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Chapter • 8

Questioning the Role of Syllables and Rimes in Early Phonological Awareness

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It is now abundantly clear that skilled reading entails, among other things, explicit awareness of the phonemic structure of words (for reviews, see Adams 1990; Blachman 1997; Brady and Shankweiler 1991; Liberman, Shankweiler, and Liberman 1989; Wagner and Torgesen 1987). Awareness of phonemes as discrete entities is not typically achieved until school age and is often triggered by reading instruction itself. However, just as reading entails phoneme awareness, so phoneme awareness, in turn, may depend on a more general phonological sensitivity: a growing appreciation of the sound structure of language that develops throughout the preschool years, including the ability to isolate or identify words, syllables, and rhyming pairs (e.g., Liberman et al. 1974). Indeed, the extent to which general phonological awareness is attained is a strong predictor of how well a child will do at acquiring phoneme awareness and at learning to read. (See Bowey and Francis [1991] for an insightful summary and review of much of the relevant evidence.)

Although phonological sensitivity in the preschool years has been found to predict later phoneme awareness and reading performance (e.g., Chaney 1998; Snow, Burns, and Griffin 1998), our knowledge of the developmental progression from lack of

awareness to full appreciation of the phonemic structure of words remains incomplete. To date, two fairly separate areas of research have explored sensitivity to phonological structure prior to school age. One, strongly influenced by linguistic theory and using experimental tasks, has focused on the awareness of the syllable and its internal onset/rime structure as the route to phoneme segmentation (e.g., Treiman and Zukowski 1991). The other, primarily based on observational data, has examined spontaneous rhyming and alliteration in early language play as the precursor to full linguistic awareness (e.g., Dowker 1989; Maclean, Bryant, and Bradley 1987).

Although there is little direct comparison of these two perspectives, we will argue that each makes fundamentally different claims about the sequence in which children become aware of phonological units within a word. In particular, we highlight the distinctions between the two views regarding whether the earliest awareness of the phonological structure of words usually occurs for syllables or for word rhymes. We believe that a better understanding of the typical progression of children's sensitivity to phonological units is critical both for appropriate assessment, and for the design of instructional activities that best meet the needs and abilities of preschool and kindergarten children.

Before describing the study itself, we review the results of prior studies of phonological awareness in young children, and examine the evidence for early sensitivity to rhymes and syllables. To refer to sublexical phonological units, we adopt terminology used by Shattuck-Hufnagel (1987) to describe the implicit lexical organization of both children and adults.[1] Following her framework, we will distinguish between two major hypotheses about phonological awareness development: 1) a *syllable-based* orientation that grants an important status to the syllable and to intrasyllabic units such as the onset and rime; and 2) a *word-based* orientation that focuses on sublexical units such as the word onset and the stressed vowel that are defined not in terms of the syllable but directly in terms of the word.

[1]Although Shattuck-Hufnagel's discussion concerns implicit organization as evident in linguistic behavior, and we are concerned with units on which children are able to focus attention in doing awareness tasks, it seems plausible that units that come to awareness are those that naturally exist in linguistic analyses.

BACKGROUND

Evidence for Syllable-Based Organization

Research on children's phonological awareness has long emphasized the developmental primacy of the syllable over the phoneme, with numerous studies reporting that the ability to segment words into syllables is easier, and occurs earlier, than the ability to segment words into phonemes (e.g., Content et al. 1986; Fox and Routh 1975; Liberman 1973; Liberman et al. 1974; Treiman and Baron 1981; Treiman and Zukowski 1991). For example, when Liberman et al. (1974) asked preschoolers, kindergartners, and first graders to tap out the number of syllables or phonemes in words, the syllable task was performed more accurately than the phoneme task at each age level. Treiman and her colleagues have replicated these earlier findings, and argue that there is yet another level, *onset-rime*, intermediate between the syllable and the phoneme.[2] Treiman and Zukowski (1991) asked children whether two words presented to them had any sounds in common. In one condition, the shared sounds constituted syllables (e.g., *ham*mer-*ham*mock; com*pete*-re*peat*); in a second, they were onsets or rimes (e.g., *pl*ank-*pl*ea; sp*it*-w*it*); and in a third, they were phonemes (e.g., *s*teak-*s*ponge; smo*ke*-ta*ke*). As was the case in the Liberman et al. (1974) study, Treiman and Zukowski found that the syllable task was easier than the phoneme task at each grade level. Moreover, they found the onset-rime task to be easier than the phoneme task and more difficult than the syllable task, confirming their prediction of a developmental progression from awareness of syllables, to onsets and rimes, to phonemes.

The idea that the awareness of phonemes should be the most difficult sublexical level to isolate stems from speech perception research demonstrating that phonemes are abstract and embedded linguistic segments that overlap acoustically (and articulatorily) with neighboring phonemes within a word, (Liberman et al. 1967) making it impossible, for example, to produce stop consonants in isolation. Extraction of phoneme segments in ordinary listening is hypothesized to be an automatic function of the speech system, occurring below conscious awareness (Liberman 1992). Whereas

[2]The onset is defined as the initial consonant or consonant cluster in each syllable. An onset may consist of a single phoneme (e.g., *p*an) or a phoneme cluster (e.g., *pl*an). The rime consists of the vowel(s) plus any remaining consonants within a syllable. For example, the onset of "car" is "c" and its rime is "ar." Similarly, the onset of "spa" is "sp" and its rime is "a." Every syllable has a rime, but some have no onset (e.g., act, ear).

the parallel transmission of phonemes within the word may contribute to the difficulty of becoming explicitly aware of the individual segments, awareness of larger sublexical units is thought to be easier to attain (Gleitman and Rozin 1977; Liberman et al. 1977). As in the studies mentioned above, the syllable has often been proposed to be the likely "larger" unit in early phonological awareness. Note, for example, that unlike phonemes, syllables are clearly marked in the language; each is distinguished by a vocalic center with well-defined acoustic properties and can be produced in isolation.

Other kinds of evidence also suggest that syllable segmentation is easier (or more "natural") than phoneme segmentation. For example, although Portugese-speaking adults who have not been exposed to writing instruction have proven largely unable to perform oral phoneme segmentation tasks, they mastered syllable segmentation with relative ease (Morais et al. 1986). Further evidence suggesting that syllables are more accessible than phonemes derives from historical research showing that writing systems in which the orthographic units represent syllable-level units have been independently created by a number of cultures, whereas the alphabetic writing system has evolved only once, and then, apparently, as much by accident as by insight (Gleitman and Rozin 1977). Correspondingly, learning to read a syllabary is argued to be conceptually less difficult than acquiring the alphabetic writing system of English (DeFrancis 1991; Gleitman and Rozin 1973).

Within linguistic theory itself, the syllable has often served as an important unit of analysis, motivated by the need to account for both phonotactic constraints (i.e., dictating possible phoneme sequences) and prosodic structure (e.g., Fudge 1969, 1987; Hooper 1972; Kahn 1976). Indeed, the role of the syllable has been a foundational assumption of a number of phonological theories whose focus has been the internal structure of the syllable (e.g., Clements and Keyser 1983; Fudge 1987; Selkirk 1982; Vennemann 1988). In these theories, which underlie Treiman and Zukowski's proposal for development of phonological awareness, it is generally agreed that the syllable is not a string of phonemes but has an internal hierarchical organization involving the onset (i.e., the pre-vocalic consonant[s]), the *vowel nucleus*, and the *coda*, (i.e., the final consonant[s]). The most prevalent hypothesis suggests that there is, in addition, an initial division into the onset and the rime (nucleus and coda), as in str-aight (e.g., Fudge 1987, 1989; Selkirk 1982).

This syllable-based, onset-rime hypothesis has obtained additional support from adult psycholinguistic data. For example, in both spontaneous and elicited speech errors, adults tend to ex-

change whole onsets (e.g., "throat cutting" → "coat thrutting" [from MacKay 1972]) far more often than parts of onsets or than other parts of the syllable (e.g., as in the hypothetical errors "croat thutting" or "thrut coating"). Similarly, in novel word games, adults were better able to follow rules involving onset and rimes (e.g., "kig" → "kaz ig"), than rules referring to subsets of these postulated units (e.g., "skig" → "saz kig")(Treiman 1983, 1986). It has been noted too that word games from a variety of cultures appear to adhere to the onset/rime, as in the case of Pig Latin (e.g., "Jane speaks" → "ane-Jay eaks-spay") (Fudge 1987). Likewise, errors in memory point to an onset-rime division within the syllable. For example, when adults were asked to repeat strings of nonsense syllables that exceeded their memory span, the errors produced in recall showed a preponderance of exchange errors involving whole onsets (Treiman and Danis 1988). (See Treiman [1989] for a complete review of the evidence that English syllables have an onset-rime structure.)

Still other evidence taken to support onset-rime organization stems from errors from young children learning to read and to write. Treiman (1993) notes that children are far more likely to read or write correctly the first letter of *pat* than the last letter of *tap*, presumably because the onset is more readily isolated than is a portion of the rime. Similarly, beginning writers frequently delete one of the phonemes when attempting to spell initial consonant clusters, apparently because of difficulty apprehending that clusters can be subdivided (Bruck and Treiman 1990; Shankweiler 1992; Treiman 1985). This interpretation is supported by other experimental demonstrations that young children are better able to recognize phonemes that comprise whole onsets than they are the same phoneme occurring as part of a cluster (Treiman 1985).

Evidence for Word-Level Organization

In contrast to the linguistically motivated focus on the syllable and its constituents, a quite separate area of research has examined linguistic sensitivity demonstrated in young children's spontaneous language play. This research suggests that "children first begin with an awareness of rhyme and alliteration and, through that awareness, gradually develop a more general phonological segmentation capacity" (Dowker 1989, p. 199). In contrast to the above noted experimental measures for comparing phoneme and syllable awareness, Dowker and others have relied primarily on observational measures to investigate early language play with particular focus on children's sensitivity to rhyme and alliteration.

Although the literature connecting language play with phoneme awareness is fairly small, a number of studies and much children's literature speak to an appreciation of alliteration (i.e., when initial onsets are repeated, as in *big brown bear*) and of rhyme (as in *silly willy*) in very young children.

In this paper, the word-level rhyme unit is defined as including the final stressed vowel and everything beyond, whether this consists of a portion of a syllable (e.g., *me-bee*) or more than a syllable (e.g., *mountain-fountain*) (Clements and Keyser 1983; Fudge 1987). Thus, the rhyme necessarily reflects word-level structure: only one rhyme exists per word and, as noted, this may occur within a syllable or may extend across a syllable boundary. Although rhymes restricted to the final or to the sole syllable (e.g., sa*loon*-ba*boon*, m*e*-b*ee*) meet criteria for rimes as traditionally defined, rhymes initiating in other, non-final syllables (e.g., m*ountain*-f*ountain*) are quite distinct. To reiterate, word-level rhyme incorporates the *only stressed vowel* in the word and *the remainder of the word*, however long, whereas syllable-based rimes are present in every syllable, regardless of stress. Here we distinguish word-level rhyme from the subsyllabic rime unit by the variation in spelling.

Observational studies suggest that rhyme and alliteration can emerge very early in childhood, with informal reports of spontaneous rhyming in children as young as, or even younger than, two years of age (Chukovsky 1968; Van Kleeck and Schuele 1987; see Bryant and Bradley 1985, for complete discussion). More formal studies of rhyming and alliteration are limited, but revealing (Bryant et al. 1989; Bryant et al. 1990; Chaney1992; Maclean, Bryant, and Bradley 1987). For example, in a longitudinal study examining sensitivity to phonological similarities, MacLean, Bryant, and Bradley (1987) report that some of the three-year olds they studied were able to detect rhyme and alliteration in oddity tasks in which they had to tell which one of three words did not belong, and that some were able to produce rhymes and alliterations when given a target word.

Perhaps the most extensive study of rhyme and alliteration was conducted by Dowker (1989), who examined the frequency of these phonological devices in original poems elicited from 133 children ranging in age from two to six years of age. When presented with two-line poems as models to emulate, 58% of her sample responded with at least one "poem," that is, a production with an "obvious rhythmical structure" (p. 185). The poets included 50% of the children under three and a half years of age and 67% of the children over that age. Several findings are of interest for the present purposes. First, rhyme was used much more fre-

quently (in 42% of all poems) than was alliteration (in 26%), despite the fact that all children were presented with models of each type. Second, although there was a dramatic effect of age on productivity, the proportion of poems with rhyming devices did not vary over age. In sum, rhyming ability appears to develop very early, potentially before either alliteration or syllable segmentation skills.

Here we suggest that this rhyme research, albeit phenomenological, connects neatly with recent work on early phonological development. At one point, it was simply assumed that lexical items of children beyond the age of one or two years were represented in terms of the same phoneme and syllable categories as adult lexical entries; what differed with age was accessibility to conscious awareness. More recent research on children's early productions suggests that children start with only words and articulatory gestures (sometimes referred to as features or articulatory routines) and that they must go about constructing intermediate linguistic units such as the syllable and the phoneme (Studdert-Kennedy 1987). This shift in thinking suggests that changes in accessibility may depend on changes in lexical organization (for discussion see Fowler 1991; Treiman, Zukowski, and Richmond-Welty 1995; and Walley 1993).

Of particular relevance to our current concerns about the course of phonological awareness are studies of children's malapropisms (Aitchison and Straf 1981; Vihman 1981), defined in those studies to include incorrect variants of a target word, whether used consistently or not. Vihman's data, on children from one to five years of age, suggest that children, like adults, tend to preserve the correct number of syllables and the position and shape of the stressed syllable. However, whereas adults tend to preserve the initial consonant and vowel, even when not stressed, she reports that children were most likely to retain the stressed vowel and its surrounding consonants, next most likely to preserve word-final segments, and least likely to retain word-initial segments. This is largely in keeping with the findings from Aitchison and Straf (1981), who note that children tend to preserve the stressed vowel and word endings (e.g., *monuments* for *condiments*), whereas adult malapropisms tend to preserve word onset and the stressed vowel (e.g., *tumors* for *tubers*). Further, although adults generally maintain syllable structure, their malapropisms altered the number of syllables (e.g., *Bavarian* for *barium*) twice as often as those by the children (33% vs. 16%).

There are two lessons of relevance from these data: First, they suggest that not all segments, or syllables, in the word are equally

salient. And second, they suggest that one cannot necessarily extrapolate from adult data what is most central for children. In particular, whereas much of the work on word-level structure in adults has focused on the unit of word-onset, this unit lacks support as being especially prominent for pre-school children. Rather, one would be encouraged to look to the stressed vowel, and its consonants. We find this very interesting in light of the anecdotal evidence pointing to the conspicuousness of rhyme, with its stressed vowel, for very young children.

Interestingly, even research on lexical organization in adults has begun to question the pre-eminence of syllable-level organization in English. Although our goal is not to test whether the syllable constitutes a 'real' psycholinguistic unit, we present these concerns because they add to our motivation to question the potential role of syllable structure in phonological awareness.

One line of evidence raising doubts about the status of the syllable in English is the frequent difficulty in defining where one syllable ends and another begins. For example, although one measure of syllable awareness in young children involves segmenting words into their component syllables, this task proves to be difficult in English for even the most literate and reflective adult speakers of English. For the word "butter," is it /bu-ter/, /but-er/, or /but-ter/? Although linguists have a notation to indicate this apparent "ambisyllabicity" (e.g., /bu[t]er/; Kahn 1976), the ambiguity apparently can detract from the status of the syllable itself. In French, a language with clear syllable boundaries, French speakers show evidence of syllable-level organization when asked to identify strings of phonemes (Mehler et al. 1981). Thus, when asked to detect the string /pa/, French students responded faster to "palace" than to "pal-mier," consistent with the syllable boundaries. Analogously, subjects recognized /pal/ faster in "pal-mier" than in "pa-lace." In contrast, a comparable experiment with English speakers suggests no such evidence for syllabifying segmentation (Cutler et al. 1986). That is, English speakers were equally fast at recognizing /pa/ or /pal/, whether listening to "pa[l]ace" or to "palpitate." This was true despite the fact that one would predict an advantage for /pal/ in "palpitate," where ambisyllabicity is not a problem. Cutler et al. went on to find that English speakers also do not show evidence for syllabification when presented with French words, despite its unambiguous syllable boundaries, but that French speakers do syllabify English (though with a stronger effect, as expected, for "palpitate" over "palace"). On the basis of these data, Mehler et al. conclude that alternative word segmentation routines are available to the human language processor, and

hypothesize that because syllable segmentation is less efficient for English, it is not the system that is used.[3]

A series of studies with adults in Treiman and Zukowski (1990) also suggest that syllabification in English is not fixed, but fluid. In a variety of word games requiring adults to make a decision regarding where the word divides into syllables, several principles of syllabification were evident, and often competing. The authors suggest that one possible response to their findings is to "argue that there exists no discrete level of representation [in English] that corresponds to the syllable. . .syllables are not primary linguistic units but result from other interacting factors [stress, phonological legality, sonority. . .]" (p. 82).

Other evidence placing the syllable in question derives from a shift in interpretation. Results previously taken as strong support for the internal structure of the syllable, particularly syllable onsets, are now being reinterpreted as evidence for the internal structure of the word (e.g., word onsets). In particular, adult speech errors and tip-of-the-tongue phenomena suggest that the primary cut below the level of the word is not between syllables but between the word onset and the remainder of the word (Berg 1989; Browman 1978; Davis 1989; Shattuck-Hufnagel 1983). For example, Browman (1978) and Shattuck-Hufnagel (1983) report that syllable-sized units exchange rarely in either spontaneous or elicited speech errors (e.g., "Al Lucinder" for "Lou Alcinder"). Whereas syllable-sized units make up less than 3% of all the exchange errors discussed in Shattuck-Hufnagel (1983), word onset exchanges (e.g., "breathing and smoking" to "smeething and broking") constitute as much as 91% of the exchange errors presented in Shattuck-Hufnagel (1987). Significantly, Browman (1978) and Shattuck-Hufnagel (1983) note that most exchanges involve word onsets rather than just any syllable onset. When errors occur that do not involve the word onset, the source is often the onset of the stressed syllable, again invoking word level organization (e.g., "pomato" for "potato," influenced by tomato) (Browman 1978; see also Browman and Goldstein 1990). They

[3]Recent results buttress the conclusion that various word segmentation procedures are possible. A study of Dutch, which like English is ambisyllabic, finds that Dutch listeners nonetheless treat it in a French-like manner (i.e., they are faster at recognizing syllabic subdivisions of words)(Zwitserlood et al. 1993). Zwitserlood et al. suggest that segmentation behavior may vary across languages because "languages vary with respect to their phonological structure and, as a consequence, with respect to the knowledge listeners may use in structuring the speech input," p. 270. They point out that English and Dutch differ in the nature of ambisyllabicity in terms of the language specific rules that determine which consonants can become ambisyllabic.

summarize, "cohesion in speech production errors appears to be defined with respect to the word. The featurally cohesive units are not the same everywhere in the word, nor are they segments, or even onsets of syllables" (Browman and Goldstein 1990, p. 421).

In recent work with adults, Treiman and her colleagues have taken a more moderate stance on whether words are represented by a syllable-based structure or a word-based structure. Mixed results have been obtained when adults are presented with tasks involving multisyllabic non-words. For example, supporting their perspective, adult listeners are better able to play word-games with onsets of an embedded syllable than with corresponding codas (Treiman et al. 1995). That is, for words with a C_1V-C_2VC_3-C_4VC_5 structure, they can more readily learn the rule $C_2 \rightarrow /g/$ (e.g., / ʃəˈpolhað / → / ʃəˈgolhað /) than the rule $C_3 \rightarrow /g/$ (e.g., / ʃəˈpolhað / → / ʃəˈpoghað /). Accordingly, the authors argue that the proposed onset-rime division of syllables is not restricted to monosyllabic words, but is also supported in medial syllables of multisyllabic words (see also Fowler, Treiman, and Gross [1993]).[4] Yet, in other conditions (e.g., Treiman, Zukowski, and Richmond-Welty 1995, E 2), only one of two groups of participants showed the predicted pattern. Pertinent to the present discussion, in a further study by Bruck, Caravolas, and Treiman (1995) in which adult participants had to compare pairs of stimuli, results were inconsistent for two experiments with non-word pairs that shared either an entire stressed final syllable (e.g., /horˈ*ten*/ - /Nɛgˈ*ten*/) or that shared rimes of stressed final syllables (also rhymes) (e.g., /mɪˈ*tark*/ - /soˈd*ʒark*/). The authors argued that syllables play a role in the initial processing of speech, but conceded that there also seem to be effects of word rhyme. Though less extreme than earlier statements with respect to the adequacy of the syllable-structure hypothesis, such comments fail to address the intersection between syllable structure and word structure.

A reexamination of the status of the syllable in early phonological awareness

Despite the apparent salience of the syllable in contrast to the segment in emerging phonological awareness, reports of rhyme and alliteration abilities in very young children suggest other possible entry points of metaphonological analysis. Keeping word-based or-

[4]From a word-based perspective, because the words in this experiment were medially stressed, the interpretation is not clear. The outcome of Treiman et al. (1995) may reflect the syllable structure of the embedded syllable; alternatively, it may speak to the salience of a proposed word-level unit, the onset of the stressed syllable.

ganization in mind as an alternative way of looking both at early phonological awareness and at lexical representation, we can now reexamine the role of the syllable in the development of phonological awareness with a more critical eye. Several concerns have led us to question whether the syllable is the most accessible unit, below the word, for young children.

First, as now noted by a number of critics, much of the evidence taken to support the salience of syllabic structure in early phonological awareness is ambiguous because of heavy reliance on monosyllabic stimuli. For example, in response to the Treiman and Zukowski (1991) study, Carlisle (1991) and Read (1991) cautioned that because only monosyllabic words were used as stimuli in the onset-rime condition, little is known regarding the status of onsets and rimes in multisyllabic words or in unstressed syllables. Read proposed that it would be helpful to examine young children's performance on words sharing syllables versus parts of syllables in unstressed portions of words (e.g., *re*fer/*re*mit versus p*re*fer/cr*ea*te) in order to test whether the hierarchy of awareness proposed by Treiman and Zukowski still would be evident.

Second, studies testing whether children find syllables easier to detect than onsets or rimes have sometimes confounded unit size and linguistic status, making it difficult to interpret the results. Treiman and Zukowski (1991) acknowledge this confound in their first experiment, noting the fact that the syllables were longer than the onsets and rimes, which were, in turn, longer than the phonemes. In two further experiments, they separated these variables, designing conditions in which units of the same size could function at two different linguistic levels. In their second experiment they compared sensitivity to single phoneme onsets with awareness of single phonemes that were part of onset clusters (e.g., *p*acts, *p*eel vs. *p*lan, *p*row), finding that onsets (even if composed of a single phoneme) are more salient than phonemes that do not themselves constitute an onset. However, in the third study, comparing performance on tasks involving syllables and parts of syllables (e.g., re*treat*, en*treat* vs. ac*claim*, in*flame*), they obtained equivalent performance on syllables and parts of syllables (consisting of rimes, and in some cases rimes with additional phonemes). As Treiman and Zukowski comment, this outcome suggests that size, as opposed to linguistic status, may have determined the superiority for syllables seen in their first experiment.

An experiment by Walley, Smith, and Jusczyk (1986) also suggests that size, or at least the number of shared constituents, influences the ease with which children detect phonological commonalities across words. In their study, kindergartners' and second

graders' auditory classifications of two-syllable nonsense words were examined to evaluate whether children's ability to classify together utterances that share whole syllables (e.g., /*nu*tae/, /*nu*li/) would emerge prior to their ability to classify utterances that share single phonemes (e.g., /*n*uli/, /*n*ato/) or more than one phoneme not conjoined within a syllable (e.g., /son*a*/, /sib*a*/); for all comparisons, stress was kept constant across the two syllables. This study failed to support the developmental sequence from syllable to phoneme or to indicate any special significance of the syllable per se. Instead, the factors that affected the perception of similarity in speech sounds were a combination of the number of phonemes shared across two words and position. For example, though the participants generally performed best on pairs sharing initial syllables, children were not as likely to link pairs sharing final syllables as they were to link pairs sharing the word onset and word final phonemes (e.g., /son*a*/, /sib*a*/).

These concerns, emphasized in Brady, Gipstein, and Fowler (1992), prompted Treiman and Zukowski (1996), in a replication and extension of their earlier work, to focus on size of the shared unit as a potential factor in the ease of judging whether two words "share sounds." When preschool and kindergarten children were comparing trisyllabic words in which the medial syllable was stressed, they were more accurate at recognizing shared medial syllables (e.g., /və'gænli/ - /su'gænmo/) than shared medial syllable rimes (e.g., /mo'varnli/ - /du'zarnbə/) even when the length of the shared portions in both conditions were matched for number of phonemes. The authors concluded that although size of the shared portion can be a factor in children's performance, their results confirm the relevance of syllable structure for awareness. While this study confronted the issue of size, it should be noted that the results did not uniformly indicate syllable structure as a primary level of awareness. One of the experiments reported (E. 2) compared sensitivity to syllables in final position (e.g., re*treat*, en*treat*) with ability to detect shared rimes in final stressed syllables (e.g., opp*ressed*, undr*essed*) (i.e., rhymes). In this instance, children were equally sensitive to both. Similar to their handling of their studies of adults described earlier, Treiman and Zukowski state that, "discounting the confounding effect of rhyme, the results support the linguistic status hypothesis in the case of syllables" (p. 210). This remark evades the very issue of how the emergence of awareness of rhymes and of awareness of syllables layer in normal development.

Accordingly, our final concern with granting the syllable primacy in the development of phonological awareness is the lack of

explicit comparisons with other candidate units, using comparable methodology. The Treiman and Zukowski (1996) study had a single rhyming condition with multisyllabic stimuli (and obtained results that question a strong syllable structure hypothesis), but did not address the role of stress in other portions of the word. The study did not allow explicit comparison of syllable rime and word rhyme as a test of the role of syllable structure in emerging awareness.

The challenge of making comparisons across conditions also is evident in a recent study looking at the development of phonological sensitivity in two- to five-year-old children (Lonigan et al. 1998). This investigation included measures of oddity detection both for rhyme (e.g., fish, dish, book) and for alliteration (e.g., bed, hair, bell), but very different types of measures of blending (e.g., "What word do you get when you say *bro. . .ther* together?") and of elision (e.g., "Now say battle without the *til*") to assess awareness of syllables. In this case the differences in measures contribute to problems in interpreting the results. In the sample of two-year olds, for example, 26% scored above chance on rhyme oddity although only 9% could blend syllables and only 6% could delete them in the elision measure. Whether these results reflect earlier development of rhyming skills or the greater conceptual ease of the oddity task is difficult to judge.

In the Walley, Smith, and Jusczyk (1986) study described earlier, to reconcile their findings with studies that stress the role of the syllable, they argued that their task may have tapped a less explicit level of awareness than, for example, the segmentation or manipulation tasks that are more commonly used. Walley, Smith, and Jusczyk propose that the syllable may play a special role only in the context of certain types of phonological awareness tasks that require more explicit, or conscious, awareness. Dowker (1989) echoes this theme, noting that spontaneous rhyming and alliterative ability, although forms of phonological awareness, are clearly not identical to the ability to carry out specific requirements in phonological awareness tasks. She also cites Lundberg (1978) as stressing the differences between the implicit level of phonological awareness implied in spontaneous sound play and the explicit level tapped in traditional phonological awareness tasks that require conscious analysis of words into their constituent elements. In sum, although there has been considerable evidence that preschoolers are sensitive to both the syllable and the word rhyme, most of the support for each comes from very distinct traditions of methods. This circumstance makes it difficult to bridge the approaches and to ascertain which phonological unit, the syllable or

the rhyme, is easier for young children to discover and which theoretical perspective, syllable-based or word-based, is supported.

GOALS

Asking whether initial phonological awareness conforms with syllabic structure or word structure, our first goal was to make a direct comparison between children's awareness of the syllable and the word-level rhyme, using comparable methods. A second question relating to the role of syllabic structure in metaphonological development concerns whether syllable rimes function as constant linguistic units. To address these questions, we designed a study of four- and five-year olds' sensitivity to three different kinds of phonological units: Rhyme, Syllable, and Rime. These units were presented in disyllabic words so that syllable status could be distinguished from word-level factors. Playing a puppet game, children were asked to judge whether pairs of words shared some of the same sounds.

The Rhyme condition assessed children's ability to identify word pairs that share the stressed vowel and the rest of the word. Half of the items in this condition rhymed only within the second syllable (e.g., sa*loon*-ba*boon*) and an equal number rhymed from immediately following the word onset (e.g., m*ountain*-f*ountain*). Thus, an attempt was made to control for the effects of position of the rhyme. However, it is acknowledged that in items such as m*ountain*-f*ountain*, larger shared segments (i.e, longer strings of phonemes) as well as multiple shared linguistic units (i.e., syllables as well as rhymes) are included, raising the possibility that more than one factor may contribute to the children's performance on this subcondition.

The Syllable condition measured children's awareness of syllables. Half of the items consisted of word pairs that share the first syllable (e.g., *gar*den-*gar*lic) and half consisted of word pairs sharing the second syllable (e.g., tea*cher*-na*ture*).

Finally, the Rime condition examined children's awareness of syllable rimes that are in the stressed but initial syllable (e.g., pe*ncil*-te*nder*) and syllable rimes that are in the final but unstressed syllable of disyllabic words (e.g., wiz*ard*-sheph*erd*). The goal in limiting the syllable rime stimuli to these types of pairs was to avoid, for purposes of comparison, syllable rime pairs that are also word rhymes (i.e., for disyllabic words, rimes occurring in the final, stressed syllable). All items in the Syllable and Rime conditions were made up of words in which the first syllable was

stressed in order to keep the permutations of conditions to a practical number and to minimize confounding these conditions with rhyme.

By employing these three conditions, we hoped to gain information about factors contributing to the development of phonological awareness. If the hypothesized syllabic hierarchy within the word is the basis for explicit phonological awareness, all other things being equal, the primary unit that children would become aware of would be the syllable. Performance on the rhyme condition in which more than a syllable is shared (e.g., *mountain-fountain*) might be expected to be even better than performance on shared single syllables (e.g., *gar*den-*gar*lic), but one would anticipate full-shared syllables to be more salient than shared partial syllables (e.g., Syllable: tea*cher*-na*ture*; Rhyme: sa*loon*-ba*boon*). If, instead, children are more successful in the Rhyme condition than in the Syllable condition, especially when the number of phonemes are equal, this outcome would support a word-based unit as the easier subword level of analysis, rather than a syllable-based unit. A stringent test of this hypothesis would predict that Rhyme would be more salient than Syllable even when the two are matched for stress and length, as in *gar*den-*gar*lic versus sa*loon*-ba*boon*.

The second test of the importance of the syllable-onset-rime hierarchy in the development of phonological awareness will come from a comparison of the Rhyme and Rime conditions in the second syllable (e.g., sa*loon*-ba*boon* vs. wi*zard*-she*pherd*). As noted above, in both cases the shared material constitutes rimes. If syllable structure is the overriding factor, no difference would be expected on these two conditions. If, instead, the rhyming items are easier for the children, this too would suggest that word-level factors are important.

Our study was designed to examine the impact of structural units (i.e., the syllable and the rhyme) in phonological awareness, working under the assumption that linguistic organization provides the basis for the development of metaphonological awareness. We acknowledge, however, that other linguistic factors, specifically size and stress, may prove to be more relevant. In coming to appreciate that words have sounds in common, it may be easier for a child to notice larger chunks of shared information than smaller chunks; that is, a child might recognize the shared sounds in *mountain-fountain* more easily than in sa*loon*-ba*boon*. Stress may also enhance accessibility, with children becoming aware of units with shared stressed vowels regardless of the size or status of the segment. So, for example, the stressed rimes in

sa*loon*-ba*boon* should then be more salient than full syllables that are unstressed (e.g., tea*cher*-na*ture*).

METHOD

Participants

The participants included 195 children (100 girls and 95 boys) from fifteen nursery schools, day-care centers, and private schools serving primarily middle-class children. They included 102 children in the four-year-old group (mean age = 54.22 months, *SD* = 3.31, range = 46-59 months) and 93 five-year olds (mean age = 64.14 months, *SD* = 3.38, range = 60-71 months).

A total of 249 consent forms were returned. Seven children did not choose to participate, and two who did would not speak to the examiner; these nine children therefore could not be included in the study. Certain eligibility requirements eliminated six additional children: four children who spoke languages other than English as their primary language and two who had diagnosed hearing problems. (Information regarding primary language spoken in the home and hearing problems was gathered from a parent questionnaire returned with consent forms.) An additional 39 did not pass a pretest demonstrating understanding of the task requirements. This is discussed further below. The remaining 195 children met all the criteria for participation in the study. One additional piece of information, the educational level of subjects' mothers, was monitored, not for screening purposes, but to allow a closer examination of whether the children in the different conditions came from comparable home environments. This particular variable was assessed because the educational background of the mother appears to be related to children's language development (e.g., Snow 1991).

Each study participant served in one condition—Rhyme, Syllable or Rime. An effort was made to balance the number of children from each school participating in each condition, since schools and centers may differ in the emphasis of language activities, thereby facilitating development of phonological awareness to different degrees (Wilkinson 1991). Table I provides a summary of subject characteristics.

Measures

Phonological Awareness Pretest. A brief training procedure, drawn from the method used by Treiman and Zukowski (1991), introduced the child to a pretest. It was explained and demonstrated

Table I. Subject Characteristics by Age and Condition

	Condition	*n*	Females/ males	Mother education[a] (Mode)	Age, in mos. M	(*SD*)	Age range
Four-year-old group	Rhyme	34	16/18	5	53.68	(3.60)	46-59
	Syllable	35	22/13	5	53.66	(3.04)	49-59
	Rime	33	18/15	4	53.36	(3.05)	48-59
	Total	102	56/46	5	53.57	(3.23)	46-59
Five-year-old group	Rhyme	31	12/19	4	65.10	(3.29)	60-71
	Syllable	31	20/11	5	63.19	(3.43)	60-71
	Rime	31	12/19	5	64.13	(3.24)	60-71
	Total	93	44/49	5	64.14	(3.32)	60-71
All conditions, both age groups		195	100/95	5	58.61	(3.27)	46-71

[a]Based on a scale in which 1 = some high school; 2 = high school graduate; 3 = some college; 4 = college graduate; 5 = graduate or professional school

that the puppet held by the examiner was "happy" when it heard words that had some of the same sounds (*cat-sat*), but "sad" when it heard words that did not have any of the same sounds (*bed-rake*). The child had to listen to pairs and say if they make the puppet "happy" or "sad." If the child did not seem to understand, further examples were given. The child's understanding was then tested using four word pairs (*bay-ray*, *more-pack*, *land-sand*, and *lake-grass*). (All of the word pairs presented in the pretest and in the other conditions were spoken by the examiner with care being taken to pronounce the designated portions in the same way.) Children who answered three of the four test items correctly proceeded to one of the three conditions of the phonological awareness task described below. Children who did not pass the pretest were praised and thanked for participating in the study, and escorted back to the classroom. A total of 39 children failed to pass the pretest. More four-year olds ($n = 32$) than five-year olds ($n = 7$) did not pass the pretest, X^2 (1, $n = 39$) = 7.42, $p < .05$. (See Appendix A for summary characteristics of those who did not pass.)[5]

[5]Initially, the examiner immediately proceeded to the four pretest items following one positive and one negative example. However, this protocol resulted in a large portion of subjects (19 of the first 68 subjects, or 28 percent) not passing the pretest. The reason for this appeared to be related, in large part, to a lack of comprehension of the task. It was at this point that we changed the protocol to allow for additional pretraining for those who did not appear to understand the task (i.e., up to four additional pairs of examples were presented). Whether or not subjects displayed understanding of the four additional examples, the examiner proceeded to the pretest items. Following these changes in procedure, an additional 127 children were tested. Twenty children out of 127 (16 percent) failed both the six training examples and the pretest, and were thus eliminated from the study.

Phonological Awareness Task. This task, consisting of eighteen trials, followed the same format as the pretest described earlier. Prior to each of the conditions, four examples (two positive pairs and two negative pairs) were given to demonstrate to the child what kinds of words made the puppet happy or sad. (Examples of positive items: Rhyme condition—n*umber*-l*umber*, cart*oon*-racc*oon*; Syllable condition—*car*go-*car*pet, bu*gle*-wi*ggle*; Rime condition—*far*mer-*gar*lic, leop*ard*-haz*ard*). The examiner then presented the word pairs, asking the child to indicate after each pair whether the puppet would be happy or sad. The positive and negative items were presented in a single randomized order. (See Appendix B for a full list of the test items in each of the three conditions.) Four scores were calculated for each child: (1) number of the negative trials correctly eliciting a "sad" response (maximum = 6); (2) the number of pairs correctly judged for items sharing 'sounds' at the beginning of the word (maximum = 6); (3) the number of trials correctly judged as sharing sounds in the second syllable of the word (maximum = 6); and (4) the sum of these accurate responses to positive trials (maximum = 12).

Prereading/Reading Tests. Reading and letter knowledge were assessed to determine whether the reading skills of the children were comparable across the three conditions and between age-groups. Measuring reading skills also allowed us to evaluate the relationship between reading level and phonological awareness as measured in the current study. Selected subtests from the Woodcock Reading Mastery Tests-Revised (WRMT-R), Form G (Woodcock 1987) were administered to each child, including Letter Identification (the supplementary letter checklist that includes capital and lower case letters), Word Identification (i.e., reading real words), and Word Attack (i.e., reading pseudowords). Raw scores were used for data analyses.

Procedure

Each child was tested individually in a single 10-minute session by the first author in a quiet space in his or her school or center. The session began with the pretest. Next, nine trials of one of the phonological awareness tasks were administered to each child who passed the pretest. In order to avoid the children becoming bored with the task, we then changed activities and administered the prereading/reading assessment. Then, after a brief review of the "puppet game," the child was given nine more trials of the phonological awareness task. The order of the first and second nine items was alternated with each child. A pilot study had confirmed that the test procedure was suitable for four-year olds and five-year olds.

RESULTS

First, a series of analyses of variance were conducted to obtain pertinent information regarding comparability of experimental groups on background variables. No significant differences were found across the three experimental conditions for mothers' education, age of subjects, or reading ability. (See table II for a summary of reading scores for the two age groups). As one would anticipate, there was a significant effect of age on reading attainment for Letter Identification, $F(1,189)= 13.78$, $p < .05$; for Word Identification, $F(1,189) = 6.82$, $p < .05$; and for Word Attack, $F(1,189)= 4.23$, $p < .05$. Likewise, children designated "readers" (i.e., those with a score of at least three on the Word Identification subtest, $n = 34$) performed significantly better on the phonological awareness measures than did the other participants, $F(2,189) = 39.87$, $p < .001$). However, there was no interaction between reading ability (readers versus nonreaders) and condition (Rhyme, Syllable, and Rime).

Having established that the subjects included in the different conditions were comparable with respect to potentially relevant variables such as reading skill and age, it was next of interest to examine accuracy as a function of condition (Rhyme, Syllable, Rime) and of position of the shared unit (i.e., first or second syllable). At the same time, the data were analyzed to determine whether age had an effect on scores. (Table III provides mean scores for each condition, by age group.)

To ascertain whether children performed differently on the three conditions, three 2 X 3 (Age X Condition) Anovas were carried out using: (1) the scores for the positive trials (i.e., when the pair "shared sounds"); (2) the scores for the negative trials (i.e., when no "sounds" were in common); and (3) the total score (i.e., a combined score for the positive and the negative pairs). For all three sets of scores, significant condition effects were obtained: Positive, $F(2,189) = 28.96$, $p < .0001$; Negative, $F(2,189) = 9.28$, $p < .0001$; Total, $F(2,189) = 39.75$, $p < .0001$. Follow-up analyses

Table II. Woodcock Reading Mastery Test-Revised Subtest Scores[a] by Age-Group

		Letter Identification		Word Identification		Word Attack	
	n	M	(*SD*)	M	(*SD*)	M	(*SD*)
Four-year olds	102	29.56	(16.52)	1.00	(5.27)	.21	(1.50)
Five-year olds	93	37.69	(13.70)	3.94	(9.91)	.99	(3.46)

[a]Raw scores for the number correct.

Table III. Phonological Awareness Scores for Each Condition, by Age-Group

Condition	Age Group	Positive[a] Pairs		Negative[b] Pairs	
		M	(SD)	M	(SD)
Rhyme	4	10.50	(2.23)	5.35	(1.07)
	5	10.35	(2.59)	5.42	(1.26)
Syllable	4	8.34	(2.29)	4.49	(1.74)
	5	8.80	(3.11)	5.23	(0.96)
Rime	4	6.52	(3.42)	4.06	(1.73)
	5	6.74	(3.20)	4.45	(1.80)

[a]maximum score = 12

[b]maximum score = 6

(Fisher's Protected LSDs) yielded significant differences between all three conditions (Rhyme, Syllable, Rime) for each of the three types of scores (Positive, Negative, Total). Performance in the Rhyme condition was significantly better than in the Syllable condition, and performance in the Syllable condition was significantly better than in the Rime condition. As one might anticipate, when the targeted "shared sounds" were easier for children to discern, the absence of a shared constituent was likewise recognized more easily. Accordingly, performance on the Negative trials complemented the performance on the Positive trials.

Age effects were not obtained for either the Total scores (four-year-old mean = 12.99; five-year-old mean = 13.66) or for the Positive pairs (four-year-old mean = 8.45; five-year-old mean = 8.63), nor were there age by condition interactions. However, on the Negative items the less accurate performance by the four-year olds was marginally significant (four-year-old mean = 4.63; five-year-old mean = 5.03), $F(1,189) = 3.76$, $p = .054$, though there was not a significant age by condition interaction.

We were somewhat surprised that the group scores for the five-year olds were not significantly greater on the Total or Positive Scores than the scores for the four-year olds. One possibility was that there was not a sufficient difference in age between the two groups. Due to a high concentration of older four-year olds and younger five-year olds in our sample, only a four month gap was present between the modal ages of the children in the two age groups. To see if the small difference in age was responsible for the lack of an age effect, a follow-up analysis of variance was performed on the Total scores using only the younger four-year olds (46 to 54 months, $n = 57$) and older five-year olds (64 to 71 months, $n = 41$). Still, no age effect was found. We suspect that this was because the selection procedure eliminated many four

year olds who could not do the pretest; we project that if our task had required the child to isolate phonemes, an age effect would have been found. The present study targeted only awareness of larger phonological components.

It was next of interest to determine whether the ease of detecting shared similarities of a phonological unit was influenced by whether it occurred in the first or second syllable of a word. A 2 x 3 x 2 repeated measures design was employed to analyze whether there was a significant difference between performance on items involving shared units in the first syllable and items involving shared units in the second syllable. Positive scores on the two different positions served as within-subjects factors, and the three conditions and two age-groups served as between subjects factors. Again, we obtained a significant condition effect, $F(2,191) = 29.38$, $p < .0001$, no age effect, and no age by condition interaction. The new focus in this analysis was on the effects of position. A significant Position effect was found, $F(1, 191) = 3.94$, $p < .05$, as was a Position by Condition interaction, $F(2,191) = 5.28$, $p < .01$. (Age did not interact with Position). Simple effects tests demonstrated a significant position effect for the Syllable condition, but not for the Rhyme and Rime conditions. In the Syllable condition, children in both age groups scored higher on trials involving words that shared the first (stressed) syllable (e.g., *gar*den-*gar*lic) than on pairs sharing the second (unstressed) syllable (e.g., tea*cher*-na*ture*).

In order to assess whether children's patterns of performance reflect word-based or syllable-based organization, we next focused on comparisons across subconditions using follow-up Fisher protected LSD tests. In first position subconditions, Rhyme (e.g., m*ountain*-f*ountain*) was significantly easier than Syllable (e.g., *gar*den-*gar*lic), which, in turn, was significantly easier than the Rime subcondition (e.g., *pen*cil-*ten*der). In second position, children more accurately identified Rhymes that are portions of syllables (e.g., sal*oon*, bab*oon*) than they did fully shared Syllables (e.g., tea*cher*, na*ture*). Because that advantage might be attributed to stress differences, we also did one non-orthogonal comparison using a *t*-test to examine how performance on second syllable rhymes (e.g., sal*oon*-bab*oon*) compared to performance on first position (stressed) syllables (e.g., *gar*den-*gar*lic). The Rhyme task was again found to be easier ($t(129) = -2.03$, $p = .04$), despite the fact that the syllable stimuli were stressed and necessarily incorporated the word onset. Paralleling the results for the first position subconditions, children did significantly better on the second position Syllable pairs (e.g., tea*cher*-na*ture*) than on the second position Rime stimuli (e.g., shep*herd*-haz*ard*). A further comparison concerned rhymes versus rimes in second syllable position

(e.g., sa*loon*-bab*oon* vs. shep*herd*-haz*ard*). Here again, a Fisher Protected LSD test confirmed a significant advantage for the Rhyme items, supporting the need to differentiate between different kinds of rime units.

Lastly, because we observed a trend for rhymes following the onset (e.g., m*ountain*-f*ountain*) to be easier for the children than rhymes at the end of the word (e.g., sa*loon*-bab*oon*), we were interested in whether unit size may have exerted an influence on the pattern of results. The stimuli were not designed to control for this and we wanted to check the extent to which the results mirror the relative size of the stimuli in the six subconditions (Rhyme, Syllable, and Rime in first and second syllables). To assess unit size, the number of phonemes in the shared segments were tallied. Long, stressed vowels were counted as two phonemes (e.g., /iy/ in caff*eine*-mach*ine*). Since there is some debate as to whether syllabic /r/, /l/, and /n/ (e.g., as in napk*in*-gard*en*) constitute one phoneme (e.g., n) or two (e.g., ɛn), unit size was calculated both ways. (Table IV provides subconditions and phonological awareness scores listed in the order of unit size.) Spearman r correlations between the mean number of phonemes per unit and the phonological awareness scores yielded a coefficient of .72 when the "one-phoneme" method of counting syllabic phonemes was used and a correlation

Table IV. Subconditions Listed in Order of Unit Size, Phonological Awareness Scores[a], and Rank Order of Mean Phonological Awareness Scores

A. Syllabic /r/, /l/, and /n/ counted as *one* phoneme

Subcondition	Mean # of Phonemes	Mean Phonological Awareness Score	Rank Order: Phonological Awareness Scores
Rhyme—Position 1	3.83	5.28	1
Syllable—Position 1	3.17	4.61	3
Rhyme—Position 2	3.00	5.15	2
Syllable—Position 2	2.33	3.92	4
Rime—Position 1	1.83	3.23	6
Rime—Position 2	1.67	3.39	5

B. Syllabic /r/, /l/, and /n/ counted as *two* phonemes

Subcondition	Mean# of Phonemes	Mean Phonological Awareness Score	Rank Order: Phonological Awareness Score
Rhyme—Position 1	4.83	5.28	1
Syllable—Position 1	3.17	4.61	3
Syllable—Position 2	3.17	3.92	4
Rhyme—Position 2	3.00	5.15	2
Rime—Position 2	2.33	3.39	5
Rime—Position 1	1.83	3.23	6

[a]on Positive Trials

of .63 for the "two-phoneme" method. These values demonstrate a strong positive relationship between these two factors. That is, in general, the greater the number of phonemes in the shared units, the higher the phonological awareness scores. Yet, there were interesting exceptions that will be noted in the discussion.

Hierarchical multiple regression was used to determine if the condition variable (Rhyme, Syllable, Rime) improved the prediction of phonological awareness scores beyond that predicted by length. Several analyses were carried out with similar patterns of results. We present here the results of only the most stringent test. In that test, in order to hold stress constant, phonological awareness of the first position subconditions was the criterion variable. In these subconditions, all 18 pairs shared a stressed vowel in the first syllable (e.g., m*ountain-fountain*, *gar*den-*gar*lic, p*encil-ten*der). To be on the conservative side, we employed the one phoneme method of calculating length, as it had correlated more highly with performance than had the two phoneme method. Using this technique, length accounted for 62% of the variance when it was entered first and condition accounted for an additional 17% of the variance: the r^2 change value was significant, $F(1,16) = 14.19$, $p < .001$. In contrast, when condition was entered first, it accounted for 79% of the variance; no further variance was accounted for by length.

DISCUSSION

Linguistically motivated research on early phonological awareness has demonstrated that awareness of the syllable unit emerges before awareness of the subsyllabic units of onset and rime. Other research, however, looking at language play and language awareness from a developmental perspective, has documented the ability to recognize and produce rhymes in children as young as two years of age. The present study was motivated by these developmental findings to reconsider the role of the syllable in emerging phoneme awareness. We asked, too, whether rimes, as a hypothesized sub-unit of syllables, function as constant units of phonological awareness. That is, we investigated whether the evidence for the rime obtained with monosyllabic words would hold up if multisyllabic stimuli were used in which rimes can be presented in both stressed and unstressed syllables. Four-year-old and five-year-old children were tested on phonological awareness in three conditions using disyllabic stimuli: Rhyme, Syllable, and Rime. Our results indicate that word-level rhymes are particularly salient for

young children, much more so than are syllables and syllable rimes.

Concerning the relative ease of Rhymes versus Syllables, Rhymes were significantly easier to detect both for first and second syllable position comparisons. The results for pairs sharing elements in the first syllable (e.g., *mountain-fountain* vs. *gar*den-*gar*lic) are interesting because they suggest that rhyme is even easier than word onset for young children to detect. In addition, the findings for the second syllable pairs (e.g., sa*loon*-ba*boon* vs. tea*cher*-na*ture*) are compelling because the portions of the words shared in the Rhyme and Syllable stimuli were fairly comparable in length, indicating that the relative ease of the Rhymes was not simply a function of size. The salience of rhyme is further indicated by the finding that second syllable Rhymes (e.g., sa*loon*-ba*boon*) were even easier for children to recognize than were (stressed) Syllables shared at the beginning of words (e.g., *gar*den-*gar*lic). This result would be problematic for an analysis based strictly upon hierarchic linguistic units: in linguistic terms it would mean the stressed rime (e.g., sa*loon*-ba*boon*) is more salient than the stressed syllable. The outcome with this experimental measure corroborates the previous observational data obtained with young children demonstrating the early accessibility of rhyme (e.g., Dowker 1989) and supports the claim that rhyme awareness is the earliest stage of metaphonological development (e.g., Bryant et al. 1990).

Our evidence also underscores difficulties with positing rime as a constant unit of subword analysis. In the present study, the use of disyllabic stimuli allowed the differentiation of stressed and unstressed rimes (e.g., Rhymes vs. Rimes), yielding strikingly different results. Thus the Rhymes and Rimes in second syllable position (e.g., sa*loon*-ba*boon* vs. shep*herd*-ha*zard*) both constitute rimes, yet they were designed to differ in stress. The children's performance on the unstressed Rimes was significantly worse. Comparison of Rhymes and Rimes in the first syllable position (e.g., m*ountain*-f*ountain* vs *pen*cil-*ten*der) makes a different point. In this contrast both targets incorporate stressed vowels, but the shared portion in the Rhymes constitutes a word-level rhyme, extending to the final word edge, while in the Rime stimuli the shared portion was restricted to the first syllable. As anticipated, performance on the Rhyme stimuli was much superior.

These results confirm doubts, raised in Treiman and Zukowski (1991), about the adequacy of the syllabic hierarchy as a framework for explaining the acquisition of phonological awareness. As noted in our introduction, Treiman and Zukowski (1991) observed comparable performance on full syllables and on parts of syllables

(e.g., re*treat*, en*treat* vs. acc*laim*, in*flame*), rather than obtaining the hypothesized advantage for the full syllabic units (see Treiman and Zukowski [1996] for a replication of this same result). We find a further exception to the syllable hypothesis in a study by Fox and Routh (1975), often cited as providing strong evidence for superior performance by young children on syllables versus phonemes. In the experiments reported in Fox and Routh, children were asked to "say a little bit of" a word. Fox and Routh describe two scoring procedures used for the syllable task (e.g., "say a little bit of *window*"): First, the number of words segmented in any way (e.g., "indow" or "o") and second, the number segmented at the conventional syllable boundary (e.g., "dow") (*our examples*). By age four, children were able to segment words according to the first procedure. However, the authors note that even the oldest children (seven-year olds) had not acquired accuracy using canonical syllabification. Surprisingly, these older children were *more* accurate on the phoneme segmentation task than on canonical syllable segmentation, and the syllable task proved to be an even more potent index of reading skill. In other studies purportedly demonstrating syllable awareness, the children are asked only to tap out the correct number of syllables (e.g., Liberman et al 1974; Mann and Liberman 1984). We speculate that children may base their responses on the salient portions of speech signals associated with the vowel nuclei rather than on canonical syllables. Read (1978) likewise comments that, " the syllable . . . has resisted satisfactory delimitation, but there is a simple acoustic criterion for the number of syllables, if not for their boundaries" (p. 73). In short, the apparent consistency in the prior literature concerning the relative ease of segmentation tasks may have stemmed from an overreliance on monosyllabic stimuli in which multiple factors are confounded and on the use of measures for which the interpretation is ambiguous. Consequently, even before the present results, the case for the primacy of the syllable was questionable.

Further evidence that rhyme awareness precedes awareness of syllables derives from several prediction studies reporting that syllable measures in kindergarten are better predictors of later reading success than are measures of rhyme. We speculate that this may be a function of the fact that rhyme awareness is generally at ceiling by this age (e.g., Bowey and Frances 1991; Stanovich, Cunningham, and Cramer 1984). In contrast, syllable and phoneme segmentation are good predictors because awareness of these elements is still developing in kindergarten.

Three caveats are necessary here. First, it must be noted that not all children have achieved rhyme awareness in the preschool

years. For example, in our study, a sizeable proportion of four-yea olds were not able to pass the pretest that involved a simple rhym task. Similarly, rhyme awareness may not yet be acquired b kindergarten children who are disadvantaged or language delaye (e.g., Brady et al. 1994; Lonigan et al. 1998; Robertson 1997 Warrick and Rubin 1992). Hence, rhyme may prove to be a sensi tive predictor in younger or at-risk groups of children.[6] The secon caveat relates to the particular measure itself and the developmen tal age of the child. As the discussion of the Fox and Routh (1975 research implied, the nature of a syllable task will influence th stage at which children can carry it out successfully. Therefore, th success of different measures for prediction purposes will depen upon both the developmental level of the children assessed an upon the actual task employed (cf., Bowey and Frances 1991) Third, we also need to qualify our conclusions, stressing that the pertain only to the development of phonological awareness fo children who speak English. One would anticipate that for lan guages organized in terms of different structural principles tha those for English, emerging awareness of the phonological struc ture would differ accordingly (Caravolas and Bruck 1993). For ex ample, in languages such as French that are syllable timed (Cutle et al 1986), syllable organization may play a more pivotal role i metaphonological development.

Explaining the salience of word-level rhyme

Because the results obtained in this study highlight the earl salience of word-level rhyme, at least for English, it is now wort considering the basis for the early recognition and production o rhymes by young children. Two possibilities come to mind, an both may apply: first, rhymes may constitute a structural unit ger mane to linguistic processing; and second, rhymes may incorpo rate other attributes such as stress, unit size, and word positio that may help focus attention and heighten the detectability o rhyme. We will consider each of these in turn.

In the introduction, we presented a view that intra-wor analyses are based on word-level organization rather than or syllable-based organization, with special status accorded to th word-onset (Browman and Goldstein 1990; Shattuck-Hufnage

[6]For younger or at-risk groups, the development of phonological sensitivity is likely to be at an earlier stage. Research with older reading-disabled children con firms that their phoneme awareness skills are comparable to those of younger read ing-age matched participants (Metsala, 1999).

1987). Although the rhyme has not been discussed as a candidate for a word-level unit, one could argue that the rhyme constitutes the structural subdivision of the word complementing the word onset or, to be more accurate, the stressed onset. We are intrigued with this possibility. The evidence that children can not only detect rhymes, but can also generate rhyme patterns (e.g., Dowker 1989), may indicate an appreciation of the overall structure of the rhyme unit.

If rhyme and onset are important linguistic units for young children, it does not appear to be the case that the child discovers them simultaneously. As noted in the introduction, research on children's speech indicates that the onset is somewhat late to develop as a salient unit of word organization especially if the first syllable is not stressed. For example, when producing multisyllabic words, it is common for young children to drop the portion of the word including the word onset and to preserve the second, stressed syllable, incorporating the rhyme (e.g., /raef/ for giraffe) (e.g., Echols and Newport 1992). Correspondingly, it does not appear that the word onset is available at a metalinguistic level to young children at as early an age as rhyme is. As Treiman and Zukowski (1991) reported, shared rimes (in fact, rhymes) tend to be easier to recognize than are shared onsets. This outcome is consistent with studies reporting that the ability to detect word onset emerges later than sensitivity to other phonological segments such as rhymes and syllables (e.g., Stanovich, Cunningham, and Cramer 1984; Treiman and Zukowski 1991). Although the present study did not explore the availability of word onsets to young children, one result was telling. We found both Rhyme subconditions (e.g., *mountain-fountain*; *saloon-baboon*) to be easier than even the first stressed Syllable (e.g., *garden-garlic*), despite the presence of a word onset in the Syllable condition.

Although less accessible than the rhyme, the word onset (when it is a single phoneme), does seem to be the easiest single phoneme within the word for children to isolate and identify. As mentioned in the beginning of this chapter, the frequent use of alliteration in children's literature and the spontaneous use of alliteration by young children indicate the salience of the word onset even before formal instruction in reading has begun. Likewise, tasks requiring segmentation between the word onset and the remainder of the word have been found to be strong predictors in kindergarten of subsequent success in reading (e.g., Share et al. 1984). In short, the literature on early phonological development and on the emergence of phonological awareness has numerous indications that word level rhymes and onsets are relevant linguistic

units for young children. We submit that the rhyme and onset ca plausibly be viewed as word-based structures. Yet, it appears tha the rhyme may play an even more central role in early lexical orga nization, and that it is available as a metalinguistic unit at an ear lier age.

The alternative explanation for children's superior perfor mance in the Rhyme condition rests on other linguistic factors, in cluding stress, duration, and position. We did not set out to evaluate the role these factors might play so the stimuli have shortcomings for addressing these issues. With this caution in mind, we will first consider whether the impact of the stressed vowel, with its attendant acoustic salience, explains the results. Clearly, performance on pairs sharing stressed segments tended to be superior. The three easiest conditions (the two Rhyme subconditions and the first syllable subcondition) all included the stressed vowel. Within the Rhyme condition, no significant difference was found between the first and second position rhymes, demonstrating the salience of rhyme (or the stressed vowel) independent of the size of the shared segment. In the Syllable condition, children performed better when the shared unit was the first (stressed) syllable (e.g., *gar*den-*gar*lic), rather than the second (unstressed) syllable (e.g., tea*cher*-na*ture*). Similarly, Treiman and Zukowski (1991) failed to obtain a position effect for syllables when stress was balanced across first and second positions, or, in Treiman and Zukowski (1996), an effect for syllables when stressed final syllables were contrasted with stressed rimes (rhymes) in the final syllable. Both outcomes support our interpretation that the difference in detectability found in the present study was due to stress.

Further evidence consistent with the stress account is the comparison of performance on Rhyme versus Rime measures. Children performed significantly better on items involving shared rhymes in the second portion of the word than on shared rimes in the same position. Given that stress constitutes a major contrast in this comparison, a strong case can be made for the impact of the stressed vowel on the salience of phonological segments. As mentioned above, this particular effect raises a question regarding the generalizability of the concept of rime. The English language, with numerous multisyllabic words, necessarily includes many rime units that are unstressed, and these are apparently less accessible than those that are stressed.

However, one outcome from the present study hints that rhyme status, and the corresponding availability of rhyme units, goes beyond the presence of a stressed vowel. Performance on the

Rimes in first position (e.g., *pen*cil-*ten*der) was fairly low, despite the fact that a stressed vowel was incorporated in the shared segment. We are also struck by the evidence that even very young children can sometimes generate rhyme patterns, indicating an appreciation of the overall structure of the rhyme unit, not merely the stressed vowel (Dowker 1989). It is even possible that rhyme generation may precede a consistent ability to recognize rhyme patterns in a formal task.

A second factor that appears to influence early phonological awareness performance is the size of the shared portion. Strong correlations between number of shared phonemes and phonological awareness scores were obtained for both of the methods of counting phonemes. In addition, in multiple regression analyses, length accounted for a large portion of the variance in phonological awareness scores. This pattern is in agreement with the findings from other studies (e.g., Treiman and Zukowski 1991; Walley, Smith, and Jusczyk 1986) that support the number of segments in common as one of the factors affecting performance on phonological awareness tasks. On the other hand, it was somewhat surprising that no significant difference was observed between performance on the rhymes beginning in the first syllable and on those in the second syllable, despite the notable size difference. Either a ceiling effect may be obscuring the distinction between these two subconditions or the salience of the rhyme/stress may override the effect of unit size. Other results, described earlier, indicate that unit size alone is not the major determinant of the results obtained (see also Treiman and Zukowski [1996]). For example, awareness scores were significantly better on second position Rhymes than on the second position Syllables, though a comparison of mean number of phonemes in each demonstrates that the items making up rhymes in the second position contained equal or fewer phonemes. Similarly, the mean number of shared phonemes in the Rhyme and Rime conditions in the second position was nearly the same, yet performance on these subconditions was markedly different. In multiple regression analyses, entering length first (with stress constant across conditions), a significant amount of variance was accounted for by linguistic status (Rhyme, Syllable, Rime). These results point to the impact of rhyme as a salient unit, beyond quantity of shared material.

One difficulty in evaluating the role of size concerns the issue of how size should be estimated. Here we defined it as the number of shared phonemes and ran into problems with how phonemes are to be counted. A further possibility is that it is not the number of shared phonemes that is relevant, but the actual duration of the

shared portions.[7] Should duration turn out to be the relevant dimension, several predictions would follow about what kinds of phonemic patterns young children first acquiring phonological awareness should find easier to detect. For example, rhymes containing long vowels before voiced consonants (e.g., *made-spade*) might be notably easier than those with short vowels before voiceless consonants (e.g., *hit-mit*).

A third possible factor relates to position within the word. We have already mentioned the accessibility of word onsets for young children, as indicated by alliteration. There are several reasons to think that word final position is also salient to young children. For example, as noted in the introduction, teachers have long observed that beginning readers and spellers often perform better on the ends of words than on the middle position (ig., spelling "bd" for *bed*), indicating the relatively easier detection of word edges (Treiman 1993; see also Treiman et al. 1995). Similarly, recent studies of language production (Echols 1993; Echols and Newport 1992) report that for spontaneous utterances and elicited imitations, very young children (under 2 years) more often pronounce the final portion of the word accurately, whether or not it is stressed. Similarly, Vihman's (1981) work on children's malapropisms finds that the preserved segments of words tend to be from the ends of the target items.

To illustrate how these various factors (stress, unit size, word position) may have interacted to influence performance, we charted factors present in each of the conditions we tested (see table V). The results clearly show a disadvantage for the Rime stimuli, mirroring the poor performance on the Rime condition. Looking at the confluence of factors for the Rhyme and Syllable conditions, the obtained pattern of results is again seen (i.e., rhyme > syllable) suggesting we need to further explore the role of these linguistic factors in the development of phonological awareness. To assess fully the basis for the advantage of rhymes, it would be necessary to create stimuli in which the linguistic unit and the other factors are manipulated independently. For example, would first syllable rimes (e.g., *pen*cil-*ten*der) be more easily detected if the size of the unit were increased (e.g., *sand*wich-h*and*some)? Similarly, though rhyme necessarily incorporates both the vowel and word final position, do young children just discovering rhyme perhaps find long rhymes easier to recognize than short rhymes?

[7] "Sonority" or "prominence" has been identified as a feature of stress carried by certain syllables. In a study of what acoustic attributes specify sonority, it was found that absolute duration of the stressed segment(s) is an important cue (Price1980).

Table V. Stimuli Characteristics in the Rhyme, Syllable, and Rime Conditions

Subcondition	Stress[a]	Word Edge[a]	Final Unit Size[b]	Total
Rhyme				
first position: m*ountain*-f*ountain*	1	1	2 (3)	4 (5)
second position: sal*oon*-bab*oon*	1	1	2 (2)	4 (4)
Syllable				
first position: *gar*den-*gar*lic	1	0	2 (2)	3 (4)
second position: tea*cher*-na*ture*	0	1	1 (2)	2 (3)
Rime				
first position: p*encil*-t*ender*	1	0	0 (1)	1 (2)
second position: wiz*ard*-shep*herd*	0	1	0 (0)	1 (1)

[a]Stress: a score of zero indicates the absence of stress, one indicates the presence. Word edge: a score of zero indicates the absence of a final word edge, one indicates the inclusion of a common word final edge. (Note, the decision to count only shared word final edges was based on the evidence mentioned earlier that these are salient to very young children, whereas there is little evidence of an advantage for word beginnings. If beginning word edges were included, only the score for the first position syllable condition would change.)

[b]In the first column, unit size is based on means for the one-phoneme method listed in table IV. In the second column (in parentheses), the two-phoneme method of counting is represented. For both, a size of four(+) phonemes was given a score of 3; a size of three phonemes was given a score of 2; a size of two phonemes was given a score of 1, and a size below two phonemes was given a score of 0. This arbitrary scoring system was chosen for the present purposes to reflect the distribution of size values without excessively weighting the contribution of unit size in comparison to the other word characteristics considered here.

In sum, the importance of phoneme awareness in reading development has raised interest in how children progress from lacking phonological awareness in their early years to attaining insights gradually about the phonemic structure of words. The results of the present study suggest that the syllable hierarchy hypothesis may not be the correct framework for explaining the early development of phonological awareness in English. They demonstrate that rhyme is an easier, and probably earlier, subword unit of phonological awareness for young children to identify. The present data, obtained using a phonological awareness measure, can be explained by two alternative though not incompatible accounts: (1) In accord with recent work on lexical organization, word-level units (i.e., rhyme) may warrant important status. (2) Certain properties of words (e.g., stress, size of shared segments) may facilitate children's abilities to analyze word structure. By either account, the results of this study point to the need to use the syllable/onset/rime terminology cautiously, particularly for monosyllabic words in which word-level units (word onset/rhyme) overlap with syllable-level units (onset/rime).

In practical terms, for very young children, activities that target rhyme and awareness of onsets (i.e., alliteration) appear to be sensible starting points for drawing attention to the sound structure of words. On the other hand, whether extensive instruction in rhyme is a necessary component of phoneme awareness instruction beyond the first month of kindergarten is yet to be resolved. At least two successful approaches to phoneme awareness instruction (Lindamood and Lindamood 1998; Ball and Blachman 1991) deliberately sidestep extensive rhyming games as unnecessary and as possibly even confusing their efforts in kindergarten or first grade to direct the child's attention to phoneme-level segments. Consistent with the sequence of development observed in our research, other programs begin with rhyming (including of multisyllabic words) as the earliest step, and then move on to segmenting of syllables and phonemes (Catts and Vartiainen 1993; Robertson and Salter 1997; Torgesen and Bryant 1994).

We have made considerably less progress regarding whether, where, and how to direct children's attention to the syllable structure of words. It clearly is not as "natural" as rhyming for the entry level to awareness, but it does seem a logical step in helping children to learn to segment words into the sublexical components (e.g., Fox and Routh 1975). For this goal, counting and clapping tasks are both engaging and apparently helpful. Yet, the role of the syllable in the development of awareness and in learning to read needs to be investigated further. It may be that awareness of syllables at an explicit level, as opposed to a grosser appreciation of syllabic gestures in the syllable counting or clapping tasks, pertains to the syllable division skills honed as English-speaking children move into reading multisyllabic words in second and third grades (e.g., Aronoff and Koch 1996; Johnson and Bayrd 1993; Stanback 1992).

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APPENDIX A
Summary Characteristics of Those Who Did Not Pass Pretest

Age-group	n[a]	Percentage of total given pretest	Females/ males	Mother Ed.[b] (Mode)	Age, in mos. M	(SD)
Four-year olds	32	14	9/23	5	52.31	(4.26)
Five-year olds	7	3	2/5	4.5[c]	64.43	(4.04)

[a]Fourteen of the four-year olds and five of the five-year olds were given the initial procedure. Eighteen of the four-year olds and two of the five-year olds were given the revised procedure.

[b]Based on a scale in which 1 = some high school; 2 = high school graduate; 3 = some college; 4 = college graduate; 5 = graduate or professional school.

[c]There were equal numbers of mothers at these two educational levels.

APPENDIX B

Test Stimuli[a]

Rhyme		Syllable[b]		Rime	
Rhyme Following Word Onset:		First (Stressed) Syllable Shared:		Rime in First (Stressed) Syllable:	
1. HANDLE	CANDLE	1. GARDEN	GARLIC	1. BARBER	MARKET
2. BUTTER	CUTTER	2. BARLEY	BARGAIN	2. BUILDER	SILKY
3. MOTION	LOTION	3. FURTHER	FURNACE	3. PENCIL	TENDER
4. DIMPLE	SIMPLE	4. BANJO	BANDIT	4. TURTLE	THERMOS
5. MOUNTAIN	FOUNTAIN	5. WINTER	WINDOW	5. PASTURE	BASKET
6. SOCCER	LOCKER	6. CRADLE	CRAYON	6. BISCUIT	WHISPER
Rhyme in Second Syllable:		Second (Unstressed) Syllable Shared:		Rime in Second (Unstressed) Syllable:	
7. SALOON	BABOON	7 GABLE	BABBLE	7. WIZARD	SHEPHERD
8. TONIGHT	POLITE	8. TEACHER	NATURE	8. CARRIAGE	LUGGAGE
9. MACHINE	CAFFEINE	9 CURTAIN	MOUNTAIN	9. EXPERT	CONCERT
10. BEHIND	UNWIND	10. STATION	LOTION	10. NAPKIN	GARDEN
11. GUITAR	BAZAAR	11. NOTICE	LETTUCE	11. PALACE	TENNIS
12. CEMENT	INVENT	12. WIZARD	HAZARD	12. WAGON	MELON
Nothing Shared:		Nothing Shared		Nothing Shared	
13. BUNNY	SUPER	13. CARROT	SIMPLE	13. WORKER	EMPTY
14. NUMBER	PILLOW	14. NUMBER	WAFFLE	14. NUMBER	DOLPHIN
15. WAFFLE	CIRCUS	15. DESERT	PILLOW	15. DESERT	PILLOW
16. SUMMER	BANJO	16. HANDLE	FOREST	16. FOREST	HANDLE
17. GIRAFFE	BEGIN	17. WELCOME	FANCY	17. ARTIST	WELCOME
18. THIRTEEN	CABOOSE	18. BANJO	SALAD	18. POWDER	BANJO

[a]Note the order of test items within each condition was randomized.

[b]Although, as discussed in the text, disagreement exists about the location of syllable boundaries, for this task, the experimenter was careful to pronounce the stimuli to conform to the boundaries indicated.

PREDICTION AND PREVENTION OF READING FAILURE

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