Preschool foundations of early reading acquisition

Susan Rvachew PhD S-LP(C)[1], Robert Savage PhD[2]

S Rvachew, R Savage. Preschool foundations of early reading acquisition. Paediatr Child Health 2006;11(9):589-593.

The present paper describes research on the skills and processes associated with word and text reading acquisition in preschool children and during the first years of school. The aim is to provide an overview that gives a sense of the important milestones in language and literacy acquisition. A comparison of children's performances against these milestones may thus guide effective intervention for health professionals, parents and other professionals. Also summarized and explored are the role of speech perception and production, grammatical and syntactic skills, and metacognitive skills, including phonological awareness.

Key Words: *Child development; Emergent literacy; Language development; Reading*

Les fondements préscolaires de l'acquisition précoce de la lecture

Le présent article décrit les recherches sur les compétences et les processus associés à l'acquisition des mots et de la lecture de textes chez les enfants d'âge préscolaire et pendant les premières années d'école. Il vise à fournir un aperçu qui procure une notion des principales étapes de l'acquisition du langage et de l'alphabétisation. Une comparaison du rendement des enfants par rapport à ces étapes peut ainsi orienter des interventions efficaces de la part des professionnels de la santé, des parents et d'autres professionnels. Est également résumé et étudié le rôle de la perception de la parole et de l'expression orale ainsi que les compétences expressives, grammaticales, syntaxiques et métacognitives, y compris l'éveil phonologique.

What is reading? Common sense usage suggests that reading requires a range of different skills. For example, we use terms such as 'mind-reading' or 'reading the runes', reflecting a view of reading that is highly personal and interpretive in nature. On the other hand, a credit card 'reader' deciphers a card's bar code in a very direct 'data-driven' sense. In fact, it makes sense to view reading ability both ways. Research has shown that skilled reading requires both fast and efficient word recognition as well as the somewhat distinct capacity to understand connected text. In other words, reading comprehension is the product of word reading skills and linguistic comprehension (1). In turn, word reading and linguistic comprehension are each dependent on phonological processing, which is defined as the ability to represent acoustic speech input as a linear ordering of abstract speech sound units called phonemes.

The present article begins with a brief discussion of the biological and social determinants of reading acquisition. Subsequently, the development of language and emergent literacy skills in the preschool period and their relationship with the acquisition of reading are discussed.

ETIOLOGICAL FACTORS

Evidence from large-scale twin studies (2) suggest very strongly that there is a genetic basis for reading, with a heritability of approximately 0.5 being typical. There are probably quite distinct genetic influences on word reading and listening comprehension (3). Furthermore, there appear to be separable genetic influences on early precursors to these skills, with both behavioural and genetic linkages between preschool phonological processing measures and later word reading, and between preschool oral language abilities and later reading comprehension (4). Despite the possibility of unique genetic influences on these two foundations of literacy, they are not fully independent, as there is evidence of reciprocal interactions among oral language and phonological processing abilities and between word reading and reading comprehension skills (5).

Attempts are well underway to identify specific brain sites associated with word reading. Replicated evidence from positron emission tomography and magnetic resonance imaging studies link phonological processing to left temporoparietal cortex activation in adults (6). Diffusion

[1]*Department of Communication Sciences and Disorders, Faculty of Medicine;* [2]*Department of Educational and Counselling Psychology, Faculty of Education, McGill University, Montreal, Quebec*

Correspondence: Dr Susan Rvachew, Department of Communication Sciences and Disorders, Faculty of Medicine, McGill University, 1266 Pine Avenue West, Montreal, Quebec H3G 1A8. Telephone 514-398-4136, fax 514-398-8123, e-mail susan.rvachew@mcgill.ca

tensor magnetic resonance imaging has revealed that connectivity within this brain region is correlated with children's reading ability across a wide range of ability levels (from deficient to superior) (7). Relatively little is known about the relationship between more specific neurophysiological mechanisms and reading. Recent research (8) suggests that reading is closely related to DAT1, a high-risk allele closely associated with dopamine transmission and linked with inhibitory control difficulties. However, such work is still in its infancy and should be interpreted cautiously at this stage.

Although the heritability of reading and its precursors have been emphasized, social determinants of reading outcomes are also clearly evident. Variations in language input to the child and child language outcomes have been documented as a function of social class (9). There is plenty of evidence of socioeconomic status and ethnic differences in literacy skills at school entry and beyond (10).

SPEECH AND LANGUAGE UNDERPINNINGS

Oral language skills that are acquired during the infant and preschool periods are critical to the later acquisition of reading skills. Accurate perception and production of speech sounds are essential for learning the relationship between sounds and letters. The ability to understand oral language and express oneself coherently with grammatically correct sentences is directly related to written language comprehension and writing.

Speech perception

The foundation for oral language development is laid in the first year when the infant learns to perceive the speech sound contrasts of the maternal language. The infant is able to extract knowledge about language-specific meaningful sound contrasts, without knowledge of the meaning of words, through statistical learning mechanisms that are influenced by the distribution of sounds that occur in the speech input. The outcome of this learning process is governed by a complex interaction between the infant's auditory and learning abilities and the amount and nature of the speech input. The infant learns to ignore speech sound differences that are not meaningful while developing a heightened sensitivity to sound contrasts that are critical to later comprehension of language. Language-specific sensitivity to vowel contrasts is acquired during the first six months of life, while special sensitivity to consonant contrasts appears toward the end of the first year (11). The ability to respond to different words emerges during the second year of life, with toddlers responding initially to words that sound very different. Similar-sounding words (such as 'bear' and 'pear') are correctly identified before two years of age, when the words are produced very distinctly and presented in quiet conditions (12). The ability to perceive speech that is degraded or presented in difficult listening conditions is acquired very gradually through late childhood (13). The importance of speech perception to reading acquisition is highlighted by studies showing that speech perception abilities in infancy are associated with vocabulary learning in toddlerhood (14), that speech perception skills in preschoolers are associated with phonological awareness skills in kindergarten (15), and that speech perception deficits are associated with reading difficulties in older children (16). Furthermore, neurophysiological investigations have found that infants with a family history of dyslexia show unusual cortical responses to speech stimuli (17). The underlying cause of these speech perception deficits is not clear, although behavioural investigations suggest that children with dyslexia suffer fundamental difficulties with basic auditory processing (18).

Speech production

The ability to articulate speech also begins in infancy, with the emergence of canonical babble (ie, speech-like but nonmeaningful repetitive syllable sequences) between seven and 11 months of age. The development of babbling is profoundly impacted by the child's access to speech input and is clearly associated with the emergence of meaningful words in the second year of life (19). Although the child's first words are often inaccurate and difficult to understand, speech should be generally intelligible by three years of age and largely accurate by seven years of age (20). Difficulties with speech articulation offer an easily observable marker for developmental delays because parents are known to be reliable observers of their child's speech production accuracy, and these reports have been shown to be correlated with later speech and language development. For example, parents are able to reliably report when their infants first begin to babble (21). Parent ratings of the intelligibility of their preschool-aged child's speech have been shown to have excellent specificity and sensitivity as a screen for speech and language disability (22). Speech sound disorders and difficulties with phonological processing and reading are also clearly linked and may share a common genetic etiology (23).

Oral language

Delayed achievement of early expressive language milestones is another readily observable risk factor for ongoing difficulties with linguistic development and academic achievement. First words typically emerge at or before the first birthday. Total expressive vocabulary size expands rapidly thereafter, reaching approximately 100 words at 18 months of age and 200 words by 24 months of age, on average. Parental reports of vocabulary size can be used to identify late-talking toddlers as children who produce fewer than 20 words at 18 months of age or fewer than 50 words at 24 months of age. Although the majority of late-talking children achieve language skills that are at least minimally within the average range by three years of age, late-talkers as a group display significantly worse language skills than their peers through high school (24). The risk of persistent delays is substantial for certain subgroups of late-talking children, specifically toddlers, who have concomitant delays in language comprehension

and/or a family history of language or reading disability (25). Because language comprehension is difficult to observe in young children, all late-talking children should be referred to a speech-language pathologist for further assessment.

Difficulties with grammar are also correlated with reading disability and can be identified early as the failure to produce word combinations by two years of age or the persistence of certain grammatical errors (such as 'him walk' rather than 'he walks' or 'he walked') through to four years of age. Close behavioural correlations and genetic linkages are observed for vocabulary and grammar development (26), although these language skills are also strongly influenced by the quantity and sophistication of the language input provided by parents (27). Further advances in language skills are observed in the form of increasingly mature narrative skills as children progress through the early school years. The inability to tell a coherent story at school entry is a particularly good predictor of persistent language and reading disability among children with a history of delayed language development as preschoolers (28).

EMERGENT LITERACY SKILLS

Emergent literacy skills in general, and phonological awareness skills in particular, form a bridge between a child's development of oral language skills and the eventual acquisition of written language competence. These skills emerge in the preschool period from the interaction of the child's facility with oral language, and specific modelling and instruction on the part of parents and other caregivers (29).

Phonological awareness

Usually described as the capacity to reflect on the sound structure of the spoken language, phonological awareness is indexed by such diverse abilities as tapping out the number of syllables in a word, matching words that rhyme with each other, or deleting sounds from a given word (ie, Say 'rat' without the 'rrr'). Why is it important? The results of 30 years of research worldwide have shown that phonological awareness is perhaps the best predictor of reading ability that we currently have. Furthermore, poor knowledge of the sound structure of spoken language is considered to be the 'core' deficit that underlies reading disability (30). Kindergarten-aged children should be able to identify words that rhyme or share the same beginning sound. In fact, many children show some awareness of rhyme and alliteration as early as three years of age.

Letter knowledge

Letter name knowledge has a complex relationship with reading. While closely related to reading, it is also known that training letter names does not itself raise reading ability (31). Letter sound knowledge is also an important predictor of phonological skills, and may partly emerge from letter-name knowledge (32). Children may often represent the sounds in words using a combination of letter names and letter sounds (ie, 'bn' [bean]) in early spelling. Children are particularly likely to use letters from their own names at this stage (33). The authors have recently found that name writing ability (as measured by accuracy in representing initial, final, initial and final, or all letters of a child's name) is an excellent predictor of phonological abilities in five-year-old children. The ability to identify their own name or common environmental print items (ie, 'Coca-Cola', 'Loblaws' or the 'Ottawa Senators' hockey logo) were poor predictors of phonological abilities. It may be that in name writing, with a conscious and effortful focus on ordered letter representation, children first learn how to use explicit phonological abilities for literate ends.

Print concepts

As Marie Clay noted some years ago, more general print knowledge predicts reading success. In Clay's Sand: The Concept About Print Test (SANDS) (34), children are asked to point to the front of a book, signal directionality of print and identify a title (etc). Such measures used in kindergarten and early in the first year of school are predictive of reading (35), possibly because they index the child's prior experience with print and the extent to which the home and school environment supports the early acquisition of literacy skills. However, phonological awareness performance is a better indicator of risk for dyslexia.

SCREENING AND FOLLOW-UP

Many general development screening tools have items related to language and literacy development (ie, Infant and Child Development Inventories <www.childdevrev.com>; Ages and Stages Questionnaire <www.brookespublishing.com>). Parent-reported inventories that are specific to language development are also available (ie, Language Development Inventory <www.aseba.org>; McArthur Communicative Development Inventories <www.brookespublishing.com>). A speech and language milestones checklist is available at no charge from the Canadian Association of Speech-Language Pathologists and Audiologists (<www.caslpa.ca/PDF/milestones_brochure.pdf>). Screening instruments for the identification of delays in preliteracy and literacy skills have been developed, primarily for use by preschool and grade school teachers (ie, Phonological Awareness Literacy Screening <pals.virginia.edu>). As mentioned earlier, children who demonstrate delays in the acquisition of language or early literacy skills are at particular risk for dyslexia if there is a family history of language and literacy impairments. Children who are deemed at-risk should be referred to a speech-language pathologist or a developmental clinic for further assessment.

Indicators for the risk of future reading difficulties are the same for children who are learning to read in their first or second language; that is, language delay in the first language and/or poor letter name knowledge and phonological awareness skills in the first or second language would be cause for concern. Children who are not speaking the language of instruction at kindergarten entry have a disadvantage for phonological awareness skills in comparison with

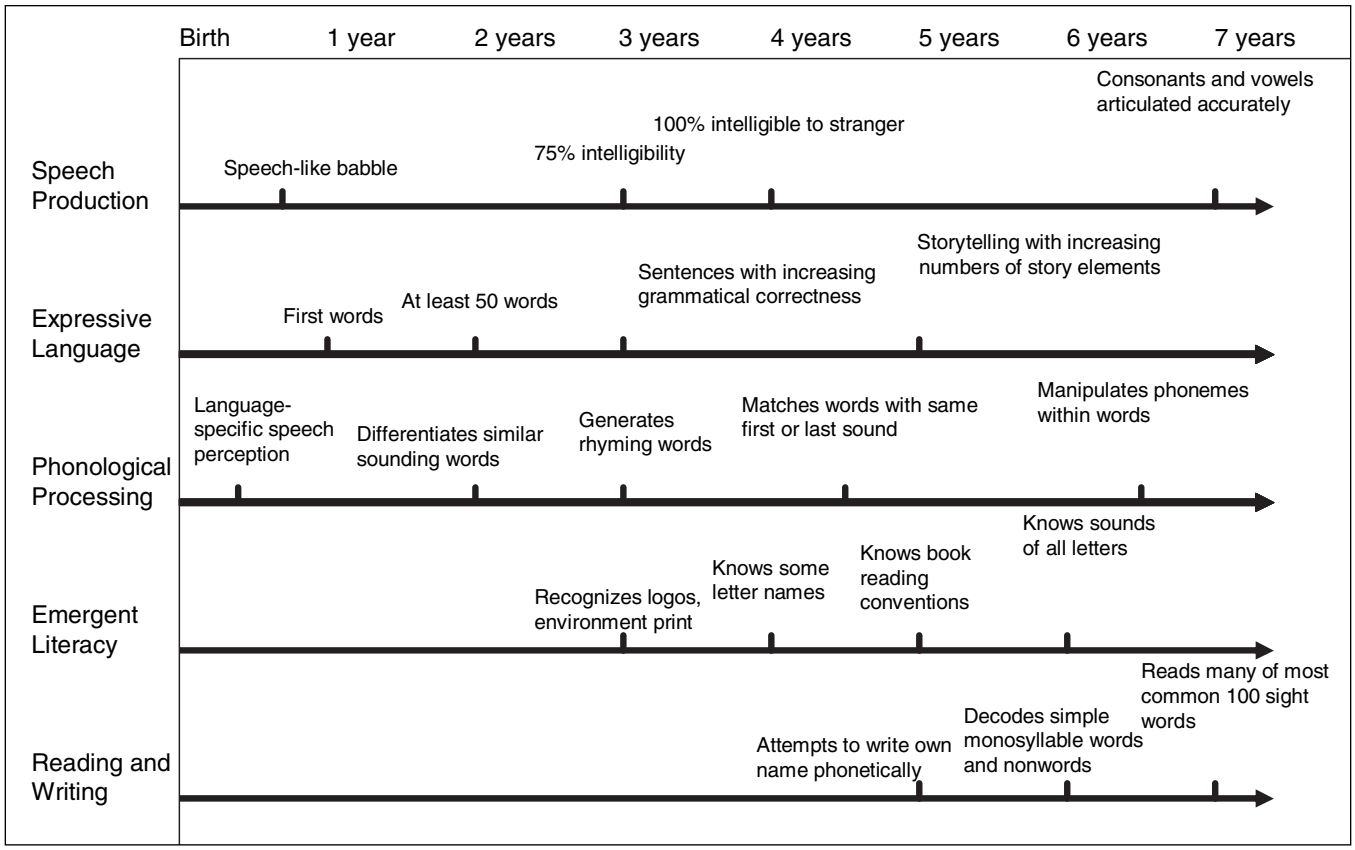

Figure 1) *Milestones on the path to literacy in the preschool period, extracted from a range of sources. They are based on a school entry of six years of age and adequate learning opportunities and experiences. Variations from this pattern should be seen as the starting point for a more detailed analysis, and do not in themselves allow for diagnosis. Children exposed to several languages at home or (pre)school may show different profiles*

children who speak the majority language. However, given appropriate instruction in preliteracy skills during the kindergarten year, these children will achieve expected levels of preliteracy and word reading skills by the first grade. This has been shown to be the case even when the child's first language is characterized by a markedly different phonological and writing system than English (ie, Chinese). Unfortunately, children's oral language skills in the second language typically do not catch up even after 17 months of education in the second language. These delays in oral language skills are likely to impact on reading comprehension in the later primary grades if they persist. However, delays in the acquisition of letter sound knowledge and basic decoding skills are not expected in children who are learning to read in a second language, and should thus be of equal concern for grade 1 children regardless of language background (36).

INTERVENTIONS

Individual differences in reading ability may be minimized through appropriate environmental inputs before the onset of formal reading instruction. Structured interventions during the preschool period have a significant impact on later reading acquisition. Randomized controlled trials have demonstrated unequivocally that language stimulation, interactive reading, explicit teaching of letter sounds and phonological awareness interventions, administered in daycare and kindergarten classrooms, can improve language and phonological awareness abilities in the short term and lead to improved reading outcomes over the long term (37-40). Furthermore, it has been shown that interventions for at-risk children are most effective when they begin during infancy (41). These studies show that simply exhorting parents to read to their children is not likely sufficient to prevent reading disability. Shared reading activities influence reading acquisition when the parent uses books for explicit teaching of new vocabulary, letter names and sounds, and print conventions. Parents and other caregivers can improve language skills by asking questions about the pictures and story that are designed to teach the child new words, encourage the child to recall and retell the story, and help the child to relate the story to their own experiences. Books can also be used to teach the child to identify letters and letter sounds and to focus on the sound structure of words.

CONCLUSIONS

Large-scale and longitudinal investigations of reading acquisition have shown that children who prove to be reading disabled are different from birth, evidencing atypical neural and behavioural responses to speech in infancy, delayed achievement of speech and language milestones as

preschoolers, and deficient emergent literacy skills at school entry. Many of these signs of future language and literacy difficulties are readily observable (Figure 1) and offer an opportunity for early identification and subsequent provision of interventions that focus on vocabulary development and phonological awareness as a means to prevent reading delay. However, we caution that although a focus on verbal cognition is important, it is not the only factor to consider. Space constraints in the present article preclude a detailed discussion of these wider issues, but clinical experience suggests that the fostering of a love of reading in a culture that values literacy, shared attention with an adult over books (in enjoyable low-stress contexts), personal motivation and interest are all likely to play a significant role in literacy acquisition.

ACKNOWLEDGEMENTS: This work was supported by funds from the Canadian Language and Literacy Research Network.

REFERENCES

1. Gough PB, Tunmer WE. Decoding, reading and reading disability. Remedial and Special Education 1986;7:6-10.
2. Rack JP, Olson RK. Phonological deficits, IQ, and individual differences in reading disability: Genetic and environmental influences. Dev Rev 1993;13:269-78.
3. Keenan JM, Betjemann RS, Wadsworth S, DeFries JC, Olson RK. Genetic and environmental influences on reading and listening comprehension. J Res Read 2006;29:75-91.
4. Hayiou-Thomas ME, Harlaar N, Dale PS, Plomin R. Genetic and environmental mediation of the prediction from preschool language and nonverbal ability to 7-year reading. J Res Read 2006;29:50-74.
5. Dickinson DK, McCabe A, Anastasopoulos L, Peisner-Feinberg ES, Poe MD. The comprehensive language approach to early literacy: The interrelationships among vocabulary, phonological sensitivity, and print knowledge among preschool-aged children. J Educ Psychol 2003;95:465-81.
6. Paulesu E, Demonet JF, Fazio F, et al. Dyslexia: Cultural diversity and biological unity. Science 2001;291:2165-7.
7. Beaulieu C, Plewes C, Paulson LA, et al. Imaging brain connectivity in children with diverse reading ability. Neuroimage 2005;25:1266-71.
8. Cornish KM, Manly T, Savage RS, et al. Association of the dopamine transporter (DAT1) 10/10-repeat genotype with ADHD symptoms and response inhibition in a general population sample. Mol Psychiatry 2005;10:686-98.
9. Hart B, Risley T. American parenting of language-learning children: Persisting differences in family-child interactions observed in natural home environments. Dev Psychol 1992;28:1096-105.
10. Duncan LG, Seymour PHK. Socio-economic differences in foundation-level literacy. Br J Psychol 2000;91:145-66.
11. Kuhl PK. Early language acquisition: Cracking the speech code. Nat Rev Neurosci 2004;5:831-43.
12. Mills DL, Prat C, Zangl R, Stager CL, Neville HJ, Werker JF. Language experience and the organization of brain activity to phonetically similar words: ERP evidence from 14- and 20-month-olds. J Cogn Neurosci 2004;16:1452-64.
13. Hazan V, Barrett S. The development of phonemic categorization in children aged 6-12. Journal of Phonetics 2000;28:377-96.
14. Tsao FM, Liu HM, Kuhl PK. Speech perception in infancy predicts language development in the second year of life: A longitudinal study. Child Dev 2004;75:1067-84.
15. Rvachew S. Longitudinal prediction of implicit phonological awareness skills. Am J Speech Lang Pathol 2006;15:165-76.
16. Joanisse MF, Manis FR, Keating P, Seidenberg MS. Language deficits in dyslexic children: Speech perception, phonology, and morphology. J Exp Child Psychol 2000;77:30-60.
17. Pihko E, Leppanen PH, Eklund KM, Cheour M, Guttorm TK, Lyytinen H. Cortical responses of infants with and without a genetic risk for dyslexia: I. Age effects. Neuroreport 1999;10:901-5.
18. Halliday LF, Bishop DV. Auditory frequency discrimination in children with dyslexia. J Res Read 2006;29:213-28.
19. Oller DK. The emergence of the speech capacity. New Jersey: Lawrence Erlbaum Associates, 2000.
20. Smit AB, Hand L, Freilinger JJ, Bernthal JE, Bird A. The Iowa Articulation Norms Project and its Nebraska replication. J Speech Hear Disord 1990;55:779-98. (Erratum in 1991;34:446).
21. Oller DK, Eilers RE, Basinger D. Intuitive identification of infant vocal sounds by parents. Developmental Science 2001;4(1):49-60.
22. Coplan J, Gleason JR. Unclear speech: Recognition and significance of unintelligible speech in preschool children. Pediatrics 1988;82:447-52. (Erratum in 1988;82:862).
23. Smith SD, Pennington BF, Boada R, Shriberg LD. Linkage of speech sound disorder to reading disability loci. J Child Psychol Psychiatry 2005;46:1057-66.
24. Rescorla L. Age 13 language and reading outcomes in late-talking toddlers. J Speech Lang Hear Res 2005;48:459-72.
25. Lyytinen P, Eklund K, Lyytinen H. Language development and literacy skills in late-talking toddlers with and without familial risk for dyslexia. Ann Dyslexia 2005;55:166-92.
26. Dionne G, Dale PS, Boivin M, Plomin R. Genetic evidence for bidirectional effects of early lexical and grammatical development. Child Dev 2003;74:394-412.
27. Chapman RS. Children's language learning: An interactionist perspective. J Child Psychol Psychiatry 2000;41:33-54.
28. McCabe A, Rollins PR. Assessment of preschool narrative skills. Am J Speech Lang Pathol 1994;3:45-56.
29. Senechal M, LeFevre JA. Parental involvement in the development of children's reading skill: A five-year longitudinal study. Child Dev 2002;73:445-60.
30. Stanovich KE, Beck IL. Progress in Understanding Reading: Scientific Foundations and New Frontiers. New York: Guilford Press, 2000.
31. Adams MJ. Beginning to read: Thinking and learning about print. Cambridge: MIT Press, 1990.
32. Lonigan CJ, Burgess SR, Anthony JL. Development of emergent literacy and early reading skills in preschool children: Evidence from a latent-variable longitudinal study. Dev Psychol 2000;36:596-613.
33. Bloodgood JW. What's in a name? Children's name writing and literacy acquisition. Reading Research Quarterly 1999;34:342-67.
34. Clay M. Sand: The Concept About Print Test. Portsmouth, Heinemann, 1972.
35. Stuart M. Prediction and qualitative assessment of five- and six-year-old children's reading: A longitudinal study. Br J Educ Psychol 1995;65:287-96.
36. Chiappe P, Siegel LS, Wade-Wooley L. Linguistic diversity and the development of reading skills: A longitudinal study. Scientific Studies of Reading 2002;6:369-400.
37. Ehri LC, Nunes SR, Willows DM, Schuster BV, Yaghoub-Zadeh Z, Shanahan T. Phonemic awareness instruction helps children learn to read: Evidence from the national reading panel's meta-analysis. Reading Research Quarterly 2001;36:250-87.
38. Whitehurst GJ, Epstein JN, Angell AL, Payne AC, Crone DA, Fischel JE. A picture book reading intervention in day care and home for children from low-income families. Dev Psychol 1994;30:679-89.
39. Whitehurst GJ, Zevenburger AA, Crone DA, Schultz MD, Velting ON, Fischel JE. Outcomes of an emergent literacy intervention from head start through second grade. J Educ Psychol 1999;91:261-72.
40. Byrne B, Fielding-Barnsley R, Ashley L. Effects of preschool phoneme identity training after six years: Outcome level distinguished from rate of response. J Educ Psychol 2000;92:659-67.
41. Campbell FA, Ramey CT, Pungello EP, Sparling J, Miller-Johnson S. Early childhood education: Young adult outcomes from the Abecedarian Project. Applied Developmental Science 2002;6:42-57.

Internet addresses are current at time of publication