THE INTERACTION OF PHONOLOGICAL AND MORPHOLOGICAL KNOWLEDGE IN CHILDREN'S INTUITIVE SYLLABIFICATIONS*

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This paper addresses the question whether a morphological boundary affects the position of a syllable boundary in young children's intuitive syllabifications of words. Bisyllabic words where a single intervocalic consonant is at the same time the final phoneme of the word stem are the ideal domain for studying the interaction of phonological and morphological knowledge. We presented the same set of materials to three age groups: five-year old Kindergarten children, eight-year old third graders and ten-year old fifth graders. In a comparison of monomorphemic words and phonologically matched plurals there was no sign of a morphological effect in any of the three age groups. An effect was obtained for diminutives (in all age groups), but this seems to have been due to phonological rather than morphological factors. The present study does not support the hypothesis that a morphological boundary affects intuitive syllabifications.

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1. Introduction

It is well-known that syllables play an important role in the production and perception of speech (Elbers, 1982; Oller, 1986; Bertoncini & Mehler, 1979). Research on phonological awareness has shown that children are able to segment speech in syllables at a very young age. One interesting aspect of these syllabifications is the position of the syllable boundaries in the phoneme sequence. These boundary positions can be used to achieve insight into the nature of the child's phonological knowledge, more particularly the syllabification principles it applies. In order to discover these principles and their age of acquisition, one can present simple syllabification tasks to children of different age groups. Thus Gillis & De Schutter (1996) studied to what extent five-year olds and eight-year olds observe universal and language-specific (i.e. Dutch) syllabification principles that are proposed in phonological theory.

In such studies one should take account of the possibility that non-phonological knowledge sources also determine the position of syllable boundaries. One such candidate - orthographic knowledge - was investigated by Gillis & Sandra (in press) and indeed appears to affect subjects' syllabification patterns. Literate subjects make many ambisyllabic syllabifications when the vowel preceding a single intervocalic consonant is short (e.g., /*apəl*/), apparently because the utch spelling (doubling of the consonant grapheme in this phonological context, <*appel*>) suggests that the phoneme is shared by the two syllables. In the present paper we will study the role of morphology: does the presence of a morphological boundary affects subjects' perception of syllable boundaries in a word?

In order to study the relative importance of phonological and morphological knowledge we selected words in which different segmentations were predicted by phonological principles and by the morphological structure of the word. The way in which subjects resolve this conflict will shed light on the principles that guide them in intuitive syllabification tasks. In Dutch, the language under study, the above-mentioned conflict between phonological and morphological structure can be found in bisyllabic, bimorphemic words with a single intervocalic consonant which is at the same time the final phoneme of the first morpheme in the word. An example in case is the word /*stre:pən*/ - <*strepen*> (stripes), which would be segmented as *stre:-pən* by syllabification principles but as *stre:p-ən* (stem+suffix) if the morphological structure of the word is respected. The syllabification *stre:-pən* is predicted by a number of universal principles on syllable structure, which predict that the intervocalic consonant will combine with the following vowel (*stre:-pən*) rather than with the preceding one (*stre:p-ən*) or with both (ambisyllabicity; *stre:p-pən*). First, syllables ending in a vowel are the universally preferred syllable type (i.e., *stre:-* is a better first syllable than *stre:p-*). Second, the Obligatory Onset Principle (Hooper, 1972) stipulates that the onset of a syllable, i.e. the position preceding the vowel, should be filled with a consonant when a consonant precedes the vowel in the phonological sequence and the combination is phonotactically legal (i.e., *-pən* is a better second syllable than *-ən*). Third, the Sonority Principle (Clements, 1990) states that the sonority of a syllable decreases minimally from the vowel to the end of the syllable but increases maximally from the onset of the syllable to the vowel (i.e., *stre:-pən* is a better syllabification than *stre:p-ən* or *stre:p-pən* because a plosive is situated at the lower extreme of the sonority scale). Finally, according to the Law of Syllable Contact (Murray & Venneman, 1983; Venneman, 1988) the sonority contrast between the coda of a syllable and the onset of the following syllable must be as large as possible (i.e., *stre:-pən* is to be preferred to *stre:p-pən*).

As the example word /*stre:pən*/ has made clear, the syllabification principles that have been formulated in phonological theory will treat bimorphemic words in exactly the same way as monomorphemic ones. In other words, syllabification principles are blind to morphological boundaries in words. However, it is an empirical question whether language users too separate these two separate linguistic levels in a rigourous way.

When investigating the effect of a morphological boundary in the phonological context of a single intervocalic consonant, two phonological variables may be expected to interact with the hypothesised effect: the length of the preceding vowel and the nature of the intervocalic consonant.

In Dutch a long vowel can occur in syllable-final position whereas a short vowel cannot. This distributional fact is captured in the so-called Bimoraic Principle (Trommelen, 1983; Van der Hulst, 1985). For words where a short vowel is followed by a single intervocalic consonant (e.g., /ap∂l/) the syllabification pattern predicted by this language-specific principle (*ap-∂l*) conflicts with the pattern predicted by the above-mentioned universal principles (*a-p∂l*). A way to resolve the conflict is to make the consonant ambisyllabic (*ap-p∂l*). Gillis and De Schutter (1996) demonstrated that five-year old and eight-year old children make significantly more ambisyllabic responses in the context of a short vowel than in the context of a long one, indicating that they had acquired the Bimoraic Principle. The same line of reasoning would apply to bisyllabic words that are also bimorphemic; a word as */map∂n/-<mappen>* (maps) would be syllabified as *map-p∂n*. In the present context this means that the interplay of language-universal and language-specific syllabification principles already predicts a syllabification pattern in which the first morpheme is represented. This, however, is not the case for words with a long vowel (e.g., */stre:p∂n/*), which would be syllabified immediately after that vowel (*stre:-p∂n*) such that the first morpheme (*/stre:p/*) would be disrupted. In other words, if morphological boundaries affect the syllabification pattern of words, it seems the effect would be restricted to long vowels or be more pronounced for these vowels. Of course, one cannot discard the possibility that a morphological effect can manifest itself only within the constraints of phonological principles. In such a case, the effect would translate itself as an increase in the number of ambisyllabic responses in the context of short vowels (thus reinforcing the tendency already present for monomorphemic words) rather than the emergence of such responses in the context of long vowels.

The nature of the intervocalic consonant is another phonological factor that could interact with an effect of the morpheme boundary. Gillis and De Schutter (1996) and Gillis and Sandra (in press) demonstrated that more ambisyllabic responses were found with fricatives in intervocalic position (e.g., *buf-f∂l - <buffel>,* [buffalo]) than with plosives (*ap-p∂l - <appel>,* [apple]). This effect seems to be restricted to subjects who have not learnt to spell yet (Gillis & Sandra, in press). Dutch spelling conventions (i.e., doubling of a consonant grapheme when a single intervocalic consonant follows a short vowel: <buffel>, <appel>) seem to suggest ambisyllabic responses for both consonant types in an intuitive syllabification task. Again, if the purported morphological effect overrides the effect of phonological principles, it will be stronger with plosives than with fricatives, i.e. the difference between the number of ambisyllabic responses for polymorphemic and the number of monomorphemic words will be larger for plosives than for fricatives. However, if phonological principles have priority over morphological ones, the reverse pattern is predicted.

As knowledge of phonological principles and knowledge of morphological structure are developmental factors, we decided to study three age groups: five-year olds (last year of Kindergarten), eight-year olds (third year elementary school) and ten-year olds (fifth year elementary school).

2. Experiment 1

2.1. Method

Materials and Design

The comparison between monomorphemic and bimorphemic words was the most important manipulation in the experiment. For each word type we selected 18 words (see Table 1).

Phonological context	Monomorphemic	Polymorphemic
VV + plosive	le:p∂l <lepel>	stre:p∂n <strepen>
	pro:p∂r <proper>	sto:p∂n <stopen>
	køt∂l <keutel>	tøt∂n <teuten>
	bo:t∂r <boter>	po:t∂n <poten>
	ta:k∂l <takel>	ka:k∂n <kaken>
	pe:k∂l <pekel>	be:k∂n <beken>
V + plosive	ap∂l <appel>	map∂n <mappen>
	kop∂l <koppel>	pop∂n <poppen>
	let∂r <letter>	pet∂n <petten>
	ot∂r <otter>	grot∂n <grotten>
	smIk∂l <smikkel>	bIk∂n <biccen>
	mak∂r <makker>	tak∂n <takken>
V+ fricative	buf∂l <buffel>	juf∂n <juffen>
	kof∂r <koffer>	stof∂n <stoffen>
	wis∂l <wissel>	vIs∂n <vissen>
	mos∂l <mossel>	bos∂n <bossen>
	kax∂l <kachel>	lax∂n <lachen>
	box∂l <bochel>	kux∂n <kuchen>

Table 1. Phonological and orthographic representations of the items used in the monomorphemic and polymorphemic conditions in Experiment 1.

All bimorphemic words were regular Dutch plurals, i.e. formed by adding the plural suffix *-en* to the stem. The plurals were matched to monomorphemic items (i.e., singulars) on a number of phonological variables. The phonological context was the same in all items of both word types: a single intervocalic consonant was preceded by either a short or a long vowel and followed by a schwa ([V]VC∂ as in */ap∂l/* and */map∂n/*). The schwa was followed by a single, word-final consonant: a liduid (*l* or *r*) for the category of monomorphemic words (the singulars) and an *n* for the category of bimorphemic words (the plurals). Since we wanted to make sure that morphological complexity was the only variable distinguishing the singular and plural categories, we matched the singular and plural items pairwisely on phonological context: same first stressed vowel, same intervocalic consonant and same final vowel (schwa). This matching could not be achieved for the first vowel in only one case (out of 18): box∂l-kux∂n.

Within each word type the phonological variables “vowel length” (long-short) and “consonant type” (plosive-fricative) were manipulated. Since earlier research (Gillis & De Schutter, 1996) had shown that the effect of consonant type was restricted to a short vowel environment - ambisyllabicity being virtually absent in the context of a long vowel - consonant type was not manipulated in the context of long vowels. This yielded three phonological context conditions: VV+plosive, V+plosive, and V+fricative. For each word type we selected six items per phonological condition.

A third word type was added to the set of critical items in the experiment: diminutives. Whereas plurals belong to the domain of inflectional morphology, diminutives are situated within the field of lexical morphology. The diminutives were derived from the same stem morpheme as the plurals (e.g., /map∂n/ - <mappen> versus /mapj∂/ - <mapje>, /be:k∂n/ - <beken> versus /be:kj∂/ - <beekje>). As a result, the comparison between the two sets of bimorphemic words could not be disturbed by lexical differences. Note, however, that the two word sets did differ in their phonological environment: whereas all plurals had a single intervocalic consonant, the diminutives had two such consonants. Considering the phonological nature of the task, this might turn out to be an important factor.

In order to avoid repetition effects, each subject saw the same stem morpheme only once, either as the first morpheme in a plural or as the stem of a diminutive. Two lists were constructed. When a word appeared in its plural form in list A, it appeared as a diminutive in list B and vice versa. In each list, half of the words in each phonological context condition (n=3) appeared in their plural form, the other half in their diminutive form. Thus, each list consisted of nine plurals and nine diminutives. Nine items of the monomorphemic words described above were added to yield a total of 27 critical items. These were combined with 26 filler items. Three filler items in each list were diminutives, the remainder were bisyllabic monomorphemic words with word stress on their final syllable and more than one intervocalic consonant (e.g. */balkon/- <balkon>,* balcony). Both lists were given to the same number of subjects.

Each list was randomized and the words were recorded on an audiotape by a professional speaker. They were then digitalized and entered into a programme for auditory presentation on a Macintosh Powerbook 5300 cs.

Procedure

The experimenter told the children in the classroom that they were going to perform a language task in a separate room of the school. It was stressed that they could make no errors in this task and had to react on the basis of their intuition. Each child received the instruction individually, when it presented itself for the experiment. The purpose was to repeat each word very slowly, "in pieces". The experimenter gave an example by syllabifying her own name. Then the child was invited to syllabify its own first name and then do the same with the name "Samson" (a well-known character, a dog, from a popular Flemish children's programme).

The children were tested individually in a silent room of the school. Each trial was built up of the following events: the word was presented auditorily, the subject syllabified the word, the experimenter noted the type of syllabification on a scoring form. When the child's syllabification was unclear, the experimenter asked the child to repeat the word very slowly again. Then the next trial was initiated. All responses were tape-recorded.

Subjects

Fourty children from the oldest group in Kindergarten took part in the experiment (mean age: 5 years 11 months). They were recruited from the schools *Reuzepas* in Sint-Niklaas and *Sint-Jozef Bloemendaal* in Schoten. They were native speakers of Dutch and had not received any spelling instruction yet.

2.2. Results

As the two experimental lists were presented to the same number of subjects and the plural and diminutive forms of the same stem never belonged to the same list, the results were calculated across the lists. Thus we obtained the same number of data points for each word type.

For each combination of word type and phonological condition we determined the frequencies of each syllabification pattern. Since the proportion of postconsonantal segmentations was very low (2.9 %) this pattern was removed from further analysis (in the case of diminutives this was the pattern where the syllable boundary immediately followed the consonant cluster). For monomorphemic words and plurals we will distinguish between an ambisyllabic and a non-ambisyllabic (i.e. preconsonantal) pattern. For diminutives we will distinguish between an interconsonantal and a non-interconsonantal (i.e. preconsonantal) pattern. The chi-square test will be used to assess the statistical significance of each comparison.

	monomorphemic		plural		diminutive	
	(V)V-CV	(V)VC-CV	(V)V-CV	(V)VC-CV	(V)V-CV	(V)VC-CV
VV+plosive	113 (94.2)	4 (3.3)	117 (97.5)	0 (0.0)	93 (77.5)	27 (22.5)
V+plosive	114 (95.0)	4 (3.3)	113 (94.2)	2 (1.7)	74 (61.7)	46 (38.3)
V+fricative	85 (70.8)	31 (25.8)	70 (58.3)	43 (35.8)	35 (29.2)	78 (65.0)

Table 2. Frequencies (percentages in brackets) of the two dominant syllabification patterns for each combination of word type and phonological context condition (the [V]VC-CV pattern refers to ambisyllabic responses in the case of monomorphemic and plural items and to interconsonantal segmentations in the case of diminutives). A total of 31 responses (2.9 %) did not fall in either syllabification category and were removed from the analyses.

Table 2 lists the frequencies of occurrence of the various syllabification patterns for each combination of word type and phonological condition. As the contrast between monomorphemic words and plurals was the most important comparison in the experiment, we tested whether the distribution of responses over the ambisyllabic and non-ambisyllabic patterns was the same for both word types in each of the three phonological conditions. In the short vowel conditions, the outcome of the statistical test was non-significant, both for plosives ($X^2 < 1$, $p > .10$) and for fricatives ($X^2 = 3.36$, $p > .05$). The effect was significant in the context of a long vowel followed by a plosive ($X^2 = 4.07$, $p = .04$). However, the latter effect does not support the experimental hypothesis, as more ambisyllabic responses occurred for the monomorphemic words than for the plurals (virtually none in both conditions!).

The effect of vowel length (V+plosive versus VV+plosive) did not reach significance, neither for the category of monomorphemic words ($X^2 < 1$, $p > .10$), nor for the category of plurals ($X^2 = 2.05$, $p > .10$). In contrast, the effect of consonant type (V+plosive versus V+fricative) was highly significant, both for monomorphemic items ($X^2 = 25.04$, $p < .0001$) and for plurals ($X^2 = 47.45$, $p < .0001$). There were virtually no ambisyllabic responses with a plosive and a sizeable amount with a fricative.

The diminutives constituted a distinct category in the experiment, which behaved differently from both the monomorphemic and plural items. The children used the (V)VC.CV pattern much more frequently for diminutives than for monomorphemic words. Note that this syllabification pattern refers to an ambisyllabic segmentation in the context of monomorphemic words and to an interconsonantal segmentation in the context of diminutives. The contrast between the two word types was highly significant in each of the three phonological conditions (VV+plosive: $X^2 = 18.97$, $p < .0001$; V+plosive: $X^2 = 43.78$, $p < .0001$; V+fricative: $X^2 = 41.07$, $p < .0001$). Diminutives also behaved differently from the other category of polymorphemic words, i.e. the plurals. The difference between these two word types was highly significant as well, again in each type of phonological condition (VV+plosive: $X^2 = 29.71$, $p < .0001$; V+plosive: $X^2 = 48.38$, $p < .0001$; V+fricative: $X^2 = 21.79$, $p < .0001$).

The diminutives also differed from the other two word types as far as the effect of the phonological factor “vowel length” was concerned. Whereas this effect was nonsignificant for the monomorphemic and plural items, it was significant for the diminutives ($X^2 = 7.11$, $p < .01$), the frequency of morphological segmentations (i.e., interconsonantal) being higher after a short vowel than after a long one. The effect of "consonant type" was also highly significant ($X^2 = 22.02$, $p < .0001$), as was the case in the categories of monomorphemic items and plurals.

2.3. Discussion

The design of the present experiment included two variables that had been investigated earlier by Gillis and De Schutter (1996) - vowel length and the nature of the intervocalic consonant - but added a new factor to the research: morphological complexity. The results replicate the earlier findings by Gillis and De Schutter regarding the role of the two phonological factors. The children in our experiment "knew" that vowel length is an important variable in determining syllable boundaries, more particularly that long vowels can be the last phoneme of a Dutch syllable whereas short vowels cannot (although they did not rigourously apply this principle). This is evidenced by the significant effect of this factor in the category of diminutives (VV+plosive versus V+plosive). Notice that exactly the same consonant clusters were used in the short and long vowel conditions (2 x *pje, tje and kje*), such that a pure effect of vowel length is involved here. It is strange to find no effect of the factor "vowel length" for the monomorphemic and plural items. In a previous study Gillis and De Schutter (1996) found the effect of this factor to be significant in a similar set of monomorphemic items (single intervocalic consonant). The dissociation becomes comprehensible when the nature of the intervocalic consonant is considered. The effect that Gillis and De Schutter reported was calculated over items with different kinds of intervocalic consonants: plosives, fricatives, nasals and liquids. As a matter of fact, these authors obtained a strong dissociation in their results between the number of ambisyllabic responses in the context of plosives (very few) and the number of such responses in the context of continuants (the three other types of consonants they used in their item set). As the intervocalic consonant in the present experiment was always a plosive for the items used to assess the effect of vowel length, this finding replicates the earlier results of Gillis and De Schutter.

As far as the effect of the factor “consonant type” (V+plosive versus V+fricative) is concerned, the finding that significantly more ambisyllabic responses occurred with a fricative than with a plosive replicates the earlier finding of Gillis and De Schutter.

However, the main purpose of the experiment was to study the effect of a morphological boundary on the syllabification of bisyllabic words in the phonological context of a single intervocalic consonant. If the word’s morphological structure affects the position of the syllable boundary, it will interact with universal and language-specific syllabification principles. The phonological contexts VV+plosive, V+plosive and V+fricative were considered crucial to measure the effect. If a morphological effect does not take syllabification principles into account, its magnitude (measured relative to a baseline of monomorphemic words) should decrease from the VV+plosive condition to the V+fricative condition (as ambisyllabic segmentations occur least frequently with long vowels for monomorphemic items). On the other hand, if the effect does not occur (or less often) in contexts where it would violate the effect of syllabification principles, its magnitude should decrease from the V+fricative condition to the VV+plosive condition. This is the opposite ordering of conditions from the preceding one. As a matter of fact, neither of these predictions was borne out by the data for the plural items. There was not the smallest indication in the data that subjects made more ambisyllabic responses for plural items than for monomorphemic items. The conclusion of the present findings is that the morphological boundary between a word stem and the plural suffix does not affect the syllabification behavior of five-year old children.

However, the above conclusion seems to be contradicted by the results that we obtained for the diminutives. Indeed, in each of the three phonological contexts the children used different syllabification patterns for diminutives than for monomorphemic items. The category of diminutives behaved also differently from the plurals. Could it be that the research question (“Do morpheme boundaries affect children’s syllabifications?”) is formulated in too general terms? Perhaps the effect of morpheme boundaries is restricted to particular morphemes (e.g. diminutive suffixes but not plural suffixes).

There are two ways to approach the observed dissociation between plurals and diminutives. The first is to treat the effect for diminutives as a genuine morphological effect. In that case one must find an explanation why such an effect was absent for the plurals. A possibility would be that the children did not represent the stem morpheme of the plurals in their syllabification pattern because they wanted to avoid ambisyllabic segmentations. Recall that in the case of diminutives the (V)VC-CV segmentation was not an ambisyllabic response. This hypothesis seems to be supported by the fact that there were very few ambisyllabic responses for the category of monomorphemic items in the context of an intervocalic plosive (3.4 %) and that they remained a minority even in the context of an intervocalic fricative (26.7 %). This could indeed indicate a tendency to avoid the ambisyllabic pattern as much as possible. A radically different account is to treat the effect for diminutives as a non-morphological effect. In that case one would have to find a non-morphological factor which predicts segmentations at the morpheme boundary. A plausible candidate is a phonological factor. Indeed, the consonant clusters in intervocalic position (*pje, tje* and *kje* - with a plosive as an initial consonant - and *fje, sje, chje* - with a fricative as an initial consonant) are illegal or highly infrequent clusters at the beginning of a Dutch word or syllable. In other words, there seem to be phonotactic reasons why subjects in the experiment would split the words in the middle of the consonant cluster, i.e. at the morpheme boundary.

As it is possible to adduce arguments in favour of each of the two positions outlined in the previous paragraph, the issue cannot be settled on the basis of the results of the present experiment. Despite the attractiveness of the phonotactic argument it is not possible to reject the hypothesis that the null effect for plurals is due to subjects' avoidance of the ambisyllabic pattern. Indeed, in the phonological context that usually gives rise to the largest proportion of ambisyllabic responses - V+fricative (see Gillis & De Schutter, 1996) - the difference between the number of ambisyllabic responses for monomorphemic words and plurals was marginally significant ($p = .07$). In this particular case the morpheme boundary seems to have affected subjects' syllabification behavior. Although one must be extremely careful to draw conclusions on the basis of marginal significance, this finding should make one cautious to reject the hypothesis concerning the effect of morpheme boundaries too quickly.

In order to find out whether syllabifications are affected by morphological boundaries or not we decided to study older children: third graders (eight-year olds) and fifth graders (ten-year olds). Indeed, if a reluctance to make ambisyllabic responses accounts for the absence of the morphological effect in the category of plurals, one should find this effect when subjects are more prepared to make ambisyllabic responses. Previous research (Gillis & De Schutter, 1996) indicated that the frequency of such responses increases with age: eight-year olds made many more ambisyllabic responses than five-year olds. If, however, the effects in the present experiment were determined solely by phonological factors, subjects in the older age groups would still not show a morphological effect for the plurals. Instead the effect for the diminutives would be expected to be even larger than the one found in the present experiment, as the phonological knowledge it involves (i.e., knowledge of phonotactic restrictions) would be more developed.

Note that the increase in ambisyllabic responses in older age groups may be controlled by the child's acquisition of orthographic knowledge, more particularly the convention in the Dutch spelling that a single intervocalic consonant following a short vowel is realized as a double grapheme (/apəl/ - <appel>). However, as long as the children do not generalize the ambisyllabic pattern to all such items (which is not to be expected on the basis of our earlier research) and as long as syllabifications of literate children are not entirely controlled by an orthographic representation of the stimulus, it should be possible to measure morphological effects, even in the short vowel condition.

3. Experiments 2a and 2b

3.1. Method

The materials and procedure were the same as in the previous experiment. The only difference was the subjects' age and the associated fact that the children were literate, hence mastered the orthographic convention for the spelling of a single intervocalic consonant following a short vowel and also knew that segmentation of the orthographic pattern at the end of a line of text had to occur in between the two consonant graphemes (e.g., <*ap-pel*>). We decided to study two samples of older children: third graders in Experiment 2a and fifth graders in Experiment 2b to see whether further development of orthographic knowledge would affect the results. Fourty subjects participated in each experiment. The mean age of the third grade children was 8 years and 10 months. They were recruited from the third year in the elementary schools *Sint-Jozef Bloemendaal* in Schoten and the *Gemeentelijke Basisschool* in Alken. The mean age of the fifth grade children was 10 years and 5 months. They were pupils in the fifth year of the elementary schools *Don Bosco Instituut* in Halle and *Gemeentelijke Basisschool* in Alken.

3.2. Results

Experiment 2a

Table 3 presents the frequencies of the various syllabification patterns in the three phonological conditions of the experiment.

	monomorphemic		plural		diminutive	
	(V)V-CV	(V)VC-CV	(V)V-CV	(V)VC-CV	(V)V-CV	(V)VC-CV
VV+plosive	117 (97.5)	2 (1.7)	117 (97.5)	3 (2.5)	31 (25.8)	85 (70.8)
V+plosive	59 (49.2)	57 (47.5)	65 (54.2)	51 (42.5)	10 (8.3)	110 (91.7)
V+fricative	40 (33.3)	75 (62.5)	35 (29.2)	78 (65.0)	10 (8.3)	110 (91.7)

Table 3. Frequencies (percentages in brackets) of the two dominant syllabification patterns for each combination of word type and phonological context condition (the [V]VC-CV pattern refers to ambisyllabic responses in the case of monomorphemic and plural items and to interconsonantal segmentations in the case of diminutives). A total of 25 responses (2.5 %) did not fall in either syllabification category and were removed from the analyses.

Subjects' syllabifications of plurals and monomorphemic words did not differ from each other. In each phonological condition, similar distributions of responses over the ambisyllabic and non-ambisyllabic patterns were obtained for the two word types (VV+plosive: $X^2 < 1$, $p > .25$; V+plosive: $X^2 < 1$, $p > .25$; V+fricative: $X^2 < 1$, $p > .25$).

The diminutives behaved differently from the monomorphemic and plural items. In each phonological condition there were significantly more interconsonantal segmentations for diminutives than ambisyllabic segmentations for monomorphemic and plural items (VV+plosive: $X^2 = 129.14$, $p < .0001$ [monomorphemic] and $X^2 = 126.35$, $p < .0001$ [plural]; V+plosive: $X^2 = 51.56$, $p < .0001$ [monomorphemic] and $X^2 = 61.90$, $p < .0001$ [plural]; V+fricative: $X^2 = 24.53$, $p < .0001$ [monomorphemic] and $X^2 = 19.14$, $p < .0001$ [plural]).

The effects of the phonological variables "vowel length" and "consonant type" were significant in the categories of monomorphemic and plural items (vowel length: $X^2 = 70.36$, $p < .0001$ [monomorphemic] and $X^2 = 57.47$, $p < .0001$ [plural]; consonant type: $X^2 = 6.10$, $p < .02$ [monomorphemic] and $X^2 = 14.61$, $p < .0001$ [plural]). In the category of diminutives only the effect of vowel length was significant ($X^2 = 13.90$, $p < .0002$; consonant type: $X^2 < 1$, $p > .10$).

Experiment 2b

Table 4 lists the frequencies of the various syllabification patterns in each phonological condition.

	monomorphemic		plural		diminutive	
	(V)V-CV	(V)VC-CV	(V)V-CV	(V)VC-CV	(V)V-CV	(V)VC-CV
VV+plosive	118 (98.3)	2 (1.7)	114 (95.0)	4 (3.3)	48 (40.0)	69 (57.5)
V+plosive	55 (45.8)	65 (54.2)	56 (46.7)	64 (53.3)	10 (8.3)	102 (85.0)
V+fricative	32 (26.7)	86 (71.7)	24 (20.0)	95 (79.2)	2 (1.7)	95 (79.2)

Table 4. Frequencies (percentages in brackets) of the two dominant syllabification patterns for each combination of word type and phonological context condition (the [V]VC-CV pattern refers to ambisyllabic responses in the case of monomorphemic and plural items and to interconsonantal segmentations in the case of diminutives). A total number of 39 responses (3.1 %) did not fall in either syllabification category and were removed from the analyses.

The distribution of responses over the ambisyllabic and non-ambisyllabic patterns did not differ between monomorphemic and plural items, in none of the three phonological conditions (VV+plosive: $X^2 < 1$, $p > .25$; V+plosive: $X^2 < 1$, $p > .25$; V+fricative: $X^2 = 1.59$, $p > .20$). However, in each phonological condition significant differences were found between the category of diminutives and each of the other two word types (VV+plosive: $X^2 = 92.72$, $p < .0001$[monomorphemic] and $X^2 = 84.76$, $p < .0001$ [plural]; V+plosive: $X^2 = 39.12$, $p < .0001$[monomorphemic] and $X^2 = 40.53$, $p < .0001$ [plural]; V+fricative: $X^2 = 25.11$, $p < .0001$ [monomorphemic] and $X^2 = 16.55$, $p < .0001$[plural]). There were more interconsonantal segmentations for diminutives than ambisyllabic responses for the other two word types.

For all word types the effect of "vowel length" was highly significant (monomorphemic: $X^2 = 82.18$, $p < .0001$; plural: $X^2 = 72.72$, $p < .0001$; diminutive: $X^2 = 31.17$, $p < .0001$). The effect of "consonant type" was also invariably significant (monomorphemic: $X^2 = 8.99$, $p < .005$; plural: $X^2 = 18.84$, $p < .0001$; diminutive: $X^2 = 4.53$, $p < .05$).

3.3. Discussion

In each of the three phonological conditions of the two experiments the same syllabification patterns were observed for the monomorphemic items and for the plurals. In other words, the presence of the morpheme boundary in the latter category of words did not in the least affect subjects' syllabifications. In the context VV+plosive, where the highest increase in ambisyllabic responses is (theoretically) possible, extremely few instances of this pattern were obtained (3 in Experiment 2a and 4 in Experiment 2b). In the context V+fricative, which lends itself best to the ambisyllabic pattern, we counted only a few ambisyllabic responses more for the plurals than for the monomorphemic items (difference = 3 in Experiment 2a, difference = 9 in Experiment 2b). On the other hand, a very high percentage of diminutives was syllabified at the morpheme boundary (91.7 % in Experiment 2a, 79.2 % in Experiment 2b).

We observed the same dissociation between plurals and diminutives in the previous experiment. In the present experiments, however, there are considerably more ambisyllabic responses after a short vowel for the monomorphemic items than was the case in Experiment 1 (47.5 % and 54.2 % in Experiments 2a and 2b respectively when the intervocalic consonant was a plosive, 62.5 % and 71.7 % in Experiments 2a and 2b respectively when the consonant was a fricative). This means that the absence of a morphological effect in the category of plurals cannot be due to subjects' reluctance to make ambisyllabic responses. Reasoning along the lines of the discussion in Experiment 1 this would mean that the effect for diminutives is not morphological in nature. More particularly, it would be the result of the illegitimacy or very low frequency of the word-medial consonant cluster as a word onset. The low percentage of cases in which this cluster appeared at the beginning of a syllable in subjects' responses is in line with such an account: only 14.2 % in Experiment 2a and 16.7 % in Experiment 2b (in contrast to 57.2 % in Experiment 1). This is what would be expected if the effect for diminutives is due to subjects' knowledge of phonotactic restrictions. Such knowledge would indeed be more developed in older subjects.

Note that the number of ambisyllabic responses for momomorphemic words did not reach ceiling level, which means that it was possible to measure an effect of the presence of a morphological boundary.

The observed effects of the phonological factors "vowel length" and "consonant type" were already obtained with the group of five-year olds that we studied in Experiment 1. However, there are also differences between the preliterate and literate groups . First, the effect of vowel length, which was restricted to the category of diminutives in the previous experiment, was now also significant for the monomorphemic and plural items. This is due to the fact that the five-year olds reserved their ambisyllabic responses for words with a fricative as an intervocalic consonant. As the factor "vowel length" was manipulated in the phonological environment of a plosive only, its effect could not be significant in this age group. Third and fifth grade children also made ambisyllabic responses when the intervocalic consonant was a plosive (in about 50 % of the responses in the V+plosive condition of both subexperiments). This developmental fact suggests that some factor caused older children to treat plosives differently than Kindergarten children do.

We believe that the development of literacy skills, i.e. learning the spelling conventions of the Dutch language, is the causal factor here (see also Gillis & De Schutter 1996, Gillis & Sandra, in press). In Dutch a short vowel in an open syllable must be followed by two consonant graphemes, whether there are two consonant phonemes in intervocalic position (e.g., <balkon>) or only a single one (e.g., <appel>), and whether the intervocalic consonant is a fricative (e.g., <mossel>) or a plosive (e.g., <appel>). If the double grapheme spelling of a single consonant following a short vowel affects phonological operations (syllabification), this would account for the expansion of ambisyllabic responses from fricatives to plosives between the preliterate and literate stages in development.

In light of the above account it is remarkable though that we still observed an effect of consonant type for the monomorphemic items and the plurals in the experiment. Gillis and De Schutter did not find this effect for monomorphemic words in the group of eight-year olds they studied. If subjects syllabify on the basis of an orthographic representation, an equivalence between fricatives and plosives is what would actually be expected. Whereas this earlier finding suggests that orthographic knowledge can completely override phonological principles in a phonological task, the present data suggest that both orthographic and phonological principles may be operational simultaneously. It is unclear what explains the discrepancy between the findings reported here and those in the Gillis and De Schutter study.

A second difference between the preliterate and literate groups is the absence of an effect of consonant type for the category of diminutives. This is a ceiling effect. Virtually all segmentations of the third and fifth graders in the context of a short vowel occurred at the morpheme boundary, such that an effect of consonant type could no longer surface in the data.

4. General Discussion

The paper set out from the question whether children's syllabifications are affected by morphological factors. Even though syllables and morphemes are different kinds of linguistic units it is quite possible that children are unable to keep them well apart in a syllabification task.

Bisyllabic words with a single intervocalic consonant which is also the last phoneme of the word stem offered the ideal testing ground. Depending on the length of the first vowel and the nature of the intervocalic consonant one would expect different interactions between phonological knowledge (i.e., universal and language-specific syllabification principles) and morphological knowledge (i.e., word structure). In the case of a long vowel the two knowledge sources lead to a conflict. Both universal and Dutch principles of syllable structure predict that the consonant will not be part of the first syllable, whereas a morphological segmentation will include the consonant in the first unit. No conflict would occur with a short vowel in the initial syllable. The bimoraic principle in Dutch makes it impossible to have a short vowel in syllable-final position and thus leads to an ambisyllabic segmentation. Such a (phonologically induced) segmentation already represents the stem morpheme of a bimorphemic word in the syllabification pattern. Yet, if ambisyllabicity is not applied as a rule (i.e. is only a tendency) one could still observe a morphological effect (i.e., an increase of ambisyllabic responses). This effect might even be larger than the effect in the context of a long vowel if morphological factors cannot overrule phonological principles. Within the context of a short vowel, different effects could again be found for different types of intervocalic consonants. More particularly, fricatives lend themselves better to ambisyllabic responses than plosives. Again, the effect of morphology might be largest for fricatives, as this phonological context lends itself best to ambisyllabic responses in the context of monomorphemic words. However, we found no trace of a morphological effect in any of the three experiments reported in this paper. Kindergarten children, third graders and fifth graders syllabified plurals in exactly the same way as monomorphemic words.

We also included a category of diminutives in the experimental materials. Although these words were derived from the same set of stems as the plurals, they differed from them in one important respect. Whereas the plurals were closely matched to the set of monomorphemic words on their phonological environment, such matching was (by definition) impossible for the category of diminutives. The latter words all had two intervocalic consonants whereas the monomorphemic and plural words had a single consonant in that position. This phonologically based division between word types was reflected in the data. Across the three experiments we obtained no morphological effects for the plural items whereas we did find many syllabifications at the morpheme boundary in the case of diminutives. We believe there is sufficient evidence in the data of the three experiments to reject the effect for diminutives as a morphological effect. First, although the absence of an effect for plurals in Experiment 1 could be explained as the result of subjects' reluctance to make ambisyllabic responses, this explanation could not be upheld for Experiments 2a and 2b, where subjects made many ambisyllabic responses to monomorphemic items. Second, the difference between the effects for plurals and diminutives seems to be related to the difference in the number of intervocalic consonants (one versus two). More particularly, the consonant clusters used in the diminutive category were illegal or extremely infrequent clusters in word-initial position in Dutch. These phonotactic facts are likely to have caused subjects to split up the consonant clusters, which accidentally resulted in a morphological segmentation pattern. The increase in the number of interconsonantal segmentations between the ages of five and eight seems to support this claim (development of the knowledge of phonotactic restrictions) .

Our conclusions regarding the effect of morphological boundaries on subjects' intuitive syllabifications are necessarily limited. The phonological account of the "morphological" effect for diminutives indicates that the diminutive suffix was actually a poor choice for studying the phonology-morphology interaction. The inflectional suffix for plural, does not support the hypothesis that morphological boundaries affect the intuitive syllabification of preliterate and literate children. Of course, it is impossible to generalize the findings obtained with one suffix to the entire class of suffixes. Given the complications with the diminutive suffix we even cannot say anything with respect to derivational suffixes. Considering the phonological sequence of the plural suffix studied in the present experiments, it might be a fruitful line of follow-up research to investigate the effect of the Dutch derivational agentive suffix <-er>, which differs from the plural suffix in its final consonant only.

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