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An experimental investigation on syllable geometry in Spanish (Expanded version)

(expanded version of the paper presented at the SyllabeS *conference, held in Nantes in March 1999)* ([+] Universidad de Vitoria-Gasteiz)

The behaviour of Spanish subjects in performing segment(s) substitutions and blend preference tasks on nonsense (phonotactically allowed) materials was investigated, in order to shed light on the internal organization of the syllable. Substitution tasks did not yield any clear indication, whereas the blend task provided evidence for the preference of the 'Onset+Rhyme' structure over 'Body+Coda'. Thus, the situation seems to be very similar to the one observed with Italian subjects, where only a weak tendency towards the right-branching structure emerged. By contrast, English presents a very strong orientation in this direction. In addition, English presents a strong word-onset facilitation, whereas Spanish (and Italian) show a very neat word-offset facilitation.[*]

1. *Inroduction*

It is generally assumed that syllables have an internal hierarchical structure, with terminal elements, and possibly intermediate ones. For Indo-european languages, the prevailing opinion dictates the structure in [1b] below, but this is just one among other possibilities. The three main options are those illustrated in [1]:[1]

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* The project of this research is due to PMB, who also wrote the final report; MA reanalysed the entire set of responses and performed the statistical computations; LC is responsible for the software implementation; EGP took care of the collection of the data. The materials were recorded, as a class assignment, by a group of doctoral students of the department of linguistics in Vitoria-Gasteiz university, who also provided the first analysis of the responses, under the supervision of MLGL; their collaboration is gratefully acknowledged.

1 The abbreviations used in the paper are the following:
Beg = initial position
Bo = Body
Co = Coda
Dis = disyllable
End = final position
Ext = external position
Int = Internal position
Mon = monosyllable
On = Onset
Rh = Rhyme
WOff = word-final position,
WOn = word-initial position.

[1](a) flat (b) left-branching (c) right-branching

σ σ σ

t| ¥ 2 2

On Nu Co Bo Co On Rh

2 2

On Nu Nu Co

The left-branching structure (Bo+Co) exhibited in [1b] is apparently at work in at least some Far-East languages, such as Japanese and Korean, according to the evidence put forth by Kubozono [1989; 1995] and Derwing et al. [1993]. On the other hand, there is substantial body of experimental evidence that English presents right-branching structure (On+Rh), as has repeatedly been proved by Treiman and Derwing, and co-workers (see for instance Treiman [1983], Derwing et al. [1988]; see also Bertinetto [1999] and the bibliography cited therein).

Speech errors corpora provide additional support concerning the right-branching structure of the English syllable. As observed among others by Stemberger [1983], there is crucial evidence that the onset and the rhyme tend to behave - well beyond chance level - as independent and coherent units in substitution or exchange errors, thus suggesting a hierarchical arrangement within the syllable. This finding has been generalized to Germanic languages by Berg [1991; 1998], presenting evidence that similar results obtain for German, Dutch and Swedish. Interestingly, however, Berg points out that there appear to exist substantial differences between the Germanic languages and Spanish, with respect to a number of parameters indirectly related to syllable structure. In particular, speech errors corpora suggest that:

(i) stressed syllables tend to attract significantly more errors than unstressed ones in the Germanic languages, but not in Spanish;

(ii) in purely phonemic (i.e. not word-level) errors,[2] word-onsets tends to attract significantly more errors than the rest of the word in the Germanic languages, but not in Spanish.

Although these parameters are only indirectly related to syllable structure, they have a bearing on our problem. In particular, the word-onset phenomenon referred to in point (ii) intersepts the syllable-hierarchy phenomenon, for in most of the English materials used in psycholinguistic experiments syllable-onsets coincided with word-onsets. Thus, results suggesting that onsets behave independently of rhymes may in fact have hit a false target, as Davis [1989] had it. Fortunately, further tests carried out by Fowler et al. [1993] proved that this is not the case. When the target onset is situated in the second syllable of a trisyllabic stimulus, it still shows a significant advantage with respect to the rhyme of the same syllable.[3]

As to point (i), it should be observed that Germanic languages show a strong tendency to stress the first syllable, and in addition present a larger number of monosyllables than Romance languages. Thus, in Germanic languages there seems to

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2 In word-level errors, on the other hand, all languages seem to behave in the same way. Apparently, when lexical access comes into play, WOn recovers its crucial role also in Spanish.

3 Pierrehumbert & Nair [199x] criticized these results. We are not in a position to assess the respective merits of these alternative positions. What seems sufficiently clear to us is that various groups of English subjects have repeatedly shown sytematically different results with respect to other groups of speakers performing the same types of task. Thus, from our contrastive point of view, it seems to be meaningful to assume Treiman et al.'s results as the standard for comparison.

be mutual enhancement by these two parameters: both the stress-position and the word-onset effects converge in concentrating speech errors at the beginning of the word, and these in turn interact with the structural tendency to separate onset and rhyme within the syllable. By contrast, Spanish presents alternative prosodic tendencies. It may thus be of some interest to see how these two parameters interact with the syllable geometry issue.

In fact, a series of experiments briefly summarized in Bertinetto [1999] have shown that Italian differs considerably from English. The main differences may be summarized as follows:

- instead of a word-onset effect, Italian exhibits a strong word-offset effect, i.e. a dramatic facilitation for substitution tasks involving the final as opposed to the initial part of the stimulus.
- The evidence for right-branching structure at the syllable level is much weaker in Italian than in English. Indeed, it is virtually absent in segment(s) substitution tasks, and emerges only with time-compressed blending tasks.[4]

Although there is some evidence for right-branching in Italian, this tendency is not overwhelming. In addition, the word-prosody effects (in a broad sense of this term) point to a very different situation, with the final part of the word playing a much more important role than the initial one.

The purpose of the research reported on in this paper is to verify whether a language like Spanish, typologically very close to Italian but sufficiently different in terms of prosodic structure, shows the same general tendencies as Italian. Note, in fact, that Spanish disyllables of the type CVC(C)VC - where the final C is not an inflectional ending - tend to be stressed on the second syllable, whereas in Italian the correspondong type CVC(C)V is mostly stressed on the first. With this in mind, a number of tasks were performed in an experimental setting that reproduced the main conditions of the Italian experiment. The mothodology of the experiment is described in section 2. Section 3 reports the results, while section 4 presents the general discussion.

2. *Method*

The experiment consisted of twelve substitution tasks and one blend preference task, as summarized in Table 1. The materials consisted of a series of nonsense words, carefully chosen in order to conform to the phonotactic constraints of Spanish (see the Appendix for the list of the stimuli). The choice of nonsense rather than meaningful materials was dictated by the need to avoid possible biases caused by the uncontrolled factor of lexical frequency, which is known to have a strong impact on speakers' performance.

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4 By substitution tasks we mean experimental tasks in which subjects are asked to substitute a previously indicated phoneme (or sequence of phonemes) in a selected position within the experimental stimulus. See section 2 for more details. As to blending tasks, they consist in the experimental merging of two stimuli into a single one. The latter type of task may be performed in different ways. In the experiments reported on in Bertinetto [1999] two techniques were exploited: blending learning and blend preference. In the first technique, subjects have to apply a previously learned blending strategy to two (visually or auditorily) presented stimuli. The strategy eliciting statistically superior results is considered to more closely reflect the underlying prosodic tendencies of the language under investigation (in the given case, On+Rh vs. Bo+Co strategy). In the blend preference technique, on the other hand, subjects are allowed to choose among two auditorily presented blending alternatives, following two visually presented stimuli. Here again, the statistically prevailing strategy provides relevant information on the underlying prosodic structure.

In the substitution tasks, subjects had to produce a verbal response in reaction to an acoustic input. The underlined segment (or sequence of segments) in the ‘scheme’ column of Table 1 indicates the element(s) that had to be replaced in each task. The appropriate interpretation in terms of syllable structure is indicated in the columns headed ‘On / Co’ and ‘Bo / Rh’. The remaining columns inform about target position and stimulus length.

The procedure was as follows. The phoneme (or sequence of phonemes) to be used for the substitution was shown in the middle of a screen positioned in front of the subject, just before the auditory presentation of each target stimulus. For instance, if in task 1 subjects saw the character <t> shortly before hearing *kin*, they were expected to utter *tin*. The dependent measure was the percentage of correct responses in the performance of each task; pairwise comparisons between the results of two tasks, or two sets of comparable tasks, yielded the measure of statistical significance. It should be noted that subjects had only 1.34 seconds to produce their response. This caution was adopted because, in the experiments reported on in Bertinetto [1999], it was observed that in order to obtain any significant effect with Italian subjects there ought to be a considerable time pressure, enhancing the possible contrast between ‘easy’ and ‘difficult’ tasks. Indeed, in the first three experiments performed with Italian subjects it was found that subjects were generally able to perform most of the tasks quite successfully, regardless of the syllable constituent involved (although with a very strong word-offset advantage).

The logic of substitution tasks is as follows. Subjects perform the various tasks with different degrees of success. When the success rate is high, this indicates that the targeted syllable component is easily accessible to the speaker. This provides evidence that the given component is in a dominant position in the internal structural hierarchy. By contrast, a high number of errors (i.e. incorrect or missing responses, the latter due to an excessively long processing time) indicates that the targeted syllable component is not easy to access, due to its embedded structural position.

The substitution tasks were designed in such a way as to control for a number of factors, as shown in Table 1. First, the respective advantage of onset and coda on the one side, and of body and rhyme on the other side, were compared. The possible prevalence of onset and rhyme over coda and body respectively are evidence of right-branching, whereas the alternative results are evidence of left-branching. In addition, we compared the respective advantage of the relevant syllable components in the initial vs. final position of the word (see the column 'Beg / End') and in external vs. internal positions (see the column 'Int / Ext'), as well as the respective advantage of the same components in monosyllabic vs. disyllabic stimuli (see the column 'Mon / Dis'). The latter three comparisons are possible sources of evidence with respect to word-level prosodic constraints. Note that not all tasks in Table 1 are marked for each parameter. This is obvious in the case of mutually exclusive components (e.g. On, Co, Bo, Rh), but might not be equally obvious in other instances. For instance, tasks 8,9,11,12 involve disyllabic stimuli, yet they are not marked for this parameter. The reason is that not all tasks are equally relevant for the given statistical comparison. For instance, when comparing the respective effects of monosyllabic and disyllabic stimuli on the various syllabic components, we selected only the tasks which enabled a fair comparison of the relevant syllabic components in comparable positions. Since by definition monosyllabic stimuli do not present such components in internal position, all tasks marked 'Int' (see the column 'Int / Ext') were excluded from the 'Mon / Dis' comparison. Similarly, all tasks marked 'Mon' were excluded from the 'Int / Ext' comparison, and all tasks marked 'Int' were excluded from the 'Beg / End' comparison.

Considering that the locus of the substitution differed from case to case, each task was introduced by a short series of training stimuli, different from the ones used in the test session. Thus, prior to each task, subjects were perfectly aware of the locus of the substitution. However, to prevent spurious effects due to the possible persistence of the previously learned strategy, half of the subjects accessed the tasks sequence in permuted order, namely: 2, 1, 4, 3, 6, 5 etc.

Here follows the description of a microcycle of the test procedure:

- alert signal
- 0.34 seconds silent pause
- visual presentation of the prime (which remained visible throughout each cycle)
- 0.34 seconds silent pause
- auditory presentation of the stimulus
- 1.34 seconds (starting from stimulus offset) allowed for vocal response
- (deletion of the visual prime and) alert signal …

The blend preference (task 13) was performed differently. By pressing the appropriate key, subjects had to choose one of the two visually suggested blending strategies relating to two auditorily presented words. For instance, if the two stimuli were *kin raf*, the two possible responses were *kif* (Bo+Co) or *kaf* (On+Rh). Needless to say, the order of presentation of the two types of output (as well as the order of presentation of the two initial stimuli) was balanced, in order to minimize experimental biases. Again, subjects had no more than 1.5 seconds to produce their choice by clicking on the appropriate screen area. After this interval, a warning signal alerted them for the next pair of stimuli. In this case, the statistical measure was obtained by comparing the respective number of responses yielded by the two types of blending strategy. Obviously, in the blend preference task there were no incorrect responses (apart from misses), for any of the two suggested responses was in principle acceptable.

The blend preference task was also preceded by a short training session. The experimental procedure was as follows:

- alert signal
- 0.5 seconds silent pause
- auditory presentation of the first stimulus
- 0.65 seconds silent pause
- auditory presentation of the second stimulus
- 2 seconds silent pause
- visual presentation of the two possible responses, contained in two big squares horizontally arranged on the screen; subjects were allowed 1.5 seconds to click with the mouse on one of the squares
- (deletion of the visual responses and) alert signal …

Subjects received initial instructions (both oral and written) by one of the experimenters, and were invited to make questions on anything that looked unclear to them. When they claimed to have fully understood the procedure, the actual experiment began. The sequence of the tasks was guided by interactive screen instructions, that proved to be fairly handy. The software was produced at Laboratorio di Linguistica of

Scuola Normale Superiore in Pisa. The data were collected in Laboratorio de Fonética of the University of Vitoria-Gasteiz.

The subjects were 20 local students, chosen among those having Spanish as their first (possibly only) language. They were divided in two groups, one accessing the normal, the other the permuted order of substitution tasks. The vocal responses produced during the first 12 tasks by each subject were recorded and later on submitted to perceptual inspection and transcription, initially carried out in Vitoria-Gasteiz and subsequently entirely redone in Pisa. The responses of task 13, on the other hand, were directly inputed to a computer file, immediately ready for the statistical analysis.

Table 1. *Structure of the experiment* (see fn.1 for the abbreviations used).

task ¬	*scheme* ¬	*On/Co*	*Bo/Rh*	*Mon/Dis*	*WOn/WOff*	*Int/Ext*
1	$\underline{\text{C}}\text{VC}$	On	-	Mon	WOn	-
2	$\text{CV}\underline{\text{C}}$	Co	-	Mon	WOff	-
3	$\underline{\text{C}}\text{VCVC}$	On	-	Dis	WOn	Ext
4	$\text{CVCV}\underline{\text{C}}$	Co	-	Dis	WOff	Ext
5	$\text{C}\underline{\text{VC}}$	-	Rh	Mon	WOff	-
6	$\underline{\text{CV}}\text{C}$	-	Bo	Mon	WOn	-
7	$\underline{\text{CV}}\text{CCVC}$	-	Bo	Dis	WOn	Ext
8	$\text{CVC}\underline{\text{CV}}\text{C}$	-	Bo	-	-	Int
9	$\text{C}\underline{\text{VC}}\text{CVC}$	-	Rh	-	-	Int
10	$\text{CVCC}\underline{\text{VC}}$	-	Rh	Dis	WOff	Ext
11	$\text{CVC}\underline{\text{C}}\text{VC}$	On	-	-	-	Int
12	$\text{CV}\underline{\text{C}}\text{CVC}$	Co	-	-	-	Int
13	*blend preference* ∅	*Input*: CVC + $\underline{\text{CVC}}$		*output*: $\text{C}\underline{\text{VC}}$ or $\text{CV}\underline{\text{C}}$		

Table 2. *Means and standard deviation of percentage correct responses.*
NB: numbers in the 'features' column refer to the tasks (as described in Table 1).

task	*means*	Rh (5, 9, 10)	69.44 (22.37)
1	70.00 (19.19)	WOn (1, 3, 6, 7)	74.89 (18.44)
2	89.16 (11.18)	= : Mon (1, 6)	77.49 (16.68)
3	79.16 (16.99)	= : Dis (3, 7)	72.29 (19.91)
4	77.49 (15.78)	WOff (2, 4, 5, 10)	80.62 (17.12)
5	85.00 (13.40)	= : Mon (2, 5)	87.08 (12.36)
6	84.99 (09.20)	= : Dis (4, 10)	74.16 (18.85)
7	65.41 (20.64)	Ext (3, 4, 7, 10)	73.22 (19.29)
8	53.33 (20.66)	= : On & Co (3, 4)	78.33 (16.21)
9	52.50 (18.94)	= : Bo & Rh (7, 10)	68.12 (20.92)
10	70.83 (21.37)	Int (8, 9, 11, 12)	52.18 (17.57)
11	49.58 (17.62)	= : On & Co (11, 12)	51.45 (15.54)
12	53.33 (13.35)	= : Bo & Rh (8, 9)	52.91 (19.57)
13' (CVC)	55.09 (32.10)	Mon (1, 2, 5, 6)	82.29 (15.36)
13" (CVC)	31.94 (32.74)	= : On & Co (1, 2)	79.58 (18.29)
features	*means*	= : Bo & Rh (5, 6)	85.00 (11.35)
On (1, 3, 11)	66.25 (21.61)	Dis (3, 4, 7, 10)	73.22 (19.29)
Co (2, 4, 12)	73.33 (20.10)	= : On & Co (3, 4)	78.33 (16.21)
Bo (6, 7, 8)	67.91 (21.79)	= : Bo & Rh (7, 10)	68.12 (20.92)

3. *Results*

Before performing the statistical computations, the behaviour of the individual subjects was inspected. The criterion for retention was that subjects did not exceed the mean error value by more than twice the standard deviation of the entire population. As it happens, no subject exceeded this criterion in the substitution tasks, while two subjects did so in the blend preference task. Consequently, the statistical computations concerning the latter task are based on only 18 subjects.

As to the comparison between normal vs. permuted order of substitution tasks, there was no significant difference. This allowed us to treat both sets of subjects as belonging to a homogeneous population.

Table 2 presents the percentage means and standard deviations of correct responses. The complement to 100 in each table refers to the percentage of errors, i.e. incorrect and missing responses (e.g. in task 1 errors were exactly 30%). The double-framed section of the table presents the data for the twelve substitution tasks and the two alternative responses of the blend preference task (task 13). In the latter case the figures relating to the two alternatives belong to the same total: i.e. in about 87% of the cases (55.09 +

31.94) our subjects provided a response, while in the remaining 13% they missed it.[5] The right handside of the table exhibits the relevant data with respect to the various features factorized in the experiment, referring to: 'syllable constituency' (On, Co, Bo, Rh), 'target position' within the stimulus (Beg / End, Int / Ext), 'stimulus length' (Mon / Dis). Note that the various feature selections may involve more than two contrasting tasks, according to the general structure of the experiment exhibited in Table 1.

Table 3 shows the results of the statistical comparisons between contrasting tasks (possibly sets of tasks grouped according to the parameters involved), or between the two conceivable responses of the blend preference task. In the latter case, the statistical test used was Pearson's χ^2, whereas in all other cases the analysis was based on Wilcoxon's test. The statistical results are presented with respect to a number of predictions, partly inspired by preceding research on English, namely:

(i) *syllable constituency*: a) On > Co b) Rh > Bo
(ii) *target position*: a) WOn > WOff b) Ext > Int
(iii) *stimulus length*: Mon > Dis

where > stands for: "(behaviourally) prevails over". Note that in the case of the blend preference task, hypotheses (i,a-b) are combined together, producing the following expectation: On+Rh > Bo+Co.

As may be seen, these predictions were born out only in part. Indeed, hypotheses (i,a-b) are not supported by the results of the substitution tasks (although, as noted below, they are supported by the blend preference task). In fact, prediction (i,a) is even contradicted by our data, in the sense that the statistically significant results obtained reverse - especially with monosyllabic stimuli, and partly also in the general comparison - the direction of the expected advantage. However, this apparently capricious outcome is substantially consistent with the Italian data reported in Bertinetto [1999], the difference being that with Italian subjects hypothesis (i,b) was strongly supported while hypotesis (i,a) was strongly rejected even more than with Spanish subjects. On the other hand, the blend preference task yielded a strong advantage for On+Rh geometry (i.e. right-branching), in full agreement with the Italian data elicited for a comparable type of materials in the same experimental condition (i.e. blend preference under time pressure).

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5 As mentioned before, there could not possibly be incorrect responses in task 13, for each of the two alternatives was in principle acceptable.

Table 3. *Statistical comparisons of correct responses.*

Wilcoxon's test for substitutions, χ^2 test for the blend task. NB: > stands for "(behaviorally) prevails over"; numbers refer to the tasks of Table 1. YES and NO stand respectively for 'conforming/non conforming' to prediction. Significance levels: ** = 0.01; * = 0.05; (*) = 0.06 - 0.08; ø = non-significant.

Predictions		*Results*
On > Co	overall (1, 3, 11 > 2, 4, 12)	(*) NO
	Mon (1 > 2)	** NO
	Dis, Ext (3 > 4)	ø
	Dis, Int (11 > 12)	ø
Rh > Bo	overall (5, 9, 10 > 6, 7, 8)	ø
	Mon (5 > 6)	ø
	Dis, Ext (10 > 7)	ø
	Dis, Int (9 > 8)	ø
WOn > WOff	overall (1, 3, 6, 7 > 2, 4, 5, 10)	* NO
	Mon (1, 6 > 2, 5)	* NO
	Dis (3, 7 > 4, 10)	ø
Ext > Int	overall (3, 4, 7, 10 > 8, 9, 11, 12)	** YES
	On & Co (3, 4 > 11, 12)	** YES
	Bo & Rh (7, 10 > 8, 9)	** YES
Mon > Dis	overall (1, 2, 5, 6 > 3, 4, 7, 10)	** YES
	On & Co (1, 2 > 3, 4)	ø
	Bo & Rh (5, 6 > 7, 10)	** YES
Blend preference	C<u>VC</u> > CV<u>C</u>	** YES

As to predictions concerning target position and stimulus length, (ii,a) is fundamentally rejected, (c) fundamentally confirmed and (ii,b) definitely confirmed (i.e. confirmed not only in the overall comparisons, but also in all comparisons among relevant subsets of the data). In fact, the comparison between word-onset and word-offset (Beg > End) turns out to be significantly rejected with monosyllabic stimuli but not with disyllabic ones. Similarly, in the comparison between stimuli of different length (Mon > Dis), only 'Bo & Rh' substitutions yielded a significant result, whereas 'On & Co' substitutions - those involving shorter syllabic constituents - fell short of producing a significant effect. Only prediction (ii,b) is significantly supported in all cases. Thus, the behaviour of the Spanish subjects tested seems to reflect a number of local perturbations, depending on specific feature configurations. This is in agreement with the behaviour of the Italian subjects described in Bertinetto [1999], who also turned out to be sensitive to word prosody factors. The main difference between the two languages is that the factor 'target position' yielded in all instances a very robust word-offset advantage with the Italian subjects.

Tables 4 and 5 provide the data for the missing responses in the substitution tasks, according to the same pattern established by Tables 2 and 3. Note, however, that in Table 5 the direction of the advantages indicated by the various predictions is reversed with respect to the corresponding cells in Table 3. This is consistent with the observation put forth in section 2, concerning the diverging directions of correct vs. incorrect and missing responses. Indeed, while easier

Table 4. *Means and standard deviation of percentage missing responses.*
NB: numbers in the 'features' column refer to the tasks listed in Table 1.

task	*means*	Beg (1, 3, 6, 7)	5.00 (11.06)
1	5.83 (12.99)	= : Mon (1, 6)	3.54 (9.78)
2	1.25 (3.05)	= : Dis (3, 7)	6.45 (12.15)
3	4.16 (8.76)	End (2, 4, 5, 10)	2.60 (11.52)
4	2.08 (4.58)	= : Mon (2, 5)	1.04 (2.79)
5	0.83 (2.56)	= : Dis (4, 10)	4.16 (16.01)
6	1.25 (4.07)	Ext (3, 4, 7, 10)	5.31 (14.17)
7	8.75 (14.67)	= : On & Co (3, 4)	3.12 (6.98)
8	8.33 (16.88)	= : Bo & Rh (7, 10)	7.50 (18.66)
9	7.91 (11.62)	Int (8, 9, 11, 12)	6.35 (11.80)
10	6.25 (22.27)	= : On & Co (11, 12)	4.58 (8.42)
11	5.83 (10.15)	= : Bo & Rh (8, 9)	8.12 (14.30)
12	3.33 (6.28)	Mon (1, 2, 5, 6)	2.29 (7.26)
features	*means*	= : On & Co (1, 2)	3.54 (9.60)
On (1, 3, 11)	5.27 (10.62)	= : Bo & Rh (5, 6)	1.04 (3.37)
Co (2, 4, 12)	2.22 (4.82)	Dis (3, 4, 7, 10)	5.31 (14.17)
Bo (6, 7, 8)	6.11 (13.36)	= : On & Co (3, 4)	3.12 (6.98)
Rh (5, 9, 10)	5.00 (14.65)	= : Bo & Rh (7, 10)	7.50 (18.66)

Table 5. *Statistical comparisons of missing responses.*
NB: see table 3 for the interpretation of the symbolization used.

Predictions		*Results*
Co > On (2, 4, 12 > 1, 3, 11)		** NO
	Mon (2 > 1)	** NO
	Dis, Ext (4 > 3)	ø
	Dis, Int (12 > 11)	ø
Bo > Rh (6, 7, 8 > 5, 9, 10)		ø
	Mon (6 > 5)	ø
	Dis, Ext (7 > 10)	ø
	Dis, Int (8 > 9)	ø
End > Beg (2, 4, 5, 10 > 1, 3, 6, 7)		** NO
	Mon (2, 5 > 1, 6)	** NO
	Dis (4, 10 > 3, 7)	ø
Int > Ext (8, 9, 11, 12 > 3, 4, 7, 10)		ø
	On & Co (11, 12 > 3, 4)	ø
	Bo & Rh (8, 9 > 7, 10)	ø
Dis > Mon (3, 4, 7, 10 > 1, 2, 5, 6)		** YES
	On & Co (3, 4 > 1, 2)	ø
	Bo & Rh (7, 10 > 5, 6)	** YES

tasks yield a higher number of correct responses, a comparatively high number of incorrect or missing responses is an indication of the difficulty met by the subjects in the given task. It should be noted that Table 4 and 5 only refer to misses, to the exclusion of incorrect responses proper, which occurred in non negligible percentages in tasks 1-12. The reason for this is that since incorrect responses made up the majority of errors, they are implicitly taken care of in Tables 2 and 3, where the complement to 100 in each cell provides precisely the percentage of errors. On the other hand, although the percentage of misses was highest in task 13 (where it reached the remarkable level of 13%, see above), precisely this datum is not reported in tables 4 and 5, because (given the structure of the blend preference test) it was obviously impossible to assign missing responses to either of the two alternatives (C<u>VC</u> or CV<u>C</u>).

Needless to say, although the number of misses was relatively high with our Spanish subjects, the statistical comparisons exhibited in Table 5 yielded a smaller amount of significant results as compared with correct responses, due to lower absolute figures. Nevertheless, the pattern emerging is coherent with the one shown in Table 3. This lends further credibility to the general pattern emerging from our test. The single most relevant difference is that concerning the comparison between external and internal position (Ext > Int), which produced no significant results.

4. *Conclusion*

Our data suggest that - as to the internal geometry of the syllable - Spanish is much more like Italian than like English. Although there is some hint that right-branching prevails over left-branching, the evidence is not overwhelming, in the sense that it emerged only in the (admittedly more sensitive) blend preference task, whereas substitution tasks yielded rather contradictory (and partly contrary) results. In addition, Spanish subjects, just like Italian ones, exhibited a robust word-offset effect. Leaving aside the latter point, for which we do not have at present any convincing explanation, let us briefly consider the first issue.

We do not want to suggest that the conflicting results of Spanish (and Italian) as opposed to English point to a different role of the syllable as a phonological unit. For that matter, we do not even claim that the syllable is a basic element in the phonological component. Presumably, syllable geometry arises at relatively shallow phonological levels, due to phonotactics and higher-order prosodic constraints [Vennemann 1994; Dziubalska-Kolaczuk 1995; Ohala & Kawasaki-Fukumori 1997]. The varying prominence of syllabic geometry in the different languages may thus simply reflect the processing requirements imposed by a relatively complex vs. simple phonotactics [Bertinetto, 1999]. In fact, due to their rather elementary syllabic structure, Spanish and Italian do not need to develop an elaborate processing strategy to help the speaker assemble the speech chain into chunks of segments conforming to the phonotactics of the language, ultimately sustaining the process of lexical recognition. By contrast, English - which exhibits a more complicated syllable structure - might be in need of establishing precisely this sort of mechanism, based on a fairly rigid internal hierarchy of syllabic constituents. Since this language allows rather complex sequences of segments, it is to be expected that a subtler scale of intersegmental cohesion arises; as a consequence, the reciprocal attractions between adjacent segments are more finely graded, giving rise to the observed behaviour in terms of separability of syllabic constituents.

The linguistic counterpart of this psycholinguistic datum is presumably to be sought in the relatively high vs. low number of syllable-driven phonological processes in the various languages. Obviously, much work needs to be done on both the theoretical and the psycholinguistic side of this issue in order to shed light on it. For a first attempt towards an interpretation of the overall picture emerging from the different psycholinguistic experiments concerning the internal organization of the syllable, and the syllable's role in speech processing, see now Bertinetto [to appear].

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Appendix

Task 1

L - men F - nar L - bon F - lir N - dul F - ral
N - tar R - dus M - tun R - pel M - fel R - tiz

Task 2

R - pel S - ril T - sir L - cus R - dis R - sot
N - zor Z - sen N - bor F - som S - per N - sar

Task 3

L - dumón S - bepil L - tarén R - betón N - lodás R - cisén
M - lepós N - vucol T - rufán F - lusar S - tifán G - maser

Task 4

L - teríz L - veróz L - poson N - misol S - polún Z - butol
N - codéz R - cosín N - tobús N - casel Z - mevir R - molíz

Task 5

UL - men IN - bor IL - bun OZ - ral AR - cus OS - bin
OR - gan US - car AR - tiz EZ - lir UN - zor AZ- mos

Task 6

LA - men NI - zor LI - bun NE - bor BE - tol MU - fel
BU - len MU - lir RI - pel FA - zol RO - tiz FU - ral

Task 7

TU- discar PO - rustil FI - ralpás NA - cistor FA - tistún TE - dulpón
SE - nolfur PA - tumber SU - pantor CU - pesmor CA - pesmor LO - fermús

Task 8

TE - firgón SA - penvil CU - bartíz FO - naltús SU - dentor FI - porbás
TI - palsor MO - feltir LU - cuspur MO - jusbán RI - falmún MA - pertós

Task 9

IL - benrás US - bompar OR - pustén ON - yurber AL - cuspur EL - nistán
ES - lambur AS - penvil AL - pesmir ER - salvín EL - dintor IS - rampor

Task 10

IN - certús AR - yunbés AL - misvor AN - jisbel IN - tombás ER - dastón
OR - casfén IR - zesmún UN - fanpés UR - mislón IS - dempón OR - distún

Task 11

C - mirtén L - monfur T - peslún P - vurcón L - pisvóz T - dansol
L - pistur C - posmur T - posmún F - mersún C - bestul P - jisdor

Task 12

S - colpar M - fasbéz N - cuspóz S - tontil N - masril S - tirbal
N - josbel L - vurcón L - rispán S - nurtal R - lospén R - neltúz

Blend preference

men+dul - mel/mul bon+tar - bor/bar nar+pel - nal/nel cus+tor - cur/cor
dis+bor - dir/dor res+gan - ren/ran tiz+sar - tir/tar zor+fel - zol/zel
rin+ses - ris/res men+sir - mer/mir tun+mos - tus/tos ral+tiz - raz/riz