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The hierarchical structure of the syllable in Italian. (Or: Does one really start from the beginning?)

(work in progress)

1. *Introduction.* *

1.1.*Theoretical and experimental issues.*

In the last few years, the syllable has attracted a great deal of attention, in both the theoretical and the experimental domain. The debate is still going on, so that no easy conclusion can be drawn at the moment. Indeed, besides those (still the majority) who believe the syllable to be a basic concept in phonological research, there is now a renewed (and growing) wave of skepticism. On the one hand, there are those holding that the syllable is no more than an epiphenomenon of more fundamental properties. This is the case, e.g., of Vennemann [1988b] and Clements [1990] on purely phonological grounds, and of Ohala [1992] on phonetic grounds. On the other hand, there are scholars who go beyond that, by claiming that the syllable may be dispensed with altogether as a basic unit, because its role in phonology is only apparent, and may be reduced to more basic principles of phonotactics and prosodic cohesion; this is, notably, the position recently taken by Dziubalska-Kolaczyk & Dressler [1995].

Nevertheless, despite the wide range of opinions, it is remarkable and encouraging that people may dispute on this matter with a fundamental understanding of the respective views. That is, although the various positions differ on important details, there is widespread consensus on the premises. For one thing, when confronted with a sample of speech, there is generally good agreement among speakers on the number of syllables it consists of.[1]

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1 Generally, but not unanimously. One should factor out from the mainstream the position developed within Government Phonology, which makes very strong assumptions. According to (at least some recent versions of) this model, a word such as strike would

At the present stage of our knowledge, it seems necessary to acquire as much experimental evidence as possible relating to the inner perception of the syllable possessed by the native speakers of various languages. This is precisely the enterprise initiated by R. Treiman and pursued by B. Derwing and co-workers (see below for references), and it is within this perspective that the present paper should be looked at. This is a preliminary report on three series of experimental tasks performed by Italian speakers, in which a particular version of the word-game technique has been employed.

Obviously, the kind of word-games used in this type of experimentation is highly artificial. The subjects are asked to perform very unusual tasks, such as: (a) switching syllables from one position in the (pseudo-)word to another; (b) adding, subtracting or substituting speech materials, corresponding to specific subcomponents of the syllable, as this is normally conceived of; (c) blending (pseudo-)words according to one's preferences, or according to a predefined mould; (d) inserting syllable breaks (in either written or spoken form) into (pseudo-)words; (e) monitoring segments or sequences of segments located in specific structural positions; and so forth. It is quite clear that these tasks bear but a vague resemblance with 'natural' (i.e. historically developed) language-games, developed by virtually any linguistic community with ludic or cryptic purposes. Although the latter games are equally artificial constructions, they have at least the merit of having been accepted by a community of speakers, and (supposedly) acclimatized into a particular prosodic system, so that they may yield relevant informations on the structure of the prosodic component of the host language.

On the contrary, when using the experimental techniques described above, which are often purposely devised in defiance of the inherent prosodic tendencies of the language under scrutiny, one should always be aware that the findings may not be easily interpretable. They may indeed be an artifact, for we do not know exactly which particular cognitive capacity has been solicited, and what relation may exist between this capacity and the ones active in the normal process of speech production and comprehension. Nevertheless, if we can gather contrasting results from speakers of different languages, this may at least be an indication that some crucial target has been hit, so that interesting speculations may arise concerning the phonological component. And this seems precisely to be the case in the experimental investigation of syllabic structures. In addition, it should be noted that the results so obtained are strictly behavioural, in as much as they exhibit the competence of the speakers in their actual behaviour, rather than through the elicitation of metalinguistic judgments.

This sort of experimentation was first applied to English, and subsequently extended to a growing number of other languages. As to English, the following conclusions appears to be pretty robust:[2]

i) the attraction between N and C is stronger than the attraction between N and O [Treiman et al. 1982; Treiman 1983], and this particular aspect of the phonological competence is refined in the course of time, up to the age of adolescence [Treiman 1985; Derwing et al. 1988]; in agreement with this, the R has been shown to be more easily detachable than the B [Fowler et al. 1993]; [3]

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underlyingly consist of no less than four syllables. Clearly, this position stands out as fairly extreme.

2 We shall make use of the following abbreviations:
C = coda, **N** = nucleus, **O** = onset, **B** = body (i.e., O+N), **R** = ryme (i.e., N+C).

3 Also relevant here is the finding by Derwing et al. [1992] and Beinert & Derwing [1993] based on 'sound similarity judgements', according to which the R component gives a statistically significant contribution, alongside with other factors, among which phonemic identity plays the major role.

ii) cohesiveness is stronger within a multisegmental O than within a multisegmental C [Treiman 1983; 1986], and again this tendency strengthens in the course of the time [Derwing et al. 1988];

iii) the consonants following the N show variable degrees of attraction towards the latter, according to the following hierarchy (obviously reminiscent of the notorious 'consonantal strength' hierarchy): glides, liquids, nasals, obstruents; indeed, the cohesion between the N and a following glide is so strong, that the latter appears to behave as a sort of feature attached to the preceding vowel, rather than as an independent segment [Treiman 1984; Derwing et al. 1988];

iv) a mirror-image of this hierarchy is to be observed w.r.t. the relationship between the prenuclear consonant and the N [Derwing et al. 1988]; however, among the prenuclear consonants themselves there does not seem to be substantial differences, for their cohesiveness is altogether very strong [Treiman 1986];

v) intervocalic consonants show varying degrees of propensity towards ambisyllabicity (relative also to stress position and the quantity of the preceding vowel), again conforming to the aforementioned hierarchy [Treiman & Danis 1988];

vi) the syllabification of intervocalic consonantal clusters depends on the following factors (stronger factors come first in the list): internal geometry of the syllable, intersegmental cohesiveness, maximum O principle, stress position, vowel quantity [Treiman & Zukovski 1990]; a marginal role is played by other factors, such as morphological boundaries and phonotactic redundancy [Treiman 1986];

vii) among the distributional restrictions to be observed in English w.r.t. the segment sequences actually admissible within the syllable, the only ones which are psychologically relevant for the speaker are those depending on structural reasons (i.e., with the exclusion of the so-called 'occasional gaps') [Treiman 1988].

1.2. *The current (experimental) knowledge on the internal geometry of the syllable.*

One major finding of the experimental research conducted on the English syllable (as suggested by points (i-ii) above) is that its structure is right-branching. That is, of the three possibilities depicted below, the one appropriate to represent the internal hierarchy of the English syllable seems to be [1c]:

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

      O     N     C            B     C                      O     R

                            O     N                            N     C
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This might come as no surprise. However, the remaining options are perfectly plausible on theoretical grounds, and may find support in several phonological processes to be observed in natural languages [Vennemann 1988a]. Indeed, as we are soon going to show, languages may differ w.r.t. this parameter. But before seeing this, let us consider some evidence concerning English as a right-branching language at the syllabic level (more evidence is cited e.g. by Brady et al. [in press]).

Treiman [1983], in a substitution task, has shown that when English subjects are taught alternative strategies, they perform significantly better when manipulating the R instead of the C alone (experiment 3), or the O alone instead of the B (experiment 4). Treiman et al. [1982], in two phoneme monitoring tasks, have shown that the initial consonant is detected significantly faster when embedded in CV or CVC sequences, than when embedded in a CCV sequence. Treiman [1985], besides replicating the preceding result with children between ages 4.6 and 6.5 (which involved the exploitation of an appropriate technique, based on the use of puppets with funny names), has shown that children between ages 7 and 9.4 are very sensitive to syllabic structure. The task performed demonstrates that the substitution of the first two segments is significantly easier in CCV than in CVC sequences, while the substitution of the last two segments is significantly easier in CVC than in CCV sequences. The identical task, performed by adults [Treiman 1986, exp. 7], has shown an even sharper distribution of the responses.

Additional support for the right-branching model comes from Fowler [1987], who asked her subjects to exchange either the initial or the final consonant in two simultaneously presented CVC nonsense words. Performance was faster and more accurate for exchanges of initial consonants (i.e., for the O) than for exchanges of final consonants (i.e., for the C).

Finally, Berg [1989; 1991] observes, among other things, that English speech error corpora show that O errors are far more common than C errors, and even more so after normalization of the data (i.e., after taking into account the different frequencies of these positions). He remarks that O errors dominance has also been reported for German, Dutch and Swedish.

In sum, there seems to be abundant evidence that English has a right-branching syllable structure, and that this type of internal hierarchy is probably present in other languages as well. However, there is also evidence that some languages behave differently. In a preliminary investigation, Derwing et al. [1991] claimed that Taiwanese subjects exhibit no predominant pattern in a blending task based on nonsense monosyllables: i.e., O_1+R_2 and B_1+C_2 responses were equally frequent (the integers refer to the first and the second word). This encouraged the speculation, hastily adopted in Bertinetto [1992], that monosyllabic languages may possibly possess a flat syllabic structure as shown in [1a] above, having no need to develop an elaborated segmentation strategy. But further research by Wang & Derwing [1993] has shown that the above mentioned result might have been an experimental artifact: a more careful experimental design produced overwhelming O_1+R_2 responses, although the results still present some puzzling aspect.

Although we still lack indisputable experimental proves that languages may have a flat syllabic structure, as claimed on purely theoretical bases by Clements & Keiser [1983], there is however some clear evidence that languages may have a left-branching syllable. This seems to be the case in Japanese and Korean. As to the former language, Kubozono [1989] presents two types of evidence. First, contrary to English, in Japanese speech errors it is not the case that R errors prevail over B errors. Second, word blends (both in word-formation and in spontaneous errors) tend to present a switching-point of the type B_1+C_2, rather than O_1+R_2 as is in English (again, in both errors and word-formation; as an example of the latter, cf. *smog* from *smoke* and *fog*). [4] As to Korean, Derwing et al. [1993] have shown in two word-blending experiments that the type B_1+C_2 significantly prevails over the type O_1+R_2.

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4 Interestingly, one proposal for adapting the loanword smog to Italian is fubbia (from fumo and nebbia), where we have a B1+C2 structure. However, since we do not have enough data concerning similar formations (which seem to be fairly rare in Italian), we do not venture to suggest that this is a structural tendency of the language. Incidentally, fubbia did not enjoy any popularity, and remains an idiosyncratic proposal.
It is worth pointing out that Kubozono presents abundant evidence to the effect that the mora, over and above the syllable, is the real kernel of the prosodic system of Japanese. The importance of the mora, as the most prominent prosodic unit, stems also from Otake et al. [1993].

Although, to our knowledge, Korean is the only language for which it has so far been experimentally proven that the syllable may have a left-branching structure, the mere existence of this remarkable example compels us to verify how the situation is like in other languages. Notice that English, a typical right-branching language, is typologically very different w.r.t. Korean at most levels, including the prosodic level, which is the one with which we are concerned here. It is therefore interesting to see what happens in Italian, which (being syllable-timed as opposed to stress-timed) again differs typologically from English. In the experimental section of this paper we shall present data obtained with Italian subjects.[5]

But before exposing the results of the experimental investigation, we would like to address another theoretical issue.

1.3. *The marginality factor.*

In the preceding section, we discussed evidence to the effect that the internal geometry of the syllable may be differently organized in different languages. But another issue has emerged in the recent literature, as a result of a remark put forth by Davis [1989]. A convinced supporter of the flat structure model of the syllable, Davis has contended that several experimental

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5 The internal geometry of the syllable is not the only point on which the experimental research has gathered contrasting results. A relevant factor is the 'consonantal strength' hierarchy exhibiting the different degrees of cohesiveness among segments, with special regard to the attraction exerted by the N on surrounding segments. In this respect, Agonigi et al. [1992] showed that in Italian, as opposed to English, prenuclear glides are much more vowel-sticky (to employ Derwing et al.'s [1988] term) than postnuclear ones. Bertinetto et al. [1995], on the other hand, provided evidence that the consonantal hierarchy valid for Italian (again in contrast to English) does not differentiate between liquids and nasals. Unsurprisingly, these contrasting pieces of data seem perfectly in agreement with the phonology of the two languages mentioned. There is also some evidence that in Korean the class of liquids (concretely represented by the dental flap) patterns like obstruents rather than like sonorants [Derwing et al. 1993], and this too makes sense, if one considers that a flap is something different from a usual liquid. Finally, we have experimental data showing that 'stop + liquid' clusters are heterosyllabic in Finnish, contrary to the prevailing tendency, but definitely tautosyllabic in German [Berg et al. 1993], Italian [Bertinetto et al. 1995] and English [Treiman et al. 1992]; while /s + C/ clusters have been shown to be heterosyllabic in medial position in English [Treiman et al. 1992], but essentially tautosyllabic in Italian [Bertinetto et al., 1995].

Although this research is still in the preliminary stage, there is ground to believe that in the long run it might provide useful information as to the actual forces which regulate the internal cohesion of segment sequences. The equipe guided by B. Derwing has begun collecting data on a number of languages, including Arabic [Derwing et al. 1992; Beinert & Derwing 1993], Swiss German [Wiebe & Derwing 1992] and Blakfoot [Derwing 1992]. The special interest of this experimental enterprise lies in the fact that the information gathered comes from behavioural evidence, rather than from purely distributional facts. Thus, it is less likely to be subject to the circularity flaws which vitiate any traditional attempt at defining the 'consonantal strength' hierarchy on phonological grounds. Besides, in addition to providing a hierarchy, the experimenter may have, at least in some privileged cases, the opportunity to measure somehow the different degrees of cohesiveness exhibited by the various segments: a result totally unavailable to the traditional approaches.

results gathered by Treiman and Derwing (and co-workers) are misguiding, in as much as they wrongly suggest a predominance of the O+R structure, which might simply be the consequence of other structural tendencies. In particular, Davis observes that much of the argument on which the right-branching model of the English syllable is based stems from the fact that the O consonant is also the word-initial consonant. Now, we know from English speech errors corpora that word-initial consonants are more liable than any other consonant to undergo disruption. Thus, the fact that subjects perform better when manipulating word-initial consonants rather than non-initial ones (possibly final, when the test word is monosyllabic) does not constitute a solid proof w.r.t. the issue of syllable geometry. This result may simply be due to the contribution of ‘marginality' factors (in the sense of: close to the margins of the word), which apparently play a substantial role in speech performance.

Although immediately counterattacked by Fudge [1989] on theoretical grounds, Davis' objection needs to be taken seriously, and demands an appropriate experimental scrutiny. Indeed, the challenge has been taken by Fowler et al. [1993; cf. also Treiman et al. in press]. These authors have shown that, for English at least, the hypothesis put forth by Davis is indeed relevant. Specifically, when subjects were asked to perform various O, C, B or R substitutions in one of two visually presented disyllables of the type $C_1VC_2C_3VC_4$, they were consistently faster and more accurate when performing the task on the first than on the second syllable (cf. experiments 3). However, with trisyllables of the type $C_1VC_2VC_3C_4VC_5$, a substitution task concerning C_2, C_3, C_2V or VC_3 showed a clear advantage of O over C, and of R over B (experiment 4). The same result was replicated with oral presentation of the stimuli, without time pressure (experiment 5). Thus, it appears that when marginality factors are minimized, as in the middle portion of a polysyllable, the internal hierarchy of the syllable turns out to be a very effective predictor of subjects' behaviour.

Despite the experimental disconfirmation provided by Fowler et al. [1993], the problem raised by Davis deserves to be considered also w.r.t. Italian. Since we know that in the prosodic domain under scrutiny there may be interlinguistic differences, we cannot take for granted that the solution valid for English speakers should be directly extended to other subjects.

Summing up the discussion so far, the two major issues that we are going to address in the remainder of this paper are:

(a) the internal geometry of the syllable in Italian;

(b) the possible impact of marginality factors in the experimental tasks conceived for the study of syllabic structures.

2. *Experiments I and II.*

2.1. *Starting assumptions.*

In our work, we started from the parsimonious assumption that Italian speakers would conform to the same behaviour exhibited by English subjects. This seems *prima facie* a reasonable assumption, since the only examples so far attested of languages with left-branching structure come from the Far East (Korean and Japanese), i.e. from language families quite remote from Indo-European. We also hypothesized that marginality factors could have an effect, at least in mono- and disyllables.

Thus, in our segment(s) substitution tasks, we assumed that:

a) O should be easier to replace than C;
b) R should be easier to replace than B;
c) initial segments should be easier to replace than non-initial ones;
d) final segments should be easier to replace than medial ones.

Assumptions (a-b) may be condensed in the following formula:

$$O = R > C = B$$

where = stands for “behaves like”, and > stands for “has a structural advantage over”. As to assumption (d), this was not directly put forth by Davis [1989], but it looks like a reasonable one, if marginality is really what is at stake here.

2.2. *Materials and method.*

The materials consisted of a series of nonsense mono- and disyllables, carefully chosen in order to conform to the phonotactic restrictions valid for Italian. The choice of nonsense materials is dictated by the following two reasons. First, we wanted to avoid possible biases caused by the uncontrolled factor of lexical frequency, which is known to have a heavy impact on the behaviour of subjects in experimental tests. Second, it may be assumed that the presentation of a nonsense word forces the subject to activate the most sensitive parsing strategies. In other words, if we are allowed to assume that there is a global phonological representation for frequent words (at least according to some theoretical views), this is certainly not the case with nonsense words. Since the speaker is not supposed to have met them before, he has to scan them in a more rifined manner than is normally the case with real words.[6]

As to phonotactic constraints, Italian restricts the C position, with very few exceptions, to sonorants, i.e. to /l r m n/.[7] Thus, given a monosyllabic stimulus like *nar*, <l> was a possible consonant for substitution in C position. Actually, in this particular case, <l> was the only possibility, because of two additional precautions that we adopted. First, /n/ and /m/ were never simultaneously involved in any given stimulus, to avoid possible misperceptions by the speakers while performing the task, or by the experimenters while interpreting the data. Second, we never had a single consonant doubly involved in a stimulus: i.e., we excluded stimuli such as *nar* with <r> as a substitution consonant for O, or <n> as a substitution consonant for C. This precaution was adopted in order to avoid possible interferences of the unattended consonant on the articulation planning: something which may prove disrupting in the case of disyllables.

However, when dealing with disyllables, we relaxed somehow the restriction relating to the type of consonants, in the sense that we allowed non-sonorant C consonants to appear in the unattended syllable. This solution, besides being a necessary consequence of the second precaution reported above, was also adopted in order to avoid excessive boredom and unnaturality in the construction of our stimuli. Thus, in the task concerning the replacement of the O of the first syllable, a possible stimulus was *maros* (with <l> as a possible substitution

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6 It is reassuring, in any case, to observe that according to Treiman [1986] there is no statistical difference between real and nonsense words in this type of experimentation. So, whatever is the cognitive operation that is activated in this type of tasks, it does not seem to differ for linguistic and non-linguistic materials.

7 A systematic exception is obviously offered by geminates, whose first part acts as the C of the preceding syllable. However, geminates put severe constraints, for not all of them would produce a legal sequence in the course of the experimental manipulation. In addition, one should at least consider postnuclear glides. However, since diphthongs pose additional problems, as shown in previous researches [Bertinetto 1987; Agonigi et al. 1992], we decided to exclude glides from the present experiment. Finally, one could also consider /s + C/ clusters, which are frequently encountered in medial position in the Italian lexicon. However, the experimental evidence collected suggests that in Italian they definitely tend to behave tautosyllabically [Bertinetto 1987; Bertinetto 1992; Bertinetto et al. 1995].

consonant); while in the task concerning the replacement of the B of the first syllable, a possible stimulus was *narsi* (with <le> as a possible substitution sequence).

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insert table I approximately here

As to the specific tasks performed by the subjects in experiments I and II, see table I. In order to understand the content of this table, though, a clarification is in order. As it happens, we ran two separate experiments, i.e. two series of experimental tasks, with two altogether different sets of subjects. This was due to the need to replicate the findings of the first session. However, when we did the replication, we introduced some modifications in the experimental design, both in order to increase the coverage of the data collection, and in order to mend some inefficiency of the previous design. As a result of this, we had 14 tasks in experiment II, as opposed to 10 in experiment I. In addition, the last two tasks of experiment II involved a different technique, based on the blending of two orally presented monosyllables.

Experiments I and II were run in the following way.

First, we recorded (by means of a Sony DAT apparatus) and digitized (by means of the SoundEdit package, available to Apple computers) the test items. Whenever a given task was repeated in experiment II, the test items were exactly the same, and in the same order of presentation. However, the person who actually read the stimuli was a different one in the two experiments. This was done in order to control for possible biases due to the pronounciation of the first speaker. In both cases, the speaker was a woman: both came from the town of Pisa, and spoke a fairly standard variety Italian.

The test was administered through a Mac II computer. The subjects, who were run individually, were briefly instructed at the beginning of the session by means of written as well as oral instructions. Obviously, the word “syllable" was never mentioned in the instructions. So, for instance, in task 8, consisting in the substitution of the B of the second syllable, the instruction given was: “Perform the substitution in the middle of the word, as shown in the following examples". Thus, the attention of the subjects was never attracted to the metalinguistic dimension. In any case, the subjects were students in domains other than linguistics, i.e. not likely to be biased by personal theoretical expectations.

The subjects were instructed to guide the experimental procedure by themselves. They were sitted in front of the screen, and clicked the mouse to proceed from one stage of the experiment to the next. They began with a screen announcing the first task, which was briefly described. For task 1, for instance, the instruction was: “Perform the substitution in the first part of the word as shown in the following examples. Press «return» to initiate the practice series". By hitting the return key, the series of the practice items began. Each item was shortly preceded by the visual presentation of the substitution segment(s), and followed, after a silence of about 2 sec., by the appropriate response, pronounced by the same voice. At the end of the practice series, a new screen asked whether the subject wanted to repeat the practice session. This opportunity was exploited by a number of people (notably with tasks 13 and 14). If the subject chose not to repeat the practice session, s/he could pass on to the test session by clicking on the appropriate area of the screen. In this case, of course, the subject heard only the test item, and had altogether 3 seconds to provide the response, before a warning announced that s/he had to prepare for the next item. The responses provided by the subjects were recorded on a Sony DAT apparatus, so that later on they could be analysed for correctness. At the end of each test series, a screen announced the next task, and the whole procedure was restarted.

As said before, tasks 13 and 14 differed from the others, being based on the technique of blending, rather than substitution. In this case, the instruction was to mix the beginning of the first word and the end of the second, as in the examples provided in the practice session.

During this session, subjects heard the two monosyllables to be blended, followed by the appropriate response pronounced by the same voice. In the test session, subjects had to provide their own response. As table I shows, task 13 was supposed to yield B+C blends, whereas task 14 was intended to yield O+R blends. It is worth noting that in tasks 13 and 14 the input was purely intramodal (auditory), as opposed to the remaining tasks which presented a cross-modal paradigm (auditory and visual), as described above. Note that Fowler et al. [1993] hypothesize that the results obtained in their experiment 3 with disyllables (where marginality factors predominated over structural ones) may have been enhanced by the visual presentation of the stimuli in a speeded task, which may create "strong early-to-late gradients in segment shifting times". However, in our experiments we adopted a cross-modal presentation: the segment, or segments, to be used in the substitution task were presented visually, while the stimulus on which the substitution had to be applied was presented orally. So, our procedure should circumvent this problem. [8]

Each of the 14 tasks consisted of 12 test items, preceded by 5 practice ones. In order to avoid possible biases due to order of presentation, we introduced two further precautions. First, in both experiments the sequence of the tasks was permuted, by reversing the order of even and odd numbers. Thus, half of the subjects performed the tasks in the obvious numerical order, while the other half performed the tasks in the following order: 2, 1, 4, 3, 6, 5, 8, 7 … and so on. In other words, one half of the subjects met the O task (n.1) first and the C task (n.2) afterwards, while the other half had the reverse order; and so forth. Second, within each permutation group, half of the subjects heard the stimuli in a given within-task order, whereas the other half heard them in the reverse order. Since the total number of subjects was 20 in each experiment, this gives four groups of 5 subjects each in both experiments.

2.3. *Predictions and results.*

Before considering the results, let us remind the possible theoretical expectations, based on the assumption that Italian behaves like English. These are listed in table II, where the symbol > means that the task on the left should have an advantage over the task on the right. So, for instance, 1 > 2 means that task 1 is expected to be performed better, i.e. more accurately, than task 2. The set of predictions listed in table II displays in a detailed way, relative to the actual tasks administered, the expectations condensed in § 2.1 above. In addition, the prediction is made that monosyllables should be easier to manipulate than disyllables, since the materials to process are shorter in the former case.

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insert table II and III approximately here

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[8] On the other hand, our cross-modal approach might in turn have created other undesired effects. To anticipate part of the results to be presented in § 2.3, it should be noted here that instead of a word-onset effect we found a strong word-offset effect: i.e., the position which enhanced the number of correct responses turned out to be the final, rather than the initial one. As A. Lahiri has pointed out to us, it is possible that the visual part of our procedure has produced some kind of inhibition on the auditory access to the lexicon, thus yielding this unexpected outcome.
We cannot at the moment discard this possibility. Nevertheless, some sort of inhibition should have been present also for the English subjects, since (whatever the presentation procedure) they also had to attend to a specific segment, or sequence of segments, to be used in the experimental manipulation of the materials. However, English subjects exhibit a strong word-onset effect, in contrast with our Italian subjects.

The results, in terms of percentages of correct responses, are shown in table III. The statistical computations are shown on the right handside of table II (see below for explanation). Note first that there is no error count in these experiments, because all responses which did not conform to the task taught in the practice session were *ipso facto* considered errors. Thus, the number of errors can be computed straightforwardly from the number of correct responses. [9] Note further that in both experiments the responses of the various subgroups of subjects are collapsed together. Indeed, an ANOVA performed with the factors 'permutation' and 'order', relating to the order of presentation of the various tasks and of the stimuli within each task, gave a largely non significant statistical outcome. Finally, note that in addition to the percentages of correct responses obtained for the individual tasks in the two experiments, table III exhibits the cumulative percentages relating to the italicized items in table II. Let us give an example. On top of table II, we read "Onset > Coda", followed by the italicized label "monosyllables & disyllables"; correspondingly, in table III we find a numerical value for O and another one for C, referring to tasks 1+3 and 2+4 respectively, as indicated in table II.

As the right hand-side of table II shows, the results were not quite as expected. "YES" and "NO" indicate whether or not the prediction was born out. Besides, when these labels are written in small characters, this means that the actual difference between the task(s) indicated was rather small, whatever its direction. Statistically significant differences (at the 0.05 level of significance), assessed by means of pairwise t-tests, are marked by an asterisk. When the asterisk is contained within parentheses, the expected level has only been approached, rather than actually attained. In the discussion that follows, we shall constantly refer to table II. It is reassuring to observe that there is a fair degree of consistency between the two experiments. With the exception of tasks 3 and 9, and partly 8, the two groups of subjects gave quite comparable responses (cf. table III), although the first group provided sharper contrasts, as revealed by the larger number of statistically significant results in table II.

Let us separately consider the two issues of marginality and syllable geometry.

As it happens, the predictions about marginality were completely reversed. It is true that external positions (initial and final) fare definitely better than internal ones, but the surprising fact is due to the extraordinary advantage of the word-final position over the word-initial one. This indeed runs against the hypothesis put forth by Davis [1989], and demands for a proper interpretation. We shall turn to this in the following section.

As to the issue of syllable geometry, the hierarchy which seems to emerge from our data is the following: C = R > B = O. This conclusion is based not only on the percentages exhibited in table III, but also on the direct pairwise comparisons reported in table II. Contrary to our predictions, there is no hint of a right-branching structure in the Italian syllable. Indeed, although the O+R division is clearly supported in some cases (cf. the advantage of R over B), the alternative B+C division is also supported (cf. the advantage of C over O). This result may

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9 However, deciding what counts as a correct response was not a straightforward task. In our data collection we decided to be liberal in a few cases: typically, when subjects pronounced /n/ after hearing a word containing /m/, or viceversa. This was done because, although the quality of the speech materials was quite high, one must allow for some degrading of the signal due to digitization. For the same reason, we were tolerant when the subjects pronounced cognate sounds in the unattended part of the disyllable: e.g., when they said kamir instead of tamir in a task in which the first syllable was not involved (however, a response such as samir was definitely considered to be an error, just as tamil, in which a segment of the attended syllable is mispronounced).

be regarded as quite surprising. Note, however, that the two groups of subjects are altogether fairly consistent, so that this result may not be dismissed as purely accidental.

A notable fact emerging from our data is that the length of the stimulus clearly affects the results. Indeed, there was altogether a clear advantage of monosyllables over disyllables. But the remarkable detail is that, in both O vs. B and R vs. C comparisons, monosyllables and disyllables yield contrasting results. This effect is not to be confused with the marginality factor discussed below, because the comparison was done in this case between structurally equivalent elements (i.e., for the sake of this comparison, not all R were pooled together, but only those which occupied a word-final position, to the exclusion of word-internal R). Thus, the factor of word length, although predicted to have an influence, brought in a major, and quite surprising, distortion of the data. Let us clarify this point with an example. A priori, one might wish to say that if subjects can perform well on R, then they will equally be likely to perform well on O; and the same is true about B and C. In fact, our prediction w.r.t. this was obviously: O = R > B = C, as indicated in 2.1. However, this was not the case: apparently, with disyllables subjects performed better in tasks in which they were asked to manipulate single segments (O or C) rather than sequences of segments (B or R), while the opposite occurred with monosyllables. It is hard to reconcile this datum, which seems merely connected with performance constraints, with theoretical reasons.

2.4. *Discussion.*

Let us now attempt at providing an interpretation of the data. We shall separately consider the marginality and geometry issues.

As to the marginality factor, the obvious solution that *prima facie* comes to mind is that we have to do with a recency effect. This might possibly arise from the auditory presentation of the stimuli, adopted in our test. Note, however, that most of the experiments run by Treiman's and Derwing's équipes were based on auditory presentation. Thus, the fact that we found a sharp advantage of the word-final position in Italian cannot be easily dismissed in that way. Apparently, this has to do with some higher level prosodic characteristics of the language, which is not encountered in English. One suggestion for the understanding of this phenomenon comes from Berg [1991], who compares the findings in English, German and Spanish speech errors corpora. He observes that English corpora provide “unequivocal indication that the word onset position is more often affected in malfunctions than any other position in the word or syllable" [p.268]; and the same is true of Dutch, Swedish and German, with the exception that in the latter language the morpheme-initial position is also very relevant. In contrast to this, Spanish corpora exhibit a radically alternative outcome: “Phonological speech errors show no inclination towards involving word onsets more frequently than other positions. Even more remarkably, word-initial consonants are significantly less often affected than would be expected by chance" [p.286]. Indeed, in Spanish the favoured location for slips-of-the-tongue is the syllable-initial position (also favoured in English), rather than the word-initial one.[10]

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10 A matter of clarification is in order here. The word onset advantage is valid only for segmental slips-of-the-tongue, not for whole-word errors, which “resemble their targets more strongly in the initial position, less strongly in the final position and least strongly medially" [Berg 1991, p.269]. This is important, because malapropisms are the result of an access difficulty, while segmental slips manifest lower level malfunctions, probably at the level of performance of the articulatory plan, as indeed is the case in segmental exchanges involving two different words. Obviously, w.r.t. whole-word errors, Spanish behaves exactly like English or any other language so far investigated [id., p.292].

Interestingly, Berg also observes that in Spanish, unlike English and German, stress does not show any inclination to attract errors. Even taking into account the different probabilities of stressed vs. unstressed syllables in Spanish words, it becomes evident that slips in stressed syllables are just as likely as in unstressed ones. Now, it is a well-known fact that both English and German are essentially initial-stress languages; thus, at least for these languages one may argue that the enhanced number of slips in word-initial position is the result of the overall prosodic pattern. By the same logic, we would like to hypothesize that the word-offset advantage resulting from our data may be due to the fact that Italian, like Spanish, is not an initial-stress language, so that the focus of attention may supposedly be shifted towards the end of the word, rather than the beginning.

While we offer this as a tentative explanation of our finding, we are obviously aware of its shortcomings. First, we have at the moment no information concerning the effect of the initial vs. middle vs. final location on speech errors in Italian. Second, a comparable experiment should be run with Spanish subjects, in order to ascertain whether the two phenomena considered here (word-offset advantage and irrelevance of stress for speech errors) are really connected. Finally, it should be noted that, as Berg himself observes, there may be some conceptual flaw in an argument which simultaneously denies to stress the power of attracting speech errors and attributes to it the power of distracting them from word-onsets. Perhaps, one logical way out to this paradox would consist in saying that in languages where stress has no bearing on the distribution of errors the situation should be as in Italian and (presumably) Spanish, i.e. with word-offset advantage, while in languages like English, where stress does have an effect on error location, this in turn should yield an advantage for the position in the word which is statistically more likely to be stressed. Clearly, more theoretical and experimental work is in order (cf. again fn. 8).

As to the issue of syllable geometry, the results of experiments I and II are by and large against our predictions. Clearly, according to these data there does not seem to be any hint at a right-branching structure in Italian. We have to aknowledge that this outcome was so surprising to us, that we decided to run experiment II precisely in order to have a reliable replication, with different subjects and a different speaker for the test items. As it happens, although the overall level of statistical significance is somewhat weaker in experiment II, the general trend is generally the same. Thus, we cannot easily dismiss these results as an artifact: it is quite possible that they reflect some structural property of the language under investigation. However, before taking this for granted, further tests are in order. With this aim, we performed experiment III.

3. *Experiment III.*

3.1. *Starting assumptions.*

Experiments I and II provided quite surprising results w.r.t. the marginality and geometry issues. Although both results are difficult to interpret, the second one seems to present the hardest challenge. One possibility is of course that Italian has no internal hierarchy at the level of the syllable. This is probably the most parsimonious hypothesis at this stage of our research. But we believe that the question should be further analysed, for experiments I and II presented some conflicting results in this respect. Indeed, although most results contradicted our predictions as to syllable geometry, some went in the expected direction. One such example is the outcome stemming from the blending tasks (13 and 14). However, there is one detail that is worth considering in this connection. Remember that in our experiments we manipulated in C position only the sonorants /l r n m/, i.e. the only consonants which may appear in that position in the native Italian lexicon. This group of sonorants behaves exactly in the same way in Italian, as opposed to English, as demonstrated in previous experimental researches (cf. fn. 5). Note, however, that the O position was often occupied by non-sonorants. Thus, we often had in O and C consonants exhibiting a different degree of strength, which also means (as stated in § 1.1) a different degree of attraction towards the N. One question that is suggested by this is: What would happen if the consonantal strength were the same. This is interesting also from a general point of view, for it is possible that in previous experiments, addressing the issue of syllable geometry in other languages, the neglect of this factor has brought about some artifactual results. Namely, it is possible that the intimations of internal hierarchy found in English, Taiwanese and Korean (cf. § 1.2 for references) are due, in part at least, to the fact that the consonantal inventory considered in the test is not the same for Os and Cs. Indeed, Wang & Derwing [1993] themselves hint at this possible disturbing factor in the analysis of their data on Taiwanese. We cannot thus exclude that, by using the same set of consonants in both O and C, the evidence for a hierarchical structure would weaken considerably, or even vanish. In this event, one should have to conclude that the internal hierarchy is but an epiphenomenon of the intersegmental cohesion factor, which certainly plays a crucial role in phonotactics. This would imply that the geometry of the syllable is essentially flat, as suggested by scholars such as Clements & Keyser [1983] and Davis [1985], with the hierarchical arrangement ultimately arising as the result of phonotactic restrictions on the occurrence of consonants in pre- vs. postnuclear position. And this, in turn, would give credit to the ideas of Dziubalska-Kolaczyk & Dressler [1995, as well as Ohala [1992], suggesting that the syllable is a mere reflex of segments' binds, ultimately rooted in articulatory and perceptual constraints.

In order to verify whether this factor had a bearing in our case, we decided to replicate tasks 13 and 14 with the same set of stimuli and two additional ones. Tasks 13 bis and 14 bis have sonorant consonants in both O and C, in order to equalize the consonantal strength; tasks 13 ter and 14 ter, by contrast, have sonorants in C but only stops in O, in order to maximize the difference in consonantal strength. The new blending tasks may thus be labeled in the following way: 'mixed' (13 and 14), 'equal' (13 bis and 14 bis), and 'different' (13 ter and 14 ter). The predictions that we formulated w.r.t. these tasks, as expressed in Table V, were made ignoring the outcome of experiments I and II, i.e. assuming once more that Italian should have a rigth-branching structure, by analogy with English. This might appear surprising, at this point, but we feel it preferable to be consistent troughout the paper in the presentation of our data. W.r.t. the issue of consonantal strength, we further assumed that condition 'different' would yield more correct responses than 'equal', with 'mixed' somewhat in between, due to the (alleged) easier detachability of stops than sonorants in O position.

In addition, we also wanted to complete the series of our tests with disyllables, by including a few tasks that we did not consider in the previous experiments. In particular, we wanted to contrast O and C in internal position (cf. tasks 15 and 16 vs. 17 in Table IV). The reason for having both task 15 and task 16 is that an internal C is necessarily part of a consonantal cluster, while an internal O may be the only intervocalic consonant. We call 'bound O' an O consonant that is part of a cluster (as in task 16), as opposed to a 'free O' (as in task 15). Again, our predictions are stated in Table V. We predicted that an O, of whatever type, would be easier to manipulate than a C, while a 'free O' would yield more correct responses than a 'bound O'.

Finally, following the example of Fowler et al. [1993], we wanted to extend the analysis to trisyllabic stimuli. These authors were able to show that the marginality factor can be effectively neutralized in the internal position of polysyllables. Although our first experiments did not prove the existence of a right-branching syllable structure in Italian, there is still the possibility that the impact of the marginality factors operating in Italian could have superseded the (supposedly present) geometry factor. Four tasks (18-21) were designed in such a way that a factorial analysis could be performed, with 'syllable components' (R vs. B) and stress position (second vs. third syllable) as factors. The prediction here was again that R would be easier to manipulate than B, while the stress on second syllable would increase the number of correct responses, being closer to the portion of the word containing the target of the experimental manipulation.[11] Moreover, in analogy with the case of disyllables just discussed, we added a control for ‘free’ vs. ‘bound’ B (tasks 20 vs. 22), which in turn allowed a comparison between R and B in tasks 21 vs. 22 (with identical stress position), 19 vs. 22 (different stress position), and 23 vs. 22 (where R and B belong in both cases to the same cluster, i.e. the one separating the first two syllables of the word). Once more, Table V exhibits our very conservative predictions.

3.2. *Materials and method.*
The materials employed in experiment III are reported in the appendix. They were built according to the same principles explained in § 2.2.

The experimental method was the same as before. The only difference lies in the method for collecting the results. This time we decided to have two separate counts: one dichotomic contrast of correct responses vs. errors, and one further count which distinguished between absolutely correct responses and ‘other’, i.e. responses which approximated the correct target but contained minor mistakes. For some examples of these, cf. fn. 8. Correspondingly, Tables V and VI present two columns of results, one for ‘Correct only’ and one for ‘Correct + Other’. The first one is computed according to the same criteria adopted with experiments I and II.

3.3. *Predictions and results.*
As can be seen from Table VI, there are some divergences between the columns ‘Correct only’ and ‘Correct + Other’. These are particularly striking in the case of tasks 15 and 20. However, on the whole the comparison between the two counts is reassuring; and indeed, Table V exhibits altogether a fair correspondence between the two methods of count.

The latter table shows that, once again, our predictions, made according to a very conservative hypothesis, turned out to be largely incorrect. The section of the experiment concerning blends yielded definitely negative results, although none reached significance. It is quite clear that, if anything, the direction is contrary to the one predicted w.r.t. the geometry issue (right-branching vs. left-branching). As to the consonantal strength issue, it is interesting to observe that the discrepancy in the number of correct responses between a right-branching and a left-branching recomposition of the two monosyllables was enhanced in the case of the ‘different’ condition, i.e. when the different degree of consonantal strength in O and C position was maximized. Thus, as we anticipated, it seems to be the case that this factor has a bearing on the results. We believe that further research on this topic should take this fact into consideration.

The section concerning disyllables provided conflicting results, partly due to the divergence between the two methods of counts to be observed in task 15. In particular, the comparison between tasks 15 and 17 cannot be interpreted. While we do not have an explanation for the unusual amount of ‘other’ responses in this task, it is nevertheless interesting to note that, at least when the figures relative to ‘Correct + Other’ are taken into consideration, there is a fundamental agreement in the outcome of the two comparisons between ‘free’ and ‘bound’ (15 vs. 16, 20 vs. 22). Thus, there is some indication that this feature has an effect on the results.

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11 It should be noted that the stimuli with stress on the first syllable could not be employed, because very few Italian words may have a closed unstressed penult; thus, no internal R could undergo analysis in such a case.

The section concerning trisyllables comprised a subsection designed for factorial analysis of the factors syllabic structure and stress position, each with two values. The main result here was a statistical significant interaction between these two factor for the ‘Correct only’ count. It turns out that the number of correct responses increases for B manipulation when stress is on the second syllable, and for R manipulation when stress is on the third syllable. A possible explanation is that the stressed vowel exerts a backward attraction on the preceding Cs. If this is the right interpretation, we would have to admit that there is a level at which a stretch of speech is devided into chunks corresponding to open syllables, later to be syllabified according to subtler criteria. Whatever is the right interpretation, it is a fact that in the ‘Correct + Other’ count no significant interaction emerges.

The further comparisons performed in the trisyllables section yielded by and large the expected results, and so did the comparison between di- and trisyllables. The latter result confirms the trend already emerging from experiments I and II, according to which shorter words are easier to manipulate than longer words. This is of course a performance factor, rather than a structural one, but it is worth pointing it out. This shows, among other things, that the general pattern stemming from our data cannot be dismissed as purely fortuitous. Although the results are from many points of view sorprising, there is a logic behind them. The challenge for us is to find an explanation.

3.4. *Discussion.*

Experiment III addressed the following issues: (a) the internal geometry of the syllable in Italian; (b) the role of stress; (c) the role of the different degree of consonantal strength; (d) the comparison between ‘free’ and ‘bound’ constituents. Together with experiments I and II it also allowed us: (e) to compare the behaviour of di- and trisyllables.

Some of these points received a straightforward answer, others present a serious challenge. Among the former, we list above all point (e), but also, to some extent, points (c) and (d). As to the three last points, suffice what we said in § 3.3. Here we would only like to discuss the first two, with special regard to point (a).

W.r.t. the role of stress, the results of experiment III confirm one fact that already emerged from a previous research [Bertinetto et al. 1995]. Although this element clearly has an effect on the behaviour of the subjects performing syllabic manipulations, the interpretation of this effect is quite problematic. Rather than as a structural factor, it seems to act as a performance factor, whose consequences are not easily predictable. Further research is needed to clarify this issue.

We come now to the geometry issue. Two results are especially relevant in this connection. First, we have to note that in the blending tasks of experiment III, all conditions (different, mixed, equal) pointed to a negative response. This is particularly striking in the case of tasks 13 and 14, which provided a positive (albeit non-significant) response in experiment II. Since the stimuli were the same, we have to conclude that the evidence for an internal structure of the syllable in Italian is fairly elusive, and may vary according to unpredictable factors. It is possible, in our case, that the different experimental setting, namely the different series of tasks composing each experiment, has a bearing in this contrasting set of data.

The second type of results that is relevant for us is the R vs. B comparison comprised in the factorial analysis of trisyllabic stimuli. In this case, the response is positive. However, as we anticipated, this tendency interacts heavily with the stress factor, so that altogether it appears to be rather weak.

Together, these two pieces of evidence lead us to conclude that the results of experiment III do not solve the problem of the internal geometry of the syllable in Italian. As it happens, the direction emerging from the responses of our subjects seems to vary from task to task. To this we return in the following section.

4. *General discussion.*

Minor issues aside, this paper addressed above all two problems: the geometry and the marginality factors. For a discussion of the latter, we refer the reader to § 2.4. Here we would like to add a few remarks on the former.

Although at this point we do not wish to discard the idea that Italian presents a hierarchical structure at syllabic level, we would like to observe that there are nevertheless several hints pointing towards the flat structure solution. Consider e.g. tasks 13 vs. 14, where marginality factors could not play any role, since in both types of blends the four major subconstituents of the syllable (O, B, R, C) were at the edges of the word. While our experiments II and III yielded conflicting results, in other languages, such as Taiwanese (an O+R language) and Korean (a B+C language; cf. § 1.2 for reference), an analogous blending paradigm provided clear evidence of a hierarchical structure. However, as noted above, some caveat are in order relative to the latter languages, until these are analysed with the same precautions that we adopted in experiment III w.r.t. the type of O and C consonants.

Whatever the case, we believe that the data collected in our research legitimate also a radically alternative solution of the geometry issue. The hypothesis we venture to propose is that the syllable in Italian has a 'variable geometry' structure. By this we mean that, depending on the effect of various forces acting upon this prosodic component, the syllable may adopt one or another structural profile. In order to make sense of this, let us reconsider the equal advantage of C and R, as attested e.g. in table II. This is in itself ambiguous. It may actually suggest that the syllable structure is definitely flat, and that different subcomponents may in turn be detached according to the forces acting upon them (cf. the different effect of the word-final position in mono- and disyllables). Alternatively, it may suggest that the structure of the syllable is hierarchical, but may assume different structural profiles depending on the forces that model it.

One possibility, admittedly very abstract, would be to conceive of a situation such as the following, where the intermediate levels B and R would be intermittently activated, depending on the situation:

[2] σ

(B) (R)

O N C

However, in our data there is no hint that the B ever plays a role. **beh, coi trisillabi con accento sulla seconda sillaba sì!** Accordingly, a better picture for the structure of the Italian syllable could be as in [3a], suggesting that the syllable geometry may alternatively assume one of the two profiles depicted in § 1.2 as [1a] and [1c], and repeated here as [3b-c]:

[3] (a) σ (b) σ (c) σ

O (R) O N C O R

N C N C

In other words, the geometry of the Italian syllable might be flat or right-branching, depending on the pressures acting upon it. Obviously, this solution might appear somewhat deviant w.r.t. the graph structures normally assumed to play a role in linguistics. However, it is not inconceivable from the theoretical point of view, and should ultimately be seen of as a simple kind of lattice structure. Whatever the plausibility of this proposal, note that our data seem to provide some support to it. Indeed, both R and C emerge as privileged subcomponents of the Italian syllable. If the R never emerged, it would be reasonable to assume that there is no internal hierarchy, so that the C advantage would merely derive from external factors (presumably, the word-offset advantage). But since R emerges as a favoured unit in some of our tasks, we are deemed to assume that it plays a role, although admittedly not in all cases. If this variable geometry model proved to be a valid one, Italian would provide the best example yet of Vennemann's [1988a] view of the syllable, conceived of as a dynamic structure rather than a static template, as is the case in most theories. Indeed, diachronic linguistics shows abundant evidence that languages may restructure their syllable model in the course of time, suggesting that alternative arrangements are always (latently) available.

The final problem to consider is: why should Italian have such a weak hierarchical arrangement (or indeed no internal hierarchy at all, according to the flat model hypothesis that we do not dare to reject)? The answer that we would like to offer is that Italian is a language with a rather elementary syllabic structure, so that it does not need to develop an elaborated processing strategy, which would help the speaker to assemble the speech chain into chunks of segments conforming to the phonotactics of the language, and ultimately guiding her/him in the process of lexical recognition. In contrast, a language like English, which exhibits a much more complicated syllabic structure, might be in need of establishing precisely this sort of mechanism, based on a rigid internal hierarchy. According to this view, the internal hierarchy of the English syllable would be a consequence of the more complicated phonotactics of the language. In other words, since English, as opposed to Italian, allows fairly complex sequences of segments, it is quite natural that these should develop a subtler scale of intersegmental cohesion, with the result that the reciprocal attractions would be more finely graded, giving rise to the observed behaviour in terms of detachability of syllabic constituents. We believe that this solution may ultimately be reconciled with the theoretical views of such scholars as K. Dziubalska-Kolaczyk, W.U. Dressler and J.J. Ohala. There is however an important caveat to consider. If this hypothesis is correct, why should languages like Korean and Taiwanese, with a very simple syllabic structure, present a hierarchical arrangement, while Italian apparently does not? Does it mean that languages with a simple syllabic structure correlate only with left-branching or with flat arrangement, while languages with a complex syllabic structure require right-branching geometry?

We intend to pursue our research in order to shed more light on these issues. One possibility that we are presently entertaining is to replicate some of our tasks using a speeded time technique. It is arguable, in fact, that the relative ease of most of our tasks, which produced in general a rather small amount of errors, has yielded a sort of floor effect, sweeping away the structural differences that may exist between the relevant subcomponents of the syllable. If it turns out that these differences re-emerge as soon as the subjects are put under pressure, we shall then have to conclude that the hierarchical organization of the syllable in Italian, although weaker than in other languages, is nevertheless present.

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Appendix

Materials used in the three experiments.