Phonological Distribution and Syllable Length in Spanish

J. Halvor Clegg

Joseph Brannen

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J. Halvor Clegg
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Brigham Young University

Much experimental work needs to be done before any understanding of the syllable will be arrived at. This study is part of a larger, long-term study that aims at understanding some of the features of this difficult concept.

It is not the purpose of this study to provide a definition of the syllable. There are many in the different manuals that can be referred to for definitions. We will assume the existence of the syllable and use its classical definition. This means having a nucleus and limits. In our materials the nuclei are always vowels. Our measurements will include these vowel nuclei and their limits. These may be realized as consonants, vowels or modulations in the vowel nucleus itself.

There are many studies on syllable length. These are extremely varied in nature and often conflict. The most common concept that has emerged is that there are languages that are "syllable-timed" and others that are "stress-timed". English is given as an example of a language that is stress-timed. This means that the rhythm of English goes from stress to stress. This results in a stressed syllable that is considerably longer than an unstressed one. For example, in the sentence "This is an incredibly complicated phenomenon", the syllable form would look like this:

```
  '   '       '       '              '
-----/ --/ -/ -/ ---/ -/ -/ ---/ -/ -/ -/ -/ ---/ -/ -
This   is an in cred i bly com pli ca ted phe nom en on
```

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

The Romance languages have been listed as being syllable-timed. The same equivalent in Spanish (Es un fenómeno increíblemente complicado (with minor changes for grammatical acceptability) would theoretically look like this:

```
'   '       '               '       '              '
--/ --/ --/ --/ --/ --/ --/ --/ --/ --/ --/ --/ --/ --/ --
Es  un fe   no  me  no  in  cre i   ble men  te com pli  ca  do
```

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

The only exception given among the Romance languages has been Portuguese, but the evidence for Portuguese is still inconclusive. The latest studies give it as being "half and half". Authors such as Peter Ladefoged give French as being an example of syllable-timed but less and less mention is being made of Spanish.

The earliest study done for Spanish was made by Tomás Navarro Tomás. His conclusions were that Spanish syllables greatly varied in length according to whether they were stressed or not, the stressed syllables being much longer. He based his views on Spanish poetry which is interesting but not an example of "real" language. Samuel Gili y Gaya concludes, in his study of read breath groups, 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. Pointon (1978) 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.

Pierre Delattre did a comparative spectrographic analysis of English, Spanish, French and German. His results 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.

Carroll Olsen (1972 and repeated 1984) did a study on a recording of a speech by Octavio Paz. His overall conclusion in both cases 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.

Pointon, in a review of all of the above researchers, found that there are many factors which influence the length of the syllable. These include stressed vs. 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 adds the obvious factors of 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 "segment-timed" being a mixture of the segments of the syllable combined with stress.

In this study we tried to mantain a uniform sociological level. The informants were all female (6), from the same generation (21-35) and from the same social class (middle class). We felt that we wanted to work with a closed text (which was read by the informants) since earlier studies had been done giving an indication of what basic phenomena we wanted to work with. Besides, Clarke (1975), in his study comparing free text versus read materials found no appreciable difference between the two. We, therefore, created a questionnaire which would examine various aspects of the elements of the syllable.

Âlvarez (1981) showed for Spanish what Fails & Clegg (1983) did for Portuguese; that the type of syllable did not affect the vowel quality. Some care had to be taken in the selection of items due to neighboring phonemes since Âlvarez showed that some consonants (among them the phonemes /s/ and /r̄/) can influence the quality of the vowel. For our overall study, position in the phonic group was very important. It is generally known that acoustic phenomena diminish towards the end of a sentence. We also did our analysis speaker by speaker to mitigate individual differences.

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), Columbian (Bogotá), Salvadoran (San Salvador), Puerto Rican (San Juan), and Mexican (Mexico City).

We asked them to read the questionnaire which included 94 words that gave us some 125 tokens. We recorded in an acoustic studio on a Sony cassette recorder. We processed the recordings on a Digital Sona-Graph™ 7800. We only analyzed the first 4,000 cycles, since the elements we wished to study would all show up in this segment. We made contour sonagrams for facility in reading. The sonagrams were measured by a special ruler that provided frequencies. We only used the first two formants for our vowel timbre study. The results show no differences between the timbre of each individual vowel in the different positions (tonic/atonic).

As in the timbre study, 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 used the exact same data in this study as in the timbre study for purposes of control. The same tokens were measured, only this time for duration. This was done with a ruler calibrated in millimeters, measuring both consonants and vowels that belonged to the syllable in question. This approach was different from previous ones that measured individual sounds, which is difficult at best. This type of measurement 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.

After measuring the syllables physically, we factored this measurement against actual recording time. There are 5.12 seconds of recording time on a sonagram at 4,000 hertz recording. 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 derive a factor of 16.1542 ms/mm that we used in calculating the actual duration of each syllable.

The questionnaire gave a list of words that produced each vowel /a,e,i,o,u/ in four different positions: Initial, pretonic, tonic and post-tonic. The words were measured, the measurements then totalled and an average determined. These averages were compared for differences and then averaged among themselves to produce the following results:

AVERAGES OF SYLLABLE LENGTH
IN DIFFERENT PHONOLOGICAL POSITIONS

INITIAL	PRETONIC	TONIC	POST-TONIC
	a		
8.66 mm 139.87 ms	11.31 mm 182.67 ms	13.54 mm 218.69 ms	9.02 mm 145.69 ms
	e		

7.75 mm 125.17 ms	7.06 mm 114.03 ms	10.14 mm 163.78 ms	8.03 mm 129.70 ms
	i		
9.21 mm 148.75 ms	7.00 mm 113.06 ms	12.88 mm 208.03 ms	7.55 mm 121.94 ms
	o		
7.63 mm 123.24 ms	9.38 mm 151.50 ms	11.19 mm 180.73 ms	8.11 mm 130.99 ms
	u		
7.54 mm 121.78 ms	7.00 mm 113.06 ms	9.87 mm 159.41 ms	7.18 mm 115.97 ms

RESULTS OF THE STUDY

There were some elements that we could not corroborate. For example, we did not study final vowels due to the overall design of the study. Neither did we provide phonic groups nor sense groups. We saw some tendencies in the different speakers, but would hesitate to generalize to the entire dialect due to the limited number of informants even though the research required for six informants is extensive and adequate for our design.

The results of our study do show the following: 1) Tonic syllables are longer than atonic syllables by 3.36 mm and 54.31 ms or 29.18%. 2) The difference among all the atonic syllables only amounted to .372 mm and 6.01 ms indicating great consistency in atonic position. 3) We found a 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 (1975) reports a similar phenomenon for English vowels. 4) We found no definite correlation between open and closed syllables <u>per se</u>. There were cases of very short closed syllables and very long open syllables depending on other factors such as stress and voicing.

Further study will have to be made using minimal pairs that take these factors and others, such as word length into account. These will follow as well as free speech comparisons in a continuation of the broad study.

Is Spanish syllable-timed or stress-timed? Pointon feels that perhaps it's in between. It does not possess the difference in stressed versus unstressed syllable length that English does, nor does it appear to be stress-timed as does English. In fact, it is very close to French in its syllable production and French is considered to be syllable-timed. The only difference between the two lies in where the stress falls. Perhaps a more meaningful question could be asked. Is there such a thing as a syllable timed language? It would have to be one without stress in its system since stress generally gives additional duration to the stressed element. Perhaps a more proper consideration would be to evaluate the amount of additional duration that stress provides and then say, for example, that a syllable with more than a 50% increase, thus having a major impact, leads to calling the language "stress-timed" and less than this makes it syllable-timed. In this sense, Spanish is "syllable-timed".

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