

LANGUAGE DEVELOPMENT AND LITERACY

Speech Development and Literacy

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Introduction

Literacy is essential to success in modern life. Literacy levels predict school completion,¹ vocational outcomes,² mental³ and physical health,^{4,5} and quality of life.² Ensuring optimum literacy levels requires a focus on young children because oral language skills are the foundation of literacy.⁶ According to the “simple view of reading”⁷ the ability to comprehend text is determined by oral language comprehension and decoding skills. Decoding, or sounding out letters to recover words from print, is founded on the ability to perceive speech accurately, pronounce speech clearly and understand how speech sounds are combined to form words. These are all aspects of phonology. For most children, phonological development begins before birth, when the fetus hears the melody of maternal speech in the womb, and continues through 9 years of age when the child has learned to accurately pronounce all sounds in the native language.⁸

Subject

Speaking and reading are related because these skills are dependent upon phonological processing.^{9,10} Phonological processing includes perceiving speech sounds in speech input (‘bin’ and ‘pin’ sound different), recognizing patterns in speech input (‘hat’, ‘mat’, and ‘sat’ share a similar ending), and holding phonological information in memory long enough to use it (‘b’-‘a’-‘t’, that makes ‘bat’).^{11,12} Within the first year the normal-hearing infant has learned which speech sounds are important in the native language and which speech rhythms are commonly used in words and phrases.¹³ This knowledge supports the onset of babbling as well as word learning.¹⁴ Over time the young child learns how speech sounds are combined to form words and gradually speech accuracy improves.^{15,16} The older child combines an explicit awareness of the sound structure of words with the alphabetic principle to acquire reading.^{17,18}

Problem

Children vary greatly in phonological processing skills¹⁹ and in the rate and typology of speech development.²⁰

Children with the slowest speech development are at risk for reading disability (dyslexia) when they are school-age. However, some children with unclear speech have no difficulty learning to read and many children with dyslexia had no prior speech difficulties. The challenge of identifying and intervening to prevent reading difficulties is even greater when the child speaks more than one language or does not speak the school language at school entry. Another complication is that the relationship between accurate speech production and reading acquisition is not direct: it is mediated by phonological processing which is a relatively hidden ability. If the child has poor phonological processing but reasonably clear speech the child may not be referred for intervention. When a child with unclear speech is referred to a speech-language pathologist, the intervention may focus on producing accurate speech sounds while ignoring the underlying deficit in phonological processing.

Research Context

Longitudinal studies have revealed how earlier developing skills (speech accuracy, word learning, emergent literacy) predict later developing skills (decoding, reading comprehension). These studies might follow large samples of children drawn from the general population²¹⁻²³ or clinic-referred samples with known delays in speech and language development.²⁴⁻²⁶ Other longitudinal studies have examined the relative contributions of genetic and environmental factors to language and literacy outcomes by following twins²⁷ or children born to dyslexic parents.^{28,29} Other studies have examined family characteristics and parent behaviours that are associated with the development of emergent literacy skills during the preschool period.^{30,31} Finally, some studies have tried to determine best practices for speech-language pathologists and preschool teachers when providing services to children who are at-risk for reading difficulties.³²⁻³⁵

Key Research Questions

What can parents do to help their children be ready to learn to read at school entry? Which children with speech problems are most likely to have difficulties learning to read? What are the implications of this research literature for speech-language pathology practice when treating preschoolers with speech sound disorders?

Recent Research Results

Children with delayed or disordered speech development are at increased risk for dyslexia. It is important for parents and professionals to monitor the child's achievement of important milestones in speech development, specifically:

- 7 to 11 months: onset of babbling, that is, repetitive strings of speech-like syllables like “baba” and “deedee;”³⁶
- 3 to 4 years: intelligible speech, that is, even strangers can understand almost all or all of the child's speech;^{37,38}
- 4 to 6 years: implicit awareness of alliteration and rhyme and sounds in words;
- 7 to 9 years: accurate speech sound production, that is, all speech sounds are produced correctly although slight distortion of some sounds might occur but decline during this period.

The ages at which these milestones are achieved are roughly similar regardless of the language(s) that the child is learning even though the details of speech development vary by language group.^{39,40} A useful tool has been developed for measuring speech intelligibility in different languages (see <http://www.csu.edu.au/research/multilingual-speech/ics>).⁴¹ Not all children with unclear speech are at equal risk of dyslexia however. Referral to a speech-language pathologist is most important when there are additional risk factors, specifically concomitant delay in language skills and a family history of speech, language or reading problems.⁴² Note that multilingualism is not a specific risk factor for delayed acquisition of decoding skills.⁴³

Parents can teach their child phonological awareness which is the knowledge that words are made up of smaller parts.⁴⁴ Spoken language is a continuous stream of sound that does not map easily onto the letters or words that we see in print. Word games that involve breaking up words into parts and recombining them get the point across (football, tee-ball, teacup, buttercup). Matching words that share the same beginning (sun, soup, sand) to the appropriate letter (s) is an important activity that 4-year-olds can learn.⁴⁵ Most children know some of the alphabet before they begin kindergarten.⁴⁶ Phonological awareness skills are heritable because there is a strong genetic component to the neurodevelopmental underpinnings of phonological processing.^{27,47-50} When phonological processing is poor, a large vocabulary helps the child acquire better phonological awareness than they might otherwise⁹ as well as supporting future reading comprehension.^{18,51} High quality parental language input is essential to language development and shared reading is an excellent context for vocabulary teaching.⁵²⁻⁵⁴

These kinds of parental inputs will be especially important if the child is struggling to speak clearly. Speech sound disorders affect 3 to 5% of preschool aged children,²³ 11% of kindergarten aged children⁵⁵ (with at least a third of these also having a language disorder)⁵⁶ and 18% of 8-year-old children.⁵⁷ Children with unclear speech should be referred to a speech-language pathologist. Early intervention is desired because persistence of the speech problem past the point at which reading instruction begins is another risk factor for dyslexia.⁵⁸⁻⁶⁰ The speech-language pathologist must organize resources to address the child's challenges in the areas of speech accuracy, phonological processing and oral language development.⁶¹⁻⁶⁶

Research Gaps

Children with speech sound disorders are a heterogeneous population made up of different subgroups with varied risk of future reading difficulty.⁵⁹ The development of effective interventions for these specific subgroups is in the beginning stages. Furthermore, little is known about optimum intensity and scheduling of treatment.^{64,67} Boys are at greater risk of speech disorders^{68,69} and often score worse than girls on measures of emergent literacy and reading.^{70,71} More research to understand these gender differences and to develop gender-sensitive responses to speech and reading difficulties is required.

Conclusions

Phonological development begins before birth and continues throughout childhood with parallel and gradual improvements in speech perception, speech production accuracy and phonological awareness. Phonological development is closely linked to reading development and the ability to decode words in print is built upon these earlier developing oral language skills.

Implications for Parents, Services and Policy

Parents, educators and health care workers should monitor the child's achievement of certain easily observable milestones in speech production development—babbling by 11 months, speech intelligibility by 4 years and speech accuracy by 7 to 9 years. Parents and teachers can use direct teaching and shared reading to increase vocabulary size and phonological awareness, thus preparing the child for success when reading instruction begins in school.

For children with delayed speech development, the speech-language pathologist must attend to speech accuracy and underlying deficits in phonological processing that put the child at risk for dyslexia. Service providers should ensure that speech therapy services are sufficiently intense and multidisciplinary, engaging families, educators, and other professionals when necessary, to ensure that children achieve normalized speech, language and emergent literacy skills before the onset of formal reading instruction.

References

1. Hernandez DJ. *Double jeopardy: How third grade reading skills and poverty influence high school graduation*. Baltimore, MD: The Annie E. Casey Foundation; 2012.
2. OECD/Statistic Canada. *Literacy for life: Further results from the adult literacy and life skills survey*. Paris: OECD Publishing; 2011. <http://dx.doi.org/9789264091269-en>
3. Lincoln A, Espejo D, Johnson P, Paasche-Orlow M, Speckman JL, Webber TL, White RF. Limited literacy and psychiatric disorders among users of an urban safety-net hospital's mental health outpatient clinic. *The Journal of Nervous and Mental Disease* 2008;196(9):687-693. doi:10.1097/NMD.0b013e31817d0181.
4. Dewalt DA, Berkman ND, Sheridan S, Lohr KN, Pignone MP. Literacy and health outcomes: a systematic review of the literature. *Journal of General Internal Medicine* 2004;19(12):1228-1239.
5. Marcus EN. The silent epidemic — The health effects of literacy. *New England Journal of Medicine* 2006;355(4):339-342.
6. Rvachew S, Savage R. Preschool foundations of early reading acquisition. *Pediatrics and Child Health* 2006;11(9):589-593.
7. Gough PB, Tunmer WE. Decoding, reading, and reading disability. *Remedial and Special education* 1986;7(1):6-10. <https://doi.org/10.1177/074193258600700104>
8. Rvachew S, Brosseau-Lapr e F. *Developmental phonological disorders: Foundations of clinical practice*. 2nd ed. San Diego, CA: Plural Publishing, Inc.; 2016.
9. Rvachew S, Grawburg M. Correlates of phonological awareness in preschoolers with speech sound disorders. *Journal of Speech, Language, and Hearing Research* 2006;49(1):74-87.
10. Lyon GR, Shaywitz SE, Shaywitz BA. A definition of dyslexia. *Annals of Dyslexia* 2003;53(1):1-14. doi:10.1007/s11881-003-0001-9
11. McBride-Chang C. Phonological processing, speech perception, and reading disability: An integrative review. *Educational Psychologist* 1995;30(3):109-121.
12. Metsala JL. Young children's phonological awareness and nonword repetition as a function of vocabulary development. *Journal of Educational Psychology* 1999;91(1):3-19.
13. Kuhl PK. Early language acquisition: Cracking the speech code. *Nature Reviews: Neuroscience* 2004;5(11):831-843.
14. McGillion M, Herbert JS, Pine J, Vihman M, dePaolis R, Keren-Portnoy T, Matthews D. What paves the way to conventional language? The predictive value of babble, pointing, and socioeconomic status. *Child Development* 2017;88(1):156-166. doi:10.1111/cdev.12671
15. Roulstone S, Miller LL, Wren Y, Peters TJ. The natural history of speech impairment of 8-year-old children in the Avon Longitudinal Study of parents and children: Error rates at 2 and 5 years. *International Journal of Speech-Language Pathology* 2009;11(5):381-391.
16. Smit AB, Hand L, Freilinger JJ, Bernthal JE, Bird A. The Iowa articulation norms project and its Nebraska replication. *Journal of Speech and Hearing Disorders* 1990;55(4):779-798.
17. Lonigan CJ, Burgess SR, Anthony JL. Development of emergent literacy and early reading skills in preschool children: evidence from a latent-variable longitudinal study. *Developmental psychology* 2000;36(5):596-613.

18. Storch SA, Whitehurst GJ. Oral language and code-related precursors to reading: Evidence from a longitudinal structural model. *Developmental psychology* 2002;38(6):934-947.
19. Noble KG, McCandliss BD, Farah MJ. Socioeconomic gradients predict individual differences in neurocognitive abilities. *Developmental Science* 2007;10(4):464-480.
20. Vick JC, Campbell TF, Shriberg LD, Green JR, Abdi H, Rusiewicz HL, Venkatesh L, Moore CA. Distinct developmental profiles in typical speech acquisition. *Journal of Neurophysiology* 2012;107(10):2885-2900. doi:10.1152/jn.00337.2010
21. Thomas E, Senechal M. Long-term association between articulation quality and phoneme sensitivity: A study from age 3 to age 8. *Applied Psycholinguistics* 2004;25(4):513-541.
22. Durand VN, Loe IM, Yeatman JD, Feldman HM. Effects of early language, speech, and cognition on later reading: A mediation analysis. *Frontiers in Psychology* 2013;4:586. doi:10.3389/fpsyg.2013.00586
23. Eadie P, Morgan A, Ukoumunne OC, Ttofari Eecen K, Wake M, Reilly S. Speech sound disorder at 4 years: prevalence, comorbidities, and predictors in a community cohort of children. *Developmental Medicine & Child Neurology* 2015;57(6):578-584. doi:10.1111/dmcn.12635
24. Bird J, Bishop DV, Freeman NH. Phonological awareness and literacy development in children with expressive phonological impairments. *Journal of Speech and Hearing Research* 1995;38(2):446-462.
25. Rvachew S. Phonological processing and reading in children with speech sound disorders. *American Journal of Speech-Language Pathology* 2007;16(3):260-270.
26. Lewis BA, Avrich AA, Freebairn LA, Hansen AJ, Sucheston LE, Kuo I, Taylor HG, Iyengar SK, Stein CM. Literacy outcomes of children with early childhood speech sound disorders: Impact of endophenotypes. *Journal of Speech and Hearing Research* 2011;54(6):1628-1643. doi:10.1044/1092-4388(2011/10-0124)
27. Hayiou-Thomas ME, Harlaar N, Dale PS, Plomin R. Preschool speech, language skills, and reading at 7, 9, and 10 years: Etiology of the relationship. *Journal of Speech, Language & Hearing Research* 2010;53(2):311-332.
28. Snowling MJ, Melby-Lervåg M. Oral language deficits in familial dyslexia: A meta-analysis and review. *Psychological Bulletin* 2016;142(5):498-545. doi:10.1037/bul0000037
29. Lyytinen H, Aro M, Eklund K, Erskine J, Guttorm T, Laakso ML, Leppänen PH, Lyytinen P, Poikkeus AM, Torppa M. The development of children at familial risk for dyslexia: Birth to early school age. *Annals of Dyslexia* 2004;54(2):184-220.
30. Burgess SR. The influence of speech perception, oral language ability, the home literacy environment, and pre-reading knowledge on the growth of phonological sensitivity: A one-year longitudinal investigation. *Reading and Writing: An Interdisciplinary Journal* 2002;15(7):709-737.
31. Senechal M, LeFevre JA. Parental involvement in the development of children's reading: A five-year longitudinal study. *Child Development* 2002;73(2):445-460.
32. Justice LM. Evidence-based practice, response to intervention, and the prevention of reading difficulties. *Language, Speech & Hearing Services in Schools* 2006;37(4):284-297.
33. Justice LM, McGinty AS, Piasta SB, Kaderavek JN, Fan X. Print-focused read-alouds in preschool classrooms: Intervention effectiveness and moderators of child outcomes. *Language, Speech & Hearing Services in Schools* 2010;41(4):504-520.
34. Lonigan CJ, Anthony JL, Bloomfield BG, Dyer SM, Samwell CS. Effects of two shared-reading interventions on emergent literacy skills of at-risk preschoolers. *Journal of Early Intervention* 1999;22(4):306-322.
35. Hesketh A, Dima E, Nelson V. Teaching phoneme awareness to pre-literate children with speech disorder: a randomized controlled trial. *International Journal of Language and Communication Disorders* 2007;42(3):251-271.
36. Oller DK, Eilers RE, Basinger D. Intuitive identification of infant vocal sounds by parents. *Developmental Science* 2001;4(1):49-60.
37. Coplan J, Gleason JR. Unclear speech: Recognition and significance of unintelligible speech in preschool children. *Pediatrics* 1988;82(3 Pt 2):447-452.
38. McLeod S, Harrison LJ, McCormack J. The Intelligibility in Context Scale: Validity and reliability of a subjective rating measure. *Journal of Speech, Language, and Hearing Research* 2012;55(2):648-656. doi:10.1044/1092-4388(2011/10-0130)
39. Brosseau-Lapré F, Rvachew S, MacLeod A, Findlay K, Bérubé D, Bernhardt B. Une vue d'ensemble : Les données probantes sur le développement phonologique des enfants francophones canadiens. *Revue canadienne d'orthophonie et d'audiologie* 2018;42(1):1-19.
40. Brosseau-Lapré F, Rvachew S. Cross-linguistic comparison of speech errors produced by English- and French-speaking preschool age children with developmental phonological disorders. *International Journal of Speech-Language Pathology* 2014;16(2):98-108.
41. McLeod S. Intelligibility in Context Scale: A parent-report screening tool translated into 60 languages. *Journal of Clinical Practice in Speech-Language Pathology* 2015;17(1):7-12.

42. Rvachew S, Rafaat S. Report on benchmark wait times for pediatric speech sound disorders. *Canadian Journal of Speech-Language Pathology and Audiology* 2014;38(1):82-96.
43. Chiappe P, Siegel LS, Gottardo A. Reading-related skills of kindergartners from diverse linguistic backgrounds. *Applied Psycholinguistics* 2002;23(1):95-116. doi:10.1017/S014271640200005X
44. Senechal M, LeFevre J, Thomas EM, Daley KE. Differential effects of home literacy experiences on the development of oral and written language. *Reading Research Quarterly* 1998;33(1):96-116.
45. Schaefer B, Stackhouse J, Wells B. Phonological awareness development in children with and without spoken language difficulties: A 12-month longitudinal study of German-speaking pre-school children. *International Journal of Speech-Language Pathology* 2017;19(5):465-475. doi:10.1080/17549507.2016.1221449
46. Lerner MD, Lonigan CJ. Bidirectional relations between phonological awareness and letter knowledge in preschool revisited: A growth curve analysis of the relation between two code-related skills. *Journal of Experimental Child Psychology* 2016;144:166-183. <http://dx.doi.org/10.1016/j.jecp.2015.09.023>
47. Newbury DF, Monaco AP. Genetic advances in the study of speech and language disorders. *Neuron* 2010;68(2):309-320.
48. Lewis BA, Shriberg LD, Freebairn LA, Hansen AJ, Stein CM, Taylor HG, Iyengar SK. The genetic bases of speech sound disorders: Evidence from spoken and written language. *Journal of Speech, Language, and Hearing Research* 2006;49(6):1294-1312.
49. Tkach JA, Chen X, Freebairn LA, Schmithorst VJ, Holland SK, Lewis BA. Neural correlates of phonological processing in speech sound disorder: A functional magnetic resonance imaging study. *Brain and Language* 2011;119(1):42-49.
50. Preston JL, Felsenfeld S, Frost SJ, MencI WE, Fulbright RK, Grigorenko EL, Landi N, Seki A, Pugh KR. Functional brain activation differences in school-Age children with speech sound errors: Speech and print processing. *Journal of Speech, Language, and Hearing Research* 2012;55(4):1068-1082.
51. 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. *Journal of Educational Psychology* 2003;95(3):465-481.
52. Silven M, Niemi P, Voeten MJM. Do maternal interaction and early language predict phonological awareness in 3 to 4 year olds? *Cognitive Development* 2002;17(1):1133-1155.
53. Weizman ZO, Snow CE. Lexical input as related to children's vocabulary acquisition: Effects of sophisticated exposure and support for meaning. *Developmental psychology* 2001;37(2):265-279.
54. Mol SE, Bus AG, de Jong MT, Smeets DJH. Added value of dialogic parent-child book readings: A meta-analysis. *Early Education and Development* 2008;19(1):7-26.
55. Beitchman JH, Nair R, Clegg M, Patel PG, Ferguson B, Pressman E, Smith A. Prevalence of speech and language disorders in 5-year-old kindergarten children in the Ottawa-Carleton region. *Journal of Speech and Hearing Disorders* 1986;51(2):98-110.
56. Shriberg LD, Tomblin JB, McSweeney JL. Prevalence of speech delay in 6-year-old children and comorbidity with language impairment. *Journal of Speech, Language, and Hearing Research* 1999;42(6):1461-1481.
57. Wren Y, McLeod S, White P, Miller LL, Roulstone S. Speech characteristics of 8-year-old children: Findings from a prospective population study. *Journal of Communication Disorders* 2013;46(1):53-69. <http://dx.doi.org/10.1016/j.jcomdis.2012.08.008>
58. Nathan L, Stackhouse J, Goulandris N, Snowling MJ. The development of early literacy skills among children with speech difficulties: A test of the "critical age hypothesis". *Journal of Speech, Language, and Hearing Research* 2004;47(2):377-391.
59. Hayiou-Thomas ME, Carroll JM, Leavett R, Hulme C, Snowling MJ. When does speech sound disorder matter for literacy? The role of disordered speech errors, co?occurring language impairment and family risk of dyslexia. *Journal of Child Psychology and Psychiatry* 2017;58(2):197-205. doi:10.1111/jcpp.12648
60. Raitano NA, Pennington BF, Tunick RA, Boada R, Shriberg LD. Pre-literacy skills of subgroups of children with speech sound disorders. *Journal of Child Psychology and Psychiatry* 2004; 45(4):821-835.
61. Rvachew S, Brosseau-Lapr e F. An input-focused intervention for children with developmental phonological disorders. *Perspectives on Language Learning and Education* 2012;19(1):31-35.
62. Williams AL. Integrating phonological sensitivity training and oral language within an enhanced dialogic reading approach. In: Justice LM, ed. *Clinical approaches to emergent literacy intervention*. San Diego, CA: Plural Publishing Inc.; 2006:261-294.
63. Schmitt MB, Justice LM. Optimal intervention intensity for emergent literacy: What we know and need to learn. *International Journal of Speech-Language Pathology* 2012;14(5):451-455. doi:10.3109/17549507.2012.687057
64. Schmitt MB, Justice LM, Logan JA. Intensity of language treatment: contribution to children's language outcomes. *International Journal of Language & Communication Disorders* 2017;52(2):155-167. doi:10.1111/1460-6984.12254

65. Torgesen JK. The response to intervention instructional model: Some outcomes from a large-scale implementation in Reading First Schools. *Child Development Perspectives* 2009;3(1):38-40. doi:10.1111/j.1750-8606.2009.00073.x
66. Snow CE, Scarborough HS, Burns MS. What speech-language pathologists need to know about early reading. *Topics in Language Disorders* 1999;20(1):48-58.
67. Williams AL. Intensity in phonological intervention: Is there a prescribed amount? *International Journal of Speech-Language Pathology* 2012;14(5):456-461. doi:10.3109/17549507.2012.688866
68. Campbell TF, Dollaghan CA, Rockette HE, Paradise JL, Feldman HM, Shriberg LD, Sabo DL, Kurs-Lasky M. Risk factors for speech delay of unknown origin in 3-year-old children. *Child Development* 2003;74(2):346-357.
69. McLeod S, McKinnon DH. Prevalence of communication disorders compared with other learning needs in 14,500 primary and secondary school students. *International Journal of Language & Communication Disorders* 2007;42(Suppl. 1):37-59.
70. Deasley S, Evans A, Nowak S, Willoughby D. Sex differences in emergent literacy and reading behaviour in junior kindergarten. *Canadian Journal of School Psychology* 2018;33(1):26-43.
71. Walker S, Berthelsen D. Gender differences in early literacy and mathematics achievement and self-regulatory behaviours in the first year of school: An Australian study. *Australasian Journal of Early Childhood* 2017;42(1):70-78. doi:10.23965/AJEC.42.1.08