

THE ONSET OF LITERACY

***Cognitive Processes
in Reading Acquisition***

edited by PAUL BERTELSON



A COGNITION *Special Issue*

The Onset of Literacy
Cognitive Processes in
Reading Acquisition

edited by
Paul Bertelson

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The onset of literacy: Liminal remarks*

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Abstract

As an introduction to the Special Issue, a tutorial examination of recent developments important to understand current research on reading acquisition is offered. The accent is put on the interrelations between studies of skilled adult performance, of effects of neurological damage and of early reading. The central puzzle of reading research is to identify the causes of the specific difficulties which acquiring literacy appears to entail. The problem has generally been attacked through correlational methods, based on the comparison of better and poorer achievers. The merits and shortcomings of that approach are examined and the need for linking differential studies to a general theoretical conception of the reading process and of its development is emphasized. The line of studies stemming from the hypothesis that a major difficulty in acquiring alphabetic literacy is to manipulate language at the level of phonemic segments is examined, and also the way the results of these studies can be related to current theories of lexical access. The limitations of the approach consisting of deriving hypotheses about development from theories of the adult stage are discussed and illustrated by data from studies of the reading performance of both children with normal reading achievement and developmental dyslexics. Finally, the possibility that sources of acquisition difficulties might be found at levels beyond that of word recognition is discussed.

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Traditions of research on reading

Psychological research on reading has in the last 15 years or so gone through a remarkable process of acceleration. As a result, reading is today one of the most actively investigated topics in cognitive psychology.

As is usually the case when sudden progress occurs in a field of inquiry, the present development has resulted from the converging effects of extrinsic and intrinsic factors. The main extrinsic factors are the practical problems arising from the difficulties encountered by many children in acquiring literacy. Intrinsic factors are conceptual and methodological developments in cognitive psychology, psycholinguistics and neuropsychology that have made it possible to deal with complex issues which in earlier times appeared to defy rational analysis.

Three main research traditions have been involved in those developments: the experimental analysis of skilled adult readers' performance, the neuropsychology of acquired reading disorders and the study of reading development. Communication has however not been equally distributed between these three fields of inquiry.

During the 1970s, a close interaction has developed between the people working with normal adults and with neurological patients. The critical event here has probably been the adoption by specialists of the two fields of the same conceptual framework, that of the information processing approach, that is, the view of the cognitive apparatus as a network of partially autonomous functional units, sometimes called "modules", which can be analyzed both through experimental manipulations and through observation of the effects of brain damage. As a result, the most influential contemporary ideas regarding the architecture of the apparatus involved in basic processes such as word recognition and sentence understanding (see the book by Ellis, 1984, for an excellent simple presentation) are based on evidence from these two fields. For instance, the classical dual-route model of lexical access finds its origin in efforts by experimental psychologists to analyze the role of phonological conversion in written word recognition. It received a decisive impetus when Marshall and Newcombe (1973) showed that the complementary symptoms of the patients they called "deep" and "surface dyslexics" could be interpreted as providing a double dissociation between two procedures for identifying written words. The dual-route model has more recently come under attacks based on arguments from both experiments with normal readers and studies of dyslexic patients (Henderson, 1982; Humphreys & Evett, 1985).

There are certainly differences in emphasis on different aspects between the experimental and the neuropsychological traditions. Neuropsychologists,

for instance, have generally been mainly interested in the general architecture of the processing system, and have not been very specific about details of procedures, while experimental psychologists have concentrated more on the latter aspects. It is nevertheless clear that a close and fruitful dialogue has been established between the two traditions.

Until recent years, the study of acquisition and of development has to some extent stayed away from that dialogue and has followed a path of its own.

There are historical reasons for that situation. In the early pre-1914 psychological research on reading, as reviewed by Huey (1908) in his classic book, studies of development and of the adult state were well integrated. That line of research virtually disappeared during the behavioristic era—with the notable and significant exception of studies of the directly observable phenomenon of eye movement. Practitioners—clinicians, educators, physicians—developed their own conceptions of the nature of reading. Whatever research there was concentrated on problems of diagnosing and predicting acquisition failures, and there was by and large little concern for the analysis of the reading process itself. It is during that period that some views of the etiology of reading retardation, which have exerted a strong influence on remediation and teaching practices up to now, were formulated. Most conspicuous among them are Orton's notion that dyslexic children, because of delayed lateralization of brain function, have difficulties with spatial orientation, which in reading manifest themselves in inversions of letter sequences and mirror-image confusions, and also various proposals that linked reading difficulties to some lag in the maturation of holistic perception capacities (e.g., Bender, 1957).

Research relevant to understanding reading performance resumed within experimental psychology in the 1950s, with New Look work on word recognition. Within cognitive psychology, identification of tachistoscopically presented words soon became one of the most intensively studied experimental tasks. This focusing originally was not only due to the role of word recognition in reading, but also to questions of technical expediency: written words are a category of perceptible objects regarding which our knowledge can be more rigorously described and measured than, say, things in the everyday environment, and on the other hand, written words can be presented under controlled conditions more easily than spoken ones. Nevertheless, this research was the basis for the elaboration of models of the mental lexicon which then played a central role in analyzing the reading process (Forster, 1976; Morton, 1979).

In that line of inquiry, developmental aspects have rarely received serious consideration. When new directions of research on reading acquisition developed in the late 1960s, the main influences came from linguistics,

psycholinguistics and phonetics, with cognitive psychology only in the background, as examination of the very influential collection of papers published by Kavanagh and Mattingly (1972) shows.

There are many signs however that the gap between developmental and other studies of reading might be filling fast. Several contributions to the present issue are representative both of a movement toward integration and of the difficulties that lie in its path.

Reading is difficult

The notion that some particular difficulty is attached to the process of reading acquisition has consistently provided reading research with both its principal practical incentive and its main theoretical challenge.

Learning to read is difficult in at least two senses.

First, it is difficult to the extent that it requires instructional support of the kind generally provided by schools. That feature puts reading and writing in a different category of skills from speaking and understanding speech, which develop in practically all hearing children independently of any deliberate effort on the part of the adults. Exactly how much instruction is necessary to get the child started on the path to literacy, we do not know. Cases of children who supposedly learned to read "by themselves" have been reported (Torrey, 1979) but the reports generally do not contain the critical information about the amount of support provided by the environment. On the other hand, the spontaneously acquired script-related skills of some pre-school children may have little relation to actual autonomous reading. The point is well documented for the capacity to recognize familiar graphic patterns such as brand names in the work of Masonheimer that **Barron**¹ describes in this issue. The performance of pre-readers with such material is apparently closely tied to the habitual graphic appearance, and plunges to near zero when the same names are presented in ordinary print.

The second form of difficulty is the one encountered by that substantial minority of school-attenders who progress slowly in reading and writing, and sometimes leave school without having attained the minimum level of mastery necessary for practical reading. These children are often found to have normal intelligence and to be adequately motivated, hence the notion of some specific disability responsible for their particular problems with the written medium.

¹References to the papers appearing in the present issue are printed in boldface type.

The opinion has often been held that research concerned with the sources of developmental reading disorders should concentrate on the second form of difficulty and considerable efforts have been made selecting the subjects supposed to be affected by the hypothetical specific reading disability. It can be doubted however that these efforts were justified. Both Carr (1981) and Stanovich (1982a) note that there is little evidence that the pattern of deficiency depends very much on how the sample of deficient readers is selected.

The question of the right research population has generally been associated with the notion of a so-called biological determination of reading disorders: the most extreme deficient readers would be those with a problem of biological origin. The assumption is not unreasonable, but it does not rest on any strong base of data, so that for the time being it is better to consider the two issues as orthogonal. The problem of possible biological roots of reading disorders is one that none of the contributors to the present issue addresses. The reason, I shall propose, is not that the possibility is being denied. Many demonstrated facts, such as the strong association of reading disorders with gender, support it. The question is rather one of research strategy. We need a good description of reading performance at its own behavioral level before the relation of that description to aspects belonging to other levels of description can be fruitfully examined.

The locus of the difficulty: Differential psychology of good and poor readers

The major part of research on acquisition has been aimed at localizing the sources of learning difficulties. It has generally used the correlational approach, in one of its main variants: either groups of poor and proficient readers have been tested for capacities that might be involved in reading acquisition, or correlations have been measured between reading skill and other capacities within one sample.

The classical evaluation of earlier work is to be found in the book by Vellutino (1979) and reviews of more recent contributions have been provided by Carr (1981) and by Stanovich (1982a, 1982b). For a more selective but highly readable presentation, see the recent little book by Bryant and Bradley (1985).

The main casualties of Vellutino's critical scrutiny have been the various theories that located the origin of reading difficulties in visual perception, whether of the Orton or of the Laurretta Bender variety. Correlations that had been presented as supporting the role of visual perception repeatedly disappeared once the tasks were redesigned in order to isolate the visual

component from more general cognitive or linguistic processes. Several studies by Vellutino and his collaborators have shown that retarded readers are inferior to non-retarded ones in *naming* written words but not in *copying* them, and that they commit left-right confusions in naming but not in copying. Regarding orientation mistakes, Stanovich (1982a) notes that a number of studies have now shown that although they are observed often in the reading of poor readers, they do not occur *proportionately* more often than in better readers, and are thus not characteristic of retarded reading. Carr (1981, p. 75) concluded his own review of that research by the remark that "visual discrimination theories thus appear to be unique in that the factor supposed by many of them to underlie the entirety of dyslexia may not account for any of it". Theories that saw the origin of dyslexia in a general capacity for cross-modal integration of all sorts of materials or in serial order recall appear to fare equally poorly. Vellutino argued convincingly that many results which have been quoted in favor of the preceding views are flawed by lack of control for possible common factors such as intelligence, motivation and verbal coding capacities.

On the positive side, Vellutino's major conclusion was that the main difficulties encountered by poor readers reside in the linguistic domain, in operations concerned with the phonological aspects and possibly the syntactic ones, but not with semantics. These were important conclusions which, as **Shankweiler and Crain** claim in this issue, cleared the way for more detailed exploration.

While there can be little doubt as to the importance of Vellutino's monumental effort, one point which its outcome makes clear is that the correlational approach is more efficient at eliminating groups of factors as possible sources of important difficulties than at identifying the particular operations which poor readers cannot perform.

This state of affairs is linked to some extent to the well-known limits of the differential method. Correlations do not allow causal inferences. If poor readers are also poor in skill X, it does not follow automatically (a) that deficiency in X is the origin of poor reading. Another possibility is (b) that literacy, or some of the activities necessary to attain it, promote X. And it can also be the case (c) that literacy and X are both influenced by some common factor, such as intelligence, socio-economic status or motivation for school achievement. And of course, these three types of relations are not mutually exclusive, and we should expect most observed correlations to reflect various combinations of the three. These problems of course arise only when a significant correlation has been obtained. The interpretation of non-correlation is much simpler: if poor readers perform on X as well as better ones, then X is unlikely to be one cause of reading retardation. This asym-

metry in the interpretability of positive versus negative results would explain why the differential approach is so much better at eliminating groups of possibilities than at finer grain analysis.

Several ways of dealing with the problems of interpreting correlations have been developed within the differential tradition. The influence of intelligence or of social class has often been controlled for by use of groups matched on those variables or of partial correlation techniques. To partial out the backward effect of reading experience on correlated capacities, one can use the reading-age match advocated by Bryant and Bradley (1985), which consists of comparing retarded readers with non-retarded ones matched on reading ability: any difference between such groups can obviously not have been caused by differences in reading experience. The method has however not been used very often. Other approaches which have been applied with some success to disentangle factors of reading acquisition are partial correlations between measures taken at different points during acquisition (Perfetti, Beck, & Hughes, 1981) and path analysis (Torneus, 1984).

The most tricky question for the interpretation of correlations is certainly the possible influence of unknown third factors: how do we know that there is not some common cause we have not thought of? Probably the best answer is the solution, advocated persuasively by Bryant and Bradley (1985), of using a correlational and an experimental approach in parallel. If children trained on X progress in reading faster than control subjects, a causal link from X to reading performance is demonstrated. Of course, it does not follow automatically that causality does not operate in the reverse direction also. Semi-naturalistic experiments, where one tries to influence overall reading proficiency (Bradley & Bryant, 1983), are costly in terms of time and effort, and can only be attempted to check on well explored hypotheses. For faster analyses, one may prefer to simulate aspects of reading acquisition in the laboratory and there are some interesting examples of the application of that strategy (Ehri, 1984; Treiman & Baron, 1983; Reitsma, 1983).

The solution advocated by Bryant and Bradley is thus a convergent appeal to the differential and the experimental approaches. As they note, the weaknesses and strengths of the two methods combine very well. The experimental approach provides more efficient control on effects and the differential approach provides the necessary check that the variables one is manipulating in the laboratory are relevant to actual reading.

The preceding discussion has been focused on the choice of methods for testing predictions, and thus misses what is probably the main limitation of the differential approach: the fact that it has too often consisted of testing a series of disconnected local predictions. What is needed is a more integrated strategy, where the question of the origin of reading difficulties is related to a general theory of reading performance and of its development.

Phonological awareness and explicit analysis of speech

Of all plausible loci for reading acquisition difficulties, one has in recent years drawn more attention than any other: the ability to analyze speech into phoneme-level units. The main cause of that concentration is no doubt that, unlike for other possible origins, the present notion was backed by an articulate set of theoretical proposals. These proposals, which took form in the early 1970s (see Liberman, 1973 and the book edited by Kavanagh & Mattingly, 1972, for early formulations, and the twin papers by Gleitman & Rozin, 1977, and Rozin & Gleitman, 1977, for a more extensive presentation; also the collection of papers edited by Sinclair, Jarvella, & Levelt, 1978) resulted from the convergence of lines of thought from developmental psycholinguistics, generative linguistics, the biology of language, experimental phonetics and the history of writing systems.

The basic idea was that of a fundamental difference between the skills involved in dealing with print and with speech. Speaking and listening are *primary linguistic activities* (Mattingly, 1972) which emerge through maturation of some universal pre-wired machinery, hence the fact that all children allowed some minimal linguistic input become expert with great facility. These activities, however, are largely automatic and only their end product reaches consciousness. In the absence of specific tuition, the speaker-hearer will become aware mainly of the meaning of utterances and be much less prepared to take account of more superficial aspects such as syntax and phonology. Reading, on the other hand, like versification, is a *secondary linguistic activity* and involves *meta-linguistic* knowledge. Reading a particular orthography would involve explicit, conscious manipulation of the linguistic units which the written symbols stand for: mapping speech segments onto the characters makes it possible to decipher text into some phonetic rendering which can then be dealt with by the existing speech interpretation mechanisms (Liberman et al., 1977). That means that the student must be able to represent speech as a succession of units at the corresponding levels, and attaining such *linguistic awareness* ("phonological awareness" is the familiar expression, but it can normally be used only in relation with submorphemic units) would be the main difficulty some children encounter in learning to read.

Linguistic awareness was conceived as possessing several levels, words and possibly morphemes being accessed more easily than syllables and syllables more easily than phonemes. Learning to read in different writing systems would as a consequence be more or less difficult according to the accessibility of the linguistic units being mapped onto the characters. Logographic systems, which represent words or morphemes, would be easiest and alphabetic ones, which represent phonemic segments, would be the most difficult, with

syllabaries somewhere in between. One early study that was seen as supporting the conception was one by Rozin et al. (1971) showing that children who had failed learning to read simple words written alphabetically could rather easily learn to read the same words represented by Chinese logographs. Gleitman and Rozin (1977) linked the problem of levels of linguistic awareness to Gelb's (1963) conception of the history of writing systems. They suggested that the order in which the logographic, syllabic and alphabetic principles were introduced reflects the difficulty of access to the corresponding levels of description of language.

The phonological awareness hypothesis has stimulated an extremely active line of developmental investigations of the ability to manipulate language at the level of submorphemic units, a group of capacities that will be designated here by the term "speech analysis". On the other hand, the more theoretical aspects of the hypothesis, which have been elaborated by Rozin (1978) in an important paper, have not received much further attention. There has been very little discussion, for instance, of the status of the attribute of "consciousness" or of the nature of those aspects of primary linguistic activity that are supposed to be accessed. A general discussion of the methodological issues is presented by De Gelder (1986).

The empirical work has demonstrated a robust correlation between speech analysis and reading performance. Better readers have been shown to perform better on a wide range of speech analysis tasks, even when differences in general intelligence and socio-economic status have been controlled for.

A good deal of work has been devoted to analysing the source of the correlation. Three papers in the present issue (**Read et al.**, **Morais et al.** and **Mann**) deal with that problem, so that the basic data need not be examined in detail here.

There is evidence both for effects of speech analysis capacity on progress in reading and for effects of reading acquisition on speech analysis.

Evidence for the influence of speech analysis ability on progress in reading has come from two types of studies. First there are longitudinal studies showing that performance on speech analysis at one stage predicts later progress in reading performance. To interpret these data, it is of course necessary to make sure that at the time it was measured, speech analysis ability had not yet been influenced by reading experience. The danger exists not only when the initial test of analysis ability is carried out after the start of reading instruction, but also when it takes place shortly before, at a time when some children can receive various types of reading tuition at home. There are a few studies in which the contamination can probably be ruled out. The best known is the monumental study by Bradley and Bryant (1983) where correlations, which survived controls for general intelligence and memory span,

were obtained between a test of the ability to categorize words on the basis of sound similarity, carried out at 4 or 5 years of age, and performance on standard reading and writing tests 3 or 4 years later. Using sophisticated partial correlation techniques, Perfetti et al. (1981) have provided what looks like convincing evidence for causal influences of phone deletion and addition capacities on subsequent progress in word decoding and spelling.

The other form of evidence comes from experiments where training on some speech analysis ability has been shown to improve reading capacity. Here also, the best known contribution is the training experiment carried out by Bradley and Bryant with a sub-sample of the population of their longitudinal study. Giving children who had scored poorly on sound classification extensive tuition on that kind of activity enabled them to score better on the final reading tests than equally poor performers trained on semantic manipulations. The superiority, however, was significant only for children trained on both sound classification and letter-sound correspondences. Results going in the same direction have been provided by Lundberg and his collaborators at Umeå (Oloffson & Lundberg, 1983) and by several other groups.

The main demonstration that, on the other hand, reading acquisition can influence speech analysis comes from the sudden improvement in segmentation ability that generally follows the beginning of reading instruction. Several studies have suggested that the improvement is time-locked to reading instruction and not to chronological age: it can be shifted on the age axis when instruction begins one year later, as for example in Denmark (Skjelfjord, 1976), or for the children who are older at the beginning of the school year (Alegria & Morais, 1979) and it does not occur in illiterates who at adult age perform at the same low level as pre-school children (Morais et al., 1979). On the other hand, the improvement depends on the content of instruction: it is delayed when a whole-word method rather than a phonic method is being used (Bruce, 1964; Perfetti, Beck, & Hughes, 1981; Alegria et al., 1982).

Another line of evidence comes from demonstrations that orthographic knowledge is being used in speech analysis tasks. Ehri and Wilce (1979) have shown that in the phoneme counting situation, children are influenced by the number of letters in the corresponding orthographic representation: they count for instance one more unit in PITCH than in RICH. Mann describes similar tendencies in the phone counting performance of her Japanese subjects. Findings of that sort could be taken as simply revealing weaknesses in the tests designed for measuring phonological awareness. They might also be seen as demonstrations of changes of forms of speech processing brought about by the acquisition of literacy. They would add to a corpus of data showing for example that pronunciation is influenced by spelling (Kerek, 1976), that apparent location of extraneous noises in spoken sentences can

be influenced by direction of writing (Bertelson, 1972) and that rhyming decisions concerning pairs of spoken words are influenced by their spelling (Seidenberg & Tanenhaus, 1982). The result of Brady, Shankweiler and Mann (1983) that good readers are better at recognizing noise-masked speech could also imply some use of orthographic knowledge in listening to speech.

There has been a tendency to ask regarding the relation between speech analysis and reading some version of the familiar "chicken and egg" question: is segmentation ability a prerequisite of reading acquisition, or one of its consequences? This is not a very fruitful way of looking at the problem. The reason is that entities such as reading acquisition and the emergence of speech analysis capacities are both too global to expect to observe a unidirectional causal relation between them. Only by analyzing both processes into simpler episodes can one hope to reach a level of description at which unidirectional influences would be found. Frith's (1985) insightful analysis of the interaction between reading and writing during development might here show the way.

The question asked by Morais et al. (1979) in the illiterates study was simply whether speech analysis can develop spontaneously, through maturation of the linguistic machinery and/or practice of speech communication, or whether it requires more specific experience. The inability of the illiterates seemed to imply the necessity of some specific kind of experience. It was not claimed, however, that only reading instruction can provide that experience, simply that possibly effective alternatives were not available to the population in question. On the other hand, the result was not inconsistent with the notion of an important role of speech analysis in reading acquisition: one plausible reason why the ex-illiterate subjects performed better in the tests could be simply that the curriculum of the literacy classes included some form of tuition in manipulation of language segments.

The first three papers in this volume each throws some new light on the issue.

(1) **Read et al.** show that literate Chinese who only learned the logographic characters perform in phonetic segmentation at the same low level as pre-school children and adult illiterates, whereas those who also received instruction in the alphabetic "pinyin" system are comparable to second-grade European children and to alumni of Portuguese adult literacy classes. Mann shows that Japanese first-graders who have learned both syllabic "kanas" and logographic "kanji" cannot perform phonetic segmentation as well as American first-graders. These results are consistent with the notion that the form of phonological awareness promoted by learning to read a particular writing system depends on the level of the linguistic units which that system maps onto the characters.

(2) The fact that logographic literate Chinese are at the same low level as

Portuguese illiterates has important implications for the interpretation of the latter subjects' performance. In the Portuguese situation, the subjects who took the opportunity of literacy classes may have been the more enterprising and intelligent ones, and their superior performance in speech analysis could be due to some unknown extent to these pre-existing superiorities. The non-alphabetic Chinese had presumably had no opportunity to learn the alphabetic characters at the time they had gone to school, so that the argument of selection does not apply to the Chinese study. Was the factor an important one, one would have obtained a smaller inter-groups difference in the latter study.

(3) **Morais et al.** address the question of the degree of specificity of the difference in speech manipulation capacity between illiterates and ex-illiterates. Two aspects of specificity are considered. The first concerns the type of phonological unit that must be manipulated. Illiterates perform as poorly as in the previous study with consonants, in both a deletion and a detection task. But they perform at a non-negligible level in tasks involving syllabic segments and also in rhyme detection. These results are consistent with those obtained with pre-readers, who also are much better at judging rhyme and manipulating syllables than at manipulating phonetic segments, and who progress much more in the phonetic skills than in the other ones when they learn to read. The findings would suggest that some forms of speech manipulation are acquired up to some point spontaneously, although they can still be improved by specific training, but that manipulation of particular phonetic units, consonants, requires training.

(4) The second aspect of the specificity question concerns the possibility that part of the superiority of literate subjects would be due to general cognitive abilities rather than to specific linguistic or metalinguistic ones. This is of course a question that currently commands much attention in psycholinguistics. **Shankweiler and Crain** in this issue argue strongly against the notion that difficulties of reading acquisition might originate in general non-linguistic cognitive capacities. Authors working in different traditions have been attracted by such a notion. Lundberg (1978) for instance has proposed that the condition for attaining phonological awareness may lie in the Piagetian process of decentration. Treiman and Baron (1981) on the other hand have given serious consideration to the notion that the onset of speech segmentation abilities might be a reflection of a general progress in the capacity to deal in analytic fashion with parts and local features of all sorts of patterns, linguistic or not. **Morais et al.** address the question by giving their subjects a musical segmentation task, and find no difference between illiterates and ex-illiterates. The finding goes against an interpretation in terms of a general analytic capacity, but of course the fact that both groups perform nearly at floor level

invites caution in the interpretation. Other relevant aspects of the results are that the level of difficulty of the tasks depends essentially on the type of unit that must be manipulated, and little on the type of instruction.

(5) **Mann**'s main finding is that Japanese children appear eventually to acquire the ability both to count phonemes and to delete them without being taught the alphabet. That finding no doubt creates problems for the notion of the non-spontaneity of phonetic segmentation. Mann considers the possibility that exposure to a *phonological orthography* promotes the development of speech analysis up to phonetic segments, but rejects it on the basis of **Read et al.**'s data on non-alphabetic Chinese readers. Chinese orthography, she reasons, has phonetic radicals, hence is a phonological orthography. One important consideration might be that those phonetic radicals stand for whole morphemes, so that, although they require attention to the sound aspect of language, they do not engage the reader in submorphemic segmentation proper. One possibility which **Mann** does not consider might thus be that the critical experience for reaching segmentation into phonemic units would be exposure to a *submorphemic orthography*. Another factor which might have its importance is the fact, mentioned by the author, that a few kana characters actually stand for sub-syllabic segments. Kanas are thus not pure syllabaries. One should consider the possibility that manipulating some particular letter-phoneme correspondences might be sufficient to get children started on phonemic segmentation. The finding that pre-readers given experimental tuition on particular phones readily transfer the effect of the training to other phones (Content et al., 1982) is favorable to that sort of conception. Also relevant is Treiman and Baron's (1983) result showing that among pre-readers trained to segment syllables, the most successful subjects gave evidence of spontaneously segmenting syllables they had not been trained on.

(6) **Read et al.** observe that some of their alphabetic subjects could no longer read pinyin well, yet could perform the segmentation task. They conclude that "the segmental conception acquired with alphabetic literacy may persist even when the literacy itself is dormant". In a similar vein, **Morais et al.** note that differences in segmentation ability between their better and poorer readers are small compared to those between poorer readers and illiterates. These findings are relevant to the distinction between two ways in which reading instruction can promote speech analysis. On one hand, we have the possibility that reading instruction involves direct teaching of segmentation or the imposition of exercises designed to promote it. That is the possibility considered by Bertelson et al. (1985) when they suggested that the relation between speech analysis and reading instruction is a part-whole one. On the other hand, literacy, especially the availability of stored alphabetic representations of words or other units, provides, as we have mentioned al-