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Home literacy environment and phonological awareness in preschool children: Differential effects for rhyme and phoneme awareness

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ABSTRACT
The literature to date suggests that the best predictor of early reading ability, phonological awareness, appears to be associated with the acquisition of letter-sound and vocabulary knowledge and with the development of well-defined phonological representations. It further suggests that at least some aspects of phonological awareness critically depend upon literacy exposure. In this study of 4- to 6-year-olds, we examine whether aspects of the home literacy environment are differentially associated with phonological awareness. Parental responses to a questionnaire about the home literacy environment are compared to children's awareness of rhyme and phonemes, as well as to their vocabulary, letter knowledge, and performance on measures of phonological strength (nonword repetition, rapid naming skill, phonological distinctness, and auditory discrimination). The results showed that a teaching focus in the home literacy environment and exposure to reading-related media are directly associated with phoneme awareness and indirectly associated via letter knowledge and vocabulary. Exposure to reading-related media and parents' active involvement in children's literature were also directly and indirectly linked with rhyme awareness skills via their association with letter and vocabulary knowledge.

Although it is well documented that phonological awareness plays a central role in early reading achievement (Gottardo, Stanovich, & Siegel, 1996; Lyon, 1994; Mann, 1998; Muter, Hulme, Snowling, & Taylor, 1998; Stanovich, 1994; Wagner & Torgeson, 1987), less is understood about its development. Some lines of research place phonological awareness in the context of primary language development (e.g., Elbro, 1996; Fowler, 1991; Metsala, 1997), whereas others emphasize the role of alphabetic literacy (e.g., Mann & Wimmer, in press; Morais, Cary, Alegria, & Bertelson, 1979; Read, Zhang, Nie, & Ding,

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1986). In a previous paper (Foy & Mann, 2001) we concerned ourselves with the spoken language factors that relate to awareness about rhyme and phonemes, showing that phonological perception and production skills were more directly associated with rhyme awareness than with phoneme awareness. Specifically, we found that speech perception was closely associated with rhyme awareness measures when age, vocabulary, and letter knowledge were controlled and that children with a less developed sense of rhyme also had a less mature pattern of articulation, independent of age, vocabulary, and letter knowledge. Whereas phoneme awareness was associated with phonological perception and production and children with low phoneme awareness skills showed a different pattern of speech perception and articulation errors than children with strong abilities, these differences appeared to be largely a function of age, letter knowledge, and especially vocabulary knowledge.

In pursuit of some of the determinants of individual differences in phonological awareness, vocabulary knowledge, and letter knowledge, we have turned to examining the role of the home literacy and language environment. Prior to formal reading instruction, children's home literacy environments are modest predictors of later reading achievement (Bishop & Adams, 1990; Bus, van Ijzendorn, & Pellegrini, 1995; Catts, 1993; Cunningham & Stanovich, 1997; Magnusson & Naucler, 1993; Mason, 1997; Schuele & van Kleeck, 1987; van Kleeck, 1990), even in children with a family history of reading difficulties (Scarborough, 1991a, 1991b). Scarborough and Dobrich's (1994) meta-analysis of a large number of studies estimates the amount of variance in literacy development predicted by shared reading experiences to be about 8%. This link between the home literacy and language environment and later reading achievement raises the possibility that there are some specific associations between the home environment and the development of such prereading skills as letter knowledge, vocabulary, and ultimately, phonological awareness. As a necessary preface to our study of these associations, we begin with a brief review of the construct of phonological awareness before turning to the relevant literature on the home literacy environment and its relation to reading and some of the oral language skills. We conclude this preface with a brief presentation of three factors (phonological skills, letter knowledge, and vocabulary) that could mediate a relation between the home literacy environment and phonological awareness before continuing to the design of our study and its outcome.

PHONOLOGICAL AWARENESS: A UNITARY CONSTRUCT?

Recent evidence suggests that there are at least two separate dimensions to phonological awareness: the awareness of such larger units as onset–rime components or syllables and the awareness of such smaller units as individual phonemes (Hoien, Lundberg, Stanovich, & Bjaalid, 1995; Treiman & Zukowski, 1991). The dimensions of rhyme sensitivity and phoneme awareness differ in ease of learning and sensitivity to instruction exposure (e.g., Mann, 1986; Stahl & Murray, 1994; see Smith, Simmons, & Kameenui, 1998, for a review), and although there is considerable debate about which develops first, it is clear that they do not necessarily develop concurrently. Some researchers find that

awareness of larger units precedes awareness of smaller units such as phonemes (e.g., Bryant, MacLean, Bradley, & Crossland, 1990; Liberman & Shankweiler, 1985; Liberman, Shankweiler, Fisher, & Carter, 1974). However, research (Duncan, Seymour, & Hill, 1997; Seymour, Duncan, & Bolik, 1999) showing that explicit awareness of smaller units in fact precedes awareness of larger units, even in children with well-developed knowledge of larger units, is equally convincing.

It is also clear that different factors may be at stake in the development of the two different types of awareness. Although both syllable awareness and rhyming abilities are related to alphabetic reading ability (Bradley & Bryant, 1983; Mann & Liberman, 1984), rhyme and syllable awareness are more likely to develop spontaneously, in contrast to phoneme awareness, which most often depends upon formal reading instruction (for rhyme, see Dale, Crain–Thoreson, & Robinson, 1995; Johnston, Anderson, & Holligan, 1996; Smith et al., 1998; for syllables, see Mann & Liberman, 1984; Morais, 1991; Morais et al., 1979). Rhyme awareness is more strongly associated with speech perception than is phoneme awareness, which relates more strongly to age, vocabulary, and letter knowledge (Foy & Mann, 2001). Although phoneme awareness is the single best predictor of reading achievement during the early elementary school years, rhyme ability also relates to reading and emerges as an independent factor in the equation (Bryant et al., 1990; Hoien et al., 1995; Singson & Mann, 1999). In light of all of this evidence about the dissociation between the awareness of rhyme and the awareness of phonemes, the present study was designed to investigate the separate contribution of the home literacy environment to each of these types of awareness.

HOME LITERACY ENVIRONMENT AS A FACTOR IN LANGUAGE DEVELOPMENT AND EARLY READING ACHIEVEMENT

Three related aspects of the home environment have been discussed in the literature relating home literacy environment to reading achievement and to language skills known to support reading. These include shared reading experiences between the parents and children, parental beliefs about shared reading experiences and literacy, and the parents' own literacy experiences.

Shared reading experiences are recognized as providing significant opportunities for children to develop the language abilities needed for skilled reading (Chaney, 1994; Descovi & Baumgartner, 1993; Payne, Whitehurst, & Angell, 1994; Senechal, LeFevre, Thomas, & Daley, 1998; Snow, 1991; Snow & Dickinson, 1990; Whitehurst, Epstein, Angell, Payne, Crone, & Fischel, 1994). Shared reading in the home is also linked to receptive vocabulary in 3- to 6-year-olds (Senechal, LeFevre, Hudson, & Lawson, 1996) and in kindergartners (Jordan, Snow, & Porche, 2000). Such an impact on vocabulary is not surprising: shared book-reading experiences provide exposure to spoken language and increased opportunities to learn new vocabulary words (Elley, 1980). They also help to draw the children's attention to print and to facilitate the development of connections between prior experiences and the text (Shapiro, Anderson, & Anderson, 1997; Sulzby, 1986). Frijters, Barron, and Brunello (2000) showed

that in addition to predicting vocabulary, shared reading experiences, combined with other facets of home literacy (including parental knowledge of children's literature and reported feelings about literacy activities), also accounted for significant variance in letter-sound knowledge but not phonological awareness in kindergartners. Children with reading difficulties are also less likely to have had access to these shared reading experiences than children who are developing normal reading skills (Laakso, Poikkeus, & Lyytinen, 1999).

Differences in the home environment may be a product of differences in the beliefs or attitudes around which the parents center their interactions with their children. Consistent with this, parental attitudes and beliefs about the importance of early literacy exposure are moderately predictive of children's language skills (DeBaryshe, 1995; Donahue, Pearl, & Herzog, 1997; Greenberg & Crnic, 1988; Siegel, 1982; Sigel, McGillicuddy–Delisi, Flaugher, & Rock, 1983). Mothers' beliefs about their teaching roles are significantly associated with the teachers' ratings of prereading abilities of 4- to 5-year-olds (Dunn, 1981). In part, this may be due to the fact that parents who hold strong beliefs about the importance of early literacy exposure tend to practice what they preach, engaging in shared reading practices that are broader, more frequent, and more interactive with their children than parents who hold less strong beliefs (DeBaryshe, 1995).

It is also consistent that parents' own literacy practices have been related to their children's language and literacy development. Parental reading habits are associated with early reading skills in normally developing readers (Symons, Szuskiewicz, & Bonnell, 1996). Literacy-oriented parents also tend to provide home activities that expose their children to richer opportunities to learn about language and print than parents who are not literacy oriented (Scarborough & Dobrich, 1994). For example, they may take their children to the library more frequently (Briggs & Elkind, 1977) and have more books in the home (Share, Jorm, MacLean, & Matthews, 1984).

HOME LITERACY ENVIRONMENT AND PHONOLOGICAL AWARENESS

A relation between home literacy environment and phonological awareness is implied by research linking environmental factors to reading and reading to phonological awareness. To date, however, there are conflicting findings to reconcile. In some studies of beginning readers, both parental print exposure (i.e., title recognition; Symons et al., 1996) and parental reports of the quantity of shared reading predicted performance on both kindergarten and first grade onset–rime awareness (Senechal et al., 1998), where parental print exposure only predicted true phoneme awareness in kindergarten. Other research shows that first-grade children's print exposure (measured via a checklist of popular children's book titles given to the children) is significantly associated with orthographic processing skills but not with phonological processing skills per se (Cunningham & Stanovich, 1993). Perhaps mere exposure to literacy is insufficient for the acquisition of phonological awareness skills. Rather, some specific aspects of the exposure may be more critical, such as an emphasis on letter names or sounding out words. Consistent with this, Singson and Mann (1999)

showed that the parents of kindergartners who are precocious readers tend to expose their children to as many books as do the parents of nonreaders but place greater emphasis on sounding out the words in a text. Precocious readers, in turn, are distinguished from their nonreading peers by their superior phoneme and onset–rime awareness.

One reason why it may be difficult to see the effects of home literacy environment on phonological awareness is that they are mediated by other abilities. Researchers who have considered the development of phonological awareness in the preschool years have identified several antecedent factors, including strength of phonological representations (see, e.g., Elbro, 1990; Elbro, 1996; Elbro, Borstrom, & Petersen, 1998; Elbro, Nielsen, & Peterson, 1994; Fowler, 1991), letter knowledge (see, e.g., Barron, 1991, 1994; Frijters et al., 2000), and vocabulary (e.g., Flege, Walley, & Randazza, 1992; Walley, 1993). In the following three sections we review the evidence that supports each factor, justifying its consideration as a possible mediator of a link between phonological awareness and home literacy factors.

PHONOLOGICAL AWARENESS AND PHONOLOGICAL STRENGTH

Converging evidence points to the importance of certain qualitative dimensions of phonological representations for the normal development of phonological awareness and reading. We will follow the convention of referring to these dimensions collectively as measures of phonological strength. (For further discussion, see the September 2001 *Applied Psycholinguistics* Special Issue.) A variety of measures (speech perception, rapid naming, nonword repetition, and phonological distinctness) and a variety of subject samples have been used to support the role of phonological strength in phonological awareness and reading.

One line of evidence about the role of phonological representation in reading comes from the study of speech–language impairment (SLI) where it has been shown that children with speech–language problems that are unresolved by 4 years of age are 6 times more likely to develop reading problems than children with normal speech and language development (Bishop & Adams, 1990). Research suggests that children with SLI have more holistic phonological representations than even younger normally developing children, who are able to utilize representations that are relatively distinctive and segmental in nature (Edwards & Lahey, 1998; Manis et al., 1997).

Speed for naming familiar objects or concepts is consistently slower in reading-disordered individuals than normal readers. Paired with the findings that slower naming speeds are usually associated with slower articulation rates, researchers have concluded that reading disorders may be a function of impaired access to individual phonological representations in the lexicon (e.g., Catts, 1989; James, Van Steenbrugge, & Chiveralls, 1994; Raine, Hulme, Chadderton, & Bailey, 1991; Wolff, Michel, & Ovrut, 1990) or to less phonologically complete lexical representations (Katz, 1986).

Several studies have proposed that the poorer readers' difficulties with nonword repetition may also reflect problems with the specificity or strength of the underlying phonological representations (Edwards & Lahey, 1998; Gathercole,

Willis, Baddeley, & Emslie, 1994; Manis et al., 1997). It may reflect an implicit assumption in the field that, to our knowledge, not a single study has examined the possible relation between phonological strength and the home literacy environment. If qualitative aspects of phonological representations are indeed endowed and heritable, then one would expect that there would be only very weak associations, except in studies that involve extreme cases of language deprivation. In the present study, however, we make no such assumption and therefore examine the possible connection between qualitative and quantitative aspects of the home literacy environment in relation to the strength of phonological representations.

PHONOLOGICAL AWARENESS AND VOCABULARY KNOWLEDGE

The possibility that vocabulary knowledge may play a central role in the development of phonological representations and phonological awareness, in turn, is suggested by Metsala (1997), who proposed that both the speech perception problems found among poor readers and the concomitant difficulty these children show with phoneme awareness follow from the fact that phonemes are not preformed perceptual units whose conscious accessibility changes with literacy exposure. Instead, she argues that phoneme representations gradually develop over childhood, as the growth of spoken vocabulary causes lexical representations to become more segmental. Others have noted that strong speech perception skills may contribute to literacy by facilitating vocabulary development (Sawyer & Butler, 1991; Walley, 1993). In this light, we next consider the evidence that vocabulary is related to phonological awareness and to the home literacy environment.

Several results are consistent with a link between phoneme awareness and vocabulary, possibly mediated by maturing phonological representations. The strongest of these is the consistent finding that vocabulary skills, and expressive vocabulary skills in particular, are related to the development of reading ability (for reviews, see Bowers & Wolf, 1993; Wolf, 1999). It may also be consistent that dyslexic adults more often confuse similarly sounding words in a vocabulary task (Elbro et al., 1994) and that vocabulary is a significant predictor of nonword repetition accuracy, another factor that relates to reading ability (Gathercole & Baddeley, 1989). Nevertheless, Singson (2000) and Singson and Mann (1999) showed that phoneme awareness made a unique and significant contribution to reading ability even when the effects of vocabulary knowledge were partialed out from the regression equation. Yet in our previous study (Foy & Mann, 2001) we found vocabulary to be a primary associate of phoneme awareness, which overwhelmed any direct effects of phonological perception and production.

KNOWLEDGE OF LETTER–SOUND RELATIONS AND THE ALPHABETIC PRINCIPLE

Research suggests that there is a strong and reciprocal relationship between the development of phonological awareness and an understanding of the alphabetic

principle (e.g., Bowey, 1994; Stanovich, 1994; Wagner, Torgesen, Laughon, Simmons, & Rashotte, 1993). Although at least some children and adults can demonstrate phoneme awareness in the absence of alphabetic literacy (Mann, 1984, 1986), alphabet-illiterate adults tend to have difficulty performing tasks that demand phoneme awareness (Morais et al., 1979; Read et al., 1986). In preschool children, phonological awareness appears to develop around the same time as the acquisition of both letter–sound correspondence knowledge (Barron, 1991, 1994; Bowey, 1994; Johnston et al., 1996; Stanovich, 1994) and early reading skills (Dale et al., 1995), suggesting that children may need two distinct skills, phonological awareness and letter knowledge, in order to master the alphabetic principle (Treiman, 2000). Seymour and colleagues (e.g., Duncan et al., 1997; Seymour et al., 1999) provided convincing evidence that, even in children with strong rhyme awareness skills who have been exposed to teaching strategies that emphasizing rime-sized units, letter–sound knowledge is the strongest determinant of early decoding abilities. Moreover, Burgess and Lonigan (1998) demonstrated that phonological awareness and letter knowledge are reciprocally related in preschool children. Barron's (e.g., Barron, 1991, 1994) proto-literacy hypothesis assumes that the critical level of literacy for the inducement of phonemic awareness is merely letter knowledge, as opposed to decoding ability. In his view, a child who, for example, learns that *A* is /ae/ may become aware of /ae/ as an invariant segment of words yet be unable to recover the sequence of phonemes that a sequence of letters transcribes. Consistent with this proposal, Mann and Wimmer (2002) showed that phoneme awareness is almost completely lacking among German kindergartners, who identified only 28% of letters, whereas it is quite well developed among American children, who identified 94% of letters. In their data, however, there was an even closer connection between reading ability (in particular, phonological recoding ability) and phoneme awareness than between letter knowledge and phoneme awareness, similar to the findings in Bowey (1994).

For now let us accept the contention that children who know letter names are more likely to be aware of phonemes than those who do not. What is the basis of their superior knowledge about letters? Children could know more letters because they have a superior ability to learn new vocabulary items, perhaps as an attribute of segmental phonological representations. Many letter names are highly confusable (e.g., *b*, *p*, *d*, *t*), and the same hypothetical change in phonological representations that promotes phonological awareness may allow the child to distinguish among letter names and other highly similar words in the lexicon (see Walley, 1993). However, the acquisition of letter names, like the acquisition of vocabulary, is clearly something that requires exposure. To learn letters a child must be exposed to them and their names and sounds. Aside from classroom experiences, the home literacy environment is surely the most important source of such exposure (see Cunningham & Stanovich, 1993; Whitehurst et al., 1994, and for a major review of the literature, see Smith et al., 1998). Consistent with this, 4-year-old children in Headstart who were randomly assigned to an emergent literacy curriculum that included a home literacy component demonstrated significant gains in letter–sound knowledge compared to children who did not experience the home intervention (Whitehurst et al., 1994).

OBJECTIVES OF THE PRESENT STUDY

The literature suggests that there is a potential relationship between home literacy environment and phonogical awareness, possibly mediated by strength or maturity of phonological representations and knowledge of vocabulary and letter–sound relationships. Few studies have examined the association between the home literacy environment and these early cognitive skills. Few have asked whether the impact of the home literacy environment depends upon the level of awareness (rhyme or phoneme) being examined. Given the critical importance of the early detection and remediation of reading problems, we will attempt to identify factors in the home literacy environment that predict phonological processing in children who have not yet been exposed to formal reading experiences. We will examine hypotheses that:

1. The children's home literacy environment is related to measures of phonological awareness and reading.
2. The association between home literacy environment and phonological awareness may distinguish between rhyme awareness and phoneme awareness as separable levels of awareness.
3. The home literacy environment is linked with performance on tasks purported to measure strength of phonological representations.
4. Letter knowledge and vocabulary are also related to the home literacy environment, and they mediate the relationship with phonological awareness.

METHOD

Participants

Forty monolingual children (17 males, 23 females) from three private preschools in middle-class neighborhoods in southern California volunteered for the study; all participated with the written consent of their parents. The children ranged in age from 4.0 to 6.2 years (M = 4.86, SD = .67); 20 were 4-year-olds, 18 were 5-year-olds, and 2 were 6-year-olds. The schools all had strong language-based programs; none taught reading, but one classroom in one of the schools (n = 8) taught children letter names and letter–sound combinations. None of the children attended other school or day care programs, including kindergarten. All of the parents had finished high school and 21% had received some post high school education. Mean education was 14.5 years for mothers (SD = 2.06) and 14.0 years for fathers (SD = 2.3). Participants were all monolingual and predominantly Caucasian. Parental education and gender were unrelated to the criterion or predictor variables and are not described in further detail.

Materials

Expressive vocabulary. The Wechsler Preschool and Primary Scale of Intelligence Vocabulary subtest (Wechsler, 1992) was used as a measure of expressive

vocabulary. In this test children are asked to give definitions for words of increasing difficulty.

Letter knowledge. The letter identification and letter–sound subtests of the Concepts about Print Test (Clay, 1979) were administered. This test involves identification and naming of all upper and lower case letters in random order. In addition, letter-sound knowledge in four blends (Singson & Mann, 1999) were also assessed. The letter knowledge score reflects the summed scores on the letter identification and letter–sound subtests.

Reading. Word identification and decoding skills for isolated words were assessed with the Word Identification and Word Attack subtests of the Woodcock Reading Mastery Test (Woodcock, 1987).

Home literacy environment

Following Senechal et al. (1988), we approached the children's exposure to literature from two directions. First, we obtained information about the children's storybook exposure from the parents (storybook exposure); second, we assessed the parents' own familiarity with children's books with recognition checklists (parental familiarity with children's literature), taking this as a less biased measure than the self-report measure (Senechal et al., 1998). In addition, we assessed teaching practices adopted by parents, exposure to reading-related media, and parental print exposure. The normality of the criterion variables was assessed with both statistical and graphical methods. Except for the parental familiarity with children's literature factor described below, all of the measures were normally distributed, as revealed by statistical and graphical analysis of the data. Descriptive statistics for each of the items pertaining to the children's home literacy environment are provided in Table 1. Items relating to the parents' literacy environments are described next.

Storybook exposure. The questions concerning storybook exposure in the home were the same as those used by Senechal et al. (1998), namely, the frequency of storybook reading in a typical week (at bedtime and other occasions), the frequency with which children made requests to be read to, the estimated frequency of library visits, the estimated number of children's books available in the home, and the child's age when the parents started reading to him or her. Whereas Senechal et al. had one question devoted to the frequency of storybook reading (at bedtime and other), we used two: one for frequency of bedtime reading and another for frequency of reading at times other than bedtime. Our storybook exposure score represented a sum of the scores on these items.

Parental familiarity checklists. Performance on two recognition checklists taken from Senechal et al. (1996) was assumed to reflect the parents' relative exposure to children's literature. Senechal et al. (1996) previously showed that these checklists predict children's language better than self-report measures. In these two checklists the parents were asked to recognize authors (the Children's Au-

Table 1. *Descriptive statistics for the home literacy measures*

Items	*M* (*SD*)		Range
Freq. of reading to child			
At bedtime (/week)	4.17	(2.58)	0–7
Other times (/week)	3.53	(2.02)	0–7
No. of books in home	81.30	(66.08)	0–250
Freq. of library visits (/month)	1.10	(1.39)	0–4
Freq. child asks to be read to (/week)	5.77	(4.90)	0–30
Children's Author Checklist	0.20	(0.17)	–0.11–0.64
Children's Title Checklist	0.01	(0.13)	0–0.53
Freq. of teaching child			
To print words (/week)	3.51	(1.12)	1–5
To read words (/week)	3.42	(0.97)	1–5
Emphasis on helping child develop broad interest in literature	6.03	(2.86)	0–10
Emphasis on teaching child to recognize and learn alphabet	7.58	(2.87)	0–10
Emphasis on developing child's ability			
To sound out words and letters	6.08	(3.00)	0–10
To associate words with pictures	5.45	(3.08)	0–10
To repeated practice with words	5.45	(3.16)	0–10
Freq. of child			
Watching reading-related TV or videos (min/day)	56.92	(50.29)	0–180
Playing educational computer programs (min/day)	85.05	(112.51)	0–360

thor Checklist or CAC) and titles of popular children's books (the Children's Title Checklist or CTC) from lists containing plausible foils by placing a checkmark next to the targets (Senechal et al., 1996). The CAC contained 40 authors of popular children's books and 20 foils and the CTC contained 31 titles of popular children's books and 19 foils. Foils and targets were presented in random order to the parents. A parental familiarity with children's literature score (labeled parental familiarity in the tables and figures) was calculated by obtaining subscores for the CAC and CTC. This was done by subtracting the foil scores from the target scores, converting these difference scores to z scores, and summing them. In Senechal et al.'s (1998) study, the Spearman–Brown reliability coefficients for the checklists were .88 and .90 for the CTC and CAC, respectively.

Parent teaching. Parental focus on teaching of reading-related skills was assessed by asking parents about the frequency of teaching behaviors and preferences for various methods. Using the same questions as Senechal et al. (1998), we asked parents to indicate on a 5-point scale the frequency with which they taught their child to read words and to print words (1 = *never*, 2 = *seldom*, 3 = *sometimes*, 4 = *often*, 5 = *very often*). The interitem reliability of this measure was .79 in the Senechal et al. (1998) study and .66 in the present study. In addition to the two items assessed by Senechal et al., we also asked the parents

questions about the emphasis they placed on various behaviors while reading with their child. These were emphases placed on developing a broad interest in literature, teaching the child to read by associating words with letters, teaching the child to read by associating words with pictures, helping the child to sound out letters and/or groups of letters, and providing repeated practice with a given set of words. A factor analysis (using varimax rotation) of z scores for the teaching items revealed that Senechal et al.'s two items and our additional items loaded on two separate factors. Thus, we derived two separate scores reflecting parental teaching patterns: the sum of the component scores for Senechal et al.'s teaching frequency factor (frequency of teaching the child to read words and print words), which explained 45.89% of the variance in the teaching measures; and the sum of the component scores for the remaining parental teaching items (with emphasis placed on developing a broad interest in literature, teaching the child to read by associating words with letters, teaching the child to read by associating words with pictures, helping the child to sound out letters and/or groups of letters, and providing repeated practice with a given set of words). This latter score, termed teaching emphases, accounted for 26.02% of the variance.

Parent's reading activities. Given the previously reviewed evidence that literacy-oriented parents tend to have children who are better readers, we asked the parents to answer several questions about their own reading habits in order to assess the parents' exposure to adult reading materials. Specifically, in a multiple choice format where higher numbers indicate higher levels of literacy activity, we asked parents to answer questions about the frequency of reading nonwork or school books ($M = 2.82$, $SD = 1.17$, range = 1–5), reading for pleasure ($M = 3.88$, $SD = 1.17$, range = 1–5), library visits ($M = 1.79$, $SD = .81$, range = 1–3), newspaper reading ($M = 3.13$, $SD = 1.04$, range = 1–5), and magazine subscriptions ($M = 2.23$, $SD = 1.02$, range = 1–4). The parental reading activities measure was the sum of the z scores for these items. All the items on the parental reading activities measure correlated significantly with the composite measure ($p < .05$), except for the newspaper item ($r = -.02$, $p = .90$) and the magazine subscription item ($r = .09$, $p = .64$).

Reading media. Several previous studies have proposed that children's exposure to reading-related media may be associated with their development of reading and language skills. For example, children with a language impairment who performed daily computer games specifically designed to improve auditory processing showed significant improvements (Tallal et al., 1996). Preschool children at risk for learning disabilities who were assigned to a computer-based early reading program performed better than children assigned to a traditional teacher-based instruction program on phonological awareness, early reading, and letter knowledge tasks (Mioduser, Tur–Kaspa, & Leitner, 2000). Torgesen and Davis (1996) also reported the success of using computer-based instruction in phoneme and synthesis. These results inspired us to examine the contribution to our measures of commercially available computer games and TV or video that emphasize reading. Both types of activities were readily available in our

sample. A factor analysis revealed that both items loaded equally on the same factor, explaining 57% of the total variance in the items. The media measure thus reflected the sum of scores for the computer and TV or video items.

Phonological awareness

Phoneme awareness. The composite phoneme awareness score (PA) was calculated by summing the raw scores on six phoneme manipulation subtests (Singson & Mann, 1999), partially adapted from Chaney (1992). These tests each consisted of two practice items and 10 test items (with the exception of the first test, which had 20 test items). The tests were administered in standard order: phoneme judgment (initial position for 20 items and final position), phoneme deletion (initial and final positions), and phoneme substitution (initial and final positions). In the phoneme judgment tests, the children were told that Morpo, a Martian puppet, wanted them to help him play "the sound game." Following demonstration and practice, the examiner presented a stimulus word followed by two test words and the children responded with the word that started (initial) or ended (final) with the same sound as the target word. In the phoneme deletion tasks, the children were told that Morpo, the puppet, wanted to see what happened to the words when the first (initial) or last (final) sound was taken out. After demonstration and practice, the children responded by indicating how the word would sound when the target sound was removed from each word. In the phoneme substitution tests, the children were told that the examiner liked the letter /k/ and were invited to "change the words from Morpo's planet" by changing the first (initial) or last (final) sound to /k/. Following demonstration and practice, the children responded by changing the nonsense words into nonsense words that began (initial) or ended (final) with /k/. For the phoneme awareness tasks, 68% of the 4-year-olds and 29% of the older children achieved scores of zero.

Rhyming awareness. The composite rhyme awareness score was derived by summing the raw scores on two rhyming tasks (Singson & Mann, 1999). In the rhyme recognition task, adapted from Chaney (1992), children saw three pictured objects at a time, two of which had names that rhymed. The examiner named the three objects, and pointed to them. The children were asked to point to the pictures that "rhymed" or "sounded almost the same." After this demonstration and three practice trials, the children indicated their responses to eight trials by pointing to the two rhyming objects. In the rhyme production task, the children were asked to say "what word rhymes with ____" for five trials consisting of common words (e.g., hop). Words and nonwords were scored as correct as long as they rhymed with the target word. For the rhyme awareness tasks, 16% of the 4-year-olds and 5% of the older children achieved scores of zero.

Strength of phonological representations

This construct was assessed using a number of different measures, as described below.

Articulation test. The Goldman–Fristoe Test of Articulation (Goldman & Fristoe, 1986) was administered to each child, and the responses were transcribed phonetically on-line and later analyzed. A licensed and certified speech–language pathologist performed the transcription and phonological analyses using standard phonetic transcription. The score on the articulation test reflected the number of errors made on phonemes identified for testing in the Goldman–Fristoe Test of Articulation.

Naming speed. An English-language adaptation (Singson & Mann, 1999) of Elbro's naming task (Elbro, 1990) was used to measure picture-naming speed. It is a simple task with color pictures taken from magazines. These names are within the vocabulary of 5-year-old children. Pictures from the same semantic category (e.g., chair, sofa, table) are presented three at a time on a single card and the child is asked to name the objects depicted in the picture as quickly as possible. The test has two trial items and 15 test items. If the child failed to name a picture, misnamed a picture, or took longer than 15 seconds to name the items on the card, the data from that item was disregarded in the naming data (*Mdn* of missed items = 2). The individual scores are average naming time in seconds.

Phonological distinctness task. This task, also modified from Elbro (1990), used English words (see Foy & Mann, 2001) to measure the distinctness of unstressed vocalic segments in multisyllabic words. The child was shown a hand-held puppet (once again the Martian, Morpo) and told that the puppet had some difficulties with our language: he did not pronounce the words well, so the child was supposed to teach the puppet the most distinct pronunciation. The experimenter showed an object to the puppet and the child and pronounced it "the way Morpo usually says it." The pronunciation was at a level of distinctness intended to be below the level for the least distinct child. For example, the word crocodile was pronounced [ka: di]. The child was then asked to teach the puppet the correct pronunciation. The accuracy score was based on standard pronunciation according to 10 adult speakers of standard American dialect. The words selected for the task were all well within the active vocabularies of 5- and 6-year-old children. The children's responses were recorded as correct or incorrect.

Nonword repetition. A modification of the Children's Test of Nonword Repetition (Gathercole et al., 1994) was used to assess nonword repetition ability. In order to shorten the task, only the first five nonwords from two-, three-, and four-syllable nonwords were administered to the children. According to Gathercole and colleagues (1994), the phoneme sequences in each stimulus nonword conformed to the phonotactic rules of English, and within each number of syllables, the items were constructed to correspond to the dominant syllable stress patterns in English for words of that length (strong–weak for two-syllable nonwords, strong–weak–weak for three-syllable nonwords, and variable stress patterns for four-syllable words). The phoneme sequences for the nonwords thus are both phonotactically and prosodically legal. Test–retest reliability was calcu-

Table 2. *Descriptive statistics for reading-related measures*

Measure	*M*	*SD*	Range
Vocabulary	11.65	7.94	0–32
Letter knowledge	41.27	31.06	0–108
Reading	3.95	11.15	0–62
Phoneme awareness	9.23	13.70	0–58
Rhyme awareness	6.49	4.70	0–13
Articulation errors	8.10	9.43	0–45
Naming speed (s)	6.58	2.51	3.13–14
Pronunciation distinctness	7.05	2.99	0–11
Nonword repetition	8.53	3.83	1–15
Speech discrimination errors	10.59	5.29	0–24

lated to be .77. Pronunciation was modified for the American sample according to pronunciation of 10 normally reading adults (see Foy & Mann, 2001). On-line scoring was previously reported at agreement on 97% of the items. Deletions, substitutions, and additions were all scored as errors. Percentage of correct words was calculated.

Speech discrimination task. The Test of Auditory Discrimination (Goldman, Fristoe, & Woodcock, 1970) was used to assess the children's ability to discriminate phonemes in a forced choice paradigm. The child is asked to discriminate between four pictures that represent words that differ by a single phoneme (for example, lake, make, rake, and wake) and is asked to point to the picture matching a spoken word. The spoken words are tape-recorded under quiet conditions and played to the child via bilateral headphones. There are a total of 30 items, and the score is the number of errors.

Design and procedure

The children were tested individually in two 45-min sessions spaced 2 days to 1 week apart. They were rewarded with stickers. The tests were administered in a standard sequence, following procedures described in the manuals for the standardized tests and published procedures for the nonstandardized tests (e.g., administration of phoneme and rhyme awareness tests utilized procedures and instructions developed from Chaney, 1992).

RESULTS

Descriptive statistics for the major reading-related variables are provided in Table 2.

Intercorrelations between home literacy measures

As an initial approach to analysis of the data, we computed zero-order correlations between the home literacy and media measures. As can be seen from Table

Table 3. *Zero-order correlations among the home literacy measures*

	Storybook Exposure	Parental Familiarity	Teaching Frequency	Teaching Emphases	Parental Reading Activities
Storybook exposure	1.00				
Parental familiarity	0.78***	1.00			
Teaching frequency	–0.17	–0.11	1.00		
Teaching emphases	–0.43*	–0.46**	0.00	1.00	
Parental reading activities	0.11	0.10	–0.34	–0.16	1.00
Reading media	–0.06	0.03	0.06	–0.10	–0.10

Two-tailed: *$p < .05$. **$p < .01$. ***$p < .001$.

3, storybook exposure was positively correlated with the parental familiarity with children's literature measure (in contrast to the results of Senechal and colleagues, 1998), negatively correlated with teaching emphases, and unrelated to teaching frequency. Parents who provided frequent storybook exposure to their children (as surmised from the storybook exposure and parental familiarity with children's literature measures) tended to set low priorities on teaching their children to read (teaching emphases measures). Parental exposure and reading media were unrelated to any of our measures of children's exposure to literacy experiences.

Association between age and home literacy measures

Because our measures were uncorrected for age, we examined the relation between age and our variables in order to determine whether the home literacy environment may be shaped by the child's chronological age and assumed developmental stage. Age was not correlated with any of the home literacy measures, which were our predictor variables.

Association between age and reading-related measures

Contrary to our findings regarding the predictor variables of home literacy, age was significantly correlated with several of our criterion variables, namely, phoneme awareness ($r = .42$, $p < .01$), rhyme awareness ($r = .55$, $p < .001$), vocabulary ($r = .38$, $p < .01$), letter knowledge ($r = .52$, $p < .001$), reading ($r = .43$, $p < .01$), naming speed ($r = -.46$, $p < .01$), and articulation ($r = -.42$, $p < .01$).

Age-corrected associations between home literacy and reading-related measures

Given that age was a factor in children's performance on some of the criterion variables, we next conducted a partial correlation analysis, partialing out the effects of age. As shown in Table 4, when age was controlled, teaching frequency was positively associated with phoneme awareness ($r = .37$, $p < .05$),

Table 4. *Zero-order and partial (age partialed out) correlations between home literacy measures and major variables*

	Storybook Exposure	Parental Familiarity	Teaching Frequency	Teaching Emphases	Parental Reading Activities	Reading Media
Phoneme	−.25	.05	.35*	.16	−.37*	.40*
awareness	(−.27)	(.09)	(.37*)	(.17)	(−.19)	(.14)
Rhyme	−.01	.14	.03	.05	.13	.42*
awareness	(−.03)	(.43*)	(−.29)	(−.15)	(.30)	(.26)
Vocabulary	−.12	.06	.32	.16	−.33	.20
	(−.19)	(.01)	(.20)	(.13)	(−.11)	(−.14)
Letter	.13	.07	.29	.29	−.38*	.29
knowledge	(−.29)	(−.01)	(.29)	(.27)	(−.27)	(−.01)
Naming	.17	−.14	−.17	−.11	.15	.24
speed	(−.19)	(−.27)	(−.26)	(.01)	(−.00)	(−.05)
Distinctness	.29	.30	.32	−.11	−.12	.03
	(.24)	(.39)	(.33)	(−.12)	(−.04)	(−.24)
Nonword	.21	.22	.16	−.14	−.06	−.01
repetition	(.22)	(.40)	(.07)	(−.17)	(.12)	(−.16)
Articulation	−.23	−.10	−.31	−.02	.15	.14
	(−.25)	(−.18)	(−.31)	(−.04)	(−.03)	(.08)
Speech						
discrimination	−.18	−.32	−.13	−.05	.23	−.28
errors	(−.25)	(−.43*)	(.02)	(.12)	(.08)	(−.21)
Reading	−.16	−.05	.20	.07	.07	.29
	(−.21)	(.20)	(.20)	(−.01)	(−.01)	(.03)

Note: The values in parentheses represent correlations with the age partialed out. Two-tailed: $*p < .05$.

accounting for almost 14% (r^2) of variance. In addition, with age controlled, the parental familiarity factor positively predicted rhyme awareness and speech discrimination ($r = .43$, $p < .05$), accounting for 16% of variance in each score.

Linear models

Our next series of regression analyses was motivated by our interest in examining whether the contribution of home literacy skills to variance in phonological awareness is independent of contributions made by vocabulary and letter knowledge. We conducted a series of separate stepwise multiple regression analyses for each of the correlations that had reached statistical significance in our previous analyses (zero order and partial), first entering letter knowledge alone (or vocabulary alone) and then the relevant home literacy variable. As previously reported, age and several of our criterion variables were linked. Thus, removing variance due to age may also remove variance due to important mediator variables, such as letter knowledge and vocabulary. Although it is clearly important to investigate age-corrected relationships between home literacy and phonologi-

Table 5. *Summary of multiple regression analyses*

		Correlation		Variable Removed[b]	
Predictor Variable	Dependent Variable	Zero Order	Partial[a]	Vocabulary	Letter
Teaching frequency	Phoneme awareness	+	+	—	—
Reading media	Phoneme awareness	+	—	+	—
Reading media	Rhyme awareness	+	—	+	+
Parental reading activities	Phoneme awareness	+	—	—	—
Parental reading activities	Letter knowledge	+	—	—	NA
Parental familiarity	Rhyme awareness	—	+	—	+
Parental familiarity	Speech discrimination	—	+	—	+

Note: (+) the predictor was a significant independent predictor of the relevant dependent variable; (—) the predictor was not a significant independent predictor of the dependent variable.
[a]Age partialed out.
[b]Variable removed separately by initial entry into a stepwise regression analysis.

cal awareness, as we do in the path analyses that follow, in order to determine specific effects on possible mediator variables, which covary with age, we also examined relationships between our predictor and criterion variables without partialing out the effects of age. Nonsignificant results in the following regression analyses illustrate that removing the effects of a variable significantly weakened the relationship between the predictor and criterion variable. We can then infer that the removed variable functions as a significant mediator between the predictor and criterion variables. The results of our analyses are described next and summarized in Table 5.

Effect of separately controlling letter knowledge and vocabulary on the relations between home literacy measures and reading-related measures

Phoneme awareness. The relation between teaching frequency and phoneme awareness appeared to be mediated by vocabulary and letter knowledge as teaching frequency did not predict phoneme awareness independent of letter knowledge ($R^2\Delta = 0.03$, *ns*, $\beta = 0.17$, *ns*) or vocabulary ($R^2\Delta = 0.03$, *ns*, $\beta = 0.17$, *ns*). Presumably the parents' teaching (which focused on reading and printing words, as shown in Table 1) contributed to the children's phoneme awareness because it enhanced their vocabulary and letter knowledge.

Parental reading activities also failed to predict phoneme awareness independent of letter knowledge ($R^2\Delta = 0.01$, *ns*, $\beta = 0.13$, *ns*) or vocabulary ($R^2\Delta = 0.03$, *ns*, $\beta = -0.18$, *ns*), and failed to predict letter knowledge independent of vocabulary ($R^2\Delta = 0.04$, *ns*, $\beta = -0.22$, *ns*). Thus, letter knowledge and vocabulary appear to mediate the association between parental reading activities and pho-

neme awareness and vocabulary mediates the relation between parental reading activities and letter knowledge.

The most direct effect we uncovered was due to reading media, which predicted phoneme awareness independent of vocabulary ($R^2\Delta = 0.08$, $p = .05$, $\beta = 0.29$, $p = .05$). However, its effect on phoneme awareness did appear to be mediated by letter knowledge ($R^2\Delta = 0.06$, *ns*, $\beta = 0.26$, *ns*). Arguably, letter development may be a principal goal for most commercially available reading-related computer games and TV or video programs for the preschool population.

A multiple regression conducted by first entering age and then entering reading media and teaching frequency demonstrated that the two home literacy variables explained an additional 17.4% of the variance in phoneme awareness, $R^2\Delta = 0.17$, $p < .05$, F (3, 27) = 4.553, $p < .01$, whereas without age included in the regression equation, the two variables explained 25.0% of the variance in phoneme awareness, $R^2 = 0.25$, $p < .05$, F (2, 28) = 4.668, $p < .05$.

Rhyme awareness. Rhyme awareness was significantly predicted by reading media, independent of vocabulary ($R^2\Delta = 0.11$, $p < .05$, $\beta = 0.34$, $p < .05$) and letter knowledge ($R^2\Delta = 0.09$, $p = .05$, $\beta = 0.313$, $p = .05$). The development of rhyme awareness appears to involve concomitant developmental changes in areas that are age related but are relatively independent of vocabulary and letter knowledge. Parental familiarity with children's literature also predicted both speech discrimination ($R^2\Delta = 0.18$, $p < .01$, $\beta = -0.42$, $p < .01$) and rhyme awareness ($R^2\Delta = 0.09$, $p = .05$, $\beta = 0.30$, $p = .05$, respectively) but not independent of vocabulary ($R^2\Delta = 0.01$, *ns*, $\beta = 0.11$, *ns*). When the effects of letter knowledge were removed, the results were marginally significant ($R^2\Delta = 0.08$, $p = .05$, $\beta = -0.29$, $p = .05$), suggesting that print exposure provided by involved parents may enhance speech discrimination, vocabulary development, and, to a lesser extent letter knowledge, which are all, in turn, associated with rhyme awareness.

A multiple regression conducted by first entering age and then entering reading media and parental familiarity demonstrated that the home literacy variables explained an additional 8% of the variance in rhyme awareness, $R^2\Delta = 0.08$, *ns*, F (3, 27) = 4.997, $p < .001$, and 18% of the variance when age was not included in the equation, $R^2\Delta = 0.18$, *ns*, F (2, 26) = 2.848, *ns*.

Path analyses of the relation between home literacy environment and phonological awareness

To further investigate the degree of influence on one variable on another, we looked at path analyses within a causal framework that assumes that home literacy may have both direct and indirect effects (via letter knowledge, vocabulary, and speech discrimination) on rhyme and phoneme awareness, as separable components of phonological awareness. In addition to the influence of some home literacy measures, vocabulary, letter knowledge, and speech discrimination impose significant independent weights on phonological awareness. These independent weights are often coupled with indirect influences from other variables. Path analysis affords us a view, not only of the independent contribution

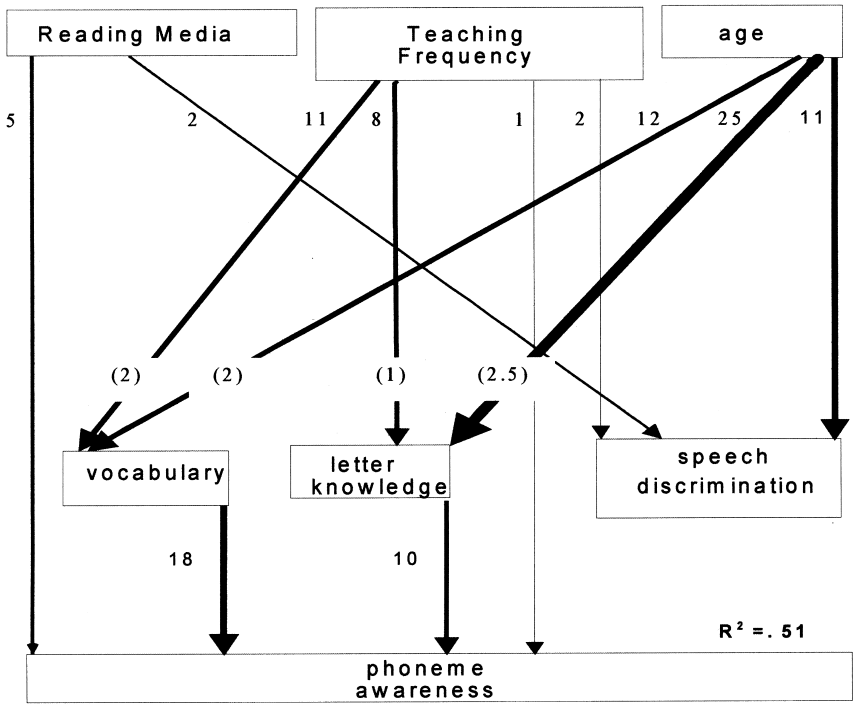

Figure 1. A path diagram showing the direct and indirect influences of age, home literacy, vocabulary, letter knowledge, and speech discrimination on phoneme awareness. *Note:* The raw numbers indicate the percentage of variance explained by the predictors $(100)(ß^2)$. The numbers in parentheses indicate the indirect relations between the home literacy variable and phoneme awareness via the mediating variable $(ß_1 \times ß_2)^2 \times 100$. Nonsignificant relations are excluded from the diagram. The line width reflects the relative strengh of the relationships.

made by each variable, but also of the interrelationship among our predictors. We consider a separate set of analyses for phoneme and for rhyme awareness, using AMOS 4 (Arbuckle, 1999). For the purpose of the analysis, the relevant home literacy measures and age were considered as exogenous variables, which are independent of the other exogenous variables (Arbuckle & Wothe, 1999, p. 121). Vocabulary, letter knowledge, and speech discrimination[1] were considered endogenous variables, which are dependent on other variables. Error variance contributing to each of the endogenous variables is excluded from the figures for the purpose of clarity.

Phoneme awareness

Figure 1 illustrates the significant direct and indirect contributions of the relevant home literacy measures, reading media and teaching frequency, to the prediction of phoneme awareness, with age included in the model. Taken together,

these six variables explain 51% ($R^2 = 0.51$) of the variance in phoneme awareness. As the figure shows, age contributes a large proportion of variance (β^2) to vocabulary, letter knowledge and speech discrimination (12, 25, and 11%, respectively). Teaching frequency contributes a significant portion of the variance to vocabulary and letter knowledge as well, explaining close to the same proportion of the variance in vocabulary (11%) as does age and 8% of the variance in letter knowledge. Teaching frequency and reading media each contribute about 2% of the variance to speech discrimination, which is uncorrelated with phoneme awareness. Thus, the interactions between the home literacy variables and speech discrimination do not contribute indirectly to an influence on phoneme awareness and are not included in the path diagram. The effects of reading media on phoneme awareness appear to be more direct, explaining 5% of the variance in phoneme awareness, whereas there were no significant direct effects of teaching frequency and age on phoneme awareness in this model.

Independent of age and home literacy, vocabulary and letter knowledge explain about 18% ($\beta_{V\text{-}PA} = 0.42$, $p < .01$) and 10% ($\beta_{LETT\text{-}PA} = 0.32$, $p < .05$) of the variance in phoneme awareness, respectively.

Indirect effects of the home literacy variables via vocabulary, letter knowledge, and speech discrimination are calculated by multiplying the beta values, squaring the product, and converting the number to a percentage by multiplying by 100. The interaction between teaching frequency and vocabulary ($\beta_{TEACH\text{-}V} = 0.33$, $p < .05$), combined with the interaction between vocabulary and phoneme awareness ($\beta_{V\text{-}PA} = 0.42$, $p < .01$), provides an indirect weight of $(0.33)(0.42) = 0.14$, about 2% of variance ($0.14^2 \times 100 = 1.96$) to the prediction of phoneme awareness. Similarly, the correlation of teaching frequency with letter knowledge ($\beta_{TEACH\text{-}L} = 0.28$, $p = .05$) results in an additional effect of 0.09 (0.28×0.32) on phoneme awareness, explaining about 1% of variance ($0.09^2 \times 100$). Indirect effects of age contribute 2% of the variance in vocabulary ($[0.34 \times 0.42]^2 \times 100$) and about 2.5% of letter knowledge ($[0.5 \times 0.32]^2 \times 100$). Teaching frequency also has its own direct effect, accounting for 1%. Thus, approximately half of the variance in phoneme awareness can be explained by variance in vocabulary and letter knowledge, and the effects of teaching frequency and age are mediated by these skills. Reading media has more direct effects. The results support a combined model of both direct (for reading media) and indirect (for teaching frequency and age, via vocabulary and letter knowledge) contributions of home literacy effects on phoneme awareness.

Rhyme awareness

Figure 2 illustrates the proportion of the variance explained by the direct and indirect contributions of age and in addition to the relevant home literacy measures, reading media and parental familiarity with children's literature, to the prediction of rhyme awareness. Together with letter knowledge, vocabulary, and speech discrimination, age and these home literacy measures explain 47% of the variance in rhyme awareness. It is clear that a large proportion of the relationship between the home literacy measures and the proposed mediating variables (vocabulary, letter knowledge, and speech discrimination) is related to

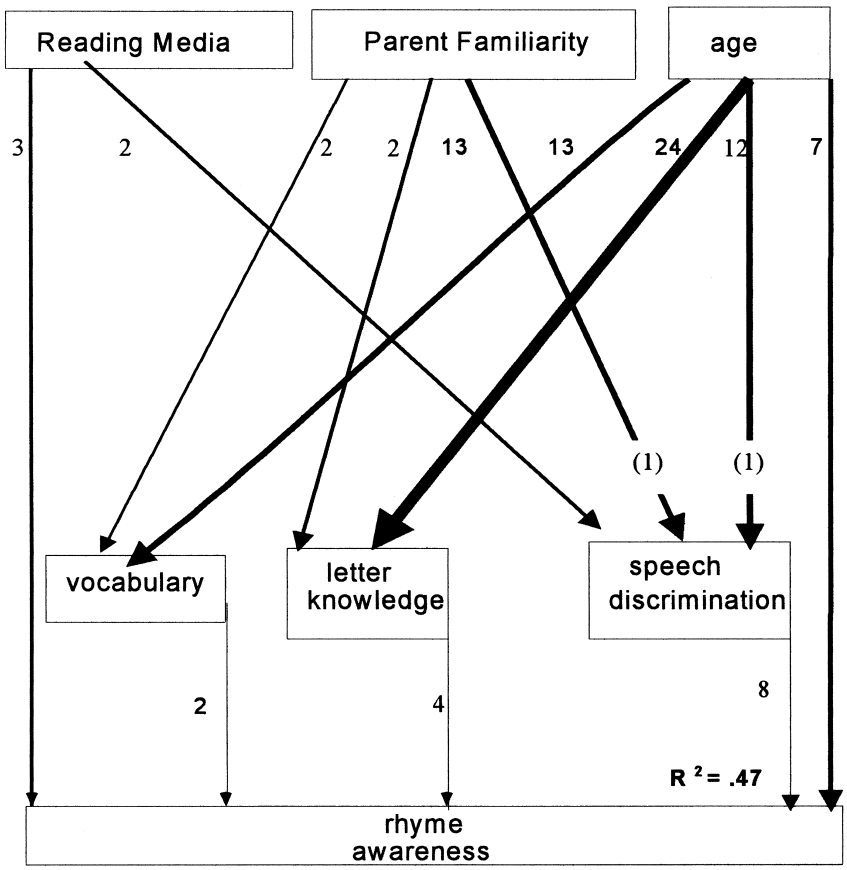

Figure 2. A path diagram showing the direct and indirect influences of age, home literacy, vocabulary, letter knowledge, and speech discrimination on rhyme awareness (see note to Figure 1).

age. However, as discussed in more detail later, the factor of parental familiarity with children's literature explains as much variance in speech discrimination as age (13%), as well as exerting influences (2% each) on vocabulary and letter knowledge. Reading media (3%) and age (7%) exert direct and indirect influences, as will be discussed next.

Indirect effects were calculated in the same way as for the path analyses for phoneme awareness, $(\beta_1 \times \beta_2)^2 \times 100$. There are two major indirect effects of the mediator variables on rhyme awareness: parental familiarity with children's literature via speech discrimination and age via letter knowledge. The interaction between parental familiarity with children's literature and speech discrimination ($\beta_{CHECK\text{-}D} = -0.36$, $p < .05$) exerts an indirect weight of $(-0.36)(-0.28) = 0.10$ (i.e., 1%) on rhyme awareness. The indirect effect of age via letter knowledge also adds 1% ($[0.49 \times 0.2]^2 \times 100$) to rhyme awareness.

Summary of the path analyses

Our path analyses highlight the degree of overlap between some home literacy measures, age, vocabulary, letter knowledge, and speech discrimination. Apart from their own independent contributions to phoneme awareness, vocabulary and letter knowledge are significantly correlated with teaching frequency and therefore share significant indirect effects. The reading media home literacy measure also adds direct effects to phoneme awareness and rhyme awareness. The parental familiarity with children's literature measure affects rhyme awareness, primarily via effects of speech discrimination. The major influence of age on rhyme awareness appears to be direct, while also exerting indirect effects via letter knowledge. Reading media has direct effects on both phoneme and rhyme awareness.

What is clearest in the above analyses is that aspects of the home literacy environment (as measured by the teaching frequency, parental familiarity with children's literature, and reading media measures) offer both direct and indirect contributions to phonological awareness through their interactions with vocabulary, letter knowledge, and speech discrimination. Phoneme awareness is enhanced indirectly via mechanisms involving vocabulary and letter knowledge, such as teaching children to read and to print words, and directly via reading-related media. Reading-related media exposure and exposure to parents who are highly involved in their children's literature experiences also enhances speech discrimination skills, which are strongly linked with rhyme awareness.

DISCUSSION

Our first two questions addressed the relationship between the home literacy environment and measures of phonological awareness and reading. In answering them we examine our findings regarding phonological awareness and reading separately, recognizing the strong association between phonological awareness and reading (e.g., Adams, 1990; Wagner & Torgesen, 1987) that has now been widely reported. Our final two questions, which concern the mediating role of phonological representation, vocabulary, and letter knowledge, are answered in the context of our discussions of home literacy and phonological awareness.

Home literacy is best described as a complex, multidimensional phenomenon including both an access to opportunity (exposure) facet and an instructional quality aspect (e.g., see Leseman & deJong, 1998). Certain aspects of the home literacy environment have been previously linked with phonological awareness (Senechal et al., 1998; Symons et al., 1996) whereas others, such as exposure to print, appear to be unrelated (Cunningham & Stanovich, 1993). We separately investigated the associations for phoneme awareness and rhyme awareness, reflecting our expectation (supported in Foy & Mann, 2001) that phoneme and rhyme awareness involve separable cognitive processes with separable etiologies. Indeed, we found that phoneme awareness alone was linked with frequency of parental instruction, independent of the child's age, which strengthens the position that phoneme awareness is more closely linked with instruction than rhyme awareness (Dale et al., 1995; Johnston et al., 1996; Mann & Liberman,

1984; Morais, 1991; Morais et al., 1979; Smith et al., 1998). Consistent with the findings of Cunningham and Stanovich (1993), we found no significant correlation between phoneme awareness and our parental familiarity with children's literature measures (which included a preschool version of the Title Recognition Test developed by these authors).

The reading habits of the parents in our sample were linked with phoneme awareness, but negatively, in contrast to the findings of Symons and colleagues (1996), who used onset-rime awareness as their measure of phoneme sensitivity. Age was a strong factor in our results and we suggest that, in our sample, parents with stronger personal reading habits tended to spend less time teaching letters to their children. Although not significant, as can be seen from Table 4, the children whose parents had high print exposure also tended to have less strong vocabulary skills than those with parents who read less. A possible interpretation of these findings is that there may be a trade-off for parents in terms of time: time for their own reading versus time to teach their children the skills that will support the development of phoneme awareness (vocabulary and letter knowledge). This interpretation appears plausible given a trend toward a negative correlation (see Table 3) between parental reading activities and teaching frequency.

We also found that the availability of media related to reading instruction was linked with both the development of phoneme awareness and rhyme awareness, suggesting that the learning that occurs as a result of exposure to reading-related TV shows and computer games is somehow different from that occurring when parents begin to teach their children how to read. For example, the relation between reading media and phonological awareness was not independent of age, suggesting that only older children may be provided with these learning opportunities afforded by computer games and the like or that only older children are more likely to profit by such types of instruction.

We found only weak direct links between any of our home literacy measures and vocabulary, which were marginally significant. In the path analysis, vocabulary clearly exerted indirect effects on phoneme awareness skills through exposure to reading-related experiences via direct instruction from parents on reading and printing words. A larger, more diverse sample may yield more promising findings in this area. It is interesting to note, however, that our measure of vocabulary taps expressive language skills, rather than the receptive language skills that tended to be the emphasis in prior studies linking vocabulary and the home literacy environment (e.g., Frijters et al., 2000; Jordan et al., 2000; Senechal et al., 1996). Future research with larger sample sizes and the use of diverse language measures may reveal differential links between receptive and expressive vocabulary and the home literacy environment.

In contrast to phoneme awareness, the development of rhyme awareness is relatively independent of formal instruction (Mann & Liberman, 1984; Stahl & Murray, 1994) and is strongly associated with speech perception (Foy & Mann, 2001). These reports are consistent with our present finding that rhyme awareness in this preschool sample was uncorrelated with the parental instruction measure. Instead, we found that rhyme awareness was more closely associated with the parents' familiarity with children's literature, which was more strongly

linked with speech discrimination abilities than with vocabulary and letter knowledge (although these also contributed). Although it is not clear what the parental familiarity with children's literature measure directly indicates, the strong negative correlation between it and the teaching emphases measure may suggest that parents who are highly familiar with children's literature have different goals during shared reading experiences. They may be more actively engaged in surveying the literature and less engaged in the actual teaching of reading. Whatever the goals of shared reading experiences are for these parents, the experiences they offer appear to strengthen their children's rhyme awareness but have no association with their phoneme awareness. Our results therefore clearly distinguish between rhyme awareness and phoneme awareness as separable levels of awareness, with phoneme awareness emerging in this preschool sample as a result of early reading instruction in the home and through exposure to reading-related media, which is associated with vocabulary and letter knowledge development. In contrast, rhyme awareness seems more closely associated with parents' active engagement in the reading of a broad sampling of children's literature, which, most importantly, is most strongly linked with children's speech discrimination skills.

We examined several measures of phonological strength. Because we previously showed that these measures do not represent a unitary construct (Foy & Mann, 2001), we expected that they might be differentially associated with aspects of the home literacy environment. Indeed, we found that the ability to discriminate speech sounds was the only one of the six measures of phonological strength that was linked with home literacy. Moreover, it was linked with only one of the literacy environment measures, namely, with the parents' familiarity with children's literature. This association was independent of the children's age and suggests that children whose parents were aware of providing a rich offering of books for shared reading tended to have superior speech perception skills. It was not the frequency but rather the variety of the exposure that seemed to matter.

Turning now to the results of our examination of the relationship between the home literacy environment and early reading achievement, these are far less interesting than our examination of home literacy and phonological awareness. Very few of our participants were reading any words, so it is not surprising that we found a low correlation between these variables. The strongest relationship was for the reading media variable ($r = 0.29$, *ns*), as can be seen in Table 4, and even it falls short of significance. However, our results invite the conclusion that at this early stage in reading acquisition, the home literacy environment may be more closely linked with precursors of reading than with reading itself.

Reading itself was the concern of Scarborough and Dobrich's (1994) observation that approximately 8% of the variance in early reading reflected a home literacy factor in a meta-analysis of several studies. When we turn to phonological awareness instead of reading per se, we find much brighter prospects in this smaller sample. To begin with, the home literacy measures, combined with age and the variables of letter knowledge, vocabulary, and speech discrimination, can describe close to half of the variance in our phonological awareness measures. More to the point, unadjusted correlations between individual literacy

measures and phonological measures are as high as $r = 0.4$ or 16% of variance. Our path analyses reveal that home literacy, age, vocabulary, letter knowledge, and speech discrimination taken together account for a total of 51% in phoneme awareness and 47% in rhyme awareness. When we consider the effect of home literacy variables adjusted for the age of the child, the path analysis indicates that they account for nearly 10% of the variance in phoneme awareness (6% direct and 4% indirect effects mediated by vocabulary and letter knowledge), where the less conservative multiple regression indicates that they account for 17% (18% when age is not accounted for). Likewise, home literacy variables account for approximately 6% of the variance (about 4% direct and 2% indirect) in the path analysis and 8% in multiple regression for rhyme awareness (18% when age is not included).

Beyond the obvious limitations imposed by a small sample on robustness of statistical analyses and the tentativeness of the consequent interpretations, several characteristics of our sample may limit the generalizability of our findings. First, the children in this study were from middle-class families in which both parents typically had some college education and had positive literacy orientations for themselves and their children. Second, the children in the study were not readers and many of them had low phoneme awareness. Third, relations between the children's home environments and their classroom experiences may have interacted, or may interact in the future, to influence phonological awareness. These limitations all speak to fairly restricted ranges for the relevant variables, possibly resulting in an underestimation of the role of the home literacy environment in the emergence of phonological awareness. Higher predictive power may be obtained in a longitudinal study begun prior to letter learning and continuing at least until after acquisition of the alphabetic principle, incorporating a wider range of subjects from more diverse home literacy environments. It may well be that some threshold level of literacy exposure is needed, in terms of qualitative and quantitative aspects, in both the home and school setting before phoneme awareness is achieved.

In conclusion, we nevertheless found that aspects of the children's home literacy environment are indeed related to measures of phonological awareness but not to early reading ability in this sample of largely preliterate preschoolers. We clearly established that different aspects of the home literacy environment are associated with rhyme awareness and phoneme awareness, further supporting our position (Foy & Mann, 2001) that they are separable levels of awareness. Phoneme awareness appears to be more closely linked to instructional aspects of the home literacy environment that operate primarily by enhancing vocabulary and letter knowledge, which are then strongly linked to phoneme awareness. Thus, we see that phoneme awareness is increased by parental teaching and also by TV and computer activities that build early reading skills. In contrast to phoneme awareness, rhyme awareness is more closely aligned to parental familiarity with children's literature, although it also shows a positive effect of exposure to the reading media. Where the aspects of the home literacy environment that appear to develop phoneme awareness build primarily upon the child's vocabulary and letter knowledge, those that develop rhyme awareness build more strongly upon speech discrimination. Our findings thus illustrate that the

home literacy environment during the preschool years has an important and multifaceted influence on the development of phonological awareness by contributing to the development of vocabulary, letter knowledge, and speech discrimination abilities. We have provided a preliminary view of aspects of the home literacy environment that may be responsible for the separate development of phoneme awareness and rhyme awareness. Future research should address the mechanisms by which these different aspects of the home literacy environment have their influence.

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NOTES

1. We chose speech discrimination as the sole measure of representation strength because we previously showed that phonological strength measures do not constitute a unitary measure (Foy & Mann, 2001) and the only measure of phonological strength that correlated with home literacy measures in this study was speech discrimination.

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