Issues in Phonological Awareness Assessment

Patricia C. Lindamood
Nanci Bell
Phyllis Lindamood

Lindamood-Bell Learning Processes
San Luis Obispo, California

Awareness of the internal phonological structure of words is a causal factor in success with the alphabetic principle in word recognition. However, findings with the Lindamood Auditory Conceptualization (LAC) Test reveal 25–30% of the population show deficiency in a subtle component of phonological awareness termed comparator function. *We argue that this comparator function—an ability to hold the phoneme and/or syllable segments of two phonological structures in mind and compare and represent any variations in the number, identity, or order of their segments—is a primary sensory-cognitive function underlying the secondary function of self-correction in word recognition and spelling. And since word recognition correlates highly with comprehension, comparator function also indirectly impacts this basic purpose for reading. We suggest that the needs of many individuals, including educators themselves, for development and refinement of phonological awareness/comparator function may be misdiagnosed and underaddressed unless more sensitive measures of phonological awareness are used. The consequence of inadequate assessment/remediation of these deficiencies in educators is that they may be less able to assess and address these deficiencies in their students. Standard phonics instruction is known to be ineffective in developing phonological awareness for many individuals. However, phonological deficits can be addressed both preventively and remedially using procedures that are fundamentally different from typical phonics instruction.*

Annals of Dyslexia, Vol. 42, 1992.

ISSN 0736–9387

Introduction

During the 1960s and 70s, there was strong interest in a search for the causes of misreading. The National Institute of Child Health and Human Development (NICHD) sponsored interdisciplinary meetings of experts who were researching the speech, language, and reading processes. It was hoped that by comparing the processes that underlie speech and reading, and by studying the relationships between them, it would be possible to understand better why many children acquire speech with ease, but have difficulty with reading and writing. The aim was to reveal what was known about this comparison, and "by framing the important questions, to stimulate appropriate and useful research" (Kavanagh and Mattingly 1972, p. x). That aim is still an important one and our aim in this article is closely related. We hope to frame important questions on assessment of a specific aspect of phonological awareness we have termed *comparator function*—the ability to hold the phoneme segments of two phonological structures in mind and analyze variations in their number, identity, and order.

Framing the Important Questions

In a paper for the fourth and last NICHD conference, Shankweiler and Liberman (1972) expressed concern that much of the current research examined the child's oral reading of connected text. They stated, "None of these investigations ask what we believe to be a basic question: whether the major barrier to reading acquisition is indeed in reading connected text or whether it may be instead in dealing with words and their components" (p. 294). They concluded the problem in reading acquisition is indeed primarily at the level of the word and its components and that "children do not have the conscious awareness of phonemic segmentation needed specifically in reading but not in speaking and listening" (p. 314).

Studies have continued through the 80s and into the 90s on this factor of phonemic segmentation and reading development. It has been further confirmed as a causal factor in successful reading acquisition for both children and adults (Bradley and Bryant 1983; Lie 1991; Pratt and Brady 1988), and is associated with reading comprehension, the purpose for reading (Perfetti 1985; Roth and Beck 1987; Stanovich, Cunningham, and Feeman 1984). The general question—is phonological awareness related to reading acquisition—clearly seems to have been answered. And now it is time to frame more specific questions, and apply the answers gained to what is done with students.

Which Tasks Measure Phoneme Segmentation Relevant to Literacy?

Although phoneme segmentation is identified as a primary factor in reading, there is no agreement on how to measure this ability. In numerous studies reported, tasks used to measure phonemic segmentation have varied widely in the simplicity or complexity of metacognitive processing required. Some are auditory discrimination tasks in which two oral words are judged simply as same or different (Wepman 1960). Some require analyzing whether a beginning or ending phoneme is the same (Karlsen, Madden, and Gardner 1976), or omitting a designated syllable or phoneme from a given word (Rosner and Simon 1971), or counting phonemes or syllables in words (Liberman and Shankweiler 1985; Lundberg, Olofsson, and Wall 1980). Other tasks require detecting the odd word which does not share a common phoneme in given groups of three and four (Bradley and Bryant 1983). Synthesizing syllables or phonemes into words is also used (Lundberg, Olofsson, and Wall 1980). Lewkowicz (1980) cites ten kinds of tasks commonly used to tease apart various components of phonemic awareness. Stanovich, Cunningham, and Cramer (1984) analyze phonemic awareness measures relevant to literacy, and cite an increase in predictive value when sets of measures are used.

There also is wide variation in the terminology used to describe this cognitive ability. Terms such as linguistic awareness, phonetic segments, acoustic signal, auditory analysis, speech perception, phonological perception, phonological analysis, phonemic awareness, and others are used somewhat interchangeably in many studies. We agree with Berninger et al. who caution that since the term used does not always appropriately describe the task, it is necessary for the reader to consider the task's relevance to literacy in evaluating the findings of research on phonemic awareness and literacy (Berninger et al. 1987).

Yet another term was added—*auditory conceptualization*—with the development of the Lindamood® Auditory Conceptualization (LAC) Test (Lindamood and Lindamood 1979) and its current revision, the Lindamood®-Bell Auditory Conceptualization Test-Revised (LACT-R), in development. In addition to assessing the concept of number, sameness/difference, and order of isolated phonemes, these tests assess *comparator function* for *how* and *where* two syllables differ, and conceptualization of that difference in a visual medium. Shankweiler and Liberman (1972) made an important contribution with their earlier referenced question "whether the major barrier to reading acquisition is indeed in reading connected text or whether it may be instead in dealing with words and their components." Should it also include: *"and whether a lack of comparator function for word components interferes with self-correction and attainment of full potential in reading"*? This assess-

ment of *comparator function* may be the LAC Test/LACT-R's most important contribution to more refinement in measuring phonological awareness critically related to independence in literacy skills.

Why Assess Comparator Function?

Comparator function is a level of metalinguistic processing that goes beyond the phoneme segmentation and analysis tasks with syllables or words commonly described in phonological awareness studies. Activating comparator function involves requiring a conscious comparison of the phonological structure of one word with that of another. For example, in the LAC Test and LACT-R formats in which the examiner says "If that says /---/, show me /---/," the subject manipulates colored units to conceptualize visually *how* and *where* two spoken patterns are the same or different. *The comparator function brought into action when two phonological structures have to be specifically compared is the same processing required for self-correction during decoding and spelling activity.*

Children and adults performing poorly on the LAC Test or LACT-R commonly make unphonetic errors in decoding, such as reading a single consonant as a cluster or vice versa (i.e./unt/ for /ut/ on a word attack test, or /blend/ for /bend/ with real words). They also substitute vowels (i.e./book/ for /bike/ or /expand/ for /expend/). Context often does not cue a decoding error, as it would not if a student read, "We must *expend* our resources," for "We must *expand* our resources." Unable to self-correct the misreading, a subsequent misunderstanding of content can occur. *Even if context does cue an error, these individuals are often unable to self-correct for the precise word needed because they cannot precisely compare the phonological structure of the word they have said with that represented by the graphic sequence.* Without intact comparator function and the consistent ability to detect and self-correct errors, they cannot become completely independent in reading and spelling. To clarify the hold-and-compare process assessed in the LAC Test/LACT-R their format will be discussed below.

Rationale of the LAC Test/LACT-R

An analysis of unphonetic word recognition and spelling errors of children and adults shows five types of phoneme-grapheme correspondence errors: addition, substitution, omission, repetition, or reversal of order. These errors can be classified as involving problems with *identity, number,* or *order* judgments. When letter symbols are in-

volved, it is difficult to know whether the errors relate to problems with the component sounds of words or their symbol associations. Therefore, phoneme identity, number, and order judgments are presented in the LAC Test/LACT-R without the use of letter symbols.

The LACT-R extends the LAC Test to obtain further information about individuals' comparator function for more complex single-syllable and for multisyllable phonological structures. The cognitive load of the LAC Test/LACT-R is heavier than most other phonological measures in use in that two syllables have to be held in mind, compared, and their point of phonemic contrast analyzed, categorized, and represented with color units. *However, since its load is directly comparable to the cognitive load for self-correction of decoding and spelling errors, an important aspect of independence in literacy, this load is relevant and desirable.*

For example, to self-correct my error spelling of "pant" for "plant," my sensory feedback processing starts with an auditory image or auditory gestalt of the word "plant." However, as I produce its written form and read it back, either internally or aloud, and specifically compare the segments of its phonological structure with those of my intended word, the auditory-to-auditory comparison confirms the omission of the /l/ and I know where the letter "l" must be added to correct the spelling. In reading, to correct my error reading of "stop" for "spot," my sensory processing starts with a graphic image or gestalt. However, as I convert its visual units to the phonological structure they represent, and read it either as inner language or aloud, and specifically feed back and compare the phoneme segments I said with those represented, the auditory-to-auditory comparison permits me to detect the reversed order of the /t/ and /p/ and I know how to correct my reading error.

Format of the LAC Test

The LAC Test enables a relatively clean look at phonemic conceptualization by examining the ability to compare and conceptualize phoneme identities and relationships without requiring a learned medium for response, such as sound-letter associations. The test procedure uses colored blocks to represent number, sameness/difference, and order of phonemes, and the task is demonstrated for each category. The subject performs the test simply by placing the blocks in a row in a left-to-right orientation. Different phonemes within a pattern are shown by different colored blocks. There is no constant relationship between a specific color and a specific phoneme except to indicate repetition of a phoneme within a pattern. A representative sampling of the classes of English phonemes is incorporated, but not all phonemes

are included. Color blindness does not prevent persons from taking the test, as they are not asked to name the colors, and they are able to discern shades of difference sufficiently to code with the blocks.

Category I

In its presently published form the LAC Test is divided into two categories. In Category I the subject conceptualizes the number, sameness/difference, and order of two and three isolated phonemes spoken in patterns by the examiner. Each response is recorded and removed before the next pattern is given. See Figure 1 for examples of the coding process.

Category II

Category II requires the subject to *hold and compare* changes that occur within single-syllable structures of two to four phonemes as a phoneme is added, substituted, omitted, shifted, or repeated. Building on a basic block pattern for the stimulus syllable, the subject alters the pattern to show the contrast perceived in the next syllable spoken by the examiner. *Nonwords are used to avoid the possibility of the subject's responses being influenced by the known spelling of words or by nonstandard dialect associations for words.* The subject is not asked to repeat the stimulus items, as the LAC Test is measuring receptive processing. See Figure 2 for examples of the coding process.

Format of the LACT-R

In the LACT-R, syllable complexity has been increased from four to five phonemes in Category II. A more sensitive diagnosis of phonological awareness/comparator function is possible, as a sharp cut-off

STIMULUS	RESPONSE	
Show me /z/ /z/	□□	two same phonemes— two same color blocks
Show me /v/ /m/	□■	two different phonemes— two different color blocks
Show me /p/ /p/ /ch/	□□■	three phonemes with first two the same— three blocks with first two the same color

Figure 1. Examples of LAC Test Category 1 items (Lindamood and Lindamood 1979)

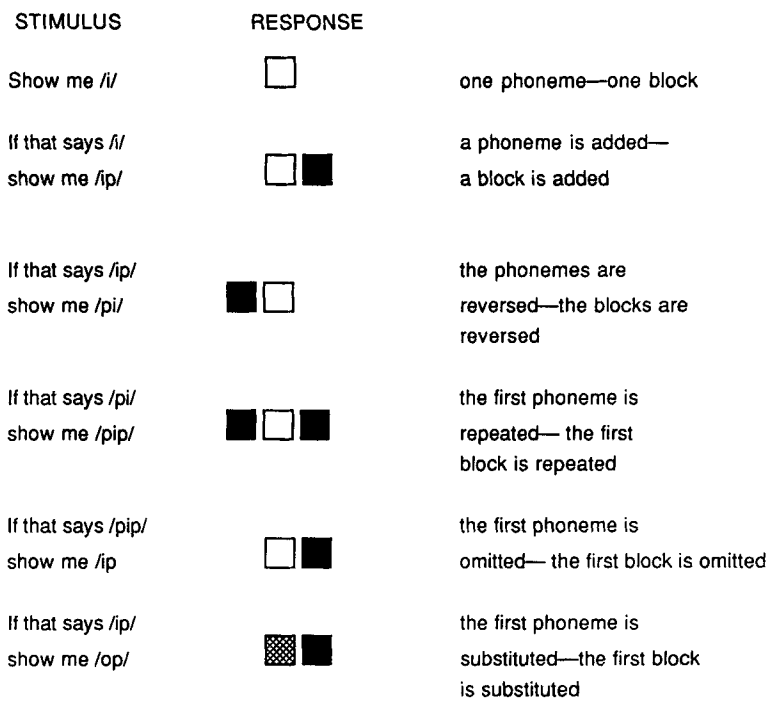

Figure 2. Examples of LAC Test Category II items (Lindamood and Lindamood 1979)

or more unstable performance is often revealed for both children and adults when syllable complexity is increased and the processing involves more subtle contrasts.

A new multisyllable section, Category III, uses larger colored squares to show syllables in nonword two to five-syllable contrasts most typical of words in English. To our knowledge, there are no comprehensive data currently available on the emergence and development of multisyllable levels of phonological awareness/comparator function among children and adults. The LACT-R provides an assessment tool for collecting this information.

Multimedia Version of the LACT-R

In addition to a print version, a computerized interactive multimedia version of the LACT-R is in development. The examiner's face is visible as the stimulus patterns are pronounced, and the colored blocks and squares are movable graphics on a touch screen. No keyboarding is required. The computerized version of the LACT-R may contribute to better research, since its administration will be consistently stan-

dard, and the retrieval and analysis of data will be rapid and accurate. *Standard administration* is an issue because it has been found that psychologists, speech pathologists, teachers, and other education personnel who are likely to use the test cannot be assumed to have intact phonological awareness and comparator function (Lindamood 1975). Individuals generally are unable to give the LAC/LACT-R correctly if they need development or refinement of their own auditory conceptual function.

LAC Test Findings and Potential for New Findings with the LACT-R

Phoneme segmentation/comparator function research with the LAC Test indicates that this specialized cognitive ability has two stages of development. Although emergence of the first phase precedes the second, it does not predict development of the second. In Category I, the ability to conceptualize the number, identity, and order of isolated phonemes in patterns appears to emerge spontaneously for the bulk of the population by about eight to nine years of age. *However, the ability to compare and conceptualize phonemes spoken in syllables, Category II, appears not to emerge developmentally for one third or more of the population, even into adulthood.* By second grade, a strong bimodal trend emerged in the distribution and continued through grade twelve.

Performance on the LAC Test cannot be predicted on the basis of age, sex, general intelligence, socio-economic or ethnic-linguistic group, or amount of education. Some individuals who are significantly retarded in language and cognitive development have performed better on the LAC Test than some dyslexic gifted individuals. Some five- and six-year olds have demonstrated more phonological awareness on the LAC Test/LACT-R than some adults in professional positions who have reading and spelling disabilities. However, within large groups tested, there are indications of some covariance between LAC Test performance and IQ (Felton, Naylor, and Wood 1990; Thatcher 1980).

Correlation with Decoding and Spelling

The initial LAC Test research with 660 students, K–12, revealed high correlations (.73 ave., range .66–.81) between LAC Test performance and at-or-above grade reading and spelling ability on the Wide Range Achievement Test (WRAT) at every grade level (Calfee, Lindamood, and Lindamood 1973). A study on spelling performance of college students showed that for those who accurately judged all the syllable contrasts on the LAC Test, 79 percent scored at-or-above the 50th percentile on the spelling subtest of the WRAT. Of those missing more than three items on the LAC Test, only 17 percent scored at-or-

above the 50th percentile in spelling on the WRAT (Lindamood and Lindamood 1979). Pratt and Brady (1988) found that LAC Test performance and two other phonological awareness measures accounted for much of the variance between good and poor readers for both third graders and adults.

Correlation with Comprehension

A relationship between phoneme segmentation ability and reading comprehension was corroborated in a study with the LAC Test and 1440 third graders. Students who scored at-or-above the LAC Test recommended minimum score of 81 for third graders had a 78 percent probability of being at-or-above grade level in reading comprehension on the California Primary Reading Test. Those who scored below the recommended minimum had a 76 percent probability of being six months or more below grade level in reading comprehension (Lindamood and Lindamood 1974). Shankweiler and Liberman (1989) have also reported on the positive relationship between phonological awareness and reading comprehension.

The link between phonological awareness and comprehension may be related to links between decoding, imagery, and comprehension. Readers or listeners construct mental models of the situation a writer is describing (Bower and Morrow 1990). Oliver (1982) stresses that visualization enhances comprehension and Long, Winograd, and Bridge (1989) concluded that imagery seems to function as an organizational tool for coding and storing meaning gained from reading. However, a severe phonological processing disorder, causing numerous decoding errors, may cause enough imagery distortion to interfere with comprehension (Bell 1991).

LACT-R and Potential for New Findings

Research with the LAC Test on comparator function for single-syllable structures revealed a breakpoint score that was sharply discriminative of both decoding and reading comprehension performance at-or-above versus below grade level (Calfee, Lindamood, and Lindamood 1973; Lindamood and Lindamood 1974). As it becomes possible to gather further information with the LACT-R, more questions can be asked: *in identifying students at risk for lack of development of full literacy potential, will minimum levels of comparator function for single syllables be sufficiently predictive, or will minimum levels of multisyllable processing be critical? Another question: at both younger and older ages, will combining single and multisyllable performance provide minimum scores yet more sharply discriminative of age and grade appropriate literacy skills?*

Phonological Deficiencies

Causes

If phonological awareness is the best single predictor of reading competence for both children and adults (Liberman et al. 1989; Pratt and Brady, 1988), what causes phonological awareness deficits?

Olson et al. (1989) reported data from identical and fraternal twins indicating that the phonological coding deficit of children with reading disability was highly heritable. The phonological deficit accounted for most of the heritable variance in their word recognition deficits and was also related to deficits in rhyming and phoneme segmentation.

Our clinical experience concurs with Olson's conclusion that phonological coding deficits are highly heritable. When we test children with weakness in phonological awareness/comparator function, one or both parents often indicate they themselves cannot perceive sounds within syllables. They describe the difficulty they experienced in school and usually note that their difficulty with reading and spelling is still unresolved.

Misdiagnosis of Reading Difficulty

When information is not available on the student's ability to make phonological structure comparator judgments, it is common to find diagnostic confusion where visual processing is thought to be the primary cause of the decoding errors. Such diagnostic summaries may be similar to the one below:

> J. was a male, 8 years 4 months of age, with a grade placement of 3.2 when referred for testing. On a word recognition test, J. performed at a mid-first grade level, and at a beginning second grade level on a word attack test using nonsense words. In reading real words, he read *on* for *no*, *itly* for *little*, *pal* for *play*, *gud* for *up*, *earache* for *early*, *pastry* for *passage*, *growl* for *ground*, etc. In reading nonsense words he read, *bee* for *dee*, *bog* for *pog*, *west* for *weat*, *piple* for *plip*, *bus* for *dud's*, etc. He attempted to sound out words and had some phonetically reasonable spelling errors, indicating that he does possess some word attack skills but that his errors are due to *difficulty with visual orientation and sequencing of letters*. Remediation should capitalize on his perceived strengths in auditory skills and develop whole-word memory and attention to visual detail.

In our opinion, J.'s errors in word recognition and word attack were misdiagnosed. They were attributed to his not attending closely to visual details in letters and words. Although there were some audi-

tory processing tests given, comparator function as presented in the LAC Test was not assessed. Our research and clinical experience indicate that J.'s errors involving incompatibility of phoneme-grapheme identity, number, and order are typical of students who lack intact phonological awareness and comparator function. If that function is not measured without letter symbols, relevant information in regard to the oral level cause of decoding errors is not available, and misdiagnosis and inappropriate remedial recommendations are likely to occur.

Adult Phonological Awareness

Although the psychology of reading literature has references to "adult levels" of phonological awareness (Cooper 1972; O'Neil 1972), findings with the LAC Test indicate that this is an assumption not borne out in reality. *Adulthood does not predict access to phonological awareness.* Findings by the Rockford Area Literacy Council, Rockford, Illinois, with an adult population who had opportunities for schooling, but were essentially illiterate, indicate LAC Test performance was severely impaired. Their performance stands in stark contrast to the LAC Test performance of their volunteer tutors. (See Figure 3.) However, notice that approximately 30 percent of the volunteer tutors did not have completely intact phonological awareness. Considering that many of the tutors were college graduates and had even been teachers, and the test syllables contained only two to four phonemes, this is interesting information. It lends support to our earlier statement that approximately 30 percent of the general population may lack intact phonological awareness for one-syllable words. Investigators from several countries have reported similar findings regarding lack of phonological awareness in adults (Byrne and Ledez 1983; Liberman, Shankweiler, and Liberman 1989; Marcel 1980; Morais et al. 1979).

A longitudinal study reported by Felton, Naylor, and Wood (1990) followed reading disabled children into adulthood and documented the persistence of a phonemically related processing deficit. This is regardless of actual improvements in reading as measured in adulthood. In our experience, the persistence of the phonological deficit indicates that the improvement in reading is not likely to match the potential signaled by IQ.

From among children tested by June Lyday Orton and diagnosed as reading-disabled, borderline, or normal readers, 115 subjects were extensively retested as adults. The question was whether the three groups would be discriminated by their cognitive profiles as adults. Although several of the language and memory tests did not discriminate the groups, there were three tests that did: the LAC Test, nonword reading on the Woodcock Word Attack Test, and rapid naming. These effects were significant even after controlling for childhood IQ.

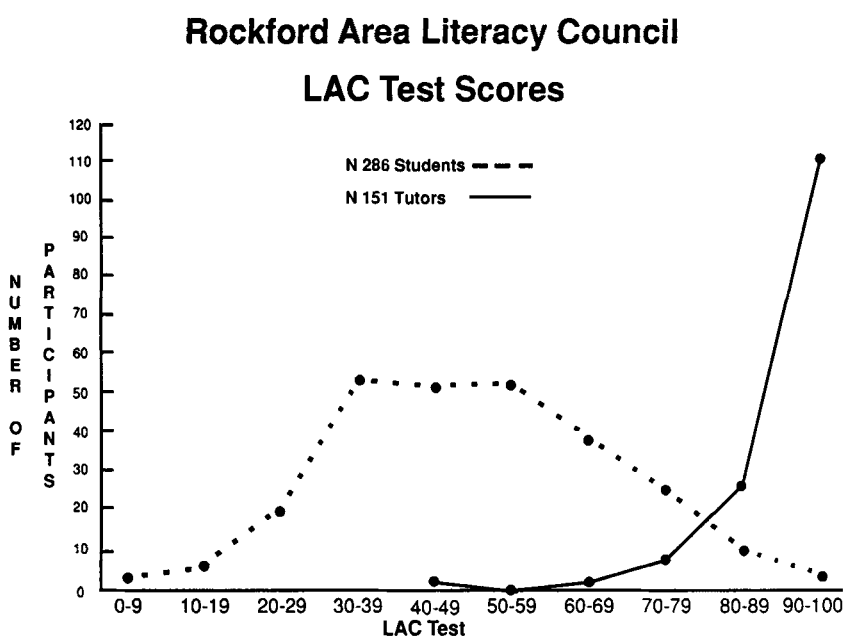

Figure 3. LAC Test performance of adult literacy students and literacy tutors

Prevention and Remediation

Are there individuals who are incapable of developing phonological awareness/comparator function? Olson et al. (1989) reported that significant heritability does *not* imply that phonologically based developmental or remedial efforts would be ineffective, but that when severe deficits in phonological processes are involved, a more effective method than traditional phonics programs may be needed.

Phonics activities offer *practice* in phoneme segmentation. But unless there is a sufficient level of phonological awareness accessible at the beginning of phonics instruction, the activities may be frustrating rather than productive for students. *Being asked to make a judgment does not necessarily stimulate the ability to make that judgment.* Torgesen and Morgan (in press) found in a study on phonics instruction for kindergarten children that 30 percent made no progress in phonological awareness. Phonics instruction may lack effectiveness for students with more severe phonological deficits because it asks students to listen to *sounds* in words. Liberman and her Haskins Laboratories colleagues have repeatedly shown that the acoustic features of a phoneme vary depending on adjacent phonemes in the syllable. They maintain that what is consistent for a given phoneme are its motor features or gestures, not its sounds (Shankweiler and Liberman 1989).

We will speak briefly about treatment for phonological dysfunction, but it is not possible to provide an adequate discussion of prevention and remediation issues within the space constraints of this paper. In our experience, Olson et al.'s (1989) call for a more efficient way to assist children and adults to apply the alphabetic principle in decoding and spelling can be met, but *it requires stimulating conscious access to cognitively processed feedback from articulatory gestures.*

The Orton-Gillingham multisensory concepts and various phonics programs that are related to those concepts do call attention to articulatory information (Sheffield 1991). We suspect that if this articulatory feedback is to become *cognitively* accessed, the processing "demands neurological underpinnings" (Pribram 1971) that may not integrate or converge during phonics instruction. See Alexander et al. (1991) for a detailed description of the Auditory Discrimination in Depth (ADD) Program (Lindamood and Lindamood 1975), a cognitive stimulation program that challenges the brain to access articulatory information for verification of phonological structure. This feedback enables students to verify independently the reality of phoneme identity, number, and order within words and supports comparator function for self-correction in decoding and spelling. Ehri and Sweet (1991) describe beneficial effects from a phonological awareness training task in which children use mouth pictures to represent the sound segments in words, and indicate the task is patterned after ADD Program procedures. The ADD Program emphasis on articulatory-motor information to verify phoneme identity, number, and order in syllables and words distinguishes it from phonics programs with their emphasis on key words, sounds, and letters. Alexander et al. (1991) cite findings with this program in remediation of severe dyslexia. See Howard (1982, 1986) for findings with kindergarten and first grade students on prevention of disabilities and acceleration of reading skills in an extended longitudinal study.

Phonological Awareness of Educators

Investigators have confirmed over and over again the critical role of phonological awareness in reading acquisition and the mastery of the alphabetic principle. Liberman has pointed out, however, that this information is not reaching prospective teachers. Many professional teacher-trainers in Schools of Education, in her observation, are not teaching prospective teachers how to identify children who are deficient in phonological awareness and what to do to help them. She maintained it is the obligation of Schools of Education to do so (Liberman 1987).

We concur with Liberman's strong position, but it leads to a specific question. Can Schools of Education routinely teach prospective teachers how to identify and help children who are deficient in phonological awareness without first determining that prospective teachers themselves have intact phonological awareness? Almost 35 years ago, Carroll and two of his Harvard School of Education graduate students concluded that phonological awareness of educators cannot be assumed. They presented evidence of phonological awareness deficits among in-service elementary teachers and college students majoring in elementary education (Carroll and Austin 1957; Shannon 1959). Nearly 20 years ago, Lindamood (1975) also documented a need for assessment and remediation of phonological awareness deficits among teacher-trainers, teachers-in-training, inservice teachers, psychologists, speech pathologists, and other education personnel.

This issue was documented again in a study with speech pathology Masters' candidates in a Communication Disorders Program. An experimental form of the LAC Test was used with syllables of up to five phonemes because of candidates' familiarity with the published form of the LAC Test. These individuals could be considered to have sophisticated background knowledge about the phonological structure of the English language because they had been required to pass a course in Phonetics. Yet, more than 50 percent did not have an intact level of phonological awareness comparator function on the stimulus syllables given. Those who had virtually intact performance on the LAC Test achieved the highest scores in reading and spelling on the WRAT (Lindamood 1981) in comparison to others in the group.

Similar findings were documented in a study with 37 sophomores entering a teacher-training program. These individuals had passed prior screening measures to determine their suitability as teacher-training candidates, so they were a somewhat select population. Yet, less than 50 percent had virtually intact phonological awareness/comparator function performance on the LACT-R. Of the twelve who did have virtually intact performance on the LACT-R, 92 percent had standard scores at-or-above 100 on both the word recognition and spelling tests of the WRAT. Of the 25 who did not have virtually intact performance on the LACT-R, only 44 percent had standard scores at-or-above 100 on both word recognition and spelling on the WRAT (Lindamood 1990).

Obviously, education personnel must have intact phonological processing themselves if they are to become competent in testing or remediating the deficient phonological processing of students. Liberman's concerns cannot be met until the importance of assessing educators' phonological awareness is appropriately understood and addressed.

Summary

Alphabet symbols represent the phonological structure of our language. A word is a phonological structure whether it is spoken or written. Therefore, children and adults must be aware of the phonological structure of words if they are to have full access to the alphabetic principle in decoding and spelling. Numbers of research studies have documented the predictability of this relationship.

We have posed or implied questions about an aspect of phonological processing—comparator function—that is particularly relevant to command of the alphabetic principle. Phonological awareness/comparator function—the ability to compare how and where two words differ in phonemic structure—is fundamental to self-correction in decoding and spelling. However, findings with the LAC Test indicate this function does not develop fully in approximately 30% of the population for syllables with as few as two to four phonemes. Without assessment, this function is often assumed to be available, resulting in misdiagnosis and subsequent ineffectual remediation of reading and spelling disorders.

Further research is planned on phonological awareness/comparator function with the LACT-R, (under development in print format and also in computer administered interactive videodisc format). This is an extended version of the LAC Test that includes more complex single syllables as well as a multisyllable section. Although references are made in the literature to "adult" phonological awareness, we know of no data to support the use of this term. In reality, there is need to establish a comprehensive data base on the emergence and development of this cognitive function and its relationship to literacy development:

- across the span from early childhood into senior adult ages
- from simple to very complex and subtle levels of function,
- and on the relationship between different levels of function and competence in beginning and advanced levels of literacy.

We have expressed concerns for wider use of more subtle measures of phonological assessment, both with students and educators themselves. Other researchers have expressed similar concerns. Mann (1986) and Berninger et al. (1987) reviewed the research which provides evidence that deficient linguistic awareness is an important factor in reading disability. Mann said the time is now upon us to refine tests of phoneme and syllable awareness for practical application and larger-scale use; Berninger and her associates called for all school psychologists to establish testing and remediation programs for phonemic skills in a preventive approach to reading disabilities.

Preliminary findings with the LACT-R suggest that more sensitive measures may identify an additional segment of the population with a

more subtle degree of dysfunction. For example, it appears that approximately 30% of preservice and inservice teacher populations have subtle dysfunction, and some also have moderate to severe degrees of dysfunction. The group with subtle dysfunction, as well as those with moderate to severe dysfunction, can acquire more advanced levels of literacy with refinement of phonological awareness/comparator function. However, they are generally not being identified through traditional education and provided the stimulation procedures they need. The ramifications of this in terms of possible impact on the diagnosis and treatment of student needs are readily apparent.

Procedures are available for addressing phonological awareness deficits preventively and remedially. However, stimulation procedures consistently found to be effective in establishing phonological awareness/comparator function for both children and adults are fundamentally different from phonics procedures that focus on sounds and letters. These effective procedures do not separate the study of phonemes from the articulatory actions that produce them. Rather, discovery activities are used to assist conscious awareness of the motor features or gestures that identify phonemes. This sensory information is then used to verify and compare phoneme identity, number, and order in syllables and words, and establishes a conceptual base for using alphabet symbols to code sequences of phonemes in reading and spelling.

We hope the issues raised regarding more sensitive and relevant assessment of phonological awareness may stimulate further research in this area. It is possible such research will move forward the global attempts to diagnose and address the causes of reading disorders.

References

Alexander, A., Andersen, H., Heilman, P., Voeller, K., and Torgesen, J. 1991. Phonological awareness training and remediation of analytic decoding deficits in a group of severe dyslexics. *Annals of Dyslexia* 41:193–206.

Bell, N. 1991. Gestalt imagery: A critical factor in language comprehension. *Annals of Dyslexia* 41:246–259.

Bower, G. H. and Morrow, D. G. 1990. Mental models in narrative comprehension. *Science*: Jan:44–48.

Berninger, V. W., Thalberg, S.T., DeBruyn, I., and Smith, R. 1987. Preventing reading disabilities by assessing and remediating phonemic skills. *School Psychology Review* 16:554–565.

Bradley, L. and Bryant, P. E. 1983. Categorizing sounds and learning to read—a causal connection. *Nature* 301:419–21.

Byrne, B. and Ledez, J. 1983. Phonological awareness in reading disabled adults. *Australian Journal of Psychology* 35:185–97.

Calfee, R., Lindamood, C., and Lindamood, P. 1973. Acoustic-phonetic skills and reading—kindergarten through twelfth grade. *Journal of Educational Psychology* 64:293–298.

Carroll, J. and Austin, M. 1957. Underachievement in reading: A study of its extent and

causes in the public schools of Newton, Massachusetts. Unpublished research. Laboratory for Research in Instruction. Cambridge, MA: Harvard University.

Cooper, F. 1972. How is language conveyed by speech? *In* J. F. Kavanagh and I. G. Mattingly (eds.). *Language by Ear and by Eye: The relationships between speech and reading.* Cambridge, MA: MIT Press.

Ehri, L. and Sweet, J. 1991. Finger-point reading of memorized text: What enables beginners to process the print? *Reading Research Quarterly* 26:442–462.

Felton, R., Naylor, C., and Wood, F. 1990. Neuropsychological profiles of adult dyslexics. *Brain and Language* 39:485–497.

Howard, M. 1982. Utilizing oral-motor feedback in auditory conceptualization. *Journal of Educational Neuropsychology* 2:24–35.

Howard, M. 1986. Effects of pre-reading training in auditory conceptualization on subsequent reading achievement. Doctoral Dissertation, Brigham Young University.

Karlsen, B., Madden, R., and Gardner, E. 1976. *Stanford Diagnostic Reading Test—Red Level. Manual for administering and interpreting.* New York: Harcourt, Brace, Jovanovich.

Kavanagh, I. and Mattingly, J. 1972. *Language by Ear and by Eye: The relationship between speech and reading.* Cambridge, MA: MIT Press.

Lewkowicz, N. 1980. Phonemic awareness training: What to teach and how to teach it. *Journal of Education Psychology* 72:686–700.

Liberman, I. 1987. Language and literacy: The obligation of the schools of education. *In* W. Ellis (ed.). *Intimacy with Language: A forgotten basic in teacher education.* Baltimore: The Orton Dyslexia Society.

Liberman, I. and Shankweiler, D. 1985. Phonology and the problems of learning to read and write. *Remedial and Special Education* 6:8–17.

Liberman, I., Shankweiler, D., Fischer, F., and Carter, B. 1974. Explicit syllable and phoneme segmentation in the young child. *Journal of Experimental Child Psychology* 18:201–12.

Liberman, I., Shankweiler, D., and Liberman, A. M. 1989. The alphabetic principle and learning to read. *In* D. Shankweiler and I. Liberman (eds.). *Phonology and Reading Disability.* Ann Arbor: University of Michigan Press.

Lie, A. 1991. Effects of a training program for stimulating skills in word analysis in first-grade children. *Reading Research Quarterly* 26:234–250.

Lindamood, C. 1975. The incidence of auditory conceptual dysfunction among teachers of reading and language arts. Paper presented at the National Council for Research in English. Washington, D.C.

Lindamood, C. and Lindamood, P. 1975.*The A.D.D. Program: Auditory Discrimination in Depth.* 2d ed. Allen, TX: DLM, Inc.

Lindamood, C. and Lindamood, P. 1979. Lindamood Auditory Conceptualization Test. 2d ed. Allen, TX: DLM, Inc.

Lindamood, P. 1990. Unpublished data from University of Idaho School of Education study.

Long, S. A., Winograd, P. N., and Bridge, C. A. 1989. The effects of reader and text characteristics on reports of imagery during and after reading. *Reading Research Quarterly* 19:353–372.

Lundberg, I., Olofsson, A., and Wall, S. 1980. Reading and spelling skills in the first school years predicted from phonemic awareness skills in kindergarten. *Scandinavian Journal of Psychology* 21:159–173.

Mann, V. 1986. Why some children encounter reading problems: The contribution of difficulties with language processing and phonological sophistication to early reading disability. *In* J. K. Torgesen and B. Y. Wong (eds.). *Psychological and Educational Perspectives on Learning Disabilities.* New York: Academic Press.

Marcel, A. 1980. Phonological awareness and phonological representation: Investigation of a specific spelling problem. *In* U. Frith (ed.). *Cognitive Processes in Spelling*. London: Academic Press.

Morais, J., Cary, L., Alegria, J., and Bertelson, P. 1979. Does awareness of speech arise spontaneously? *Cognition* 7:323–31.

Oliver, M. E. 1982. Improving comprehension with mental imagery. Paper read at the Annual Meeting of the Washington Organization for Reading Development of the International Reading Association, Seattle, Washington, March 1982.

Olson, R., Wise, B., Conners, F., Rack, J., and Fulker, D. 1989. Specific deficits in component reading and language skills: Genetic and environmental influences. *Journal of Learning Disabilities* 226:339–348.

O'Neil, W. 1972. Our collective phonological illusions: young and old. *In* J. F. Kavanagh and I. G. Mattingly (eds.). *Language by Ear and by Eye: The relationships between speech and reading*. Cambridge, MA: MIT Press.

Perfetti, C. 1985. *Reading Ability*. New York: Oxford University Press.

Pratt, A. and Brady, S. 1988. The relationship of phonological awareness to reading disability in children and adults. *Journal of Educational Psychology* 80:319–323.

Pribram, K. 1971. *Languages of the Brain: Experimental paradoxes and principles in neuropsychology*. New York: Brandon House, Inc.

Rockford Area Literacy Council. 1990. Rockford, IL. Unpublished research.

Rosner, J. and Simon, D. 1971. The auditory analysis test: An initial report. *Journal of Learning Disabilities* 4:384–392.

Roth, S. and Beck, I. 1987. Theoretical and instructional implications of the assessment of two microcomputer word recognition programs. *Reading Research Quarterly* 22:197–218.

Shankweiler, D. and Liberman, I. 1972. Misreading: a search for causes. *In* J. F. Kavanagh and I. G. Mattingly (eds.). *Language by Ear and by Eye: The relationships between speech and reading*. Cambridge, MA: MIT Press.

Shankweiler, D. and Liberman, I. (eds.). 1989. *Phonology and Reading Disability*. Ann Arbor: University of Michigan Press.

Shannon, M. 1959. The measurement of phonetic understandings relevant to the teaching of reading. Doctoral Dissertation, Harvard University.

Sheffield, B. 1991. The structured flexibility of Orton-Gillingham. *Annals of Dyslexia* 41:41–54.

Stanovich, K., Cunningham, A., and Cramer, B. 1984. Assessing phonological awareness in kindergarten children: Issues of task comparability. *Journal of Experimental Child Psychology* 38:175–190.

Stanovich, K., Cunningham, A., and Feeman, D. 1984. Intelligence, cognitive skills and early reading progress. *Reading Research* 19:278–301.

Thatcher, R. 1980. Personal Communication. Unpublished research. Applied Neuroscience Laboratories, University of Maryland School of Medicine.

Torgesen, J. and Morgan, S. In press. The effects of two types of phonological awareness training on word learning in kindergarten children. *Journal of Experimental Psychology*.

Wepman, J. 1960. Auditory discrimination, speech and reading. *Elementary School Journal* 60:325–333.