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Structure of the Syllable and Syllable Length in Spanish

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The purpose of this paper is to present data concerning syllable length in open versus closed syllables in Spanish. This research is part of an ongoing project on acoustic values of the syllable. Curiously enough, much remains unknown on this vital, yet taken for granted, phonetic concept. Our own incipient research has been presented on other occasions, but little is being done on the syllable in other centers.

It is not our current purpose to provide new insights into the definition of the syllable; our objective is to supply new data concerning syllable length in Spanish. We will therefore assume the existence of the syllable and will use the classical phonetic rules of Spanish syllable division in determining the syllabification of our tokens. Consequently, the syllables in our materials all contain vocalic nuclei and may or may not contain consonantal limits. For the present study, we deliberately eliminated tokens containing diphthongs due to their varied structure. In measuring the length of the syllables, we included both the vocalic nucleus and its consonantal limits.

Previous Studies

There have been several studies dealing with the matter of syllable length. The scope and intent of these are extremely varied and their results are at times contradictory. The most common concept that has emerged is that there are languages that are 'syllable-timed' and others that are 'stress-timed.' According to Pike¹, English is an example of a language that is stress-timed. This means that the rhythm of English goes from stress to stress. This produces a stressed syllable that is considerably longer than an unstressed one.

 ' ' ' ' ' '
 ----/--/--/--/----/--/----/----/----/--/----/----/----/
 She was as in-sens-i-tive as she was beau-ti-ful.

Note that the long syllables are all stressed and that the short syllables are all unstressed.

The Romance languages have been generally considered to be syllable-timed. In his book on the intonation of American

English, Pike used Spanish as his prime example of a 'syllable-timed' language. The Spanish equivalent for our English example is 'Ella era tan insensible como era hermosa.' The pattern of stressed syllables would be:

' / / / / / / / / / / / / / /
 ---/---
 E-lla e-ra tan in-sen-si-ble co-mo e-ra her-mo-sa.

Note that all the syllables are theoretically of the same length regardless of stress.

Portuguese has been the only language mentioned in the literature as a possible exception to the general categorization of the Romance languages as 'syllable-timed' languages.² Authors such as Peter Ladefoged mention French as an example of a 'syllable-timed' language.³

Previous Studies on Syllable Length in Spanish

There have been a few studies which have related to the issue of syllable length in Spanish. The earliest were done by Tomás Navarro Tomás, who wrote three articles in the *Revista de Filología Española* on the length of accented vowels (1916),⁴ unaccented vowels (1917),⁵ and consonants (1918).⁶ In 1922, he published a study dealing directly with syllable length based on readings of the poetry of Rubén Darío.⁷ In his study, Navarro used three separate informants who were speakers of unspecified peninsular dialects. His conclusions were that Spanish syllables varied greatly in length according to whether they were stressed or not, the stressed syllables being much longer.

In his study of read breath groups, Samuel Gili y Gaya concludes that there is a general psychological tendency to syllable-timing, but that there are mitigating physiological factors such as style, number of unstressed syllables between stresses and complexity of the syllable.⁸ His research was based on the recording of one reading of a prose passage presumably by a peninsular informant. In 1980, Pointon reanalyzed Gili y Gaya's materials and found that the difference between stressed and unstressed syllables amounted to a 50% increase for stressed over unstressed syllables.⁹

Pierre Delattre conducted a comparative analysis of syllable length in English, Spanish, French and German in 1966.¹⁰ Unlike previous studies which had been based on kymograms and oscillograms, Delattre's research was carried out using spectrograms of a five-minute segment of free speech. Although he does not

specify the number nor origin of his informants, they were presumably Latin American. His results in general showed that closed syllables tended to be longer than open ones, that stressed syllables tended to be longer than unstressed ones and that unstressed, open syllables tended to be of the same duration regardless of their position.

In 1972, Carroll Olsen studied a recording of a speech by Octavio Paz.¹¹ His overall conclusion was that Spanish is syllable-timed. He recognized that there are differences in length, but the differences are much smaller than in English, for example.

In his review article of all of the above research, Pointon noted that there are many factors which influence the length of the syllable. These include stressed versus unstressed syllables (Navarro); speed of movement of the articulators from sound to sound, style, the number of unstressed syllables between stresses and the complexity of the syllable (Gili y Gaya); open versus closed syllables (Delattre); rhythm pattern, sound sequence, structural sequence and length sequence (Olsen). Pointon also mentioned other factors which bear on syllable length such as dialect, elements measured (vowels versus consonants with or without transitions), sense groups versus breath groups versus isolated words, tempo, and number of informants. Still other factors, particularly sociolinguistic ones, would add other dimensions. Pointon concluded that Spanish is neither syllable-timed nor stress-timed. He felt that it is 'some form of segment-timing, in which the number and type of segments in each syllable, together with the presence or absence of stress, determine the duration of a syllable.'

In earlier studies, Clegg & Brannen¹² and Clegg & Fails¹³, we determined that: 1) Tonic syllables are longer than atonic syllables in non-final positions by 50%. 2) The difference in length among all the atonic syllables only amounted to 13%, indicating great consistency in non-final atonic positions. 3) Absolute final syllables are 123% longer than syllables in other positions. 4) Stressed final syllables are 35% longer than unstressed final syllables. 5) We found a general correlation between length and voicing in all syllables where the following consonant was voiced. The more voiced the consonants (sonorants versus unvoiced stops, for example) the longer the preceding syllable. Ladefoged reports a similar phenomenon for English vowels.¹⁴

Our Study

Basic Spanish phonetics texts generally assume that Spanish is 'syllable-timed.'¹⁵ The stated implication is that native speakers of Spanish will take the same amount of time to utter each syllable regardless of its stress, position or complexity. The scant and obscure technical articles on the subject, Navarro, Gili y Gaya, Delattre and Olsen, however indicate that there are differences in syllable length. Because these works are obscure and because their focus has been elements other than the syllable itself, new studies into the syllable are necessary.

In order to further investigate the syllable in Spanish, we have collected data in the form of both a questionnaire and free speech. We have submitted a portion of the questionnaire to spectrographic analysis. This work presents an analysis of findings to date. The purpose of this part of the research is to examine variation in syllable length according to syllable type. We do not propose to settle here the issue raised by Pointon as to whether or not Spanish is syllable-timed. Subsequent analysis of the free-speech portion of our data will allow us to determine the variation of length according to syllable form and position within the phonic group.

Methodology

Much discussion has taken place over the use of data from free speech versus questionnaires. We felt that we could use a questionnaire for two reasons. First, Clarke found no appreciable difference in acoustic parameters between free text and read materials.¹⁶ Second, a questionnaire composed of a word list provides a uniform ratio of examples that would require an enormous equivalent of free speech samples to duplicate.

The basic phenomenon we wanted to work with was the syllable type (open and closed). Our questionnaire contained a list of 20 words that produced each vowel /a,e,i,o,u/ in each of these environments.

The use of a word list differs from the approach of previous studies, some of which were concerned with segments other than the syllable. One of the difficulties they encountered was the determination of syllabic limits. These determinations were further complicated by phonosyntactic transitions typical of the syllable but difficult to delineate with the equipment and techniques utilized by earlier researchers. Measurement by syllable rather than by phone eliminated the question of transitions except between syllables. This means that the sonorants

that tend to complicate vowel/consonant boundaries were included neatly in their separate syllables.

In selecting our informants, we maintained a uniform sociological level. The six informants were all female, from the same generation (ages 21 to 27) and from the same socio-economic level (middle class). We wanted to compare persons from different dialect areas, hence we selected informants from different general areas in the Americas. The dialects chosen were: Argentine (Buenos Aires), Chilean (Santiago), Colombian (Bogotá), Salvadoran (San Salvador), Puerto Rican (San Juan), and Mexican (Mexico City).

We asked the informants to read the questionnaire and recorded them in an acoustic studio on a Sony cassette recorder. We made contour sonagrams of the recordings on a Digital Sonagraph Model 7800, analyzing the first 4000 Hz. We measured the syllables for duration using a ruler calibrated in millimeters, including both the consonants and vowels that belonged to the syllable in question.

After measuring the syllables physically, we factored this measurement against the 5.12 seconds of speech recorded on a sonagram displaying the acoustic information from 0 to 4,000 Hz. This recording time converted into a physical measurement of length is equal to 317 millimeters. Converting the time (5.12 seconds) into milliseconds (5120 ms) and dividing by the 317 mm, we derived a factor of 16.1542 ms/mm that we used in calculating the actual duration of each syllable.

We averaged the results for this study, individual by individual and position by position. The individual results were, in general, the same as the average for all of the informants, that is, no instance varied appreciably from any other. We also did our analysis speaker by speaker to mitigate individual differences. The words were measured, the measurements then totalled and an average determined.

Results of the Study

A study designed to specifically examine open versus closed syllables showed that stressed closed syllables were 13% longer than stressed open syllables in 'minimal pairs.' The unstressed closed syllables were 55% longer than unstressed open syllables (pretonic) in 'minimal pairs.' An average of stressed and unstressed closed syllables versus stressed and unstressed open syllables showed an overall 34% increase in length for closed syllables over open syllables.

AVERAGES OF SYLLABLE LENGTH
IN FINAL PHONOLOGICAL POSITIONS

Vowel	STRESSED		UNSTRESSED	
	OPEN	CLOSED	OPEN	CLOSED
a	359 ms	359 ms	249 ms	323 ms
e	389 ms	394 ms	260 ms	291 ms
i	357 ms	441 ms	260 ms	318 ms
o	363 ms	415 ms	268 ms	281 ms
u	336 ms	420 ms	275 ms	317 ms
AVG.	361 ms	406 ms	262 ms	306 ms

Further data on stress showed that in final position, stressed closed syllables were 27% longer than unstressed closed syllables. In final position, unstressed closed syllables were 48% longer than unstressed open syllables.

AVERAGES OF SYLLABLE LENGTH
IN OPEN VS. CLOSED SYLLABLES

Vowel	STRESSED		UNSTRESSED	
	OPEN	CLOSED	OPEN	CLOSED
a	275 ms	334 ms	132 ms	204 ms
e	376 ms	485 ms	179 ms	220 ms
i	220 ms	309 ms	141 ms	210 ms
o	257 ms	315 ms	141 ms	207 ms
u	265 ms	333 ms	139 ms	239 ms
AVG.	279 ms	355 ms	146 ms	216 ms

Summary

In summary, the our study shows the following: 1) Closed syllables average 34% longer than open syllables in 'minimal pairs.' 2) Stressed closed syllables average 27% longer than unstressed closed syllables in 'minimal pairs.' 3) Again, we found a general correlation between length and voicing (as did Ladefoged for English vowels in all syllables where the following consonant was voiced. The more voiced the consonants (sonorants versus unvoiced stops, for example) the longer the preceding syllable.

Much work remains to be done on the syllable. We still need to study the effects of different types of following consonants and the effect that complex syllable form (V, CV, CVC, CCVC, etc.) has on syllable length. The many manifestations of intensity remain to be related. Additionally, we wish to compare these findings with those we will obtain from free speech samples. In the realm of spontaneous speech, such factors as phonosyntactic syllables, phonic groups and sentence or emphatic stress must also be considered.

Through all of this data and that which we have projected, the question raised by Pointon still remains to be answered. Our data shows that the traditional concept of 'syllable-timing,' interpreted to mean syllables of the same length, is unacceptable. Hopefully, the results obtained in future investigation will lead to an answer to the 'timing' of Spanish.

Endnotes

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³Peter Ladefoged, A Course in Phonetics (New York: Harcourt Brace Jovanovich, 1975), p. 222.

⁴Tomás Navarro Tomás, "Cantidad de las vocales acentuadas," Revista de Filología Española (1916) 3, 387-408.

⁵Tomás Navarro Tomás, "Cantidad de vocales inacentuadas," Revista de Filología Española (1917) 4, 371-388.

⁶Tomás Navarro Tomás, "Diferencias de duración entre las consonantes españolas," Revista de Filología Española (1918) 5, 367-393.

⁷Tomás Navarro Tomás, "La cantidad silábica en unos versos de Rubén Darío," Revista de Filología Española (1922) 9, 1-29.

⁸Samuel Gili y Gaya, "La cantidad silábica en la frase," Castilla (Valladolid, 1940) 1, 287-298.

⁹Pointon, p. 294-295.

¹⁰Pierre Delattre, "A Comparison of Syllable-Length Conditioning Among Languages" International Review of Applied Linguistics (1966) 4(3), 183-198.

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¹²J. Halvor Clegg and Joseph Brannen, "Phonological Distribution and Syllable Length in Spanish," in Robert A. Russell (Ed.), Deseret Language and Linguistic Society Proceedings: Eleventh Annual Symposium 14-15 February 1985, (Provo, Utah: Brigham Young University, 1986).

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¹⁴Ladefoged, p. 223.

¹⁵Antonio Quilis and Joseph A. Fernández, Curso de fonética y fonología españolas 6th ed. (Madrid: C.S.I.C., 1972), p. 161.

¹⁶W. M. Clarke, "The Measurement of the Oral and Nasal Sound Pressure Levels of Speech," Journal of Phonetics (1975) 3, 257-262.