

Introduction

Speech and Reading: One Side to Two Coins

Beatrice de Gelder
Tilburg University, The Netherlands

José Morais
Université Libre de Bruxelles, Belgium

Speaking and understanding speech stand out as natural linguistic activities, whereas reading qualifies commonly as a highly artificial skill. Speech and reading have been studied by different groups of researchers with different explanatory agendas, for different purposes and with very different methods. As a consequence, it is so far mostly the differences between speech and reading that have captured attention. However, as they are both linguistic activities what could be more natural than to expect them to be closely linked and to assume they are two expressions of the human competence for language that have a common core? This book continues the tradition inaugurated nearly 25 years ago with the volume edited by Kavanagh and Mattingly (1972) *Language by ear and by eye*. The notion that reading acquisition has close links with speech processing competence has gained momentum during the last two decades of research when in a different area of research it became increasingly clear that there was a specific biological basis for language and a dedicated information-processing infrastructure.

The present volume is built around the search for links between speech, reading and reading acquisition. The common theme is that the most promising approach to understanding the acquisition of reading skill is to see it as building upon speech skills. On such an approach the problem of understanding reading acquisition squarely belongs to the domain of investigations of the biology of language, and specifically that of phonological processes. This vantage point allows one to outline new perspectives and brings into focus little explored domains of research with the hope of showing results to be relevant for the biology of reading. The most obvious implication of this perspective is that the study of spoken language processing might contribute to our understanding of the process of reading acquisition.

In their classic paper "Perception of the speech code", Liberman, Cooper, Shankweiler, and Studdert-Kennedy (1967) noted that although written language is parasitic on speech, reading and writing do not follow necessarily from the maturation of the speech machinery. The perception and production of speech develop naturally and below the level of consciousness as part of a biological specialisation that is universal. Reading and writing, in contrast, do not ordinarily develop without direct instruction and also have been rare among the peoples of the world. The difficulty of literacy acquisition is further compounded in the alphabetic writing system which, it is assumed, requires of the learner an awareness of the internal phonological structure of words, an awareness found to be lacking in both preliterate children and illiterate adults. This perspective has been elaborated in a series of well-known papers (see Bertelson & de Gelder, 1989; 1991; Gleitman & Rozin, 1977; Liberman, 1971; 1983; Morais, Alegria, & Content, 1987; Rozin & Gleitman, 1977) and has dominated the research on reading acquisition for the last 15 years. It is clearly the case that conscious phonological representations remain a topic of central interest. But more recently the importance of phonological representations has come to the foreground in models of reading that have an indirect or phonology-based route.

The subtitle of this volume indicates the focus and the direction of inquiry common to a majority of the articles. The notion of a comparative approach is to be understood in a number of interlocking ways. By adequate use of the comparative method it should be possible to identify the components of reading acquisition and track down the specific problems encountered in each domain. A number of domains can be distinguished.

A first issue concerns the distinction between specific effects of literacy training and the general cognitive influence of schooling. Literacy training is usually provided in school, together with training in other activities, some of which also imply the development of analytic skills. The specific effects of literacy training, as far as the first stages of literacy acquisition are concerned, may be assessed by comparing illiterate adults and ex-illiterates, i.e. people who are learning, or have learned, to read and write as adults in special classes. On the other hand, possible effects of literacy acquisition on the development of other skills, such as those involved in visual analysis and in memory encoding and retrieval, are worth investigating.

Next, various metaphonological abilities need to be distinguished. It has recently become clear that the set of abilities called metaphonological is highly heterogeneous, not only because they concern different aspects or units of the phonology of language, but also—and above all—because they involve different kinds of mental operations. An intriguing question, for instance, is how some people manage to detect rhyme in word sets, apparently without being able to analyse their internal phonological structure. In this context the evidence from the illiterates is highly relevant. Adults who are illiterates for socio-economic or cultural reasons rather than as a consequence of failure to benefit from

instruction offer a unique opportunity to disentangle the effects of literacy itself from those of cognitive maturation. Likewise, evidence from nonalphabetic literates promises an essential contribution to our understanding of the relation between speech and reading. The study of nonalphabetic literates (for instance readers of Japanese or Chinese writing systems exclusively) is necessary to determine the extent to which phonemic awareness, as a special form of phonological awareness, depends on learning an alphabet.

None of the above reduces in any way the need to study the populations traditionally studied: pre-school children, developmental and acquired dyslexics. The study of pre-school children provided useful information both about the precursors of metaphonological skills and about the relationships between the emergence of these skills and a still developing primary phonological awareness. Complementary evidence is supplied by the study of developmental dyslexics. Detailed assessment of failures both in metaphonological operations (knowledge of these operations, attained degree in automaticity, etc.) and in reading and writing performance should contribute to the understanding of the role of conscious processes in literacy acquisition as well as be useful for prevention and remediation. Different types of acquired dyslexia and dysgraphia are an important source of information about the normal processes underlying word recognition and spelling. The study of such patients may also provide suggestions as to the role that metaphonological abilities play in the skilled reader and writer, as well as to the modularity of these abilities.

This comparative approach has two additional dimensions. One concerns the relevance of questions on the representation of speech for understanding reading and reading acquisition. The latter provides a new system of language processes and representations, which, although being derived from the primary, biologically determined system for spoken language, may in turn affect it. It is of great importance for the study of the architecture of language to specify which levels, in the perception of speech, are affected by the development of a reading skill and which are not. The second dimension concerns evidence from sensory-deprived subjects. Both deaf and blind people have acquired alternative means and procedures for dealing with spoken and written language. The development of these procedures may require special forms of linguistic awareness. The differential development of phonological awareness in deaf and blind subjects can help to define crucial components of the literacy acquisition process.

The volume is organised in four sections. The organisation of the sections respects a so far accepted division of labour as well as a logical order of topics, starting with studies of speech representation and continuing with reading acquisition. It proceeds by contrasting adult studies with developmental research, by looking at alphabetic vs. nonalphabetic reading and by examining language skills in the case of normal auditory input vs. less usual or exceptional nonauditory input such as lip-reading in deaf subjects or tactile reading in blind subjects. Common themes run across all these subdivisions, and these as much

as the cross-modal comparisons represent the major impetus for putting these various domains of research together and expecting some degree of cross-fertilisation. In what follows we first point to common issues and then give an overview of the major dimensions of the present comparative approach.

SPEECH PROCESSING, ITS SPECIFICITY AND ITS RELATION TO READING

The chapters in Part I of this volume deal with speech processing and this may appear surprising. When the issue of reading is considered on its own, like in familiar dual-route models of reading, speech processing receives very little attention indeed. A basic assumption of the classic dual-route model is that meaning can be obtained by accessing the phonological input lexicon on the basis of an assembled phonological representation. Other models draw attention to a phonology-mediated reading route. Theories of reading that stress the involvement of phonological processes thus add independent support to the central point made by Liberman about reading acquisition building on spoken language representations. Most importantly, they draw attention to the relevance of the study of spoken word representation for understanding reading and reading acquisition. Indeed, the whole point about the indirect route is that the link must be made between the written representation and the phonological representation of the word. Therefore, the student of reading and *a fortiori* the student of reading acquisition cannot ignore the research aimed at understanding speech processing. At least three sub-domains in the area of speech processing are likely to be relevant for investigating the final details of the phonological representations contacted in the reading process. The most obvious area is that of the nature of speech representations in on-line processing. The study of short-term memory is also important because of the observations of phonological memory impairments in poor readers. The third and equally critical issue concerns the development of speech representations. These three aspects are addressed in the chapters following Liberman's general statement of the speech and reading relation.

A forceful statement of the logic underlying the present collection is found in the chapter by Alvin Liberman. He emphasises the notion that speech is natural and orthographies are artifacts. At the same time he claims that our understanding of reading and reading acquisition must be built on our understanding of speech. He argues against a traditional approach of reading that ignores the importance of the readers' spoken language competence and emphasises instead the visual aspects of the reading process. This focus on spoken language competence orients the study of reading acquisition and its impairments towards the domain of phonological and metaphonological processes and away from peripheral visual explanations of reading difficulties. The picture that seems to emerge clearly from current research on reading acquisition is that phonological processes are the critical component in successful reading acquisition.

Anne Cutler and James McQueen defend a specific position in the debate regarding ongoing speech segmentation. A central problem confronting the student of speech processing is one that has no equivalent in reading because in the latter, but not in the former, word boundaries are marked unambiguously. Is the segmentation issue addressed in the course of the word recognition process or, alternatively, is it more plausible to have two separate processes or stages, one pre-lexical and another lexical? In the former case, the representational format of the spoken words is one that allows the speaker to segment words in the speech stream in the course of word identification itself. The phonological form may thus contain multiple components, some of which are important vehicles in the print-to-sound mapping, for example, segmental format of the phonological representations, while others are not, for example, metrical or prosodic aspects. Cutler and McQueen argue for the existence of a segmentation strategy based on the assumption that strong syllables signal word beginnings. This procedure operates at a pre-lexical level. The phoneme monitoring task as well as phonetic categorisation have been extensively used to investigate the issue of speech representation. Even independently of the issue of a pre-lexical segmentation stage, data obtained with phoneme monitoring have been taken as evidence for the phonemic structure of implicit speech representations. Cutler and McQueen present evidence obtained with these tasks that supports the notion of a lexicon-independent segmentation procedure. Besides this major claim, the approach defended in the chapter stresses the linguistic specificity of segmentation procedures. The authors argue that the pre-lexical segmentation strategy they propose is specifically suited to the phonological properties of English but not, for example, to those of French. That position is an important one in the debate on phonological representations. Intuitively, one might expect that in languages where segmentation strategies build on a clearly syllabically segmented speech stream a syllabic procedure would be the platform from where reading acquisition takes off. Against this background of language-specific phonological procedures, there is room for different patterns of written to spoken language conversion procedures in different languages. Later chapters introduce a second dimension of complexity in the speech-to-reading issue, one following from cross-linguistic differences in written representation. Needless to say, a realistic picture of reading must acknowledge contrasting phonologies as well as contrasting orthographies.

Phonological processes in short-term memory are the second area where concerns of the students of speech processing overlap with those of the student of reading and reading acquisition. The research of Crowder and collaborators fits in with the notion that there is a subsystem of short-term memory that is specifically devoted to phonological processes. In a series of interesting experiments Robert Crowder and Aimee Surprenant show that recency and suffix effects, which in the 1960s and 1970s were typically taken as the signature of auditory processes, in fact result from the involvement of the speech processor

in short-term memory. Examining short-term retention for different kinds of auditory materials like speech, music or animal sounds, and considering general properties of auditorily presented information like discriminability and familiarity, they arrive at the conclusion that the critical dimension of processing is whether subjects perceive the input as speech.

So far, issues of phonological representation, contrasting phonologies and contrasting orthographies were mentioned as they arise in the context of understanding normal adult listening and reading. In the final chapter of Part I the authors tackle what is the third area of speech processing investigations relevant for speech and reading, i.e. the development of speech representations. Michael Studdert-Kennedy and Elizabeth Whitney Goodell suggest that phonemes emerge at an unconscious level from units of articulatory action, called gestures, which are progressively organised within the word. They report evidence from a child about two years of age who produces deviant forms, which can be readily accounted for according to this conceptual framework, but not using a featural description. The emergence of phonemes is seen as a biologically based process where the developmental process of selecting a representational format is driven by imperatives of economical storage and rapidity of access.

The chapters in Part I all support the importance of studies of speech processing for understanding reading but they also present new challenges to the received view in these matters. The most straightforward statement of the relation between spoken and written language pictures the issue as one of mapping graphemic units onto the units of spoken word perception. It was at some time tacitly accepted that the latter were phonemes and that the critical intellectual contribution required from the apprentice reader consisted of accessing the corresponding implicit spoken representations. The study of reading acquisition problems as well as, more recently, the evidence from illiterates and from nonalphabetic readers have challenged this view. Evidence of the latter type showed that explicit alphabetic training is still needed. On the other hand, reading disorders such as developmental phonological dyslexia showed that access remained elusive notwithstanding intensive phonics tuition.

LANGUAGE AND READING IN DIFFERENT MODALITIES

The study of speech processing in input modalities other than audition presents opportunities for addressing in a novel way some of the issues so far mentioned. Cross-modal research of linguistic processes should offer a privileged avenue for disentangling abstract linguistic and modality specific aspects of language processing. Two different routes are open for such cross-modal studies. One is to look for commonalities across different input modalities, whether in normal adult processing, in development, or in impairment. The other is to examine systematically processing in populations in which one of the input modes for

language is absent, or impaired for peripheral reasons. Besides understanding the nature of the impairment and how it explains the difficulties, we might gain from these studies a better understanding of the normal phonological skills, their subcomponents and their interaction in the building of the speech-to-reading interface.

Comparisons between input modalities have so far been largely limited to the cases of listening to speech and of visual reading. As a consequence it is often difficult to know which of several coexistent modality characteristics are responsible for observed intermodal differences in performance. Paul Bertelson argues that consideration of other, generally neglected, input modes is necessary for a full use of the comparative approach. He draws supporting examples from the work of his group on braille reading by the blind. One study shows that so-called garden-path effects occur in the reading of braille just as in that of printed prose, but that they affect different parameters of exploratory behaviour. In another study it was shown that the manifestations of sequential use of input information for word recognition demonstrated in previous work with spoken words can be replicated for braille words and also for printed words presented letter-by-letter. Those findings suggest that sequential processing is not contingent on a particular input mode, but rather on the temporal distribution of the input.

Ruth Campbell and Vivian Burden re-examine and challenge the old view that deaf children are poor at tasks requiring phonological skills thought to be associated with sensitivity to sound regularities and sound similarities between words. Deaf youngsters generally become poor readers. For a long time it was considered evident that, being deaf, they lacked phonological representations of speech and thus could not resort to them to transcode written language into meaning. The study of Campbell and Burden emphasises that the phonological decoding skills of the deaf are in most respects normal. Why this picture of poor reading in the presence of normal phonological skills? The authors suggest that as a consequence of absent spoken input the interactions between the separate components of the phonological system do not become properly established. As poor reading is thus not explained by the absence of separate decoding skills, but also manifests itself in reduced skills to take advantage of the context, one might ask to what extent training the existing decoding abilities will improve reading.

Poor reading ability is often associated with deficits in short-term phonological codes. So far these studies have been limited to speech input in the auditory modality. As we noted, the chapter by Crowder and Surprenant underscored the existence of a specifically phonological storage in short-term memory. This is a finding that combines well with the evidence from impaired short-term memory performance for spoken input in young poor readers. Based on these two lines of evidence one might predict that poor short-term memory for linguistic material would also be shown when poor readers had to recall memory items present in

the lip-read modality. Beatrice de Gelder and Jean Vroomen present a systematic study of serial recall performance in young as well as in adult poor readers and find very symmetrical performance in the two modalities. On the basis of recency as well as suffix effects, they conclude that, compared to normal controls, performance is normal except for an overall reduced span. The overall reduction is the same in the two modalities and this for young as well as for adult readers. The picture of a specifically phonological memory disorder is thus complemented by evidence from an unusual speech input modality.

READING IN DIFFERENT ORTHOGRAPHIES

One may address the evidence from studies of reading, reading acquisition, and reading impairments in nonalphabetic orthographies from different perspectives. At the very least, the existence of nonalphabetic orthographies raises the issue of the generality of the findings on reading ability in alphabetic orthographies. In this sense evidence from nonalphabetic readers should be welcome because of its potential disentangling general and orthography-specific aspects of reading. In the context of this volume, such evidence allows us also to tackle another issue, that of the degree of intimacy between speaking and reading skills and the question of whether some orthographies do make spoken language more visible than others (DeFrancis, 1989).

A phrase which has been repeatedly called into service to characterise the job of the apprentice reader is that of the critical moment of "discovering the alphabetic principle". In the perspective of researchers of the 1970s such as, for example, Gleitman and Rozin (1977), this formulation reflected the view that the alphabetic system maps onto an existing level of spoken language representation. Discovery of the alphabetic principle was viewed as a matter of access to speech representations. Reading acquisition difficulties were blamed on children's problems with grasping the alphabetic principle, but no more detailed proposals were made. Evidence concerning the difference between good and poor readers in conscious manipulations of subsyllabic units fitted well with this conception and its emphasis on access to unconscious speech representations.

In the 1970s nonalphabetic orthographies served already as a reference point. It was assumed that Chinese orthography was logographic instead of phonology-based. Anecdotal evidence about the absence of reading difficulties in cultures where logographic writing systems like Japanese or Chinese were in use seem to support this picture. In the past decade the notion of Chinese as an exclusively logographic writing system has been attacked by students of Chinese writing who called attention to the importance of the phonetic components of Chinese characters (DeFrancis, 1989) and by psychologists inquiring into Chinese reading behaviour. Foremost among them, Ovid Tzeng and his collaborators have advanced evidence for the importance of sound-based processing of characters, thereby criticising the misleading opposition between purely phonographic and

purely logographic writing systems. Their chapter in this volume offers a new and fascinating insight into the role of the phonetic information contained in the characters for children's reading development. They examine the role played by the phonetic radical in a task requiring the beginning and advanced readers to read pseudocharacters. The leading notion is that once children have mastered a sizable set of Chinese characters they will read pseudocharacters by adopting a naming strategy based on their knowledge of sound/orthography regularities derived from the known words.

The evidence advanced by the study of Chinese pseudocharacters lends support to the notion of a biological basis of reading skills because it shows that phonological representations are also important for reading in nonalphabetic orthography. This is just the phonology-based view of reading that Lukatela, Turvey, and collaborators have been arguing for since a decade and it represents a challenge to the dominant position of a direct visual route for reading. On the latter view phonological information is only available after lexical access and can have no influence on written word recognition. On this picture speech processing skills are not called upon in fluent reading. Evidence from Serbo-Croatian as well as from English shows the existence of a phonological ambiguity effect for nonwords as well as for words. In their chapter Georgije Lukatela and Michael Turvey return to this issue and argue, as they did in earlier articles, in favour of an important role of prelexical phonology in word recognition. Their contribution presents a comprehensive review of the arguments and the data supporting this role and a comparison of results obtained with Serbo-Croatian with results obtained in English. To integrate these results in a general perspective they argue for a difference between languages in the distinctiveness of the phonemic level and, correspondingly, to a differential contribution of that level to prelexical processes. In Serbo-Croatian as contrasted with English, the phonemic level comes much more to the foreground because there are fewer phoneme/grapheme pairs and these have stronger connections than is the case in English. In the latter case only weak phonological priming effects are found, but they still testify to the role of a prelexical phonological level.

The research presented by Sam-Po Law and Alfonso Caramazza addresses the same issue as Tzeng et al. but now in the context of a neuropsychological approach. They describe the basic features of the Chinese writing system and present data from six Cantonese aphasics. These patients produced responses that phonologically resembled the target, as do patients who write alphabetically. Errors involving either the signfic or the phonetic component of a character are analysed and two main suggestions arise. First, the components are apparently treated as wholes at some level of processing; and second, information about the position and the identity of the component can be disrupted selectively. These neuropsychological findings thus point in the same direction as the findings from the developmental study by Tzeng et al.

The chapter by Sumiko Sasanuma and Karalyn Patterson takes as its point of departure the apparent inconsistency observed in some patients who show nonsemantic reading while at the same time making regularisation errors on exception words. The aim of the chapter is to see to what extent the comparison of these cases with data from Japanese patients also displaying nonsemantic reading can throw light on this specific phenomenon and thereby on the ways in which orthography constrains word reading. The critical contribution here concerns kanji word reading performance in the Japanese subjects as the correct reading of the kanji characters making up a multi-character word is fixed by the whole intra-word context. In this sense kanji word reading can be assimilated to exception word reading in alphabetic orthographies. The authors discuss the similarities between the patient populations across the linguistic differences. Yet they also point to relevant differences in the reading impairments for the English vs. the Japanese subjects. They suggest that one major difference between reading in these two languages might be related to the fact that the English orthography, even in the case of fully irregular spellings, is still based on a fine-grained network of graphemes that scaffolds impaired performance.

READING, THE IMPACT OF ITS ACQUISITION ON LANGUAGE PROCESSES AND READING DISORDERS

While the above picture is relevant for the study of reading per se, it also touches directly on long-standing issues in reading acquisition. As will be seen in Part IV, students of reading acquisition and of its problems are very much confronted with the issue of phonological awareness as this remains the single best indicator of reading progress in young children. Yet it is still very much an open question whether single phoneme manipulation skill is the critical component of phonological awareness. This issue is touched on in the chapters by Bryant, by Morais and Kolinsky, and by Karanth et al., as well as in the chapters by de Gelder and Vroomen and by Campbell and Burden dealing with language in other modalities.

In the past, the role of phonological awareness in learning to read has been stressed quite often, whereas the role of other language capacities such as grammatical awareness received much less attention. Peter Bryant recalls his position on how metaphonological awareness precedes and facilitates learning to read and goes on to present evidence in favour of the notion that awareness of grammatical properties may also play a causal role in reading development. He discusses which aspects of the reading progress these sensitivities may act on. Grammatical awareness may help children to take advantage of the context to read words they cannot read in isolation. But then, the effect of grammatical awareness might be on language comprehension in general rather on reading itself.

The study of the language skills of patients with brain lesions has become a major source of information about the possibility that separate subsystems are involved in the cognitive processing of language. A new promising tool is provided by the techniques of brain imagery. Thomas Carr and Michael Posner review the most important findings obtained with the subtractive method on PET images with regard to written word cognition. They report evidence in favour of a specific subsystem concerned with the orthographic encoding of letter sequences and localised in the left-medial prestriate visual cortex of literate adults. The authors argue that the data present a good illustration of the functional reorganisation of the brain driven by the experience of learning to read and write.

Illiterate adults have provided clear evidence of the close relationship between some forms of phonological awareness, particularly awareness of phonemes, and learning to read and write in an alphabetic system. There are, on the other hand, only few data concerning grammatical awareness in illiterates. Prathibha Karanth, Asha Kudva and Vaparna Vijayan present here a study of a large range of grammatical knowledge to ascertain which aspects of it illiterate adults are aware of. The results suggest that many aspects of grammatical awareness are influenced by the experience of written language. A comparison between school-going and nonschool-going children provided converging evidence. Interestingly, lack of syntactic awareness seems to affect comprehension in listening as well as in reading. The authors admit that these efforts would be larger in Kannada, a highly inflected agglutinative language, than in languages, like English, that depend more on free morphemes and on word order.

José Morais and Régine Kolinsky address the issue of the consequences of phonemic awareness. After having recalled that in their view phonemic awareness is critical for reading ability, they address the two sides of this coin. Phonemic awareness is a crucial factor of successful alphabetic literacy acquisition as is illustrated clearly by studies showing the effects of phonemic training on reading acquisition. Moreover, the bulk of available evidence converges on the importance of combining explicitly taught grapheme-phoneme correspondences with phonemic awareness in bringing about successful reading acquisition. As a corollary to this view, the authors review evidence in favour of effects of phonemic awareness on speech recognition and suggest possible loci for this influence in the speech-processing system.

As far as the general theme of lexical activation is concerned, the study of the difficulties of lexical search may fruitfully complement that of difficulties in word access. Indeed, lexical access triggered by speech or print as well as lexical search initiated deliberately by the subject occur during comprehension of both spoken and written language. In reading as well as in conversation and listening to discourse, words consistent with the context are called to mind more or less intentionally. Jennifer Gurd and John Marshall report a study of word-finding difficulties in patients with Parkinson's disease. They argue for the existence of

a double dissociation between two types of internal retrieval from a single lexical semantic store, namely a routinised vs. a nonroutinised retrieval.

One general comment is in order. Very likely, reading acquisition is an interactive process involving a succession of quantal steps, some in the sphere of phonological ability and some in other domains of the skill. A full understanding of the process of reading acquisition requires identification of those steps. Moreover, among the many studies that have attempted to analyse the mental representations and processes required for learning to read, the majority have taken as subject the younger reader in a normal school environment. This volume defends an approach that goes beyond that bias and integrates relevant expertise in spoken and written language developed in closely related research domains.

As is to be expected, such a comparative venture is based on the existence of common themes, but also introduces new areas of possible disagreement as well as potentially misleading areas of agreement. Aside from the common themes we have reviewed, some contentious issues emerge from the new materials presented in the volume. One such major issue concerns not so much disagreement as uncertainty. What is the format of phonological representations? Is it affected by cross-linguistic differences as well as by cross-orthographic ones? Is there a developmental course for the phonological formats as Studdert-Kennedy and Goodell claim? Is this developmental course partly driven by orthographic experience as Morais and Kolinsky argue? Or should more emphasis be put on the role of early phonological awareness and its role in early reading acquisition?

At the same time, some convergences may be misleading. Is reading in nonalphabetic orthographies based on phonological processes and representations just as much and in the same way as it is in alphabetic orthographies? The traditional dual-route model may not give one the appropriate handle on that issue. Reading, for example, Chinese cannot depend on phonological representation assembly in the same way it does in alphabetic reading. Evidence on phonological representation in Chinese and in Serbo-Croatian may not involve the same level of fine-grained phonological representations even if phonological effects in written language tasks point in the same direction. Thus learning to read in alphabetic writing systems may capitalise more directly on the kinds of representations that arise in the course of phonological development as outlined by Studdert-Kennedy and Goodell and assumed by Liberman. Finally, it is worth noting that the controversy on the relation between phonological awareness and reading acquisition now seems to expand into the area of syntactic development. For example, whereas Bryant highlights the causal role of these capacities, Karanik et al. present evidence of limited syntactic knowledge in illiterates.

REFERENCES

- Bertelson, P., & de Gelder, B. (1989). Learning about reading from illiterates. In A. M. Galaburda (Ed.), *From neurons to reading* (pp. 1-23). Cambridge, MA: MIT Press.
- Bertelson, P., & de Gelder, B. (1991). The emergence of phonological awareness: Comparative approaches. In L.G. Mattingly & M. Studdert-Kennedy (Eds.), *Modularity and the motor theory of speech perception* (pp. 393-412). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.
- DeFrancis, J. (1989). *Visible speech: The diverse oneness of writing systems*. Honolulu: University of Hawaii Press.
- Gleitman, L.R., & Rozin, P. (1977). The structure and acquisition of reading I: Relations between orthographies and the structure of language. In A.S. Reber & D.L. Scarborough (Eds.), *Toward a psychology of reading* (pp. 1-53). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.
- Kavanagh, J.F., & Mattingly, L.G. (1972). *Language by ear and by eye*. Cambridge, MA: MIT Press.
- Liberman, A.M., Cooper, F.S., Shankweiler, D., & Studdert-Kennedy, M. (1967). Perception of the speech code. *Psychological Review*, 24, 431-461.
- Liberman, I.Y. (1971). Basic research in speech and lateralization of language: Some implications for reading disabilities. *Bulletin of the Orton Society*, 21, 7-87.
- Liberman, I.Y. (1983). A language oriented view of reading and its disabilities. In J.L. Myklebust (Ed.), *Progress in learning disabilities* (Vol. 5, pp. 81-101). New York: Grune & Stratton.
- Morais, J., Alegria, J., & Content, A. (1987). The relationships between segmental analysis and alphabetic literacy: An interactive view. *Cahiers de Psychologie Cognitive*, 7, 415-438.
- Rozin, P., & Gleitman, L.R. (1977). The structure and acquisition of reading II: The reading process and the acquisition of the alphabetic principle. In A.S. Reber & D.L. Scarborough (Eds.), *Toward a psychology of reading* (pp. 55-141). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.