

The Emergence of Phonological Awareness: Comparative Approaches

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Abstract

The notion that the capacity to represent explicitly some aspects of the phonological structure of utterances is an important condition of the acquisition of alphabetic literacy has been, since its introduction by the Libermans and their coworkers, a cornerstone of research on reading acquisition. The capacity is generally referred to by the term "phonological awareness." With attention focused mainly on its role in the acquisition process, the question of the conditions under which phonological awareness itself develops has been somewhat neglected. One central issue is whether phonological awareness develops spontaneously, through maturation or sheer experience of speech communication, or whether it requires specific learning opportunities. In 1977, Liberman, Shankweiler, Liberman, Fowler, and Fischer proposed to approach the question through comparisons of the metaphonological abilities of populations with different educational experiences. Arguments favorable to a nonspontaneity view derive from the fact that illiterate adults, and also some readers of nonalphabetic scripts, show poor ability to manipulate utterances at the level of phonetic segments. The strength of the argument is being critically examined. The necessity to distinguish between different levels of phonological awareness is stressed and illustrated with some so far unpublished results. In spite of some contradictions, the bulk of the available evidence is compatible with the view that the capacity to appreciate phonological similarity and awareness of some sub-morphemic units, like syllables and rimes, develops spontaneously, but command of segmental units generally requires deliberate instructional help. Contrary to an often expressed opinion, this view is in no way inconsistent with the notion of an important role of phonological awareness in reading acquisition. Finally, it is suggested that the conception of phonological awareness as result-

ing from "access" to intermediate stages of speech processing has created unnecessary difficulties for the kind of modular view advocated by Alvin Liberman and should be avoided.

Alvin Liberman on Reading

In the classical paper on "The perception of the speech code," Liberman, Cooper, Shankweiler, and Studdert-Kennedy (1967) mentioned written language at several places. That was mainly to emphasize by contrast some specific features of speech that reading/writing does not possess, and these were features that were later going to be called *modular*. On one hand, speech is "a complex code," whereas the written representation is "a simple cipher" (p. 433). Technology was called to the bar on that point: "If speech were a cipher, like print, it would be no more difficult to build a speech recognizer than a print reader" (p. 445). On the other hand, for human beings, the opposite order of difficulty holds. "In the history of the race, as in the development of the individual, speaking and listening come first; writing and reading come later, if at all. . . . Perceiving the complex speech code is thus basic to language, and to man, in a way that reading an alphabet is not" (p. 434).

Liberman developed these ideas further the following year in the discussions that took place at a symposium organised by Kavanagh (1968) and that was a sort of precursor to the famous "Language by ear and by eye" conference (Kavanagh & Mattingly, 1972). One aspect of the difference in difficulty between reading and listening, he noted, is that "Listening doesn't really need to be taught. One only needs to bring up a child in something other than a dark closet. Reading needs to be taught" (in Kavanagh, 1968, p. 119). One possible reason why the maturation of the speech machinery does not allow reading was alluded to in a later passage discussing the psychological reality of phonemes. It was noted (p. 127) that if phonemes "are real psychologically, they are not necessarily real at a very high level of awareness. That is to say, it does not follow from anything I have said that the man in the street can tell you about phonemes, or that he can even tell you how many phonemes there are in particular utterances". That Liberman was thinking of this lack of awareness of phonemes as a possible source of the difficulty of reading is shown by the immediately following remark that "if phonemes existed at a higher level of awareness than they do, then it wouldn't have taken so long for man to invent the alphabet."

Thus, the essential point that Liberman was stressing is that the development of reading capacity does not display the autonomy of a process under mainly endogenous control. This aspect makes reading a sort of test case in the framework of current discussions of modularity. In the fluent adult reader, written

word recognition presents several of the Fodorian modular features (Fodor, 1983): (a) Its functioning is mandatory, as demonstrated by Stroop interference and semantic priming, (b) it proceeds through largely inaccessible intermediate representations, (c) it is fast and probably encapsulated and, (d) it shows highly specific breakdown patterns after brain lesions, but its development is strongly dependent on intentional learning and on contributions from central cognitive processes. The case of reading, thus, suggests that the relation between the candidate modular features is more complex than one of necessary coexistence.

Reading Acquisition and Phonological Awareness

Liberman's notion that the acquisition of reading requires some explicit representation of the phonological structure of utterances—now generally referred to by the term "phonological awareness"—that is not necessary for speech communication has been elaborated in well-known papers by Mattingly (1972), Isabelle Liberman (1973), Rozin (1976, 1978), Gleitman and Rozin (1977), and Rozin and Gleitman (1977). It has exerted a decisive influence on empirical studies of reading acquisition.

We tried elsewhere (Bertelson & de Gelder, 1989) to summarize the existing support for the notion, and we can limit ourselves here to a brief recapitulation. Early arguments were based largely on logical analyses of the principle of alphabetic representation and of the task it was supposed to set to students, and on evidence from the history of writing systems. Direct empirical evidence consisted first of demonstrations of correlation between success in reading and performance on tasks involving the analysis of utterances into submorphemic units—syllables or phonetic segments. More recently, evidence for properly causal effects of forms of phonological awareness on progress in reading has been provided by both experimental training studies (e.g., Bradley & Bryant, 1983, 1985; Fox & Routh, 1984) and applications of partial correlation methodology (e.g., Bradley & Bryant, 1983, 1985; Stanovich, Cunningham, & Cramer, 1984; Perfetti, Beck, & Hughes, 1987). Taken together, these studies support reasonably well the notion that at least some forms of phonological analysis competence contribute to success in reading acquisition.

With attention focused mainly on its role in reading acquisition, the question of how phonological awareness itself develops has been rather neglected. One reason might be the fact that reading has often been lumped together under such unitary headings as metalinguistic abilities or "secondary linguistic activities" with achievements like appreciation of rhyme, generation of puns, or speech repairs, which clearly need not be taught. Examination of the literature of the 1970s reveals a good deal of hesitation concerning the conditions for the emergence of phonological awareness.

A Comparative Approach

A critical step was initiated by Liberman, Shankweiler, Liberman, Fowler, and Fischer (1977) in a discussion of possible interpretations of their earlier finding that counting the number of segments a spoken word is made of is virtually impossible for kindergarteners but well within reach of first-graders. One possibility was that maturation made children aware of phonemes at about that age, the other that awareness of the phonological structure of words is something that is brought about by alphabetic reading acquisition. They suggested that one way to decide between the alternatives would be to find out whether a similar change with age occurs when it is a logographic script, Chinese for instance, that is acquired. Then, in a footnote, they remarked that the test was probably no longer feasible, because reading instruction in the People's Republic of China now starts with teaching of an alphabetic script, the Hanyu Pinyin. Nevertheless, the authors' suggestion was essential in pointing to a comparative approach to the effects of reading instruction experience.

Granted that the evidence from Chinese readers was no longer available, an alternative way to examine the question was to assess phonological awareness in adult illiterates. One difficulty for that approach is that in societies where reading instruction is generally available, those who do not profit from the opportunity might well be a selected sample. The problem is less acute where illiteracy is still a normal fact of life. Portugal is one of the countries of Europe with a high rate of illiteracy, and we had several former students working there. One of them, Luz Cary, obtained access to an agricultural area where schools were normally not available, but some inhabitants had attended adult literacy classes. She administered a task to both illiterate and "ex-illiterate" subjects in which they had either to delete the initial consonant from a spoken word or pseudoword, or add a consonant at the beginning. These tasks had already been run on Belgian school children (Alegria & Morais, 1979). The results show that illiterates performed at the same floor-level ($\pm 20\%$) as Belgian first-graders tested at the beginning of the year, and ex-illiterates at a comfortable 70% correct level, similar to that of second-graders (Morais, Cary, Alegria, & Bertelson, 1979). The low performance of illiterates or semiliterates on phonetic manipulations has since been confirmed in several studies from our group and from others (Byrne & Ledez, 1983; Liberman, Rubin, Duques, & Carlisle, 1986; Morais, Bertelson, Cary, & Alegria, 1986; Read & Ruyter, 1985; Bertelson, de Gelder, Tfouni, & Morais, 1989).

These observations are of course consistent with the notion that some competence necessary for manipulating phonetic segments does rarely develop spontaneously, and it generally requires some specific learning experience that the literacy classes provide. However, they are not sufficient by themselves to establish the point. Any performance difference between the two populations cannot be immediately attributed to the direct effect of reading instruction per se. Other

possibilities are: (a) differences before enrollment in the literacy program; for instance, the individuals who took advantage of the existence of literacy training could have been on the average brighter or better motivated than the ones who did not; (b) general cognitive or attitudinal changes induced by class attendance (e.g., familiarity with test situations, understanding of instructions, capacity to infer a rule from examples); (c) wider life experiences—access to books and printed information in general, better jobs—made available by literacy. We do not think one can control for these confounding factors completely. However, it is possible to obtain an estimate of their respective contributions by adequate use of the comparative method (i.e., by extending both the types of populations and the range of tasks on which the populations are compared). In the rest of the paper, we examine how the interpretation of the basic finding can, thus, be narrowed down.

Before embarking on that examination, we must note that there need not be a contradiction between the notion of the nonspontaneity of some aspects of phonological awareness and the possibility that those aspects facilitate reading acquisition. We have argued (Bertelson, 1986; Bertelson & de Gelder, 1989), as have our colleagues (Morais, Alegria, & Content, 1987a), that the "chicken and egg" question, "Is phonological awareness a prerequisite of reading acquisition or one of its consequences?" is not one that could ever allow a single yes or no answer. The reason is that notions such as phonological awareness and reading acquisition are too global. Reading acquisition is very likely an interactive process involving a succession of quantal steps, some in the sphere of phonological ability and some in other domains of the skill (de Gelder, 1987, *in press*). A full understanding of the process would involve identification of those steps, and only on that level could one expect to identify simple unidirectional causal links.

Specific Effect of Literacy Training versus General Cognitive Influence of Schooling

The performance difference between illiterates and ex-illiterates might be linked to general cognitive or attitudinal effects of schooling that would affect a wide range of activities. Many early studies of the influence of literacy have been flawed by failure to control for such effects. A nice demonstration has been provided by Scribner and Cole (1981), in their famous study of the Vai people of Liberia, where they could study users of different writing systems living together with complete illiterates in otherwise similar socioeconomic circumstances: readers of the Vai script, a local syllabic writing taught only through private tuition, readers of Arabic writing learned at Koranic school, and readers of the alphabet learned at western-type schools. Only the latter subjects were found superior to illiterates at solving logical problems, namely syllogisms. Although the finding shows the necessity of distinguishing between general effects of schooling and

specific effects of literacy, it certainly does not imply that the same pattern of influence must hold for all domains of competence. Logical thinking is in fact not a sort of capacity one would expect to be influenced directly by reading instruction. Regarding the more relevant metalinguistic capacities, Scribner and Cole's exploration, which was limited to asking their subjects to name "a long word," was not adequate to detect the specific effects of the particular orthographies they had learned.

Some recent data directly address the question of the generality of the effect observed in segmental analysis. Kolinsky, Morais, Content, and Cary (1987) compared subjects from the same two populations on a visual part-probe task (Palmer, 1977) consisting of deciding if a pattern of lines contains a particular subpattern. The task bears some formal resemblance to a consonant detection task (finding the word in a sentence that begins with a particular target consonant) in which ex-illiterates have been found much superior to illiterates (Morais et al., 1986). In the visual task, only a nonsignificant difference in performance was obtained between ex-illiterates (65.1% correct) and illiterates (61.6%). Clearly, the superiority of ex-illiterates in segmental analysis does not mean that they are better at analyzing all sorts of things into parts. In a similar vein, ex-illiterates showed no significant superiority relative to illiterates in a musical tone deletion task consisting of playing back a short melody on a simplified xylophone without its initial note (Morais et al., 1986).

The visual part-probe task has also been administered to Belgian children in kindergarten, first, and second grade. The performance of kindergartners was comparable (59% correct responses) to that of unschooled illiterate and ex-illiterate Portuguese subjects, but first- and second-graders reached higher levels (74.5% and 89.0% respectively). These results suggest that the critical ability involved in the task is one that, like syllogisms and unlike segmental analysis, is promoted not by reading instruction proper but rather by other school activities.

Distinguishing among Metaphonological Capacities

As we have noted already, in many early presentations, phonological awareness was conceived as an homogeneous achievement. Yet many data were available that pointed in the direction of dissociable levels. Prereading children appreciate nursery rhymes and engage in word games that involve attending to the form rather than the meaning of the items. Illiterate societies have poets who rely on phonological relations like assonance, rhyme and alliteration in their work. In the classical study demonstrating that prereaders cannot count phonemes, Liberman, Shankweiler, Fischer, and Carter (1974) found that the same children performed substantially better on syllable counting. Similarly, Alegria and Morais (1979) found that kindergartners were much better at manipulating syllables, that is, at adding a syllable to an utterance or deleting the initial syllable of an utterance,

than at performing the same manipulations on phonetic segments. These data suggested that the incapacity of illiterates with consonants might not extend to all submorphemic units or all sorts of phonological properties.

The suggestion has been supported by the results of a new study again with Portuguese illiterates and ex-illiterates but using a wider range of tasks (Morais et al., 1986). Illiterates performed very poorly in all tasks in which they had to deal with segments, irrespective of the form of the task: in consonant deletion, detection of a consonant target in a spoken sentence, or free segmentation of an utterance into smaller units. They attained more substantial levels of performance, although still inferior to those of ex-illiterates, in rhyme judgment (choosing a picture with a name rhyming with a target) and in tasks involving the manipulation of syllabic targets (deleting the initial syllabic vowel of an utterance and detecting a syllabic target in a spoken sentence).

Interestingly, there was no significant difference in the effect of phonological similarity on short-term retention of picture names between the groups: Rhyming names created the same relative degree of interference in illiterates and in ex-illiterates. The result adds to a body of data that cast doubt on the existence of a strong relation between the use of speech-based codes in short-term retention—the correlate of reading acquisition on which the presentation of Crain and Shankweiler (chapter 16 this volume) is focused—and explicit segmental analysis (see e.g., Content, Morais, Kolinsky, Bertelson, & Alegria, 1986).

A more recent study with Brazilian adults, some illiterate and some with rudimentary reading capacity resulting from school attendance in second-grade at most, has produced results that agree with a multicomponential view of phonological awareness (Bertelson et al., 1989). The subjects were tested successively on rhyme judgment (deciding if two words pronounced by the experimenter—*cola mola*, *mito fama*—rhyme or not), syllabic vowel deletion (*ako* → *ko*), and consonant deletion (*fin* → *in*). The instructions were conveyed exclusively by examples (e.g., "When I say *ako*, you say *ko*; when I say *asur*, you say *sur*," etc.), and corrective feedback was provided throughout each test whenever the subject failed to produce the expected response ("I said *afir*; you should have said *fir*"). For rhyme judgment and vowel deletion, testing continued to a criterion of six successive correct responses. The criterion was reached by all readers in both tasks, and by 12 out of 16 illiterates in rhyme judgment and 10 in vowel deletion. In the consonant deletion task, which involved 24 trials, irrespective of results, the criterion was reached by 7 out of 9 readers and by only 3 out of 16 illiterates. Overall percent correct was 77 for readers and 33 for illiterates. Thus, illiterates can infer a phonological manipulation rule from examples, when it applies to rhyming or to syllabic units, but not when it involves phonetic segments.

These results suggest the existence of a dissociation from the point of view of developmental history between segmental analysis proper and other manifestations of phonological awareness.

Evidence from Nonalphabetic Literates

Charles Read discovered that in China one can still find readers of the traditional logograms who never learned to read the alphabetic Pinyin introduced after the revolution. Thus, the investigation contemplated by Liberman et al. (1977) was still feasible. Together with Chinese colleagues, Read applied the consonant addition and deletion tasks to two groups of Chinese subjects, a group of alphabetic readers who could read both the logograms and the pinyin, and a group of pure logographic readers who had attended school before the revolution (Read, Zhang, Nie, & Ding, 1986). Mean percent correct responses over the two tasks for the trials with pseudowords was 21 in the logographic subjects and 83 in the alphabetic ones. The difference is, thus, as large as the one obtained between illiterates and literate subjects.

An important implication of this result concerns the possible role of factors other than literacy training in the causation of the difference between literates and illiterates. Two of the factors we have considered, pre-existing difference in ability or motivation, and general cognitive benefits of class attendance, should play a lesser role for the Chinese subjects: The introduction of Pinyin instruction was an administrative decision that presumably applied to whole groups of children irrespective of preference or ability; the logographic subjects had been to a regular school. We are not claiming, of course, that the effects of the schooling enjoyed by the two groups were necessarily equivalent but simply that whatever difference there may be between the learning opportunities available to these two groups must be smaller than the one between literacy training and no school instruction at all.

One can ask if the differential profile of performance obtained in the comparison between illiterates and ex-illiterates would hold also for the present contrast. In a pilot study carried out in Tilburg with Jean Vroomen, we had the opportunity to examine Chinese adults, all of whom could read logograms, but some of whom had learned to read Dutch and the others not.¹ All understood spoken Dutch. They were tested on rhyme judgment (with Dutch words), initial consonant deletion (Dutch pseudowords) and on separate enunciation of the initial phoneme of a pseudoword, either a vowel or a consonant. As appears in Table 1, non-alphabetic subjects were virtually as good as alphabetic ones on rhyme judgment, but much poorer on consonant deletion. The profile of differences found with illiterates and ex-illiterates is thus reproduced. In phoneme enunciation, a task that has not been used so far with illiterates, the non-alphabetic subjects performed poorly with both consonants and vowels.

Results by Mann (1966) might create difficulties for the view that acquiring a

¹The majority of the subjects came from Hongkong and had never been exposed to Pinyin. However, even a few who came from mainland China reported no knowledge of that system. Pinyin instruction might be less universal than has been reported.

Table 17.1
 Chinese Logographic Monoscriptals and Chinese-Dutch Biscrptals:
 Mean Percent Correct Responses on Metaphonological Tasks
 (Unpublished Data of de Gelder, Vrooman, & Bertelson)

Task	Monoscriptals N = 15	Biscrptals N = 16
Reading Dutch words	13.3	87.7
Reading Dutch pseudowords	0.3	58.1
Rhyme judgment	76.3	78.4
Deletion of initial consonant	21.7	56.9
Enunciation of initial segment:		
vowel	17.3	77.5
consonant	1.3	51.3

non-alphabetic orthography does not promote segmental analysis. She tested Japanese school children in different grades on initial segment deletion and initial mora deletion.² The first graders were much inferior to American contemporaries on the segment tasks (24% correct responses against 56%) and slightly superior on the mora task. This profile of performance that corresponds to the school experiences of the two groups is consistent with the data described so far. The discrepant result is that Japanese fourth graders, who in principle had been taught no alphabetic reading,³ gave 63% correct responses. A segment counting and a mora counting task were also applied and gave similar results, which might, however, be contaminated to an unknown degree by the fact that many subjects were found to use an orthographic strategy based on counting kanas and applying a correction to the count.

There is, for the time being, no ready-made interpretation for these results. Mann considered the possibility that experience of any *phonological orthography* promotes the development of speech analysis up to the segmental level, but then rejected it on the basis of the results of Read et al. (1986) with nonalphabetic Chinese readers. The Chinese "phonetic compound" characters are composed of a "radical," which refers to the meaning, and of a "phonetic," which refers to the pronunciation, hence, she reasoned, Chinese orthography is phonological. There is, however, an important difference between reading Chinese phonetic compounds and either kanas or alphabetic characters: The phonetics represent whole morphemes and do not engage the reader in submorphemic segmentation. Thus, a viable hypothesis that Mann did not consider is that learning a *sub-*

²Japanese moras are the rhythmic units of speech that kana characters represent. The majority are CV syllables, but the phoneme /n/ in isolation or in final position, and the final segment of double vowels, count also as moras.

³Japanese children begin learning the Romaji, an alphabetic orthography, in the second part of the fourth year of school.

morphemic orthography is sufficient to start the reader on the road to full segmental analysis.

It is also possible that some particular features of the kanas facilitate the discovery of segments. The kanas are actually not pure syllabaries. First, some characters represent single segments: the five vowels */a/*, */e/*, */i/*, */o/* and */u/*, and the consonant */n/*. Also, the fact that different kana stand, for instance, for */pa/*, */ta/*, */ka/*, */ma/*, and */a/* may indirectly draw attention to the consonants. The probability of such discovery is increased, because the kanas are usually presented to the pupils in matrix arrangement with columns corresponding to the initial consonant of the represented mora and the rows corresponding to the vowel. Another important factor may be that foreign names and terms are spelled by using katakana to represent the initial segments of the corresponding moras.

Finally, we have to consider the more trivial possibility of straightforward teaching of Romaji in the family before it is officially taught at school. The competitive Japanese society, with its high premium on school achievement, is one in which we could expect such factors to play an important role. Mann unfortunately did not examine knowledge of alphabetic characters in her subjects. Any progress along this line of investigation will require the collection of data on out of school training as well as on the possible influence of educational television programs. We shall have to return to these issues in the next section.

The Evidence from Preschool Children

In the Morais et al. (1979) study, an important comparison was one between illiterate adults and Belgian precaders. The fact that both groups performed at about the same low level on consonant manipulation was considered as suggesting that maturation and experience of speech communication have little influence on the development of segmental analysis. More detailed examination of the literature, however, raises some difficulties for that conclusion. Many studies have confirmed that, consistent with a multicomponential view of phonological awareness, preschool children are better at judging phonological similarity and at manipulating syllables than at dealing with segments (Lundberg, Olofsson, & Wall, 1980; Alegria, Pignot, & Morais, 1982; Stanovich et al., 1984). However, on the other hand, there are reports of nonnegligible ability to manipulate the latter units in some preschool children (Fox & Routh, 1975; Lundberg et al., 1980; Bradley & Bryant, 1983; Stanovich et al., 1984). To interpret that evidence, one must consider two points, which concern respectively the possible origin of the reported performance and the tasks that have been used.

In developed countries, preschool children can have already benefited from various forms of informal training, ranging from word games (see "Geography" as described by Mann, 1986) to tuition in reading proper provided by the family (parents, school-attending siblings) or television (see programs such as "Sesame

Street"). Information regarding these factors is difficult to obtain and is generally not provided in the papers.

One case where information is available illustrates how serious the problem can be. About two-thirds of the Swedish kindergarteners tested by Lundberg et al. (1980) in their well-known longitudinal study had some elementary reading capacity, which was correlated with performance on both measures of phonemic analysis and synthesis and with later achievement in reading. On the basis of information provided by the authors, Valtin (1984) showed that these subjects were largely responsible for the substantial average performance of the whole group on phonemic tests. As appears in Table 17.2, the performance of the nonreaders on segment-level tasks was in the range previously obtained with illiterates, with the exception of a segment detection task on which they reached an appreciable 47%. It was better on syllable-based tasks and came close to ceiling on a rhyme production task. Thus, when the effect of preschool reading ability is controlled for, real prereaders have a profile of performance comparable to that of most other alphabet illiterates who have been examined so far.

The extent to which informal preschool tuition may have influenced the performances reported in other studies (especially Stanovich et al., 1984) is difficult to establish. The importance of the data from illiterate adults living in low-literacy environments is that these subjects are much less exposed to experiences likely to promote phonological awareness. Regarding kindergarteners, efficient use of data from such populations would require more attention than has been usual to assessment of out of school instruction.

Table 17.2
Performance on Metaphonological Tasks of Kindergarteners
With and Without Elementary Reading Ability
(Data of Lundberg et al., 1980, after Valtin, 1984)

<i>Task</i>	<i>Non-readers</i> <i>N = 48</i>	<i>Readers</i> <i>N = 85</i>
Rhyme production	75	86
Fusioning syllables into words ¹	65	92
Analyzing words into syllables	50	52
Fusioning segments into syllables ²	20	82
Analyzing syllables into segments	35	89
Inversing segments	5	60
Detecting segment ³	47	89

¹task SYNSYLC;

²task SYNPHONC;

³task ANPHONPOS.

The descriptions of the tasks are based on Lundberg et al. (1980) and the figures are recalculated from those in Table 12.4 of Valtin (1984, p. 245).

Turning to tasks, it is clear that some of those that have been used to measure phonemic analysis are more difficult than others. We have already noted that the nonreaders of the Lundberg et al. (1980) study performed much better on segment detection than on any of the other segment-based tasks. In the study by Stanovich et al. (1984), deletion of the initial consonant was more difficult than various syllable-matching tasks (e.g., finding the syllable among three that has the same initial sound as the target syllable). Two kinds of interpretation of such differences have been developed.

One consists of invoking particular cognitive operations that the more difficult tasks may impose in addition to speech analysis. In that way, the differences can be explained without abandoning the notion of phonological awareness as an homogeneous attribute. Bryant and Bradley (1985), for instance, proposed that prereaders' inability in phoneme counting and in phoneme deletion or addition reflects the difficulty of the counting, deletion, or fusion operations that these tasks impose in addition to analysis into individual segments. The "sound classification task," which the subjects of their longitudinal study already performed reasonably well in kindergarten, consists of identifying that item among three or four CVC words presented by the experimenter that differs from the others at the level of either the first, the medial, or the final segment. That task would not require additional difficult operations, and that would be the reason why it is within the reach of prereaders. One problem for that interpretation is that the counting or deletion operations do not create similar difficulties when the target is a syllable or a syllabic vowel instead of a segment.

The other interpretation is based on the notion that different tasks tap different levels of metaphonological ability. For instance, one can question that Bradley and Bryant's sound classification task specifically taps segmental analysis. If we consider the conditions with initial and with final consonantal target, the presented words always had the medial vowel in common. A typical trial would involve quartets such as *pig, pit, pill, fin* or *fat, put, cat, man*. The authors interpret the task as implying the identification of the consonant by which the odd item differs from the distractors. As a matter of fact, what the distractors have in common is either the initial CV- or the final -VC, and identifying such strings might be easier than identifying consonants. As part of a study in progress, Content and Bertelson have administered five-year-old prereaders both the initial and the final consonant conditions of Bradley and Bryant, which will be called here the "constant vocalic context" task, and a "variable vocalic context" task. In the latter, the four words presented on a trial have different vowels. To succeed in that task, it is, thus, necessary to focus on the critical consonant itself. Examples of the four types of trials we ran appear in Table 17.3, together with the results of the 56 children tested so far. They found the variable vocalic context tasks very difficult. Actually only 12 (18%) scored better than chance on these tasks. In comparison, 23 (41%) performed above chance in the constant vocalic context conditions. Thus, the relative easiness of Bradley and Bryant's sound classifica-

Table 17.3
 Word Classification Tasks: Mean Percent Correct Responses in Each
 Condition (Unpublished Data of Content & Bertelson)

<i>Vocalic context</i>	<i>Critical segment</i>	<i>Example</i>	<i>Percent correct</i>
Constant	Initial	DUC, DUNE, DUR, CHUTE /dyk, dyn, dʏr, ʃyt/	38.2
	Final	GUIDE, VIDE, RIDE, FICHE /gʏd, vid, rid, fiʃ/	37.9
Variable	Initial	DATE, DOUZE, DONNE, CHEF /dat, duz, dɔn, ʃef/	32.0
	Final	RONDE, CHAUDE, SOUDE, MECHE /rɔd, ʃod, sud, mɛʃ/	32.4

tion task might be due to the fact that it does not require attention to segments proper.

It would be worthwhile to examine whether other differences in difficulty reported in the literature might also be interpreted in terms of degree of explicitness of the segmental analysis that the task requires. The question has actually two aspects. One concerns the size of the critical phonological string. It was the focus of the preceding example. The other aspect is whether the task requires explicit identification of that critical string. For instance, one can wonder whether judging rhyme (deciding, e.g., that one word rhymes with a target word and that another does not) implies, as has often been assumed, identification of the string common to the rhyming items, the rime. It is equally possible that such a judgment could be carried out on the basis of a global impression of phonological similarity.

There are for the time being few data on which to base a decision. However, one observation goes strongly in the direction of the similarity view. With Jose Morais and Luz Cary, we have examined a Portuguese illiterate poet (for more details, see Morais, Alegria, & Content, 1987b, and Bertelson & de Gelder, 1989). He could produce rhymes with great facility and was 100 percent correct in all the rhyme judgment tasks we submitted him to, including the discrimination between full rhymes (*capa-papa*) and other forms of phonological resemblance such as assonances (*gola-cota*) or quasi-rhymes (*cara-raro*). However, he failed in spite of repeated attempts on our part to enunciate the "part" that the rhyming items had in common. When we asked him to explain his (correct) judgment that *miro* did not rhyme with *cola*, he would typically provide examples of rhyming items.

The distinction between explicit analysis of utterances and judgment of phonological similarity requires more systematic study. This might help us to understand the recurring finding that segment detection and classification tasks are easier than segment manipulation ones.

Nature of the Critical Experience

Reading instruction, whether at school, at literacy classes, or at home, could conceivably influence phonological awareness by two different routes. One, that can be called *direct*, is through teaching of the alphabetic principle and exercises in speech analysis. The other, *indirect* route is through the availability of orthographic representations.

That the way literate people represent spoken language is influenced by orthographic knowledge is illustrated by many examples, such as the fact that linguistic change often goes in the direction of adaptation to spelling, or the phenomenon of "spelling pronunciation", in which the pronunciation of words with inconsistent spelling is modified in the direction of a better match with the orthographic representation (Kerek, 1976).

An effect described by Seidenberg and Tanenhaus (1979) offers a striking demonstration of the use of orthographic representations when effecting operations on heard words. These authors found that the time it takes to decide that two spoken words rhyme is shorter when the spelling of the rime is identical (*pie-tie*) than when it is different (*pie-guy*).

One can also cite a phenomenon demonstrated by one of us some time ago. In the click location task, in which the subject must judge at what time in a spoken sentence an extraneous sound was produced, the judgment is influenced by the spatial relation between click and sentence: With English or French material, the click is reported as coming earlier when it is delivered to the left ear and the sentence to the right one than with the opposite arrangement. We have shown that the polarity of the effect depends on the direction of writing of the language used in the task. French-Hebrew bilinguals showed the usual pattern when tested with French sentences and the mirror one with Hebrew sentences (Bertelson, 1972). That phenomenon would seem to imply the use of some orthographic image in relating the click to the sentence.

More specific examples of the influence of orthography have been reported in the context of tests of segmental analysis. Ehri and Wilce (1980) reported that in the segment counting task readers would for instance count one unit more for *pitch* than for *rich*, and Mann (1986) described similar errors in the segment counting performance of her Japanese subjects. It is true that these results are linked to the ambiguity of the instructions. They nevertheless have the important implication that once available, the orthographic representation is considered a reliable source of information about phonological structure.

Our present problem is of course to know if the effect of reading instruction on phonological awareness is completely mediated by orthographic knowledge. This extreme hypothesis can apparently be excluded. A number of studies have now shown that performance on segment manipulation can be trained in pre-school children independently and prior to reading acquisition (Content, Morais, Alegria, & Bertelson, 1982; Olofsson & Lundberg, 1983; Fox & Routh, 1984;

Content, Kolinsky, Morais, & Bertelson, 1986; Lundberg et al., 1988). Recently, we have shown that even illiterates can make progress in the consonant deletion task when provided with continuous corrective feedback plus some limited tuition in segmental analysis (Morais, Content, Bertelson, Cary, & Kolinsky, 1988).

However, a question one can ask about such acceleration studies is whether the type of segmental awareness they promote is equivalent to that which results from full reading acquisition. Some unpublished experiments by Alain Content (Content, 1985) are relevant. Content examined in kindergarteners the transfer that training on initial consonant deletion produced on performance on two other classical segmental awareness tasks: the segment counting task (Liberman et al., 1974) and a syllable classification task (Treiman & Baron, 1981) in which the child decides which of three CV syllables are closest and can choose on the basis of either a common segment or of overall similarity. In a way, the latter task measures the degree of saliency of segments compared to overall similarity. The results were not completely clear-cut, but, on the whole, little transfer was apparent. It is, thus, possible that training promotes locally efficient procedures specific of the particular task rather than full segmental awareness.

Comparisons of the effects of different teaching methods could bring useful evidence about the present issue. Alegria et al. (1982) compared, on a segment inversion task, first-graders taught by a strict look-say and by a phonic method, and found a strong superiority of the latter. That result might indicate that the direct effect is important. The authors unfortunately did not measure the reading performance attained by their subjects, so that the possibility that some of the obtained difference in the inversion task might result from differences in level of literacy cannot be excluded. One can remark, however, that the differences in reading achievement induced by different teaching methods, as reviewed by Chall (1967), are much smaller than the effects observed at the level of segmental analysis.

Relevant also is the fact mentioned by Read et al. (1986) that some of their alphabetic subjects who could no longer read Pinyin, nevertheless performed well on segmental analysis. Similar observations were made in our Brazilian study.

Access or Discovery?

Thus far, we have hardly considered the two most fundamental questions concerning phonological awareness. They are: (a) Why would awareness of segments be so rarely attained without external help? and (b) what is the nature of the change that occurs when it is attained? The two questions are of course closely related and are best considered together.

Although it was not couched in modularist language, the dominant answer, as expressed during the 1970s by several theorists (Mattingly, 1972; Rozin, 1976,

1978; Rozin & Gleitman, 1977), referred essentially to the nonaccessibility to conscious inspection of the internal workings of the speech module. Phonemes, they reminded us, have no separate physical correlates in the acoustic stream. They are computed within the speech module, but at a preconscious stage. In other words, they are not represented as such in the final output of the module, available for ulterior cognitive elaborations. Finally, the intermediate phonemic representations can be accessed by some deliberate effort.

For the sake of historical accuracy, one should note that there was some hesitation concerning the exact object of access. Some formulations, clearly influenced by the Chomskyan conception of linguistic competence as consisting of propositional knowledge, were in terms of tacit or implicit knowledge that, when accessed, became explicit. Rozin (1978), for instance, wrote: "A significant portion of human learning can be described, along with the alphabetic insight, as gaining access to knowledge already in the head" (p. 434). Other formulations were in terms of processes. Mattingly (1972) made the distinction between "primary linguistic activity" and "awareness of that activity". Rozin and Gleitman (1977) proposed that "the use of an alphabet requires . . . gaining access to the machinery in the head which analyzes and produces sound segments" (p. 56).⁴

Beyond these differences in formulation, the important emphasis was on retrieval of some representations inherent in the preformed linguistic equipment. This notion of acquisition as retrieval had of course axiomatic status in generativist thinking.

The notion of a module that is normally not accessible but becomes so, if sufficient insistence is applied, is somehow unsatisfactory and creates difficulties for the modular view. Modularity is being invoked to account for both inaccessibility and access—eating the cake and having it. Serious application of the notion would require some specification of the conditions under which a typically "closed" module (following the terminology of Mattingly & Liberman, *in press*), such as the phonetic module, can be accessed.

It would, thus, be worth giving more consideration to possible alternatives. One candidate is discovery of implicit properties of things at the level of conscious postperceptual representations. A good deal of our important intellectual insights consist of discovering new properties of objects or concepts. Such discoveries can occur without implying the perceptual processes in any way. We can, for instance, realize that a square's diagonals cross at right angles, and

⁴It is worth noting that "access" and "accessibility" have sometimes been used in the more neutral sense of reaching a particular level of linguistic description. When Klima (1972), for instance, wrote that "the various levels of language structure may, by their very nature, not be equally accessible" (p. 59), he was not committing himself to a particular assumption regarding location in a sequence of processes.

nobody will presumably propose that when we do so, we have accessed the operation of diagonal analyzers in the visual system. Similarly, the discovery of the phonological structure of linguistic objects might proceed completely at the post-perceptual level. The proposal is consistent with the stimulating speculations of Mattingly (1987) concerning the way an illiterate speaker could gain some understanding of phonology by applying paradigmatic analysis to morphologically related tokens. The proposal, which should presumably not be construed as a realistic description of how children usually become aware of segments, has the important property that it implies no reference to the way language is being processed.

Other theorists have already proposed that awareness of segments might be the result of a process of discovery without link to what happens at the level of speech processing (Warren, 1976; Marcel, 1983). For these authors, however, the proposal was part of a conception following which phonemes play no role in speech processing proper. Our position is that the question of the role of phonemes in perception and that of segmental awareness are orthogonal. Phonemes could play no role in perception and emerge only in postperceptual elaborations. Alternatively, they could be detected within the module, then be integrated into a holistic percept in which they are not represented separately and finally be rediscovered as a result of postperceptual analysis of the latter.

Evidence relevant to the latter question has been provided by a study of selective dichotic listening in illiterates and ex-illiterates by Morais, Castro, Scliar-Cabral, Kolinsky and Content (1987). These authors found no difference between the two groups of subjects in the tendency to commit "feature blendings" (i.e., to attribute to a segment of the attended utterance a feature of the corresponding segment of the nonattended utterance). This type of mistake would seem to reveal extraction of information at the segmental level. The result is consistent with the notion that segments are extracted on-line during speech processing irrespective of degree of awareness.

This kind of finding is important also regarding the wider question of the origin of phonological awareness. If phonological awareness effectively resulted from access to representations within the speech module, we should expect at the same time to observe some degree of cognitive penetration of the operation of the module. Speech processing might be modified by the availability of explicitly segmented representations, for instance, in the way considered by Mehler, Morton and Jusczyk (1984). There is for the time being very little relevant evidence, apart from the result of Morais and his collaborators. The data showing correlations between accuracy of speech recognition and reading ability (Brady, Shankweiler, & Mann, 1983; Werker & Tees, 1987) are ambiguous to the extent that the differences in speech recognition performance may have arisen at the postperceptual level. We clearly need systematic comparative studies of on-line speech processing in subjects with different literacy statuses.

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