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Using visual support in preschool phonemic segmentation training

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Abstract. In an earlier training study we found that the use of visual support in phonemic segmentation training provided no additional value for poor readers and spellers from schools for children with learning disabilities, having problems segmenting speech (Kerstholt, van Bon & Schreuder 1994). Previous research (e.g., Hohn & Ehri 1983) suggests, however, that visual support – such as alphabet letters – does facilitate the segmentation teaching of *preschoolers*. Hence, it was expected that visual support would be beneficial in phonemic segmentation training only *prior* to formal reading and spelling instruction. The purpose of the present study was to test this expectation. One group of preschoolers was trained in phonemic segmentation with diagrams and alphabet letters as visual support, another group was trained without visual help. Results show the preschoolers to improve their phonemic segmentation, reading and spelling skill significantly. It made no difference, however, whether the children were trained in phonemic segmentation with or without the help of visual support. The findings of the present study and those of our earlier study indicate visual support to be useful in phonemic segmentation training only under certain conditions. It is suggested that differences in orthographic properties of the languages involved may explain the difference between the Anglo-Saxon studies that did show an additional effect of letters and a number of Dutch studies that did not.

Key words: Decoding skill, Early intervention, Language, Phonological awareness, Spelling acquisition

Introduction

There is ample evidence that phonemic segmentation can be taught to preschoolers (e.g., Cary & Verhaeghe 1994; Hohn & Ehri 1983; Lundberg, Frost & Petersen 1988; Treiman & Baron 1983). Even more important, several training studies have indicated that training in phonological skills prior to formal reading and spelling instruction is beneficial for subsequent reading and spelling achievement (e.g., Ball & Blachman 1991; Blachman, Ball, Black & Tangel 1994; Bus 1985). Or, as Treiman and Weatherston have noted: ‘Such instruction helps children grasp the alphabetic principle and become successful readers’ (1992: 180). Hence, it can be assumed that phonemic segmentation instruction does not necessarily have to be delayed until formal reading and spelling instruction in elementary school starts. Moreover, as it has been shown that preparatory phonemic segmentation training has positive effects on later learning to read and spell, such training may be beneficial for children that are at risk for developing reading and spelling problems. Thus, it may be useful to teach segmentation to preschoolers in order to avoid reading and spelling difficulties later on.

The present study deals with the question whether preschoolers can benefit from visual support in phonemic segmentation training. This question is addressed in particular, because the findings of a recent training study on phonemic segmentation suggest that visual support – diagrams or alphabet letters – may not be helpful to all children or under all circumstances (Kerstholt, van Bon & Schreuder 1994). In that study, the way in which children with reading and spelling problems respond to different phonemic segmentation training programs was examined. In line with the findings of studies with preschoolers (Hohn & Ehri 1983; Lewkowicz & Low 1979), it was expected that poor segmenters from elementary schools who have had formal reading and spelling education, would benefit from phonemic segmentation training that uses diagrams and/or alphabet letters as visual support. To test this hypothesis, poor readers and poor spellers, who were weak in phonemic segmentation skills, received one of three types of computer-assisted training programs. Two programs used diagrams and/or alphabet letters as visual support. In the third program the children practised phonemic segmentation in a merely auditory fashion. It was expected that the children in the training programs using visual support would perform at a higher level on phonemic segmentation, reading and spelling tasks than the children in the auditory training program. Furthermore, since phonemic segmentation was hypothesised to be instrumental in early stages of literacy acquisition, superior performance on reading and spelling posttests were expected. The results of the study of Kerstholt et al. revealed the children to improve their phonemic segmentation, reading and spelling ability, but the three programs had no differential effects.

The facilitating effects of visual support in prior phonemic segmentation training

The finding that letters have no facilitating effects in remedial phonemic segmentation training is inconsistent with the outcomes of studies on preschool phonemic segmentation training, showing training supplemented with visual support to be a better way to train phonemic segmentation than a merely auditory method (e.g., Bradley & Bryant 1983; Hohn & Ehri 1983). The possibility exists, however, that the different groups of subjects – older children with reading and spelling problems versus preschoolers – account for the contradictory findings. The conflicting findings may indicate that preschoolers and older children with learning disabilities cannot be treated in the same way. Hence, it would be interesting to replicate our previous study but now with preschoolers as subjects. If the group of subjects make out the difference, it can be expected that preschoolers – in contrast to older children with reading and spelling problems – will benefit from the way we used letters in phonemic segmentation training in our 1994 study.

In order to explain why visual support could be helpful in teaching preschoolers to segment but has no surplus value in remedial segmentation training, it is useful to consider the manner in which diagrams and letters could influence phonemic segmentation learning. Diagrams consist of a row of squares representing the number of speech sounds in a word. Usually, the child is required to place a counter in the appropriate square and simultaneously pronounce the sound (Elkonin 1973). The diagrams may be functional in supplying information about the number of segments in the word to be segmented. This information can be useful in late stages of word segmentation, if the child is about to omit a phoneme of a consonant cluster, or to leave a cluster unsegmented. The number of remaining squares in the diagram will then confront the child with the information about the number of segments left to specify.

Alphabetic letters, in the first place provide information about the identity of phonemes. The graphemes remind the child of the (phonemic) elements that can be used in executing the segmentation task. Furthermore, the letters may serve as a mnemonic aid, that is, if every phoneme is represented by the corresponding grapheme, the phonemes that are already mentioned need not be remembered. Consequently, the working memory of the child will then be less burdened. Moreover, by representing phonemes with their written counterparts the child can also deduce from this visual counterpart where to continue segmenting. Finally, the use of letters provides corrective feedback that may be more effective than the feedback provided orally by the experimenter. As graphemes are visible entities, the feedback provided is less fleeting than the oral corrections given by the experimenter.

If visual support is only instrumental in phonemic segmentation training prior to formal reading and writing instruction, preschoolers and older children with segmentation problems obviously will not be influenced by visual support in the same way. A number of explanations for such finding are possible. For example, preschoolers may benefit from diagrams because they usually do not have word knowledge of individual words yet. As they have to rely completely on the speech stream while segmenting, the availability of diagrams may be helpful because they render the structure of a spoken word in a simplified way. That is, the diagrams show at the outset the number of segments a word consists of. Teaching preschoolers in addition grapheme-phoneme correspondence rules may lead to an even more improved representation of a word's structure in that the identity of the phonemes can also be derived.

Other researchers have also stressed the importance of finding the identity of phonemes as a basis for further success in reading and spelling. Byrne and Fielding-Barnsley (1990, 1991, 1993), for example, have provided ample evidence for the suggestion that successful instruction in phoneme identity is associated with acquisition of the alphabetic principle. The results of there studies were furthermore consistent with the claim that phonological awareness and letter knowledge in combination are necessary but not sufficient for acquisition of the alphabetic principle.

Poor segmenters in elementary schools as a rule are able to divide words with a simple structure into component phonemes (Kerstholt 1995). They probably already have some insight into the structure of spoken language. However, they have persistent difficulties with the segmentation of complex words or word parts and for these problems the diagrams and the letters used in the way we did in our previous studies (Kerstholt, van Bon & Schreuder 1994) may simply not provide the right clue. For example, informing these poor segmenters about the number of segments may not be sufficient because they may be aware that a word contains, for instance four segments, but have difficulty breaking up these complex speech sound clusters (Schreuder & van Bon 1989; Treiman & Weatherston 1992).

Teaching preschoolers to segment with the help of visual support

In the present study, the effects of phonemic segmentation training with visual support were examined to determine whether the visual support used in the 1994 study does help preschoolers, as opposed to poor segmenters, to acquire phonemic segmentation skill.

We were primarily interested in the question whether visual support has an additional value in teaching preschoolers to segment. The comparison of the effects of visual support is adopted as the key question of this study. It was argued that a number of training studies already has provided substantive evidence to assume that preschoolers can be taught to segment and that such early phonological training can have favorable effects on the subsequent reading and spelling abilities of these children (e.g., Ball & Blachman 1991; Bradley & Bryant 1983). A no-treatment condition could therefore be left aside and the treatment without visual support (further referred to as standard treatment) could be considered as the control condition.

Two different training programs were compared. In one training program, the *visual support treatment*, the children are trained with the help of both letters and diagrams. This visual support was given with the help of a device, which we refer to as the *segmentation board*. In the other program, the children are trained in phonemic segmentation without any kind of visual support, the *standard treatment*. The present study corresponds to the 1994 study in that the same types of visual support are used. The two studies, however, differ in three aspects: (1) preschoolers, instead of older children with reading and spelling problems participated in the present study, (2) no computer was used, and (3) only the treatment using both types of visual support was contrasted with the merely auditory treatment.

In accordance with the findings of earlier training studies with preschoolers as subjects, we expected that children who are trained with letters and diagrams as visual support would surpass others on a phonemic segmentation, a reading and a spelling posttest.

Method

Subjects. The subjects were 29 preschoolers (16 boys and 13 girls) from preparatory classes in two public schools. The mean age of the children was 6 years, 3 months. Not all children from the two kindergarten classes participated in the study. Only children who, according to their teachers, were ready to go to the first grade of elementary school after the summer holidays were included in the sample.

Prior to training, the children learned to match eight phonemes to their written counterparts (a, u, i, m, k, r, s, t). These letters were chosen from the total sample of 36 grapheme-phoneme correspondences, because they are phonetically most distinct from each other in the Dutch language (Nooteboom & Cohen 1984). Each letter was printed on a card and the children practised naming the sound of the eight randomly presented letters for seven sessions (the total practice time was approximately 60 minutes). If necessary, the experimenter gave corrective feedback in every session but the last (this was the test trial and used as the letter-naming pretest). Next, a phonemic segmentation, reading, spelling and non-verbal intelligence test (Coloured Progressive Matrices, Raven 1956, 1962) were administered. Children who performed very well on the phonemic segmentation test were believed to understand the segmentation principle and were therefore not included in the study. The word material, used in the phonemic segmentation, reading and spelling pretests will be described in the *materials and procedure* section.

Two subgroups were formed with equal distributions of scores on the last trial of the letter-naming task, the three pretests and the Coloured Progressive Matrices (CPM). Subsequently, these groups were randomly assigned to the two treatments, resulting in 15 subjects in the visual support treatment and 14

Table 1. Mean age (in months), mean pretest scores and standard deviations for each of the three treatment conditions

Measure	Max. score	Visual support Mean (SD)	Standard Mean (SD)
Phonemic segmentation	16	2.20 (2.31)	2.29 (2.53)
Letter naming	8	5.73 (2.19)	6.14 (2.38)
Reading	8	0.50 (0.94)	0.57 (1.16)
Spelling	8	1.43 (1.99)	1.71 (1.59)
CPM	9.5	4.93 (1.99)	4.84 (1.59)
Age		75.67 (5.14)	73.21 (4.63)

subjects in the standard treatment. Table 1 displays the mean age (in months), the mean scores on the last letter-naming trial, and the pretest scores of the two subgroups.

The two treatment groups did not differ significantly with respect to mean age, phonemic segmentation, reading and spelling (all F's < 1). The difference in letter-naming ability did not reach conventional levels of statistical significance either [$F(1,28) = 1.82$; $p > 0.10$].

Materials and procedure

The word material used in training and testing sessions was formed by combining the eight letters into all possible phonetically legal words. This resulted in a corpus of 168 pseudowords and 32 real words. Not all the real words will have been familiar to the children. Fifteen of these items had a VC structure, 66 a CVC structure, 59 a CCVC structure, and 60 a CVCC structure.

The items for the phonemic segmentation, the reading and the spelling pre-, intermediate and posttests were randomly taken from this set of 200 pseudo- and real words. The phonemic segmentation pretest used 16 of these items; 6 VCs, 6 CVCs, 2 CCVCs and 2 CVCCs. Only four words in this test were real words. Both the reading and the spelling pretest consisted of four items with a VC structure and four items with a CVC structure. In the reading pretest there were six pseudowords and two real words. The spelling pretest contained five pseudowords and three real words. All tests were administered individually.

Prior to training, the children were tested for their phonemic segmentation, reading and spelling skills (*pretesting)*. The procedure of the test was practised segmenting three words. In the phonemic segmentation test the experimenter said the word to be segmented and asked the child to divide the word into ‘little parts’. Trials were counted correct, only if all word segments were named in the correct order. In the reading test, the eight words were printed on a sheet in a random order. A word was only counted as correct if the child pronounced the whole blend correctly. In the spelling test the experimenter pronounced a word and the children had to spell the word with the help of letter tokens (each showing one of the eight graphemes taught prior to training). The response of the child was registered as correct, if the correct letter tokens were chosen from the total set and were displayed in the right order.

The children were trained individually for eight sessions. There were two sessions per week, every session lasting approximately 15 minutes. In each training session, the children segmented 5 VCs and 10 CVCs. These words were also randomly selected from the total set of words mentioned above. In each session a different set of words was used.

After four sessions a phonemic segmentation, reading, and spelling test were administered (*intermediate tests*). The phonemic segmentation test again consisted of 6 VCs, 6 CVCs, 2 CCVCs and 2 CVCCs. Only five of these were real words. The reading and the spelling test consisted of 4 VCs and 4 CVCs. The words differed from the ones used in the pretesting. The reading test contained seven pseudowords and one real word, the spelling test consisted of six pseudowords and two real words. This intermediate testing was conducted to determine whether the number of errors warranted further training. The procedures of the intermediate tests were the same as those of the pretest.

After the last (eighth) training session *posttests* were administered for letter naming, phonemic segmentation, reading and spelling. The letter-naming test was the same as the one used as pretest. The other three posttests used the same words as the pretest, but these tests were supplemented with other words to avoid ceiling effects. The phonemic segmentation test now contained 10 VCs, 10 CVCs, 4 CCVCs and 4 CVCCs. There were 22 pseudowords and six real words. Both the reading and the spelling posttest consisted of 6 VC, 6 CVC, 2 CCVC and 2 CVCC items. The reading test consisted of 13 pseudowords and 3 real words and the spelling test consisted of 11 pseudowords and 5 real words. The procedures of the posttests were the same as those of the pre- and intermediate tests.

Training

General procedure. The procedures of both training programs were practised with the help of six words.

Visual support treatment. In this treatment condition the subjects were trained in phonemic segmentation with the help of the segmentation board. This board was made of two plates of hard plastic material (32 × 23 cm), which were fitted onto each other in such way that some space was left between the two plates. The upper plate contained three rows of windows, one row consisting of two windows and two rows consisting of three windows. In front of the windows shutters were placed. A sheet with one VC and two CVC words could be placed between the bottom and the upper plate so that each separate letter of a word fell in the middle of a window. The training procedure was as follows. The experimenter mentioned the word to be segmented and pointed at, for example, the second row. Because this row has three windows, the subject at the outset knew how many segments had to be reported. The subject then mentioned the first segment, opened the first shutter, could see the first grapheme of the word, and could verify whether he or she had mentioned the correct segment. Next, the child said the second phoneme and opened the second shutter. Finally, the child mentioned the last phoneme of the word and opened the third shutter. Every error was immediately corrected by the experimenter. For example, when the subject segmented ‘mit’ and said /e/ (as in the English word *bed*) instead of /i/ (as in the English word *sick)*, the experimenter pointed at the grapheme and said: “You don’t see an /e/ in the window, but an?” If the child did not know the correct sound of the letter, the experimenter prompted the sound. “You now know that the second part of the word ‘mit’ is an /i/. Can you tell what the last part of ‘mit’ is? Name the first and second part of ‘mit’ again and tell me what the last part is”. When the child had mentioned all segments of the word and had opened all shutters, the experimenter pointed at the graphemes shown in the windows and asked the subject to say the corresponding sounds. Then the shutters were closed and the experimenter named the next word to be segmented.

Standard treatment. In this treatment condition, the experimenter named the word to be segmented, for example ‘mit’. Subsequently, the subject mentioned the first segment, /m/, and tapped simultaneously with a little pencil on the table. Next, the child named the second segment, /i/, and tapped. Then the child named the third segment, /t/, and tapped again. If the child made an error, the experimenter immediately corrected this in the following way. For example, the child said /m/ – /t/. The experimenter then said: “The second part of the word ‘mit’ is not /t/, but /i/. You now know that the first two parts of ‘mit’ are /m/ and /i/. Do you know what the next part of ‘mit’ is? Repeat the first two parts of ‘mit’ again and tell me what the next part is.” When the subject had mentioned all segments, they were repeated by the experimenter.

Results

The results will be described in the following order. First, the overall performance during training and the results of the intermediate and posttest will be

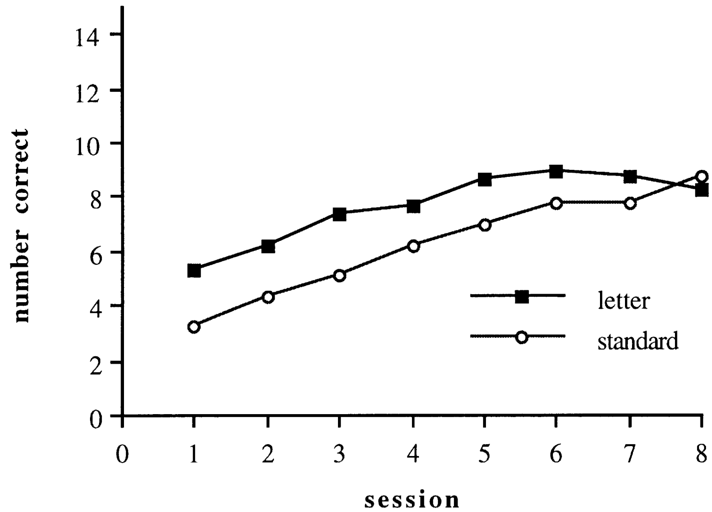

Figure 1. The mean phonemic segmentation scores on the eight training sessions for the two treatment groups.

discussed. Next, the results for the different word structures during training and on the posttest will be described.

Training sessions

In order to examine whether there were differences between the two treatments in phonemic segmentation performance during training, mean phonemic segmentation scores per session were calculated for each treatment group. These mean scores are shown in Figure 1.

A multivariate analysis of variance with treatment as the between subjects factor was conducted to test the linear, quadratic and higher-order components in the polynomial time curve as the within-subjects contrast. The analysis indicated no significant interaction between treatment and time [F(7,21) = 2.32; $p = 0.14$]. The main effect of treatment was also not significant [$F < 1$]. The main effect of time, however, was significant [F(7,21) = 4.68; $p < 0.01$]. The linear as well as the quadratic component in the polynomial time curve were significant [F(1,27) = 38.40; $p < 0.01$ and $F(1,27) = 7.16$; $p < 0.05$, respectively]. Apparently, after an initial increase phonemic segmentation skill levels off.

The results suggest that the children improved their phonemic segmentation skill during training, but it makes no difference in which manner the children are trained. Both treatment conditions appear to be of the same difficulty.

Table 2. Mean scores on the phonemic segmentation, reading and spelling tests after session four and session eight (standard deviations in parentheses)

Test	Phonemic segmentation	Reading	Spelling
After session 4	max = 16	max = 8	max = 8
Letter treatment	5.47 (3.74)	1.53 (2.00)	2.73 (2.92)
Standard treatment	6.57 (4.33)	1.93 (2.90)	3.21 (2.46)
After session 8	max = 28	max = 16	max = 16
Letter treatment	12.53 (9.07)	3.07 (4.06)	4.73 (4.45)
Standard treatment	11.00 (8.15)	4.43 (5.83)	5.29 (5.09)

Intermediate tests and posttests

Table 2 gives the mean scores on the phonemic segmentation, reading and spelling tests administered after session four (intermediate tests) and session eight (posttests) on learning to read and spell.

To test whether there are differences between the two treatments in phonemic segmentation, early reading and spelling performance on the intermediate tests and posttests, these scores were submitted to two separate multivariate analysis of variance with treatment (2) as the between-subjects factor. No significant differences between the two treatments were obtained (for both the intermediate tests and posttests, $F < 1$). The use of diagrams and letters apparently has no facilitating effects in acquiring phonemic segmentation skill, nor does it have positive effects on reading and spelling.

Pretest versus posttest

Phonemic segmentation. In order to verify whether the children improved their phonemic segmentation skill from pretest to posttest, the mean scores on these tests were subjected to an analysis of variance with treatment as the between-subjects factor and time (pretest versus posttest) as the within-subjects factor. These mean scores are displayed in Table 3. Note that for this analysis posttest data are calculated over the words that are common to the pre- and posttest. No interaction between treatments and time was found ($F < 1$). The main effect of treatment was also not significant ($F < 1$). The main effect of time, however, was significant [$F(1,27) = 38.48$; $p < 0.01$, overall pretest means 2.24 and posttest means 7.24].

Reading. Table 3 gives the mean scores on the reading pre- and posttest. An analysis of variance with treatment and time (reading pretest versus reading

Table 3. Mean scores on the phonemic segmentation, reading and spelling pre- and posttests for both treatment groups (standard deviations in parentheses)

Treatment	Test		
	Phonemic segmentation max = 16	Reading max = 8	Spelling max = 8
Visual support			
Pretest	2.20 (2.31)	0.50 (0.94)	1.43 (1.99)
Posttest	7.73 (5.23)	1.73 (2.12)	2.93 (2.87)
Standard			
Pretest	2.29 (2.53)	0.57 (1.16)	1.71 (1.59)
Posttest	6.71 (4.78)	2.57 (3.23)	3.07 (2.87)

posttest) as independent variables, and the reading test scores as a dependent variable showed no significant interaction between treatment and time ($F < 1$). The main effect of treatment was not significant ($F < 1$) either. The main effect of time, however, was significant [$F(1,26) = 16.65$; $p < 0.01$]. The overall means on the pre- and posttest were 0.54 and 2.14, respectively.

Spelling. Table 3 shows also the mean scores on the spelling pre- and posttest. The analysis of variance with treatment and time (spelling pretest versus spelling posttest) as the independent variable and spelling scores as the dependent variable showed no significant interaction between treatment and time ($F < 1$). The main effect of treatment was not significant ($F < 1$). The main effect of time, however, was significant [$F(1,26) = 15.89$; $p < 0.01$, overall means at pre- and posttest were 1.57 and 3.00, respectively].

Letter knowledge. To examine whether the use of letters as visual support has effects on letter knowledge after training, the scores on the letter knowledge pre- and posttest were submitted to an analysis of variance with treatment and time (pretest versus posttest) as the independent variable and letter knowledge scores as the dependent variable. A significant interaction between treatment and time was obtained [$F(1,27) = 8.43$; $p < 0.01$]. The means for the visual support treatment group were 5.73 and 7.0, respectively. The means for the standard group were 6.14 and 5.57, respectively. There were no main effects of treatment or time [$F < 1$, and $F(1,27) = 1.44$; $p = 0.24$, respectively]. Paired *t*-tests indicated that the children in the visual support treatment group had mastered more phoneme-grapheme correspondences at the end of training than prior to training [t (14) = –2.35; $p < 0.05$, two-tailed]. The children in the standard treatment, however did not improve their letter knowledge significantly [t (13) = 0.54; $p = 0.60$, two-tailed].

The foregoing results show the children to improve their phonemic segmentation skill, and early reading and spelling ability from pretest to posttest, but except for letter knowledge, performances under the two treatments improved at the same rate. However, although the performance of the children progressed from pretest to posttest, it is undecided whether these improvements were due to training in phonemic segmentation, because a control group was not part of our study.

Word structure

Performance during training. To assess the possibility that the two treatments have different effects depending on word complexity, an analysis of variance was carried out with the treatment group as the between-subjects factor, and time (8) and word structure (VC and CVC) as within-subjects factors. Testing of the linear, quadratic and other higher-order components in the polynomial time curve as within-subjects contrast revealed no three-way interaction between treatment, word structure and time ($F < 1$), and no interaction between treatment and time ($F < 1$). There was, however, a significant interaction between word structure and treatment [$F(1,27) = 4.51$; $p < 0.05$]. Further analysis of this interaction shows that the children in the visual support treatment and the standard treatment on the average perform equally on segmenting words with a VC structure (means 3.28, s.d. 1.74 versus 3.43, s.d. 1.87). Children in the visual support treatment, however, show on the average superior performances with respect to the segmentation of CVC words (means 4.43, s.d. 4.05 versus 2.83, s.d. 3.13). This finding indicates that visual support becomes facilitative only in segmenting more difficult word structures.

No significant main effect of treatment was revealed ($F < 1$). The main effects of word structure and time were significant [$F(1,27) = 48.33$; $p < 0.01$ and $F(7,21) = 4.44$; $p < 0.01$, respectively].

Intermediate test. Proportions correct for the four word structures of the intermediate phonemic segmentation test were subjected to an analysis of variance with treatment as a between-subjects factor. No significant interaction between treatment and word structure was found ($F < 1$). The main effect of treatment was not significant either ($F < 1$). The main effect of word structure, however, was significant [$F(3, 27) = 39.96$; $p < 0.01$].

Posttest. Proportions correct on the four word structures were submitted to an analysis of variance with treatment as the between-subjects factor and word

Table 4. Mean proportion correct on the four word structures of the phonemic segmentation posttest for both treatment groups (standard deviations in parentheses).

Treatment	Visual support	Standard
Word structure		
VC (n = 10)	0.70 (0.42)	0.71 (0.38)
CVC (n = 10)	0.25 (0.26)	0.20 (0.27)
CCVC (n = 4)	0.18 (0.38)	0.05 (0.11)
CVCC (n = 4)	0.10 (0.23)	0.04 (0.09)

structure (VC, CVC, CCVC and CVCC) as a within-subjects factor. Table 4 displays the mean scores.

The interaction between treatment and word structure was not significant ($F < 1$). The main effect of treatment was also not significant ($F < 1$). The main effect of word structure, however, was significant [$F(1,27) = 45.55$; $p < 0.01$]. Inspection of Table 4 indicates that words with a more complex structure are more difficult to segment. Although the children performed differently on the separate word structures, the pattern of posttest performance was the same for both treatments.

Discussion

The present study was conducted to test the explanation for the difference between our finding of no effect of visual support (Kerstholt et al. 1994) and the finding of earlier training studies showing visual support to have favourable effects in segmentation instruction (Hohn & Ehri 1983; Lewkowicz & Low 1979). As a different group of children was used in our previous study (i.e., poor segmenters who already had been instructed in reading and spelling), we concluded from the results of these studies that preschoolers may benefit from visual support in phonemic segmentation training while poor segmenters with reading and spelling problems appeared not to. We suggested that the lack of competence of poor segmenters might be such that visual support is not sufficient in helping them to overcome their difficulties. In order to determine whether the training method with the visual support used in our previous study is indeed profitable in early stages of segmentation teaching, comparable training methods to teach preschoolers to segment were used in the present study.

The results, however, indicate that our subjects from preschools do not benefit from the visual support either. The preschoolers improved their phonemic segmentation, reading and spelling ability from pretest to posttest, but it made no difference whether or not the training program used visual support. The children in the standard treatment group improved their reading and spelling ability at the same rate as the children in the visual support treatment group, although they did not – as the children in the visual support treatment – improve their letter knowledge significantly.

The finding that preschoolers do not benefit from visual support in phonemic segmentation training is not consistent with the outcomes of the training study of Hohn & Ehri (1983), the earlier study that is most comparable with our study. The results of their study revealed that children who were trained in phonemic segmentation with letters as visual support surpassed the children who were trained without the mediation of letters on a phonemic segmentation posttest. These contradictory findings cannot be explained in terms of differences in amount of training: The two experiments were quite comparable with regard to number of training sessions and duration of training session.

However, not all the training studies on the effects of visual support in phonemic segmentation training report positive effects. Bus (1985), for instance, trained preschoolers in phonemic segmentation and blending with either an auditory program, or an auditory-visual program. A control group received no training. The visual support consisted of words on cards that could be partially hidden. The experimenter hid parts of the word and pronounced the remaining blend. In this way the child was given the opportunity to discover the constituent phonemes of the word. The results of the study indicated that the children in both groups had become better segmenters after training. Thus, no differential facilitating effects of the visual support were found.

The findings of the four different studies (i.e., Bus 1985; Hohn & Ehri 1983; Lewkowicz & Low 1979, and our 1994 study) taken together suggest that visual support is only useful in phonemic segmentation training under specific conditions. In the introduction section, we proposed several possible functions of visual support. Diagrams were expected to be useful by giving information about the number of segments of the word to be segmented. Letters could be instrumental in segmentation training, (1) to provide information about the identity of phonemes, (2) by unburdening working memory, and (3) by providing corrective feedback. As the findings of our previous studies were contradictory to the outcomes of earlier training studies on phonemic segmentation, we concluded from that study that diagrams and/or alphabet letters might have differential effects on different groups of children. However, in the present study with preschoolers we again did *not* find beneficial effects of visual support in initial phonemic segmentation learning. This finding strongly suggests that it is not the group of subjects that made the difference between our previous studies (Kerstholt et al. 1994) and other studies. Perhaps, the explanation for the contradictory findings is to be found in the way visual support is used in the different studies. In the Hohn and Ehri study, the children had to choose independently the appropriate letter from a set of letter markers, and after selecting a marker for each phoneme, they had to pronounce the whole blend again. In this way the letters were not only used as visual support, but other basic aspects of reading and spelling ability were possibly trained as well. The children had first to segment a blend into its component phonemes. Next, they had to match the separate phonemes with their written counter-parts. They had to convert the graphemes into phonemes, and finally they had to blend the separate phonemes into the whole word, in order to read the word aloud. In our training studies the children also segmented blends into their constituent phonemes, but they did not need to select the corresponding graphemes and they did not necessarily have to blend the phonemes again. By using alphabet letters as an active means of reading and spelling, the reading and spelling context of the Hohn and Ehri study was more extensive than the context of both our 1994 study and the present one.

The fact that in the study of Bus (1985), who found no positive effects of visual support either, the letters were also used as visual support rather than as an active means of reading and spelling, is in agreement with the suggestion that the *context* in which letters are used is the crucial factor. In Bus (1985), the experimenter folded away parts of the blend printed on a card, pronouncing the original and remaining blend. The children did not have to blend and spell the words themselves. This suggests that letters only are beneficial in phonemic segmentation training when children are required to actively practise the mapping of phonemes to graphemes and/or to blend the graphemes again into a whole word. In the studies reporting positive effects of letters, the letters not only functioned as visual support but also trained basic aspects of reading and spelling. In contrast to our study, these subjects actually practised the phoneme-grapheme mapping along with blending. The context of, for example, the Hohn and Ehri study can thus be regarded as less restricted than the context of our previous studies (Kerstholt et al. 1994)

To examine whether the more restricted use of visual support might account for the lack of differences in our study, a training study with procedures resembling those in the Hohn and Ehri study has been carried out by our research group (Schoenmaker 1993). In this study, the training of two types of phonemic segmentation with visual support were compared. In the training program with procedures resembling those in our previous study, children with reading and spelling problems were trained with the 'segmentation board' of the present study. The board was adjusted for the use of words with a CVC, CCVC, CVCC, and CCVCC structure (i.e., 4 rows of windows consisting of either 3, 4 or 5 windows), and the procedure was identical to the procedure described in the present study.

In the other training program, the procedures resembled those in the Hohn and Ehri study. Ten separate letter markers were displayed on a holder in front of the subject in alphabetic order. The graphemes were selected in such a manner that a least one word with a CVC, CCVC, CVCC, and CCVCC structure could be composed. The experimenter mentioned the word to be segmented, and the subject was then asked to pronounce each phoneme in isolation and to choose the appropriate letter marker from the holder. Any error was immediately corrected by the experimenter. When the segmentation was complete and the relevant letters had been selected, the subject was then asked to translate the graphemes into phonemes and blend them into an entire word (i.e., read and pronounce the target word).

Once again, no significant differences were found between the two types of training. The program with a less restricted, more active use of visual support did not procedure superior phonemic segmentation, reading or spelling. The context in which the letters are used, therefore, does not account for the differences in results of the present study and the Hohn and Ehri study (1983).

One explanation for the absence of positive effects of letters is left to be considered. This explanation concerns a fundamental difference between our studies and the English-speaking studies, and it pertains to the difference in language. English has a rather irregular orthography and very few one-to-one relationships between phonemes and graphemes. In a language in which phonemes are difficult to represent, explicit representation of every phoneme by means of a grapheme may certainly foster greater insight into the phonological structure of spoken words. In our studies, in contrast, the provision of additional visual support may contribute little extra to the children's grasp of the phonological structure of words. The suggestion of a basic linguistic difference is substantiated by the findings of the Dutch study of Bus (1985) who also found no additional effects for visual support and clearly indicates the need for more extensive cross-linguistic research.

In addition to the difference in transparency for Dutch and English, instructional differences stemming from these differences in transparency might also have contributed to the conflicting findings for Dutch and English. In the Netherlands, children are primarily taught to read with a phonics approach (Reitsma & Verhoeven, 1990). Already in preschool, children are prepared for the acquisition of the knowledge and skills required to apply the alphabetic principle in word identification. In preschool, the focus is already on various phonological skills, such as rhyming, sound to word matching (e.g., "Does man start with /m/?") and segmenting words into syllables. In other words, they already are *introduced* to the fact that spoken words are composed of speech sounds and that in printed words a particular speech sound corresponds to a letter or combination of letters. This phonics approach is advocated internationally by many reading researchers (e.g., Adams 1990; Chall 1983; Liberman & Liberman 1992; Vellutino & Scanlon 1987), who agree that the teaching of phonological decoding forsters early insight into the correspondence between written and spoken language.

English-language reading methods for the instruction of reading, on the other hand, still emphasise knowledge of whole-word spelling patterns even in the initial phases of reading instruction. This focus on whole-word learning may also explain the positive findings in the Anglo-Saxon studies. In these studies, the children receiving visual support may simply have profited from the early emphasis on the correspondences between the written and spoken word-structures (van Bon, Schreuder, Duighuisen & Kerstholt 1994). These two interrelated factors – the more transparent orthography of Dutch and the emphasis on decoding in the Dutch reading curriculum – may explain the absence of training differences in the Dutch studies and thus the contradiction to the English-language studies.

Although the present study did not show differential effects of the two types of training, the study does support the notion that phonemic segmentation is related to learning to read and spell. By computing the correlations between the gain in phonemic segmentation (i.e., posttest minus pretest) and the gain in reading or spelling, it appears that the progress in reading and spelling is associated with advanced phonemic segmentation skill ($r = 0.58$ and $r = 0.53$; $p < 0.01$, respectively).

It is still unclear, however, under which specific conditions letters play a supporting role in phonemic segmentation training. The findings of the present study suggest that the use of letters as visual support does not necessarily facilitate the phonemic segmentation learning process of Dutch preschoolers. However, although no facilitating effects of visual support could be found, no *negative* effects of visual support in the segmentation learning process were found either. On the contrary, the results showed that in the early stages of segmentation training, words with a more difficult word structure were easier to segment when visual support was used. This finding suggests that visual support may be facilitating in training when the segmentation task is more difficult. The notion that visual support in phonemic segmentation training might be helpful should therefore not be rejected yet. It is still possible that under specific conditions visual support is helpful in phonemic segmentation training. The findings of the present study, for example, suggest that visual support becomes facilitative only in segmenting more difficult words. By narrowing down these specific conditions, we might be a step further in finding the most efficient way of teaching children to segment.

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