicke	Conduction	Anomic	Average
Manner of articulation	45.51	34.64	56.88	32.43	47.78
Place of articulation	13.14	8.61	10.70	21.62	11.83
Manner and place of articulation	27.88	18.90	23.54	16.22	24.16
Voiced/voiceless (oral stops)	4.17	8.66	4.28	8.11	5.10
Vocalic	9.29	29.13	4.58	21.62	11.08

[a]Percentages are based on the total number for each group.

Sensory group). This accords with the fact that the phonological errors analyzed in our study were four times more frequent in the Motor aphasic group.

The phonemic transformations involving vowels were approximately equal for all groups (44 for the Motor group and 45 for the Sensory group). This means that, in relative terms, vocalic switches were four times more frequent in the Sensory aphasics.

DISCUSSION

Generally, the error mechanisms we found in our patients are those that have been reported for speakers of other languages. Nevertheless, as far as we know, this is the first in-depth study of paraphasia in Spanish, and as such, our findings can be considered with other cross-language investigations in the search for common patterns of language disintegration secondary to cerebral damage. There are, however, several aspects of our study that we would like to highlight.

The Motor aphasias comprised a greater number of phonological transformations than did the Sensory aphasias. These paraphasias were particularly evident on repetition tasks. However, we should point out that it is likely that many of the purely paradigmatic phonemic substitution errors found in our Broca's and Conduction aphasics (the Motor aphasias as we have defined them) were in reality phonetic in nature, characterized by articulatory aberrations that changed acoustic signals such that in many instances we perceive other phonemic units; that is, the patient produces a phonetic switch, but we the hearers perceive phonemic substitutions (cf. Buckingham, 1986). This might very well explain the high percentages of pure substitutions that we have listed in Table VI.

We also note that in Conduction aphasia there were fewer purely paradigmatic substitutions and a much greater proportion of reduplicative substitutions. Not only does this accord with the fact that there would predictably be less motor involvement (although very interestingly there is still a motor component in Conduction aphasia) with a lesion leading to a Conduction aphasia (i.e., more posterior), it also implies that in Conduction aphasia the intruding error phonemes come from the immediate phonetic context (i.e., from phonemes in adjacent syllables). This, of course, would lead to a tendency to either perseverate (e.g., /pomada/–/popada/, /salina/–/sasina/) or anticipate (e.g., /resina/–/sesina/, /peseta/–/peteta/).

Deletion paraphasias are relatively rare in the Sensory aphasias, while addition paraphasias are slightly greater in number in the Wernicke's patients. This accords with the clinical observation that in the Motor aphasias (specially Broca's) the error word is generally shorter than the target word. It also squares with the fact that error words in phonological jargon tend to have a greater number of phonemes than the targets. We should also point out that since the words in the repetition tasks contained basic syllable types CV, the context was restricted from inducing cluster simplification, deletion errors.

The distinctive feature system we used initially revealed very few differences in the phonological errors of our patients. Only the feature confusion pair [grave/compact] (which, we should point out, is an acoustically based opposition rather than articulatory) distinguished the Motor aphasics from the Sensory. Nevertheless, feature distinctions utilized subsequently (manner and place of articulation, voice onset time among the oral stops, and vocalic distinctions) revealed appreciable differences. In reality, though, it is often possible to map acoustically based features onto various articulatory parameters (Chomsky & Halle, 1968, p. 306). For instance, the articulatory feature [Motor] correlates precisely with the acoustic feature [Diffuse], while the articulatory feature [Coronal] (roughly, the alveolars) corresponds closely to the acoustic feature [Grave], but with the opposite value. Nevertheless, in the analysis of phonemic paraphasias in the production mode, it is more convenient to utilize articulation-based systems.

Switches in manner of articulation have been long observed in the Motor aphasias and particularly in Conduction aphasia. The Conductions as well often produce phonemic errors that differ in both place and manner, thus increasing the paradigmatic distance between error and target. In Sensory aphasia, when compared with the other types of errors, voice onset time and vocalic errors are notable. In some sense, the confusions in Motor aphasias are more articulatory in nature, while those of the Sensory patients are more acoustically based. In any event, both types of production confusion have severe phonological consequences for hearers, and as we have mentioned above, the hearers may be perceiving at the level of phoneme switches, while the aphasics are producing slightly altered phonetic productions (for correctly selected phonemes) that change the acoustic spectrum in some way or another, and that this acoustic change leads hearers to "uncover" phonemes other than those selected by the patient.

The possibility of distinguishing different aphasic groups in accordance with the characteristics of their phonological paraphasias has given rise to much polemic. Kohn (1984) observes that the paraphasias produced in Conduction aphasia by and large involve linear transpositions, unlike typical errors in Broca's and Wernicke's aphasia. Her theory is that the ordering problems are caused by a breakdown in parietal programming of the integration of acoustic and motor information in speech production. Shinn and Blumstein (1983) consider that in Broca's aphasia the "static" aspects of language production are conserved (i.e., the patients achieve adequate place of articulation), but their production is defective owing to the deficits in temporal motor integration. Nevertheless, Ziegler (1984) questions the Shinn and Blumstein interpretations. For instance, Ziegler feels that too little is known about the propieties of the short-time spectrum measured at the point of consonantal release since those propieties play a role in acoustic cuing for the feature of place. There is an acoustic space with the spectrum, but Ziegler claims that the correlates of overshoot or undershoot in attempting an "idealized" spectral template are unknown. He asks, for example, where the diffuse-rising spectral shape of an alveolar plosive heads to as the tongue becomes more and more retracted from its alveolar position. He wonders whether there is a continous path from "diffuse-rising" to "compact" (note here, of course, our previous claims that acoustic features can be mapped roughly onto articulatory parameters), which would correlate with the already established continuum that extends along the roof of the oral cavity from the alveolar ridge to the alveopalatal region to the hard palate and from there to the velum. In other words, to make fine measurements to study the phonetic/phonemic breakdown in Broca's aphasia, the spectral characteristics of oral stops is an unreliable parameter. Blumstein and Shinn (1984) rebut Ziegler's claims, however. In the first place, they contradict Ziegler's claims that next to nothing is known about the spectral proprieties of the acoustic space within the first 25 msec postrelease by referring to the recent findings of Lahiri, Gewirth, and Blumstein (1984), not referenced by Ziegler in his critique. Lahiri et al. showed precisely that the measure *is* sensitive to a variety of, for English, subphonemic variations in articulatory placing, all affecting gross shapes of the onset spectra. Dental, retroflex, and palatal stop allophones of /t/ and /d/ have different onset spectral shapes, and each of them differs from the typical shape of the alveolar. There was some problem with the term *static* for Ziegler. For him, there is nothing but dynamic movement from stop release to the following vowel. Blumstein and Shinn are completely aware of this, but they note that one *can* concentrate analysis on the first 25 msec postrelease, and to that extent the spectral picture is more "static."

In our patients, switches in manner of articulation were much greater in the Motor than in the Sensory aphasic group, and significantly greater in Conduction aphasia as compared with Broca's aphasia. Such results do not accord with Shinn and Blumstein's (1983) observations. However, we used two very specific tasks (repetition and naming) and not free speech; this could at least partially account for the discrepancy.

The acoustically based paraphasias in our patient populations were witnessed particularly in the Sensory aphasics, although to a lesser extent than we would have expected (Luria, 1976). We should point out nevertheless that the phonemic perceptual difficulties are salient in the acute stages (70%) and notably less in chronic stages (4%) (Varney, 1984). Our patients, however, were from 6 months to 8 years postinsult and accordingly had fewer paraphasias that seemed to be acoustically based. Admittedly, a strict distinction between what is essentially acoustic and what is essentially articulatory is difficult to draw. That is, do we see place-of-articulation errors because of a strictly articulatory problem or is it that the neural programs that allow perceivers to appreciate spectral information are disrupted and that *that* is the cause of the phonemic paraphasia? Nevertheless, vocalic confusions [± voice], switches among the oral stops, and switches between [grave/compact] features were significantly prevalent in patients with Sensory aphasias.

Everything said to this point emphasizes the importance of continuing the search for a better understanding of the specific characteristics of phonemic paraphasias and of their underlying mechanisms.

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