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Explicit speech segmentation and syllabic onset structure: Developmental trends

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Abstract Recent applications of the hierarchical theory of the syllable to the development of explicit speech segmentation are critically examined. One particular prediction, that an initial consonant is more easily isolated when it constitutes the complete onset of a syllable than when it is part of a cluster onset, was tested on children with grade levels ranging from kindergarten to second grade. At each level, two independent groups of children worked with either CVCC (first consonant complete onset) or CCVC (part of cluster onset) syllables. First- and second-graders performed better on the CVCC than on the CCVC material in an initial consonant deletion task, but not when the task was comparison on the basis of that consonant. With the same instructions as the older children, kindergarten children performed at floor level on both tasks with both materials. However, in a new experiment in which the deletion task was presented as a puppet game, and with pretraining and selection on vowel deletion, a significantly higher level of success was achieved by the children working with the CVCC material. These results are consistent with the notion of developmental precedence of onset segmentation on phoneme segmentation. On the other hand, the results of the first and second graders show that onset superiority is not specific for the pre-reading stage.

Introduction

Much research on reading acquisition has converged on the notion that the abilities to segment utterances into phonological fragments and to represent them explicitly as concatenations of such fragments are critical components of early reading skill. (For reviews see Bertelson, 1986; Bertelson & de Gelder, 1989, 1991; Goswami & Bryant, 1990; Morais, Algeria, & Content, 1987; Seymour & Evans, 1994; and the volume edited by Gough, Ehri, & Treiman, 1992.) When the notion was first introduced, two main fragments were focused upon: the syllable and the phoneme. It was established very soon that segmentation into syllables can be performed by pre-reading children, while segmentation into phonemes is rarely observed until some progress has been made in alphabetic reading (Liberman, Shankweiler, Fischer, & Carter, 1974). The same dissociation between syllabic and phonemic segmentation was later demonstrated in comparisons between illiterate and alphabetically literate adults (Bertelson, de Gelder, Tfouni, & Morais, 1989; Morais, Bertelson, Cary, & Alegria, 1986) and between readers of non-alphabetic and alphabetic scripts (de Gelder, Vroomen, & Bertelson, 1993; Mann, 1986; Read, Zhang, Nie, & Ding, 1986). Taken together, these data were consistent with a picture in which syllabic representations appear more or less spontaneously as a part of normal linguistic development, while phonemic representations are contingent on specific educational experiences, like those typically provided by alphabetic reading instruction.

Recently, attention has been drawn to possible implications for the emergence of phonological competence of the hierarchical view of the syllable proposed by autosegmental phonology (Fudge, 1969; Halle & Vergnaud, 1980; Goldsmith, 1990). According to this view, the syllable is best described as comprised of two main constituents: the *rime*, which consists of the vowel plus any ensuing consonants, and an optional *onset*, consisting of any consonant or cluster of consonants preceding the vowel. The rime in turn can be divided into a *nucleus* (the vowel plus optionally a liquid consonant) and an optional *coda* (a final consonant or consonantal cluster). For a detailed presentation of

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this conception, see Treiman (1988) or Levelt (1989, pp. 290–297).

The main linguistic arguments for the hierarchical view are distributional: constraints on the occurrence of phonemes change with the particular slot within the syllable they occupy. In English, cluster /nt/ can be a coda (as in mint) but not an onset, while /pr/ can be an onset (as in pram) but not a coda. On the other hand, the relevance of the view to speech processing is now supported by data (reviewed by Treiman, 1988) on speech production errors, on confusions in memory, and on performance in word games.

Our focus in the present paper is the notion proposed by Treiman (1985, 1987) and by Goswami and Bryant (1990) that awareness of the syllabic constituents of onset and rime might have a status intermediate between syllables and phonemes in terms both of age of emergence and of degree of dependence on instruction. This notion, which we shall call "the onset-rime precedence hypothesis," has often been considered as following naturally from the hierarchical view: development would run down the hierarchical tree, from word to phoneme, via syllables and syllable constituents. Recently, Seymour and Evans (1994) argued that this *progressive* conception of the developmental seqence is not self-evident, and that a viable alternative is a *disjoint* sequence with an abrupt transition, following the beginning of alphabetic reading instruction, from representation of syllables to representation of phonemes, with eventual representations of intermediate units coming later.

Examination of the literature shows that the idea of onset-rime precedence is not as well established as has been assumed.

Among results supporting the notion, the clearest were reported by Treiman and Zukowsky (1991). In a game with dolls which amounted to forced-choice similarity judgements concerning pairs of spoken words, pre-readers achieved the highest performance when similar pairs shared a whole syllable (hammer and hammock), an intermediate one when they shared either the onset (plank and plea) or the rime (spit and wit), and the lowest one when they shared either the initial consonant (steak and sponge) of a cluster onset or the final consonant of the rime (smoke and tack). In comparison, first-graders reached the criterion on all three tasks with very few errors. Unfortunately, the subjects were presented in mixed order with beginning-sharing pairs and end-sharing ones, which makes it impossible to separate sensitivity to onset from sensitivity to rime. However, in an earlier study with an initial-consonant detection task, Treiman (1985) showed that pre-readers were less accurate (22% errors) when the target was part of a consonant cluster (e.g., /s/ in spa) than when it was followed by a vowel (/s/ in sap) (11%).

Another study that has been presented as supporting onset-rime precedence is one by Kirtley, Bryant, MacLean, and Bradley (1989). Using an oddity task with CVC words, the authors showed that 5-year-old children performed above chance (42% correct choices) when the odd word differed from the other ones by the initial consonant, which in this case was also the onset (e.g., man, mint, mug, *peck*) but not (29%) when the difference was located in the final consonant, a part of the rime (e.g., pin, gun, men, *hat*)[1]. In a second experiment with 5-, 6- and 7-year-old children, performance was better in all three groups when the difference involved either the whole rime (top, hot, *rail*) or the single-consonant onset (doll, deaf, *caf*) rather than only the last consonant (mop, whip, *lead*). In the latter task, the pre-readers were again at chance level (33.9%), while the older children performed above chance. However, the inferiority of the final consonant task relative to both the rime task and the onset task persisted and even tended to increase in the older children. In other words, the results are consistent with the notion of better access to onsets and to rimes than to phonemes across the age ranges covered by the study but do not support the hypothesis of a difference specific to pre-readers. In fact, similar conclusion applies to most of the studies described by Treiman (1992) in her review concerning the role of intrasyllabic units in pre-readers and early readers.

On the other hand, clearly negative results concerning the role of syllabic constitutents were obtained by Seymour and Evans (1994, Exp. 1) with a set of free segmentation tasks consisting of separately pronouncing either the onset and the rime, the onset, the nucleus and the coda, or all four phonemes of a monosyllabic word. Each task was introduced by having the child perform a blending task in which the corresponding fragments were pronounced by the experimenter and the child had to combine them into a word. Kindergarten children failed completely in all the segmentation tasks. Older first-graders were more successful, but they performed better on the phoneme task than on those involving larger units.

Apart from the studies we have just been considering and which were inspired directly by the hierarchical view, the results of earlier studies carried out in the framework of the phoneme-syllable dichotomy are nevertheless relevant to the present concern. On the one hand, it has been abundantly demonstrated that pre-reading children (Bradley & Bryant, 1983; Knafle, 1974; Lenel & Cantor, 1981; Lundberg, Olofsson, & Wall, 1980; MacLean, Bryant, & Bradley, 1987; Stanovich, Cunningham, & Cramer, 1984), illiterate

[1] However, this result was not replicated by Content and Bertelson in an independent study with the same task and similar (though French) CVC words in which the Belgian kindergarten children they tested achieved the same performance (32%) in the two conditions (described by Bertelson & de Gelder, 1991, pp. 404–405). When the critical fragment of the words was either the initial CV or the final VC (the rime), performance rose in both conditions to 38%. This other finding, which raises doubts about the particular status of the rime compared to other multi-segment sequences, is also in contradiction with the data of Kirtley et al. (1989).

adults (Bertelson et al., 1989; Morais et al., 1986), and non-alphabetic readers (de Gelder et al., 1993) can produce, detect, and manipulate rhymes, which in most languages involve the rime of a word's last syllable. As we noted elsewhere (de Gelder et al., 1993), the good performance with rimes was not considered as evidence for a specific level of description, because rimes are themselves syllables.

In contrast, the evidence regarding onset segmentation was often negative. A good deal of the data which at one time were presented as demonstrating the poor phonemic segmentation performance of the same non-alphabetically literate populations were focused on the initial consonants of CV-initial utterances, which in terms of syllabic structure are of course onsets (Bertelson et al., 1989; Bruce, 1964; Calfee, Chapman, & Venezky, 1972; de Gelder et al., 1993; Morais et al., 1979, 1986; Read et al., 1986; Rosner & Simon, 1971). In most of the latter studies, the task consisted of deleting the initial consonant-onset, and deletion tasks have often been found to be more difficult than detection or comparison tasks (Stanovich et al., 1984; Yopp, 1988). It has sometimes been argued (Goswami & Bryant, 1990; Stanovich et al., 1984) that the additional difficulty was due to a cognitive factor independent of the linguistic level of the target fragment. This proposal, however, is inconsistent with the fact that deletion becomes easy when the target is a syllable (Bertelson, Morais, Cary, & Alegria, 1987; Bertelson et al., 1989; de Gelder, 1990; Morais et al., 1986). Bertelson et al. (1989) have argued that a more plausible reason for the specific difficulty of consonant deletion is that it requires more explicit identification of the target than do detection or comparison tasks, which might be performed on the basis of global impressions of similarity. However, it is to be noted that, nevertheless, difficulty with initial consonants has also been found with detection tasks (Morais et al., 1986).

The possibility that deletion tasks might tap different aspects of processing than do comparison tasks was strongly suggested by Content, Kolinsky, Morais, and Bertelson (1986) in their study of the effect of corrective feedback on consonant deletion in pre-readers. They first showed (Exp. 1) that if pre-readers, as shown in other studies, are originally unable to delete initial single-consonant onsets, they can make significant progress within a single session when provided with corrective feedback. In another experiment (Exp. 3) they found that kindergarten children could match syllables on the basis of initial single consonants better than on the basis of final ones, a result that was consistent with that of Kirtley & al. (1989) but that produced exactly the opposite pattern in deletion: better performance with *final* than with *initial* consonant.[2]

[2]The effect of position was significant by items but not by subjects for deletion, and the opposite pattern of significance was obtained for comparison.

The main purpose of the present study was to examine the idea of development precedence of onsets using the demanding initial consonant deletion task. Two main questions were asked. First, do pre-readers delete initial consonants better when they constitute the whole onset than when they are part of a consonantal cluster? Second, does the eventual onset superiority disappear with progress in reading ability, or does it persist for older subjects, as was found with other tasks? Given that the existing evidence for the onset precedence idea is based principally on the application of comparison tasks, a same-different task was conducted parallel to the deletion task in the two first experiments.

In every experiment, two separate groups of children worked with single-consonant onset (CVCC) or cluster onset (CCVC) utterances. Corrective feedback was provided after each trial. The effect of onset structure could thus be examined at the levels of both initial performance and later progress.

Experiment 1: Kindergarten and first-grade children

Children from kindergarten and from first grade were tested on initial consonant deletion and on initial consonant comparison, with either single-consonant or consonantic cluster onsets. At each grade level, separate subgroups worked with each onset structure throughout.

Method

Tasks and material. The material consisted of familiar Dutch monosyllabic words, all 4-phoneme long. In one condition all the words had a CVCC structure (e.g.: *berg*); in the other structure was CCVC (e.g.: *kring*).

Two speech-analysis tasks were administered. In the *comparison* task, two words were pronounced by the experimenter and the child had to say "het zelfde" (the same) or "niet het zelfde" (not the same), depending on whether the words had the same initial consonant or not. The experimenter explained, "I will say two words, and you must tell me if they sound a little the same." She then presented the first practice pair (*mild-mars* in the CV condition, and *klein-kwal* in the CCVC condition) and asked the child to make a decision. She gave feedback on the results: if the child correctly said, "The same", she said "Very good." If it said "Not the same", she corrected, "No, 'mild' and 'mars' (or 'klein' and 'kwal') do sound the same." After three more practice pairs, one "same" and two "different," she proceeded with 40 experimental pairs, providing corrective feedback after each trial. Half the pairs required a positive response, the other half a negative one.

On each trial of the *deletion* task, the experimenter pronounced a word and the child had to pronounce what remained of that word after the deletion of the initial consonant. The instructions were, "I will say a word and you must say a word that goes with it. I'll say 'berg ('kring') and you must say 'erg' ('ring')." The experimenter gave three more examples, each time providing the response. She then proceeded with the 40 experimental trials, each followed by appropriate corrective feedback ("Very good" or "No, you should have said ... "). For some words, the remaining fragment was itself a word;

for others it was a pseudo-word. An a posteriori examination of the data showed that this difference had no effect on performance.

Subjects. Subjects were (a) 20 kindergarten children (mean age 5.8; range 5.7–6.2), and (b) 40 first-grade children (mean age 7.0; range 6.7–8.0) with nine months of reading instruction from a public school in Tilburg. Each child participated in one session. There were equal numbers of girls and boys in each group.

Procedure. One week before testing on speech analysis, all the children were administered a letter-recognition task in which they were shown all the letters of the alphabet (except *Q*, *W*, and *Y*) and were asked to identify them. Either the letter names or the associated sounds were accepted as correct responses.

In the speech-segmentation tasks, half the children of each grade level worked under the CVCC condition throughout, and the other half under the CCVC condition. Allocation to conditions was based on sex and performance on letter recognition, so that the subgroups working with the two syllabic structure were always comparable regarding these two variables.

Results

Kindergarten children

Mean percent correct responses in the two tests for the first and last 20 trials of the session under each of the two conditions appear in Fig. 1.

For the *deletion* task, performance was constantly close to zero in both conditions. In a MANOVA with two factors – Conditions as a between-subjects factor and Practice (first vs. second half of the session) as a within-subjects one–the effect of Condition was non-significant, $F < 1$, while the effect of Practice fell just short of significance, $F(1, 18) = 4.31$, $p = .055$. The Condition by Practice interaction was significant, $F(1, 18) = 6.44$, $p = .02$. This outcome corresponds to the fact that in group CVCC, performance, in spite of its low level in the first half of the session, still fell in the second half, while no such trend occurred in the other group. There is no obvious explanation for this pattern.

For the comparison task, the percent correct remained in the vicinity of the chance 50% value for both conditions, but with a slight superiority for condition CVCC. By MANOVA, neither the effect of condition, $F(1, 18) = 1.86$, $p = .095$, of Practice, $F < 1$, nor their interaction, $F < 1$, was significant.

First-graders

In the deletion task, performance improved gradually during the session in both conditions, and the improvement appears to have been more pronounced in group CVCC. In the two-factor MANOVA, the effect of Practice was significant, $F(1, 38) = 10.06$, $p = .002$, that of Conditions fell short of significance, $F(1, 38) = 3.91$, $p = .056$, and the interaction was non-significant, $F(1, 38) = 1.56$, $p = .11$. However, the 2-tailed F-test by which the Condition effect was judged non-significant takes no account of the fact that the observed superiority of performance in the CVCC condition was predicted. In consequence, a Student's test for independent samples was applied, which gave $t(38) = 1.98$, p(1-tailed) $= .028$.

In the comparison tasks, there was no apparent difference between the conditions, but there was a suggestion of a small within-session improvement. By MANOVA, however, neither the effect of Conditions, $F(1, 38) < 1$, that of Practice, $F(1, 38) = 1.46$, $p = .12$, nor their interaction, $F(1, 38) < 1$, was significant.

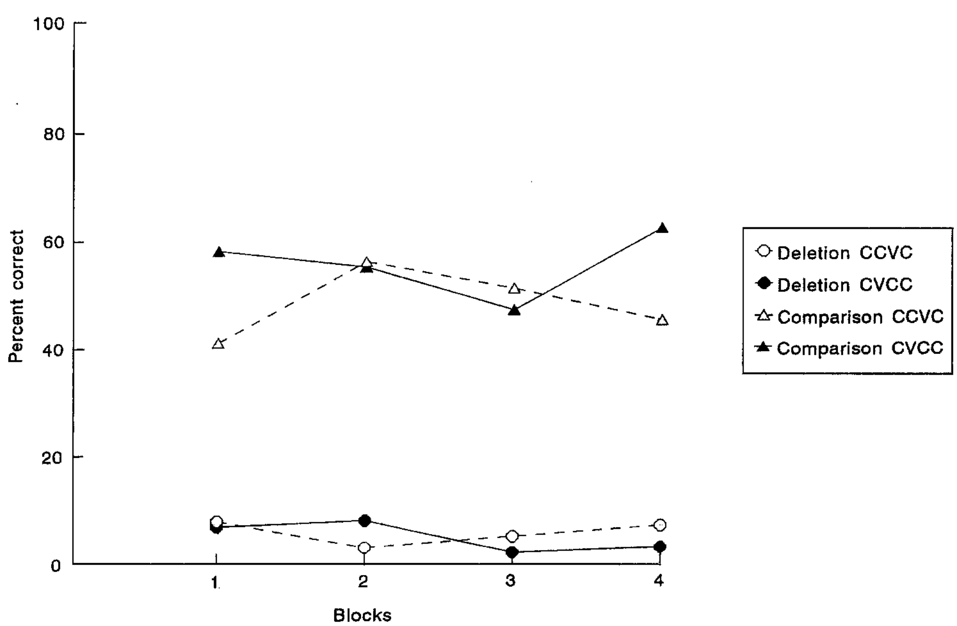

Fig. 1 Exp. 1, kindergarten children. Mean percent correct responses in the two tasks, in successive blocks of 10 trials

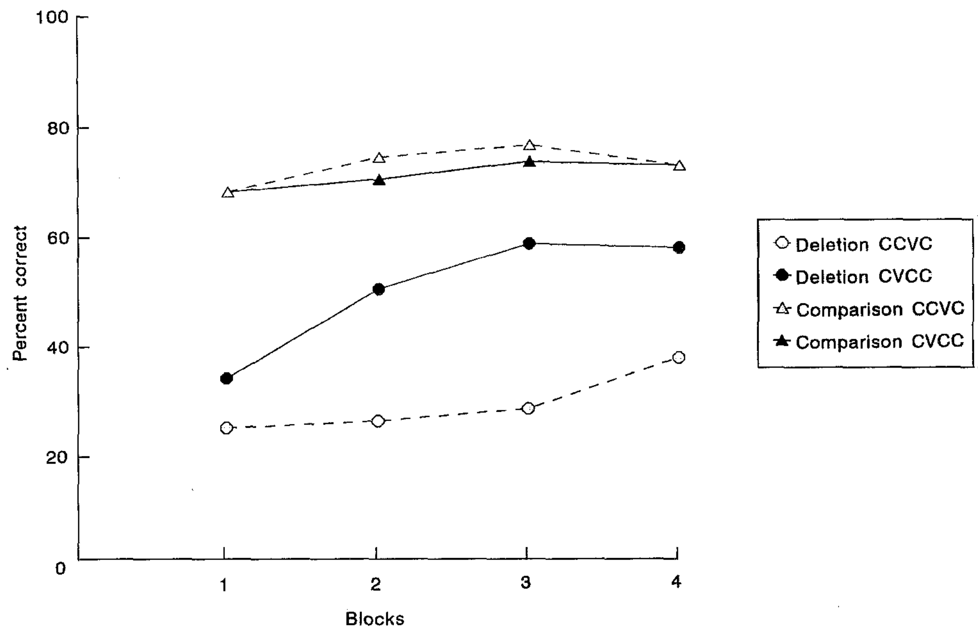

Fig. 2 Exp. 1, first-graders. Mean percent correct responses in the two tasks, in successive blocks of 10 trials

Discussion

In kindergarten children, performance in the deletion task was at floor level throughout the session in both conditions, and in the comparison task it likewise remained at chance level, around 50% correct, in both conditions. Apparently, the tasks were too difficult for this group of children, even under the CVCC condition. This might mean that, contrary to the onset precedence hypothesis, the representation of onsets does not emerge prior to reading instruction. However, an alternative possibility is that the present pre-readers simply did not understand the cognitive operations required by the tasks. The question will be considered again in Exp. 3.

In first-graders, typically different patterns of performance were observed in the two tasks. In the deletion task, the performance was better in the CVCC than in the CCVC condition. The superiority in overall performance was accompanied by a steeper training effect, but the latter difference fell short of significance. In the comparison task no performance difference between the two conditions was observed. In this task, however, overall performance was well above chance level. (Of course, there is no clear chance level for deletion.) Thus, comparisons on the basis of the initial consonant could be performed in both phonological contexts with about the same degree of success. It might be the case that deletion and comparison tap on different operating modes, differently sensitive to the contrast between the phonemic and the onset level.

For deletion under the CVCC condition, the first-graders reached only a final performance of the order of 55%. In the same task, Belgian first-graders tested by Alegria and Morais (1979) achieved an average score above 80%. Although we have no explanation for this discrepancy, it is clear that the segmentation ability of the present group of children does not reflect the full effect of reading instruction. For this reason, the same two tasks were applied in a new experiment to more experienced readers of the second grade.

Experiment 2: Second-graders

Two groups of 20 second-graders were tested on the initial consonant deletion and comparison tasks used in Exp. 1 in February-March of their second school year, i.e., 17 months after the start of reading instruction. Allocation to conditions CVCC and CCVC was based, as in Exp. 1, on performance on the letter-recognition task. Each child was administered 4 practice and 20 experimental trials on each task. In each group, 5 children started with the deletion task and 5 with the comparison task.

Performance per successive blocks of 5 trials in each of the 2 tasks appears in Fig. 3.

For the comparison task, little difference between the two conditions was apparent. In a MANOVA with Conditions and Order (Deletion-Comparison vs. Comparison-Deletion) as between-subject factors and Practice (trials 1–10 vs. 11–20) as a within-subject factor, no main effect nor any of their interactions reached significance.

For the deletion task, performance was better in condition CVCC, where it stayed at about 80% correct across the session, than in CCVC, where it remained below 60%. By MANOVA, the effect of Conditions was significant, $F(1, 36) = 7.4$, $p = .01$, as well as that of Practice, $F(1, 36) = 5.9$, $p = .02$, while the Conditions × Practice interaction was non-significant ($F < 1$),

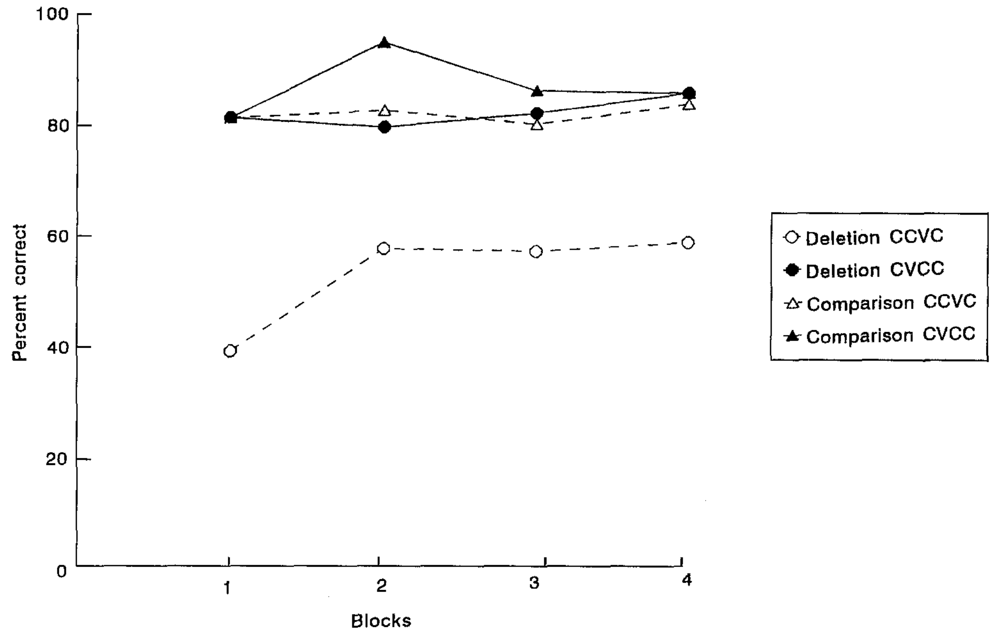

Fig. 3 Exp. 2, second-graders. Mean percent correct responses in the two tasks, in successive blocks of 5 trials

as well as the effect of Order ($F < 1$) and all other interactions.

A clear answer to the initial question was thus obtained for the deletion task. The performance of the present subjects in the CVCC condition shows the full effect of reading instruction, and their performance in the CCVC condition is still at a significantly lower level. Thus, the form of onset-on-phoneme segmentation superiority which is observed in the deletion task is not one that disappears immediately under the effect of alphabetic reading instruction. In the comparison task no difference between the conditions was again apparent. The suggestion that the two tasks might reveal different processes is thus upheld.

Experiment 3: Kindergarten children with a puppet procedure

In Exp. 1, kindergarten children performed at floor level under both conditions in the two tasks. As a consequence, there was no opportunity to address the question of an effect of condition. It was noted that the low performance level could reflect a cognitive difficulty rather than the absence of the relevant explicit phonological representations. In studies of metalinguistic abilities in pre-school children, the tasks have often been presented as games involving make-believe dialogues between puppets. For instance, in the study by Content et al. (1986), in which pre-readers provided with corrective feedback learned onset deletion, one puppet, described as speaking incorrectly, uttered the items, and the other, the "corrector," provided the responses. Initially, the experimenter manipulated both puppets, and then the corrector puppet was given to the child, who thus had to find the responses. To further facilitate understanding of the task, each child was first tested on problems involving deletion of a constant initial syllabic vowel before the task was shifted to the more difficult consonant-deletion task. It was expected that a similar procedure might raise kindergarten children's consonant-deletion performance into the range in which differences linked to the linguistic status of the target might manifest themselves.

Given the failure to obtain condition effects in the comparison task in Exps. 2 and 3, it was decided to limit the present investigation to the deletion task.

Two new groups of kindergarten children were administered the initial consonant deletion task under conditions replicating as closely as possible those of Content et al. (1986, Exp. 1) : the task was presented as a dialogue between puppets, it was first applied with vowels, and the target phoneme to be deleted was the same throughout for each child. Also as in Content et al., the material consisted only of pseudo-words, each of which produced another pseudo-word after deletion of the critical phoneme. Finally, a selection operation was added to the procedure: children who did not reach a criterion of performance on vowel deletion were not tested on consonant-deletion.

Method

Tasks. The two main tasks were *initial vowel deletion* and *initial consonant deletion.*

Each item in the vowel-deletion task was a dissyllabic pseudo-word starting with the syllable /a/ followed by either a CV (e.g., amo) or CVC (e.g., anap) syllable. The task was to produce the second syllable alone. There were 4 examples and 24 experimental items.

For initial-consonant deletion we used 4 different tests, each comprised of 4 examples and 20 experimental items that were all

Dutch pseudo-words. In two versions, all items were CVCC syllables, with /s/ as the initial consonant in one version (e.g., /sork/), and /k/ (e.g., /kolk/) in the other. In the two other versions, items were CCVC syllables, with again /s/ as the initial consonant in one version (e.g., /skep/), and /k/ (e.g., krif) in the other. Initial /s/ was followed by either /k/, /l/, /m/, /n/ or /t/, and initial /k/ by /l/, /n/, /r/ or /w/.

Procedure. Each child was first administered the vowel-deletion task. The experimenter showed the child two puppets and invited her or him to give each one a name. She explained that puppet *X* could not speak well and made many errors, while *Y* spoke very well and could correct *X*'s mistakes. She gave four examples in the following form. *X*: "Ako." *Y*: "No, no. Not 'ako' – 'ko'." After the four examples, she concluded, "You see, *X* always says something too much at the beginning and *Y* takes it off. Now, you are *Y* and you correct *X*." Then, playing the role of *X*, she uttered experimental items. When the child produced the expected correction, she said "Very good." When it failed, she gave the correction: "*X* said 'apon'; you, *Y*, should have said 'pon'." The experimenter uttered experimental items until the child reached a criterion of 6 correct responses in 9 successive items, or until 24 items had been presented. Children who had not reached the criterion by then were not submitted to any further testing.

The child was then administered the same letter-recognition task as in the preceding experiments and sent back to the classroom. He or she was called back half an hour later for the consonant-deletion task.

Six children, three girls and three boys, were tested on each of the four consonant-deletion tests. Allocation was organized in such a way that mean performance on vowel deletion (number of items to reach criterion) and on letter recognition were comparable for the four sextets. The experimenter explained that the same game would be played as before, but that the items uttered by *X* would be somewhat different. She gave the four examples, manipulating the two puppets herself again, then handed puppet *Y* over to the child. Corrective feedback was provided after each trial, just as for the vowel-deletion task.

Subjects. Thirty-four children from a public school in Tilburg were tested, of whom ten were discarded for having failed to reach the criterion on the vowel-deletion task.

Results

Mean performance of each child on consonant deletion in each half of the experimental session was submitted to a three-factor MANOVA with Conditions (CVCC vs. CCVC) and Target (/s/ vs. /k/) as between-subject factors, and Practice (trials 1–10 vs. 11–20) as a within-subject factor. The effect of Targets was not significant ($F < 1$); neither was its interactions with both Conditions and Practice ($F < 1$). The effect of Conditions fell just short of significance, $F(1, 20) = 3.36$, $p = .082$, but that of Practice was significant, $F(1, 20) = 6.14$, $p = .012$, as well as the Conditions × Practice interaction, $F(1, 20) = 9.76$, $p = .005$.

Mean performance per Condition for successive blocks of five trials appears in Fig. 4. Performance starts at the same low level ($\pm$ 15%) in the two conditions and stays there in condition CCVC, while it improves continuously in condition CVCC.

Discussion

In contrast to those of Exp. 1, the pre-readers tested in the present experiment under the CVCC condition achieved significant intra-session progress, just like those of Content et al. (1986). The low performance of the first group of children probably resulted from a failure to understand the very principle of the deletion operation required by the task. In the present experiment, special care was applied to insure such understanding. The two critical steps were presumably: (1) introducing the deletion task with the easy vowel targets, and then (2) limiting testing on consonants to those children who had demonstrated a sufficient level

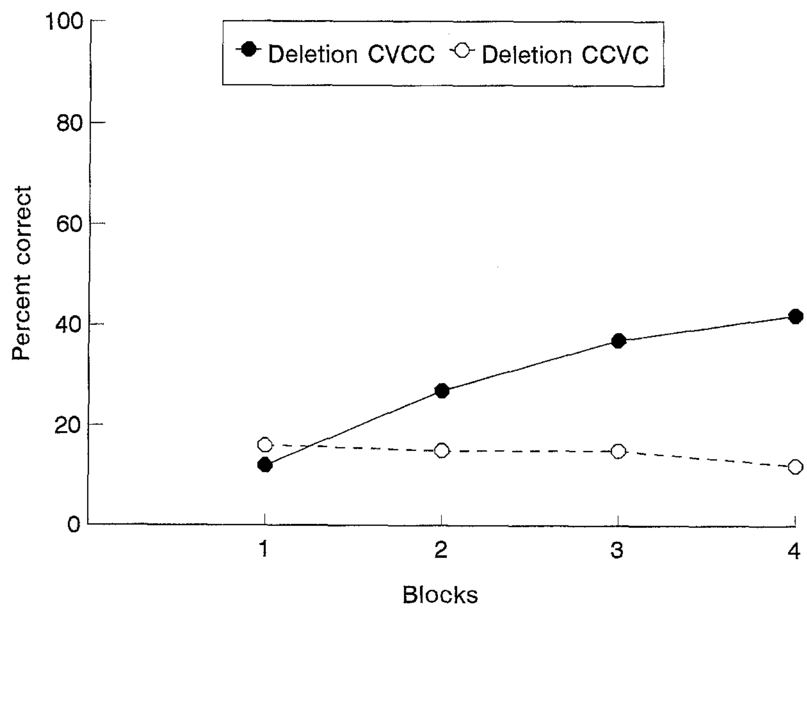

Fig. 4 Exp. 3, kindergarten children tested with a puppet procedure. Mean percent correct responses in the task for initial consonant deletion in successive blocks of 5 trials

of mastery with vowels. With performance on the CVCC material off the floor, the greater difficulty of the CCVC material could be demonstrated.

The contrasting results of the two groups of pre-readers are consistent with the notion that success in metaphonological tasks depends on both access to the target fragments and an understanding of the particular cognitive operation required by the task (Bertelson et al., 1987; Bertelson, 1993; Morais et al., 1987; Stanovich et al., 1984).

General discussion

Relatively clear answers have been obtained to the two questions asked in the Introduction.

First, under the influence of corrective feedback, pre-readers can learn to delete initial consonants when they constitute the complete onset, but not when they are part of a cluster. This result, which duplicates for the deletion task those obtained previously with detection and comparison tasks, was obtained only when adequate precautions were taken (in Exp. 3) to insure that the children understood the principle of the sound-deletion task. The failure of the pre-readers tested in Exp. 1 to perform consonant deletion in any of the two conditions was presumably due to a lack of such an understanding.

Second, the effect of onset structure persists in first- and second-graders. This result confirms earlier reports of onset superiority in reading-age children obtained with other tasks (Kirtley et al., 1989; Bruck & Treiman, 1990) as well as with initial-consonant deletion itself (Morais, Cluytens, & Alegria, 1984). Presumably, onset superiority disappears only when performance reaches the ceiling, even in the cluster condition. It is thus not the case that the phoneme-segmentation ability brought about by reading acquisition rapidly eliminates the superior facility of complete onset segmentation.

The same-different comparison task was run in Exps. 1 and 2 parallel to deletion because earlier demonstrations of onset-on-phoneme segmentation precedence, as shown in the Introduction, had been obtained with either detection or comparison tasks. It turned out that our first- and second-graders achieved the same level of performance with both onset structures. One possible reason why a difference in accessibility between phonemes and onsets that was clearly revealed in the deletion task would go undetected in a comparison task is that comparing two utterances does not require the same explicit identification of the target fragment as does deleting that fragment, a idea already mentioned in the Introduction. Of course, it must still be explained why evidence for onset precedence was obtained by Treiman (1985) in a detection task and by Kirtley et al. (1989) in an oddity task, and not by us in the present same-different judgement task. It might be the case that comparison tasks are not as homogeneous as we have been implicitly assuming.

The results obtained with the deletion task are consistent with the onset-rime precedence hypothesis, and they contradict the disjoint development proposal of Seymour & Evans (1994). However, the implications of those data should not be exaggerated. Only one prediction from the hypothesis, the one concerning deletion of a complete onset consonant vs. a consonant in a cluster, has been put to the test. Although the results support this particular prediction, they can also be accounted for by other ideas. Another possibility is stronger cohesion between consonants within a cluster than between a consonant and the following vowel. Obviously, other predictions, like those concerning final vs. initial consonants, or initial CV vs. final VC, concerning which we saw in the Introduction that the present evidence is somewhat inconsistent, should be tested before stronger conclusions are drawn.

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