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The Relationship of Linguistic Awareness to Reading Skill in Children and Adults

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THE RELATIONSHIP OF LINGUISTIC AWARENESS

TO READING SKILL

IN CHILDREN AND ADULTS

BY

ANNE CAROLINE PRATT

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE

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I

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ABSTRACT

Extensive experimental evidence suggests that reading disability is related to linguistic deficits. One linguistic skill, linguistic awareness (awareness of the units that comprise one's language), has been shown to be related to beginning reading skills in young children, but little research has been conducted with older children or adults.

In Experiment 1 of the present study, third-grade good and poor readers were compared on three measures of linguistic awareness and a non-speech control task. Significant differences were found on all three linguistic awareness measures, but not on the non-speech control task. When the sample was divided by verbal and non-verbal I., high verbal IQ subjects performed significantly better on only one of the linguistic awareness measures, indicating that verbal IQ is only partially related to differences between the groups. Non-verbal IQ could not account for any of the differences between groups.

In Experiment 2, Adult Basic Education good and poor readers were compared on the same tasks. Like the children in Experiment 1, adult poor readers' performance on linguistic awareness tasks was inferior to that of the good readers, but the two groups were not

significantly different on the non-speech control task. Non-verbal IQ could not account for this difference; however, there was a difference between the two groups in verbal IQ which may account for some of the effect.

Deficits in linguistic awareness appear to play a part in the reading problems of both children and adults. The nature of the relationship between linguistic awareness and reading skill (e.g. it could be considered a pre-requisite for success in reading, or, alternatively, a consequence of reading instruction) are discussed.

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Reading disorder is a serious and pervasive problem in our society (Weaver & Resnick, 1979). In recent years, universal literacy has become a goal, and the failure of many individuals to achieve literacy has prompted much research into the correlates and causes of reading disability. It has been claimed that "no disorder of childhood has generated more interest or prompted more controversy (Vellutino, 1979, p. 1)."

It is important to define here what is meant by "reading disorder." (I use the terms reading disorder and reading disability interchangeably, and, in addition, refer to those affected as poor readers.) While researchers and practitioners have been plagued by difficulties in defining reading disorder, the following definition is similar to many others currently in use. "Specific reading disability" is "the failure to learn to read with normal proficiency despite conventional instruction, a culturally adequate home, proper motivation, intact senses, and freedom from gross neurological defect (Eisenberg, 1978, p. 34)." This type of definition has been widely criticized as "definition by exclusion" (Eisenberg, 1978; Rutter, 1978; Vellutino, 1979), and therefore lacking specific behavioral criteria (i.e. reading skills). Additionally, it has been applied with varying degrees of stringency in different studies, posing problems in interpretation of the research (Vellutino,

1979).

Despite both theoretical and practical difficulties with this definition, it is generally accepted as the best one currently available (Vellutino, 1979).

The difficulty establishing a definition reflects, in part, the conflicting views as to the bases of reading disorders. I will review the history of theories of reading disorders, evaluate current theories, and discuss in detail the research contributing to the theory that reading disability is related to linguistic deficits.

Early Theories

As early as the turn of the century, physicians described a syndrome labeled "congenital word blindness" in which children were unable to learn to read although they were apparently normal in other respects (Hinshelwood, 1900, 1917; Morgan, 1896). These physicians postulated deficits in localized areas of the brain thought to be responsible for storage of visual images.

However, other than occasional case histories and isolated articles, little attention was given to the problem until 1925,

When Samuel Orton's initial paper was published. Orton's theory was comprehensive, detailed, and specific; it continues to influence reading specialists even today. Orton hypothesized that reading disability is caused by a developmental delay in hemispheric dominance for language (1925; 1937). Support for this position was based on observations from case studies. Orton postulated that for visual tasks, visual images were produced by both hemispheres, each a mirror image of the other. As a child matured, one hemisphere became dominant, and effectively suppressed the information in the non-dominant hemisphere. He speculated that immature and reading-disabled children were subject to interference from the non-dominant hemisphere because dominance was not established, thus producing the problems he observed in such children, namely, reversals and poorly established lateral preference. However, more recent research has found that reversals do not account for most of the errors made by poor readers, that reversals of orientation (e.g. b/d) are not correlated with reversals of sequence (e.g. was/saw), and that reversal errors occurred much less often in tachistoscopic presentation than in connected text (which would argue against a visual interpretation of such errors) (Fischer, Liberman, & Shankweiler, 1978; Liberman, Shankweiler, Orlando, Harris, & Berti, 1971). These findings call into question the basic tenets of Orton's theory. Nonetheless, Orton is credited

... focusing on reading disability as a specific disorder with a possible organic basis.

Recent Theories: I. Single-Factor Theories

More recent theories of the cause of reading disorder can be roughly divided into two categories: those that postulate one major cause, and those that posit several distinct subtypes, each with different causes.

The predominant single-factor theory is that some disturbance of visual processing causes difficulty in learning to read. It is certainly the oldest theory, initially put forth by Morgan (1896) and Hinshelwood (1900, 1917) and elaborated by Orton (1925, 1937). Most of the visual-perceptual deficit theories hypothesize that the child with adequate visual acuity nevertheless has some disorder in discrimination of similar visual stimuli, in spatial orientation, in visual-motor coordination, in figure-ground perception, and/or with visual memory. The literature investigating these hypotheses is highly contradictory, but recent reviewers have drawn essentially negative conclusions regarding the validity of the visual deficit hypothesis (Benton, 1975; Stanovich, 1982a; Vellutino, 1979). The reviewers note several persistent problems which appear in those studies which had suggested a relationship between visual processing and reading. First, many of these studies used samples of poor readers obtained in clinics, rather

than in the public school population. Such children are more likely to have multiple handicaps, thus increasing the likelihood of finding deficits which may not be related to reading disorders (Vellutino, 1979). Others have used measures which cannot be shown to be exclusively visual in nature; sometimes even letters or words (stimuli which are clearly linguistic in nature) have been used to measure spatial orientation, visual discrimination, or higher-level visual perceptual skills (e.g. Doehring, 1968). In his exhaustive review of the literature on the relationship of visual perception, form perception, visual analysis, and visual memory to reading skill, Vellutino (1979) concludes that the well-controlled studies (e.g. Calfee, 1977; Calfee, Chapman, & Venezky, 1972; Vellutino, Smith, Steger & Kaman, 1975; Vellutino, Steger, Kaman, & DeSotto, 1975; Vellutino, Steger & Kandel, 1972) provide strong evidence against a causal relationship.

Another single-factor theory holds that reading disorder is caused by a deficit in short-term memory for sequence. This is based on extensive anecdotal and descriptive evidence, as well as on experimental evidence that poor readers do not perform as well as good readers on tasks requiring recall of the order of verbal stimuli (Bakker, 1967, 1972; Groenendaal & Bakker, 1971;

Zurif & Carson, 1970). Interestingly, this finding did not hold up when the stimuli were non-meaningful (Bakker, 1967; Groenedaal & Bakker, 1971), prompting these researchers to postulate a verbal mediation deficit. The interpretation of poor readers' deficient performance on tasks involving recall of sequence of verbal stimuli as evidence of a primary deficit in "sequencing" or "temporal order perception" has been questioned by others (Vellutino, 1979). In particular, it has been shown that this finding can be accounted for by another explanation: that poor readers' difficulty with item order recall may be related to ineffective use of phonological coding strategies in short-term memory. Poor readers, in comparison to good readers, show a deficit in recall of linguistic ("nameable") stimuli but no deficit for recall of items which cannot be represented linguistically (Liberman, Mann, Shankweiler, & Werfelman, 1982). This suggests that the problem is not necessarily one involving sequencing; rather, it is part of a broader difficulty with certain linguistic skills (described in more detail later in this paper) (Katz, Shankweiler, & Liberman, 1981).

A third single-factor theory of reading disability postulates an immaturity in intersensory integration (Birch, 1962). It is thought that poor readers have difficulty in integrating information from the sensory systems, such as visual

and auditory information. Because reading involves the conversion of print (visual information) into a phonological representation, it is thought that a deficit in integration of sensory information could be at the base of reading problems. While extensive research has been conducted to gather support for this theory, serious questions have been raised by a few seminal studies. Intrasensory deficits in poor readers have been found by several researchers, calling into question the idea that integration is the foremost problem (Blank & Bridger, 1966; Blank, Weider, & Bridger, 1968; Friedes, 1974.) Other researchers have shown that very young infants are capable of intersensory transfer (see Walk, 1981, for a review). This raises serious doubts about the validity of Birch's concept of a gradual maturation of this skill (Birch & Lefford, 1963).

In sum, the single-factor theories reviewed have been backed with inconclusive or insufficient empirical evidence, and most have been generally rejected. It was the hope of many (e.g. Applebee, 1971; Boder, 1973; Mattis, French, & Rapin, 1975; Satz & Morris, 1981) that multifactor theories would prove more fruitful.

Recent Theories: II. Multifactor Theories

The use of multivariate methods or the development of multifactor theories has been considered by many to be an antidote to the conflicting results and inconclusive findings in the reading disability literature. Applebee (1971) suggested that the search for a single causal defect relies on a model too simplistic to fit the problem. He has been cited by numerous researchers who are attempting to build more comprehensive theories.

Two methods have been used in attempts to delineate subtypes of reading disability (Satz & Morris, 1981). The first consists of administering a wide variety of measures to normal and reading disabled youngsters and deriving syndromes (either by visually inspecting the data or by using statistical means). The other involves development (usually through descriptive research) of subtypes based on achievement variables. To test the validity of the classification scheme, children of each subtype are then compared on measures of various reading-related processes.

The first approach is illustrated by the work of Mattis and his colleagues. A large sample of clinic-referred reading

disabled children was administered a battery of language, speech, motor, and perceptual tasks. The following subtypes were identified (by visual inspection of the results): (a) a language disorder subtype; (b) an articulatory and graphomotor dyscoordination subtype; and (c) a visual-spatial perceptual disorder subtype (Mattis, French, & Rapin, 1975). Cross-validation of these subtypes on a larger sample has been carried out (Mattis, 1978). Similar studies have been performed using statistical methods to derive subtypes (Lyon & Watson, 1982; Petrauskas & Rourke, 1979; Rourke & Finlayson, 1978).

While there are similarities across studies as to the subtypes obtained, this literature is difficult to interpret for several reasons. These theories do not include an overall description of the process of reading and how the various syndromes interfere with that process. We cannot be assured that similar subtypes are actually reflecting valid, stable syndromes across studies when they are obtained using different measures (Satz & Morris, 1981). There are internal inconsistencies within classification schemes, for example, both subtypes (a) and (b) above include a linguistic component. Criticisms which apply to studies utilizing clinic-referred children apply to most of this research (Lyon & Watson, 1982, is an exception). Children who are referred to clinics and

hospitals for evaluation are more likely to have multiple handicaps than are poor readers from a regular public school population (Vellutino, 1979). Therefore, groups of clinic-referred children could display deficits in some area (e.g. motor incoordination) without this being a causal factor in their reading problems.

The second method of developing a multifactor theory of reading disability is to delineate subtypes based on patterns of performance on achievement variables (Boder, 1973; Doehring & Hoshko, 1977). A good example of this method is the work of Boder (Boder, 1971, 1973; Boder & Jarrico, 1982). Based on patterns of reading and spelling errors in clinic-referred poor readers, Boder derived three subtypes: dysphonetic, dyseidetic, and dysphonetic-dyseidetic, or mixed. Dysphonetic readers appear to be impaired in phonetic analysis skills and to rely heavily on a whole-word approach to word recognition. Dyseidetic readers apparently have intact word analysis skills and laboriously "sound out" each word they encounter. They seem to be impaired in the ability to recognize and remember words as gestalts. Dysphonetic-dyseidetic readers share the weaknesses of both of the other subtypes and the strengths of neither.

Several studies have addressed the validity of these

subtypes, with weakly positive results (Aaron, 1979; Camp & Dolcourt, 1977; Fried, Tanguay, Boder, Doubleday, & Greensite, 1981; Obrzut, 1979; Pratt & Rapport, 1983). However, one study investigated the performance of the different subtypes on a speech perception task. One might predict that dysphonetic readers, with their difficulty in phonetic analysis skills, would perform more poorly than dyseidetic readers. In fact, there was no difference between the subtypes, although both performed much more poorly than normal readers (Godfrey, Syrdal-Lasky, Millay, & Knox, 1981).

An alternate interpretation of the varying patterns of strengths and weaknesses exhibited by poor readers of Boder's subtypes is that they vary in degree of disability, not in type. Much of the research on the performance of dysphonetic and dyseidetic readers on various tasks could also be interpreted to support this alternative hypothesis. For example, Pratt & Rapport (1983) found that a weighted combination of the psychological, neuropsychological, and achievement variables used in their study could significantly discriminate among dysphonetic, dyseidetic, and normal readers, whereas none of the measures alone could. However, inspection of the means of the three groups revealed that on most of the language-related measures their performance could be ordered normal, dyseidetic,

dysphonetic; with normal readers having the best performance and dysphonetic (poor phonetic analysis skills) readers having the worst. It may be that the pattern of strengths and weaknesses observed in dyseidetic readers does not mean that they are strong in phonetic analysis and weak in visual memory. Rather, they may be better in phonetic analysis than dysphonetics but not accomplished enough to use this skill "automatically" as normal readers do. As we have seen, it is certainly likely that visu memory and other visual perceptual skills do not play a significant causal role in reading disorder.

Multifactor theories have not fulfilled the promise of providing conclusive, valid evidence of causes of reading disorder. There is, however, a promising body of research produced by psychologists and linguists who have approached the problem from a linguistic perspective. Through careful examination of the process of reading, these researchers have identified linguistic skills which would appear to be crucial in reading acquisition. Some have argued that this is a single-factor approach, and thus, too simplistic to explain adequately reading disability (Fletcher & Satz, 1979). We might consider language a single factor, but it is a rich, complicated variable. This approach pursues the question from a different

perspective: first identifying skills essential to the process of reading, then comparing the performance of good and poor readers on tasks designed to measure these skills. This method is giving rise to a theory of the nature of reading disorders (Lieberman, 1983). This area of research is based on a particular model of reading, one which is not universally accepted. A basic assumption of the model is that the printed word is converted into a phonological form during the process of reading (Gough & Cosky, 1977; Rozin & Gleitman, 1977). While it has not been proven conclusively, this assumption has received extensive support in the literature.

Linguistic Deficits in Relation to Reading Disorder

A group of researchers began to address the problem of reading disability by examining the process of reading from a linguistic perspective. Print is, obviously, a form of language. Reading, according to this viewpoint, will involve linguistic skills and processing. Indeed, Mattingly (1972) emphasizes that reading is "parasitic on speech." In this vein one might expect that reading skills will be related to other language abilities, and in fact, examination of linguistic processes has proven a fruitful source of information about the difficulties encountered by poor readers. The research linking reading problems to linguistic deficits will be reviewed next. These deficits include problems with short-term memory for linguistic material, syntactic ability, paired-associate learning of linguistic material, naming ability, speech perception and listening comprehension.

Poor readers have long been known to have short-term memory problems (see Stanovich, 1982b for a review). Why might short-term memory, particularly short-term memory for linguistic material, be important in reading? It is the nature of our language that we derive meaning from words, not one at a time, but in relation to each other. Many words in English have

ambiguous meanings, and the listener or reader often will not know which meaning is intended until the rest of the sentence is available to provide a context. In addition to ambiguous meanings, there are some words which have very little meaning alone (e.g. "of"). These words derive their meaning from the syntactic structure of sentences. When one processes a sentence, whether in reading or listening, one must store the words in short-term memory until enough of the sentence is available to extract meaning, using syntactic information. A deficiency in short-term memory could thus seriously hinder comprehension, both for spoken and written language.

Many studies have, in fact, demonstrated a correlation between reading ability and short-term memory (see Stanovich, 1982a, for a review). To examine short-term memory in relation to reading ability, researchers have used paradigms originally developed to investigate adult coding strategies in short-term memory. Early work by Baddeley (1966, 1968) suggested that adults utilize a phonetic coding strategy when required to retain items for a short time. This conclusion stemmed from the observation that recall of a list of phonologically confusable (i.e. rhyming) items is more difficult than recall of a list of phonologically distinct (i.e. nonrhyming) stimuli.

Recent research has found that for children who are good readers the phonological similarity of items to be recalled likewise affects performance (i.e. nonrhyming strings are easier to recall than rhyming strings). However, for children who are poor readers this pattern is not found: varying the phonological confusability of list items did not affect recall level (Liberman, Shankweiler, Liberman, Fowler & Fischer, 1977). This difference in susceptibility to rhyming effects led to the insight that perhaps the problem underlying inferior recall by poor readers arises from a difficulty utilizing a phonetic strategy when required to retain items for a short time. (It should be noted that the rhyme effect is not always this consistent, and is subject to age effects (Olsen, Davidson, Kliegl, & Davies, 1984) and sensitive to subject characteristics (Hall, Wilson, Humphreys, Tinzmann, & Bowyer, 1983).)

Further, this difference on memory tasks for good and poor readers is obtained whether visual presentation is used, as was previously found, or auditory presentation (Shankweiler, Liberman, Mark, Fowler & Fischer, 1979). In other words, the difficulty poor readers encounter in short-term memory is not specific to visual reading tasks, but appears to be a more general problem with recall. Similar results have been produced by good and poor readers in studies employing recognition memory

paradigms (Byrne & Shea, 1979; Mark, Shankweiler, Liberman, & Fowler, 1977), suggesting that the problems experienced by poor readers do not stem from different rehearsal strategies. More recently, the tendency for good and poor readers to differ in their use of phonetic coding strategies was examined developmentally, in children ages 7 - 16 years (Olsen et al, 1984). The younger children replicated the findings of Mark et al (1977), and the performance of the older reading-disabled children resembled that of the younger normal children. It appears that poor readers' phonological skills improve as they get older: they begin to show a rhyme effect as they mature, but their short-term memory skills continue to lag behind those of their age-mates.

Some question existed about the nature of the stimuli in these studies: how closely related to reading were tasks involving lists of letters or numbers? The findings of Shankweiler et al (1979) were extended to a task which has more face validity for reading: instead of letter strings, whole sentences were devised which were either phonologically confusable or non-confusable. This study again found poor readers to be less affected by the confusability of the stimuli (Mann, Liberman, & Shankweiler, 1980). Thus, the important conclusion to be drawn from these studies is not whether or not

the stimuli are meaningful. Rather, it is the process of analyzing the phonetic structure (of sentences, words, or non-words) that presents difficulty. Taken together, these studies provide strong support for the hypothesis that poor readers are deficient in short-term memory because of difficulty in the use of phonetic coding strategies. Indeed, in one study (Brady, Shankweiler, & Mann, 1983), errors were analyzed to provide clues as to what type of coding strategy poor readers use. Poor readers made a greater number of transposition errors (e.g. recalling "train, plate" as "plane, trait" the non-rhyming condition than did the good readers. The presence of transposition errors indicates that poor readers are attempting to encode material phonologically, but are having greater difficulty "with the preservation of order information within a word (p. 35)." This effect has been confirmed using nonsense stimuli as well as real words (Brady, Mann, & Schmidt, 1985).

Are poor readers' difficulties with short-term memory displayed with all types of stimuli? If, as the research outlined above suggests, these difficulties are based on phonological mechanisms, perhaps the short-term memory deficit should be limited to stimuli which lend themselves to such coding: stimuli which can be represented linguistically.

Indeed, this has been shown to be the case. In a task involving memory for "recodable" (nameable) stimuli (e.g. letters, pictures of common objects) and "unrecodable" stimuli (abstract squiggles), the poor readers' short-term memory deficit was only evident with the former (Katz, Shankweiler, & Liberman, 1979; Liberman, Mann, Shankweiler, & Werfelman, 1982).

In summary, the evidence that poor readers are deficient in short-term memory has recently been refined. Their deficits, though not restricted to reading tasks, now appear to be limited to short-term memory for linguistic or recodable stimuli. Further, the source of the problem seems to be difficulty in the use of phonological coding strategies. Given this evidence, one might expect that poor readers would display difficulty with comprehension of spoken language, as stated earlier, because of the heavy reliance that this type of comprehension must place on short-term memory. Listening comprehension is indeed another area in which poor readers lag behind their peers (Mann, Shankweiler, & Smith, in press; Satz, Taylor, Friel, & Fletcher, 1978). A number of studies have supported this contention (see Stanovich, 1982b, for a review). There is some evidence that deficient (or immature) syntactic ability, or limitations of verbal short-term memory, may also contribute to poor listening comprehension (Mann, et al, in press Menyuk &

Flood, 1981; Vogel, 1974; Vellutino, 1979; Weinstein & Rabinovitch, 1971), although the relationship between these two skills in poor readers is not yet clear (Shankweiler, Smith, & Mann, 1983).

Other lines of investigation have uncovered various additional linguistic deficits in poor readers. These include poor performance on learning tasks which have a verbal component, difficulty in rapid naming, and subtle speech perception deficits. The relationship of these deficits to one another, and to the difficulties with short-term memory discussed above, will be considered.

Vellutino and his associates have examined a hypothesized general associational learning deficit for poor readers. Using a variety of paired-associate learning tasks, they found that poor readers consistently performed poorly on learning tasks involving a verbal component (Vellutino, 1979). Paired-associate tasks which only involved non-linguistic stimuli did not produce the same pattern.

Deficiencies in naming ability have been uncovered by several investigators. Influenced by the neuropsychological literature, researchers have considered that there may be a

pattern of deficits in poor readers similar to that found in brain-damaged adults exhibiting aphasic symptoms. Denckla & Rudel (1976) found significant deficits in poor readers in a task requiring rapid naming of line drawings of objects, letters, numerals, and colors. Another study found that poor readers have difficulty producing object names rapidly (Katz, 1982). (Care was taken that only names the children knew were used to assess speed.) In addition, poor readers also have difficulty learning new words and their meanings (Nelson & Warrington, 1980). Such deficits appear to be related to deficiency in establishing a phonological representation in long-term memory, deficiency in applying phonological processes to the representation, or difficulty in producing a phonetic representation of a word after it has been accessed in the lexicon, or some combination of these (cf. Katz, 1982).

Another deficit in linguistic skills found in poor readers is a difficulty in speech perception. Speech perception skills of poor readers have been found to be worse than those of good readers under perceptually stressing conditions (background noise) (Brady et al, 1983). This finding is not related to a general problem in auditory perception, since the performance of the good and poor readers was not significantly different on a similar task involving perception of non-speech sounds. Rather,

it appears to be a specific difficulty with the processing of speech. This research may give us a clue regarding poor readers' problems with short-term memory for linguistic material (discussed earlier). It has been found that memory is affected when the items to be recalled are difficult to perceive (Rabbitt, 1968). It may be that the difficulty in perception for poor readers is related to their problems in memory. Perhaps the establishment of a phonetic representation of information is performed less efficiently in poor readers, and possibly less accurately, leading to difficulties in perception and subsequently in memory. Further work is needed to explore this relationship.

In summary, a wide variety of linguistic skills have been shown to be related to reading ability. These include short-term memory for linguistic stimuli (the use of phonological coding strategies in short-term memory) paired-associate learning tasks involving linguistic stimuli, naming ability, listening comprehension, and speech perception. It may be that the underlying deficit in poor readers which ties these skills together is difficulty in extracting and holding phonetic information, a problem in internal representation of the form of language.

Since it is clear that linguistic deficits are related to reading disability, a close examination of the linguistic demands of the reading process should enable us to better understand this relationship. Reading is a complex task involving many skills. An obvious component is the visual demand; however, research has revealed that this is not a major factor in accounting for reading difficulty. In addition, reading certainly involves a knowledge of the language to be read. A critical factor (which is limited to the skills of reading and writing) seems to be the skills involved in converting the visual image to a phonological representation. To accomplish this conversion, the beginning reader must know the sound-symbol relationships, not only the phonemes represented by each letter, but also the way that words can be broken down into smaller, non-meaningful units: phonemes. This latter knowledge is called "linguistic awareness," the subject of the present study, and will be explained further in the following section.

Linguistic Awareness

Linguistic awareness refers to explicit awareness of the structure of one's language. Of particular interest to reading researchers is awareness of the units that comprise one's language: words, syllables, phonemes. (In the present study, the term "linguistic awareness" refers primarily to awareness of phonemes.) Orthographies are representations of spoken languages, employing the segmentable units of those languages. It follows that in order to be a user of the writing system, one needs to be conceptually aware of the units utilized.

The history of writing indicates that earlier orthographies utilized the less abstract units, such as words or morphemes (Gelb, 1963). This type of orthography is called a logography; Chinese has such a writing system in use today. The advantages of having a writing system which uses word-like units are twofold: words are conceptually fairly obvious and are acoustically segmentable from the sound stream (that is, one can say a word in isolation). Both of these characteristics have implications for reading instruction by making it relatively easy to explain to beginning readers the relationship between a particular symbol and the word or morpheme that symbol represents. However, the conceptual clarity of a logographic system carries with it a distinct disadvantage: the reader needs to learn a unique symbol for each word in the

language. While the vocabulary of Chinese individuals may be somewhat smaller, given the lack of inflections, than for speakers of a language such as English, a conservative estimate would be a vocabulary size of 50,000 words. Therefore the task of learning a distinct written unit for each word or morpheme is prodigious. In fact, accomplished readers of logographic scripts can only recognize about 2000 logograms (Gough & Hillinger, 1980).

The syllabary, a somewhat more recent development, is a writing system representing syllabic units. While less obvious and more abstract than words, syllables are nevertheless segmentable acoustically. For certain languages which are characterized by a limited repertoire of syllables (such as Japanese, which uses a syllabary), there is an appreciable decline in the number of symbols to be memorized compared to a logographic system.

One can see that the structure of a spoken language will have implications for the kind of orthography used for written language. For example, the Japanese language has about 48 syllables. English has far more, and the memory demands of a syllabic system would be enormous, making a syllabary less well-suited for written English.

The alphabet is a third kind of writing system. In alphabets the written symbols, letters, correspond roughly to phonemes.

Phonemes are more abstract than syllables, are generally not segmentable acoustically, and are variable acoustically depending upon the context (A. Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). These are startling facts about phonemes; we tend to think of speech as comprised of discrete, invariant sounds pronounced in sequence. In fact, speech research has revealed that this is not the case at all. Phonemes are non-segmentable and non-invariant because they are co-articulated: while the mouth is producing one phoneme, the shape of the mouth is influenced by preceding and following phonemes, thus subphonemic features overlap, and acoustic information about more than one phoneme is conveyed simultaneously. The phoneme /d/, for example, is actually acoustically different when followed by different vowels. This is illustrated by spectrograms (visual representations of speech sounds). When spectrograms of the syllables /di/ and /du/ are examined, not only are the waveforms corresponding to the two vowels different, but remarkably, the two /d/ sections also differ from each other (A. Liberman, et al, 1967).

Using synthetic speech, it has been illustrated that syllables are generally not segmentable into smaller units, or phonemes. When syllables containing the /d/ sound, such as /du/, are synthesized and then segmented, the vowel sound can still be

recognized but the /d/, separated from the context of the syllable, sounds like a non-speech chirp. The characteristics of non-segmentability and non-invariance can make the phoneme a very difficult concept to master (Liberman, 1973; Liberman, Shankweiler, Fischer & Carter, 1974). However, despite the possible difficulty of grasping the alphabetic principle, the advantages of an alphabetic orthography are striking. First, alphabets are efficient: only a small number of symbols are needed to represent all the phonemes of a language. For example, the English alphabet has only 26 characters or letters, which are used (singly and in combination) to represent the 35-40 phonemes used in our language. Second, given mastery of this relatively small set of symbols, a person can read nearly any word in his or her lexicon, whether or not that word has previously been encountered in print.

It is essential for a learner of an orthographic system to understand just what is being represented by the symbols being learned, therefore, awareness of the units represented by that orthography (be they words, syllables, or phonemes) is necessary. Gleitman and Rozin (1977) argue that it will be easier to achieve linguistic awareness of orthographic units for the less abstract writing systems (those using words or syllables) than for alphabetic systems.

There are additional reasons to suppose that several aspects of linguistic awareness (e.g. word consciousness, syllable and phoneme awareness) might be related to reading. Proficient use of spoken language is not dependent upon linguistic awareness (Mattingly, 1972). Almost everyone learns to talk, and without formal instruction (for the most part). Reading skills, however, usually require instruction by trained teachers, and vary considerably in the population. As fluent readers, it is sometimes hard for us to conceive of difficulty with awareness of phonemes. However, even larger units (words) are difficult for many pre-schoolers and some 5-year-olds to segment (Ehri, 1976; Huttenlocher, 1964). A developmental trend has been found in young children's abilities to segment syllables and phonemes. Overall, among 4-, 5- and 6-year-olds, syllabic segmentation is easier than phonemic segmentation, and both get easier as children grow older (Lieberman, et al 1974). By age six, most children can do syllabic segmentation, but a substantial number still have difficulty with phonemic segmentation (Bruce, 1964; Liberman, et al., 1974). Strikingly, difficulty at age six is predictive of poor reading skills in second grade. First-graders were tested on their ability to master a phoneme-segmentation task (one aspect of linguistic awareness). The following year, their reading skill was measured. The poorest readers in second grade were those who had failed to master phonemic segmentation the year before (Lieberman, 1973).

Similarly, difficulty with syllable segmentation in kindergarten is predictive of reading problems in first grade (Mann & Liberman, 1982). Another study, utilizing path analysis, found that of a series of metalinguistic tasks administered to kindergarteners, phonemic analysis was the most important determinant of future reading and spelling achievement (Lundberg, Clofsson, & Wall, 1980). In fact, a number of studies, employing a variety of methods and types of subjects, have found a relationship between phonemic segmentation skills and ease of reading acquisition (see Golinkoff, 1978, for a review). Research has shown a clear relationship between linguistic awareness and reading with beginning readers (Bruce, 1964; Fox & Routh, 1975; Goldstein, 1976; Golinkoff, 1978; Helfgott, 1976) and suggests that this relationship might hold for older poor readers as well (Bradley & Bryant, 1979, 1983; Calfee, Lindamood, & Lindamood, 1973; Rosner, 1973, 1974). In one study, poor readers' performance on a complex linguistic awareness task was worse than that of much younger children matched for reading level (Bradley & Bryant, 1979). Inner-city and disadvantaged children, who often display reading problems, are also reported to have deficient linguistic awareness skills (Rozin, Bressman, & Taft, 1974; Wallach, Wallach, Dczier, & Kaplan, 1977).

In addition, indirect evidence exists favoring the hypothesis

that linguistic awareness is related to reading acquisition. First grade children who are unable to use the simplest letter-sound correspondences to recognize words, have been shown to learn readily a series of logograms, a task which avoids the necessity of understanding the phonological structure of words (Rozin, Poritsky, & Sotsky, 1971).

An interesting question arises about the nature of the relationship between linguistic awareness skills and reading acquisition. Is possession of these skills a pre-requisite to reading, a facilitator of reading acquisition, a correlate of reading skill, or a consequence of reading instruction (Ehri, 1976)? Several studies have explored the cause-and-effect relationships in question.

To reiterate, the majority of studies suggest that linguistic awareness is a pre-requisite or facilitator of reading instruction (Bradley & Bryant, 1979, 1983; Bruce, 1964; Calfee et al., 1973; Fox & Routh, 1975; Helfgott, 1976; Liberman, et al., 1974; Mann & Liberman, 1982; Rosner, 1973, 1974). These studies make a compelling case for the role of linguistic awareness in reading acquisition. It has been underscored by studies pointing to improvement in reading skills following training in phonemic awareness.

Phonemic awareness skills can be taught (Marsh & Mineo, 1977; McNeil & Stone, 1965; Olofsson & Lundberg, 1983), and may be superior to traditional phonic blending training as a method of teaching word analysis skills (Fox & Routh, 1976). Using a program which combined explicit training in phoneme analysis and phoneme blending with training in letter-sound correspondences and decoding, Williams (1980) found significant improvement in learning-disabled children's decoding skills, compared to the skills of the control group.

In a carefully controlled study, not only were linguistic awareness skills found to be predictive of reading achievement, but training in these skills clearly facilitated reading instruction (Bradley & Bryant, 1983). The "sound categorization" (linguistic awareness) skills of a sample of 368 pre-readers were measured, and were predictive of reading achievement over three years later, even with the effects of IQ and short-term memory removed. A subsample of this group was given training in phonemic analysis, and compared with two groups of matched controls who received training in concept categorization or no training. Children trained in phonemic analysis received significantly better reading scores than either of the control groups after two years. Other studies have added support to the contention that training in phonemic analysis facilitates reading acquisition (Elkonin, 1973; Treiman & Baron,

1983; Wallach & Wallach, 1976).

A very different argument, that linguistic awareness may instead be the consequence of reading instruction, is suggested by a study with adults (Morais, Cary, Alegria, & Bertelson, 1979). The authors investigated phonemic segmentation ability in matched groups of literate and illiterate Portuguese adults. They found that the literate group (who had received reading instruction in adulthood) was superior to the illiterate group (who had received virtually no reading instruction), suggesting that reading instruction, rather than cognitive development, is responsible for this skill. This conclusion is worth examining in more detail. Within the literate group, those who had obtained certificates for passing their adult literacy courses performed significantly better than those who had taken such courses but did not pass. The authors concluded that development of this aspect of linguistic awareness arises as a result of reading instruction, and that proficiency in linguistic awareness is therefore not a prerequisite for reading. However, it is clear that those adults in the literate group who benefitted the least from instruction (those who had not obtained course certificates) were significantly weaker on the linguistic awareness tasks. An alternative explanation is that these people resemble poor readers in other studies - their inability to develop linguistic awareness may have hindered them in

learning to read. This study was followed by one which compared Belgian first-graders who were being taught using a phonics method with others being taught by a sight-word method. The phonics groups performed significantly better on a phonemic segmentation task (Alegria, Pignot, & Morais, 1982). Therefore, not only instruction but type of instruction appears to influence development of this skill. Interestingly, although the authors conclude that awareness of phonemes results from phonics-based reading instruction, several of the children in the phonics group performed very poorly on the phonemic segmentation task. Nine percent of this group gave no correct responses at all, and 41% responded correctly to half of the items or fewer. In this group, performance on the segmentation task was significantly correlated with reading ability. Again, it appears that the poor readers in this group, like poor readers in other linguistic awareness studies, are having serious difficulty with phonemic segmentation. For these children, even phonics-based reading instruction has not resulted in well-developed linguistic awareness skills.

The question of whether linguistic awareness facilitates reading acquisition, or reading instruction facilitates linguistic awareness, or if there is an interaction between the two (Goldstein, 1976), is not completely resolved. It appears that for most children, phonics-based reading instruction facilitates

acquisition of linguistic awareness skills. For many reading-disabled children, however, awareness of phonemes is not acquired in the course of reading instruction. It may especially need to be explicitly taught to this group.

Nearly all of the studies reviewed have examined the relationship of linguistic awareness skills to acquisition of reading in beginners. This research has clearly established the importance of these skills for early reading acquisition. However, only a small amount of research has been conducted with older poor readers and illiterate adults, yielding somewhat contradictory conclusions. Older poor readers, for example, were examined by Bradley & Bryant (1979) using a complex task: in addition to linguistic awareness, this task tapped short-term memory and possibly other skills. The poor readers did not perform as well as younger good readers, suggesting that linguistic awareness may be a factor in reading problems of older children. Only one study (Morais et al., 1979) dealt with illiterate adults. The authors concluded that linguistic awareness skills are actually a consequence of reading instruction, although careful examination of their results reveals that this study, too, can be interpreted to support a facilitative role for linguistic awareness.

More information is needed about older children and adults.

There is some question as to whether a lack of linguistic awareness continues to be a factor retarding the progress of older poor readers. There have been suggestions that the difficulties in linguistic awareness displayed by young poor readers may be the result of a developmental lag (Beech & Harding, 1984; Satz, Taylor, Friel, & Fletcher, 1978). Thus, it is possible that linguistic awareness skills may improve with age (and with phonics oriented reading instruction), and that other factors are responsible for the difficulties experienced by older poor readers. However, the study by Bradley and Bryant (1978) suggests an ongoing role of linguistic awareness factors in the reading problems of older children.

At present, little attention has been paid to the basis of reading difficulties in adults. Morais et al (1978), mentioned above, studied illiterate Portuguese peasants with virtually no education. While this population was ideal for identifying the role of reading instruction in developing linguistic awareness skills, it does not offer much insight into the question of linguistic deficits in American adults who have failed to learn to read despite some exposure to conventional instruction. However, one study did examine the spelling errors in British adult literacy students, and found the pattern of errors was similar to that found in children: better readers made more phonetically accurate errors

(Perin, 1981). Other studies utilizing adult poor readers have addressed their linguistic deficits in a much more general manner (McCue, Shelly, Goldstein, & Katz-Garris, 1984), or concentrated on other issues (Birely & Manley, 1980; Finucci, Whitehouse, Isaacs, & Childs, 1984; Frauenheim, 1978; Kahn, 1980).

In order to highlight the developmental issue, the present study compared linguistic awareness skills of third-grade good and poor readers, and those of good- and poor-reading adults. The purpose of the present study was to examine the role of linguistic awareness skills in the reading problems of third graders and adults. Such skills have been shown to facilitate reading acquisition in the first grade, but it is unclear whether deficits in linguistic awareness skills continue to hamper reading achievement beyond grade one.

Predictions

It was predicted that the performance of poor readers (both children and adults) would be inferior to that of their age peers who were good readers, on three measures of linguistic awareness, but not on a non-speech control task. Further, it was predicted that these results could not be accounted for by differences in intelligence.

Confirmation of the hypothesized relation between linguistic awareness and reading in older children and adults would have both practical and theoretical implications. Practically, it could influence teaching methods for older reading-disabled students. Theoretically, a strong relationship would call into question a "developmental lag" interpretation of the deficits in linguistic awareness that have been observed in young children.

METHOD

Third grade good and poor readers, and good- and poor-reading adult basic education students, were tested on a battery of measures designed to assess linguistic awareness. Awareness of phonemes within words must be assessed somewhat indirectly. No clear agreement exists about the optimal task for its measurement (Backman, 1983; Ehri, 1979; Golinkoff, 1978). However, it has been found that a wide variety of tasks involving phoneme manipulation are strongly intercorrelated, although rhyme tasks are not related to other phonological awareness tasks (Stanovich, Cunningham, & Cramer, 1984). In the present study, a battery of tasks was employed, each using a different approach. A non-speech control task was included, to determine whether any difficulties the subjects may have with one of the linguistic awareness tasks were due to demands of the task other than conceptualization of phonemic segments.

Experiment 1

Subjects

Subjects were thirty third grade children from two suburban Connecticut school systems, ranging in age from 96 - 124 months.

They were pre-selected by school reading specialists or on the basis of group achievement tests to form groups of good and poor readers. All potential subjects were screened using the Word Attack and Word Analysis subtests of the Woodcock Reading Mastery Tests, Form A (Woodcock, 1973), the Peabody Picture Vocabulary Test-Revised (PPVT-R; Dunn & Dunn, 1981), and the Colored Progressive Matrices (CPM; Raven, Court, & Raven, 1977). In addition, the children were screened for hearing loss. The right and left ears were presented with tones at 500 Hz (25 dB), 1000 Hz (20 dB), 2000 Hz (20 dB), 4000 Hz (20 dB) and 8000 Hz (20 dB), using a standard audiometer. Those who failed the hearing screening were excluded from the study. Fifteen good and fifteen poor readers were selected on the basis of non-overlapping scores on the Woodcock subtests.

Table 1 presents the characteristics of the two groups. Before the groups were compared for equivalence on demographic variables, homogeneity of variance was assessed using the Fmax test. The Fmax values for these variables were: Age, 3.75; PPVT-R, 1.10; Raven CPM, 1.06; Woodcock Word Identification, 3.27; and Woodcock Word Analysis, 6.99. Only Word Analysis was significant, violating the assumption of homogeneity of variance ($p < .01$), so this variable was analyzed using the approximate F statistic (Winer, 1971). The groups were not significantly

different on PPVT-R (standard scores): the mean of the good readers was 104.4; the poor readers, 99.3 ($F(1,28) = 2.30$, $p > .05$). The two groups also did not differ on CPM percentile rank (good readers' $M = 68.3$, poor readers' $M = 64.07$; $F(1,28) = 0.21$, $p > .05$). The groups did not differ significantly on age (good readers $M = 110.8$ mos.; poor readers $M = 114.7$ mos.; $F(1,28) = 1.86$; $p > .05$), gender ($\text{Chi-square}(1) = .682$; $p > .05$), or town ($\text{Chi-square}(1) = .536$; $p > .05$). Woodcock Word Identification (raw scores) between good readers ($M = 116.6$) and poor readers ($M = 82.87$; $F(1,28) = 80.42$, $p < .05$).

Table 1

Subject Characteristics: Experiment 1.

Variable	Good		Poor		F
	M	(S.D.)	M	(S.D.)	df (1,28)
Age (Mos.)	110.8	(5.13)	114.7	(9.93)	1.86
PPVT-R	104.4	(8.92)	99.3	(9.36)	2.30
Raven CPM	68.3	(24.68)	64.07	(25.40)	0.21
Woodcock Word Id.	116.6	(7.05)	82.87	(12.75)	80.42*
Woodcock Word An.	45.6	(3.40)	13.2	(8.99)	170.36**

*p < .05.

**Significant using the Satterthwaite approximate test (Winer, 1971)
(F(1,12) = 170.36, p < .05).

Similarly, good readers scored significantly better ($\bar{M}$ = 45.6) than poor readers ($\bar{M}$ = 13.2; approximate $F(1,28)$ = 170.36, $p < .05$) on Woodcock Word Analysis.

The fifteen children who qualified as good readers scored well above expected grade level, with a mean reading grade equivalent of 8.8 (8 years, 8 months). The fifteen children labeled poor readers averaged more than one year below their expected level, with a mean reading grade equivalent of 2.6. (Because testing was carried out between the seventh and the ninth months of the school year, the expected grade equivalent ranges from 3.7 - 3.9.)

All children in the study were being taught using basal readers which, although they combine phonics and sight-word approaches, place a strong emphasis on phonics instruction.

Procedure

Each child was tested individually in two sessions. The first session included the screening procedure (PPVT-R, CPM, Woodcock subtests, and hearing screening). The second session included the experimental tasks (Word Length Judgement, Auditory Analysis Test (Rosner & Simon, 1971), Lindamood Auditory Conceptualization Test (Lindamood & Lindamood, 1971), and a non-speech control task), which will be described below.

All testing took place in a quiet room in the child's school. The tape-recorded stimuli for Word Length Judgement, Auditory Analysis Test, and the non-speech control task were played to subjects over earphones. Responses to the Auditory Analysis Test were recorded on audiotape, as well as being transcribed by the experimenter during testing. The tapes were played back within twenty-four hours of the experimental session in order to corroborate the transcription and to allow any necessary corrections.

Measures

Two of the measures assess linguistic awareness through phonemic manipulation. Such tasks appear to be better correlated with reading ability than segmentation measures utilizing tapping (Backman, 1983). The third task measures understanding of the basic relationship between spoken and written words through word length judgement.

The following tasks were presented to all of the subjects.

(1) Word Length Judgement: Real Words (Length - Real)
Subjects were presented with a series of 20 short (one-syllable) and long (three- and four-syllable) words and asked after each, "Is it short like 'bike' or long like 'bicycle'?" Only nouns were used, and short and long words were matched for frequency using a word frequency analysis of reading materials designed for grades three through nine (Carroll, Davies, & Richman, 1971). (A list of the words used is in Appendix E.)

(1A) Word Length Judgement: Nonsense Words (Length - Nonsense). The nonsense word condition was identical to the

real word task, except that nonsense words were used throughout. Nonsense words were constructed as pseudo-words (i.e., they are allowable given English rules of pronunciation) and were matched for length and phonemic structure with the list of real words. For example, the nonsense word "ronk" was constructed to match the word "lamp." (The liquid /l/ was matched with another (/r/), a short vowel was substituted for the /a/, etc.).

Nonsense words were used in order to control for the possibility that subjects could be confused in the real word condition, about whether to judge the length of the word in terms of the number of syllables, as instructed, or according to the length of the object which the word represents (for example, judging "bus" to be long and "asparagus" short). This condition also controlled for the possibility that subjects may have been able to provide correct responses based on some knowledge of the spelling of the words. It is conceivable that subjects might know how to spell some words while not understanding the underlying relationship between print and sound.

This task was designed to measure linguistic awareness in a somewhat different way than the other tasks. Ability

to estimate roughly the length of single-syllable versus multisyllable words indicates some awareness of their internal structure. This measure requires an awareness of the whole, or sum of the parts, that may tap different processes than the other (phoneme manipulation) tasks. Poor readers and nonreaders have shown a clear deficit in performance on variations of this task in previous studies (Katz, 1982; Lundberg & Torneus, 1978; Rozin, Bressman, & Taft, 1974). Reliability (coefficient alpha) of the measure used in the present study (Real and Nonsense combined) for the subjects in Experiments 1 and 2 was .76. Coefficient alpha for Experiment 1 (children) only was .79.

(2) Auditory Analysis Test (AAT - Rosner & Simon, 1971). This test requires the subject to repeat a word spoken by the examiner, removing a specified syllable or phoneme, for example, "Say 'smile' without the '/s/'." [See Appendix D for a copy of this test.]

The AAT has 40 items which were given in order of difficulty. If five consecutive items were answered incorrectly, the test was discontinued. The items include those in which the subject was required to omit:

the final syllable of a two-syllable word;

the initial syllable of a two-syllable word;
 the final consonant of a one-syllable word;
 the initial consonant of a one-syllable word;
 the first consonant of a consonant blend;
 a medial consonant;
 a medial syllable.

The purpose of this test was to measure the subjects' awareness of the smaller units that comprise words (phonemes), and their ability to manipulate phonemes within words.

The AAT was validated by correlating its results with language arts scores from the Stanford Achievement Test. With the effects of IQ removed, AAT correlated .50 or better in grades two through five (Rosner & Simon, 1971). Reliability (coefficient alpha) of the AAT for the subjects in Experiments 1 and 2 was .96.

(3) Lindamood Auditory Conceptualization Test (LAC - Lindamood & Lindamood, 1971). The LAC Test measures the ability to perceive and compare sounds, and to discern their number and order within nonsense syllables. The test

includes two categories of questions. In the first (Category I), the subject is required to place colored blocks in response to individual speech sounds. For example, if the examiner says /z/ /z/, the subject uses two blocks of the same color, to represent the two sounds which were the same. If the examiner says /z/ /m/, the subject uses two blocks of different colors. In Category II, the subject is required to listen to nonsense syllables, and to place different blocks to represent the individual phonemes heard within the syllables. For example, for the syllable /Ip/, the subject might choose a red block to represent the sound /I/, and a blue block to represent /p/. The subject would be required to place the blocks in order to represent the syllable /Ip/, and to change them in response to changes in the syllable (e.g. reverse the blocks for /pI/. (See Appendix B for a list of the items in the LAC.)

The score obtained is a combination of weighted raw scores from the two categories.

This test is designed to measure the ability to conceptualize phonemes and their order in syllables. Research on the reliability of the LAC, utilizing alternate forms administered at least four weeks apart to a sample of

52 students, yielded a reliability of .96. Validity was assessed in several ways. In a sample of 660 students in grades K-12, the LAC was found to correlate from .66 to .81 with the combined Reading and Spelling subtest scores from the Wide Range Achievement Test (Calfee, Lindamood, & Lindamood, 1973). The LAC, administered at the beginning of first grade to over 60 subjects, correlated .88 - .95 with reading scores at the end of first grade (Varner, reported in Lindamood & Lindamood, 1971).

(4) In addition, a non-speech control task for the LAC Test was used. Subjects were presented with sequences of tones, and were asked to manipulate colored blocks to indicate changes in the number and sequence of tones. The sequences were designed to mirror, as closely as possible, the demands of the LAC. (See Appendix C for a description of this task.) Non-speech sounds were used in order to assess whether any difficulties the subjects may have had with the LAC were due to demands of the task other than conceptualization of phonemic segments. For example, if subjects had difficulty conceptualizing the requirement of manipulating blocks to represent sounds or changes in sequences of sounds, they would score poorly on the LAC for reasons other than difficulties with linguistic awareness.

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Results and Discussion

The scores of the good and poor readers on the linguistic awareness tasks and the non-speech task were compared. First, a multivariate analysis of variance was performed, comparing good and poor readers on all of the linguistic awareness tasks and the control task, in order to determine if any significant differences existed. Homogeneity of dispersion matrices was tested and found to be non-significant [Box's $M = 24.499$; $F(15, 3156) = 1.314$, $p > .01$]. ($T^2 = 401.235$, $F(16, 13) = 11.64$, $p < .05$). Prior to individual univariate analyses of each of the dependent measures, the Length subtest scores (Real and Nonsense) were compared to determine if there were significant differences between the subtests for either good or poor readers. Neither group showed significant differences between the two subtests (good readers, $F(1, 28) = 0.00$, $p > .05$; poor readers, $F(1, 28) = .44$, $p > .05$). Therefore, for each reading group, the subjects' scores on the two subtests were combined to form one variable (Length).

In order to control for the possibility of inflated Type I error due to performing multiple analyses on this set of data, all tests were performed with an adjusted alpha

level. A Bonferroni procedure (Bray & Maxwell, 1982) was used. The alpha level for the overall experiment was set at .05; because four analyses were to be performed, this figure was divided by four, yielding an adjusted alpha level of .0125.

The two reader groups were then compared on the four dependent measures (Length, AAT, LAC, and Non-Speech) using one-way analyses of variance. The results are presented in Table 2. The assumption of homogeneity of variance was tested using an Fmax test for each variable. The Fmax values for each dependent measure were: Length, .56; AAT, 1.18; LAC, 3.44; Non-speech, 1.95. All were non-significant. As predicted, the scores of good and poor readers were significantly different on all three measures of linguistic awareness, but not on the non-speech control task. On Word Length Judgement, the mean of the good readers ($\bar{M}$ = 39.33) was significantly higher than that of the poor readers ($\bar{M}$ = 36.47; $F(1,28) = 12.41$, $p < .0125$). Similarly, good readers gave significantly more correct responses on the Auditory Analysis Test ($\bar{M}$ = 30.4) than poor readers ($\bar{M}$ = 14.4; $F(1,28) = 60.32$, $p < .0125$). On the Lindamood Auditory Conceptualization Test, good readers scored significantly better ($\bar{M}$ = 88.53) than poor readers ($\bar{M}$

= 62.80; $F(1,28) = 32.13, p < .0125$).

The scores of the two groups were not significantly different on the non-speech control task (good reader $M = 17.4$, poor readers $M = 15.5$; $F(1,28) = 2.35, p > .0125$).

Omega-squared was used to determine the proportion of variance accounted for by each of the three linguistic awareness variables, and the results are as follows: Length = .28; AAT = .68; LAC = .53. Although the two groups differed significantly on Word Length Judgement, it accounted for a much smaller proportion of the variance than the other measures. Two possible explanations exist. First, ceiling effects were noted. Both groups gave correct responses to nearly every item. Second, this task differs somewhat from the AAT and LAC. It involves a rather global judgement concerning a whole word, as opposed to responses requiring attention to specific phonemes. The two other tasks yielded impressive results. The strong effect sizes obtained on AAT and LAC strongly support the hypothesized relationship between linguistic awareness and reading skill.

Table 2

Experiment 1:Comparisons of Good and Poor Readerson Linguistic Awareness Measures

Variable	Good		Poor		F	Omega-squared
	M	(S.D.)	M	(S.D.)	df (1,28)	
Length	39.33	(1.23)	36.47	(2.90)	12.41*	.28
Auditory Analysis	30.40	(5.87)	14.40	(5.41)	60.32*	.68
LAC	88.53	(8.31)	62.80	(15.50)	32.13*	.53
Non-speech	17.40	(2.75)	14.87	(4.55)	3.41	

*p < .0125. Significant at the experimentwise .05 level.

As predicted, there was not a significant difference between good and poor readers on the non-speech task, which was designed to replicate the task demands of the LAC without using speech sounds. Thus, the large differences found between good and poor readers on the LAC are probably due to differences in linguistic awareness, rather than other demands of the task. Although the magnitude of the difference was not large enough to achieve significance, it could be argued that it constitutes a non-significant trend. Given that the LAC is a complex task, it is possible that some demands of the LAC other than linguistic awareness account for a portion of the significant difference between good and poor readers on the LAC. However, we can conclude that differences between the two groups in linguistic awareness can account for most of the variance for two reasons. First, the magnitude of the reader-group difference on the LAC is much greater than the non-significant trend on the non-speech task. Second, good and poor readers showed significant differences on all three measures of linguistic awareness. Thus, even if some demands of the LAC other than linguistic awareness are contributing to the poor readers' low scores, it is likely

that a lack of linguistic awareness can account for most of the variance.

Reading skill is correlated with intelligence, as numerous studies have found (see Stanovich, Feeman, & Cunningham, 1984). It is possible that the small, non-significant differences between the groups on verbal or non-verbal intelligence could account for some of the difference in performance on the linguistic awareness measures. In order to determine if the subjects' performance on linguistic awareness measures is due to differences in IQ, the data were re-analyzed using IQ as the grouping variable. If IQ was responsible for the reader-group differences, then a similar pattern of significant differences on the linguistic awareness measures should have occurred on such analyses. A multivariate analysis of variance was performed using Ravens Children's Progressive Matrices scores to divide the sample into high and low IQ groups. The sample mean of 66 (percentile) was the designated cutoff score, resulting in two groups of 14 and 16 subjects, respectively. Homogeneity of dispersion matrices was non-significant (Box's $M = 26.137$; $F(15,3023) = 1.399$, $p > .01$). The results of the MANOVA indicate that no significant differences exist between the high and low

nonverbal IQ groups ($T^2 = 58.013$, $F(16, 13) = 1.68$, $p > .05$).

Another MANOVA was performed, using the sample mean of 101 on the PPVT-R to divide the sample into low and high verbal IQ groups. Two groups of 15 subjects each resulted. Homogeneity of dispersion matrices was non-significant (Box's $M = 35.213$, $FF(15, 3156) = 1.889$, $p > .01$). was significant ($T^2 = 101.867$, $F(16, 13) = 2.96$, $p < .05$). Univariate analyses of variance were performed on the dependent measures, yielding a significant difference only on length ($F(1, 28) = 8.71$, $p < .0125$). It appears that the differences between good and poor readers on this variable are related, at least in part, to differences in verbal IQ. No such relationship exists for the other two linguistic awareness variables, AAT and LAC. Therefore, we can conclude that the differences between the good and poor readers on two of the linguistic awareness measures, AAT and LAC, seem not to be attributed to differences in intelligence. Rather, these differences appear to be directly related to reading level.

The results of this study strongly support the hypothesis that linguistic awareness is related to reading skills in third graders. This extends the findings of a

number of studies demonstrating this relationship in younger children with a variety of tasks (Bruce, 1964; Fox & Routh, 1975; Goldstein, 1976; Helfgott, 1976; Liberman, 1973; Liberman et al, 1974; Stanovich, Cunningham, & Cramer, 1984). Previous findings were suggestive of a relationship in older children (Bradley & Bryant, 1979, 1983; Calfee et al, 1973; Rosner, 1973, 1974), and the present results confirm this relationship up through the third grade level. The large effect sizes obtained in the present study strengthen an already impressive body of evidence supporting an important relationship between linguistic awareness and reading skill. It is clear that this relationship holds throughout the primary grades (K - 3). Still unanswered is the question about the linguistic awareness skills of much older poor readers. Could linguistic awareness deficits be impeding the progress of adults who are struggling to learn to read? Experiment 2 addressed this question.

Experiment 2

The purpose of Experiment 2 was to evaluate the hypothesis that linguistic awareness skills are related to reading skill in adults as well as children.

Method

Subjects

Subjects were twenty-six Adult Basic Education (ABE) and Literacy Volunteers students from the New Haven, Connecticut area. Poor readers were selected from beginning and intermediate ABE classes and from the Literacy Volunteers. Control subjects ("good readers") were selected from advanced ABE classes; most were nearing the time when they would take the high school equivalency examination. While not good readers by most adult standards, this group was chosen to control for variables such as geographic location, socioeconomic status, age, race, and education. All adult subjects were screened using the same procedures as in Experiment 1, except that Ravens Progressive Matrices (RPM; Raven, 1977) was used instead of the children's version. Thirteen good and thirteen poor readers were selected on the basis of non-overlapping scores on the

Woodcock subtests. Table 3 presents the characteristics of each group.

Before testing for equivalence between the groups on the demographic measures, the assumption of homogeneity of variance was assessed using the F_{max} test (Winer, 1971). The value of F_{max} for each of the variables was: age, 1.33; PPVT-R, 1.43; RPM, 1.42; Woodcock Word Identification, 15.77 (significant, $p < .01$); and Woodcock Word Analysis, 2.51. Because the Word Identification scores violated the assumption of homogeneity of variance, they were analyzed using the Satterthwaite approximate F statistic (Winer, 1971). The good readers scored significantly higher ($M = 137.85$) than the poor readers ($M = 65.77$; approximate $F(1,24) = 57.94$, $p < .05$) on Woodcock Word Identification. The two groups also differed significantly on Woodcock Word Analysis (good readers' $M = 42.69$; poor readers' $M = 3.77$; $F(1,24) = 225.71$, $p < .05$). There were no significant differences between good readers ($M = 51.15$) and poor readers ($M = 46.62$) on RPM ($F(1,24) = .30$, $p < .05$). The two groups also did not differ by age (good readers' $M = 32.38$ (yrs.); poor readers' $M = 34.92$; $F(1,24) = .24$, $p < .05$) or gender ($\chi^2(1) = 1.385$, $p > .05$). The two groups were significantly different on verbal intelligence,

as measured by the PPVT-R (good readers' $\bar{M}$ = 86.62; poor readers' $\bar{M}$ = 66.23; $F(1,24)$ = 23.68, $p < .05$). This difference will be discussed below. The composition of each group by race was identical: 12 black, 1 white. There was no difference between the groups in years of education; good readers ranged from 7 to 11 years of education, poor readers from 3 to 12 (Mann-Whitney U = 68.5; corrected for ties, z = .86, $p > .05$). Seven good readers and five poor readers remembered having had at least some phonics instruction during their schooling.

The thirteen subjects who qualified as good readers scored at the ninth grade level on the Woodcock subtests; those who were labeled poor readers had a mean grade equivalent score of 2.0.

Table 3

Subject Characteristics: Experiment 2.

Variable	Good		Poor		F
	M	(S.D.)	M	(S.D.)	df (1,24)
Age (yrs.)	32.38	(12.35)	34.92	(14.23)	.24
Raven (RPM)	51.15	(23.07)	46.62	(19.35)	.30
PPVT-R	86.62	(11.59)	66.23	(9.69)	23.68*
Woodcock Word Id.	137.85	(8.37)	65.77	(33.22)	57.94**
Woodcock Word An.	42.69	(7.89)	3.77	6 (4.99)	225.71*

*p < .05.

**Significant using the Satterthwaite approximate test (Winer, '97')
(F(1,12) = 57.94, p < .05).

Procedure and Measures

The procedure and measures were essentially the same as those of Experiment 1. ABE students were tested during class hours in a quiet room near their classrooms. Literacy Volunteers students were tested during the time they would usually meet with their volunteer tutors, often at a local library or at the tutor's home. At the end of the second testing session, the adults were interviewed using the questionnaire in Appendix A. Adult subjects were paid at the rate of \$4.00 per hour for their time.

Results and Discussion

The scores of the good and poor readers on the linguistic awareness tasks and the non-speech task were compared. First, a multivariate analysis of variance was performed, comparing good and poor readers on the dependent measures, in order to determine if any significant differences existed. Homogeneity of dispersion matrices was non-significant (Box's $M = 15.125$, $F(6,4173) = 2.176$, $p > .01$). The MANOVA was significant, $T^2 = 557.264$, $F(15,10) = 15.48$, $p < .05$). Prior to individual univariate analyses of

each of the dependent measures, the Length subtest scores (Real and Nonsense were compared to determine if there were significant differences between the subtests for either good or poor readers. Neither group showed significant differences between the subtests (good readers, $F(1,24) = 1.93, p < .05$; poor readers, $F(1,24) = 2.92, p < .05$). Therefore, for each reading group, the subjects' scores on the two tasks were combined. As in Experiment 1, an adjusted alpha level of .0125 was used, yielding an experimentwise alpha level of .05.

The two reader groups were then compared on the four dependent measures (Length, AAT, LAC, and Non-Speech). First, the assumption of homogeneity of variance was tested using the Fmax test, and two variables (LAC and Non-Speech) met this assumption. Good and poor readers were compared on these measures using one-way analyses of variance. The data for the other variables were adjusted using a log transformation, which changes the distribution so that the assumption of homogeneity of variance may be met. Following the log transformation, the data for one other variable (AAT) met this assumption, and an ANOVA was performed on the transformed data. A Mann-Whitney U test was performed on the other variable, Length.

The results of the analyses are presented in Table 4. As predicted, good readers scored significantly better ($M = 78.54$) on LAC than poor readers ($M = 50.38$, $F(1,24) = 18.86$, $p < .0125$). Similarly, good readers' scores on the AAT ($M = 24.76$) were significantly better than those of poor readers ($M = 6.69$; $F(1,24) = 23.2$, $p < .0125$). Good readers' scores ($M = 39.46$) on Length were compared with those of poor readers ($M = 37.77$) using the Mann-Whitney U test (one-sided) and found to be significantly different ($U = 134$, $p < .0125$).

Table 4

Experiment 2:Comparisons of Good and Poor Readers
on Linguistic Awareness Measures

Variable	Good		Poor		F df (1, 24)	Omega-squared
	M	(S.D.)	M	(S.D.)		
Auditory Analysis (actual scores)	24.76	(11.20)	6.69	(4.27)		
(log transform.)	1.34	(.26)	.69	(.41)	23.20*	.48
LAC	78.54	(17.49)	50.38	(15.51)	18.86*	.43
Non-speech	18.38	(5.28)	14.08	(2.69)	6.86	

*p < .0125. Significant at the experimentwise .05 level.

The scores of the two groups were not significantly different on the non-speech control task.

Omega-squared was used to determine the proportion of variance accounted for by group membership, on the measures AAT and LAC. Omega-squared for AAT was .48; for LAC it was .43. In light of such large effect sizes, we may conclude that linguistic awareness is related to reading skill in adults as well as children.

As in Experiment 1, a multivariate analysis of variance was performed using RPM scores to divide the entire sample into two groups. The sample mean of 49 (percentile) was the designated cutoff score, resulting in a high-IQ group of 15 and a low-IQ group of 11. Homogeneity of dispersion matrices was non-significant (Box's $M = 16.461$, $F(15, 1856) = 0.835$, $p > .01$). The results of the MANOVA indicate that no significant differences exist between the high and low nonverbal IQ groups ($T^2 = 67.8466$, $F(15, 10) = 1.88$, $p > .05$).

Unlike the children in Experiment 1, the scores of good- and poor-reading adults were considerably different on verbal intelligence (as measured by the PPVT-R.) Rather than conclude that linguistic awareness differences between

the adult good and poor readers are due to differences in verbal IQ, however, we should consider possible alternative explanations. It may be that illiteracy seriously retards development of vocabulary, and the poor readers' low PPVT-R scores are, in part, a result of their lack of reading skill. It is likely that PPVT-R adult norms were developed on a largely literate population. It is also probable that a good vocabulary results, at least in part, from the reading that adults do, both in school and in their daily lives.

The relationship of intelligence to reading skill has received much attention. The claim that reading skill is closely related to "g" has been disputed by a recent study, which found that decoding speed, phonological awareness, and listening comprehension accounted for more of the variance in reading comprehension than did general intelligence (Stanovich, Cunningham, & Feeman, 1984). Reading is related to IQ, but differing conceptions of the nature of intelligence will prompt different interpretations of this relationship (Crowder, 1982). Is a global conception accurate, or is intelligence comprised of a wide variety of different skills? Where do the skills that are related to reading disability, such as linguistic awareness, fit?

Given the limitations of our understanding of these relationships, it is not possible to precisely describe the nature of the relation between linguistic awareness and verbal IQ in the illiterate adults in the present study. While it is clear that some of the variance in linguistic awareness skills can be accounted for by verbal IQ, it is likely that some cannot. The results of Experiment 1, as well as numerous other studies, provide evidence that linguistic awareness is a separate skill, apart from verbal intelligence, that is strongly related to reading.

The finding of differences in linguistic awareness skills in literate and subliterale adults is similar to the results obtained by Morais et al (1979), although the conclusions drawn in the present study are different. The illiterate subjects in that study had had virtually no reading instruction, in contrast to the subjects in the present study, whose educational levels ranged from third grade to post-high school. (Three of the adult poor readers were high school graduates, and several had trade school or junior college experience. All, of course, were currently enrolled in adult education classes or tutoring specifically designed to teach basic reading skills; some of these subjects had been enrolled in such classes for three years

or more.) Morais and his colleagues concluded that linguistic awareness is probably a consequence of reading instruction. Clearly, while many children and adults acquire linguistic awareness skills as a result of reading instruction, this is not invariably the case. Alegria et al, concluded that phonics instruction, as opposed to a sight-word approach, facilitated linguistic awareness skills. While this is probably true, in the present study, the results of the informal interview indicate that five of the poor readers received some phonics instruction before they dropped out of school (as compared to seven of the control S's). The Adult Basic Education teachers combine phonics and whole word approaches, as did the Literacy Volunteers whose students were in the study. Thus, although these interview results must be considered highly tentative, due to limitations of the subjects' memories for such distant events, we may conclude that most of our subjects have received at least some phonics instruction. Even phonics-based instruction appears not to have been adequate to develop linguistic awareness skills in these poor readers.

In summary, linguistic awareness appears to be related to reading skill in adults as well as children. The

relationship of linguistic awareness skills to verbal intelligence is not clear, however, and verbal IQ may account for some of the observed differences between adult good and poor readers in linguistic awareness.

GENERAL DISCUSSION

Earlier work has demonstrated that linguistic awareness is related to reading skill in young children, and that poor linguistic awareness skills in kindergarteners can predict first-grade reading difficulties. In addition, training in phonemic segmentation, blending, and categorization has been shown to improve reading skill for young children. Therefore, linguistic awareness skills play at least a facilitative role in reading acquisition in young children. Other studies were suggestive of a similar relationship in older children. The present experiments investigated the relationship of linguistic awareness and reading skill in children beyond the first grade level and in adults. Third graders, selected on the basis of reading skill, were tested on a variety of measures of linguistic awareness. Good readers performed significantly better than poor readers on three measures of linguistic awareness, but no difference was found between the groups on a control task. These differences could not be accounted for by non-verbal intelligence, and verbal IQ could account for differences on only one of the tasks. Two measures accounted for a very large proportion of variance.

Adult good readers also performed significantly better than subliterate adults on the three measures of linguistic awareness, but not on the non-speech control task. Non-verbal IQ could not account for these differences. Some question remains about the relationship of verbal IQ to linguistic awareness in adults.

The results of both experiments provide strong support for a relationship between reading skill and linguistic awareness that extends beyond the early primary grades. These results have both theoretical and practical implications, which will be discussed below. The persistent finding of a link between linguistic awareness and reading proficiency points to an important role for this skill in the process of learning to read. Therefore, these findings have implications for instructional methods as well as for an understanding of the process of reading.

Theoretical Implications

Previous research has raised a number of questions about the nature of the relationship between linguistic awareness and reading. Do linguistic awareness skills facilitate acquisition of early reading skill?

Alternatively, does linguistic awareness arise as a consequence of reading instruction? Is linguistic awareness a pre-requisite for successful reading instruction, perhaps with a developmental basis? In other words, is it necessary to be aware of phonemes within words in order to learn the alphabetic principle and does this awareness emerge as a result of development? If so, then it is possible that a developmental delay in this skill is responsible for the difficulty some children experience in learning to read.

The research literature to date has not provided definitive answers to these questions. Support can be found for hypotheses which contradict each other. A probable explanation for this is that none of the hypotheses can be completely rejected. For example, linguistic awareness and early reading instruction have been shown to be mutually facilitative (Goldstein, 1976). This finding rules out the interpretation that linguistic awareness is exclusively a pre-requisite to reading as well as the opposite, that it is simply a consequence of reading instruction. The complex relationships among the various hypotheses will be considered below.

Many studies have shown a facilitative (if not

pre-requisite) role for linguistic awareness in beginning readers (Elkonin, 1973; Goldstein, 1976; Liberman et al, 1977; Lundberg, Olofsson & Wall, 1980; Wallach & Wallach, 1976); other research suggests that the relationship exists in older poor readers as well (Bradley & Bryant, 1979, 1983; Calfee et al, 1973; Rosner, 1973, 1974). While the present study does not directly address the causal question, the results strongly support the hypothesis that the connection between linguistic awareness and reading level found in primary-grade children is not limited to this age range. Rather, facility in linguistic awareness appears to be directly related to reading ability, regardless of the age of the subjects.

The sharp rise in performance on linguistic awareness tasks among first graders (Liberman et al, 1974) raised the question of whether this was a developmental increase or the result of initiation of reading instruction. The studies by Morais et al (1979) and Alegria et al (1982) addressed this question directly. They found that reading instruction, specifically a phonics-based approach, facilitates the development of linguistic awareness. Morais and his colleagues caution against an oversimplified interpretation of their data, however, and note that the cognitive capacity

for becoming aware, not awareness as such, is a precondition for learning to read. The authors indicated a probable interaction between development and instruction.

The results of both experiments in the present study indicate that despite the fact that most of the adults, and all of the children, had received at least some phonics-oriented reading instruction, many have not acquired linguistic awareness skills. These are the same students who are experiencing marked difficulty in learning to read. Thus, while phonics-oriented reading instruction certainly facilitates explicit knowledge of the structure of the language, the results of the present experiments suggest that instruction is not a sufficient basis for acquisition of linguistic awareness.

A similar conclusion can be drawn about the argument that linguistic awareness arises developmentally, and that poor readers' difficulties with linguistic awareness are the result of a developmental lag. Developmental processes appear to have been found to contribute to the ability to acquire linguistic awareness. This was suggested in the early work by several researchers (e.g. Calfee et al, 1973; Liberman, et al, 1974; Rosner, 1975), and is illustrated in

the study by Bradley and Bryant (1978). These authors tested a large sample of younger normal readers (ages 5 - 8) matched for reading level with older poor readers (ages 8 - 13), and found the normal readers to be superior on a measure of linguistic awareness. To further examine the differences between the two groups, they divided each group into subjects making one or no errors and those making more than one error. Normal readers showed a clear developmental trend: those making fewer errors were significantly older. This was not the case for poor readers. Thus, while in previous research developmental processes do appear to contribute to the ability to acquire linguistic awareness, in the present study it would hardly seem appropriate to attribute the results to a developmental delay, since the relation between linguistic awareness and reading skill occurred in a group of adults with a mean age of 35, as well as in children. Morais et al (1979) also found a lack of skill in linguistic awareness in adults. Rather, these findings justify conceptualizing the poor linguistic awareness skills of older, severely reading-disabled children and adults as a deficit, or as arising from a broader deficit in linguistic skills.

In summary, it is apparent that development is a factor

in the acquisition of linguistic awareness in normal children, and it undoubtedly is a factor for poor readers as well. However, the results of the present study, as well as previous research (e.g. Bradley & Bryant, 1978), don't support developmental delay as an exclusive explanation for the deficient linguistic awareness skills of poor readers.

The bulk of the research on the relation of linguistic awareness to reading ability is correlational in nature. However, the results of several training studies, showing an increase in reading skill following instruction in linguistic awareness, enable us to draw a stronger conclusion about the causal nature of the relationship (Bradley & Bryant, 1983; Elkonin, 1973; Treiman & Baron, 1983; Wallach & Wallach, 1976; Williams, 1980). We can conclude that knowledge of the structure of language aids in comprehension of the alphabetic principle, which forms the basis of the English orthography.

Several theoretical questions remain unanswered. First, what are the relationships among the various tasks used to assess linguistic awareness? The measures in the present study did not all obtain equivalent results, and this has occurred in other experiments as well (e.g.

Backman, 1983; Goldstein, 1976). It is unclear whether inter- and intra-study differences in results are due to fundamental differences in the skills measured by the various tasks, to error due to small N's, or to other factors. One study has examined task comparability of a variety of linguistic awareness measures in kindergarten children (Stanovich, Cunningham, & Cramer, 1984). The phonemic awareness tasks were highly intercorrelated. Rhyme recognition and rhyme production were not closely related to the other tasks. The other measures included recognition of alliteration, segmenting initial phonemes, and substituting phonemes, and these were good predictors of reading skill. It would be interesting to discover the relationships between the simple tasks used by Stanovich and his colleagues and more complex tasks, such as the AAT and LAC, which involve deletion, blending, and other manipulations of phonemes. Similarly, it would be interesting to discover the relationship between the simpler tasks and measures which approach linguistic awareness in a different manner, such as judging word length. In her review of studies investigating phonemic awareness, Golinkoff (1978) raises the possibility that phonemic analysis, or segmentation, is a separate process from synthesis (blending). Neither the present study or that of Stanovich and his colleagues

addressed this question directly, and it remains to be investigated.

It is interesting to speculate about the relationships among the various linguistic skills which are deficient in poor readers. The deficit in verbal short-term memory displayed by poor readers may be an underlying cause of their difficulties with linguistic awareness. It is plausible that a problem in short-term memory could limit one's ability to reflect on spoken language, and thus, one's ability to develop an awareness of its phonemic structure. A moderate correlation between phonological awareness and verbal short-term memory in kindergarten students has been found by Mann and Liberman (1982), lending tentative support to this proposition. Alternatively, poor readers may suffer from deficits in a cluster of distinct language skills. Additional research will be needed to investigate the relationships among these linguistic skills.

Practical Implications

The findings of the present study have practical, as well as theoretical, implications. Because problems in linguistic awareness appear to affect reading-disabled

adults as well as young children, we can conclude that awareness of the phonemic structure of words is important to the process of learning to decode for all ages. Therefore, inclusion of training in linguistic awareness in reading curricula (both for beginning readers and for older reading disabled students) is probably warranted. Elkonin (1973) has recommended a reading program that incorporates training in linguistic awareness. He suggests that children be taught "sound analysis" before letter names or sounds. His method involves simple materials: pictures of common objects with a series of connected squares (one for each phoneme in the object's name) beneath, and markers to place in the squares. Children are taught to pronounce words in a slow, continuous drawl, emphasizing first one phoneme, then the next, and to place markers in the designated squares as each sound is recognized. Elkonin believes it is important that training in sound analysis take place prior to teaching the alphabet because the former will give the child a less distorted concept of the meaning of the letters. He argues that when children are taught letter-sound correspondences before they are aware of phonemes within words, they come to view the letters as concrete objects, to think of their assigned sounds as their names, and to try to construct words from this series of names. If they are aware of

phonemes first, they will be in a better position to grasp the relationship between spoken and written language.

A group of researchers interested in linguistic processes in reading has outlined methods for teaching pre-reading and beginning reading skills (Lieberman, Shankweiler, Camp, Blachma, & Werfelman, 1980). Beginning with rhyming games and other enjoyable activities for pre-readers, the authors have compiled techniques, from a wide variety of sources, suitable for teaching word, syllable, and phoneme segmentation, including Elkonin's procedure.

The authors emphasize several principles of instruction: first, that essential skills be taught explicitly, rather than through a method which purports to enable the students to discover them for themselves. Second, that the students master the skill in question before another is taught; indeed, that they master it and then practice it sufficiently to make it automatic. They also point out the importance of integrating reading, phonics, spelling, and handwriting, rather than teaching them as separate, unrelated skills (Lieberman et al, 1980).

The recommendations of these researchers (Elkonin, 1973; Liberman et al, 1980) that instruction in linguistic awareness be included as part of the regular reading curriculum are seconded here for two reasons. First, prior studies have shown that such instruction facilitates reading acquisition (Bradley & Bryant, 1983; Elkonin, 1973; Rosner, 1971; Trieman & Baron, 1983; Wallach & Wallach, 1976). Second, the results of the present study demonstrate that linguistic awareness skills are deficient in older poor readers and illiterate adults, highlighting the continuing importance of these skills for reading, despite age.

In addition to those who have called for inclusion of training in linguistic awareness in curricula designed to teach all beginning readers, others have suggested that such training is particularly important for children who are failing to learn to read with conventional instruction. Wallach and Wallach (1976) emphasized phonemic awareness in a program designed for beginning readers from disadvantaged backgrounds. Older children (ages 7 - 12) labeled "learning disabled" by their school system were the target of a program developed by Williams (1980). This program includes training in segmenting and blending phonemes prior to introducing letter-sound correspondences. The program is

specifically designed to supplement regular reading programs without requiring extensive teacher retraining, advance lesson preparation, or additional personnel. In an evaluation study, learning disabled children to whom the program was administered were superior to control subjects (who received conventional instruction) in decoding novel words as well as those introduced in the program.

In sum, researchers have recommended instruction in linguistic awareness for normal beginning readers and for poor readers. The available evidence that older poor readers will benefit from such instruction must be viewed as preliminary, and additional research is necessary. However, the results of training studies such as those of Bradley and Bryant (1983) and Williams (1980) strongly suggest that instruction in phonemic analysis and synthesis will improve reading skill. It would be promising if future research demonstrated that training in linguistic awareness facilitates reading acquisition for secondary students and illiterate adults as well.

Summary

In conclusion, the finding that linguistic awareness

appears to be related to reading proficiency in adults as well as children has broad implications. The nature of the relationship between awareness of the phonemic structure of spoken words and reading acquisition is complex, and cannot be explained simply as a "developmental delay," or a "consequence of phonics-oriented reading instruction." Both developmental and instructional factors appear to influence the emergence of linguistic awareness in normal subjects, but neither factor can account for the profound deficits in linguistic awareness skills in reading-disabled adults who have received some phonics instruction. These subjects appear to have a deficit with linguistic awareness that cannot be accounted for in terms of a developmental lag.

A better understanding of the nature of the various linguistic deficits in poor readers, and their interrelationships, will assist in developing appropriate remedial techniques. Methods for teaching linguistic awareness have been shown to be effective. More work in this area should continue to refine and improve these methods.

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APPENDICES

Appendix A

Adult Questionnaire

(Note: items in parentheses will not be asked as printed; rather, the examiner will discuss these questions with the subject in a way s/he can understand.)

No. _____

Age _____

Occupation _____

How far did you go in school? GED?

How far did your mother go in school? Your father?

How much reading do you do?

(Newspaper)

(Comics)

(Letters)

(Books)

(Magazines)

(Phone book)

(Recipes, instructions)

(At work?)

Did you ever get any extra help for reading in school?

Were you ever retained (left back)?

Tell me what you remember about how reading was taught in your school.

(letter-sound correspondences)

(phonics rules)

(whole word)

How much trouble does reading give you in your everyday life?

Do you have trouble reading road signs while driving?

Appendix B

Lindamood Auditory Conceptualization TestItems

First a "precheck" is given, so that the examiner is sure the subject understands the concepts of sameness/difference, the numbers one through four, left-to-right order, and first/last.

Next, the items in Category I-A are given, with the examiner teaching the procedures as follows:

"I want you to use these blocks to show me how many sounds I make, and whether they are the same or different. Let me show you what I mean. If I say /z/ /z/, I made two sounds that are the same. So you would show two blocks that are the same color. Start here and go this way."

(Indicate by placing two blocks of the same color on the work space in front of the subject. If he or she attempts to place the blocks, say, "Let me show you first, then it will be your turn." Return the blocks to the central pile.)

"If I say /v/ /m/, I made two sounds that are not the same. They are different. So you would show two blocks that are different."

(Indicate the correct pattern. For one of the blocks, use the same color that represented /z/ in the previous pattern. Doing this will establish that a specific color does not have to be remembered as representing a specific sound.)

"If I say /p/ /p/ /ch/, I made two sounds that are the same-- and then a different one. Put the blocks in a row just the way you hear the sounds. Notice that although /ch/ can be spelled with two letters, I use only one block because it is only one sound."

(Demonstrate. Then continue from this point to administer Category I-A.)

Category I-A:

1. "Show me /v/ /v/."

(This format: "Show me x x " is used throughout.)

2. /b/ /b/ /b/

3. /ch/ /sh/

4. /k/ /p/ /f/

5. /e/ /i/

6. /s/ /s/ /s/

7. /u/ /a/ /o/

8. /v/ /z/ /th/ (voiced)

9. /d/ /d/

10. /t/ /k/

Category I-B

1. /z/ /z/ /p/

2. /m/ /ch/ /ch/

3. /l/ /n/ /l/

4. /sh/ /s/ /s/

5. /g/ /d/ /g/

6. /d/ /d/ /j/

Category II

(Only Basic Patterns are shown; Alternate Patterns, provided for a second chance in case of error, are not shown here. See Lindamood Lindamood, '97', for full test.)

1. "Show me: /a/"
2. "This says /a/, show me /ap/"
3. "This says /ap/, show me /pa/"

(This format: "This says x, show me y" is used throughout.)

4. /pap/
5. /ap/
6. /op/
7. /vop/
8. /vops/
9. /vups/
10. /ups/

11. /usp/

12. /susp/

Appendix C
Non-Speech Task

(Give LAC with precheck first.)

Instructions

"I want you to use these blocks to show me how many sounds you hear, and whether they are the same or different. Let me show you what I mean. If you hear this:

[low, low]

you heard two sounds the same. So you would show two blocks that are the same color. Start here and go this way." (Left to right.)

(Demonstrate)

"If you hear this:

[low, high]

you heard two sounds that are not the same. So you would show two blocks that are different."

(Demonstrate, using a different color for [low] than was used above.)

"Now you try it."

[high, low]

(Offer correction if necessary. Any two colors may be used.)

"If you hear this:

[high, high, low]

you heard two sounds that are the same--

(Demonstrate with two blocks of the same color)

and then a different one."

(Demonstrate.)

"Now it's your turn. Listen carefully. You'll hear each pattern of sounds only once."

Category I

1. L, L
2. H, H, H
3. L, H
4. H, L, H
5. L, L, H
6. H, L, L, H
7. H, H, L, L
8. L, H, H, H
9. L, H, L, H
10. L, H, L, H

Category II

Part 1

1. "Show me [L]"
2. "This says [L], show me [L, H]"
3. "This says [L, H], show me [H, L]"

{This format is used for all remaining items.)

4. H L H
5. L H
6. H H
7. L H H
8. L H H L
9. L L H L
10. H H L
11. H L H
12. L H L H

Part 2

1. H
2. H L
3. L L
4. L H L
5. H L
6. L L
7. H L L
8. H L L H
9. H H L H
10. H L H
11. H H L
12. L H H L

Appendix D

Auditory Analysis Test

1. birth(day)	21. (t) rail
2. bel(t)	22. de(s) k
3. (m) an	23. (sh) rug
4. ro(de)	24. cr(e) ate
5. (car) pet	25. re(pro) duce
6. (w) ill	26. s(m) ack
7. (l) end	27. s(k) in
8. (s) our	28. s(w) ing
9. (g) ate	29. (st) rain
10. to(ne)	30. (g) low
11. ti(me)	31. st(r) eam
12. plea(se)	32. c(l) utter
13. stea(k)	33. off(er) ing
14. (sc) old	34. Es(ki) mo
15. (c) lip	35. auto(mo) bile
16. (s) mile	36. car(pen) ter
17. (p) ray	37. Ger(ma) ny
18. (b) lock	38. lo(ca) tion
19. (b) reak	39. cont(in) ent
20. s(m) ell	40. phi(lo) sophy

Appendix E

Word Length Judgement Test

Instructions

I am going to say a word, and I want you to tell me if it is short, like "bike," or long, like "bicycle." "Bike" doesn't take very long to say, because it is a short word. "Bicycle" takes a little longer, because it is a long word. Now, tell me if this word is a short word or a long one: "arithmetic"

(If correct:) Yes, that's a long one.

(If incorrect:) No, that's a long one.

Listen to the next word, and tell me if it is short, like "bike," or long, like "bicycle." The word is: "hat."

(Offer correction if necessary.)

Real Words

1. hill
2. grandfather
3. gem
4. spike
5. mountaintop
6. television
7. judge
8. peg
9. thunderstorm
10. lamp
11. vacation
12. soap
13. shorts
14. motorcycle
15. alphabet
16. dragonfly
17. limb
18. president
19. macaroni
20. belt

Nonsense Words

1. sull
2. clondfeshil
3. pung
4. maintempock
5. pillachaffim
6. skote
7. vidge
8. gack
9. shandersparn
10. ronk
11. fopayshim
12. feek
13. charps
14. naderfoyppe
15. ilsatat
16. brikanslee
17. lun
18. drazipont
19. nobbaleemie
20. pard

Appendix F

Experiment 1: Summary TablesMultivariate Analysis of Variance

This MANOVA includes the demographic variables AGE, PPVT, RAVEN, ID (Woodcock Word Identification), and ATTACK (Woodcock Word Attack), as well as the dependent variables LREAL (Length - Real Words), LNON (Length - Nonsense Words), AAT, LACW (LAC), and NCNSPCOM (Non-Speech Task).

=====						
EFFECT	VARIATE	STATISTIC	F	DF	P	

G: GRP						
	-ALL----					
	TSQ=	345.688	23.46	10,	19	0.0000
PPVT	SS=	192.533				
	MS=	192.533	2.30	1,	28	0.1402
RAVEN	SS=	132.300				
	MS=	132.300	0.21	1,	28	0.6496
LREAL	SS=	17.6333				
	MS=	17.6333	14.93	1,	28	0.0006
LNON	SS=	13.3333				
	MS=	13.3333	8.36	1,	28	0.0073
AAT	SS=	1920.00				
	MS=	1920.00	60.32	1,	28	0.0000
LACW	SS=	4966.53				
	MS=	4966.53	32.13	1,	28	0.0000

NONSPCOM

SS=	26.1333				
MS=	26.1333	2.35	1,	28	0.1365

AGE

SS=	116.033				
MS=	116.033	1.86	1,	28	0.1838

ID

SS=	8534.53				
MS=	8534.53	80.42	1,	28	0.0000

ATTACK

SS=	7873.20				
MS=	7873.20	170.36	1,	28	0.0000

Chi-Squared Analysis: Experiment 1Good vs. Poor Readers by Gender

***** OBSERVED FREQUENCY TABLE 2

GRP	GENDER		TOTAL
	FEMALE	MALE	
GOODRDRS	5	10	15
POORRDRS	3	12	15
TOTAL	8	22	30

ALL CASES HAD COMPLETE DATA FOR THIS TABLE.

MINIMUM ESTIMATED EXPECTED VALUE IS 4.00

STATISTIC	VALUE	D.F.	PROB.
PEARSON CHISQUARE	0.682	1	0.4090
YATES CORRECTED CHISQ.	0.170	1	0.6797

Chi-Squared Analysis: Experiment 1Good vs. Poor Readers by Town

***** OBSERVED FREQUENCY TABLE *

GRP -----	TOWN -----		TOTAL -----
	TOWN1	TOWN2	
GOODRDRS	7	8	15
POORRDRS	9	6	15
TOTAL	16	14	30

ALL CASES HAD COMPLETE DATA FOR THIS TABLE.

MINIMUM ESTIMATED EXPECTED VALUE IS 7.00

STATISTIC	VALUE	D.F.	PROB.
PEARSON CHISQUARE	0.536	1	0.4642
YATES CORRECTED CHISQ.	0.134	1	0.7144

Multivariate Analysis of Variance

This table gives the summary statistics for the MANOVA in Experiment 1 with the subjects grouped by RAVEN scores into high and low IQ groups.

```
=====
EFFECT    VARIATE      STATISTIC          F          DF          P
-----
```

OVALL: GRAND MEAN

-ALL----

```
      TSQ=    * 108320.          3143.20    16,    13  0.0
* ABOVE STATISTIC POSSIBLY ACCURATE TO ONLY 3 DIGITS.
NUMERICALLY CONSERVATIVE F:  3141.16    16,    13  0.0
```

Multivariate Analysis of Variance

This table gives the summary statistics for the MANOVA in Experiment 1 with the subjects grouped by PPVT-R score into high and low IQ groups.

=====

EFFECT	VARIATE	STATISTIC	F	DF	P
--------	---------	-----------	---	----	---

OVALL: GRAND MEAN

-ALL----

TSQ=	* 93888.1	2724.43	16,	13	0.0
* ABOVE STATISTIC POSSIBLY ACCURATE TO ONLY 3 DIGITS.					
NUMERICALLY CONSERVATIVE F:	2723.14	16,	13	0.0	

Experiment 2: Summary TablesMultivariate Analysis of Variance

This MANOVA includes the demographic variables AGE, PPVT, RAVEN, ID (Woodcock Word Identification), and ATTACK (Woodcock Word Attack), as well as the dependent variables LREAL (Length - Real Words), LNON (Length - Nonsense Words), AAT, LACW (LAC), and NONSPCOM (Non-Speech Task).

=====						
EFFECT	VARIATE	STATISTIC	F	DF	P	

G: GRP						
	-ALL----					
	TSQ=	276.325	17.27	10,	15	0.0000
AGE	SS=	41.8846				
	MS=	41.8846	0.24	1,	24	0.6316
PPVT	SS=	2700.96				
	MS=	2700.96	23.68	1,	24	0.0001
RAVEN	SS=	133.885				
	MS=	133.85	0.30	1,	24	0.5918
LREAL	SS=	7.53846				
	MS=	7.53846	5.57	1,	24	0.0267
LNON	SS=	2.46154				
	MS=	2.46154	3.34	1,	24	0.0801
AAT	SS=	2124.04				
	MS=	2124.04	29.55	1,	24	0.0000

LACW	SS=	5152.15				
	MS=	5152.15	18.86	1,	24	0.0002
NONSPCOM	SS=	120.615				
	MS=	120.615	6.86	1,	24	0.0150
ID	SS=	33768.0				
	MS=	33768.0	57.54	1,	24	0.0000
ATTACK	SS=	9847.54				
	MS=	9847.54	225.71	1,	24	0.0000

Chi-Squared Analysis: Experiment 2Good vs. Poor Readers by Gender

***** OBSERVED FREQUENCY TABLE 1

GRP	GENDER		TOTAL
	FEMALE	MALE	
GOODRDRS	8	5	13
POORRDRS	5	8	13
TOTAL	13	13	26

ALL CASES HAD COMPLETE DATA FOR THIS TABLE.

MINIMUM ESTIMATED EXPECTED VALUE IS		6.50	
STATISTIC	VALUE	D.F.	PROB.
PEARSON CHISQUARE	1.385	1	0.2393
YATES CORRECTED CHISQ.	0.615	1	0.4328

Multivariate Analysis of Variance

This table gives the summary statistics for the MANOVA in Experiment 2 with the subjects grouped by RAVEN score into high and low IQ groups.

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EFFECT	VARIATE	STATISTIC	F	DF	P
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R: RAVEN

-ALL----

TSQ=	67.8466	1.88	15,	10	0.1570
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