Literacy training and speech segmentation

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Abstract

New groups of illiterate and ex-illiterate adults, comparable to those of Morais et al. (1979), were given a battery of tasks designed to assess the specificity of the effect of literacy training on speech segmentation. As in the previous study, a strong difference was observed between the two groups on the task of deleting the initial consonant of an utterance. The illiterates displayed the same incapacity to deal with phonetic segments in a detection task and in a progressive free segmentation task. Their performance was better, although still inferior to that of ex-illiterates, on both deletion and detection when the critical unit was a syllable rather than a consonant, as well as in a task of rhyme detection. No significant difference was observed in a task of melody segmentation, on which both groups performed poorly. The high specificity of the differences in performance level implies that they cannot result from an important extent from differences in general ability or motivation between the two groups of subjects. They rather mean that while sensitivity to rhyme and analysis into syllables can develop up to some point in the absence of the experience normally provided by reading instruction, analysis into phonetic segments requires that experience. Finally, in a picture memory task, the illiterates showed a phonological similarity effect, which is consistent with other results suggesting that the use of phonological codes for short-term retention does not require explicit phonetic analysis.

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Introduction

There is a well-documented correlation between the acquisition of alphabetic reading and the ability to deal with speech at the level of sub-morphemic units (see Content, 1984, for a review). Pre-school children generally perform poorly on speech analysis tasks and the majority make important progress once engaged in reading instruction (Alegria & Morais, 1979; Calfee, Lindamood, & Lindamood, 1973; Liberman, Shankweiler, Fischer, & Carter, 1974; Rosner & Simon, 1971). On the other hand, poor or retarded readers exhibit lower performance on such tasks than more proficient ones (Bradley & Bryant, 1978; Calfee et al., 1973; Helligott, 1976; Liberman, 1973; Morais, Cluytens, & Alegria, 1984; Treiman & Baron, 1981).

The reason behind the correlation lies presumably in the fact that, since alphabetic writing represents language mainly in terms of phonemic units, the ability to analyze utterances into such segments would be necessary to acquire text-to-speech and speech-to-text conversion procedures. The role of these procedures in ongoing fluent reading is still a matter of debate but one very likely function, especially in the early stages of acquisition, would be to allow the student to derive pronunciations for words he has not yet encountered in the written form, and thus to increase in autonomous fashion his vocabulary of visually recognizable words (Jorm & Share, 1983).

The correlation would thus reflect the fact that speech analysis is a crucial sub-component of developing reading skill (Bertelson, Morais, Alegria, & Content, 1985). One central question then concerns the conditions of emergence of that ability. Specifically, one is led to ask to what extent the underlying competence develops spontaneously, as an aspect of general cognitive and linguistic growth, and to what extent it requires specific instruction.

There is evidence of a very strong effect of reading instruction on speech analysis. In a study carried out in an agricultural area of southern Portugal, the present authors compared phonetic segmentation ability in illiterate adults and subjects of comparable age and socio-economic background who had attended literacy classes as adults (Morais, Cary, Alegria, & Bertelson, 1979). The task was either to add a particular consonant at the beginning of a spoken utterance or to delete the initial consonant. The illiterates performed at the same low level (less than 20% correct responses) as first-grade Belgian children at the beginning of reading instruction whereas ex-illiterates reached a level comparable to that of second graders (more than 70% correct).

Those results would thus suggest that phonetic segmentation is not attained in the absence of some specific training. For most people, that training is provided within school reading instruction, but it is possible to provide it inde-

pendently and prior to reading instruction. Work from our laboratory (Content, Kolinsky, Morais, & Bertelson, 1985; Content, Morais, Alegria, & Bertelson, 1982) and from others (Fox & Routh, 1984; Olofsson & Lundberg, 1983) has now established that pre-school children can be taught speech analysis independently of reading proper.

On the other hand, several studies have revealed non-negligible performance on some forms of phonological manipulation in pre-school children (Bradley & Bryant, 1983; Fox & Routh, 1975) and the level attained on those tasks predicts later reading achievement to some extent. Such findings have been proposed as demonstrations of an autonomous development of speech analysis skills which would thus function as prerequisites to reading acquisition (Bryant & Bradley, 1985).

There is no necessary contradiction between these findings and the notion that acquiring phonetic segmentation requires specific instruction. First, the speech analysis capacities displayed by some pre-readers are not necessarily the effects of spontaneous growth. They may be the product of more or less informal instruction at home, which in educated families can range from exposure to phonologically oriented games to straightforward teaching of letter-sound correspondences. The range of such opportunities which are available to illiterates is presumably more limited. On the other hand, specific instruction may be necessary to acquire some speech analysis capacities while others may develop more spontaneously. The cases of analysis into phones and into syllables are apparently different. Analysis into phonetic segments is presumably required by the consonant addition and deletion tasks which neither pre-school children nor adult illiterates can perform well at all. Analysis into syllables is performed to a non-negligible level by pre-school children (Liberman et al., 1974). Another capacity which seems to be present in pre-readers is sensitivity to rhyme and other sound aspects of utterances (Knanle, 1973, 1974; Lenel & Cantor, 1981). The “sound classification” task which the children tested by Bradley and Bryant (1983) could perform reasonably well at 4 or 5 years and which was predictive of their later success in reading involves either sensitivity to rhyme (SIT different form PIN and WIN; HAT different from POT and COT) or to identity of initial CV-segment (HILL different form PIG and PIN). These tasks can be performed by recording identity or non-identity at each phone position (e.g., SIT, PIN, WIN: 1st position, all different; 2nd position, all identical; 3rd position, SIT different from PIN and WIN). Such a procedure clearly involves sub-syllabic analysis. But one cannot at this stage eliminate the possibility or recourse to less analytic procedures, based on overall similarity. Treiman and Baron (1981) have shown that in a CV classification task, pre-readers tend to put together utterances that are globally similar rather than those that share one particular
phone. Thus, it is possible that pre-readers' success in tasks involving rhymes and other sound relations does not reveal any particular segmentation capacity, but a different ability which might be called sensitivity to sound similarity.

The results of the comparison between illiterates and ex-illiterates are not sufficient, however, to establish the existence of a specific effect of literacy training on level of speech analysis. They might also reflect more general differences between the two groups of subjects, due to general experience gained during the literacy class, to the opportunities consequent upon literacy, or because of pre-existing intellectual or motivational level. For instance, the illiterates might have difficulties with analytical tasks in general rather than specifically with analysis of speech. Or they might find it especially difficult to infer a rule from examples.

There are some arguments which point toward a specific effect of reading instruction. Alegria, Pignot and Morais (1982) have found that first-grade pupils taught by a whole-word method performed more poorly (15% correct responses) on the task of inverting initial and final consonants of a CVC syllable than children of the same age taught by a phonics method, involving specific tuition on letter–sound correspondences (58% correct). Interestingly, the two groups did not differ significantly when the task required to invert syllables. Read, Zhang, Nie and Ding’s (1984) result showing that it is only the learning of alphabetic writing that promotes phonetic segmentation goes also clearly in the direction of a specific effect of the content of instruction.

To examine the question of specificity further, it was necessary to analyze the differences between illiterates and ex-illiterates in more detail. To that purpose, new groups of subjects drawn from populations comparable to those of the original study, were submitted to a battery of tasks exploring a wider range of capacities.

(a) Several speech segmentation tasks were used. The task of deleting the initial phone of a spoken utterance was applied with two different targets: a stop consonant in a consonant-vowel (CV)-context (the deletion task of Morais et al., 1979) and a vowel in a VCV-context where it constituted a syllable by itself. As in the previous studies, the rules were demonstrated through examples. During the test phase, on some trials the target was presented in the same context as in the examples. On those trials, extrapolation from the examples unambiguously dictated deletion of the initial phone. On other trials, the context was such that the initial phone could form a cohesive cluster with the following element: for the vowel, a VCCV-context where it formed a syllable with the following consonant, for the stop consonant a CCV-context where it made part of a consonantic cluster. These trials provided transfer tests: according to his interpretation of the rule, the subject could here delete either the initial phone alone or the whole cluster.

(b) One reason for working with targets of different degrees of accessibility is to separate difficulty in accessing the particular type of linguistic unit from difficulty in inferring the deletion rule from the examples: if the difficulty lies in understanding the task, changing the target should make no difference. Another approach to the same problem consists in giving more explicit instructions. Speech analysis capacity was also evaluated in a progressive free segmentation task (Fox & Routh, 1975), where the subject is asked explicitly to produce smaller and smaller parts of an utterance.

(c) Progressive segmentation shares with initial segment deletion the feature that the subject must produce the remaining part of the presented utterance, and any difficulty may rest in this production as well as in isolating the target segment. The subjects were also submitted to a detection task involving only attention to particular units: they had to localize phonetic or syllabic targets in spoken sentences.

(d) The task of deleting the initial note from a short musical sequence was included. It makes it possible to examine the extent to which the difference between illiterates and ex-illiterates is located specifically in the analysis of speech and not in a more general capacity to analyze all sorts of materials into constituent elements.

(e) As proposed above, detection of rhyme is a task that requires attention to some sound aspect of speech but not necessarily to its phonological structure. Illiterates appear to be sensitive to rhyme in poetry. The authors are acquainted with illiterate adults who enjoy rhyme and engage in rhyming games during popular festivities. If, as we expected, our illiterate subjects showed reasonably good performance on rhyme detection, that would indicate that their inability in phonetic segmentation does not reflect a more general inability to focus on the sound properties of speech.

(f) A final task involved remembering series of pictured objects with rhyming vs. non-rhyming names. Inferior performance on rhyming series would reflect the use of speech-related codes in short-term memory. Conrad (1971) first used the present type of task with children of different ages and found no effect of rhyming before 6 years. Alegria and Pignot (1979), on the other hand, observed an effect in preschool 4-year-olds, but smaller than in older children. The use of phonological representations in short-term memory might thus be correlated with reading acquisition in the same way as speech analysis capacities, and the illiterates-ex-illiterates comparison may shed light on the origin of that correlation also.
Method

Subjects

The experiment was run in an agricultural area of south Portugal and in a Lisbon shanty-town. Subjects, 21 illiterate people (1 subject) and 20 ex-illiterates (Ex-I subjects) were all of peasant origin. The Ex-I subjects had begun learning to read at ages ranging from 18 to 40 years by attending classes of elementary instruction for adult illiterates.

I subjects, 3 males and 18 females, were aged 25 to 60. Ten of them, 2 males and 8 females, tested in the agricultural district, were all employed in agricultural cooperatives, and of the remaining 11, tested in Lisbon, 8 were servants, 2 fruit sellers and 1 a mason. None had received any reading instruction at any time.

Ex-I subjects, 5 male and 15 female, were aged 17 to 60. Eight, 2 male and 6 female, were tested in the agricultural area. They included 3 agricultural workers, 3 servants and 2 industrial workers. Of the remaining 12, tested in Lisbon, 10 were servants and 2 industrial workers.

The Ex-I subjects were administered a reading test at the end of the experiment. It consisted of reading as fast and as accurately as possible 111 current words, most of them (86) nouns, the majority disyllabic (40) and trisyllabic (41), typed in lower case. The results showed a clearly discontinuous distribution, suggesting the presence of two types of subjects who will be called better and poorer readers. Better readers read at more than 60 words/min and did not make errors. Poorer readers read at a rate considerably inferior to 60 words/min, with long pauses, and occasionally made errors. Nine of the better readers had received some kind of certificate after completing the literacy course. Among the poorer ones, three had obtained a certificate and the remaining five were still attending class. There was no systematic difference regarding age, sex or occupation between the two subgroups.

Tasks and procedure

1. Segmentation of speech (SS)

The subject had to delete the initial segment of a pseudo-word provided orally by the experimenter. There were 40 experimental trials. In half of them, the initial segment was the consonant [p] followed either by a vowel or by one of the consonants [l] or [r] (e.g.: [pʰu], [pluku], [plɾu]). In the other half, it was the vowel [a] followed either by a CV syllable—in which case it was a syllable by itself—or by [l] or [ɾ] forming a syllable with the initial vowel (e.g.: [ʌbpu], [ʌpɾul], [ʌɾdlm]). Half the subjects first worked with [a] and then with [p], and the other half had the reverse order. For each target ([p] and [a]) the rule was illustrated by 15 introductory trials, where a correction procedure was used: when the subject failed to produce the correct response, the experimenter provided it. On those trials, [p] was always followed by a vowel and [a] always constituted a syllable. The subject was told that his task was to delete the beginning "sound" of each utterance. On the experimental trials, no correction was provided and the subject was told that he was going to work with "meaningless words".

2. Segmentation of melodies (MS)

The subject had to reproduce the last three notes of a four-note melody played by the experimenter on a toy xylophone. To avoid making the task excessively difficult, only the two extreme plates of the scale, those producing the low-pitched C and the high-pitched C were used, and the remaining plates were hidden under a screen. The subject was first familiarized with the situation by having him play the two notes himself on the xylophone. The test consisted of five introductory trials, to illustrate the rule, followed by nine experimental trials. In the introductory trials, a correction procedure was used. The subject was told that the task was to delete the beginning "sound" in the sequence of four provided by the experimenter and to repeat the remaining three exactly in the same order. Half the subjects saw the experimenter play the sequences, the other half did not.

3. Progressive segmentation of speech (PS)

The experimenter uttered a sentence orally and the subject was asked to say only part of it, then only part of the part, and so on until he could go no further. This procedure was applied to each of five sentences, four to seven words long.

4. Detection of target sounds in auditorily presented speech (AD)

The subject listened to recorded sentences and had to localize a target previously enunciated by the experimenter. The stressed syllable [tʰ], the phone [ɾ], the unstressed syllable [tʰa] and the phone [kʰ] were successively used as targets. Each target appeared once at the beginning of a word in each of five sentences. There were no introductory trials. The subject was instructed to listen to the sentence and to indicate the word which contained the target.

5. Rhyme detection (RD)

Five pictures of common objects were displayed on the table, and the experimenter pronounced their names. The first picture, the target, and one of the other ones represented objects with rhyming names, and the task of
the subject was to point to the latter. Twenty-five series were used. The
instruction was to indicate the picture which had the same sound at the end
or produced a rhyme with the target.

6. Recall of pictures with rhyming and non-rhyming names (R)

Three series of 10 black-and-white pictures of common objects were used.
In one of the series (R), the depicted objects had rhyming names: JANELA
(window), CAPELA (chapel), VITELA (veal), etc. In the other two series,
NR1 and NR2, no pictures had rhyming names. The testing started with 6 to
10 training trials where the cards of series NR1 were used throughout. On
the early trials, the experimenter first showed 5 cards in succession, each time
naming the depicted object. Each card was exposed for about 2 s, then placed
face down on the table. As soon as the 5 cards had been shown, the experi-
menter exposed a strip of cardboard supporting the whole series of 10 cards,
and the subject was asked to place each of the previously presented cards,
without turning it up, on the corresponding one on the strip. This required
that the subject recall both which cards had been shown and the order in
which they had been presented by the experimenter on that particular trial.
The cards were then turned up to show any mistake. During successive train-
ing trials, the number of cards presented was adjusted until a 50–60% level
of correct responding was obtained. This number was then used for the two
series of experimental trials, one with the NR2 cards, and one with the R
cards, which were run immediately afterwards, in balanced order.

All subjects performed the tasks in the order R, RD, SS, PS, MS, AD.

Results

1. Segmentation of speech

The mean percentage of correct responses for deletion of a syllabic [a] and
of [p] followed by a vowel, the tasks for which corrective feedback had been
provided through examples, appear in Table 1.

For [p] followed by a vowel, the results replicate almost exactly those of
the previous study (19% and 73% of correct responses, on the average, for
I and Ex-I subjects, respectively). I subjects were also inferior to Ex-I sub-
jects in the deletion of syllabic [a] (t = 3.84, df = 39, p < .005), but their
performance was here substantially higher than on the former task. Eighteen
subjects (out of 19 showing a difference) gave a higher number of correct
responses in the latter task (p < .001 by sign test), showing that illiterates
can manipulate vowels better than stop consonants. It can be seen in Figure 1

Table 1. Segmentation of speech sounds and musical note: Mean percentage
of correct responses (SD in brackets) for deletion of the syllabic [a], of [p]
followed by vowel, and of musical note

<table>
<thead>
<tr>
<th>Speech segment</th>
<th>Illiterates</th>
<th>Poorer readers</th>
<th>Better readers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syllabic [a]</td>
<td>55.2 (31.7)</td>
<td>85.0 (9.3)</td>
<td>85.0 (13.8)</td>
</tr>
<tr>
<td>[p] followed by vowel</td>
<td>18.6 (26.9)</td>
<td>62.5 (21.2)</td>
<td>83.3 (15.0)</td>
</tr>
<tr>
<td>Musical note</td>
<td>26.4 (17.3)</td>
<td>26.5 (18.4)</td>
<td>41.7 (17.1)</td>
</tr>
</tbody>
</table>

Figure 1. Distributions of percent correct scores for plosive deletion ([p] followed by
a vowel), syllabic vowel deletion, rhyme detection and musical note deletion.
that distributions of the individual scores of the illiterates are very different for the two tasks, one showing the reversed J-shape and the other the J-shape.

Among the Ex-I subjects, better readers scored higher than poorer ones (t = 2.56, df = 18, p < .01), but there is no difference on syllabic vowel deletion, where both subgroups performed at the same high level.

Table 2 shows the types of responses observed most frequently for [a] followed by either [i] or [e] (VCCV-context) and for [p] followed by either [i] or [e] (CCV-context). Given that such stimuli had not been presented during the introductory phase, when corrective feedback was provided, deletion of the initial segment only and of the whole initial cluster are both responses consistent with the information available in the examples. It appears that the choice made by the subjects depends on the identity of the second consonant. When it is [r], there is among both I and Ex-I subjects a preference for deleting the whole cluster. This pattern might be linked partly at least to the particular status of [r] in Portuguese phonology where it never occurs in word-initial position. For utterances starting with [a] and with [p], the two choices are observed, with no strong bias toward either, in both groups of subjects. It would thus seem that the present subjects spontaneously place a syllabic vowel in a category of vowel-initial syllables as well as in a category of vowels, and similarly place an initial consonant in a category which contains also consonant clusters as well as in a category which contains only consonants.

2. Segmentation of melodies

Performance was not affected by the opportunity to see the hands of the experimenter, hence results were pooled over subgroups with and without such opportunity. Mean percentages correct responses appear in Table 1 and distributions in Figure 1. The difference between I and Ex-I subjects did not reach significance at p = .05 (t = 1.56, df = 39). Performance is, as a matter of fact, poor in both groups. Better readers on the other hand performed significantly better than either poorer ones (t = 1.79, df = 18, p < .05) or illiterates (t = 2.37, df = 31, p < .025).

3. Progressive segmentation of speech

As shown in Table 3, only I subjects gave responses which could not be considered as parts of the presented utterance, such as faster repetitions or paraphrases.

Table 3. Segmentation of speech sounds. Percentage of the the more frequent types of response in the cluster conditions

<table>
<thead>
<tr>
<th>Initial cluster</th>
<th>Illiterates</th>
<th>Poorer readers</th>
<th>Better readers</th>
</tr>
</thead>
<tbody>
<tr>
<td>[a]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deletion of [a]</td>
<td>38.1</td>
<td>35.0</td>
<td>55.0</td>
</tr>
<tr>
<td>Deletion of [e]</td>
<td>26.7</td>
<td>57.5</td>
<td>40.0</td>
</tr>
<tr>
<td>Repetition</td>
<td>13.3</td>
<td>2.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Word phonologically related to the stimulus</td>
<td>13.3</td>
<td>5.0</td>
<td>1.7</td>
</tr>
<tr>
<td>[e]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deletion of [e]</td>
<td>14.3</td>
<td>37.5</td>
<td>20.0</td>
</tr>
<tr>
<td>Deletion of [i]</td>
<td>22.9</td>
<td>37.5</td>
<td>58.3</td>
</tr>
<tr>
<td>Deletion of [a] + transformation of [r] into [r]</td>
<td>2.9</td>
<td>0</td>
<td>6.7</td>
</tr>
<tr>
<td>Repetition</td>
<td>37.1</td>
<td>12.5</td>
<td>6.7</td>
</tr>
<tr>
<td>Word phonologically related to the stimulus</td>
<td>20.0</td>
<td>12.5</td>
<td>1.7</td>
</tr>
<tr>
<td>[p]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deletion of [p]</td>
<td>15.2</td>
<td>40.0</td>
<td>36.7</td>
</tr>
<tr>
<td>Deletion of [p]</td>
<td>12.4</td>
<td>27.5</td>
<td>31.7</td>
</tr>
<tr>
<td>Deletion of [p] + misplacement of [l]</td>
<td>5.7</td>
<td>12.5</td>
<td>13.3</td>
</tr>
<tr>
<td>Deletion of initial syllable</td>
<td>3.8</td>
<td>7.5</td>
<td>10.0</td>
</tr>
<tr>
<td>Repetition</td>
<td>23.8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Word phonologically related to the stimulus</td>
<td>26.7</td>
<td>2.5</td>
<td>0</td>
</tr>
<tr>
<td>[r]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deletion of [r]</td>
<td>0</td>
<td>0</td>
<td>13.3</td>
</tr>
<tr>
<td>Deletion of [r]</td>
<td>29.5</td>
<td>70.0</td>
<td>61.7</td>
</tr>
<tr>
<td>Deletion of [r] + transformation of [r] into [r]</td>
<td>0</td>
<td>0</td>
<td>6.7</td>
</tr>
<tr>
<td>Deletion of initial syllable</td>
<td>4.8</td>
<td>2.5</td>
<td>3.3</td>
</tr>
<tr>
<td>Repetition</td>
<td>21.0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Word phonologically related to the stimulus</td>
<td>29.5</td>
<td>20.0</td>
<td>0</td>
</tr>
</tbody>
</table>
referring to consonants. Sub-syllabic units were produced very rarely by illiterates. Two of them produced one phone (one a vowel, the other the consonant from a CV syllable) and it is interesting to note that these two subjects scored 50 and 70% respectively on deletion of [p] followed by a vowel. Two other illiterates gave a few consonant names. Somewhat unexpectedly, the level of the syllable was not reached very often in this group: 9 subjects only (out of 21) reached it. By contrast, 6 out of the 8 poorer readers and 11 out of the 12 better ones produced sub-syllabic segments and all of the Ex-I subjects, with the exception of one poorer reader, reached the level of the syllable.

4. Detection of speech sounds

There were no erroneous localizations, only correct ones or omissions. Percentage correct responses is for all four targets higher in Ex-I than in I subjects (Table 4). The liquid [F] was in both groups of subjects detected much better than [k] and even slightly better than the syllables. This result is presumably due to the fact that this consonant can, unlike plosives, be pronounced in isolation. Besides, in Portuguese it is pronounced with great energy. On detection of the other consonant, [k], the illiterates scored much lower than on the syllables: 14 of these subjects scored better on syllables while 5 did the reverse (p = .021, by sign-test). The difference is observed also at the level of distributions (Figure 2): the distribution for detection of [k] shows the same reversed J-shape as that for deletion of [p] (Figure 1). In the ex-illiterates, there is little difference linked to type of target: as Figure 2 shows, performance approaches ceiling for all targets.

5. Rhyme detection

Table 5 shows the mean percentage of correct responses per type of rhyme (the identical sounds were either the last two syllables, or the ending vowel or diphthong). There is no apparent difference in overall performance level between the two types of target. Distributions of scores, which are shown in Figure 1, are quite similar to those for syllabic vowel deletion.

6. Recall of pictures with rhyming and non-rhyming names

As appears in Table 6, the adjustment procedure which was used during training trials to choose the size of picture sets to be used during experimental trials had the consequence that illiterates worked on the average with smaller sets than the ex-illiterates (t = 2.07, df = 39, p < .025) and gave nevertheless fewer correct responses. Short-term retention is thus slightly poorer in the illiterates. The rhyme effect, measured by the difference between performance on non-rhyming and on rhyming sets, is significant in illiterates (t = 3.23, df = 20, p < .005) and in better readers (t = 3.57, df = 11, p < .005). It approaches significance in poorer readers (t = 1.47, df = 7, p < .10). Analysis of variance yielded a significant effect of condition (F = 24.77, df = 1.38, p < .005) but no interaction with group (F = 1.12, df = 2.38).

<p>| Table 3. Progressive segmentation of speech. Percentage of final responses of each type  |</p>
<table>
<thead>
<tr>
<th>Segmentation</th>
<th>Illiterates</th>
<th>Poorer readers</th>
<th>Better readers</th>
</tr>
</thead>
<tbody>
<tr>
<td>One phone consonant or non-syllabic vowel</td>
<td>0.95</td>
<td>12.5</td>
<td>40.0</td>
</tr>
<tr>
<td>Syllable vowel</td>
<td>0.95</td>
<td>12.5</td>
<td>18.3</td>
</tr>
<tr>
<td>Name of a consonant</td>
<td>4.8</td>
<td>25.0</td>
<td>16.7</td>
</tr>
<tr>
<td>One syllable</td>
<td>24.8</td>
<td>25.0</td>
<td>20.0</td>
</tr>
<tr>
<td>One word</td>
<td>17.1</td>
<td>25.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Two words or more</td>
<td>8.6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Incorrect responses</td>
<td>Faster and/or whispered repetition</td>
<td>26.7</td>
<td>0</td>
</tr>
<tr>
<td>Paraphrase</td>
<td>7.6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Others</td>
<td>8.5</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
7. Intercorrelations

Availability of scores for a whole battery of tests yielded the opportunity to examine interrelations. In the Ex-I group however, too many distributions were affected by ceiling effects to allow much use of that approach. Exceptions were deletion of [p] followed by a vowel, melody segmentation and rhyme effect: none of the intercorrelations of these three tasks was significant. For the illiterates, the main intercorrelations appear in Table 7. Significant correlations are observed between the two speech segmentation tasks (vowel deletion and consonant deletion), between the different detection tasks, and between syllabic vowel deletion and syllable detection. Two negative results are of particular interest. First, the rhyme effect observed in the picture retention task does not correlate significantly with performance on any of the speech manipulation tasks, nor even with rhyme detection. Second, rhyme detection does not correlate significantly with any speech analysis task: noticing sound similarity and localizing a sound target appear to involve different mechanisms. Further evidence on the latter lack of relation is provided by examination of individual cases. Three out of the four subjects with the lowest scores (less than 30% correct) in rhyme detection obtained high scores (all three 80% correct) in syllabic segmentation. On the other hand, the three subjects with the lowest scores (20% or less) in syllabic segmentation obtained good scores in rhyme detection (96%, 88% and 76%).

In the I group, performance on melody segmentation was unfortunately too low to attach much confidence to the lack of correlation between this task and the deletion of [p] followed by a vowel (−.13). It may thus be more interesting to signal some individual patterns of results. Among the four I subjects with the highest scores on the deletion of [p] followed by a vowel (6 or 7 responses out of 10) three gave only one correct response (chance level) in melody segmentation. Of the two I subjects with the highest scores on the latter task (5 correct responses out of 9) one gave a good score on the former
Table 7. Inter correlations between syllabic vowel deletion (VDEL), plosive (pl) followed by vowel deletion (PDEL), syllable detection (SDET), plosive detection (PDET), liquid detection (LDET), rhyme detection (RDET) and RR (rhyme effect in retention), in the illiterate group

<table>
<thead>
<tr>
<th></th>
<th>PDEL</th>
<th>SDET</th>
<th>PDET</th>
<th>LDET</th>
<th>RDET</th>
<th>RR</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDEL</td>
<td>.48*</td>
<td>.44*</td>
<td>.30</td>
<td>.04</td>
<td>-.11</td>
<td>-.18</td>
</tr>
<tr>
<td>PDEL</td>
<td>.14</td>
<td>.28</td>
<td>-.14</td>
<td>.11</td>
<td>.22</td>
<td></td>
</tr>
<tr>
<td>SDET</td>
<td>.69**</td>
<td>.72**</td>
<td>.31</td>
<td>.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PDET</td>
<td>.48*</td>
<td>.42</td>
<td>-.17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LDET</td>
<td></td>
<td>.19</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RDET</td>
<td></td>
<td></td>
<td>.11</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p < .05; ** p < .001.

but the other failed all the items. These results, together with the lack of significant correlation in the Ex-I group, suggest that phonetic and melodic segmentation are independent abilities.

Discussion

The basic finding (Morais et al., 1979), that illiterates cannot delete a consonant from the beginning of an utterance while ex-illiterates can, has been replicated. Moreover, the performance level of the present subjects is strikingly close to that of the original groups, considering the differences in procedure between the two studies: in the former one, each subject worked only on one particular task—deletion or addition of the same phone throughout—whereas here the consonant deletion task was preceded by other exercises.

The data from the other tasks make it possible to put that basic finding in better perspective. The differences in ability for phonetic segmentation are not due to differences in the general capacity to infer the deletion rule from examples. In the progressive segmentation task, when explicitly told to analyze speech utterances, illiterates were still largely unable to produce sub-syllabic segments. And in the very explicit detection task, they performed poorly with the stop consonant target. On the other hand, they showed a much better ability to infer the rule with other targets, notably with a syllabic vowel. Finally, if the origin of the ex-illiterates' superiority rested in capacity to infer the rule, it should have showed up also in melody segmentation, where in fact they did not perform better than the illiterates.

The possibility of some contribution to the basic effect of differences in level of general ability or motivation, either consequent on literacy training or pre-existing to, and possibly influencing, enrollment in the literacy course, cannot be ruled out completely on the basis of the present data. The small superiority of the ex-illiterates in picture retention might reflect such a difference. On the other hand, the absence of a significant difference in melody segmentation performance goes against the notion. However, given the low level of performance of both groups, that task is obviously not suited to provide a baseline for comparisons. The problem, however, is not to isolate completely the direct effect of literacy training from contaminating factors—that sort of purity cannot be attained when manipulating institutional variables such as school attendance—but more simply to demonstrate its existence.

The main point to consider is thus the degree of specificity of the differences. The illiterates performed better on syllabic vowel deletion, where more than half of them produced 75% correct responses or more, than on consonant deletion, where none reached that level. A difference in the same direction was observed for syllable versus stop consonant ([k]) target in the detection task (the case of [f] will be considered below). And illiterates performed at a non-negligible level in rhyme detection, where nearly half reached the 75% correct level. The inferior performance of the illiterates is thus more evident in tasks involving phonetic segments than in those which involve syllables, or, like rhyme detection, perhaps only attention to sound properties of the whole utterance rather than of the components. Pre-school children also appear to reach on syllable segmentation and on rhyme detection levels of performance definitely superior to those obtained on phonetic segmentation (Knafie, 1973, 1974; Lenel & Cantor, 1981).

It is of course necessary to acknowledge the discordant result obtained for detection of the liquid [l], which is performed by illiterates as well (in fact slightly better) as syllable detection. Thus, strictly speaking, one cannot conclude that low accessibility in illiterates is typical of all consonants. The case of [f] which, as we have noted, is pronounced in Portuguese with strong energy, is however probably exceptional. In the previous study (Morais et al., 1979) equally low performance was obtained for deletion of initial nasal [m] and fricative [f] as of plosive [p].

Although the largest differences linked to literacy were observed in those tasks which involve dealing with phonetic segments, a superiority of ex-illiterates over illiterates showed up also in syllabic tasks (segmentation and detection) and in rhyme detection. And in progressive segmentation, the propor-
tion of subjects reaching the level of the reliable at least once was lower among illiterates. It would thus seem that although some non-negligible sensitivity to sound properties of speech and capacity to analyze it into syllables develops in the absence of reading instruction, a substantial improvement can still be brought by such instruction. This conclusion is consistent with the huge increase observed by Liberman et al. (1974) between kindergarten and Grade 1 in performance on syllable counting, contrasting with the relative stagnation between nursery school and kindergarten. That aspect of their results has on the whole received little attention. In a similar vein, Morais et al. (1984) have found that young dyslexics were inferior to first-graders in a syllable deletion task (68% vs. 95% correct responses).

Thus, the present data appear to support the following picture of the development of speech analysis abilities. Both the capacities to analyze speech into syllable-level units and to appreciate sound similarity can develop in the absence of the specific types of experience linked to formal reading instruction up to some intermediate point, but can still be improved when these become available. On the contrary, analysis into phonetic segments proper is strongly dependent for its emergence on such experience. The resultant improved analytical ability may not transfer to materials outside the linguistic sphere, as the results of the melody segmentation task suggest, but of course the conclusion must remain tentative until a wider range of non-linguistic tasks has been investigated.

Although rhyme detection and syllabic segmentation are influenced by literacy training in the same way, the absence of correlation between the corresponding scores is consistent with the notion that they are not dependent on the same underlying competences. In particular, the finding implies that speech segmentation abilities do not depend on prior development of a more general capacity to attend to the sound aspects of speech. One might thus be able to segment speech into syllables even if one is not able yet to appreciate sound similarity, and vice versa.

The results of the picture retention task deserve separate consideration. Significant rhyme effects have been observed in both illiterates and ex-illiterates. Thus, the availability of phonological codes in retention appears not to be crucially dependent on literacy training nor, as a consequence, on the phonetic segmentation abilities which it promotes. As a matter of fact, no correlation was observed between the rhyme effect and any of our tests of speech segmentation, a result consistent with previous findings by Alegria et al. (1982) (cf. also, Content, Morais, Kolinsky, Bertelson, & Alegria, 1986). These results are definitely not consistent with the notion that phonetic segmentation ability facilitates reading acquisition by making speech-mediated retention possible (for a more extended discussion, see Morais, Cluytens, Alegria, & Content, 1986).

The comparison within the ex-illiterate group of better and poorer readers was not a major objective of the present study. In most tests, better readers scored higher than poorer ones, but there is of course no guarantee that these differences are the effects of higher literacy and not of some common causal factor. In our opinion, the most interesting aspect is that in all the tasks where ex-illiterates score better than illiterates, the difference between poorer and better readers is small compared to that between poorer readers and illiterates. It looks as if the stronger effect of literacy training on speech analysis was associated to some very general, presumably early, acquisition common to the majority of students rather than with later developments that take place only in the better ones.

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Phonological awareness: The role of reading experience

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Abstract

A cross-cultural study of Japanese and American children has examined the development of awareness of syllables and phonemes. Using counting tests and deletion tests, Experiments I and III reveal that in contrast to first graders in America, most of whom tend to be aware of both syllables and phonemes, almost all first graders in Japan are aware of mora (phonological units roughly equivalent to syllables) but relatively few are aware of phonemes. This difference in phonological awareness may be attributed to the fact that Japanese first graders learn to read a syllable whereas American first graders learn to read an alphabet. For most children at this age, awareness of phonemes may require experience with alphabetic transcription, whereas awareness of syllables may be facilitated by experience with a syllable, but less dependent upon it. To further clarify the role of knowledge of an alphabet in children's awareness of phonemes, Experiments II and IV administered the same counting and deletion tests to Japanese children in the later elementary grades. Here the data reveal that many Japanese children become aware of phonemes by age whether or not they have received instruction in alphabetic transcription. Discussion of these results focuses on some of the other factors that may promote phonological awareness.

Introduction

The primary language activities of listening and speaking do not require an explicit awareness of the internal phonological structure of words any more

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