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Screening for Speech and Language Delay in Preschool Children

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Systematic Evidence Review
Number 41

**Screening for Speech and Language Delay in
Preschool Children**

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Preface

The Agency for Healthcare Research and Quality (AHRQ) sponsors the development of Systematic Evidence Reviews (SERs) through its Evidence-based Practice Program. With guidance from the U.S. Preventive Services Task Force* (USPSTF) and input from Federal partners and primary care specialty societies, the Evidence-based Practice Center at the Oregon Health Sciences University systematically review the evidence of the effectiveness of a wide range of clinical preventive services, including screening, counseling, and chemoprevention, in the primary care setting. The SERs—comprehensive reviews of the scientific evidence on the effectiveness of particular clinical preventive services—serve as the foundation for the recommendations of the USPSTF, which provide age- and risk-factor-specific recommendations for the delivery of these services in the primary care setting. Details of the process of identifying and evaluating relevant scientific evidence are described in the “Methods” section of each SER.

The SERs document the evidence regarding the benefits, limitations, and cost-effectiveness of a broad range of clinical preventive services and will help further awareness, delivery, and coverage of preventive care as an integral part of quality primary health care.

AHRQ also disseminates the SERs on the AHRQ Web site (<http://www.ahrq.gov/clinic/uspstfix.htm>) and disseminates summaries of the evidence (summaries of the SERs) and recommendations of the USPSTF in print and on the Web. These are available through the AHRQ Web site and through the National Guideline Clearinghouse (<http://www.ngc.gov>).

We welcome written comments on this SER. Comments may be sent to: Director, Center for Practice and Technology Assessment, Agency for Healthcare Research and Quality, 540 Gaither Road, Suite 3000, Rockville, MD 20850.

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*The USPSTF is an independent panel of experts in primary care and prevention first convened by the U.S. Public Health Service in 1984. The USPSTF systematically reviews the evidence on the effectiveness of providing clinical preventive services—including screening, counseling, and chemoprevention—in the primary care setting. AHRQ convened the USPSTF in November 1998 to update existing Task Force recommendations and to address new topics.

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STRUCTURED ABSTRACT

Context: Speech and language development is a useful initial indicator of a child's overall development and cognitive ability. Identification of children at risk for delay may lead to interventions, increasing chances for improvement. However, screening for speech and language delay is not widely practiced in primary care.

Objective: To determine the strengths and limits of evidence about the effectiveness of selecting, testing, and managing children with potential speech and language delay in the course of routine primary care. Key questions examined a chain of evidence about the accuracy and feasibility of screening children age 5 years and younger in primary care settings, role of risk factors in selecting children for screening, effectiveness of interventions for children identified with speech and language delay, and adverse effects of screening and interventions.

Data Sources: Relevant studies were identified from multiple searches of MEDLINE, PsycINFO, and CINAHL (1966 to November 19, 2004). Additional articles were obtained from recent systematic reviews, reference lists of pertinent studies, reviews, editorials, and websites, and by consulting experts.

Study Selection: Eligible studies had English-language abstracts, were applicable to U.S. clinical practice, and provided primary data relevant to key questions. Studies of children with previously diagnosed conditions known to cause speech and language delay were not included. Only randomized controlled trials were considered for examining the effectiveness of interventions. Studies with speech and language outcomes as well as non speech and language health and functional outcomes were included.

Data Extraction: Data were extracted from each study and entered into evidence tables.

Data Synthesis: Studies were summarized by descriptive methods and rated for quality using criteria developed by the USPSTF. A large descriptive literature of potential risk factors for speech and language delay in children is heterogeneous and results are inconsistent. A list of specific risk factors to guide primary care physicians in selective screening has not been developed or tested. The most consistently reported risk factors include a family history of speech and language delay and learning difficulties, male sex, and perinatal factors.

A total of 44 studies about evaluations taking 30 minutes or less to administer that could be administered in a primary care setting were considered to have potential for screening purposes. Studies included many different instruments, there were no accepted gold standards or referral criteria, and few studies compared the performance of 2 or more tests. Studies utilizing evaluations taking 10 minutes or less and rated good to fair in quality reported wide ranges of sensitivity and specificity when compared to reference standards (sensitivity 17% to 100%; specificity 45% to 100%). Studies did not provide enough information to determine how accuracy varied by age, setting, or administrator.

Fourteen good and fair-quality randomized controlled trials of interventions reported significantly improved speech and language outcomes compared to control groups. Improvement was demonstrated in several domains including articulation, phonology, expressive language, receptive language, lexical acquisition, and syntax among children in all age groups studied and across multiple therapeutic settings. Improvement in other functional outcomes, such as socialization skills, self-esteem, and improved play themes, were demonstrated in some, but not all, of the 4 studies measuring them. In general, studies of interventions were small, heterogeneous, may be subject to plateau effects, and reported short-term outcomes based on

various instruments and measures. As a result, long-term outcomes are not known, interventions could not be directly compared, and generalizability is questionable.

Conclusions: Use of risk factors to guide selective screening is not supported by studies. Several aspects of screening have been inadequately studied to determine optimal methods including what instrument to use, what age to screen, and what interval is most useful. Trials of interventions demonstrate improvement in some outcome measures, but conclusions and generalizability are limited. Data are not available addressing other key issues including the effectiveness of screening in primary care settings, role of enhanced surveillance by primary care physicians prior to referral for diagnostic evaluation, non speech and language and long-term benefits of interventions, adverse effects of screening and interventions, and cost.

Keywords: speech and language delay, preschool children, screening

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CHAPTER 1. INTRODUCTION

Speech and language development is considered a useful indicator of a child's overall development and cognitive ability by experts¹ and is related to school success.²⁻⁷ Identification of children at risk for developmental delay or related problems may lead to intervention services and family assistance at a young age when chances for improvement are best.¹ This rationale supports preschool screening for speech and language delay, or primary language impairment/disorder, as a part of routine well child care.

This evidence synthesis focuses on the strengths and limits of evidence about the effectiveness of screening and interventions for speech and language delay in preschool age children. Its objective is to determine the balance of benefits and adverse effects of routine screening in primary care for the development of guidelines by the U.S. Preventive Services Task Force (USPSTF). The target population includes all children up to age 5 years without previously known conditions associated with speech and language delay, such as hearing and neurological impairments. The evidence synthesis emphasizes the patient's perspective in the choice of tests, interventions, outcome measures, and potential adverse effects, and focuses on those that are available and easily interpreted in the context of primary care. It also considers the generalizability of efficacy studies performed in controlled or academic settings and interprets the use of the tests and interventions in community-based populations seeking primary health care.

Burden of Condition/Epidemiology

Speech and language development in children is a dynamic process. Language encompasses the understanding, processing, and production of communication. Language has been described as a code made up of rules that include what words mean, how to make new words, and how to combine words together.⁸ Understanding what word combinations are best in what situations is also part of the language code. Speech is the verbal communication of language.⁸

Several types of speech and language delay and disorders have been described, although terminology varies (Table 1).⁸ Expressive language delay may exist without receptive language delay but often they occur together in children as a mixed expressive/receptive language delay. Some children also have disordered language. Language problems can involve difficulty with grammar (syntax), words or vocabulary (semantics), the rules and system for speech sound production (phonology), units of word meaning (morphology) and the use of language particularly in social contexts (pragmatics). Speech problems may include stuttering or dysfluency, articulation disorders, or unusual voice quality. Language and speech problems can exist together or by themselves.⁸

Prevalence rates for speech and language delay have been reported across wide ranges. A recent Cochrane review summarized prevalence data on speech delay, language delay, and combined delay in preschool and school-aged children.⁹ For preschool children, 2 to 4.5 years old, studies evaluating combined speech and language delay reported prevalence rates ranging from 5% to 8%,^{10, 11} and studies of language delay from 2.3% to 19 %.^{9, 12-15} Untreated speech

and language delay in preschool children has shown variable persistence rates, from 0% to 100%, with most in the 40% to 60%.⁹ In one study, two-thirds of preschool children referred for speech and language therapy and given no direct intervention proved eligible for therapy 12 months later.¹⁶

Preschool children with speech and language delay may be at increased risk for learning disabilities once they reach school age.¹⁷ They may have difficulty reading in grade school,² exhibit poor reading skills at age 7 or 8,³⁻⁵ and have difficulty with written language,⁶ in particular. This may lead to overall academic underachievement,⁷ and, in some cases, lower IQ scores¹³ that may persist into young adulthood.¹⁸ As adults, children with phonological difficulties may hold lower skilled jobs than their non-language impaired siblings.¹⁹ In addition to persisting speech and language related underachievement (verbal, reading, spelling), language delayed children have also shown more behavior problems and impaired psychosocial adjustment.^{20, 21}

Healthcare Interventions

Assessing children for speech and language delay and disorders can involve a number of approaches, although there is no uniformly accepted screening technique for use in the primary care setting. Milestones for speech and language development in young children are generally acknowledged (Table 2).^{8, 22} Concerns for delay arise if there are no verbalizations by the age of one year, if speech is not clear, or if speech or language is different from that of other children of the same age.⁸ A specific diagnosis is most often made by a specialist utilizing a battery of instruments. Once a child has been diagnosed with a speech and language delay, interventions may be prescribed based on individual needs.

Screening. Most formal instruments for assessing speech and language were designed for diagnostic purposes and have not been widely evaluated for screening. Instruments constructed to assess multiple developmental components, such as the Ages and Stages Questionnaire,²³ Clinical Adaptive Test/Clinical Linguistic and Auditory Milestone Scale,²⁴ and Denver Developmental Screening Test,²⁵ include speech and language components. Instruments specific to communication domains include the MacArthur Communicative Development Inventory,²⁶ Ward Infant Language Screening Test, Assessment, Acceleration, and Remediation (WILSTAAR),²⁷ Fluharty Preschool Speech and Language,²⁸ Early Language Milestone Scale,²⁹ and several others. In addition, parent questionnaires and parent concern are often used to detect delay.³⁰

Interventions. Therapy takes place in various settings including speech and language specialty clinics, home, and schools or classrooms. Direct therapy or group therapy provided by a clinician, caretaker, or teacher can be child centered and/or include peer and family components. The duration of the intervention varies. Intervention strategies focus on one or more domains depending on individual needs, such as expressive language, receptive language, expressive phonology, receptive phonology, syntax, and lexical acquisition. Therapies can include naming objects, modeling and prompting, individual peer or group play, discrimination tasks, reading, and conversation.

Prior Recommendations and Guidelines

The Canadian Task Force on Preventive Health made recommendations on screening and intervention for global developmental disorders in preschool children, however, these do not

focus specifically on speech and language delay.³¹ The primary test evaluated in the Canadian review, the Denver Developmental Screening Test, included items on language expression and skills of articulation. However, due to limited evidence to support its validity and parental anxiety around use of the test, the Task Force did not recommend it. They also concluded that there was insufficient evidence to support either the inclusion or exclusion of other screening instruments to screen asymptomatic preschool children.

Professional organizations and other groups have recommended various levels of developmental assessment for preschool children. The American Academy of Pediatrics provides detailed interview and examination parameters for physician well child visits from newborn to late adolescence,²² as well as parameters for developmental surveillance and screening of infants to pre-kindergarten children.³² Another guide for physicians, the Harriet Lane Handbook,³³ devotes a chapter to development and behavior, describing milestones and recommendations for specific language screening tools for infants and toddlers (Clinical Linguistic and Auditory Milestone Scale)²⁴ and preschool aged children (Denver Developmental Assessment-language scales).²⁵ The American Academy of Child and Adolescent Psychiatry has recommendations for older children, however, none specific to preschool children.³⁴

Evaluations of the effectiveness of these guidelines are lacking and it is not clear how consistently clinicians screen for speech and language delay in primary care practice. In one study, 43% of parents reported that their young child (age 10 to 35 months) did not receive any type of developmental assessment at their well child visit, and 30% of parents reported that their child's physician had not discussed how the child communicates.³⁵ Potential barriers to screening include lack of time, no clear protocols, and the competing demands of the primary care visit.

Analytic Framework and Key Questions

The patient population, interventions, outcomes, and adverse effects of screening are summarized in an analytic framework (Figure 1). Corresponding key questions guide the literature review and evidence synthesis (Figure 2). Key questions examine a chain of evidence about the effectiveness, accuracy, and feasibility of screening children age 5 years and younger for speech and language delay in primary care settings (key questions 1 and 2), adverse effects of screening (key question 3), the role of enhanced surveillance in primary care (key question 4), effectiveness of interventions for children identified with delay (key questions 5, 6, and 7), and adverse effects of interventions (key question 8).

Studies addressing key question 1, corresponding to the overarching arrow in the analytic framework, would include all components in the continuum of the screening process. These include the screening evaluation, diagnostic evaluation for children identified with delay by the screening evaluation, interventions for children diagnosed with delay, and outcome measures allowing determination of the effectiveness of the overall screening process. Enhanced surveillance in primary care relates to the practice of closely observing children who may have clinical concern for delay but not of the degree warranting a referral (“watchful waiting”). Outcome measures in this review include speech and language specific outcomes as well as non-speech and language health and functional outcomes such as social behavior, self-esteem, family function, peer interaction, and school performance. Key questions 5 examines whether speech and language interventions lead to improved speech and language outcomes. Key question 6 examines whether speech and language interventions lead to improved non-speech and language

outcomes. Key question 7 evaluates the downstream effect of improved speech and language, such as improved school performance at a later age.

CHAPTER 2. METHODS

Literature Search and Strategy

Relevant studies were identified from multiple searches of MEDLINE, PsycINFO, and CINAHL databases (1966 to November 19, 2004). Search strategies are described in Appendix 2. Additional articles were obtained from recent systematic reviews,^{9, 36} reference lists of pertinent studies, reviews, editorials, and websites, and by consulting experts. In addition, investigators attempted to collect instruments and accompanying manuals, however, these materials are not generally available and must be purchased limiting the evidence review to published papers available through libraries.

Inclusion/Exclusion Criteria

Investigators reviewed all abstracts identified by the searches and determined eligibility by applying inclusion and exclusion criteria specific to each key question (Appendix 3). Full-text articles of included abstracts were then reviewed for relevance. Eligible articles had English-language abstracts, were applicable to U.S. clinical practice, and provided primary data relevant to key questions. Studies of children with previously diagnosed conditions known to cause speech and language delay (e.g., autism, mental retardation, Fragile X, hearing loss, degenerative and other neurological disorders) were not included because the scope of this review is screening children without known diagnoses. Only randomized controlled trials were

considered for examining the effectiveness of interventions. Studies related to other key questions included controlled trials, observational studies, and systematic reviews.

Studies of risk factors were included if they focused on children 5 years or younger, reported associations between predictor variables and speech and language outcomes, and were relevant to selecting candidates for screening. Otitis media as a risk factor for speech and language delay is a complex and controversial area and was not included in this review.

Studies of techniques to assess speech and language were included if they focused on children age 5 years and younger, could be applied to a primary care setting, used clearly defined measures, compared the screening technique to an acceptable reference standard, and reported data allowing calculation of sensitivity and specificity. Techniques taking more than 30 minutes to administer or could only be administered by specialists were considered inappropriate for routine screening in primary care. In general, if the instrument was administered by primary care physicians, nurses, research associates, or other nonspecialists for the study, it was assumed that it could be administered by nonspecialists in a clinic. For questionable cases, experts in the field were consulted to help determine appropriateness for primary care. Broader developmental screening instruments were included, such as the Ages and Stages Questionnaire and Denver Developmental Screening Test, if they provided outcomes related to speech and language delay specifically.

Outcome measures were considered if they were obtained at any time or age after screening and/or intervention as long as the initial assessment occurred while the child was age 5 years or younger. Outcomes included speech and language measures as well as other functional (e.g., social behavior, self-esteem, peer interaction and school performance) and health outcomes.

Data Extraction and Synthesis

All eligible studies were reviewed, and data were extracted from each study, entered into evidence tables, and summarized by descriptive methods. For some studies of screening instruments, sensitivity and specificity were calculated by the investigators if adequate data were presented in the paper. No statistical analyses were performed because of heterogeneity of studies, and investigators and members of the USPSTF concluded that speech and language outcomes do not provide data appropriate for an outcomes table model. Investigators independently rated the quality of studies using criteria specific to different study designs developed by the USPSTF (Appendix 4).³⁷ The quality of the study does not necessarily indicate the quality of an instrument or intervention, but may influence interpretation of the results of the study.

Size of Literature Reviewed

Investigators reviewed 5,377 abstracts identified by the searches (Appendix 5), and excluded 4,687 articles from further review because they focused on animals, studied the wrong population, were not applicable to U.S. clinical practice, were an opinion or letter with no data, or did not address key questions. From the searches, 690 full-text articles were reviewed. An additional 55 non-duplicate articles identified from reference lists and experts were also reviewed.

CHAPTER 3. RESULTS

Key Question 1. Does Screening for Speech and Language Delay Result in Improved Speech and Language as well as Improved Other Non-speech and Language Outcomes?

No studies addressed this question.

Key Question 2. Do Screening Evaluations in the Primary Care Setting Accurately Identify Children for Diagnostic Evaluation and Interventions?

2a. Does Identification of Risk Factors Improve Screening?

A total of 246 abstracts about risk factors for speech and language delay were identified from literature searches, and 78 full text papers were reviewed. Nine studies conducted in English speaking populations,³⁸⁻⁴⁶ and 7 studies from non-English speaking populations⁴⁷⁻⁵³ met inclusion criteria (Table 3; Appendix 6).

English-language studies included case control,^{39, 41-43, 45} cross sectional,^{38, 40, 44} and prospective cohort⁴⁶ designs. Sample sizes ranged from 24³⁸ to 1,102⁴⁵ subjects. Most studies evaluated risk for language delay with or without speech delay, and one restricted the evaluation to expressive language only.⁴⁶ Family history was the most consistent significantly associated risk factor in 5 of 7 studies that examined it.^{39, 41, 43-45} Family history was defined as family

members who were late talking or had language disorders, speech problems, or learning problems. Male sex was a significant factor in all 3 of the studies examining it.^{39, 41, 44} Three^{39, 43, 45} of 5 studies reported an association between lower maternal education level and language delay, while 3⁴³⁻⁴⁵ of 4 studies evaluating paternal education level reported a similar relationship. Other associated risk factors reported less consistently included childhood illnesses,^{38, 42} born late in the family birth order,⁴⁴ family size,⁴¹ older parents⁴¹ or younger mother⁴⁵ at birth, and low socioeconomic status or minority race.⁴² One study evaluating history of asthma found no association with speech and language delay.⁴¹

The 7 studies assessing risk in non-English speaking populations include case control,⁴⁹ cross sectional,⁴⁷ prospective cohort,⁵⁰⁻⁵³ and concurrent comparison⁴⁸ designs ranging from 72⁴⁸ to 8,370⁵³ subjects. Studies evaluated several types of delay including vocabulary,⁴⁸ speech,⁴⁷ stuttering,⁴⁹ language,⁵⁰⁻⁵³ and learning.⁵¹⁻⁵³ Significant associations were reported in the 2 studies evaluating family history,^{47, 50} and one of 2 studies evaluating male sex.⁵³ Three of 4 non-English language studies, including a cohort of more than 8,000 children in Finland,⁵³ reported significant associations with perinatal risk factors such as prematurity,^{52, 53} birth difficulties,⁴⁷ low birth weight,⁵³ and sucking habits.⁴⁷ An association with perinatal risk factors was not found in the one English language study that examined low birth weight.⁴⁵ Other associated risk factors reported less consistently include parental education level,^{51, 52} and family factors such as size and overcrowding.^{52, 53} These studies did not find associations with mother's stuttering or speaking style or rate,⁴⁹ mother's age,⁵³ and child temperament.⁴⁸

Key Questions 2b and 2c. What Are Screening Techniques and How Do They Differ by Age? What Is the Accuracy of Screening Techniques and How Does It Differ by Age?

A total of 44 papers reporting performance characteristics of 51 screening evaluations met inclusion criteria. Techniques taking 30 minutes or less to complete that could be administered in a primary care setting were considered to have potential for screening purposes, although many instruments were not designed specifically for this use. Studies utilized a variety of standardized and nonstandardized instruments and compared them with several different reference standards. No gold standard was acknowledged or used across studies. Instruments are described in Appendix 7. Studies were grouped by age categories according to the youngest ages included, although many studies included children in overlapping categories. Studies provided limited demographic details of subjects, and most included predominantly Caucasian children with similar proportions of boys and girls. Studies are summarized in Table 4 (up to 2 years old), Table 5 (ages 2 to 3 years), and Table 6 (ages 3 to 5 years). Quality scores are described in Appendix 8.

Ages 0 to 2 years. Twenty-one studies described performance characteristics of 25 evaluations for children up to 2 years old.^{12, 29, 54-72} Eleven studies from 10 publications utilized instruments taking 10 minutes or less to administer, including the Early Language Milestone Scale,^{29, 63} Parent Evaluation of Developmental Status,⁶⁷ Denver Developmental Screening Test II (language component),⁶⁸ Pediatric Language Acquisition Screening Tool for Early Referral,⁶⁰ Clinical Linguistic and Auditory Milestone Scale,⁶⁵ Language Development Survey,^{54, 58, 69} and the Bayley Infant Neurodevelopmental Screener.⁵⁶ Of these, 6 studies tested expressive and/or

receptive language,^{29, 56, 60, 63, 67, 68} 3 expressive vocabulary,^{54, 58, 69} one articulation,⁷³ and one syntax and pragmatics.⁶⁵ Testing was conducted in general health clinics, specialty clinics, day care centers, schools, and homes by pediatricians, speech and language specialists, psychologists, medical or graduate students, parents, and research assistants. Study sizes ranged from 48⁶³ to 422⁵⁸ subjects. One study enrolled predominantly African American children.⁶⁰

For the 10 fair and good-quality studies providing data to determine sensitivity and specificity of evaluating children up to 2 years old with instruments administered in 10 minutes or less sensitivity ranged from 22% to 97% and specificity from 66% to 97% (Figure 3a-b).^{29, 54, 56, 58, 60, 65, 67-69} Four studies reported sensitivity and specificity of 80% or better: a fair-quality study using the Early Language Milestone Scale,²⁹ 2 studies, rated fair to good⁶⁹ and fair,⁵⁴ using the Language Development Survey, and one fair-quality study using the Clinical Linguistic and Auditory Milestone Scale.⁶⁵ The study of the Clinical Linguistic and Auditory Milestone Scale also determined sensitivity and specificity by age, and reported higher sensitivity/specificity at age 14 to 24 months (83%/93%) than 25 to 36 months (68%/89%) for receptive function, but lower sensitivity/specificity at age 14 to 24 months (50%/91%) than 25 to 36 months (88%/98%) for expressive function.⁶⁵ A study testing expressive vocabulary using the Language Development Survey indicated higher sensitivity/specificity at age 2 years (83%/97%) than at age 3 years (67%/93%).⁵⁴

Ages 2 to 3 years. Twelve studies described performance characteristics of 14 evaluations for children ages 2 to 3 years.^{11, 74-84} Ten studies in 9 publications utilized instruments taking 10 minutes or less to administer, including the Parent Language Checklist,¹¹ Structured Screening Test,⁷⁵ Levett-Muir Language Screening Test,⁸¹ Fluharty Preschool Speech and Language

Screening Test,^{76, 83} Screening Kit of Language Development,⁷⁷ Hackney Early Language Screening Test,^{79, 80} and Early Language Milestone Scale.⁸⁴ All studies tested expressive and/or receptive language,^{11, 75-77, 79-81, 83, 84} 3 articulation,^{76, 83} and one syntax and phonology.⁸¹ Testing was conducted in general health clinics, specialty clinics, preschools, and homes by pediatricians, speech and language specialists, teachers, parents, and health visitors. Study sizes ranged from 25⁷⁹ to 2,590¹¹ subjects. One study included subjects predominantly from rural areas.⁸³

For the 8 fair and good quality studies providing data to determine sensitivity and specificity of evaluating children ages 2 to 3 years with instruments administered in 10 minutes or less, sensitivity ranged from 17% to 100% and specificity from 45% to 100% (Figure 4a-b). Two studies reported sensitivity and specificity of 80% or better: one study rated fair that used the Levett-Muir Language Screening Test,⁸¹ and one rated fair that used the Screening Kit of Language Development.⁷⁷ The study of the Screening Kit of Language Development reported comparable sensitivity/specificity at ages 30 to 36 months (100%/98%), 37 to 42 months (100%/91%), and 43 to 48 months (100%/93%).⁷⁷

Ages 3 to 5 years. Eleven studies described performance characteristics of 12 evaluations for children ages 3 to 5 years.^{73, 76, 85-93} Three studies utilized instruments taking 10 minutes or less to administer, including the Fluharty Preschool Speech and Language Screening Test,⁷³ Test for Examining Expressive Morphology,⁸⁸ and the Sentence Repetition Screening Test.⁹³ Of these, 2 studies tested expressive and receptive language and articulation,^{73, 93} and one expressive vocabulary and syntax.⁸⁸ Testing was conducted in general clinics, specialty clinics, and

preschools by nurses, speech and language specialists, and teachers. Study sizes ranged from 40⁸⁸ to 182⁷³ subjects.

For the 3 fair quality studies providing data to determine sensitivity and specificity of evaluating children ages 3 to 5 years with instruments administered in 10 minutes or less (including the study of the Screening Kit of Language Development described in the previous section⁷⁷), sensitivity ranged from 57% to 100% and specificity from 80% to 95% (Figure 5a-b).^{73, 77, 93}

Systematic review. A Cochrane systematic review of 45 studies, including most of the studies cited above, summarized the sensitivity and specificity of instruments taking 30 minutes or less to administer.⁹ Sensitivity of instruments for normally developing children ranged from 17% to 100%, and for children from clinical settings from 30% to 100%. Specificity ranged from 43% to 100%, and 14% to 100% respectively. Studies considered to be of higher quality tended to have higher specificity than sensitivity (+4.41, p<0.001), however, high false-positive and false-negative rates were often reported.⁹

2d. What Are the Optimal Ages and Frequency for Screening?

No studies addressed this question.

Key Question 3. What Are the Adverse Effects of Screening?

No studies addressed this question. Potential adverse effects include false positive and false negative results. False positive results can erroneously label children with normal speech and language as impaired, potentially leading to anxiety for children and families and further

testing and interventions. False negative results would miss identifying children with impairment, potentially leading to progressive speech and language delay and other long-term effects including communication, social, and academic problems. In addition, once delay is identified, children may be unable to access services because of unavailability or lack of insurance coverage.

Key Question 4. What Is the Role of Enhanced Surveillance by Primary Care Clinicians?

This question relates to the role of enhanced surveillance by a primary care clinician once a child demonstrates clinical concern for speech and language delay. No studies addressed this question.

Key Question 5. Do Interventions for Speech and Language Delay Improve Speech and Language Outcomes?

Twenty-five randomized controlled trials in 24 publications met inclusion criteria (Table 7; Appendix 9) including one rated good,⁹⁴ 13 fair,⁹⁵⁻¹⁰⁷ and 11 poor quality^{99, 108-117} (Appendix 10). Studies were considered poor quality if they reported important differences between intervention and comparison groups at baseline, did not use intention-to-treat analysis, no method of randomization was reported, and there were fewer than 10 subjects in intervention or comparison groups. Limitations of studies, in general, include small numbers of participants (only 4 studies enrolled more than 50 subjects), lack of consideration of potential confounders, and disparate methods of assessment, intervention, and outcome measurement. As a result, conclusions about effectiveness are limited. Although children in the studies ranged from 18 to

75 months old, most studies included children age 2 to 4 years old and results do not allow determination of optimal ages of intervention.

Studies evaluated the effects of individual or group therapy directed by clinicians and/or parents focusing on specific speech and language domains. These include expressive and receptive language, articulation, phonology, lexical acquisition, and syntax. Several studies used established approaches to therapy, such as the WILSTAAR program¹¹⁸ and the HANEN principles.^{100, 101, 107, 115} Others used more theoretical approaches, such as focused stimulation,^{100, 101, 108, 109, 115} auditory discrimination,^{105, 112} imitation or modeling procedures,^{98, 114} auditory processing or word mapping,¹⁰⁷ and play narrative language.^{102, 103} Some interventions focused on specific words and sounds, used unconventional methods, or targeted a specific deficit.

Outcomes were measured by subjective reports from parents,^{99, 100, 102, 107} and by scores on standardized instruments, such as the Reynell Expressive and Receptive Scales,^{96, 99} the Preschool Language Scale,^{94, 97, 107} and the MacArthur Communicative Development Inventories.^{102, 115} The most widely used outcome measure was Mean Length Utterances (MLUs) used by 6 studies.^{95, 97, 99, 102, 107}

Studies rated good or fair quality are described below by age categories according to the youngest ages included, although many studies included children in overlapping categories.

Ages 0 to 2 years. No studies examined this age group exclusively, although one good-quality study enrolled children 18 to 42 months old.⁹⁴ The clinician-directed, 12-month intervention consisted of 10-minute weekly sessions focusing on multiple language domains, expressive and receptive language, and phonology. Treatment for receptive auditory comprehension lead to

significant improvement for the intervention group compared to control group, however, results did not differ between groups for several expressive and phonology outcomes.⁹⁴

Ages 2 to 3 years. One good⁹⁴ and 6 fair-quality studies^{99-102, 106, 107} evaluated speech and language interventions for children 2 to 3 years old. Studies reported improvement on a variety of communication domains including clinician-directed treatment for expressive and receptive language,¹⁰² parent-directed therapy for expressive delay,^{99, 100} and clinician-directed receptive auditory comprehension.⁹⁴ Lexical acquisition was improved with both clinician-directed therapy^{106, 113} and group therapy approaches.¹⁰⁶ In 3 studies, there were no between group differences for clinician-directed expressive^{94, 107} or receptive language therapy,^{94, 107} parent-directed expressive or receptive therapy,¹⁰⁷ or parent-directed phonology treatment.¹⁰¹

Ages 3 to 5 years. Five fair-quality studies reported significant improvements for children 3 to 5 years old undergoing interventions compared to controls,^{95, 96, 98, 103, 104} while 2 studies reported no differences.^{97, 105} Both group-based interventions¹⁰³ and clinician-directed interventions⁹⁶ were successful at improving expressive and receptive competencies.

Systematic review. A Cochrane systematic review included a meta-analysis utilizing data from 25 randomized controlled trials of interventions for speech and language delay for children up to adolescence.³⁶ Twenty-three of these studies also met criteria for this review and were included,^{94-114, 117} and 2 trials were unpublished. The review reported results in terms of standard mean differences (SMD) in scores for a number of domains (expressive and receptive phonology, syntax, and vocabulary). Effectiveness was considered significant for both the

phonological (SMD=0.44; 95% CI, 0.01-0.86) and vocabulary (SMD=0.89; 95% CI, 0.21-1.56) interventions. Less effective was the receptive intervention (SMD=-0.04; 95% CI, 0.64-0.56), and results were mixed for the expressive syntax intervention (SMD=1.02; 95% CI, 0.04-2.01). In the analysis, when interventions were comparable in duration and intensity, there were no differences between interventions when administered by trained parents or clinicians for expressive delays. Use of normal language peers as part of the intervention strategy also proved beneficial.¹⁰³

Key Question 6. Do Interventions for Speech and Language Delay Improve Other Non-Speech and Language Outcomes?

Four good⁹⁴ or fair-quality^{102, 103, 107} intervention studies included functional outcomes other than speech and language (Table 7; Appendix 9). Increased toddler socialization skills,¹⁰² improved child self-esteem,¹⁰⁷ and improved play themes¹⁰³ were reported for children in intervention groups in 3 studies. Improved parent-related functional outcomes included decreased stress¹⁰² and increased positive feelings toward their children.¹⁰⁷ Functional outcomes studied but not showing significant treatment effects included well being, levels of play and attention, and socialization skills in one study.⁹⁴

Key Question 7. Does Improvement in Speech and Language Outcomes Lead to Improved Additional Outcomes?

No studies addressed this question.

Key Question 8. What Are the Adverse Effects of Interventions?

No studies addressed this question. Potential adverse effects of treatment programs include the impact of time and cost of interventions on clinicians, parents, children, and siblings. In addition, loss of time for play and family activities, stigmatization, and labeling may be potential adverse effects.

Key Question 9. What Are Cost-Effectiveness Issues?

No studies addressed this question.

CHAPTER 4. DISCUSSION

Conclusions

Results of the evidence synthesis are summarized in Table 8 by key question. Studies are not available addressing the overarching key question about the effectiveness of screening (key question 1), adverse effects of screening (key question 3), the role of enhanced surveillance in primary care (key question 4), long-term effectiveness of interventions on non-speech and language outcomes for children identified with delay (key questions 7), and adverse effects of interventions (key question 8). No studies determine the optimal ages and frequency for screening (key question 2d). Relevant studies are available regarding the use of risk factors for screening (key question 2a), techniques for screening (key question 2b and 2c), and effectiveness of interventions on short-term speech and language and non-speech and language outcomes for children identified with delay (key questions 5 and 6).

The use of risk factors for selective screening has not been evaluated and a list of specific risk factors to guide primary care physicians has not been developed or tested. Sixteen studies about potential risk factors for speech and language delay in children enrolled heterogeneous populations, had dissimilar inclusion and exclusion criteria, and measured different risk factors and outcomes. The most consistently reported risk factors included a family history of speech and language delay, male sex, and perinatal factors. Other risk factors reported less consistently included educational levels of the mother and father, childhood illnesses, birth order, and family size.

The performance characteristics of 51 evaluations using 32 instruments taking 30 minutes or less to administer were described in 44 studies relevant to screening. Studies utilizing evaluations taking 10 minutes or less and rated good to fair in quality reported wide ranges of sensitivity and specificity when compared to reference standards (sensitivity 17% to 100%; specificity 45% to 100%). In these studies, instruments providing the highest sensitivity and specificity included the Early Language Milestone Scale, Clinical Linguistic and Auditory Milestone Scale, Language Development Survey, Screening Kit of Language Development, and the Levett-Muir Language Screening Test. Most of the evaluations, however, were not designed for screening purposes, instruments measured different domains, and the study populations and settings were often outside primary care. No gold standard has been developed and tested for screening, reference standards varied across studies, few studies compared the performance of 2 or more screening techniques in one population, and comparisons of a single screening technique across different populations are lacking. The optimal methods and ages for screening cannot be determined from these studies.

Randomized controlled trials of multiple types of interventions reported significantly improved speech and language outcomes compared to control groups. Improvement was demonstrated in several domains including articulation, phonology, expressive language, receptive language, lexical acquisition, and syntax among children in all age groups studied and across multiple therapeutic settings. However, studies were small, heterogeneous, may be subject to plateau effects, and reported short-term outcomes based on various instruments and measures. As a result, long-term outcomes are not known, interventions could not be directly compared to determine optimal approaches, and generalizability is questionable.

Limitations of the Literature

There are many limitations of the literature relevant to screening for speech and language delay in preschool age children including lack of studies specific to screening as well as difficulties inherent in this area of research. This evidence review is limited by use of only published studies of instruments and interventions. Data about performance characteristics of instruments, in particular, are not generally accessible and are often only available in manuals that must be purchased. Interventions vary widely and may not be generalizable. In addition, studies from countries with different health care systems, such as the U.K., may not translate well to U.S. practice.

Although speech and language development is multi-dimensional, the individual constructs that comprise it are often assessed separately. Numerous evaluation instruments and interventions accommodating children across a wide range of developmental stages have been developed to identify and treat specific abnormalities of these functions. As a result, studies

include many different instruments and interventions that are most often designed for purposes other than screening. Also, studies of interventions typically focus on one or a few interventions. In clinical practice, children are provided with individualized therapies consisting of multiple interventions. The effectiveness of these complex interventions may be difficult to evaluate. Adapting results of this heterogeneous literature to determine benefits and adverse effects of screening is problematic. Also, behavioral interventions are difficult to conduct in long-term randomized trials, and it is not possible to blind parents or clinicians. Randomizing children to therapy or control groups when clinical practice standards support therapy raise ethical dilemmas.

Speech and language delay is defined by measurements on diagnostic instruments in terms of a position on a normal distribution. Measures and terminology are inconsistently used and there is no recognized gold standard. This is challenging when defining cases and determining performance characteristics of screening instruments in studies.

Identification of speech and language delay may be associated with benefits and adverse effects that would not be captured by studies of clinical or health outcomes. The process of screening alerts physicians and caretakers to developmental milestones and focuses attention on the child's development, potentially leading to increased surveillance, feelings of caregiver support, and improved child self esteem. Alternatively, caretakers and children may experience increased anxiety and stress during the screening and evaluation process. Detection of other conditions during the course of speech and language evaluation, such as hearing loss, is an unmeasured benefit if appropriate interventions can improve the child's status.

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Future Research

Future research should focus on determining optimal approaches of identifying preschool age children with speech and language delay in primary care settings who would be appropriate candidates for further evaluations and possibly speech and language interventions. These approaches should be integrated into routine developmental surveillance practices of clinicians caring for children.¹¹⁹ Studies evaluating the effectiveness of validated brief screening instruments that include child and caretaker components could lead to a more standardized approach. Studies of specific speech and language components of currently available broad developmental screening instruments, such as Ages and Stages, would be useful. Incorporation of risk factors and parent report in studies of screening approaches could provide information about their added value. Additional studies that compare screening instruments and methods in large primary care populations could lead to defining gold standards and acceptable referral criteria. Evaluating these in different populations of children would minimize cultural and language biases.

Future research should determine the benefits and adverse effects of undergoing screening, diagnostic evaluation, and treatment, and how these impact later development.

Translational studies of professional guidelines, Bright Futures, Centers for Disease Control and Prevention goals, and others would be useful to determine the feasibility and impact of screening. Further work about the effectiveness of interventions, including speech and language domain specific results, may provide new insights. School-based efforts could be designed to complement strategies developed for young children improving long term outcomes. Results of these studies may help determine optimal ages and intervals for screening. Functional long term outcomes such as school performance and social adjustment need to be more thoroughly addressed.

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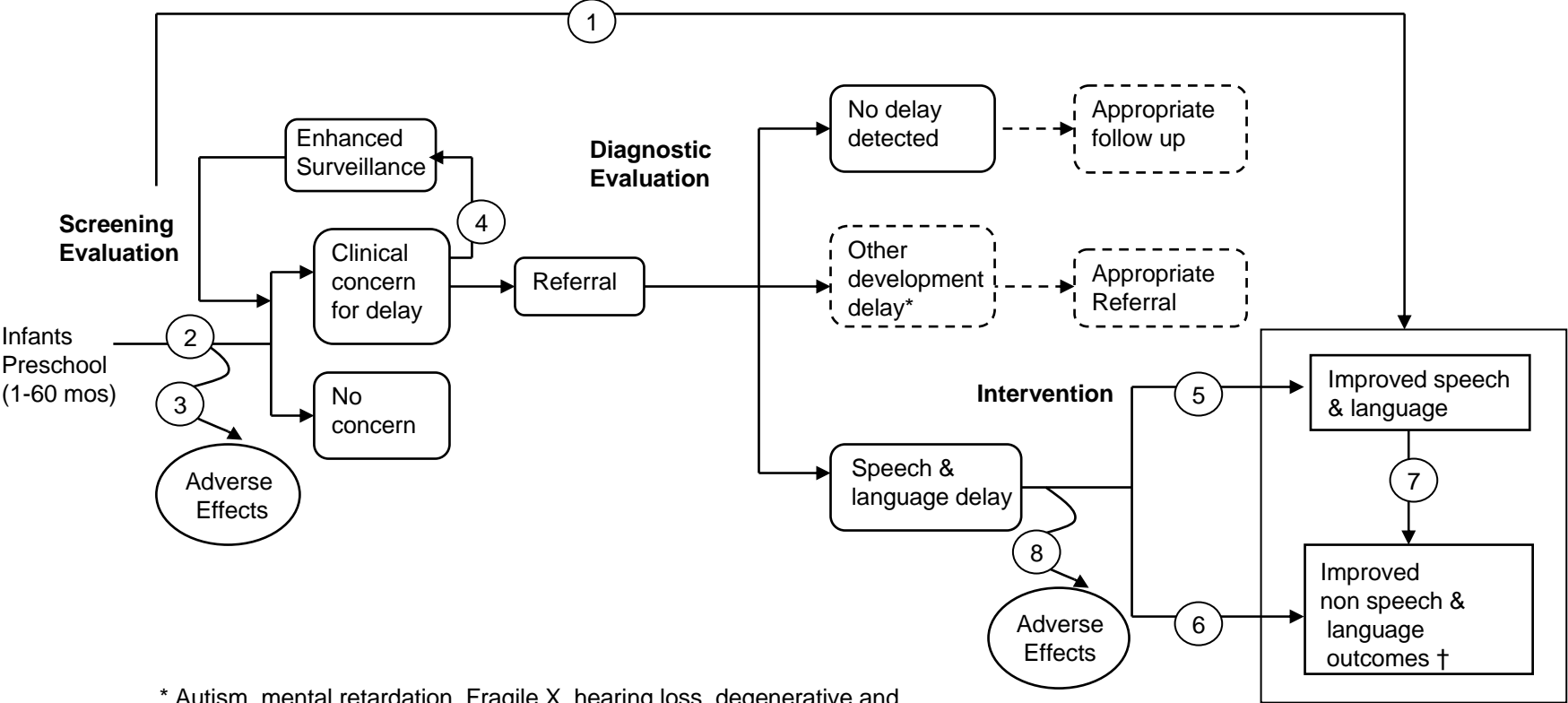
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FIGURE 1. ANALYTIC FRAMEWORK



* Autism, mental retardation, Fragile X, hearing loss, degenerative and other neurologic disorders.

† School performance, family function, social function, and others.

FIGURE 2. KEY QUESTIONS

Key Questions

1. Does screening for speech & language delay result in improved speech & language as well as improved other non speech & language outcomes?
2. Do screening evaluations in the primary care setting accurately identify children for diagnostic evaluation and interventions?
 - a. Does identification of risk factors improve screening?
 - b. What are screening techniques and how do they differ by age?
 - c. What is the accuracy of screening techniques and how does it vary by age?
 - d. What are the optimal ages and frequency for screening?
3. What are the adverse effects of screening?
4. What is the role of enhanced surveillance by primary care clinicians?
5. Do interventions for speech & language delay improve speech & language outcomes?
6. Do interventions for speech & language delay improve other non speech & language outcomes?
7. Does improvement in speech & language outcomes lead to improved additional outcomes?
8. What are the adverse effects of interventions?
9. What are cost effectiveness issues?

**FIGURE 3A. SENSITIVITY AND SPECIFICITY OF INSTRUMENTS FOR AGES UP TO 2 YEARS
STUDIES RATED FAIR TO GOOD WITH INSTRUMENTS TAKING 10 MINUTES OR LESS TIME TO ADMINISTER**

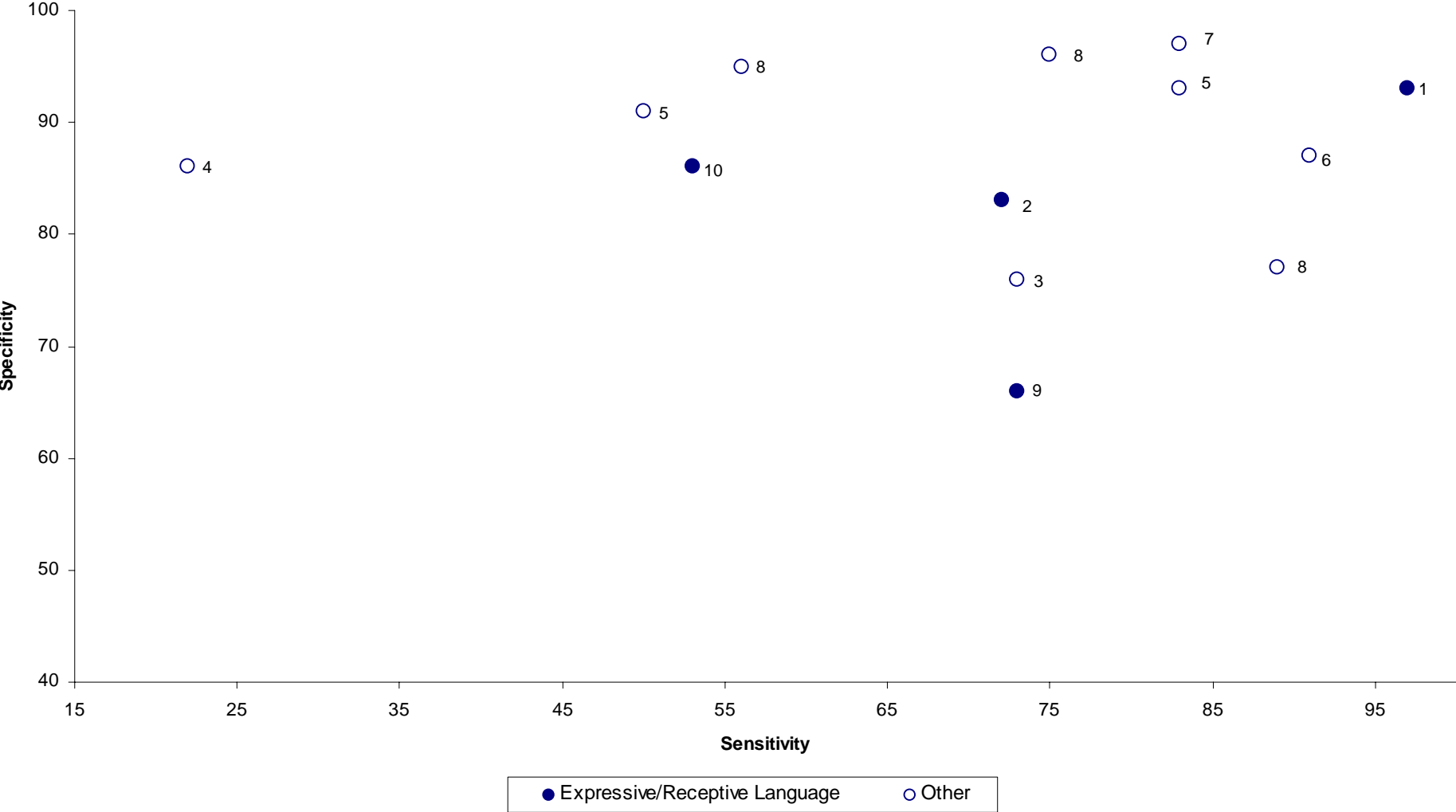


FIGURE 3B. REFERENCES FOR FIGURE 3A

1. Early Language Milestone Scale (Coplan, 1982); sensitivity 97percent, specificity 93 percent.
2. *Parent Evaluation of Developmental Status (Glascoe, 1991); sensitivity 72 percent, specificity 83 percent.
3. *Denver Developmental Screening Test II (language component) (Glascoe, 1993); sensitivity 73 percent, specificity 76 percent.
4. *Denver Developmental Screening Test II (communication component) (Glascoe, 1993); sensitivity 22 percent, specificity 86 percent.
5. Clinical Linguistic and Auditory Milestone Scale (Clark, 1995); receptive: sensitivity 83 percent, specificity 93 percent; expressive: sensitivity 50 percent, specificity 91 percent.
6. Language Development Survey (Klee, 1998); sensitivity 91 percent, specificity 87 percent.
7. Language Development Survey (Klee, 2000); sensitivity 83 percent, specificity 97 percent.
8. Language Development Survey (Rescorla, 2001); vs Bayley: sensitivity 75 percent, specificity 96 percent; vs Binet: sensitivity 56 percent, specificity 95 percent; vs Reynell: sensitivity 89 percent, specificity 77 percent.
9. *Bayley Infant Neurodevelopmental Screener (Macias, 1998); sensitivity 73 percent, specificity 66 percent.
10. Pediatric Language Acquisition Screening Tool for Early Referral (Sherman, 1996); sensitivity 53 percent, specificity 86 percent.

*Speech and language component of broader instrument.

FIGURE 4A. SENSITIVITY AND SPECIFICITY OF INSTRUMENTS FOR AGES 2 TO 3 YEARS
STUDIES RATED FAIR TO GOOD WITH INSTRUMENTS TAKING 10 MINUTES OR LESS TIME TO ADMINISTER

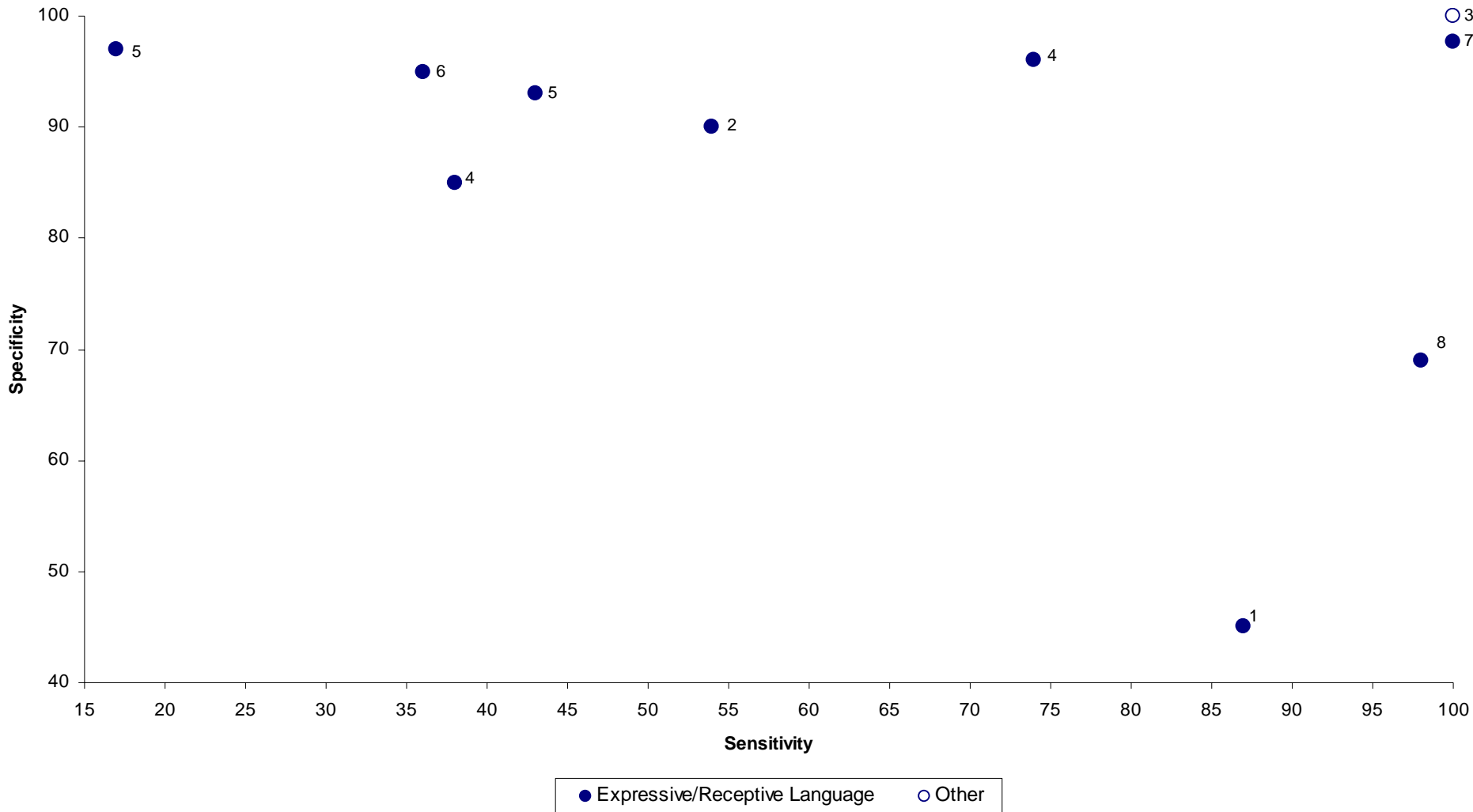


FIGURE 4B. REFERENCES FOR FIGURE 4A

1. Parent Language Checklist (Burden, 1996); sensitivity 87 percent, specificity 45 percent.
2. Structured Screening Test (Laing, 2002); sensitivity 54 percent, specificity 90 percent.
3. Levett-Muir Language Screening Test (Levett, 1983); sensitivity 100 percent; specificity 100 percent.
4. Fluharty Preschool Speech and Language Screening Test (Sturner, 1993; study 1); speech: sensitivity 74 percent, specificity 96 percent; language: sensitivity 38 percent, specificity 85 percent.
5. Fluharty Preschool Speech and Language Screening Test (Sturner, 1993; study 2); speech: sensitivity 43 percent, specificity 93 percent; language: sensitivity 17 percent, specificity 97 percent.
6. Fluharty Preschool Speech and Language Screening Test (Blaxley, 1983); sensitivity 36 percent, specificity 95 percent.
7. Screening Kit of Language Development (Bliss, 1984); sensitivity 100 percent, specificity 97.7 percent.
8. Hackney Early Language Screening Test (Law, 1994); sensitivity 98 percent, specificity 69 percent.

FIGURE 5A. SENSITIVITY AND SPECIFICITY OF INSTRUMENTS FOR AGES 3 TO 5 YEARS
STUDIES RATED FAIR TO GOOD WITH INSTRUMENTS TAKING 10 MINUTES OR LESS TIME TO ADMINISTER

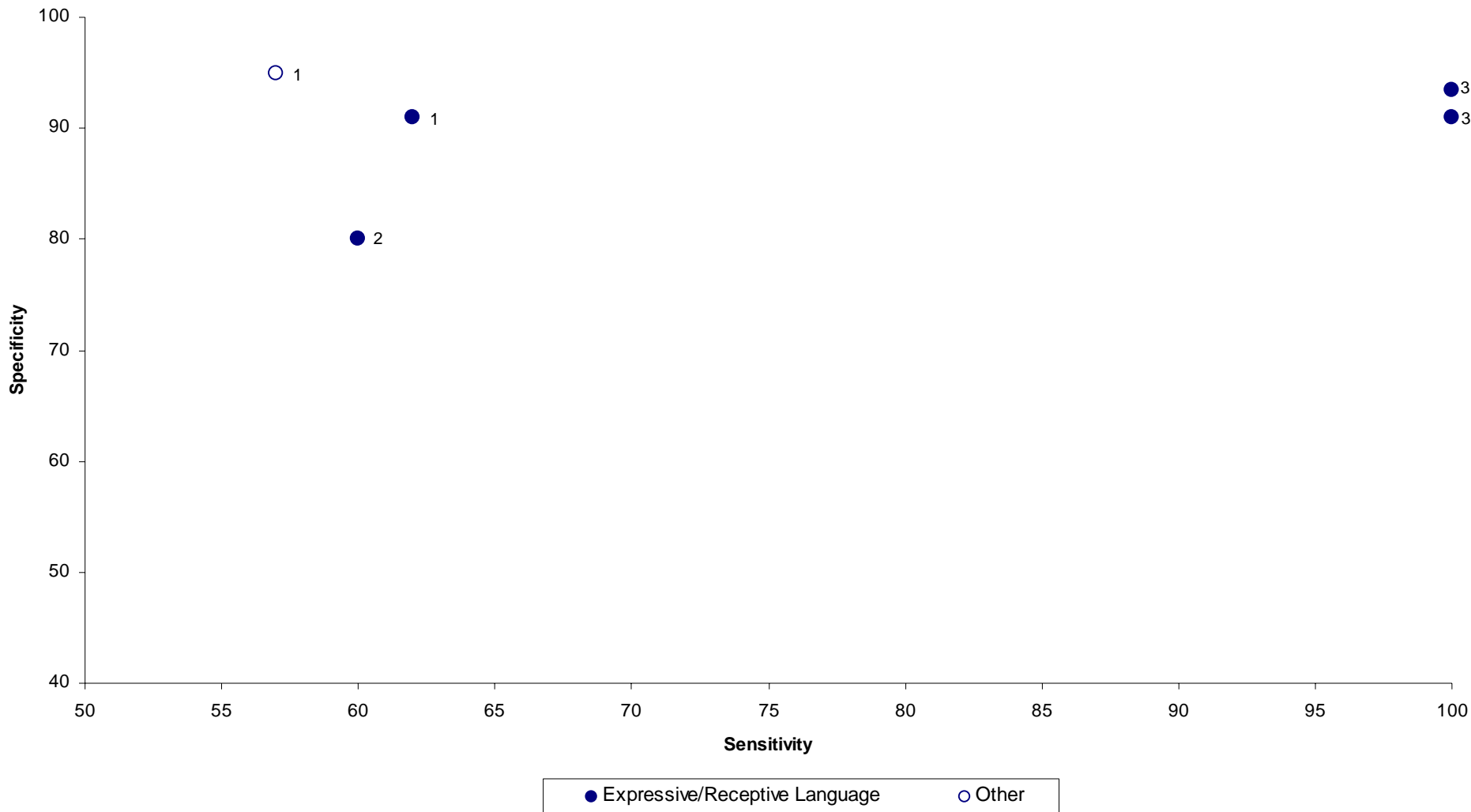


FIGURE 5B. REFERENCES FOR FIGURE 5A

1. Sentence Repetition Screening Test (Sturner, 1996); receptive and expressive language: sensitivity 62 percent, specificity 91 percent; articulation: sensitivity 57 percent, specificity 95 percent.
2. Fluharty Preschool Speech and Language Screening Test (Allen, 1987); sensitivity 60 percent, specificity 80 percent.
3. Screening Kit of Language Development (Bliss, 1984); sensitivity 100 percent, specificity 91 percent for 37-42 months; sensitivity 100 percent, specificity 93.4 percent for 43-48 months.

Table 1. Definitions of terms

Term	Definition
Articulation	The production of speech sounds
Dysfluency	Interrupted flow of speech sounds, such as stuttering
Expressive language	The use of language to share thoughts, protest, or comment
Language	The conceptual processing of communication which may be receptive and/or expressive
Morphology	The rules governing meanings of word units
Phonology	The set of rules for sound production
Pragmatics	Adaption of language to the social context
Prosody	Appropriate intonation, rate, rhythm and loudness of speech utterances
Receptive language	Understanding of language
Semantics	A set of words known to a person that are a part of a specific language (vocabulary)
Speech	Verbal production of language
Syntax	The way linguistic elements are put together to form phrases or clauses (grammar)
Voice disorders	Difficulty with speech sound production, at the level of the larynx, may be related to motor or anatomical issues, e.g., hypernasal or hoarse speech

TABLE 2. GUIDELINES FOR COMMUNICATION AND LANGUAGE SKILLS BY AGE

**American Academy of Pediatrics
Guidelines for Health Supervision III Training Materials***

Age	Full Manual	Pocket Book
2 months	Coos (making musical, vowel-like sounds); parents may notice differentiated crying for differing needs	No specific guidelines provided
4 months	Coos reciprocally, expresses needs through differentiated crying, blows bubbles, may make "raspberry" sounds	Check developmental milestones
6 months	Follows parents and objects visually to 180°, turns head toward sounds and familiar voices, babbles, laughs, squeals, takes initiative in vocalizing and babbling at others, imitates sounds, plays by making sounds	Observe developmental milestones
9 months	Responds to own name, participates in verbal requests such as "wave bye-bye" or "where is mama or dada?," understands a few words such as "no" or "bye-bye," imitates vocalizations, babbles using several syllables	Babbles, waves "bye-bye," plays peek-a-boo, plays with toys
12 months	Plays peek-a-boo, patty-cake, waves good-bye, likes to look at pictures in books and magazines, points to animals or named body parts, imitates words, follows simple commands, e.g., waves bye-bye or points when asked, "where is mommy?"	Communication between baby and caregivers; vocalization
15 months	Says single words (approximately 5-15), uses unintelligible or meaningless words (jargon), communicates with gestures, points to one or two body parts on request, understands simple commands, points to designated pictures in books, listens to stories being read	Observe developmental milestones
18 months	Understands commands, points to body parts on command, may put two words together	Observe interactions between toddler and caregiver
2 years	Has greater than 50-word vocabulary, speaks several two-word phrases, follows single-step and two-step commands, listens to short stories, uses pronouns	Observe developmental milestones
3 years	Speech is at least 75% intelligible; talks in short sentences but may leave out articles, plural markings, or tense markings; asks questions such as "what's that?" and "why?"; understands prepositions and some adjectives	No specific guidelines provided
4 years	Has extensive vocabulary; uses full sentences of at least six words; fully intelligible to strangers; asks questions with "why" "when"	No specific guidelines provided
5 years	Tells a simple story using full sentences, appropriate tenses, pronouns; counts to 10; names at least four colors; has good articulation	Speech understandable; full sentences or appropriate tenses

*American Academy of Pediatrics. Guidelines for Health Supervision III. Elk Grove Village, IL; 1997.

TABLE 3. SUMMARY OF STUDIES OF RISK FACTORS

Author, Year	Population	Age Range (Months)	Speech & Language Domains	Family History	Male Sex	SES	Birth Order	Perinatal Factors	Parental Education	Medical Conditions	Other Associations
English Language											
Brookhouser, 1979 ³⁸	24 referred from Boys Town Institute	28-62	Language	0	NR	NR	NR	NR	NR	X	NR
Campbell, 2003 ³⁹	398 cases and 241 controls from a large, prospective study in Pittsburgh, PA	36	Speech	X	X	X	NR	NR	X Mother	NR	NR
Cantwell, 1985 ⁴⁰	600 children referred from a speech and hearing clinic in Los Angeles, CA	20-191	Multiple types	NR	NR	NR	NR	NR	NR	NR	X Psychiatric, behavioral, or developmental disorder
Choudhury, 2003 ⁴¹	42 cases with positive family histories and 94 controls from New York City, NY area	36	Language	X	X	0	NR	NR	0 Mother or father	0 Asthma	X Older parents, more children in family
Singer, 2001 ⁴²	98 cases (VLBW/BPD), 70 VLBW/non BPD controls, and 95 term controls from Cleveland, OH region hospitals	36	Language	NR	NR	X	NR	NR	NR	X BPD, PDA	X Neurologic risk, minority race
Tallal, 1989 ⁴³	76 cases and 54 controls from the San Diego, CA Longitudinal Study	48-59	Language	X	NR	NR	NR	NR	X Mother or father	NR	NR

TABLE 3. SUMMARY OF STUDIES OF RISK FACTORS

Author, Year	Population	Age Range (Months)	Speech & Language Domains	Family History	Male Sex	SES	Birth Order	Perinatal Factors	Parental Education	Medical Conditions	Other Associations
English Language (continued)											
Tomblin, 1991 ⁴⁴	662 from a longitudinal cohort	30-60	Speech and language	X	X	NR	X Born later	NR	0 Mother X Father	NR	NR
Tomblin, 1997 ⁴⁵	177 cases and 925 controls from metro regions of Iowa or Illinois	Kindergarten age	Speech and language	X	NR	NR	NR	0 Low birth weight	X Mother or father	NR	X Younger mother, less breastfeeding
Whitehurst, 1991 ⁴⁶	62 cases and 55 controls from Long Island, NY	24-38	Expressive language	0	NR	NR	NR	NR	NR	NR	NR
Non-English Language											
Fox, 2002 ⁴⁷ (Germany)	65 cases and 48 controls	32-86	Speech	X	NR	NR	NR	X Birth difficulties, sucking habits	NR	NR	NR
Klein, 1986 ⁴⁸ (Israel)	72 kindergarten children from a middle-class urban area	48-108	Vocabulary	NR	NR	NR	NR	NR	NR	NR	0 Child's behavior
Kloth, 1995 ⁴⁹ (Netherlands)	93 referred because one or both parents were stutterers or had a history of stuttering	23-58	Stuttering	NR	NR	NR	NR	NR	NR	NR	0 Mother stutters, speaking style or rate

TABLE 3. SUMMARY OF STUDIES OF RISK FACTORS

Author, Year	Population	Age Range (Months)	Speech & Language Domains	Family History	Male Sex	SES	Birth Order	Perinatal Factors	Parental Education	Medical Conditions	Other Associations
Lyytinen, 2001 ⁵⁰ (Finland)	107 with familial risk of dyslexia and 93 without	0-54	Speech and language	X	NR	NR	NR	NR	NR	NR	NR

TABLE 3. SUMMARY OF STUDIES OF RISK FACTORS

Author, Year	Population	Age Range (Months)	Speech & Language Domains	Family History	Male Sex	SES	Birth Order	Perinatal Factors	Parental Education	Medical Conditions	Other Associations
Non-English Language (continued)											
Peters, 1997 ⁵¹ (Netherlands)	946 from a Dutch birth cohort in Nijmegen	84-96	Language and educational attainment	NR	0	NR	NR	0 Preterm or low birth weight	X	NR	X Dutch as a second language
Weindrich, 2000 ⁵² (Germany)	320 recruited at birth at a German hospital	Tested at 54 and 96 months	Receptive and expressive language and articulation (54 months); reading and spelling (96 months)	NR	NR	NR	NR	X Preterm, toxemia, low birth weight	X Mother or father	NR	X Parental psychiatric disorder, overcrowding, parental broken home or delinquency, one-parent family, unwanted pregnancy
Yliherva, 2001 ⁵³ (Finland)	8,370 recruited at birth from 2 northern provinces of Finland (99% of pregnant women in 1985-1986)	96	Speech, language, learning, motor abilities	NR	X	NR	NR	X Preterm, low birth weight	0 Mother	X Impaired hearing	0 Mother's age X >4 children in family, reconstructed family status

Key/Abbreviations

X=statistically significant association

0=variable examined and not associated with delay

NR=not reported

SES=socioeconomic status

VLBW=very low birth weight

BPD=bronchopulmonary dysplasia

PDA=patent ductus arteriosus

Table 4. Screening Instruments for Children Up To 2 Years Old

Author, Year	Instrument	Reference Standard	Area Tested	Setting	Screener	Admin. Time (minutes)
Under 5 Minutes to Administer						
Glascoc, 1991 ^{*,67}	Parent Evaluation of Developmental Status	Clinical assessment	Expressive language and articulation	Clinic	Doctoral students in psychology or special education	2
Coplan, 1982 ^{*,29}	Early Language Milestone Scale	Clinical assessment	Expressive and receptive language	Physician's office	Medical students	1-10
Black, 1988 ^{*,63}	Early Language Milestone Scale	Receptive-Expressive Emergent Language Scale, Bayley Scales of Infant Development	Expressive and receptive language	Large pediatric clinic, university teaching hospital	Not reported	5

Author, Year	Age Mean/ Range (months)	N	Subjects	Sensitivity	Specificity	Study Quality Rating
Under 5 Minutes to Administer, Continued						
Glascoc, 1991*, ⁶⁷	6-77	157	Subjects from an outpatient clinic or private practice 78% Caucasian 54% male	72%	83%	Good
Coplan, 1982*, ²⁹	0-36	191	Infants from private practices and pediatric outpatient department of local hospital 80% Caucasian 50% male	97%	93%	Fair
Black, 1988* ⁶³	8-22	48	Infants from low socioeconomic groups	83%	100%	Poor

Author, Year	Instrument	Reference Standard	Area Tested	Setting	Screener	Admin. Time (minutes)
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5-10 Minutes to Administer

Glascoc, 1993*, ⁶⁸	Developmental Profile II	Battery of measures	Fine motor adaptive, personal social, gross motor, and language	Day care centers	Psychologist	5-10
Sherman, 1996 ⁶⁰	Pediatric Language Acquisition Screening Tool for Early Referral	Early Language Milestone Scale	Expressive and receptive language	<i>High risk group:</i> neonatal developmental follow-up clinic <i>Control group:</i> speech and hearing clinic	Speech and language pathologist and graduate students	5

Author, Year	Age Mean/Range (months)	N	Subjects	Sensitivity	Specificity	Study Quality Rating
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5-10 Minutes to Administer, Continued

Glascoc, 1993*, ⁶⁸	7-70	89	Children from five day care centers 52% male	73%	76%	Fair
Sherman, 1996 ⁶⁰	3-36	173	123 high risk infants; 50 normal controls; <i>High risk:</i> 63% African American, 37% Caucasian <i>Control:</i> 50% Caucasian	53%	86%	Fair

Author, Year	Instrument	Reference Standard	Area Tested	Setting	Screener	Admin Time (Minutes)
10 Minutes to Administer						
Klee, 1998* ⁶⁹	Language Development Survey	Infant Mullen Scales of Early Learning	Expressive vocabulary	Home	Parent	10
Clark, 1995* ⁶⁵	Clinical Linguistic and Auditory Milestone Scale	Sequenced Inventory of Communication Development	Syntax and pragmatics	Home or school for the deaf	Speech and language pathologist	<10 [†]
Glascoc, 1993* ⁶⁸	Denver Developmental Screening Test II (communication components)	Battery of measures	Physical, self-help, social, academic, and communication	Day care centers	Psychologist	<10
Klee, 2000 ⁵⁴	Language Development Survey	Infant Mullen Scales of Early Learning	Expressive vocabulary	Home	Parent	10
Macias, 1998 ⁵⁶	Bayley Infant Neurodevelopmental Screener	Bayley Scales of Infant Development II	Expressive and receptive language	Physician's office	Developmental pediatrician	10
Rescorla, 2001 ⁵⁸	Language Development Survey	Bayley Scales of Infant Development, Stanford-Binet, Reynell Developmental Language Scales	Expressive vocabulary Delay 1 = >30 words and no word combinations Delay 2 = >30 words or no word combinations Delay 3 = >50 words or no word combinations	Home	Parent and research assistant	10

10 Minutes to Administer, Continued

Author, Year	Age Mean/ Range (months)	N	Subjects	Sensitivity	Specificity	Study Quality Rating
Klee, 1998* ⁶⁹	24.7 (24-26)	306	Toddlers turning 2-years old during the study in Wyoming 52.2% male	91%	87%	Good-Fair
Clark, 1995* ⁶⁵	0-36	99	Infants turning 1 or 2 years old during study 55% male	<i>Receptive:</i> 14-24 months: 83% 25-36 months: 68% <i>Expressive:</i> 14-24 months: 50% 25-36 months: 88%	<i>Receptive:</i> 14-24 months: 93% 25-36 months: 89% <i>Expressive:</i> 14-24 months: 91% 25-36 months: 98%	Fair
Glascoe, 1993* ⁶⁸	7-70	89	Children from five day care centers 52% male	22%	86%	Fair
Klee, 2000 ⁵⁴	24	64	Children turning 2 years in a specific month in an area of Wyoming	At age 2: 83% At age 3: 67 %	At age 2: 97% At age 3: 93 %	Fair
Macias, 1998 ⁵⁶	13 (6-23)	78	Infants randomly selected from those presenting for routine neonatal high-risk follow-up 53.8% male 61.5% African American	<i>Using middle-cut scores: 73%</i>	<i>Using middle-cut scores: 66%</i>	Fair
Rescorla, 2001 ⁵⁸	24	422	Toddlers in four townships of Delaware County, PA turning 2-years old during the study	<i>Delay 1:</i> Bayley - 70%; Binet - 52%; Reynell - 67% <i>Delay 2:</i> Bayley - 75%; Binet - 56%; Reynell - 89% <i>Delay 3:</i> Bayley - 80%; Binet - 64%; Reynell - 94%	<i>Delay 1:</i> Bayley - 99%; Binet - 98%; Reynell - 94% <i>Delay 2:</i> Bayley - 96%; Binet - 95%; Reynell - 77% <i>Delay 3:</i> Bayley - 94%; Binet - 94%; Reynell - 67%	Fair

Author, Year	Instrument	Reference Standard	Area Tested	Setting	Screener	Admin. Time (minutes)
15-30 Minutes to Administer						
Leppert, 1998 ⁵⁵	Cognitive Adaptive Test/Clinical Linguistic and Auditory Milestone Scale	Bayley Scales of Infant Development II	Visual motor and language	Physician's office	Developmental pediatrician	15-20
Borowitz, 1986*, ⁶⁴	Denver Developmental Screening Test (DDST) (language component)	Preschool Language Scale	Expressive and receptive language and articulation	Department of pediatrics of Vanderbilt University	Psychologist	20 [†]
Scherer, 1995*, ⁷²	MacArthur Communicative Development Inventory: Toddler	Clinical assessment	Language	Physician's office	Pediatrician	20

Author, Year	Age Mean/Range (months)	N	Subjects	Sensitivity	Specificity	Study Quality Rating
15-30 Minutes to Administer, Continued						
Leppert, 1998 ⁵⁵	0-36	70	Infants at two primary care pediatric settings presenting for well-baby visits 46% male 77% African American 11% premature (<38 weeks)	44%	97%	Fair
Borowitz, 1986* ⁶⁴	18-66	71	Infants from low income families referred to the clinic 82% Caucasian 77% male	46%	100%	Fair
Scherer, 1995* ⁷²	8-30	60	Children with and without cleft palate 63% male	76%	91%	Fair

Author, Year 30 or More Minutes to Administer	Instrument	Reference Standard	Area Tested	Setting	Screener	Admin. Time (minutes)
German, 1982*	Revised Denver Developmental Screening Test (language subtest)	Sequenced Inventory of Communication Development, McCarthy's Scales of Children's General Cognitive Abilities Index, Bayley Scales of Infant Development	Expressive and receptive language	Clinic	Public health nurse	<40
German, 1982*. ⁶⁶	Developmental Profile II	Sequenced Inventory of Communication Development, McCarthy's Scales of Children's General Cognitive Abilities Index, Bayley Scales of Infant Development	Expressive and receptive language	Clinic	Social worker	<40
Glascoe, 1993*. ⁶⁸	Battelle Developmental Inventory Screening Test	Battery of measures	Expressive and receptive language	Day care centers	Psychologist	30
Rescorla, 1989*. ⁷¹	Language Development Survey	Bayley Scales of Infant Development, Reynell Developmental Language Scales	Expressive vocabulary <i>Delay 1:</i> <30 words and no combinations <i>Delay 2:</i> <30 words or no combinations <i>Delay 3:</i> <50	Physician's office	Parent	30

words or no combinations

Rescorla, 1993* ¹²	Language Development Survey	Bayley Scales of Infant Development, Stanford-Binet	Expressive vocabulary <i>Delay 1:</i> <30 words and no combinations <i>Delay 2:</i> <30 words or no combinations <i>Delay 3:</i> <50 words or no combinations	Home	Parent	30
Rescorla, 2002 ⁵⁹	Language Development Survey	Child Behavior Checklist	Expressive language	Home	Parent	30

Author, Year	Age Mean/Range (months)	N	Subjects	Sensitivity	Specificity	Study Quality Rating
30 or More Minutes to Administer (Continued)						
German, 1982*	6-68	84	All children were referred to the center for delays 58% male 57% Caucasian	<i>Expressive: 92%-96%</i> <i>Receptive: 95%-98%</i>	<i>Expressive: 14%-49%</i> <i>Receptive: 14%-45%</i>	Good-Fair
German, 1982*, ⁶⁶	6-68	84	All children were referred to the center for delays 58% male 57% Caucasian	<i>Expressive: 92%-98%</i> <i>Receptive: 93%-100%</i>	<i>Expressive: 42%-72%</i> <i>Receptive: 36%-62%</i>	Good-Fair
Glascoc, 1993*, ⁶⁸	7-70	89	Children from five day care centers 52% male	78%	70%	Fair

Rescorla, 1989*. 71	24	81	Clinical and non-clinical sample 92% male	<i>Delay 1: 53%</i> <i>Delay 2: 76%</i> <i>Delay 3: 89%</i>	<i>Delay 1: 97%</i> <i>Delay 2: 89%</i> <i>Delay 3: 86%</i>	Fair
Rescorla, 1993*. 12	24	92	Subjects were from one school district	<i>Bayley:</i> <i>Delay 1: 78%</i> <i>Delay 2: 100%</i> <i>Delay 3: 100%</i> <i>Binet:</i> <i>Delay 1: 67%</i> <i>Delay 2: 89%</i> <i>Delay 3: 100%</i>	<i>Bayley:</i> <i>Delay 1: 100%</i> <i>Delay 2: 93%</i> <i>Delay 3: 90%</i> <i>Binet:</i> <i>Delay 1: 100%</i> <i>Delay 2: 93%</i> <i>Delay 3: 91%</i>	Fair
Rescorla, 2002 ⁵⁹	18-35	278	Children recruited through a national survey 49% male 57% Caucasian	18% [†]	86% [†]	Fair

Author, Year	Instrument	Reference Standard	Area Tested	Setting	Screener	Admin Time
Administration Time Not Reported						
McGinty, 2000* ⁷⁰	Mayo Early Language Screening Test	Reynell Developmental Language Scales, Edinburgh Articulation Test	Expressive vocabulary	Home	Public health nurse	Not reported
Stott, 2002 ⁶¹	General Language Screen	Reynell Developmental Language Scales, Edinburg Articulation Test, British Picture Vocabulary Scales	Expressive and receptive language	Physician's office	Parent	Not reported
Ward, 1984 ⁶²	Author created screening tool	Receptive-Expressive Emergent Language Scale	Receptive language	Physician's office	Health visitor	Not reported
Oakenfull, 2001 ⁵⁷	WILSTAAR Screen	Receptive-Expressive Emergent Language Scale	Language	Home	Speech and language pathologist	Not reported

Author, Year	Age Mean/Range (months)	N	Subjects	Sensitivity	Specificity	Study Quality Rating
Administration Time Not Reported, Continued						
McGinty, 2000* ⁷⁰	18-60	200	Children referred to the speech and language therapy department in Ireland Controls were added by random selection by the public health nurse at the clinics	<i>Reynell</i> :83.6% <i>Edinburgh</i> : 76.5%	<i>Reynell</i> : 69.9% <i>Edinburgh</i> : 72.8%	Poor
Stott, 2002 ⁶¹	Not reported	1,861	Infants participating in the Cambridge Language and Speech Project 47.2% male	90%-100%	31%-43.8%	Good-Fair
Ward, 1984 ⁶²	9.7 (7-23)	1,070	All infants attending for their hearing tests at one clinic	97% [†]	92% [†]	Fair
Oakenfull, 2001 ⁵⁷	7	2,896	Referrals from the Central Speech and Language Therapy Office	81% [†]	93% [†]	Poor

Key

*Included in Law J, Boyle J, Harris F, Harkness A, Nye C. Screening for primary speech and language delay: a systematic review of the literature. *International Journal of Language & Communication Disorders*. 1998;33(Suppl):21-23.

†Numbers were calculated.

‡Numbers were estimated.

TABLE 5. SCREENING INSTRUMENTS FOR CHILDREN 2 TO 3 YEARS OLD

Author, Year	Instrument	Reference Standard	Area tested	Setting	Screener	Admin. time (mins)
Under 7 minutes to administer						
Burden, 1996 ¹¹	Parent Language Checklist	Clinical judgement	Expressive and receptive language	Home (mailed)	Parent	<5 [‡]
Levett, 1983 ^{*,81}	Levett-Muir Language Screening Test	Reynell Developmental Language Scales, Goldman-Fristoe Test of Articulation, Language Assessment and Remediation Procedure	Receptive language, phonology and syntax	Physician's office	Medical practitioners	5 [‡]
Laing, 2002 ⁷⁵	Structured Screening Test	Reynell Developmental Language Scales	Expressive and receptive language	Physician's office	Health visitor	5 [‡]
Sturner, 1993 ^{*,83} Study 1	Fluharty Preschool Speech and Language Screening Test	Arizona Articulation Proficiency Scale Revised, Test of Language Development Primary	Expressive and receptive language and articulation	Preschool	Teacher	5-7
Sturner, 1993 ^{*,83} Study 2	Fluharty Preschool Speech and Language Screening Test	Test for Auditory Comprehension of Language Revised, Templin-Darley Test of Articulation	Expressive and receptive language and articulation	Preschool	Teacher	5-7
10-15 minutes to administer						
Chaffee, 1990 ^{*,78}	Minnesota Child Development Inventory (expressive language and comprehension conceptual subscales)	Reynell Developmental Language Scales	Expressive vocabulary	Communicative disorders clinic at the Child's hospital at Chedoke-McMaster Hospital	Parent	<15 [‡]

TABLE 5. SCREENING INSTRUMENTS FOR CHILDREN 2 TO 3 YEARS OLD

Author/year	Age mean/range (mo)	N	Subjects	Sensitivity	Specificity	Study quality rating
Under 7 minutes to administer						
Burden, 1996 ¹¹	36	2,590	All children turning 36 months. 52% male 41% from urban areas	87%	45%	Good
Levett, 1983 ^{*,81}	34-40	140	Private practice population.	100%	100%	Fair
Laing, 2002 ⁷⁵	30	376	Children from two low SES counties in London.	<i>Children with severe language problems: 66%</i> <i>Children needing therapy: 54%</i>	<i>Children with severe language problems: 89%</i> <i>Children needing therapy: 90%</i>	Fair
Sturner, 1993 ^{*,83} Study 1	24-72	279	46% male 74% Caucasian 86% from rural areas	<i>Speech/Language: 43%</i> <i>Speech: 74%</i> <i>Language: 38%</i>	<i>Speech/Language: 82%</i> <i>Speech: 96%</i> <i>Language: 85%</i>	Fair
Sturner, 1993 ^{*,83} Study 2	24-72	421	52% male 75% Caucasian	<i>Speech/Language: 31%</i> <i>Speech: 43%</i> <i>Language: 17%</i>	<i>Speech/Language: 93%</i> <i>Speech: 93%</i> <i>Language: 97%</i>	Fair
10-15 minutes to administer						
Chaffee, 1990 ^{*,78}	24-87	152	Referred to clinic. 76% male 97% Caucasian	<i>Cutoffs:</i> <i>≤110 = 99%</i> <i>≤100 = 97%</i> <i>≤90 = 92%</i> <i>≤80 = 99%</i> <i>≤70 = 75%</i> <i>≤60 = 49%</i> <i>≤50 = 23%</i> <i>≤40 = 6%</i>	<i>Cutoffs:</i> <i>≤110 = 5%</i> <i>≤100 = 9%</i> <i>≤90 = 16%</i> <i>≤80 = 45%</i> <i>≤70 = 52%</i> <i>≤60 = 82%</i> <i>≤50 = 93%</i> <i>≤40 = 98%</i>	Good

TABLE 5. SCREENING INSTRUMENTS FOR CHILDREN 2 TO 3 YEARS OLD

Author, Year	Instrument	Reference Standard	Area tested	Setting	Screener	Admin. time (mins)
10-15 minutes to administer (continued)						
Law, 1994*. ⁸⁰	Hackney Early Language Screening Test	Reynell Developmental Language Scales	Expressive language	Home	Health visitor	10
Blaxley, 1983*. ⁷⁶	Fluharty Preschool Language Screening Test	Developmental Sentence Scoring	Expressive and receptive language and articulation	Speech and hearing clinic in western Ontario	Clinician	10
Bliss, 1984*. ⁷⁷	Screening Kit of Language Development	Sequenced Inventory of Communication Development	Expressive and receptive language	Speech and language hearing clinic, day-care center, physician's office, educational and health facilities	Paraprofessionals and speech and language pathologists	10
Drumwright, 1973 ⁷⁴	Denver Articulation Screening Exam	Templin Non-Diagnostic Articulation Screening Test	Articulation	Clinic	Trained non-professionals	10-15
Dixon, 1988*. ⁷⁹	Hackney Early Language Screening Test	Clinical judgement	Expressive language	Physician's office	Health visitor	10
Walker, 1989*. ⁸⁴	Early Language Milestone Scale	Sequenced Inventory of Communication Development	Expressive and receptive language	Clinic	Speech and language pathologist	10

TABLE 5. SCREENING INSTRUMENTS FOR CHILDREN 2 TO 3 YEARS OLD

Author/year	Age mean/range (mo)	N	Subjects	Sensitivity	Specificity	Study quality rating
10-15 minutes to administer (continued)						
Law, 1994 ^{*, 80}	30	1,205	All children attending routine developmental checkups were eligible.	98%	69%	Good-Fair
Blaxley, 1983 ^{*, 76}	24-72	90	Children referred for speech &/or language assessment and intervention and controls.	<i>10th centile:</i> 36% <i>25th centile:</i> 30%	<i>10th centile:</i> 95% <i>25th centile:</i> 100%	Fair
Bliss, 1984 ^{*, 77}	30-48	602	2.5-4 year old Caucasian and African American children who attended day-care centers in metropolitan Detroit area.	<i>Standard English</i> Ages 30-36 mo.: 100% Ages 37-42 mo.: 100% Ages 43-48 mo.: 100% <i>"Black English"</i> Ages 30-36 mo.: 88.9% Ages 37-42 mo.: 87.5% Ages 43-48 mo.: 94.4%	<i>Standard English</i> Ages 30-36 mo.: 97.7% Ages 37-42 mo.: 91.0% Ages 43-48 mo.: 93.4% <i>"Black English"</i> Ages 30-36 mo.: 86.4% Ages 37-42 mo.: 85.5% Ages 43-48 mo.: 77.8%	Fair
Drumwright, 1973 ⁷⁴	30-72	300	Not reported	92%	97%	Fair
Dixon, 1988 ^{*, 79}	30	25	Pilot study at one clinic setting in Hackney.	95%	94%	Poor
Walker, 1989 ^{*, 84}	36	77	All children attending any visit at one of the clinics chosen during the study period.	0-12 months: 0% 13-24 months: 100% 25-36 months: 100%	0-12 months: 86% 13-24 months: 60% 25-36 months: 75%	Poor

TABLE 5. SCREENING INSTRUMENTS FOR CHILDREN 2 TO 3 YEARS OLD

Author, Year	Instrument	Reference Standard	Area tested	Setting	Screener	Admin. time (mins)
10-30 minutes to administer						
Laing, 2002 ⁷⁵	Parent Led Method	Reynell Developmental Language Scales	Language development	Physician's office	Health visitor	10-30 [‡]
Administration time not reported						
Stokes, 1997* ⁸²	Developmental Nurse Screen	Clinical judgement	Gross & fine motor, language development, hearing, vision, social development & self-help	Physician's office	Nurses	Not reported
Stokes, 1997* ⁸²	Parent Questionnaire	Clinical judgment	Expressive vocabulary	Physician's office	Research assistants	Not reported

Key

*Included in Law J, Boyle J, Harris F, Harkness A, Nye C. Screening for primary speech and language delay: a systematic review of the literature. *Int J Lang Commun Disord.* 1998;33(Suppl):21-23.

[†]Numbers were calculated

[‡]Numbers were estimated

TABLE 5. SCREENING INSTRUMENTS FOR CHILDREN 2 TO 3 YEARS OLD

Author/year	Age mean/range (mo)	N	Subjects	Sensitivity	Specificity	Study quality rating
10-30 minutes to administer						
Laing, 2002 ⁷⁵	30	247	Children from two low SES counties in London.	<i>Children with severe language problems: 56% Children needing therapy: 58%</i>	<i>Children with severe language problems: 85% Children needing therapy: 90%</i>	Fair
Administration time not reported						
Stokes, 1997* ⁸²	34-40	398	49% male	76%	97%	Fair
Stokes, 1997* ⁸²	34-40	398	49% male	<i>With comprehension item: 78% Without comprehension item: 78%</i>	<i>With comprehension item: 91% Without comprehension item: 95%</i>	Fair

Table 6. Screening Instruments for Children 3 to 5 Years

Author, Year	Instrument	Reference Standard	Area Tested	Setting	Screener	Admin. Time (minutes)
Under 7 Minutes to Administer						
Merrell, 1997 ⁸⁸	Test for Examining Expressive Morphology	Kaufman Assessment Battery for Children, Structured Photographic Expression Language Test II	Expressive vocabulary and syntax	School or clinic	Speech and language pathologists	7
Sturner, 1996 ^{*,93}	Sentence Repetition Screening Test	Speech and Language Screening Questionnaire	Receptive and expressive language and articulation	School	College-educated non-specialists or school speech and language pathologists	3
Author, Year	Age Mean/Range (months)	N	Subjects	Sensitivity	Specificity	Study Quality Rating
Under 7 Minutes to Administer, Continued						
Merrell, 1997 ⁸⁸	48-67	40	20 impaired and 20 normal children 52% male 73% Caucasian	90%	95%	Poor
Sturner, 1996 ^{*,93}	54-66	76	Children registering for kindergarten 48% male 65% Caucasian	<i>Receptive and expressive: 62%</i> <i>Articulation: 57%</i>	<i>Receptive and expressive: 91%</i> <i>Articulation: 95%</i>	Fair

Author, Year	Instrument	Reference Standard	Area Tested	Setting	Screener	Admin Time (Mins)
10-20 Minutes to Administer						
Alberts, 1995 ⁸⁵	Davis Observation Checklist for Texas	McCarthy Scales of Children's Abilities, Goldman-Fristoe test of Articulation Revised, informal checklist	Speech, voice, fluency, receptive and expressive language	Preschool	Teachers and aides	10-15
Gray, 2003 ⁸⁷	Children's Test of Nonword Repetition	Structured Photographic Expression Language Test II	Expressive language	School	Research assistants	15
Allen, 1987 ^{*,73}	Fluharty Preschool Speech and Language Screening Test	Sequenced Inventory of Communication Development	Expressive and receptive language and articulation	Clinic	Speech and language pathologists	10-20
Plante, 1995 ⁸⁹	Structured Photographic Expressive Language Test - Preschool	Kaufman Assessment Battery for Children, Structured Photographic Expression Language Test II	Expressive vocabulary	School	Speech and language pathologists or research assistants	15
Conti-Ramsden, 2003 ⁸⁶	Children's Test of Nonword Repetition	Clinical judgement	Phonology	School/ Nursery	Not reported	15

Feeney, 1996*, ⁹²	Revised Denver Developmental Screening Test (language component)	Clinical judgement	Language	School	Speech and language pathology students	10-20
Wilcox, 1998 ⁹⁰	Wilcox African- American English Screening Test of Articulation	Clinical judgement	Articulation and phonology	School	Investigators	15
Allen, 1987 ⁷³	Northwestern Syntax Screening Test	Sequenced Inventory of Communication Development	Syntax	Clinic	Speech and Language Pathologists	20
Dodge, 1980*, ⁹¹	Denver Developmental Screening Test	Clinical assessment	Expressive and receptive language and articulation	School	Speech clinician	20

Author, Year	Age Mean/Range (months)	N	Subjects	Sensitivity	Specificity	Study Quality Rating
10-20 Minutes to Administer, Continued						
Alberts, 1995 ⁸⁵	52-67	59	Preschool, Headstart children 20 Mexican American 19 African American 20 Caucasian	80%	90%	Good
Gray, 2003 ⁸⁷	48-72	44	22 children with impairment and 22 controls matched for age and gender. Children were between 4 years and 5 years 11 months old 72% Caucasian 77% male	95%	100%	Poor
Allen, 1987 ^{*73}	36-47	182	All children were enrolled in day care programs	60%	80%	Fair
Plante, 1995 ⁸⁹	48-72	40	75% Caucasian	83.3%	95%	Poor

Conti-Ramsden, 2003 ⁸⁶	52-70	64	66% male	25th centile: 66% 16th centile: 59%	25th centile: 100% 16th centile: 100%	Fair
Feeney, 1996 ^{*,92}	36-60	199	Children in Head Start program 45% male 67% Caucasian	95%	80%	Fair
Wilcox, 1998 ⁹⁰	60-78	26	Children enrolled in kindergarten or first grade classrooms in Indianapolis, IN Mean age: 68 months 77% male	100%	100%	Poor
Allen, 1987 ^{*,73}	36-47	182	All children were enrolled in day care programs	92%	48%	Fair
Dodge, 1980 ^{*,91}	60	486	Children entering kindergarten, who were 5 years or turning 5 that year	97%	98%	Fair-Poor

Author, Year	Instrument	Reference Standard	Area Tested	Setting	Screener	Admin Time (Mins)
25-30 Minutes to Administer						
Blaxley, 1983 ⁷⁶	Bankson Language Screening Test	Developmental Sentence Scoring	Expressive language	Speech and hearing clinic in western Ontario, Canada	Clinician	25

Author, Year	Age Mean/Range (months)	N	Subjects	Sensitivity	Specificity	Study Quality Rating
25-30 Minutes to Administer, Continued						
Blaxley, 1983 ⁷⁶	48-96	90	Children referred for speech and/or language assessment and intervention and controls	10th centile: 64% 25th centile: 63%	10th centile: 91% 25th centile: 94%	Fair

Key

*Included in Law J, Boyle J, Harris F, Harkness A, Nye C. Screening for primary speech and language delay: a systematic review of the literature. Int J Lang Commun Disord. 1998;33(Suppl):21-23.

†Numbers were calculated.

‡Numbers were estimated.

TABLE 7. SUMMARY OF RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Speech & Language Domains	N	Age (months)	Interventions	Speech and Language Outcomes	Function and Health Outcomes	Study Quality Rating
Up to 2 Years*							
Glogowska, 2000 ⁹⁴	Expressive and receptive language and phonology	159 in 2 groups	18-42	Clinician-directed individual intervention routinely offered by the therapist for 12 months vs. none	Improved auditory comprehension in intervention vs. control group; no differences for expressive language, phonology error rate, language development, or improvement on entry criterion	No differences in well being, attention level, play level, or socialization skills	Good
2 to 3 Years							
Gibbard, 1994 ⁹⁹ <i>Study 1</i>	Expressive language	36 in 2 groups	27-39	Parent-directed individual therapy 60-75 minutes every other week for 6 months vs. none	Improved scores on several measures for intervention vs. control group	Not reported	Fair
Girolametto, 1996 ¹⁰⁰	Expressive language	25 in 2 groups	23-33	Parent-directed individual focused stimulation intervention 150 minutes per week for 11 weeks vs. none	Larger vocabularies, use of more different words, more structurally complete utterances and multiword utterances in intervention group vs. control; no differences in several other measures	Not reported	Fair
Law, 1999 ¹⁰⁷	Expressive and receptive language	38 in 3 groups	33-39	Clinician-directed 450 minutes per week for 6 weeks vs. parent-directed 150 minutes per week for 10 weeks vs. none	No differences between groups	Improved parent perception of child's behavior and positivity towards child, improved child self-esteem	Fair
Robertson, 1999 ¹⁰²	Expressive and receptive language	21 in 2 groups	21-30	Clinician-directed individual therapy 150 minutes per week for 12 weeks vs. none	Improved mean length of utterances, total number of words, lexical diversity, vocabulary size, and percentage of intelligible utterances in intervention group vs. control	Improved socialization skills, decreased parental stress for intervention group	Fair

TABLE 7. SUMMARY OF RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Speech & Language Domains	N	Age (months)	Interventions	Speech and Language Outcomes	Function and Health Outcomes	Study Quality Rating
2 to 3 Years (continued)							
Gibbard, 1994 <i>Study 2</i>	Expressive language	25 in 3 groups	27-39	Clinician-directed individual therapy 60-75 minutes every other week for 6 months vs. parent-directed 60-75 minutes every other week for 6 months vs. none	Improved scores on all 5 measures for parent-directed group vs. control; improvement on 2 measures for clinician-directed group vs. control; improvement on 1 measure for parent vs. clinician group	Not reported	Poor
Girolametto, 1996 ¹¹⁵	Expressive and receptive language	16 in 2 groups	22-38	Parent-directed individual therapy 150 minutes per week for 10 weeks vs. none	More target words used in intervention group vs. control; no differences in vocabulary development	Increased symbolic play gestures, decreased aggressive behavior in intervention group	Poor
Schwartz, 1985 ¹¹³	Expressive language and lexical acquisition	10 in 2 groups	32-39	Clinician-directed individual therapy for 3 weeks vs. none	Improved multiword utterances from baseline in intervention group; no between-group differences reported	Not reported	Poor
Wilcox, 1991 ¹⁰⁶	Lexical acquisition	20 in 2 groups	20-47	Clinician-directed individual intervention 90 minutes per week for 3 months vs. classroom intervention 360 minutes per week for 3 months	No differences between groups in use of target words; more use of words at home in classroom group vs. individual group	Not reported	Fair
Girolametto, 1997 ¹⁰¹	Lexical acquisition and phonology	25 in 2 groups	23-33	Parent-directed individual therapy eight 150-minute sessions and 3 home sessions for 11 weeks vs. none	Improved level of vocalizations and inventory of consonants for intervention group vs. control; no differences in the number of vocalizations	Not reported	Fair

TABLE 7. SUMMARY OF RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Speech & Language Domains	N	Age (months)	Interventions	Speech and Language Outcomes	Function and Health Outcomes	Study Quality Rating
3 to 5 Years							
Barratt, 1992 ⁹⁶	Expressive and receptive language	39 in 2 groups	37-43	Clinician-directed interactive language therapy for 40 minutes weekly for 6 months (traditional group) vs. 40 minutes for 4 days per week for 3 weeks in two 3 month blocks (intensive group)	Improved expression score on Reynell scale for intensive group vs. weekly (or traditional) therapy group; no difference in comprehension scores, both improved	Not reported	Fair
Courtright, 1979 ⁹⁸	Expressive language	36 in 3 groups	47-83	3 clinician-directed approaches are compared for 5 months: mimicry, clinician modeling, 3rd person modeling for 5 months	Increased number of correct responses in modeling groups vs. mimicry group	Not reported	Fair
Robertson, 1997 ¹⁰³	Expressive and receptive language	30 in 3 groups	44-61	2 clinician-directed play groups with language impairments (treatment vs control) with normal peers for 20 minutes per week for 3 weeks	More words used, greater verbal productivity, more lexical diversity, and more use of linguistic markers by normal peer play group (not normal group, treatment group with language impairment) vs. control	Play-theme-related acts increased for the normal peer play group (not normal group, treatment group with language impairment)	Fair
Glogowska, 2002 ¹¹⁶	Expressive and receptive language and phonology	159 in 2 groups	≤42	Clinician-directed for 12 months vs. none	Improved receptive language in intervention group vs. control; no differences between groups for 4 other measures	Improved family response to child in intervention group	Poor
Almost, 1998 ⁹⁵	Phonology	26 in 2 groups	33-61	Clinician-directed individual therapy two 30-minute sessions per week for 4 months vs. none	Higher scores on 3 of 4 measures for intervention vs. control group	Not reported	Fair

TABLE 7. SUMMARY OF RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Speech & Language Domains	N	Age (months)	Interventions	Speech and Language Outcomes	Function and Health Outcomes	Study Quality Rating
3 to 5 Years (continued)							
Rvachew, 2001 ¹⁰⁴	Phonology	48 in 2 groups	50 (mean)	Clinician-directed individual therapy 30-40 minutes per week for 12 weeks; compares interventions for phonemes that differ (most knowledge/early developing group vs. least knowledge/latest developing group)	Improved scores on measures from baseline for both intervention groups; greater improvement for most knowledge/early developing phonemes group vs. comparison (least knowledge/latest developing) group	Not reported	Fair
Shelton, 1978 ¹⁰⁵	Phonology and articulation	45 in 3 groups	27-55	Parent-directed individual therapy 5 minutes per day (listening group) vs. 15 minutes per day (reading and talking group) for 57 days vs. none	No improvements for intervention groups vs. control	Not reported	Fair
Fey, 1994 ¹⁰⁸	Phonology and syntax	26 in 3 groups	44-70	Clinician-directed sessions (individual and group) for 3 hours per week for 20 weeks vs. parent-directed sessions for 8 hours per week for weeks 1-12 (includes intensive parent training) then 4 hours per week for weeks 13-20 vs. none	Improved grammatical output (developmental sentence scores) for both intervention groups vs. control; no significant difference between groups for phonological output (percentage consonants correct)	Not reported	Poor
Reid, 1996 ¹¹⁷	Phonology	30 in 2 groups	42-66	Clinician-directed individual therapy 30 minutes per week for 6-10 weeks vs. none	Improved scores on some measures from baseline for intervention and control groups; no between group comparisons reported	Not reported	Poor
Ruscello, 1993 ¹¹¹	Phonology	12 in 2 groups	49-68	Clinician-directed vs. clinician & parent-directed individual therapy 120 minutes per week for 8 weeks	Improved scores on measures from baseline for both intervention groups; no between group comparisons reported	Not reported	Poor

TABLE 7. SUMMARY OF RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Speech & Language Domains	N	Age (months)	Interventions	Speech and Language Outcomes	Function and Health Outcomes	Study Quality Rating
3 to 5 Years (continued)							
Rvachew, 1994 ¹¹²	Phonology	27 in 3 groups	42-66	Clinician-directed individual therapy 45 minutes per week for 6 weeks; compares 3 groups listening to different sets of words	Improved scores on measures for 2 intervention groups vs. third group	Not reported	Poor
Cole, 1986 ⁹⁷	Syntax	44 in 2 groups	38-69	Clinician-directed individual directive approach vs. interactive approach for 600 minutes per week for 8 months	Improved scores on 6 of 7 measures from baseline for both intervention groups; no significant differences between groups	Not reported	Fair
Fey, 1993 ¹¹⁴ <i>First phase</i>	Syntax	29 in 3 groups	44-70	Clinician-directed sessions (individual and group) for 3 hours per week for 20 weeks vs. parent-directed sessions for 8 hours per week for weeks 1-12 (includes intensive parent training) then 4 hours per week for weeks 13-20 vs. none	Improved scores on 3 of 4 measures for both intervention groups vs. control; no differences between intervention groups	Not reported	Poor
Fey, 1997 ¹⁰⁹ <i>Second phase</i>	Syntax	28 in 3 groups	44-70	Clinician-directed vs. parent-directed vs. none for 5 months continuing from prior study	Improved some developmental sentence scores from baseline in both intervention groups vs. control; no between group comparisons reported, except that clinician-directed treatment groups had larger and more consistent gains than parent-directed treatment groups or control	Not reported	Poor

TABLE 7. SUMMARY OF RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Speech & Language Domains	N	Age (months)	Interventions	Speech and Language Outcomes	Function and Health Outcomes	Study Quality Rating
3 to 5 Years (continued)							
Mulac, 1977 ¹¹⁰	Syntax	9 in 3 groups	52-75	Clinician-directed individual Monterey language program vs. Monterey language program with extended transfer training for 67 minutes per week for 4 weeks vs. none	Improved scores for both intervention groups vs. control; no significant differences between intervention groups	Not reported	Poor

Key

*Studies with a range of ages are not repeated across categories in the table.

TABLE 8. SUMMARY OF EVIDENCE

Key Question	Level of Evidence	Conclusions	USPSTF Quality	Generalizability
1. Does screening for speech and language delay result in improved speech and language as well as improved other non speech and language outcomes?	No studies			
2. Do screening evaluations in the primary care setting accurately identify children for diagnostic evaluation and interventions?				
2a. Does identification of risk factors improve screening?	Observational studies (II)	Studies of risk factors are heterogeneous and results are inconsistent. A list of specific risk factors to guide primary care physicians in selective screening has not been developed or tested. The most consistent risk factors include a family history of speech and language delay and learning difficulties, sex, and perinatal factors, however their role in screening is unclear	Not rated (most cross-sectional design)	Fair-good
2b & c. What are screening techniques and how do they differ by age? What is the accuracy of screening techniques and how does it differ by age?	Observational studies (II)	Many instruments are available, but no gold standard has been developed and tested for screening, reference standards vary across studies, few studies compare the performance of 2 or more screening techniques in one population, and comparisons of a single screening technique across different populations are lacking. Optimal methods have not been established. Brief instruments (≤ 10 minutes) administered by professionals and nonprofessionals are available, sensitivity and specificity vary, and most studies do not provide enough information to determine how accuracy varies by age	Fair-good	Fair
2d. What are the optimal ages and frequency for screening?	No studies			

3. What are the adverse effects of screening?	No studies			
4. What is the role of enhanced surveillance by primary care clinicians?	No studies			
5. Do interventions for speech and language delay improve speech and language outcomes?	RCTs (I)	Fourteen good and fair-quality randomized controlled trials of interventions reported significantly improved speech and language outcomes compared to control groups. Improvement was demonstrated in several domains among children in all age groups studied and across multiple therapeutic settings. Studies were small, heterogeneous, and reported short-term outcomes based on various instruments and measures. As a result, long-term outcomes are not known, interventions could not be directly compared, and generalizability is questionable	Fair-good	Poor-fair
6. Do interventions for speech and language delay improve other non speech and language outcomes?	RCTs (I)	Improvement in other functional outcomes, such as socializations skills, self-esteem, and improved play themes, were demonstrated in some, but not all, of the four studies measuring them	Fair-good	Poor -fair
7. Does improvement in speech and language outcomes lead to improved additional outcomes?	No studies			
8. What are the adverse effects of interventions?	No studies			
9. What are cost effectiveness issues?	No studies			

APPENDIX 1. REVIEWERS

Expert Reviewers

Robert Buckendorf, PhD
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National Initiative for Children's Healthcare Quality
Cambridge, MA

James Law, PhD
Department of Language and Communication Science
City University
London, UK

Fredrick Palmer, MD
University of Tennessee, Health Science Center
Memphis, TN

Brian Rogers, MD
Child Development and Rehabilitation Center
Oregon Health & Science University
Portland, OR

Bruce K. Shapiro, M.D.
Kennedy Krieger Institute
Baltimore, MD

Professional Organizations and Federal Agencies

American Academy of Family Physicians
American Academy of Pediatrics
American Speech-Language-Hearing Association
Centers for Disease Control and Prevention
National Institutes of Health
Society of Researchers in Child Development
Society for Developmental and Behavioral Pediatrics

APPENDIX 2. SEARCH STRATEGIES

Search Terms

Appropriate terms were selected in conjunction with a medical research librarian and experts in the field, and individual search strategies were created to retrieve the literature pertaining to communication disorders and the following concepts: children age 5 years and younger, primary health care practitioners, pediatricians, risk factors and risk assessment, psychological tests, diagnostic techniques and procedures, adverse effects, outcomes, quality of life, and epidemiological studies.

MEDLINE – 1966 to November 19, 2004

Screening

- 1 exp Communication Disorders/cl, di [Classification, Diagnosis]
- 2 exp Psychological Tests/
- 3 exp "Diagnostic Techniques and Procedures"/
- 4 exp mass screening/
- 5 1 and (2 or 3 or 4)
- 6 limit 5 to (english language and (all infant <birth to 23 months> or preschool child <2 to 5 years>))
- 7 limit 5 to (abstracts and (all infant <birth to 23 months> or preschool child <2 to 5 years>))
- 8 6 or 7
- 9 exp RISK/
- 10 1 and 9
- 11 limit 10 to (english language and (all infant <birth to 23 months> or preschool child <2 to 5 years>))
- 12 limit 10 to (abstracts and (all infant <birth to 23 months> or preschool child <2 to 5 years>))
- 13 11 or 12
- 14 primary care.mp. or exp Primary Health Care/
- 15 family physicians.mp. or exp Physicians, Family/
- 16 Pediatrics/ or pediatrician\$.mp.
- 17 exp child health services/ or exp preventive health services/
- 18 14 or 15 or 16 or 17
- 19 1 and 18
- 20 limit 19 to (english language and (all infant <birth to 23 months> or preschool child <2 to 5 years>))
- 21 limit 19 to (abstracts and (all infant <birth to 23 months> or preschool child <2 to 5 years>))
- 22 20 or 21
- 23 exp "Sensitivity and Specificity"/
- 24 exp Diagnostic Errors/
- 25 diagnosis, differential/
- 26 23 or 24 or 25
- 27 1 and 26
- 28 limit 27 to (english language and all child <0 to 18 years>)

APPENDIX 2. SEARCH STRATEGIES (continued)

- 29 limit 27 to (abstracts and all child <0 to 18 years>)
- 30 28 or 29
- 31 limit 1 to (all child <0 to 18 years> and (controlled clinical trial or guideline or meta analysis or multicenter study or practice guideline or randomized controlled trial))
- 32 exp epidemiologic studies/
- 33 1 and 32
- 34 limit 33 to (english language and all child <0 to 18 years>)
- 35 limit 33 to (abstracts and all child <0 to 18 years>)
- 36 34 or 35
- 37 31 or 36

Adverse Effects

- 1 exp Communication Disorders/
- 2 (adverse effect\$ or harm\$ or stigma\$).mp. or exp stress, psychological/et or exp life change events/ or exp prejudice/ or exp stereotyping/ or exp self concept/
- 3 exp diagnostic errors/
- 4 2 or 3
- 5 1 and 4
- 6 limit 5 to (english language and all child <0 to 18 years>)

Interventions/Outcomes

- 1 exp Communication Disorders/nu, dt, pc, rh, su, th [Nursing, Drug Therapy, Prevention & Control, Rehabilitation, Surgery, Therapy]
- 2 Cost of Illness/
- 3 exp Quality of Life/
- 4 exp EMPLOYMENT/
- 5 exp Psychology, Industrial/
- 6 exp Family Relations/
- 7 exp family/ or exp interpersonal relations/
- 8 exp Educational Status/ or exp Educational Measurement/
- 9 exp Motivation/
- 10 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
- 11 1 and 10
- 12 limit 11 to (english language and all child <0 to 18 years>)
- 13 exp "OUTCOME AND PROCESS ASSESSMENT (HEALTH CARE)"/
- 14 1 and 13
- 15 limit 14 to (english language and all child <0 to 18 years>)
- 16 Comparative Study/
- 17 exp Evaluation Studies/
- 18 exp Epidemiologic Studies/
- 19 16 or 17 or 18
- 20 1 and 19
- 21 limit 20 to (english language and all child <0 to 18 years>)
- 22 limit 1 to (english language and all child <0 to 18 years> and (clinical trial or guideline or meta analysis or multicenter study or practice guideline or review))
- 23 12 or 15 or 21 or 22

APPENDIX 2. SEARCH STRATEGIES (continued)

PsycINFO – 1974 to November 19, 2004

Screening

- 1 exp Communication Disorders/
- 2 exp Diagnosis/
- 3 1 and 2
- 4 limit 3 to (english language and (120 neonatal <birth to age 1 mo> or 140 infancy <age 2 to 23 mo> or 160 preschool age <age 2 to 5 yrs>))
- 5 exp RISK PERCEPTION/ or exp RISK ANALYSIS/ or exp RISK MANAGEMENT/ or exp AT RISK POPULATIONS/ or exp RISK FACTORS/
- 6 1 and 5
- 7 limit 6 to (english language and (120 neonatal <birth to age 1 mo> or 140 infancy <age 2 to 23 mo> or 160 preschool age <age 2 to 5 yrs>))
- 8 exp Primary Health Care/ or primary care.mp.
- 9 family physician\$.mp. or exp Family Physicians/
- 10 pediatrician\$.mp. or exp PEDIATRICIANS/
- 11 pediatrics.mp. or exp PEDIATRICS/
- 12 public health services/
- 13 8 or 9 or 10 or 11 or 12
- 14 1 and 13
- 15 limit 14 to (english language and (120 neonatal <birth to age 1 mo> or 140 infancy <age 2 to 23 mo> or 160 preschool age <age 2 to 5 yrs>))
- 16 exp Differential Diagnosis/
- 17 exp TEST VALIDITY/ or exp STATISTICAL VALIDITY/
- 18 1 and 17
- 19 16 or 17
- 20 1 and 19
- 21 limit 20 to (english language and (120 neonatal <birth to age 1 mo> or 140 infancy <age 2 to 23 mo> or 160 preschool age <age 2 to 5 yrs>))
- 22 ((case adj control\$) or cohort\$ or longitudinal\$ or ((prospective\$ or (follow adj up)) adj5 (study or studies))).mp. [mp=title, abstract, heading word, table of contents, key concepts]
- 23 exp experimental design/
- 24 22 or 23
- 25 1 and 24
- 26 limit 25 to (english language and (120 neonatal <birth to age 1 mo> or 140 infancy <age 2 to 23 mo> or 160 preschool age <age 2 to 5 yrs>))

Adverse Effects

- 1 exp communication disorders/
- 2 exp psychological stress/
- 3 coping behavior/
- 4 exp Stereotyped Attitudes/
- 5 exp PREJUDICE/
- 6 exp Errors/
- 7 exp self concept/

APPENDIX 2. SEARCH STRATEGIES (continued)

- 8 (adverse effect\$ or harm\$ or stigma\$ or stereotyp\$).mp. [mp=title, abstract, heading word, table of contents, key concepts]
- 9 2 or 3 or 4 or 5 or 6 or 7 or 8
- 10 1 and 9
- 11 limit 10 to (english language and (100 childhood <birth to age 12 yrs> or 200 adolescence <age 13 to 17 yrs>))

CINAHL – 1982 to November 19, 2004

Screening

- 1 exp Communicative Disorders/cl, di, ev [Classification, Diagnosis, Evaluation]
- 2 exp Psychological Tests/
- 3 (diagnostic techniques and procedures).mp. [mp=title, cinahl subject headings, abstract, instrumentation]
- 4 functional assessment/ or health screening/ or exp "speech and language assessment"/
- 5 2 or 3 or 4
- 6 1 and 5
- 7 limit 6 to (english and (infant <1 to 23 months> or preschool child <2 to 5 years>))
- 8 exp RISK ASSESSMENT/ or exp RISK FACTORS/
- 9 risk\$.mp.
- 10 8 or 9
- 11 1 and 10
- 12 limit 11 to (english and (infant <1 to 23 months> or preschool child <2 to 5 years>))
- 13 primary care.mp. or exp Primary Health Care/
- 14 family physicians.mp. or exp Physicians, Family/
- 15 pediatrician\$.mp. or exp Pediatrics/
- 16 exp Pediatric Care/ or pediatrician\$.mp. or exp Pediatrics/
- 17 exp Child Health Services/
- 18 Preventive Health Care/
- 19 13 or 14 or 15 or 16 or 17 or 18
- 20 1 and 19
- 21 limit 20 to (english and (infant <1 to 23 months> or preschool child <2 to 5 years>))
- 22 exp "Sensitivity and Specificity"/
- 23 exp Diagnostic Errors/
- 24 exp Diagnosis, Differential/
- 25 22 or 23 or 24
- 26 1 and 25
- 27 limit 26 to (english and (infant <1 to 23 months> or preschool child <2 to 5 years>))
- 28 exp Study Design/
- 29 1 and 28
- 30 limit 29 to (english and (infant <1 to 23 months> or preschool child <2 to 5 years>))
- 31 12 or 21 or 27 or 30

APPENDIX 2. SEARCH STRATEGIES (continued)

Adverse Effects

- 1 exp Communicative Disorders/
- 2 exp Stress, Psychological/
- 3 exp Life Change Events/
- 4 exp PREJUDICE/
- 5 exp STEREOTYPING/
- 6 exp Self Concept/
- 7 exp diagnostic errors/
- 8 (adverse effect\$ or harm\$ or stigma\$ or stereotyp\$).mp. [mp=title, cinahl subject headings, abstract, instrumentation]
- 9 2 or 3 or 4 or 5 or 6 or 7 or 8
- 10 1 and 9
- 11 limit 10 to (english and (infant <1 to 23 months> or preschool child <2 to 5 years> or child <6 to 12 years> or adolescence <13 to 18 years>))

APPENDIX 3. INCLUSION/EXCLUSION CRITERIA BY KEY QUESTION

Key Question 2 (Screening)

- Include RCT with speech and language measures.
Cohort, case control, or other type of observational study with speech and language measures
Review or meta-analysis with relevant information.
- Exclude Sample size too small ($N < 20$).
Case report.
Foreign language.
Test not relevant to the primary care setting (e.g., administered by specialist only).
Description of instrument only, no data.
Previously diagnosed subjects (unless a comparison group).
Wrong format (opinion, letter, editorial etc.).
Wrong age group (> 5 years old).
Related to topic but does not address key question.
No relevance to topic.

Key Question 2b (Risk Factors)

- Include RCT, cohort, case control, cross-sectional, descriptive, or other type of observational study with speech and language measures.
Review or meta-analysis with relevant information.
- Exclude Sample size too small ($N < 20$).
Case report.
Foreign language.
Focus on another diagnosis (ADHD, autism, etc.).
Wrong format (opinion, letter, editorial etc.).
Wrong age group (> 5 years old).
Related to topic but does not address key question.
No relevance to topic.

APPENDIX 3. INCLUSION/EXCLUSION CRITERIA BY KEY QUESTION (continued)

Key Question 3 and 8 (Adverse Effects)

- Include**
- RCT, cohort, case control, or other type of observational study with speech and language measures.
 - Review or meta-analysis with relevant information.
 - Adverse impact of speech and language delay diagnosis and treatment on the child (any age).
 - Adverse impact of speech and language delay diagnosis and treatment on family or others.
- Exclude**
- Sample size too small ($N < 20$).
 - Case report.
 - Foreign language.
 - Not relevant to the primary care setting.
 - Description only, no data.
 - Wrong format (opinion, letter, editorial etc.).
 - Wrong age group (> 5 years old).
 - Related to topic but does not address key question.
 - No relevance to topic.

Key Question 4 (Surveillance)

- Include**
- RCT with speech and language measures.
 - Cohort, case control, or other type of observational study with speech and language measures.
 - Review or meta-analysis with relevant information.
- Exclude**
- Sample size too small ($N < 20$).
 - Case report.
 - Foreign language.
 - Test not relevant to the primary care setting (e.g., administered by specialist only).
 - Description only, no data.
 - Previously diagnosed subjects.
 - Wrong format (opinion, letter, editorial etc.).
 - Wrong age group (> 5 years old).
 - Related to topic but does not address key question.
 - No relevance to topic.

APPENDIX 3. INCLUSION/EXCLUSION CRITERIA BY KEY QUESTION (continued)

Key Question 5, 6, and 7 (Interventions and Outcomes)

Include	RCT with appropriate speech and language outcomes. Cohort, case control, or other type of observational study with appropriate speech and language outcomes. Review or meta-analysis with relevant information.
Exclude	Case study. Foreign language. Description of instrument or intervention only, no data. Focus on another diagnosis (ADHD, autism, etc.). Wrong format (opinion, letter, editorial etc.). Related to topic but does not address key question. No relevance to topic.

APPENDIX 4. USPSTF QUALITY RATING CRITERIA

Diagnostic Accuracy Studies

Criteria

- Screening test relevant, available for primary care, adequately described
- Study uses a credible reference standard, performed regardless of test results
- Reference standard interpreted independently of screening test
- Handles indeterminate results in a reasonable manner
- Spectrum of patients included in study
- Sample size
- Administration of reliable screening test

Definition of ratings based on above criteria

Good: Evaluates relevant available screening test; uses a credible reference standard; interprets reference standard independently of screening test; reliability of test assessed; has few or handles indeterminate results in a reasonable manner; includes large number (more than 100) broad-spectrum patients with and without disease.

Fair: Evaluates relevant available screening test; uses reasonable although not best standard; interprets reference standard independent of screening test; moderate sample size (50 to 100 subjects) and a “medium” spectrum of patients.

Poor: Has important limitations such as: uses inappropriate reference standard; screening test improperly administered; biased ascertainment of reference standard; very small sample size of very narrow selected spectrum of patients.

Randomized Controlled Trials (RCTs) and Cohort Studies

Criteria

- Initial assembly of comparable groups: RCTs—adequate randomization, including concealment and whether potential confounders were distributed equally among groups; cohort studies—consideration of potential confounders with either restriction or measurement for adjustment in the analysis; consideration of inception cohorts
- Maintenance of comparable groups (includes attrition, cross-overs, adherence, contamination)
- Important differential loss to follow-up or overall high loss to follow-up
- Measurements: equal, reliable, and valid (includes masking of outcome assessment)
- Clear definition of interventions
- Important outcomes considered
- Analysis: adjustment for potential confounders for cohort studies, or intention-to-treat analysis for RCTs (i.e. analysis in which all participants in a trial are analyzed according to the intervention to which they were allocated, regardless of whether or not they completed the intervention)

APPENDIX 4. USPSTF QUALITY RATING CRITERIA (continued)

Definition of ratings based on above criteria

- Good:** Meets all criteria: Comparable groups are assembled initially and maintained throughout the study (follow-up at least 80 percent); reliable and valid measurement instruments are used and applied equally to the groups; interventions are spelled out clearly; important outcomes are considered; and appropriate attention to confounders in analysis.
- Fair:** Studies will be graded “fair” if any or all of the following problems occur, without the important limitations noted in the “poor” category below: Generally comparable groups are assembled initially but some question remains whether some (although not major) differences occurred in follow-up; measurement instruments are acceptable (although not the best) and generally applied equally; some but not all important outcomes are considered; and some but not all potential confounders are accounted for.
- Poor:** Studies will be graded “poor” if any of the following major limitations exists: Groups assembled initially are not close to being comparable or maintained throughout the study; unreliable or invalid measurement instruments are used or not applied at all equally among groups (including not masking outcome assessment); and key confounders are given little or no attention.

Case Control Studies

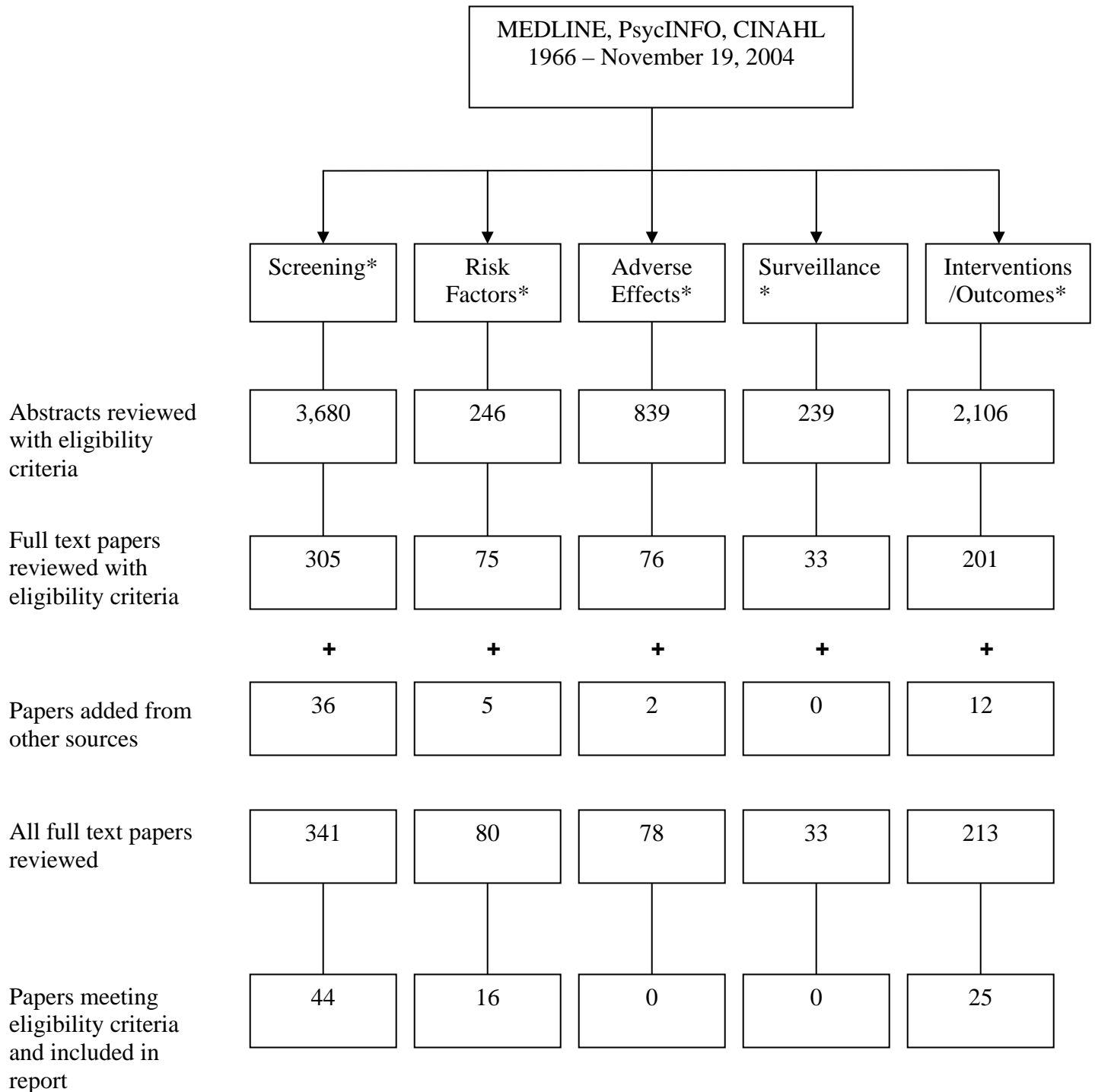
Criteria

- Accurate ascertainment of cases
- Nonbiased selection of cases/controls with exclusion criteria applied equally to both
- Response rate
- Diagnostic testing procedures applied equally to each group
- Measurement of exposure accurate and applied equally to each group
- Appropriate attention to potential confounding variable

Definition of ratings based on above criteria

- Good:** Appropriate ascertainment of cases and nonbiased selection of case and control participants; exclusion criteria applied equally to cases and controls; response rate equal to or greater than 80 percent; diagnostic procedures and measurements accurate and applied equally to cases and controls; and appropriate attention to confounding variables.
- Fair:** Recent, relevant, without major apparent selection or diagnostic work-up bias but with response rate less than 80 percent or attention to some but not all important confounding variables.
- Poor:** Major selection or diagnostic work-up biases, response rates less than 50 percent, or inattention to confounding variables.

APPENDIX 5. SEARCH AND SELECTION OF LITERATURE



*Citations overlapped multiple key questions

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	N	Study Design	Type of Disorder	Setting	Inclusion/Exclusion Criteria	Age (Months)
Brookhouser, 1979	24	Cross sectional	Language delay - moderate to severe levels	Sample from Boys Town Institute was taken from a larger population referred for evaluation	<u>Inclusion:</u> 1. Native English speakers in U.S. with English speaking parents 2. No significant retardation 3. Eight months or more delay below chronologic age in one of two language categories	28 - 62 (mean 44)
Campbell, 2003	639 Sub-sample of larger prospective study of persistent otitis media with effusion	Case control	Speech delay (transcriber can gloss ≤75% of words or speech sample contains errors not expected of a 3 year old.)	Pittsburgh, PA (2 urban, 2 suburban, and 2 small town or rural practices)	<u>Exclusion:</u> 1. Birth weight <5 lb 2. Small for gestational age 3. History of neonatal asphyxia or serious illness 4. Multiple birth 5. Foster care or adopted 6. Mother <18 years old 7. Mother ill or dead 8. Mother known to abuse drugs or alcohol or too limited to give informed consent or adhere to protocol 9. Other than English spoken in home 10. Other sibling was participating in study 11. Parents planned to move away in 5 years	36
Cantwell, 1985	600	Cross sectional	Multiple types of speech and language disorders	Large community speech and hearing clinic in Los Angeles, CA area	<u>Exclusion:</u> 1. >16 years 2. Significant hearing impairment	20.4 - 190.8 (median 58.8)

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	Assessment Method	Population
Brookhouser, 1979	Multi-disciplinary intake (history, otolaryngologist evaluation, audiological, speech and language standardized tests)	One or more risk factors were present in all study children, 87.5% had two or more. Otitis media as a sole factor accounted for 12 (50%) of children
Campbell, 2003	Family questionnaire on enrollment; pneumatic otoscopic evaluations; individual testing session with examiners blinded to child's family history of communication disorders, maternal education level, otitis media experience and health insurance status; included standardized and nonstandardized measures; hearing test of trial patients; transcription of consecutive utterances in 15 minute speech sample by assistants blinded to all participant information	Cases=398 (90 days of continuous bilateral otitis media or 135 days of continual unilateral otitis media) Controls=241 (not meeting above criteria)
Cantwell, 1985	Standardized tests for speech and language with informal methods for children who were untestable; includes psychiatric measures, interviewing parents and child, and behavior rating scales	397 cases

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	Risk Factors Studied	Results
Brookhouser, 1979	<p>HEARINGS RISK: H=history of family communication disorder; E=ear nose and throat deformities; A=anoxia at birth or low APGAR score; R=prescription for ototoxic or teratogenic drugs during pregnancy; I=maternal illness during pregnancy including infections of preeclampsia; N=neonatal intensive care or prolonged hospital stay for infant; G=growth retardation; S=stress factors in delivery; R=recurrent otitis media beginning before 2 years of age with surgical intervention and/or hearing loss; I=serious childhood illness with a fever of 104°F for a period greater than 24 hours; S=seizures diminished sucking reflex, or other signs of CNS dysfunction; K=knocked out; head trauma with loss of consciousness or bloody otorrhea; S=subjectively difficult to test audilogically</p>	<p>One factor (serious childhood infections) was significantly related to severity of receptive language delay (t=3.160)</p>
Campbell, 2003	<ol style="list-style-type: none"> 1. Male sex 2. FH of developmental communication disorder 3. Low maternal education 4. Low socioeconomic level 5. African-American Race 6. Prolonged otitis media 	<ol style="list-style-type: none"> 1. Male sex, OR=2.19 (95% CI = 1.38-3.47); 2. Positive family history, OR=1.67 (1.06-2.62); 3. Low maternal education, OR=2.58 (1.49-4.48); 4. Medicaid, OR=1.59 (1.02-2.49); but no longer significant when controlling for other factors; 5. Race not significant; 6. Otitis media history not significant <p>Aggregated risk factors, low maternal education, male sex, positive family history, OR=7.71 (2.62-22.74)</p>
Cantwell, 1985	<p>Psychiatric syndromes and their associations with speech and language disorders</p>	<p>No unique psychiatric syndrome was associated with speech and language disorders</p>

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	N	Study Design	Type of Disorder	Setting	Inclusion/Exclusion Criteria	Age (Months)
Choudhury, 2003	136 from 112 families	Case control	Specific language impairment	New York, NY, Newark, NJ, and surrounding New Jersey suburbs; obstetric and pediatric practices and samples of several pooled longitudinal studies	<p><u>Inclusion:</u></p> <ol style="list-style-type: none"> 1. Family member had at least 1 affected child or parent with language scores at least 1 standard deviation below age appropriate mean 2. Standardized test of general cognitive ability was within normal range <p><u>Exclusion:</u></p> <ol style="list-style-type: none"> 1. Prematurity, low birth weight 2. Pervasive developmental disorder or autism diagnosed in family proband, or Attention deficit disorder 3. Hearing loss 4. Neurological disorder or oral motor impairment 	36
Singer, 2001	263	Case control	Language	Level 3 NICU in the Cleveland, OH region	<p><u>Inclusion:</u></p> <p>Cases</p> <ol style="list-style-type: none"> 1. Preterm (<1500 grams) 2. >28 days with x-ray findings of chronic lung disease without neurological problems and not socially disadvantaged (Hollingshead class IV and V) <p>Controls</p> <ol style="list-style-type: none"> 1. The next born VLBW infant without bronchopulmonary dysplasia of same race social status 2. Term infants from newborn nurseries; next born of same race and social status <p><u>Exclusion:</u></p> <ol style="list-style-type: none"> 1. Major congenital malformations 2. Drug exposure 3. Mother with major psychiatric or physical illness 4. HIV or mental retardation 5. Live >2 hours drive from facility 	36 (corrected for prematurity)

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	Assessment Method	Population
Choudhury, 2003	Parent questionnaire for demographic information and family medical history; test results of affected family member (proband). Subset of cases were administered a battery of standardized language and cognitive assessments (Preschool Language Scale-3, 2 subtests of Clinical Evaluation of Language Fundamentals-Preschool, sentence structure and word structure, Stanford-Biner Intelligence Scale, 4th edition)	Positive family history=42 (37 families) Negative family history=94 (75 families) 92 children received standard language tests (32 with positive and 60 with negative family histories)
Singer, 2001	Standardized testing at facility including Bayley Scales of Infant Development II and Communication Domain Subscale of Battelle Developmental Inventory, and demographic information from hospital chart	98 cases (VLBW/Bronchopulmonary Dysplasia); 70 controls (non Bronchopulmonary Dysplasia), 95 term controls; all were patients in the NICU as newborns

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	Risk Factors Studied	Results
Choudhury, 2003	<ol style="list-style-type: none"> 1. Gender 2. Differences between family history groups for parental age, education, socioeconomic status, number and gender of children. 3. Medical disorders 	<p><u>In family aggregation study:</u> Males were more affected ($p < 0.005$), sons 41%, fathers 18%, daughters 16%, mothers 11%. Specific language impairment males were more likely to have an affected sibling ($p < 0.05$). Male probands had more brothers (1.45 brothers vs 0.05 sisters) and female probands had more sisters (1.25 sisters vs. 0.25 brothers; $p < 0.05$). No association of gender of impaired parent and number of impaired children ($p > 0.5$) but specific language impairment mothers had more girls than expected ($p < 0.05$)</p> <p><u>Comparison of positive vs negative family history:</u> Children with positive family history tended to have more children in family and older parents, but no differences in socioeconomic status and parent education. Children with positive family history were more likely to report family history of autoimmune diseases ($p < 0.001$) but not asthma.</p>
Singer, 2001	<ol style="list-style-type: none"> 1. Bronchopulmonary dysplasia 2. Patent ductus arteriosis 	<p>Bronchopulmonary dysplasia was associated with lower language score ($p < 0.005$ on Battelle); especially receptive language ($p < 0.02$) after other controlling for other factors Patent ductus arteriosis was associated with socioeconomic status, neurological risk, and minority race (all $p < 0.001$)</p>

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	N	Study Design	Type of Disorder	Setting	Inclusion/Exclusion Criteria	Age (Months)
Tallal, 1989	150	Case control	Language	San Diego, CA; referred from school, clinics, and private professionals serving language-impaired children	<u>Inclusion:</u> 1. Aged 48-59 months 2. Nonverbal performance IQ of 85 or better on the Leiter International Performance Scale 3. Mean language age at least 1 year below both performance mental age and chronologic age 4. Normal hearing and no oral, structural, or motor impairments affecting nonspeech movement of articulators 5. English language background only; no nonstandard dialectical usage or other language 6. No autism 7. No neurological disorders 8. Data could be collected from both parents	48 - 59
Tomblin, 1991	662	Case series	Speech and language	Pediatric offices in Iowa	<u>Inclusion:</u> 1. Not at risk for neurodevelopmental difficulties 2. Could get questionnaire back 3. Patient at one of 16 participating pediatricians' offices	30 - 60

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	Assessment Method	Population
Tallal, 1989	Parent questionnaire was used for the study, although a sample of cases and controls was taken after assessment of larger group.	76 cases (54 boys and 22 girls) 54 controls (27 boys and 27 girls)
Tomblin, 1991	Developmental testing by pediatrician as part of longitudinal study. Parent questionnaire included parent concerns, history of hearing impairment, history of speech/language delay, developmental issues, and questions from the Early Language Milestone Scale, Preschool Development Inventory, and the Minnesota Child Development Inventory	Part of a larger cohort in a longitudinal study

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	Risk Factors Studied	Results
Tallal, 1989	<ol style="list-style-type: none"> 1. Mothers, fathers, or siblings with history of language or learning problems 2. Parental history of below average school achievement to 8th grade (reading, writing, or kept back a grade through 8th grade) 	<p>Mothers of impaired children were more likely to have a history of language problems ($p < 0.02$), more likely kept back in school ($p < 0.03$), more likely to be poor readers ($p < 0.0001$), and writers ($p < 0.0001$) in school. More mothers of affected children met criteria for affected ($p < 0.05$). Fathers of cases were more likely to report being kept back ($p < 0.03$) and more often met criteria for affected ($p < 0.02$). Siblings of cases were more likely to be affected ($p < 0.05$), and frequency of sibling impairment was not significantly influenced by number of parents affected. Impaired children were more likely to have a positive family history (at least 1 first-degree relative affected; $p < 0.002$)</p>
Tomblin, 1991	<ol style="list-style-type: none"> 1. Sex 2. Birth order 3. Birth weight 4. Father's education level 5. Mother's education level 6. Infant risk score (at risk; question of risk; no risk) <ol style="list-style-type: none"> a. Birth events b. Family history of speech/language problem c. Family history of hearing loss 	<ol style="list-style-type: none"> 1. Male ($p = 0.043$) 2. Later born ($p < 0.0001$) 3. No difference for mean weight 4. Lower father's education level ($p < 0.029$) 5. No difference for mother's education level 6. Poor communication group rated at risk or question of risk as infant ($p < 0.0001$); (sensitivity of risk score system = 0.55, specificity = 0.76)

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	N	Study Design	Type of Disorder	Setting	Inclusion/Exclusion Criteria	Age (Months)
Tomblin, 1997	1,102	Case control	Speech and language	Metropolitan areas in Iowa or Western Illinois	<u>Inclusion:</u> 1. Monolingual English speakers 2. Consent obtained 3. Failed language test for cases 4. Age appropriate language for controls who also had normal hearing 5. Age appropriate nonverbal language Matched with cases on gender & residential variables <u>Exclusion:</u> 1. Sensory impairment 2. Mental retardation or autism 3. Cerebral palsy 4. Severe head injury 5. Visual impairment	Kindergarten age (otherwise not specified)
Whitehurst, 1991	117	Prospective cohort	Expressive language delay	Long Island, NY	Cases met criteria of expressive language delay (expressive language >2.33 standard deviations below mean, and standard scores of at least 85 for receptive language and cognitive abilities) Controls were matched to cases on age, sex, SES status, and scored in the normal range on all 3 standardized tests	24 - 38

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	Assessment Method	Population
Tomblin, 1997	Standardized language assessment battery and telephone survey using risk questionnaire; interviewers were blinded.	177 cases 925 controls
Whitehurst, 1991	Recruited through advertisements in local papers; tested on standardized tests; language sample audio taped; hearing information obtained; medical records reviewed; parental questionnaire regarding family history	62 cases 55 controls

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	Risk Factors Studied	Results
Tomblin, 1997	<ol style="list-style-type: none"> 1. Parents' socio-demographics 2. Pre and postnatal exposures of parent (infections, hypertension, drugs, immune system disorders, adverse health behaviors, work related exposures) 3. Pregnancy conditions 	<p>Significant associations: younger mothers ($p < 0.005$); fathers with learning problems (speech, learning or mental retardation) ($p < 0.05$); both parents with lower education status ($p < 0.05$). Maternal exposures had no significant differences (maternal smoking did but not when adjusted for education level). Paternal exposures significantly higher (smoking even when adjusted for education level).</p> <p>Not associated with low birth weight, type of delivery, labor history of delivery complications.</p> <p>Less time breastfeeding ($p < 0.05$)</p>
Whitehurst, 1991	Family history of late talking, speech problems, or school problems	<p>No strong familial component found; no differences for separate analyses for male and female relatives except mothers of cases more likely to have been late talking ($p = 0.049$). 85% of cases were boys</p>

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	N	Study Design	Type of Disorder	Setting	Inclusion/Exclusion Criteria	Age (Months)
Non-English Language Studies						
Fox, 2002 (Germany)	113	Cross sectional	Speech	Northern Germany from 2 private practices for speech and language therapy and 13 kindergartens	<u>Inclusion:</u> 1. German as native language 2. Monolingual living in northern Germany study area <u>Exclusion:</u> 1. More general language problem 2. Sensory impairment, organic motor disorder, craniofacial anatomical anomaly or intellectual impairment 3. Bilingualism 4. Previous speech intervention 5. Only articulation disorder	<i>Cases</i> 32.4 - 86.4 <i>Control</i> 40.8 - 73.2
Klein, 1986 (Israel)	72	Concurrent comparison group	Vocabulary	15 kindergarten classes in predominantly middle-class urban area	<u>Inclusion:</u> 1. Teacher identified children who were easy, difficult, and slow-to-warm-up 2. Parent confirmed temperament by Behavioral Style Questionnaire (BSQ)	53 - 69
Kloth, 1995 (Netherlands)	93	Case control	Stuttering	Referred by area pediatricians, members of the Dutch Association of Stutters, and speech-language pathologists	<u>Inclusion:</u> 1. One or both parents stutters 2. Children were reported to have normal intelligence 3. Demonstrated to function within age-related normal range for expressive and receptive language 4. Passed audiometric test	23 - 58
Lyytinen, 2001 (Finland)	200	Prospective cohort study	Speech and language	Maternity clinics in central Finland from 4/1/93 to 7/31/96	<u>Inclusion:</u> 1. Parents IQ >80 2. Parents with three or more scores at least one SD below norm on several reading or spelling measures	0 - 54

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	Assessment Method	Population
Non-English Language Studies		
Fox, 2002 (Germany)	Direct testing with speech instruments for children and parent questionnaire on child's developmental history	65 cases 48 controls
Klein, 1986 (Israel)	Teachers picked a child in each of 3 categories (easy, difficult, or slow-to-warm up), corroborated by parents on behavior questionnaire, and assessed cognitive performance on 3 types of tasks (vocabulary, abstract reasoning, and immediate sequential memory) using standardized tests. Vocabulary from Peabody picture Vocabulary Test and from the Wechsler Preschool and Primary Scale of Intelligence-Revised	Easy: 12 boys, 12 girls Difficult: 14 boys, 10 girls Slow-to-warm-up: 14 boys, 10 girls
Kloth, 1995 (Netherlands)	Dysfluency questionnaire and video recorded sessions were transcribed and random sections were reviewed independently by 2 judges	Subjects were children of parents who stutter or had a history of stuttering, none of the 93 children stuttered at the beginning of the study. 26 cases: children who developed stuttering during the year under study 67 controls
Lyytinen, 2001 (Finland)	Parents and relatives who reported reading problems were individually assessed for reading and related skills; serial assessments of the child from birth to 4.5 years	107 with familial risk of dyslexia 93 without familial risk for dyslexia

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	Risk Factors Studied	Results
Non-English Language Studies		
Fox, 2002 (Germany)	<ol style="list-style-type: none"> 1. Pre and perinatal problems 2. Hearing problems caused by fluctuating hearing abilities, acute middle ear infections, or a high number of further ENT problems 3. Sucking habits 4. Positive family history for speech and/or language difficulties 	Controlling for age and gender: <ol style="list-style-type: none"> 1. Birth difficulties (p=0.020) 2. ENT history (p=0.54) 3. Sucking habits (p =0.007) 4. Positive family history (p=0.020)
Klein, 1986 (Israel)	<ol style="list-style-type: none"> 1. Temperament (easy, difficult, or slow-to warm up) 	No differences were found between temperament groups on vocabulary tests, and no difference between boys and girls.
Kloth, 1995 (Netherlands)	<ol style="list-style-type: none"> 1. Communicative style, speaking rate, and language complexity of the mothers 	No significant difference in the number of mothers who stutter in the 2 groups. Mothers of stutterers had significantly shorter mean length utterances (p<0.01) than mothers of nonstutterers. Speaking style and rate were not significantly different between groups
Lyytinen, 2001 (Finland)	Family history of dyslexia	The biological (family) risk for dyslexia is still a significant predictor of language development at 5 years even after taking into account the earlier language achievements, environmental factors, and a significant number of preschool predictors of reading skills (p<0.05)

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	N	Study Design	Type of Disorder	Setting	Inclusion/Exclusion Criteria	Age (Months)
Peters, 1997 (Netherlands)	946	Prospective cohort	Language and educational attainment	Birth cohort in Nijmegen, Netherlands	<u>Inclusion:</u> 1. Either bilateral B tympanograms on two consecutive occasions between 2 and 4 years old or never had a bilateral B tympanogram	84 - 96
Weindrich, 2000 (Germany)	320	Prospective cohort	Receptive, expressive language, and articulation in the 4.5 year old and reading and spelling at age 8 years	Infants at birth from a hospital in Germany	<u>Inclusion:</u> 1. First born singletons of German speaking parents 2. Passed hearing screening <u>Exclusion:</u> 1. Severe physical handicaps, obvious genetic defects or metabolic diseases 2. Severe motor or mental handicaps or autism	Tested at 54 and 96

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	Assessment Method	Population
Peters, 1997 (Netherlands)	Regular tympanograms and age 7-8 years full audiological and tests of language; questionnaire to teacher	2X2 design according to level of subject's risk (high or low) and the presence of otitis media or control (no otitis)
Weindrich, 2000 (Germany)	Direct testing	Part of a larger cohort in a longitudinal study

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	Risk Factors Studied	Results
Peters, 1997 (Netherlands)	<p>1. With or without history of otitis media</p> <p><i>Additional risk factors</i></p> <ol style="list-style-type: none"> 1. Low educational level for both parents 2. Male sex 3. Low non-verbal intelligence 4. Preterm birth and LBW 5. Dutch as a second language 	<p><i>Significant associations:</i> Low parental education level and no otitis were associated with general language delay ($p < 0.01$); having otitis had no additional negative effect. No effect of sex with or without otitis on general language. Preterm birth/LBW and otitis had no interaction for general language or phonological ability, same risk factors in control group had poorer scores for phonological ability ($p < 0.05$) and non-verbal intelligence ($p < 0.05$), but no effect on general language. Language other than Dutch as a first language is a risk factor for language ($p < 0.0001$), but no interaction effects with otitis on language. The combined effect of early bilateral otitis and other risk factors is only small</p>
Weindrich, 2000 (Germany)	<p><i>Biologic risk:</i> birth weight, gestational age, nonelective surgical delivery, toxemia, neonatal asphyxia, neonatal complications</p> <p><i>Psychological risk:</i> low parental education level, overcrowding, parental psychiatric disorder, history of broken home or delinquency, marital discord, early parenthood, one-parent family, unwanted pregnancy, poor social integration and support of parents, severe chronic difficulties, poor coping skills of a parent.</p> <p>Child was assigned as nonrisk, moderate risk, or high risk in each of these two categories.</p>	<p>Biologic risk is most strongly associated with language development of the 4.5 year olds in the clinical group ($p \leq 0.05$), no such effect was significant at age 8 for spelling/reading or language. Psychosocial risk were more often diagnosed with language disorder than the nonrisk group (delay $p \leq 0.01$ and clinical $p \leq 0.05$). Preterm labor/birth, gestosis, and VLBW were of significance and almost all the psychosocial risk factors except marital disharmony and lack of social support were important</p>

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	N	Study Design	Type of Disorder	Setting	Inclusion/Exclusion Criteria	Age (Months)
Yliherva, 2001 (Finland)	8,370	Prospective cohort	Speech, language, learning, motor abilities	Finland, two northern provinces, included 99% of pregnant women in 1985 -1986	<u>Inclusion:</u> 1. Cohort of all children born in the determined area between July 1, 1985 and June 30, 1986 2. Mothers agreed to participate 3. Children still living in area that can be contacted	96

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	Assessment Method	Population
Yliherva, 2001 (Finland)	Structured questionnaire of mothers during pregnancy and at age 7 years for socio-demographic data; questionnaire of hospital staff and midwives; parent and teacher questionnaire at age 8 years on speech, language, learning and motor abilities	9,362 participated at birth and 8,370 responded for evaluation at 8 years

APPENDIX 6. EVIDENCE TABLE: STUDIES OF RISK FACTORS

Author, Year	Risk Factors Studied	Results
Yliherva, 2001 (Finland)	<ol style="list-style-type: none"> 1. Neonatal risk factors 2. Birth weight (<1500 g, 1500-2499 g, ≥2500 g) 3. Gestational age (>32 wk, 32-36 wk, >37 wk) 4. SGA 5. Mother's age 6. Mother's education; marital status and changes over time 7. Number of children in home 8. Place of residence 	<p>LBW (<2500 g) had poorer speech at 8 years (p=0.001) and more confusion in discriminating between sounds (p=0.001). LBW girls had poorer speech than normal weight girls (p=0.001), and LBW boys confused certain sounds more than normal boys (p=0.004). LBW boys had the highest prevalence of problems in speech, and LBW girls performed equally well compared with the NBW boys. LBW children had more difficulties following instructions concerning activities (p=0.028), and more difficulties than normal children in discriminating separate sounds from background noise (p=0.018), LBW boys especially (p=0.020).</p> <p><u>Multivariate logistic regression:</u> Children weighing 1500-2499 g were at greatest risk when adjusted for sociodemographic information. Neonatal risk, VLBW (<1500 g), problems in understanding linguistic concepts, hearing impairment, and male gender highly increased risk for speech and language delay. Four or more children in the family, and reconstructed family status were associated with problems in speech perception and understanding.</p> <p><u>Linguistic concepts:</u> Small for gestational age increased adjusted risk for problems in speech production (p=0.001), speech perception (p=0.006) and linguistic concepts (p=0.022). Preterm birth without the neonatal risk factors increased problems</p>

APPENDIX 7. DESCRIPTIONS OF INSTRUMENTS USED IN STUDIES

Instrument	Abbreviation	Components	Reference
Author created		Focuses on abnormal auditory behaviors: 1) Inconsistency of response to sound 2) Failure to separate background/foreground audition 3) Ignoring sound to abnormal degree 4) Diminishing responses to environmental sound 5) Inability to respond to auditory stimuli when more than minimally occupied with visual or tactile stimulation 6) Delayed responses 7) Habituation 8) Localization problems 9) Failure to respond to voice	Ward, 1984
Bankson Language Screening Test	BLST	17 nine-item subtests designed to test expressive language organized into five categories: 1) Semantic knowledge 2) Morphological rules 3) Syntactic rules 4) Visual perception 5) Auditory perception	Blaxley, 1983
*Battelle Developmental Inventory Screening Test	BDIST	Seven subsets: 1) Personal/social 2) Adaptive 3) Fine motor 4) Gross motor 5) Expressive language 6) Receptive language 7) Cognitive skills	Glascoe, 1993
*Bayley Infant Neurodevelopmental Screener	BINS	Assesses four areas: 1) Neurological functions/intactness 2) Receptive functions 3) Expressive functions 4) Cognitive processes	Macias, 1998
Children's Test of Nonword Repetition	CNRep	Repeating nonwords from two different lists and repeating numbers in series.	Gray, 2003; Conti-Ramsden, 2003
Clinical Adaptive Test/Clinical Linguistic Auditory Milestone Scale	CAT/ CLAMS	Includes psychometrics and speech and language milestones. CAT 19 age sets with 12 instruments and 57 items for visual motor skills. CLAMS 19 age sets with 3 instruments up to 24 months and 4 instruments after 24 months, includes 43 items for language skills.	Macias, 1998; Clark, 1995; Leppert, 1998;

APPENDIX 7. DESCRIPTIONS OF INSTRUMENTS USED IN STUDIES

Instrument	Abbreviation	Components	Reference
Davis Observation Checklist for Texas	DOCT	Observational teacher checklist on six areas of communication: 1) Speaking (expressive language) 2) Understanding (receptive language) 3) Speech 4) Fluency 5) Voice 6) Hearing	Alberts, 1995
Denver Articulation Screening Exam	DASE	34 sound elements that children are asked to produce	Drumwright, 1973
*Denver Developmental Screening Test	DDST	Four sectors: 1) Personal-social 2) Fine motor/adaptive 3) Gross motor 4) Language	Dodge, 1980
*Denver Developmental Screening Test - II	DDST II	Domains include: 1) Language 2) Fine motor-adaptive 3) Personal-social 4) Gross motor	Glascoe, 1993
*Denver Developmental Screening Test - Revised	R-DDST	Five categories: 1) Gross motor 2) Language 3) Fine motor 4) Adaptive/personal development 5) Social development	German, 1982; Feeney, 1996
*Developmental Nurse Screen		12-item checklist for gross and fine motor skills, language development, hearing, vision, social development, and self-help skills	Stokes, 1996
*Developmental Profile-II	DP-II	Five subsets: 1) Physical 2) Self-help 3) Social 4) Academic 5) Communication	Glascoe, 1993; German, 1982
Early Language Milestone Scale		41 items covering four areas: 1) Auditory expressive 2) Auditory receptive 3) Visual expressive 4) Visual receptive	Coplan, 1982; Black, 1988; Walker, 1989 Sherman, 1986
Fluharty Preschool Speech and Language Screening Test		35 items separated into 3 sections (A, B, C) including identification of 15 common objects (phoneme), nonverbal responses to 10 sentences (syntax), and imitation of 10 one-sentence picture descriptions. Assess identification, articulation, comprehension, and repetition	Blaxley, 1983; Sturner, 1993; Allen, 1987

APPENDIX 7. DESCRIPTIONS OF INSTRUMENTS USED IN STUDIES

Instrument	Abbreviation	Components	Reference
General Language Screen	GLS	11 questions about receptive and expressive language skills and one question about whether the child has any hearing difficulties	Stott, 2002
Hackney Early Language Screening Test		20-item test in seven sections: 1) Comprehension - following instructions to manipulate toys (e.g., "Make teddy drink") 2) Expression - tester manipulates toys and asks child questions about this 3) Comprehension - following instructions for placing toys (e.g., "Put the spoon in the box") 4) Comprehension - child chooses picture from three options 5) Expression - child answers question about pictures 6) Expression - child names objects 7) Comprehension - child chooses picture from four options (testing comprehension of function)	Dixon, 1988; Law, 1994
Language Development Survey	LDS	310 words arranged in 14 semantic categories. Parents indicate which words their child has spoken and describe word combinations of two or more words that their child has used	Rescorla, 1989; Rescorla, 1993; Rescorla, 2002; Klee, 1998; Klee, 2000; Rescorla, 2001
Levett-Muir Language Screening Test		Test is divided into six sections: 1) Comprehension - child is asked to pick toys from group 2) Vocabulary - child's ability to name the toys 3) Comprehension - using pictures child is required to respond to questions 4) Vocabulary - child's ability to name what's in the pictures 5) Comprehension & representation - child's ability to answer "what" and "who" questions 6) Overall - child is asked to explain the detailed composite picture	Levett, 1983
MacArthur Communicative Development Inventory: Toddler	CDI: Toddler	Expressive language is divided into two sections: 1) Vocabulary list of 680 word options; parent is asked to check the ones their child uses 2) Morphology and word combinations	Scherer, 1995
Mayo Early Language Screening Test	MELST	General checklist with specific age-related sections including questions to parents, observation of the child, and direct testing	McGinty, 2000

APPENDIX 7. DESCRIPTIONS OF INSTRUMENTS USED IN STUDIES

Instrument	Abbreviation	Components	Reference
*Minnesota Child Development Inventory	MCDI	320 items for parents include five areas of their child's development: 1) Cognitive 2) Language 3) Motor 4) Social 5) Adaptive skills	Chaffee, 1990
Northwestern Syntax Screening Test	NSST	20 receptive and 20 expressive items of grammatical forms that vary in level of complexity	Allen, 1987
Parent Evaluation of Developmental Status	PEDS	Two questions for parents to elicit concerns in general and in specific areas. Other items determine reasons for parents' concerns	Glascoe, 1991
*Parent Language Checklist	PLC	Twelve questions for parents about their child's receptive and expressive language with one question assessing hearing problems	Burden, 1996
Pediatric Language Acquisition Screening Tool for Early Referral	PLASTE R	Communication development milestones by age with seven individual areas. Each area contains 10 questions (five relate to receptive language and five relate to expressive language)	Sherman, 1996
Screening Kit of Language Development	SKOLD	Vocabulary comprehension, story completion, sentence completion, paired sentence repetition with pictures, individual sentence repetition with pictures, individual sentence repetition without pictures, auditory comprehension of commands	Bliss, 1984
Sentence Repetition Screening Test	SRST	15 sentences repeated one at a time by the child after demonstration by the tester	Sturner, 1996
Structured Photographic Expressive Language Test - Preschool	SPELT-P	25-items Child is presented with a picture and prompted to produce a sentence about it	Plante, 1995
Structured Screening Test		20 questions covering both expressive and receptive language skills	Laing, 2002
Test for Examining Expressive Morphology	TEEM	54-items targeting a variety of morphosyntactic structures using a sentence completion task	Merrell, 1997
Wilcox African-American English Screening Test of Articulation	WAAES TA	Includes 50 words targeting African-American Vernacular English	Wilcox, 1998
*WILSTAAR Screen		Description not available	Oakenfull, 2001

*Speech and language are part of a broader screening instrument.

APPENDIX 8. QUALITY RATINGS OF SCREENING INSTRUMENT STUDIES

Author, Year	Groups Similar at Baseline	Eligibility Criteria Specified	Adequate Sample Size (>50)	Adequate Attrition (≤10%)	Credible Reference Standard Used	Screening Test Adequately Described	Reference Standard Interpreted Independently	Quality Rating
Alberts, 1995	Yes	Yes	Yes (59)	N/A	Yes (McCarthy-Verbal)	Yes	Yes	Good
Allen, 1987*	NR	No	Yes (182)	N/A	Yes (SICD)	Yes	Yes	Fair
Black, 1988*	Yes	No	No (48)	N/A	Yes (REEL and Bayley)	Yes	Yes	Poor
Blaxley, 1983*	NR	Yes	Yes (90)	N/A	No (DSS)	Yes	Yes	Fair
Bliss, 1984*	Yes	No	Yes (602)	N/A	Yes (SICD)	Yes	No	Fair
Borowitz, 1986*	NR	Unclear	Yes (71)	N/A	Yes (PLS)	Yes	Yes	Fair
Burden, 1996	Yes	Yes	Yes (425)	N/A	Yes (Clinical Judgment)	Yes	Yes	Good
Chaffee, 1990*	N/A	Yes	Yes (152)	N/A	Yes (Reynell)	Yes	Yes	Good
Clark, 1995*	NR	Unclear	Yes (99)	N/A	Yes (SICD)	Yes	Yes	Fair
Conti-Ramsden, 2003	Yes	Yes	Yes (64)	N/A	Yes (Clinical Judgment)	Yes	No	Fair
Coplan, 1982*	NR	Yes	Yes (191)	N/A	Yes (Formal language and psychometric testing)	Yes	No	Fair
Dixon, 1988*	NR	No	No (40)	N/A	Yes (SLP Judgment)	Yes	Yes	Poor

APPENDIX 8. QUALITY RATINGS OF SCREENING INSTRUMENT STUDIES

Author, Year	Groups Similar at Baseline	Eligibility Criteria Specified	Adequate Sample Size (>50)	Adequate Attrition (≤10%)	Credible Reference Standard Used	Screening Test Adequately Described	Reference Standard Interpreted Independently	Quality Rating
Dodge, 1980*	NR	No	Yes (486)	N/A	Yes (Formal language assessment)	Yes	No	Fair-poor
Drumwright, 1973	Yes	Yes	Yes (1455)	N/A	Yes (TNDAST)	Yes	No	Fair
Feeney, 1996*	Yes	No	Yes (199)	N/A	Yes (SLP Judgment)	No	No	Fair
German, 1982*	N/A	Yes	Yes (84)	N/A	Yes (SICD and Bayley or McCarthy)	Yes	Yes	Good-fair
Glascoe, 1991*	Yes	Yes	Yes (157)	N/A	Yes (SLP Assessment)	Yes	Yes	Good
Glascoe, 1993*	N/A	Yes	Yes (89)	N/A	Yes (Criterion battery [†])	Yes	Yes	Fair
Gray, 2003	Yes	Yes	No (44)	N/A	Yes (SPELT-II)	Yes	Yes	Poor
Klee, 1998*	Unclear	Yes	Yes (64)	N/A	Yes (Infant MSEL)	Yes	Yes	Good-fair
Klee, 2000	Unclear	Yes	Yes (64)	N/A	Yes (MSEL)	Yes	Yes	Fair
Laing, 2002	NR	Yes	Yes (458)	N/A	Yes (RDLS)	Unclear; parent based and judgment used	Yes	Fair
Law, 1994*	NR	Yes	Yes (217)	N/A	Yes (RDLS)	Yes	Yes	Good-fair
Leppert, 1998	NR	Yes	Yes (70)	N/A	Yes (BSID II)	Yes	Yes	Fair

APPENDIX 8. QUALITY RATINGS OF SCREENING INSTRUMENT STUDIES

Author, Year	Groups Similar at Baseline	Eligibility Criteria Specified	Adequate Sample Size (>50)	Adequate Attrition (≤10%)	Credible Reference Standard Used	Screening Test Adequately Described	Reference Standard Interpreted Independently	Quality Rating
Levett, 1983*	Yes	Yes	Yes (140)	N/A	Yes (RDLS, G-F, LARSP)	Yes	Yes	Fair
Macias, 1998	Yes	Yes	Yes (78)	N/A	Yes (BSID II)	Yes	Yes	Fair
McGinty, 2000*	Yes	Yes	Yes (200)	N/A	Yes (RDLS)	Yes	Yes	Poor
Merrell, 1997	Yes	Yes	No (40)	N/A	Yes (K-ABC and SPELT-II)	Yes	Yes	Poor
Oakenfull, 2001	NR	NR	Yes (177)	N/A	Yes (REEL)	No	No	Poor
Plante, 1995	Yes	Yes	No (40)	N/A	Yes (K-ABC and SPELT-II)	Yes	Yes	Poor
Rescorla, 1989*	Yes	Unclear	Yes (81)	N/A	Yes (Bayley and Reynell)	Yes	Yes	Fair
Rescorla, 1993*	NR	Unclear	Yes (108)	N/A	Yes (Bayley and Stanford-Binet)	Yes	No	Fair
Rescorla, 2001	Yes	No	Yes (422)	N/A	Yes (Bayley and Stanford-Binet)	Yes	No	Fair
Rescorla, 2002	Yes	No	Yes (278)	N/A	Yes (CBCL)	Yes	No	Fair
Scherer, 1995*	Yes	Yes	Yes (60)	N/A	Yes (SLP assessment)	Yes	No	Fair
Sherman, 1996	Yes	Yes	Yes (173)	N/A	Yes (EMLS)	Yes	No	Fair
Stokes, 1997*	NR	Yes	Yes (398)	N/A	Yes (SLP assessment)	Yes	No	Fair

APPENDIX 8. QUALITY RATINGS OF SCREENING INSTRUMENT STUDIES

Author, Year	Groups Similar at Baseline	Eligibility Criteria Specified	Adequate Sample Size (>50)	Adequate Attrition (≤10%)	Credible Reference Standard Used	Screening Test Adequately Described	Reference Standard Interpreted Independently	Quality Rating
Stott, 2002	Yes	Yes	Yes (254)	No (15%)	Yes (EAT, RDLS, BPVS)	Yes	Yes	Good-fair
Sturner, 1993* Study 1	NR	No	Yes (279)	N/A	Yes (AAPS-R)	Yes	Yes	Fair
Sturner, 1993* Study 2	NR	No	Yes (421)	N/A	Yes (TACL-R, Templin-Darley)	Yes	Yes	Fair
Sturner, 1996*	N/A	No	Yes (76)	N/A	Yes (SLSQ)	Yes	Yes	Fair
Walker, 1989*	NR	No	Yes (77)	N/A	Yes (SICD)	Yes	No	Poor
Ward, 1984	N/A	No	Yes (1070)	N/A	Yes (REEL)	Yes	No	Fair
Wilcox, 1998	Yes	Yes	No (26)	N/A	Yes (Clinical Judgment)	Yes	No	Poor

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Objectives	Area of Intervention	Setting	N	Subjects
Almost, 1998* [†] <i>Effectiveness of speech intervention for phonological disorders: a randomized controlled trial</i>	To examine effectiveness of treatment for children with severe phonological disorders as typically seen in an ambulatory care speech-language-pathology clinic in a community hospital	Phonology	Speech and language pathology department clinic in a community hospital in SW Ontario, Canada	Assessment from 5/93 to 5/94	26	<i>Group 1:</i> mean age 42.5 months (33-61) Male: 12 Female: 1 <i>Group 2:</i> mean age 41.4 months (33-55) Male: 9 Female: 4
Barratt, 1992 [†] <i>Trial of intensive compared with weekly speech therapy in preschool children</i>	To compare the benefits of intensive individual speech therapy with the more traditional once weekly approach	Expressive and receptive language	Day nurseries, special play groups and nursery classes attached to schools in SW London, UK		39	Male: 27 Female: 12 Age range: 37-43 months
Cole, 1986 [†] <i>Direct language instruction and interactive language instruction with language delayed preschool children: a comparison study</i>	To examine effectiveness of two intervention techniques	Syntax, semantics, and pragmatics	Classrooms in the Experimental Education Unit at the University of Washington		44	Male: 34 Female: 10 Age range: 38-69 months

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Screening Criteria/Diagnostic Evaluation	Time from Screen to Intervention	Interventions
Almost, 1998* [†] <i>Effectiveness of speech intervention for phonological disorders: a randomized controlled trial</i>		Severe phonological disorder as determined by the phonological deviancy score on the Assessment of Phonological Processes - Revised (AAP-R) Receptive language skills >1 SD below the mean on the Reynell Developmental Language Scales - Revised	<i>Group 1:</i> immediate treatment implied <i>Group 2:</i> 4 months	<i>Group 1:</i> 4 months treatment followed by 4 months no treatment. <i>Group 2:</i> 4 months no treatment followed by 4 months treatment. Assessments at baseline, 4, and 8 months. <i>Treatment:</i> remediation for phonological disorders. Individual 30 minute sessions 2x per week. 4 - 6 target phonological deviations chosen for each child at treatment cycle initiation. Each target repeated 2 - 3 times or until correct in conversation
Barratt, 1992 [†] <i>Trial of intensive compared with weekly speech therapy in preschool children</i>		At least one SD below the mean for age on the Reynell Developmental Language Scales in comprehension, expression or both	Immediate treatment implied	Clinician administered interactive language therapy focusing on expressive and receptive skills 21 participants received weekly therapy and 18 received intensive
Cole, 1986 [†] <i>Direct language instruction and interactive language instruction with language delayed preschool children: a comparison study</i>		A score of 1.5 SD below the mean for age on either the Peabody Picture Vocabulary Test-Revised (PPVT-R), Form L; the Northwestern Syntax Screening Test, receptive section (NSST-R); the Preschool Language Scale (PLS), verbal ability or auditory comprehension subtests; or a Developmental Sentence Score (DSS) one full point below the 10th percentile	Immediate treatment implied	Clinician administered intervention using either a directive or an interactive approach 19 participants received directive approach, 25 participants received an interactive approach

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Length of Intervention	Outcome Measures	Speech and Language Outcomes	Non Speech and Language Outcomes
Almost, 1998* [†]	<i>Effectiveness of speech intervention for phonological disorders: a randomized controlled trial</i>	4 months	APP-R (Assessment of Phonological Processes-Revised) score GFTA (Goldman-Fristoe Test of Articulation) score PCC (Percentage Consonants Correct) score MLU (Mean Length of Utterance) score	<i>4 month assessment:</i> Group 1- scores of phonological measures reflect improvement: APP-R (p=0.05), GFTA (p=0.05), PCC (p=0.01) <i>8 month assessment:</i> Group 1- higher measures for speech intelligibility (PCC, p=0.05), but no statistically significant difference on single- word phonological skills <i>Expressive language measure (MLU):</i> no significant differences between groups at any assessment point. Group 1 had consistently higher (improved) scores than Group 2	None.
Barratt, 1992 [†]	<i>Trial of intensive compared with weekly speech therapy in preschool children</i>	Provided over 6 months either weekly (40 min), or as 2 intensive therapy blocks (40 min 4 days a week for 3 weeks in each 3 month block).	Reynell Expressive and Receptive scales	Both groups showed improvement in comprehension (p=0.07 for intensive group, p=0.02 for weekly group). Both groups showed improvement in expression scores, but the intensive therapy showed significantly greater improvement (p≤ 0.01 for intensive group, p=0.18 for weekly group)	The children in the intensive therapy group built up a relationship with the clinician quicker than those in the weekly group
Cole, 1986 [†]	<i>Direct language instruction and interactive language instruction with language delayed preschool children: a comparison study</i>	600 minutes a week given for 8 months.	MLU (Mean Length of Utterance) score Preschool language scale: overall scores Basic language concepts test Peabody Picture Vocabulary Test-Revised (PPVT-R)	There was little difference between the effectiveness of the direct-instruction program and the interactive program	None

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Objectives	Area of Intervention	Setting	N	Subjects
Courtright, 1979 [†]	<i>Imitative modeling as a language intervention strategy: The effects of two mediating variables</i>	To determine the effectiveness of a third-person modeling approach. To determine the amount imitative modeling increases the efficacy of interventions	Expressive language	Children were seen in speech and language therapy clinics	36	Male: 24 Female: 12 Age range: 47-83 months
Evans (unpublished) ^{†, ‡}	<i>The Kenilworth project: A randomised controlled trial of WILSTAAR</i>	Not reported	Not reported	Not reported	60	Children from middle class area Age: 8 months Gender mix not stated
Fey, 1993 ^{*, †}	<i>Two approaches to the facilitation of grammar in children with language impairment: An experimental evaluation</i>	To test the effectiveness of two broadly based grammar facilitation programs, one administered by a speech-language pathologist and the other by parents	Syntax and morphology	Children were recruited through advertisements and referrals from physicians and seen at a research clinic	29	Participants do not meet all criteria usually stipulated for specific language impairment. <i>Clinician Treatment Group:</i> mean age 54.7 months (SD 6.1) Male: 6 Female: 5 <i>Parent Treatment Group:</i> mean age 56.2 months (SD 7.2) Male: 7 Female: 3 <i>Delayed Treatment Group:</i> mean age 55.8 months (SD 6.3) Male: 8 Female: 1

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Screening Criteria/Diagnostic Evaluation	Time from Screen to Intervention	Interventions
Courtright, 1979 [†]	<i>Imitative modeling as a language intervention strategy: The effects of two mediating variables</i>	All subjects fell below the 10th percentile rank for age on the Developmental Sentence Score (DSS)	Immediate treatment implied	Clinician administered syntax intervention looking at effectiveness of mimicry and modeling approaches: 12 participants in mimicry condition 12 participants in modeling condition 12 participants in 3rd person modeling condition
Evans (unpublished) ^{†, ‡}	<i>The Kenilworth project: A randomised controlled trial of WILSTAAR</i>	At baseline children had to have Receptive Expressive Emergent Language (REEL) scores 1 SD below mean	Not reported	Parent administered general language intervention with training from clinician, WILSTAAR intervention: 24 participants assigned to WILSTAAR condition 36 participants assigned to no treatment condition
Fey, 1993 ^{*, †}	<i>Two approaches to the facilitation of grammar in children with language impairment: An experimental evaluation</i>	Developmental Sentence Score (DSS) below the 10th percentile for the lower of chronological or mental age	Immediate (N=21) Delayed 4.5 months (N=8)	All treatment sessions were conducted by a speech-language pathologist and included focused simulation procedures and cyclical goal-attack strategies. Each child had 4 specific treatment goals. Goals were presented in a cyclical manner, with one targeted each week. When a child began to use a target productively in the group sessions in clinician treatment or in monthly clinic sessions in parent treatment, the goal was dropped or combined with another existing related goal <i>Clinician Treatment:</i> 1-hour individual session and two 1-hour group sessions per week for 20 weeks. Each individual session began with a highly structured activity with imitation of the target for that week and of a language form contrastive with the target <i>Parent Treatment:</i> 2-hour group session per week for parents (12 weeks) then once per month (8 weeks). 3 home visits by pathologist during first 12 weeks. 1 hour monthly clinic visit with individual sessions for parent and child (final 8 weeks)

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Length of Intervention	Outcome Measures	Speech and Language Outcomes	Non Speech and Language Outcomes
Courtright, 1979 [†]	<i>Imitative modeling as a language intervention strategy: The effects of two mediating variables</i>	5 months	Utterances correct on 20 unusual sentences	Scores improved on the Preschool Language Scale (PLS) ($p < 0.001$) for all children	None
Evans (unpublished) ^{†, ‡}	<i>The Kenilworth project: A randomised controlled trial of WILSTAAR</i>	Not reported	REEL Language Quotients	All children improved regardless of therapy ($p < 0.01$). The Visualising and Verbalising technique was not a significantly better intervention than the traditional method used	None
Fey, 1993 ^{*, †}	<i>Two approaches to the facilitation of grammar in children with language impairment: An experimental evaluation</i>	20 weeks	Primary: DSS (Developmental Sentence Score) Mean Main Verb score per sentence Mean Personal Pronoun score per sentence Percentage of sentences awarded a Sentence Point	<i>Clinician Group vs. Delayed-Treatment Group:</i> The clinician group's DDS scores, Main Verb scores, and percentage of grammatically well-formed sentences were significantly higher ($p = 0.0005$, $p = 0.004$, and $p = 0.0005$, respectively) than the delayed-treatment group <i>Parent Group vs. Delayed-Treatment Group:</i> The parent group's DDS scores, Main Verb scores, and percentage of grammatically well-formed sentences were significantly higher ($p = 0.0001$, $p = 0.04$, and $p = 0.03$, respectively) than the delayed-treatment group <i>Clinician Group vs. Parent Group:</i> There were no differences between the clinician group and the parent group on DDS scores, Main Verb scores and percentage of grammatically well-formed sentences	None

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Objectives	Area of Intervention	Setting	N	Subjects
Fey, 1994 [†]	<i>Effects of grammar facilitation on the phonological performance of children with speech and language impairments</i>	To determine if a clinician-administered intervention produces better gains in phonology	Phonology	Children were recruited through advertisements and referrals from physicians and seen at a research clinic (from pool from Fey, 1993)	26	Male: 17 Female: 9 Age range: 44-70 months
Fey, 1997 [†]	<i>Two models of grammar facilitation in children with language impairments: Phase 2</i>	To evaluate the effects of either 5 months of intervention or 5 months of no intervention following completion of the first 5-month phase	Phonology	Children were recruited through advertisements and referrals from physicians and seen at a research clinic (from pool from Fey, 1993)	28	Age range: 44-70 months
Gibbard, 1994* [†]	<i>Study 1 Parental-based intervention with pre-school language-delayed children</i>	To examine the effectiveness of a parent trained intervention versus no intervention	Expressive language	Local health center where children were referred for speech and language therapy	36	Male: 25 Female: 11 Age range: 27-39 months Majority of participants in social classes I, II, or IIIM Mean mother age: 30 Mean father age: 33

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Screening Criteria/Diagnostic Evaluation	Time from Screen to Intervention	Interventions
Fey, 1994 [†] <i>Effects of grammar facilitation on the phonological performance of children with speech and language impairments</i>		Subjects from Fey, 1993 study Developmental Sentence Score (DSS) below the 10th percentile for the lower of chronological or mental age	Immediate in Subgroup 1 and Subgroup 3 (N=21) Delayed 5 months in Subgroup 2 (N=9)	Parent or clinician administered expressive syntax intervention based on focused stimulation: 10 received clinician therapy 8 received parent therapy 8 received delayed therapy
Fey, 1997 [†] <i>Two models of grammar facilitation in children with language impairments: Phase 2</i>		Subjects from Fey, 1993 study Developmental Sentence Score (DSS) below the 10th percentile for the lower of chronological or mental age	Immediate treatment implied.	Parent or clinician administered expressive syntax intervention based on focused stimulation provided in addition to that which was provided in Fey 1993: 9 had further parent treatment as Fey 1993 9 had further clinician treatment as Fey 1993 10 had no more treatment except the 4.5 month treatment received in Fey 1993
Gibbard, 1994* [†] Study 1 <i>Parental-based intervention with pre-school language-delayed children</i>		Vocabulary of <30 single words	Immediate	Parental administered expressive syntax intervention emphasizing how to maximize language use in everyday environment: 18 received parental intervention 18 received delayed intervention

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Length of Intervention	Outcome Measures	Speech and Language Outcomes	Non Speech and Language Outcomes
Fey, 1994 [†]	<i>Effects of grammar facilitation on the phonological performance of children with speech and language impairments</i>	10 months for Subgroups 1 and 2 5 months for Subgroup 3	Percentage of consonants correct derived from the Assessment of Phonological Processes - Revised (AAP-R)	Both the clinician and parent groups performed better than the control group (p=0.0006)	None
Fey, 1997 [†]	<i>Two models of grammar facilitation in children with language impairments: Phase 2</i>	10 months for two groups 5 months for one dismissal group	Developmental Sentence Scores (DSS): composite, verbs, sentence points	The clinician group had higher DSSs and main verb scores at the end of Phase 2 than at the end of Phase 1 (p=0.01 and p=0.03, respectively). The parent group had higher DSSs at the end of Phase 2 than at the end of Phase 1 (p=0.04). The reduction in DSS gains for the dismissal group over Phase 2 compared to those over Phase 1 was statistically significant (p=0.02). The clinician group had a smaller improvement in well-formed sentences over Phase 2 than over Phase 1 (p=0.03)	None
Gibbard, 1994* [†]	<i>Study 1 Parental-based intervention with pre-school language-delayed children</i>	An average of 40 minutes per week over 6 months	Reynell Expressive measure Language sample one word scores and total scores Renfrew Action Picture Test information Mother's description of vocabulary and phrase complexity MLU (mean length of utterances) from language sample	The mean scores improved for both the experimental and the no-intervention control groups, but the experimental group had larger gains on all measures (p=0.008 for language sample one word scores and p=0.000 for all other measures)	None

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Objectives	Area of Intervention	Setting	N	Subjects
Gibbard, 1994 [†] 2	<i>Parental-based intervention with pre-school language-delayed children</i>	To examine the effectiveness of a parent trained intervention versus a direct intervention	Expressive language	Local health center where children were referred for speech and language therapy	25	Male: 19 Female: 6 Age range: 27-39 months Majority of participants in social classes II, IIIM, and IIIN Average mother age: 28 and 29 Average father age: 29 and 33.5

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Screening Criteria/Diagnostic Evaluation	Time from Screen to Intervention	Interventions
Gibbard, 1994 [†] 2	Study <i>Parental-based intervention with pre-school language-delayed children</i>	Vocabulary of ≤ 30 single words	Immediate	Clinician or parent administered expressive syntax intervention Controls received a cognitive parent therapy based on Portage: 8 received clinician therapy 9 received parent therapy 8 received control therapy

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Length of Intervention	Outcome Measures	Speech and Language Outcomes	Non Speech and Language Outcomes
Gibbard, 1994 [†] 2	<i>Parental-based intervention with pre-school language-delayed children</i>	Clinician therapy 30 minutes per week for 6 months Parent therapy an average of 40 minutes per week for 6 months	Reynell expressive measure Language sample one word scores and total scores and MLU (mean length of utterances) Parent report of vocabulary and phrase complexity Renfrew Action Picture Test information	The parental involved approach made more gains than the direct approach on all measures, but only the mean length of utterances was statistically significant (p=0.008). The gains made by the parent involved group was statistically significant compared to the control group on all the measures (Reynell, p=0.018; Derbyshire one word scores, p=0.004, Derbyshire total scores, p=0.000; Renfrew, p=0.005; and mean length of utterances, p=0.000). The gains made by the direct approach group were statistically significant compared to the control group on two measures (Derbyshire total scores, p=0.007 and mean length of utterances, p=0.000)	None

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Objectives	Area of Intervention	Setting	N	Subjects
Girolametto, 1996* † b	<i>Interactive focused stimulation for toddlers with expressive vocabulary delays</i>	To examine the effects of a focused stimulation language intervention on children's' vocabulary and language development	Expressive vocabulary	Children were recruited from waiting lists for parent programs offered at two agencies in metropolitan Toronto, Canada	25	Age range: 23-35 months No gender details given

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Screening Criteria/Diagnostic Evaluation	Time from Screen to Intervention	Interventions
Girolametto, 1996* [†] b	<i>Interactive focused stimulation for toddlers with expressive vocabulary delays</i>	Vocabulary size in the lower 5th percentile for age measured by McArthur Communicative Development Inventories (CDI)	Immediate	Parental administered expressive vocabulary intervention based on HANEN principles and adapted for focused stimulation: 12 received parent intervention 13 received delayed intervention

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Length of Intervention	Outcome Measures	Speech and Language Outcomes	Non Speech and Language Outcomes
Girolametto, 1996* [†] b	<i>Interactive focused stimulation for toddlers with expressive vocabulary delays</i>	150 minutes per week for 11 weeks	Vocabulary and phrase complexity as determined by the McArthur Communicative Development Inventories (CDI) Number of different words and utterances from a language sample Post test probes for target words Control word measures, target words in interaction, multi-word utterances	Children who received treatment had larger vocabularies ($p < 0.02$) and used a greater number of different words ($p < 0.01$) compared to the control group. Those who received treatment used more structurally complete utterances and more multiword utterances than those in the control group ($p < 0.04$ and $p < 0.01$, respectively)	Mother's language interactions with child changed (language input slower, less complex, and more focused after treatment) Few words/minute $p \leq 0.01$ Shorter utterances $p < 0.01$ Used more target words and focused stimulation of target words $p < 0.01$

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Objectives	Area of Intervention	Setting	N	Subjects
Girolametto, 1996* ^a	<i>The effects of focused stimulation for promoting vocabulary in young children with delays: a pilot study</i>	To examine whether children in an experimental group would learn more words than children on a waiting list (control group)	Expressive and receptive vocabulary	Children were recruited from waiting lists for parent programs offered at two agencies in metropolitan Toronto, Canada	16	Male: 11 Female: 5 Age range: 22-38 months
Girolametto, 1997 [†]	<i>Effects of lexical intervention on the phonology of late talkers</i>	To examine the impact of a focused stimulation intervention on the vocabulary, language, and emerging phonological skills of late talkers	Phonology	Children were recruited from waiting lists for parent programs offered at two agencies in metropolitan Toronto, Canada.	25	Male: 22 Female: 3 Age range: 23-35 months

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Screening Criteria/Diagnostic Evaluation	Time from Screen to Intervention	Interventions
Girolametto, 1996* ^a	<i>The effects of focused stimulation for promoting vocabulary in young children with delays: a pilot study</i>	Delayed in the acquisition of vocabulary as measured by the Communicative Development Inventory (CDI)	Immediate	Parental administered expressive vocabulary intervention based on HANEN principles and adapted for focused stimulation: 8 received parent therapy 8 received delayed therapy
Girolametto, 1997 [†]	<i>Effects of lexical intervention on the phonology of late talkers</i>	Vocabulary size in the lower 5th percentile for age measured by McArthur Communicative Development Inventories (CDI)	Immediate	Parental administered expressive vocabulary intervention based on HANEN principles and adapted for focused stimulation: 12 received parent intervention 13 received delayed intervention

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Length of Intervention	Outcome Measures	Speech and Language Outcomes	Non Speech and Language Outcomes
Girolametto, 1996 ^a	<i>The effects of focused stimulation for promoting vocabulary in young children with delays: a pilot study</i>	150 minutes per week for 10 weeks	Parent report of vocabulary size Number of target words in probe exercise	Those in the experimental group produced significantly more target words at post-test than the control group ($p < 0.02$). Those in the experimental group used an average of twice as many target words as those in the control group at post-test	<i>Treatment group:</i> use of symbolic play gestures increased $p < 0.03$. Externalizing aggressive/destructive behavior decreased $p < 0.02$. Internalizing aggressive/destructive behavior no effect
Girolametto, 1997 [†]	<i>Effects of lexical intervention on the phonology of late talkers</i>	11 weeks 8 2.5 hour evening sessions 3 home sessions	Different vocalization Syllable structure at level 1, 2, 3 Consonants inventory: early, middle, late Consonant position: initial and final Proportion of consonants correct	There was no difference between groups on the number of vocalizations made. Children who received treatment used Level 3 vocalizations more than the controls ($p < 0.01$). Those that received treatment also used a greater inventory of consonants in all three classes	None

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Objectives	Area of Intervention	Setting	N	Subjects
Glogowska, 2000 [†]	<i>Randomised controlled trial of community based speech and language therapy in preschool children</i>	To compare routine speech and language therapy against 12 months of "watchful waiting"	Expressive and receptive language and phonology	16 community clinics in Bristol. Children were enrolled between December 1995 and March 1998	159	Male: 120 Female: 39 Age range: 18-42 months Just over half of the children were receiving child care. Most mothers had completed "O" level education. A minority either had no qualifications or had "A" levels.
Glogowska, 2002	<i>A multimethod approach to the evaluation of community preschool speech and language therapy provision</i>	To examine the effectiveness and acceptability of community speech and language therapy provision	Expressive and receptive language and phonology	Children were referred to their local speech and language therapist and seen at these clinics	159	Age range: 42 months or younger
Lancaster, 1991 ^{*, †, ‡}	<i>The effectiveness of parent administered input training for children with phonological disorders</i>	To examine the effectiveness of a parent administered intervention	Phonology	Children were referred to a speech and language clinic and subjects were selected from them	15	Males: 12 Females: 3 Age range: 40-53 months Majority had family history of speech difficulties

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Screening Criteria/Diagnostic Evaluation	Time from Screen to Intervention	Interventions
Glogowska, 2000 [†] <i>Randomised controlled trial of community based speech and language therapy in preschool children</i>		Standardized score <1.2 SD below the mean on the auditory comprehension part of the Preschool Language Scale (PLS). Standardized score >1.2 SD below the mean on auditory comprehension, but <1.2 SD below the mean on the expressive language part of the PLS. Auditory and expressive language scores >1.2 SD below the mean but with an error rate of at least 40% in production of fricative consonants and /or velar consonants and/or sounds occurring after a vowel among the 22 words included in the phonological analysis	Immediate treatment implied	Clinician administered intervention focusing on a variety of language areas. 71 received clinician intervention 88 received delayed intervention
Glogowska, 2002 <i>A multimethod approach to the evaluation of community preschool speech and language therapy provision</i>		All subjects had slow speech/language development and were referred by their local speech and language therapy clinic. No measures were specified	Immediate	Clinician administered intervention focusing on a variety of language areas. Children received either clinician intervention or delayed intervention, N not specified for each group.
Lancaster, 1991 ^{*, †, ‡} <i>The effectiveness of parent administered input training for children with phonological disorders</i>		Children needed to have a standard score of below 80 on the Edinburgh Articulation Test (EAT)	Immediate treatment implied	Clinician administered phonology intervention Clinician provided an eclectic approach, parent therapy was based on auditory bombardment therapy 5 received clinician therapy 5 received parent therapy 5 received delayed therapy

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Length of Intervention	Outcome Measures	Speech and Language Outcomes	Non Speech and Language Outcomes
Glogowska, 2000 [†] <i>Randomised controlled trial of community based speech and language therapy in preschool children</i>		Therapy continued for an average of 10 minutes per week for 8.4 months	Preschool Language Scale (PLS): auditory comprehension and expressive language Phonological errors	Although all outcome measures were in favor of the therapy group only one measure reached the significant level (auditory comprehension, p=0.025)	No significant difference for play level or attention level
Glogowska, 2002 <i>A multimethod approach to the evaluation of community preschool speech and language therapy provision</i>		12 months	Not reported	Only one of the five outcomes showed significantly more improvement in the therapy group versus the control group (receptive language, p=0.025)	The treatment group showed improvement in family's response to child (p=0.14). The therapist made parent feel better (p=0.045) in the treatment group
Lancaster, 1991 ^{*, †, ‡} <i>The effectiveness of parent administered input training for children with phonological disorders</i>		Average of 17 minutes of therapy per week for 6 months Parents were trained an average of 9 minutes per week for 6 months	Composite Deviancy Score	Those in the treatment group made significantly more gains than those in the control (p<0.05). There was no difference between the direct therapy or the parent administered therapy	None

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Objectives	Area of Intervention	Setting	N	Subjects
Law, 1999 ^{†, ‡}	<i>A comparison of two methods for providing intervention to three year old children with expressive/receptive language impairment</i>	To compare two intervention: a clinician lead and a parent lead approach	Expressive and receptive language	Not reported	38	Males: 24 Females: 14 Age range: 33-39 months Majority were of lower SES and ethnic minorities
Mulac, 1977 [†]	<i>Generalization of an operant remediation program for syntax with language delayed children</i>	To determine the extent to which clinically acquired syntax skills generalize to extraclinic stimulus settings	Syntax	Children were seen in speech and language therapy clinics and parents completed some activities at home	9	Males: 6 Females: 3 Age range: 52- 75 months
Munro, 1998 [†]	<i>Efficacy of speech and language therapy for particular speech sounds in children</i>	To assess the efficacy of therapy for children have articulation deficits (word-initial velar plosives)	Articulation	Children were seen in general pediatric services	13	Male: 6 Female: 5 Age range: 47-65 months
Reid, 1996 ^{*, †, ‡}	<i>The effectiveness of therapy for child phonological disorders: the Metaphon approach</i>	To assess the efficacy of the Metaphon approach	Phonology and receptive vocabulary	Not reported	30	Age range: 42-66 months No information on gender

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Author, Year	Title	Screening Criteria/Diagnostic Evaluation	Time from Screen to Intervention	Interventions
Law, 1999 ^{†,‡} <i>A comparison of two methods for providing intervention to three year old children with expressive/receptive language impairment</i>		Children were below 1.5 SD on comprehension measures	Not reported	Clinician or parent administered expressive and receptive language intervention Clinician therapy focused on auditory processing and word mapping Parent therapy used HANEN principles 17 received clinician therapy 11 received parent therapy 10 received delayed therapy
Mulac, 1977 [†] <i>Generalization of an operant remediation program for syntax with language delayed children</i>		Failure to pass the "is interrogative" item on the Programmed Conditioning Language Test (PCLT)	Immediate treatment implied	Clinician administered Monterey operant language program with additional outdoor and home activities for the children in the program and additional lessons condition 3 received articulation therapy 3 received Monterey language program 3 received Monterey language program and additional exercises to facilitate generalization
Munro, 1998 [†] <i>Efficacy of speech and language therapy for particular speech sounds in children</i>		Over 1.5 SD below the mean for age on the Renfrew Action Picture Test	Immediate for treatment group Delayed group received treatment later, but not reported in this study	Clinician administered intervention for phonology /k/ and /g/ 7 received immediate therapy 4 received delayed therapy
Reid, 1996 ^{*,†,‡} <i>The effectiveness of therapy for child phonological disorders: the Metaphon approach</i>		Children had to get less than 85SS on the Edinburgh Articulation Test (EAT) This is a sub-group analysis of an on-going trial; groups acknowledged to be unequal and median figures reported	Immediate treatment is implied	Clinician administered phonology intervention using Metaphon 8 received metaphon stage 1 only 7 received metaphon stages 1 and 2 15 received delayed therapy

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Author, Year	Title	Length of Intervention	Outcome Measures	Speech and Language Outcomes	Non Speech and Language Outcomes
Law, 1999 ^{†,‡}	<i>A comparison of two methods for providing intervention to three year old children with expressive/receptive language impairment</i>	Clinician therapy: 450 minutes per week for 6 weeks Parent therapy: 150 minutes per week for 10 weeks	Preschool Language Scale (PLS): expressive and receptive Parent report: vocabulary, phrase complexity, language sample: total communication acts, MLU (mean length of utterances)	There were no differences between groups on speech and language measures	Parent's rating of child's behavior and positivity towards their child went up as well as child's rating of their sense of self-esteem (p=0.03, p=0.04, p=0.05; respectively)
Mulac, 1977 [†]	<i>Generalization of an operant remediation program for syntax with language delayed children</i>	Average of 67 minutes per week for 4 weeks	Extra clinic measures of "is" interrogative	Only the group that received the language program plus extended transfer made a significant improvement (p<0.01)	None
Munro, 1998 [†]	<i>Efficacy of speech and language therapy for particular speech sounds in children</i>	60 minutes per week for 6 weeks	Edinburgh Articulation Test (EAT) Target sounds in initial position Re-telling a story with target sounds Repetition of five lexical items four times each	Preliminary data, no results were presented	Not reported
Reid, 1996 ^{*,†,‡}	<i>The effectiveness of therapy for child phonological disorders: the Metaphon approach</i>	30 minutes per week for 10 weeks	EAT Occurrence of phonological process: substest from Metaphon resources	There was a significant improvement in gains on the EAT for the Phase 1 plus Phase 2 group (p<0.02). The 10-week intervention group made significant gains on test of phoneme awareness (p<0.03) only	None

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Objectives	Area of Intervention	Setting	N	Subjects
Robertson, 1997 Study 2 <i>The influence of peer models on the play scripts of children with specific language impairment</i>	To examine the effects of peer modeling using the same peer throughout the intervention on children with speech and language impairments	Expressive and receptive language	Children were enrolled in a language-based early childhood classroom	6	Male: 4 Female: 2 Mean age: 54 months (range 48-57 months)	
Robertson, 1997 [†] Study 1 <i>The influence of peer models on the play scripts of children with specific language impairment</i>	To examine the effects of peer modeling on children with speech and language impairments	Expressive and receptive language	Children were enrolled in a language-based early childhood classroom	20	Male: 13 Female: 7 Mean age: 50 months (range 36-60 months) Mean maternal education: 14 years	
Robertson, 1999 [†] <i>Effects of treatment on linguistic and social skills in toddlers with delayed language development</i>	To examine the effects of early language intervention on the development of late-talking toddlers	Expressive and receptive language and phonology	Children were recruited from the community and seen at a research clinic	21	Male: 12 Female: 9 Age range: 21-30 months All participants from middle class households	

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Author, Year	Title	Screening Criteria/Diagnostic Evaluation	Time from Screen to Intervention	Interventions
Robertson, 1997 Study 2	<i>The influence of peer models on the play scripts of children with specific language impairment</i>	Performance at or near 2 SD below the mean on standardized measures of receptive and expressive language; measures not reported	Immediate	Play intervention for expressive narrative language: 4 participants played with each other in pairs 2 participants were paired with a normal peer
Robertson, 1997 [†] Study 1	<i>The influence of peer models on the play scripts of children with specific language impairment</i>	Performance at or near 2 SD below the mean on standardized measures of receptive and expressive language; measures not reported	Immediate	Play intervention for expressive narrative language: 10 participants played with each other in pairs 10 participants were paired with a normal peer
Robertson, 1999 [†]	<i>Effects of treatment on linguistic and social skills in toddlers with delayed language development</i>	Demonstrated significant delays in the acquisition of language measured by the Preschool Language Scale - 3 and the Bayley Scales of Infant Development (BSID-II)	≤1 week	Clinician administered intervention for expressive vocabulary and syntax Child-centered approach to provide general stimulation 11 received clinician intervention 10 received delayed intervention

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Author, Year	Title	Length of Intervention	Outcome Measures	Speech and Language Outcomes	Non Speech and Language Outcomes
Robertson, 1997 Study 2	<i>The influence of peer models on the play scripts of children with specific language impairment</i>	15 minutes per week for 3 weeks	Language sample: number of words in script, number of different words, number of play related themes	Both children in the experimental group showed significant gains in number of words used, number of different words used, and number of linguistic markers used	Both children in the experimental group showed significant increases in the number of play-theme-related acts
Robertson, 1997 [†] Study 1	<i>The influence of peer models on the play scripts of children with specific language impairment</i>	20 minutes per week for 3 weeks	Language sample: number of words in script, number of different words, number of play related themes	Those in the experimental group produced significantly more words than those in the control group immediately after treatment and at follow-up ($p < 0.0001$). The experimental group demonstrated greater verbal productivity and employed more lexical diversity than the control group. Also, the experimental group made significantly more gains in the use of linguistic markers than the control group ($p < 0.0001$)	Play-theme-related acts increased ($p < 0.0001$) for the treatment group
Robertson, 1999 [†]	<i>Effects of treatment on linguistic and social skills in toddlers with delayed language development</i>	150 minutes per week for 12 weeks	Language sample: MLU (mean length of utterances), total number of words Parent report of vocabulary (MacArthur Communicative Developmental Inventory- Words and Sentences (CDI))	Compared to children in the control group children in the treatment group demonstrated significantly greater increases in mean length of utterances ($p = 0.003$), the total number of words used ($p = 0.000$), lexical diversity ($p = 0.000$), in their reported vocabulary size ($p = 0.000$) and percentage of intelligible utterances ($p = 0.000$)	Treatment group had an increase in socialization skills ($p = 0.003$) not merely reflective of the language increases; parental stress decreased ($p = 0.000$) for the treatment group

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Author, Year	Title	Objectives	Area of Intervention	Setting	N	Subjects
Ruscello, 1993 [†]	<i>The use of different service delivery models for children with phonological disorders</i>	To develop and implement a service delivery model which incorporates parental involvement and computer-based instruction	Phonology	Children were seen at the Allen Hall Speech and Hearing Center	12	Male: 8 Female: 4 Age range: 49-68 months
Rvachew, 1994 [†]	<i>Speech perception training can facilitate sound production learning</i>	To demonstrate that speech perception training can facilitate sound production learning	Phonology	Children were referred by a speech and language pathologist who diagnosed them	27	Males: 21 Females: 6 Age range: 42-66 months
Rvachew, 2001 [†]	<i>The effect of target-selection strategy on phonological learning</i>	To investigate the effectiveness of two different sets of target-selection criteria	Phonology	Children were referred to a research clinic by clinician	48	Mean age: 50 months
Schwartz, 1985*, [†]	<i>Facilitating word combination in language-impaired children through disclosure structure</i>	To examine the effects of intensively engaging language-impaired children at the one-word utterance level in vertical structures	Lexical acquisition	Pre-testing was conducted in the home and treatment administered in clinic	10	All male Age range: 32-40 months

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Screening Criteria/Diagnostic Evaluation	Time from Screen to Intervention	Interventions
Ruscello, 1993 [†]	<i>The use of different service delivery models for children with phonological disorders</i>	A composite score at the 15th percentile or lower for age on the Khan-Lewis Phonological Analysis	Immediate treatment implied	Clinician administered phonology intervention with additional intervention from parents using Speech Viewer software <i>Group 1</i> received clinician intervention <i>Group 2</i> received half of treatment from parent and half from clinician
Rvachew, 1994 [†]	<i>Speech perception training can facilitate sound production learning</i>	Children were referred by a speech and language pathologist who had assessed the child and diagnosed a significant phonological delay	≤1 week	Clinician administered phonological therapy with additional auditory discrimination task <i>Group 1</i> : 10 received experimental auditory discrimination task <i>Group 2</i> : 9 received a tradition auditory discrimination task <i>Group 3</i> : 8 received a discrimination game not based on minimal pairs
Rvachew, 2001 [†]	<i>The effect of target-selection strategy on phonological learning</i>	Moderate to severe phonologic delays, 39 fell below the 1st percentile whereas all fell below the 9th percentile	≤1 week	Clinician administered phonological intervention with traditional therapy targeting the early developing sounds was compared to intervention that targeted later developing sounds: 24 received treatment for early developing sounds (ME group) 24 received treatment for late developing sounds (LL group)
Schwartz, 1985* [†]	<i>Facilitating word combination in language-impaired children through disclosure structure</i>	Expressive vocabularies ranged from 25-60 words and all children exhibited specific language impairments. Comprehension was 6-9 months below mental age measured by the Test for Auditory Comprehension of Language or the Auditory Comprehension subtest of the Preschool Language Scale	Immediate treatment implied	Clinician administered syntax intervention: 8 received experimental intervention 2 served as control group receiving intervention without target utterances

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Length of Intervention	Outcome Measures	Speech and Language Outcomes	Non Speech and Language Outcomes
Ruscello, 1993 [†]	<i>The use of different service delivery models for children with phonological disorders</i>	120 minutes per week for 8 weeks	30-item naming sample including words, phrases, and sentences Khan Lewis Phonological Assessment	Both groups showed significant improvement between baseline and follow-up ($p \leq 0.001$ for both Group 1 and Group 2)	Parents indicated that their children enjoyed using the computer-based program
Rvachew, 1994 [†]	<i>Speech perception training can facilitate sound production learning</i>	45 minutes per week for 6 weeks	Auditory word discrimination test Object naming speech sample	Both Groups 1 and 2 performed significantly better at post-test than Group 3 ($p=0.03$ and $p=0.01$, respectively). Group 1 and Group 2 were not significantly different at post-test ($p=0.52$). Children in Groups 1 and 2 progressed further during production training than children in Group 3	None.
Rvachew, 2001 [†]	<i>The effect of target-selection strategy on phonological learning</i>	30 minutes per week for 12 weeks	Probes for each target sound Productive phonological knowledge profile Percentage of consonants correct in conversation	Children in the ME group improved more at final assessment than those in the LL group ($p=0.004$). Generalization of learning for treated phonemes from the first assessment to the final assessment was significantly greater for the ME group than the LL group ($p=0.001$). Both the ME and the LL groups performed better than a control group of children who didn't receive any treatment ($p=0.009$)	Parents were more satisfied with treatment progress in the ME group ($p=0.035$)
Schwartz, 1985 ^{*, †}	<i>Facilitating word combination in language-impaired children through disclosure structure</i>	Therapy administered over 3 weeks	Multiword utterances used with the target stimuli	Children in the experimental group improved significantly from pre-test to post-test ($p < 0.05$)	None.

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Objectives	Area of Intervention	Setting	N	Subjects
Shelton, 1978* [†] Study 1 <i>Assessment of parent-administered listening training for preschool children with articulation deficits</i>		To compare two parent-administered listening treatments and a control group	Articulation/ Phonology	Children were from nursery schools or pediatric offices; they were seen either at their school or in their home	60	Age range: 36-54 months Bilingual children were included with 2 in each condition
Sutton, 1999 ^{†, ‡} <i>Investigating WILSTAAR</i>		Not reported	Not reported	Not reported	22	Age: 7 months
Wilcox, 1991 [†] <i>Early language intervention: A comparison of classroom and individual treatment</i>		To examine the effectiveness of classroom versus individual interventions	Lexical acquisition	Children were recruited from a speech and hearing clinic and community early intervention program	20	Age range: 20-47 months

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Screening Criteria/Diagnostic Evaluation	Time from Screen to Intervention	Interventions
Shelton, 1978* [†] Study 1 <i>Assessment of parent-administered listening training for preschool children with articulation deficits</i>		Below the cutoff score for age on the Templin-Darley Articulation Screening Test	Immediate treatment implied	Parent administered speech programs Listening therapy based on auditory discrimination compared to more traditional reading and talking therapy and delayed treatment 20 received experimental listening therapy 20 received a reading and talking therapy 20 received delayed treatment
Sutton, 1999 ^{†, ‡} <i>Investigating WILSTAAR</i>		Children had to fail WILSTAAR screen and have a standard score of below 85 on Receptive Expressive Emergent Language (REEL)	Not reported	WILSTAAR: Parent administered general language intervention designed to facilitate language development in the first year of life 13 received WILSTAAR intervention 9 were assigned to no treatment control
Wilcox, 1991 [†] <i>Early language intervention: A comparison of classroom and individual treatment</i>		Children had to score 1.5 SD below mean on both expressive and receptive scales of the sequenced inventory of communication development (SICD)	Immediate treatment implied	Clinician administered expressive vocabulary intervention: 10 received individual intervention 10 received classroom based group intervention

APPENDIX 9. EVIDENCE TABLE: RANDOMIZED CONTROLLED TRIALS OF INTERVENTIONS

Author, Year	Title	Length of Intervention	Outcome Measures	Speech and Language Outcomes	Non Speech and Language Outcomes
Shelton, 1978* [†] Study 1 <i>Assessment of parent-administered listening training for preschool children with articulation deficits</i>		57 days (listening for 5 minutes per day, and reading and talking for 15 minutes per day)	Auditory association subtest of the Illinois Test of Psycholinguistic Abilities McDonald Screening Articulation test	Only the noise subtest of the Test of Auditory Discrimination showed a significant improvement for the listening and control groups compared to the reading-talking group ($p=0.03$). There were no other significant differences between groups	None.
Sutton, 1999 ^{†, ‡} <i>Investigating WILSTAAR</i>		Experimental group received 5 home visits Control group received 2 visits over four months	Receptive Expressive Emergent Language (REEL) language quotients	Not reported	Not reported
Wilcox, 1991 [†] <i>Early language intervention: A comparison of classroom and individual treatment</i>		90 minutes per week for 3 months individually and 360 minutes per week for 3 months in groups	Overall use of target words in clinic sessions	Children in the classroom treatment group used more words in the home setting ($M=5.00$) than those in the individual treatment group ($M=2.80$), and used more at home than in the treatment setting ($M=3.00$)	None.

APPENDIX 10. QUALITY RATINGS OF INTERVENTION STUDIES

Study	Randomization	Blinding of Assessors	Similarities at Baseline	Explanation of Withdrawals	Discounting in Analysis of Missing Values	Degree of Attrition	Intention to Treat Analysis	Power	Description of Eligibility Criteria	USPSTF Quality Rating
Almost, 1998* [†]	A	A	A	A	A (last known scores used)	C (.15)	A (I to T)	A	A	Fair
Barratt, 1992*	B	B	B	A	C	A (.07)	B	A	A	Fair
Cole, 1986*	B	B	A	B	B	B	B	B	A	Fair
Courtright, 1979*	B	A	B	B	B	B	B	B	B	Fair
Fey, 1993* [†]	B	A	C (mother's education)	A	C	A (.03)	B	B	A	Poor
Fey, 1994*	B	C	A	A	A (none)	A (none)	B	B	A	Poor
Fey, 1997*	B	A	A	A	C	A (.06)	B	B	A	Poor
Gibbard, 1994* Study 2	B	B	A	A (none)	A (none)	A (none)	B	B	A	Poor
Gibbard, 1994* [†] Study 1	B	B	A	A (none)	A (none)	A (none)	B	B	A	Fair
Girolametto, 1996* [†] b	B	A	A	A (none)	A (none)	A (none)	B	B	A	Fair
Girolametto, 1996 [†] a	B	A	C (behavior)	A (none)	A (none)	A (none)	B	B	A	Poor
Girolametto, 1997*	B	A	A	A (none)	A (none)	A (none)	B	B	A	Fair
Glogowska, 2000*	A	A	A	A	C	A (.03)	A (I to T)	C	A	Good
Glogowska, 2002	A	B	B	C	B	B	B	B	C	Poor
Law, 1999 [†]	A	A	C (esteem, behaviour)	A	C	C (.12)	B	C	A	Fair
Mulac, 1977*	B	A	B	B	B	B	B	B	B	Poor
Reid, 1996* [†]	B	B	C (medians)	A (subgroup)	A (subgroup)	A (subgroup)	B	B	A	Poor

APPENDIX 10. QUALITY RATINGS OF INTERVENTION STUDIES

Study	Randomization	Blinding of Assessors	Similarities at Baseline	Explanation of Withdrawals	Discounting in Analysis of Missing Values	Degree of Attrition	Intention to Treat Analysis	Power	Description of Eligibility Criteria	USPSTF Quality Rating
Robertson, 1997	A	B	A	A	B	A (none)	B	B	A	Fair
Robertson, 1999*	B	B	A	A	C	C (.13)	B	B	A	Fair
Ruscello, 1993*	B	B	A	B	B	B	B	B	A	Poor
Rvachew, 1994*	B	A	A	B	C	C (.13)	B	B	A	Poor
Rvachew, 2001*	B	A	A	A	B	B	B	B	A	Fair
Schwartz, 1985* [†]	B	C	B	B	B	B	B	B	A	Poor
Shelton, 1978* [†]	B	B	A	A	C	A (.08)	B	B	A	Fair
Wilcox, 1991*	B	B	A	B	B	B	B	B	A	Fair

Key

*Law J, Garrett Z, Nye C. Speech and language therapy interventions for children with primary speech and language delay or disorder. *Cochrane Database of Syst Rev*. 2003(3):CD004110.

[†]Law J, Boyle J, Harris F, Harkness A, Nye C. Screening for primary speech and language delay: a systematic review of the literature. *Int J Lang Commun Disord*. 1998;33(Suppl):21-23.