The phonological bootstrapping of determiners*

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0. Introduction

Analyses of the acquisition of determiners in general, and of articles in par-
ticular, usually focus either on their morpho-syntactic characteristics without
taking phonological aspects into consideration (e.g. Dore et al 1976; Bottari,
Cipriani & Chilosi 1992; Pizzuto & Caselli 1992, 1993; Peters & Menn 1993;
Hyams 1994; Lopes 1999; Baauw 2001) or on their phonological properties
without paying attention to their morpho-syntactic characteristics (e.g. Peters
& Menn 1993; Scarpa 1993, 1999: Lléo 1997, 2000). Accordingly, the morpho-
syntactic studies have proposed that some sounds in child language are used
as proto-morphemes (*place-holders* for specific morphemes of the adult lan-
guage), whereas the phonological studies have in turn analyzed some sounds as
filler-sounds used to optimize the rhythm of children's outputs. It is also worth
noting that the phonological studies tend to focus on children's production
starting at 1;0, while the morpho-syntactic studies tend to concentrate on a
later period of acquisition, in general after 2;0.

A recent trend of research, however, has attempted to unify both lines of
inquiry mentioned above, by exploring the hypothesis that the relevant sounds
change their status during the acquisition process, starting as *filler-sounds* and
later being reanalyzed as *place-holders* (e.g. Santos 1995, Veneziano & Sinclair
2000, Peters 2001). Veneziano & Sinclair, for instance, argue that children go
through three successive periods: pre-morphological, proto-morphological
and morphological, in each of which fillers have different characteristics. Thus,
during the pre-morphological period, fillers do not have any meaning and are
used for phonological reasons, such as to preserve the number of syllables in
the target utterances, thereby keeping or optimizing their prosodic rhythm.
In turn, during the proto-morphology period, a morphological system starts
to develop, and fillers show some of the distributional and phonological

characteristics of the adult morphemes, despite still being limited in produc-
tivity. Finally, the morphological period reflects the adult use.

Discussing the acquisition of articles in Brazilian Portuguese (henceforth
BP), we argue in this paper that our results show a picture in line with Vene-
ziano & Sinclair's proposal. We will show that children acquiring BP use fillers
as early as 1;3 for prosodic reasons and at around 2;0 they display some char-
acteristics of the proto-morphemic period.

The paper is organized as follows: in Section 1, we describe the main char-
acteristics of articles in BP. In Section 2, we present the methodology used. The
results are presented in Section 3 and in Section 4, we discuss the data taking
Veneziano & Sinclair's proposal into account. Finally, we summarize our find-
ings in Section 5.

1.   Determiners in Portuguese — adult language

In BP, the prenominal position is almost always filled by a determiner such as
the definite (*o* 'the-masc', *a* 'the-fem') or the indefinite (*um* 'a/an-masc', *uma*
'a/an-fem') articles, some contractions of prepositions and articles (*do, da* 'of
the', *no, na* 'in the'), demonstratives (*este, esta* 'this', *aquele, aquela* 'that') and
possessives (*meu, minha* 'my'). Adjectives are usually post-nominal, so they
do not intervene between the determiner and the noun (cf. (1)), but it is quite
common to have a possessive between the article and the noun (cf. (2)). Also
relevant is the fact that articles are used before proper names (cf. (3)).

(1)   *o brinquedo legal*   'the nice toy'
       the toy nice

(2)   o meu cavalo   'my horse'
       the my horse

(3)   *A Maria caiu*   'Maria fell down'
       the Maria fell down

2.   Subject and Methods

The corpus reported here belongs to the *Projeto de Aquisição da Linguagem*
of the Universidade Estadual de Campinas (Lemos 1995). It constitutes pro-
duction data by two Brazilian children — R. (female) and T. (male) — from

1;1 to 3;4 years of age. Spontaneous production by the children was audio-recorded on a weekly basis, in half-hour sessions, in a naturalistic way. The data were phonetically transcribed on a perceptual basis by one of the authors and the transcriptions were checked by the other author. Only the data whose transcriptions were agreed upon by both researchers were taken into consideration here.

The data were segmented into words only when the children's utterances had more than one stress prominence. Utterances were identified according to standard intonation and pause criteria. Given that utterances with more than one prominence generally appear in later periods (from 2;5 on), until then all utterances (including unintelligible ones) were analyzed as tokens. The identification of the children's lexical production was based on the phonological form. The additional filler was defined as a syllabic sound (usually a vocalic one) that was not part of the adult phonological form. For example, the [ʊ] in [ʊ'pɛ] for [pɛ] was counted as a filler since it cannot be analyzed as part of the target word.

3. Results

Below we first highlight the characteristics of these fillers in what concerns phonology, morphology, distribution of grammatical categories, distribution in the utterance, order of appearance, and function. Secondly, we pay special attention to the occurrence of these segments before NPs in the children's data.

Phonological variety

Proto-morphemes have been standardly characterized as being weak mono-syllables, usually schwas (Bottari et al. 1992, Peters & Menn 1993, Lleó 1997, among others). In BP, the following sounds were found: [a],[o],[ʊ],[ɪ],[ə] and [ʔ], all of them filling weak positions in the utterance, as shown in (4)–(14):[1]

(4)	[ə ne´ne]	'baby'	T.1;5.3
(5)	[**a** ´gaku]	'cat'	T.1;6.4
(6)	[ʔa´si]	'like this'	T.1;6.24
(7)	[**u** ´kaku]	'monkey'	T.1;7.1
(8)	[**a** ka´kaku]	'monkey'	T.1;7.12
(9)	[**u** ´usa]	'pull'	T.1;7.12
(10)	[**a** ´la]	'there'	R. 1;3.19

(11) [ə ˈbɔla]   'ball'   R.1;5.10
(12) [a ˈpə:]   'to put'   R.1;5.18
(13) [adi i ˈlɛla]   'where is Lela?'   R.1;5.18
(14) [o a kə ˈju:]   '(it) felt down'   R.1;7.12

Morphological underspecification

Until 1;9 years old, it was not possible to find any relationship between the phonological form and the gender of the determiner/article. The data in (15)–(17) and (19)–(20) show the use of the feminine form ([a]) of the article before a masculine target:

(15) [a ne´ne:]   'baby' — masc.   T.1;5.10
(16) [a pi´piw]   'birdie' — masc.   T.1;6.10
(17) [a ´poku]   'pig' — masc.   T.1;7.12
(18) [a koˈkɔ:]   'chickie' — fem.   R.1;5.18
(19) [a ota muˈni:nu]   'another boy' — masc.   R.1;9.8
(20) [a balalə̄w ˈžĩɲu:]   'small horse' — masc.   R1;8.25

Distribution in the grammatical categories

As can be seen from (21)–(31), the distribution of these fillers is not organized in any morphological way. Besides appearing before NPs (cf. (15)–(20) above), they can also be found preceding VPs (cf. (21)–(28)) and PPs/AdvPs (cf (29)–(31)).

VP
(21) [a ˈpə:]   'to put'   R.1;5.18
(22) [a ta ´basu]   '(it) is under?'   R.1;6.29
(23) [o vɔtu´ʒa]   '(I) come back soon' R.1;9.8
(24) [o a kə ´ju:]   '(it) fell down'   R.1;7.12
(25) [a pu ´sa]   'pull'   T.1;7.12
(26) [a pe´go]   '(he) grabbed'   T.1;7.12
(27) [o: ´sita]   'sit'   T.1;10.22
(28) [ʔa ´sɛta]   'correct (it)'   T.1;10.22

PP/AdvP
(29) [a´majs]   'more'   T.1;7.12
(30) [a pate´a]   'to take off'   R.1;6.22
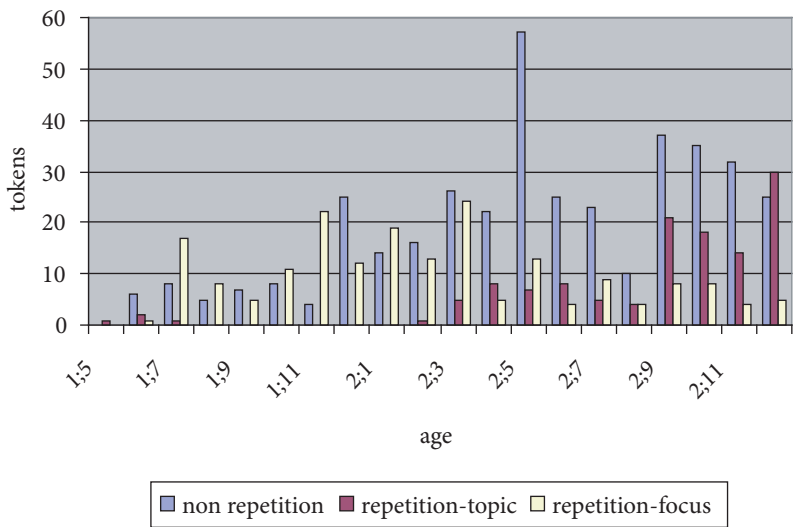
Distribution in the Utterance

Another characteristic of these fillers is that they do not appear only in the beginning of an utterance. During the first months analyzed, children's utterances were one-word long. These fillers appear not only on the left side of the word but also on the right side (therefore, in the end of the utterance — cf. (31)–(34) — and in the middle of words (cf. (35)):

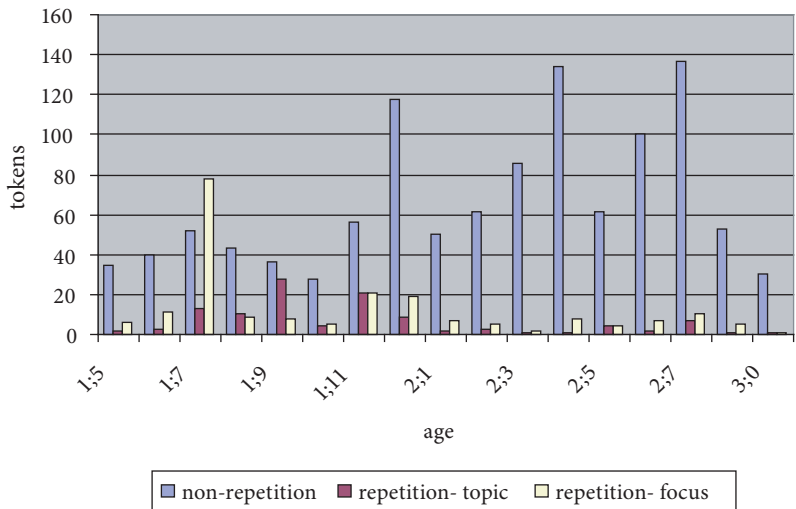|			
(31)	[de.ta.ˈʔa]	'to lay down'	T.1;6.27
(32)	[ˈmaj.si]	'more'	T.1;7.12
(33)	[ˈdoj.si]	'two'	T.1;7.12
(34)	[teˈje]	'train'	R.1;5.27
(35)	[piiˈtãw]	'captain'	T.1;11.2

Order of appearance

Two aspects are worth noting in what concerns the order of appearance and the development of the fillers. The first one is that, as seen above, these segments also appear before VPs, PPs and AdvPs. Contrary to what Bottari et al. (1992) argue to Italian, there is no temporal distinction in the period when these fillers appear and disappear regarding their distribution in relation to the category they precede. That is, it is not possible to argue that there is an order of development such as: filling of pre-nominal positions >> filling of pre-verbal positions >> filling pre infinitive-verbal positions.

The second aspect, the most important to the aim of this paper, is the appearance of these fillers preceding NPs. For T., the NPs preceded by determiners are stable only from 2;5 on (stable at 50% of fillings). Before that, there are many more outputs of NPs without fillers (75% of NPs without fillers). R. shows a more stable use of NPs with and without fillers. At 1;5 she produces 40% of her NPs preceded by fillers. However, considering only whether these fillers are placed before NPs or not does not tell us very much about their developmental nature. Therefore, we checked the data where these fillers preceded NPs to see when children were using it correctly in non-repetitions of the previous utterance spoken by their interlocutors. As can be seen in Graph 1, until 1;11 most of T.'s NPs are constituted by the repetition of the interlocutor's focus (almost 70%). From 2;0 to 2;4, the repetitions and non-repetition are more or less evenly distributed. Finally, from 2;4 onwards, there are more NPs that are non-repetitions of the input. R.'s outputs are more stable.

Graph 1. T's production of [a,o] preceding NPs.

In Graph 2, we can see that there are more non-repetitions than repetitions from the input.

Graph 2. R's production of [a, o] preceding NPs.

Function

Finally, a few words must be said about the use children make of these fillers. For T., one of the most common ways in which fillers appear around 2;1 is in sequenced utterances (which can be interrupted by his interlocutor). First, T. uses the NPs without fillers, then inserts them (cf. (36)–(37)). The same use can be found in R's data, but at an earlier age (cf. (38)):

(36) T. [na´ize]   'nose'
      M. The nose? Show (me) the nose.
      T. [**u** na´ize]   'the nose'
      T. [**u** na´ize]   'the nose'   T2;1.10

(37) M. And here, what is in here?
      T. [a mamãe]   'the mommy'
      T. [bo´inha]   'small ball'
      T. [**a** bo´inha aki] 'the small ball here' T2;9.27

(38) R. [ka´ka]   'dirty'
      M. que cacá?   'what dirty?'
      R. [ka´ka]   'dirty'
      M. ah?
      R. [**a** ka´ka]   'the dirty'
      R. [**a** ka´ka]   'the dirty'   R1;6.6

These examples show that the subjects are already working with the referential meaning conveyed by definite articles, using them exophorically (Castilho 1989). First children introduce the concept, and then they use it in a referential way.

4.   Discussion

The data presented above show that in the beginning of the acquisition process, the use of some sounds as place-holders is underspecified with respect to phonological, morphological and grammatical distribution. This can be used as evidence that at this point these sounds are not yet fully morphologically specified, as proposed by Veneziano & Sinclair (2000). However, at the end of the period, they seem to be more stable with respect to adult use. Santos (1995), assuming Scarpa's (1993) analysis for filler-sounds, proposes that these segments are filler-sounds in the beginning of the acquisition process, but are

re-analyzed as proto-determiners later on. Given these results, one question that arises is whether the data conform with the periods identified by Veneziano & Sinclair, taking into account the following criteria proposed by Peters (2001:234–36; emphasis added):

–   *Pre-morphologic fillers:* they are "not readily mappable onto target adult morphemes, have no systematic morpho-syntactic function (however idiosyncratic), and may be restricted to full syllables… [they] may be seen to have served as an utterance-planning bridge from one-word to two-word utterances an/or *served a rhythmic function, enabling the child to achieve the gestalt of a full adult sentence*"

–   *Proto-morphologic fillers:* they "are beginning to take on some of the characteristics of adult functors, both distributionally and phonologically. Individual fillers may be associated with classes of target morphemes (e.g. proto-determiners, proto-auxiliaries), but these classes are not yet differentiated. Fillers in different syntactic positions *are becoming increasingly distinguishable on phonology grounds*, although some proto-morphological fillers may be multisyllabic amalgams modelled on frequently occurring clumps of target functors."

–   *(full) morphology*: "*the morphology form must match that of an adult target well enough to identify it without much question;* their distribution must match that of the identified adult target without 'too many errors'; they seem to be used for much the same function as the adult target; their production is becoming increasingly fluent…"

Since phonology, morphology, and function are used as clues to the analysis of the development of determiners, we will discuss them separately, considering also the distribution of the segments (cf. Section 3).

The first thing to note is that it is not a simple matter to distinguish the full morphology from pre-morphology or proto-morphology periods taking into account the phonology form of these sounds. The problem is that, contrary to languages such as Spanish and Italian, the articles in BP have the same phonological form as some fillers (a weak [a, ʊ]). Therefore, there is no phonological change in children's utterances that could lead us to say that we are dealing with articles and not fillers. The criterion, in this case, is the disappearance of other sounds ([ɪ],[ə] and [ʊ]) in children's utterances.

One important characteristic that distinguishes the pre-morphological sounds from the proto-morphological and morphological ones is their use for rhythmic purposes. T.'s data from 1;10 to 2;2 give us some other clues for the

assessment of the prosodic status of filler sounds. During a period of a great incidence of filler-sounds in the speech of this child, there is a great proportion of iambs in two-syllable words, as seen in (39), (40) and (41):

(39) [fi ˈsa]   'to close'   1;10.22
(40) [bi ˈbi]   'car'   1;11.14
(41) [se ˈgo]   'arrived (3a. person sing)'   2;0.26

T. tends to avoid monosyllables, inserting a filler to the left:

(42) [aˈmɛ]   'onomatopoeia for "goat"   1;10.22
(43) [ʊ ˈtẽj]   'train'   1;11.07

This preference for iambs is at odds with Rapp (1994) findings, according to which, the tendency for early rhythm production for BP is the trochee. If this were indeed the case, children's early metrical form would already be consistent with the trochaic canonic form of the words in BP (see Massini-Cagliari 1995), for the default lexical stress rule of BP constructs a binary, left-headed *trochee* at the right boundary of the words.

However, despite the trochaic adult pattern, T. often adds one or (less frequently) two unstressed syllables to the left of the target trochee, thus creating a prosodic syllabic space to be filled by segmental material.

(44) [ʔmʔuˈsu:kʊ]   'juice'   1;10.15
(45) [mʔˈbiso]   'animal'   1;11.04

He avoids utterances composed by two-syllable trochees and creates solutions like the one in (44). In cases of monosyllables, he adds a filler to the left, creating an iamb instead of a trochee, as in (45). One could say that metrically, the basic form of T's utterances is one of *iambic foot*, with a weak final syllable in free variation (or *extrametrical*, according to the prosodic interpretation of the acquisition of filler sounds in Spanish by Lleó, 1997).

The preference for iambs in two-syllable words also explains some "rhythmic mistakes", like the production of weird anapests (. . x), with the insertion of a final filler in cases such as (46) and (47):

(46) [abiˈi]   / aˈbi/   'open'   2;0.11
(47) [segoˈo]   /ʃeˈgo/   'arrived'   2;0.21

Some data also show the less productive strategy of stress displacement when faced with lexical stress in the ante-penultimate syllable, as in (48):

(48) [muˈʃika]   /ˈmuzika/   'music'   2;0.21

A closer look at his preferred intonation configurations during this developmental period can shed light on the metric-intonational form favored by the insertion of fillers. Given that the strong syllable is necessarily high or rising, the prosodic result of his preferred intonation frame at this stage is the one that corresponds to a polar yes/no question (modal) intonation of BP (Hochgreb 1983). Around 2;0, 100% of T.'s utterances, with the exception of vocatives, are produced with this intonation contour and interpreted as a yes/no question. The intonational structure of such utterances can be represented in this way:

(L) L *H (L) ~ (L) L *LH (L)

where: L   = low, short, weak.   parenthesis = optionality
        H   = high, long, strong.   asterisk   = intonational stress
        LH = rising, strong.

The insertion of filler sounds takes place precisely at the left of trochees, which are normally avoided, and at the left of 1-syllable words, which are turned into iambs. In any case, the directionality is to the right, corroborated by the intonation description of the utterances, with the nuclear syllable exhibiting the same directionality.

The privileged use of this intonational contour explains why children correctly produce 3-syllable words with medial stress (*weak-strong-weak*) at this point in their development. Words such as *galinha* [ga'liɲa] 'hen', *coelho* [ko'eʎo] 'rabbit', *escola* 'school' [is'kɔla] are target-like not because of the prosodic template of the word, but because they fit the intonational template, whose default is an iamb or an iamb + one extrametrical syllable. This default template also explains why 4-syllable words with penultimate stress are reduced to 3-syllable words: *chocolate* [ʃo'kate] 'chocolate', *papagaio* [pə'ka.wo] 'parrot'. Although 4-syllable words with penultimate stress can fit a possible 2-feet word template, children are not working with word template yet. Let us examine why.

Studies on BP rhythm show that post-lexical rhythmic rules have prominence and branching to the right (Galves & Abaurre 1996), whereas rules of assignment of word stress apply to basic trochaic feet, with prominence to the left (Massini-Cagliari 1995). BP word-stress assignment takes into consideration moraic trochee feet, sensitivity to the weight of the syllable, and left directionality of foot construction in terms of primary and secondary stress. This means that when producing filler sound utterances, T. is maximizing a metrical template as an optimal prosodic form, by projecting a post-lexical structure of prominence, typical of prosodic domains higher than the phonological word (perhaps the phonological phrase, the basic prosodic domain for intonation

assignment in BP — cf. Tenani 2002). He does that to whatever utterance is produced, be it a word-like or a phrase-like utterance of the input.

In this work with lower levels, T. fixes a certain metric-intonational form and uses filler sounds as phonic material to fill missing parts. If the words from the input are larger than this metric-intonational form, the child deletes syllables. If the words are smaller, the child adds syllables to it. Santos (1995) points out that R. does not generalize a certain contour for her utterances, but the fillers always appear with a specific intonation contour that has the same form as T.'s preferred contour. Therefore, it is arguably the case that children are using these fillers as prosodic (metric and intonational) rather than syntactic fillers.

Turning now to the morphological issue and the use children make of these sounds, we saw in Section 3 that T.'s production of filler-sounds are more stable from 2;5 years old onwards. Most importantly, Graph 1 shows that there is a change in T's use of these sounds. Unfortunately, it is impossible to say when these sounds are being used correctly in front of NPs, since the use of articles in BP is allowed in front of almost all kinds of nouns (cf. Section 2). And furthermore, checking when children do not use them would not be very helpful either, because it would not tell us anything about the change of status of the sounds found in children's utterances.[2] The analysis of the use children make of these sounds may be more telling, though. Graph 1 shows that in the beginning of the period analyzed, most of T's use of these sounds involves simple repetitions of adult's input.

Graph 2 shows a slight different pattern: from 1;5 on, R. produces more of these sounds in non-repetitions of the input. However, if we take these results in conjunction with the prosodic analysis, which shows that R. does not overgeneralize any sound, and the use of these sounds in a referential way, we can see that R's development is in a different period, more 'advanced' than T. The question then is: do we have proto-morphemes or full articles at this point?

The answer cannot be given by looking only at articles, since, as we have seen, their phonology and distribution are not reliable cues in BP. However, if we look at other grammatical components and other determiners, we can find some cues about the status of the fillers.

The data in (15)–(20) show that until 1;9 children still use the 'wrong' phonological form of articles, that is, they use the phonological form corresponding to the feminine ([a]), instead of the masculine ([o]). Interestingly, there is no piece of data showing the opposite pattern, that is, a masculine ([o]) article in front of a feminine noun. This seems to be evidence that at this point, children are already working with a proto-determiner, although it is still phonologically underspecified.

If we turn our attention to the distribution of these sounds, we see that they appear also in front of VPs and PPs/AdvPs. In adult language, there are no pronouns in front of PPs/AdvPs and these sounds disappear around 2;0 years old from the children's utterances. The sounds in front of VPs, however, do not disappear. If in the beginning of the process they are being used for intonational/rhythmic implementation, this is not the case for the utterances around 2;0 years old. At this point, these sounds do not optimize any rhythmic pattern. If we look at the adult language, the pronouns that occupy the position preceding VP are [eu] (1st. sing), ['e.lɪ], [vo'se] (3rd.sing.) and most of the verbs children use are in the 1st singular form. Thus, it is very likely that these sounds are phonologically underspecified forms for the 1st person singular pronoun.

In sum, if we take into account all facts discussed here, it is reasonable to say that until 2;5 years old for T. and 2;0 for R., we are still dealing with proto-morphemes.

5.   Concluding Remarks

In this paper we discussed the acquisition of articles and their phonological bootstrapping, by examining the types of sound segments used, the distribution of these sounds with respect to their phonological and categorical properties, and the period in which they appear and disappear. We proposed that these initial fillers are prosodic rather than syntactic and that they go through a reanalysis that is both prosodic and syntactic, which causes some of these sounds to disappear once their structural motivation is lost. Finally, this reanalysis turns the filler sounds into place holders, giving rise to various functional categories, among which the determiners discussed here.

Notes

1. Filler-sounds are in bold.

2. An anonymous reviewer quite correctly observed that it would be useful to investigate whether the instances where children fail to produce determiners satisfy the intonational contour. Although at the moment we do not have quantitative results on this issue, it is worth mentioning that the contour chosen by the children — (L) L H⋆ (L) — suggests that this may indeed be the case for the period between 1;10 and 2;0.

Given that the first L is optional and the second one is not, children can produce an iambic target word or a 3-syllable word with penultimate stress without a filler (cf. i, ii). On the other hand, when producing a trochee target word, children must insert at least one filler to fill the contour (cf. iii):

(L) L H⋆ (L)

(i)   [si'ɾi]   'crab'
(ii) [ko 'e ʎu]   'rabbit'
(iii) [ʊ 'ga tu] 'cat'

The use of this contour is also in consonance with the findings by Fikkert & Santos (2005), who showed that children producing trochees and 2-syllable words with penultimate stress in BP usually delete the last weak syllable.

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