Speech Sound Disorders: Articulation, Functional

Indexing Metadata/Description

- **Title/condition:** Speech Sound Disorders: Articulation, Functional
- **Synonyms:** Functional articulation disorders
- **Anatomical location/body part affected:** No known anatomical basis
- **Area(s) of specialty:** Child speech and language disorders
- **Description:** A functional articulation disorder is defined as a significant delay in a child’s acquisition of intelligible, properly articulated speech sounds. For typically developing children, speech is at age 2, about 50% intelligible, and is completely intelligible by approximately age 4. Articulation errors arise from a peripheral problem in which an erroneous motor program has been learned for a specific sound or for multiple sounds. The term “functional” refers to an articulation disorder with no known anatomical basis or etiology, whereas an organic articulation disorder arises from a known physical or neurological impairment. For detailed information on organic articulation disorders, see Clinical Review...Speech Sound Disorders: Articulation Disorder, Organic; Topic ID Number: T708858
- **ICD-9 codes:**
  - 315.3 developmental speech or language disorder
  - 315.39 other developmental articulation disorder, dyslalia, phonological disorder
- **ICD-10 codes:**
  - F80.0 phonological disorder; functional speech articulation disorder
- **G-Codes:**
  - **Motor Speech G-code set**
    - G8999, Motor speech functional limitation, current status at time of initial therapy treatment/episode outset and reporting intervals
    - G9186, Motor speech functional limitation, projected goal status at initial therapy treatment/outset and at discharge from therapy
    - G9158, Motor speech functional limitation, discharge status at discharge from therapy/end of reporting on limitation

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Reimbursement: Reimbursement for therapy will depend on insurance contract coverage; no specific issues or information regarding reimbursement have been identified.

Presentation/signs and symptoms: A child with a functional articulation disorder will present with reduced speech intelligibility. The less intelligible the child’s speech, the more severe the functional articulation disorder is said to be. Intelligibility is negatively affected by substitutions, deletions, or distortions of consonant sounds and/or clusters.

Causes, Pathogenesis, & Risk Factors

Causes: The etiology of functional articulation disorders is unknown. Studies suggest that genetic factors contribute to the development of a functional articulation disorder.

Pathogenesis: Functional articulation disorders are relatively common in preschool and elementary school-aged children (ages 3–11 years). Estimates of the worldwide prevalence of functional articulation disorders range from 3.8% to 10%.

- In a study conducted in Ireland with 9 children with an SSD affecting mainly fricatives and affricates, researchers found that, compared to typically developing children, those with an SSD demonstrated higher amounts of tongue-to-palate contact during the production of oral stops /t/ (statistically significant) and /d/. Additionally, the children with SSDs had more tongue-to-palate contact (measured by electropalatography [EPG]) throughout the posterior central region of the palate, suggesting that children with SSDs make broader tongue-to-palate contract during articulation in general.

- In a study conducted in Hungary, researchers found evidence of reduced auditory processing of speech in children with functional articulation disorders compared to a group of typically developing, age-matched children. Differences in the ability to process auditory information might contribute to the development of a functional articulation disorder. For detailed information about auditory processing disorders, see Clinical Review...Auditory Processing Disorder in Children; Topic ID Number: T708565

Risk factors: Although the cause of functional articulation disorders is unknown, research has established certain risk factors of which speech-language pathologists (SLPs) should be aware:

- Existing language impairment
- Family history of speech or language disorder
- Frequent middle ear infections
- Sex (more common in boys than girls)
- Intelligence (below-normal intelligence is a risk factor)
- Low birth weight
- Premature birth
• Socioeconomic status (higher risk for children of lower socioeconomic status)\(^\text{\textsuperscript{4,5,11}}\)
• Tongue thrust\(^\text{\textsuperscript{5}}\)
• Research has been unable to produce clear evidence that prolonged pacifier use, malocclusion, or orthognathic surgery increase the risk of functional articulation disorders\(^\text{\textsuperscript{8,9}}\)

**Overall Contraindications/Precautions**

› The assessment and treatment of young children requires a team approach regardless of the setting (e.g., child’s home, preschool, rehabilitation center, hospital). Such a team may include the child’s family/caregivers, SLPs, occupational therapists (OT), physical therapists (PT), audiologists, early education specialists, preschool teachers and staff, nurses, physicians, and other team members as appropriate
› Development of an individualized family service plan (IFSP) or individualized education program (IEP) in collaboration with the parents/caregivers and school teacher(s) can be appropriate for children with speech and language disorders to address learning, speech, language, and/or cognitive problems
› A young child’s family and/or caregivers must be included in the evaluation and intervention practice according to the U.S. Individuals with Disabilities Education Act (IDEA)\(^\text{\textsuperscript{27}}\)
› See specific Contraindications/precautions to examination and Contraindications/precautions under Assessment/Plan of Care

**Examination**

› **Contraindications/precautions to examination**
  • SLPs must be careful not to over- or under-identify children as having disordered speech\(^\text{\textsuperscript{11}}\)
  • Children who are bilingual are at risk for over-identification.\(^\text{\textsuperscript{13,14}}\) Resources for accurately identifying these children are highlighted below
  • Children at risk for under-identification include children of lower socioeconomic status\(^\text{\textsuperscript{4}}\)
  • Children with functional articulation disorders are at a higher risk of developing future language or reading disorders.\(^\text{\textsuperscript{4,12}}\) If an articulation disorder is left unidentified and/or untreated until school age, the risk of language and literacy problems increases. One way to promote proper identification of children with speech and language disorders prior to kindergarten is for SLPs to educate pediatricians regarding screening measures for young children.\(^\text{\textsuperscript{4,11,13}}\) Further information regarding proper screening tools is included below

› **History**
  • **History of present illness/injury:** The child’s parent(s)/caregiver(s) should be involved in all aspects of evaluation, including case history.\(^\text{\textsuperscript{5,13}}\) Additional pertinent historical information can be obtained from evaluation reports by the child’s teachers, pediatrician, dentist, psychologist, otolaryngologist, neurologist, audiologist, or previous SLP\(^\text{\textsuperscript{5,13}}\)
    – **Mechanism of injury or etiology of illness:** Did the child have chronic ear infections? If so, how often and at what age? Is there a history of head injury? Is there a history of hospitalizations? If so, why was the child hospitalized and for how long?
    – **Developmental history:** Was the child a quiet or vocal infant? Did the child coo, babble, or imitate sounds as an infant? At what age did these behaviors begin? When did the child say his or her first word? At what age did the child begin to name objects or people? At what age did the child start to put words together (e.g., “Daddy up”)? Were the child’s first words easy or difficult to understand? Currently, what specific sounds does the child make? Which sounds or words are hard to understand?\(^\text{\textsuperscript{2}}\)
    – **History of mother’s pregnancy and delivery:** Did the child’s mother have any illnesses, accidents, or complications while pregnant with the child? Did the mother take any medications during the pregnancy? What was the length of the pregnancy with the child? What was the duration of the delivery? What was the child’s weight at birth? Were there any complications or unusual circumstances during birth or shortly after? What were the Apgar scores?\(^\text{\textsuperscript{5}}\)

› **Course of treatment**
  - **Medications for current illness/injury:** Determine what, if any, medications the physician has prescribed; are they being taken?
  - **Diagnostic tests completed:** Review school/medical/previous SLP diagnostic reports
- **Previous therapy:** Document whether patient has had speech, occupational, or physical therapy for this or other conditions and what specific treatments were helpful or not helpful

- **Aggravating/easing factors:** Are there certain times of day that the child’s speech is better or worse? Does the child speak more clearly with certain people or teachers? Are there specific situations in which the child’s speech is more or less understandable?

- **Nature of symptoms:** The errors in the speech of children with a functional articulation disorder result from problems making specific sounds, whereas phonological disorders are characterized by problems with sound patterns (phonological processes). If phonological processes are present, the child is said to have a phonological disorder; if articulation errors are present, the child is said to have an articulation disorder. Both types of errors can occur simultaneously in the child’s speech. By age 7, most speech sounds should be articulated accurately; however, during assessment of a child with a suspected functional articulation disorder, the SLP should refer to age and community norms.

- **Respiratory status:** Does the child require supplemental oxygen? Nasal cannula? Does the child have a tracheostomy tube? Does the child require ventilator support?

- **Psychosocial status:** Briefly inquire about the patient’s psychosocial status; if there are concerns regarding psychosocial status, including social anxiety or frustration, refer to a psychiatric professional for additional assessment and treatment as needed.

- **Hearing:** A hearing screening with an audiometer is within the scope of practice of a SLP and should be performed prior to all pediatric speech and language evaluations. If a child fails to achieve a threshold of 20–25 dB (thresholds vary according to state and country) across the speech frequencies (500, 1000, 2000, and 4000 Hz), a referral to audiology should be made for a full audiological evaluation.

- **Barriers to learning:**
  - Are there any barriers to learning? Yes__ No__
  - If Yes, describe__________________________

• **Medical history**

  - **Past medical history:** Has the child ever been hospitalized? If so, why? How long? What diseases or serious conditions has the child had? Were there any complications during treatment or recovery?
  - **Previous history of same/similar diagnosis:** Has the child been diagnosed with another speech or language disorder? Does the child have a history of any motor or learning disorders, or feeding issues?
  - **Comorbid diagnoses:** Ask child’s parent about other problems, including autism spectrum disorder (ASD), learning disability, diabetes, cancer, head injury, psychiatric disorders, and orthopedic disorders
  - **Medications previously prescribed:** Obtain a comprehensive list of medications prescribed and/or being taken (including over-the-counter drugs)

  - **Other symptoms:** Ask child and parent about other symptoms the child is experiencing
  - **Ear infections:** Children with chronic middle ear infections have been identified as being at increased risk for developing functional articulation disorders. Document if and when the child has had ear infections. How long did the ear infections last? How frequently did the child have ear infections? Does the child presently have an ear infection? How were they treated (e.g., tubes placed?)
  - For detailed information on the effects of conductive hearing loss on speech and language skills, see Clinical Review...Hearing Loss, Conductive, in Children: Effects on Speech and Language; Topic ID Number: T708613

• **Social/occupational history**

  - **Patient’s goals:** Document what the child and parent(s)/caregiver(s) hope to accomplish with therapy and in general. If child is school-aged, teacher goals should also be considered
  - **Academic/school history:** Did the child ever attend day-care or nursery center? Did the child ever receive early intervention for speech, physical, or occupational therapy? Did teachers ever report any problems or make recommendations about speech therapy? What grade is the child in now? What kind of grades or test scores does the child usually achieve? What are the best subjects? What are the worst subjects? How does the child feel about school? Does the child receive special classes or instruction at school? Does the child make friends easily? Does the child interact with other children? Adults?
Vocation/avocation and associated repetitive behaviors, if any: What interests, hobbies, or other activities does the child have? Vocation/avocation and associated repetitive behaviors, if any: What interests, hobbies, or other activities does the child have? Does the child’s speech affect his or her ability to participate in academic or social activities? Does the child’s speech affect his or her ability to participate in academic or social activities?

Functional limitations/assistance with ADLs/adaptive equipment: Does the child use a walker, wheelchair, or leg braces? Does the child have a hearing loss? Does the child require/wear hearing aids or have cochlear implants? Does the child require/wear glasses?

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Living environment: With whom patient lives (e.g., caregivers, siblings)

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- Identify if there are barriers to independence in the home; any modifications necessary?
- Is the child exposed to multiple languages at home or at school? If so, what percentage of time is each language spoken around/to the child?
- Bilingual children: Bilingual and monolingual SLPs are able to assess bilingual children. Children who are bilingual or who speak in dialectal varieties of a language (such as African American English or Black English) must not automatically be labeled as having disordered speech.

- According to the American Speech-Language-Hearing Association (ASHA), in the absence of a bilingual SLP, trained support personnel may be utilized in the assessment of bilingual speakers. These include professional interpreters or translators, bilingual diagnosticians, bilingual speech-languagepathology assistants, bilingual professional staff, trained adult first language speakers from the community, or a family member or friend.

- Children who speak multiple languages might display characteristics that are not disordered, but simply related to the phonology system of another language. SLPs who work in areas with large populations of bilingual or multilingual children should work with local translators, parents, and teachers to develop norms and resources specifically tailored to those populations.

- When transcribing a connected speech sample from a bilingual person, use the International Phonetic Alphabet (IPA) to accurately capture the sounds in the child’s speech sound inventory.

- Sometimes bilingual children will display sound substitutions with sounds present in one language, but not in another; in these instances, use a Web site that provides sound clips to determine what specific sound(s) the child is using.

- For detailed information on assessments for bilingual children, see Clinical Review...Language Disorders: Bilingual School-Aged Children; Topic ID Number: T709066 and Clinical Review...Language Disorders: Bilingual Infants and Toddlers; Topic ID Number:T709065

Relevant tests and measures: (While tests and measures are listed in alphabetical order, sequencing should be appropriate to patient medical condition, functional status, and setting)

- Assistive and adaptive devices: Note use of alternative or augmentative communication (AAC) devices; children with very impaired speech intelligibility may benefit from use of AAC devices.

- For detailed information on AAC devices, see the series of Clinical Reviews on this topic

- Speech and language examination (including reading)

- Speech: Utilize formal and informal measures to evaluate the child’s speech and articulation

- Connected speech sample: A connected speech sample is indicated for functional articulation disorders in order to provide a full and accurate picture of the child’s articulation. Speech samples are obtained during an evaluation session by using a conversational or play format. It is best to videotape or audiotape the sample so that it may be analyzed at a later time.

- Intelligibility: By using the connected speech sample obtained in the testing session, the SLP can estimate the child’s intelligibility. In order to calculate intelligibility, the SLP must take a random selection of 200 consecutive words, count the number of unintelligible words, subtract that number from 200, and divide by 2. This is the intelligibility percentage for that speech sample.

- Stimulability: Stimulability is the extent to which the child is able to correct or improve his or her articulation when given a model or some other type of stimulation by the SLP. The Goldman-Fristoe Test of Articulation-3 and the Test of Minimal Articulation Competence include a stimulability section. The results of a stimulability test are valuable as a prognostic indicator of how well the child might respond to therapy. Additionally, the SLP might be able to identify the type of cues to which the child best responds.

- Language: Briefly assess expressive and receptive language skills; children with functional articulation disorders are at increased risk of concomitant language impairment.
- If the child appears to have delays or deficits in expressive or receptive language, complete a full evaluation of language skills, including standardized testing
- For detailed information on assessment and treatment of language disorders in children, see the series of Clinical Reviews on this topic

**Voice:** Note the patient’s vocal quality; if there are concerns of a voice disorder, refer to otolaryngologist for full evaluation to rule out laryngeal pathologies prior to completing an evaluation of the voice
- For detailed information on voice disorders in children, see Clinical Review...Voice Disorders in Children: An Overview; Topic ID Number:T709181

**Fluency:** Briefly assess the fluency of the child’s connected speech; if disfluencies are noted and there is concern of a stuttering or cluttering disorder, complete a full evaluation of fluency
- For detailed information on assessment and treatment of stuttering, see the series of Clinical Reviews on this topic

**Reading:** Complete a brief assessment of reading skills in school-aged children; if there are concerns, refer to a learning disabilities specialist for further evaluation and treatment

**Oral structure and oral motor function:** An extensive oral mechanism examination should be completed with all children suspected of having a functional articulation disorder to help determine whether the disorder is functional or organic in nature. Articulation disorders that are secondary to muscle weakness or structural defect (such as cleft palate) would be considered organic articulation disorders. See Clinical Review...Speech Sound Disorders: Articulation Disorders, Organic, referenced above. Oral mechanism exam should evaluate:

  - **Facial muscles:** Is the face symmetrical at rest? Is the face symmetrical while making movements (smiling, raising the eyebrows, closing the eyes)? Are there any abnormal movements (twitching, spasms, grimacing)? Is the child drooling or mouth breathing?^{5,6,13}

  - **Lips:** Are the lips symmetrical at rest? Are the lips symmetrical during movements? Is ROM normal? Is the strength normal? Is the lip tissue healthy? Is there any scarring or cleft?^{5}

  - **Tongue:** Is the tongue normal in appearance? Any atrophy? Any discolorations? Any bleeding? Is ROM normal? Is the strength normal? If groping movements are noted during examination of the face, lips, and tongue, the child’s speech errors might be the result of apraxia of speech. \(^{(5)}\) For detailed information on apraxia of speech, see Clinical Review...Speech Sound Disorders: Childhood Apraxia of Speech; Topic ID Number: T708888

  - **Hard palate:** Is the hard palate intact? Any signs of fistulas, fissures, scarring? Are height and width normal? Any prostheses present? Is the coloration normal?^{5,9}

  - **Soft palate:** Is the coloration normal (should be pink and white)? Any signs of cleft or bifid uvula? Does the patient sound hyper- or hyponasal during conversational speech? Place a small mirror under the patient’s nose during production of nonnasal sounds; fogging or clouding might indicate nasal emission, which would indicate the need for a referral to the otolaryngologist.\(^{(5)}\)

  - **Teeth:** Are there any missing teeth? Are the teeth in good repair? Does the child wear braces or retainers? Is there a significant overbite or underbite?^{5}

  - **Diadochokinetic rates:** Also known as alternating motion rates (AMRs) and sequential motion rates (SMRs); refer to the speed and regularity with which the child can produce repetitive articulatory movements; rates assess the functional integrity of the child’s lips, tongue, and jaw.\(^{(5)}\)
    - Child is asked to repeat each of the syllables /pə/, /tə/, and /kə/ as fast and accurately as possible for a predetermined number of seconds (usually 5)
    - Child is asked to repeat the string of syllables /pə-tə-kə/ (or say the word “buttercup”) as fast and accurately as possible for a predetermined number of seconds (usually 5)
    - Rates are compared to the norms developed by Fletcher.\(^{(5,18)}\)
    - Abnormal diadochokinetic rates may indicate a motor speech disorder such as apraxia of speech.\(^{(5)}\) For detailed information on assessment and treatment of childhood apraxia of speech, see Clinical Review...Speech Sound Disorders: Childhood Apraxia of Speech, referenced above

**Special tests specific to diagnosis:** The errors in the speech of children with a functional articulation disorder result from problems making specific sounds, whereas phonological disorders are characterized by problems with sound patterns (phonological processes). If phonological processes are present, the child is said to have a phonological disorder; if articulation errors are present, the child is said to have an articulation disorder.\(^{(5)}\) Both types of errors often occur in the child’s speech, so an evaluation of a child with a suspected functional articulation disorder should include measures both
articulation and phonology. For detailed information about phonological disorders, see Clinical Review...Speech Sound Disorders: Phonological, referenced above

- **Assessment Link Between Phonology and Articulation**: Gives the examiner the choice of scoring the test using the traditional articulation errors, phonological processes, or both(5,13)

- **Fisher-Logemann Test of Articulation Competence**: 109 colored picture stimuli; provides a distinctive feature analysis of the child’s phonologic system(5,12)

- **Goldman-Fristoe Test of Articulation-3**: Assesses articulation of consonants in initial, medial, and final positions as well as consonant blends; evaluates connected speech(4,5,8,12,13)

- **Photo Articulation Test**: 72 colored photographs; assesses all consonant sounds in initial, medial, and final positions, all vowels, and all diphthongs as well as connected speech(5,13)

- **Syllable Repetition Task (SRT)**: 18-itemimitation task that assesses the speaker’s ability to repeat nonwords; created specifically for speakers with incomplete speech sound inventories and/or who have speech production patterns that are difficult to transcribe and score; the only speech sounds in the SRT nonwords are the four voiced consonants /b/, /d/, /m/, and /n/ and the vowel /a/19)

- **Templin-Darley Tests of Articulation**: A group of tests for articulation that includes the Diagnostic Test, the Screening Test, and the Iowa Pressure Test(5,9,13)

- **Test of Minimal Articulation Competence**: Uses a picture confrontation format to identify articulation errors on 24 consonants, /s/, /l/, and /r/ blends, 12 vowels, and 8 diphthongs(5)

### Assessment/Plan of Care

- **Contraindications/precautions**
  - Only those contraindications/precautions applicable to this diagnosis are mentioned below, including with regard to modalities. Rehabilitation professionals should always use their professional judgment
  - Development of an IFSP or IEP in collaboration with the parents and early childhood professionals can be necessary for children with speech and language disorders and/or disorders/delays among multiple domains
  - Clinicians should follow the guidelines of their clinic/hospital/school and what is ordered by the patient’s physician. The summary listed below is meant to serve as a guide, not to replace orders from a physician or a clinic’s specific protocols
  - Assessment of functional articulation disorders in children is a dynamic, long-term process that does not end after the initial evaluation. Continual assessment and analysis of the child’s speech sound repertoire and intelligibility should take place during every treatment session.13) In one case study, the client learned a “bunched” /r/ (produced by bunching the tongue) instead of an “apical” /r/ (produced with the tip of the tongue) and started to produce significantly abnormal instances of prolonged velar approximants and excessive velarization.20) The SLP must frequently re-assess the patient to ensure that the plan of intervention is progressing towards better articulation skills with increased intelligibility of speech, and not creating additional abnormal articulation patterns

- **Diagnosis/need for treatment**: Following extensive and detailed testing of the child’s speech, the SLP will determine if the child has:(5)
  - Normal articulation and phonology skills given the child’s age OR
  - Disordered articulation and/or phonology skills given the child’s age
    - If the child has a functional articulation disorder, the clinician will also make a statement regarding the severity of the disorder (mild, moderate, severe, profound). Additionally, the therapist will determine if the articulation disorder is functional or organic in nature. (For information on assessment and treatment of organic articulation disorders, see Clinical Review...Speech Sound Disorders: Articulation Disorders, Organic, referenced above)
    - A child with disordered articulation and/or phonology skills who has adequate stimulability (as determined by the stimulability testing) is a good candidate for speech-language therapy. Children with severe articulation disorders who do not respond well to stimulability testing during the evaluation, or those who have very severely disordered articulation skills, might be candidates for AAC

- **Prognosis**: The prognosis for children to develop normal speech in the presence of a functional articulation disorder is generally good, with about 75% of disorders independently resolving by the age of 6 years.4) Children who have good stimulability during the evaluation are likely to do well in speech therapy.5) The reason that some children fail to develop normal speech despite aggressive speech therapy is unknown.2 Preliminary research suggests that children
who have coexisting language formulation disorders in addition to an articulation disorder have more difficulty with long-term normalization of speech\(^{(2)}\)

› **Referral to other disciplines:** Referral to audiologist if the child fails the hearing screening; referral to a neurologist if neurological abnormalities are noted during test; referral to otolaryngologist if structural abnormalities are noted during testing; referral to a psychologist if underlying psychological or cognitive diagnosis is suspected; referral to physical and/or occupational therapy if abnormal gross or fine motor skills are suspected\(^{(6)}\)

› **Treatment summary:** Treatment of functional articulation disorders will begin with the establishment of baselines.\(^{(5)}\) The baselines describe the initial ability of the child. For example, if the child is able to produce the /s/ sound accurately in isolation, but not at the syllable level or beyond, the baseline is the isolation level. From there, the SLP must develop measurable, objective goals for therapy.\(^{(5)}\) For example, “Client will produce /s/ at the syllable level without cues with 90% accuracy.” In addition to goals, the therapist must set dismissal criterion.\(^{(5)}\) Generally, the child is dismissed from therapy once the target sound is achieved at conversation level 90% of the time

- facilitative techniques: techniques that teach the child about both perception and production of target sounds; often sounds are taught on a sound-by-sound basis\(^{(2,5)}\)
  - Phonetic placement: techniques used to teach the child the position of the articulators for specific sounds\(^{(5)}\)
    - SLP uses very direct methods of demonstrating placement
    - Instruments used: tongue blades (to manipulate or hold articulators in place); breath indicator (for mouth and nose); graphic records (such as a spectrogram)
    - Several techniques can be employed in phonetic placement\(^{(5)}\)
      - Diagrams, pictures, drawings of articulators
      - Palatograms while producing sounds
      - Observing clinician or self in the mirror while producing sounds
      - Manipulation of the articulators (with tongue blades or child’s fingers)
      - Verbal description of placement
      - Feeling the breath stream or seeing the breath on a tissue
      - Feeling the laryngeal vibration (for voiced sounds)
  - Successive approximation: technique that shapes the sound the client can already make into a new sound\(^{(5)}\)
    - Sound can be a speech sound or another type of sound (e.g., a “growl” to make the /r/ sound in “car”)
    - The production of each sound must be broken up into several steps and the clinician gradually guides the child towards each step
    - For example, if the child cannot say /b/, but can produce /p/, the clinician can teach the child to say /p/ and add laryngeal vibration (voicing) to get a /b/ sound
    - An example of successive approximation described in a professional magazine by three SLPs is vowel drills for helping a child produce the /r/ sound\(^{(2,1)}\)
      - The vowel drills are used as an oral exercise at the start of each therapy session\(^{(2,1)}\)
      - The SLP asks the child to produce vowels imitatively starting with simple vowels in isolation and increasing to pairs and then three-and four-vowel combinations; the proposed criterion for advancing to the next level was 100% accuracy for 3 consecutive sessions\(^{(2,1)}\)
      - As the child improves with vowel productions, the vocalic /r/ sounds are introduced and that is shaped into an /r/ in words and clusters\(^{(2,1)}\)
  - Modeling: clinician models the sound for the child and the child is asked to imitate\(^{(5)}\)
    - The most direct of all facilitative techniques
    - Child is told to watch the clinician’s mouth closely and copy exactly what he or she does
    - In a study conducted in the Netherlands involving 91 children (ages 4–6 years) with an articulation disorder, participants were divided into three groups: those treated with facilitative techniques/traditional therapy alone, those treated with traditional therapy and a contingency management program (behavioral therapy technique in which desired behaviors are rewarded and undesired behaviors are ignored), and a final group that received no therapy\(^{(2)}\)
    - Both therapy groups demonstrated improvement in articulation skills; however, children in the contingency management group performed significantly better on the outcome measures than those treated with facilitative techniques/traditional therapy only\(^{(2)}\)
Researchers found that participants in the contingency management group completed more homework sessions, which might have led to the greater improvements in speech.

• Sensorimotor approach: approach that is based on the theory that the syllable is the basic unit of training
  – Phonetic contexts which evoke correct productions of the target sound are called “facilitative phonetic contexts”
  – Involves heightening the child’s sensitivity to patterns of speech movement, reinforcing the correct productions of the sound, and providing facilitative contexts for the child to correctly produce the sound

• Multiple-phoneme approach: approach that targets multiple sounds in each treatment session; each sound is targeted individually in three separate phases
  – Establishment phase: First establishing the correct production of the sounds in isolation, then maintaining the accurate production of each sound
  – Transfer phase: Training the child to use the sounds in syllables, words, phrases, sentences, reading and storytelling, and, finally, conversation
  – Maintenance phase: Accomplished with return visits to the therapist, having the therapist come to the classroom, telephone conversations or reports from the parents/teachers

• Programmed Conditioning for Articulation: a commercially available program based on behavior modification
  – Follows a stimulus-response-consequence contingency paradigm
  – Recommends an average of 300 productions per hour of instruction
  – Provides programs for children who cannot produce the sounds /s/, /r/, /l/, /θ/, "sh," and "ch"
  – Includes establishment, transfer, and maintenance phases

• Contrast therapy approach: a “cognitive-linguistic” approach to treat articulation and phonological disorders
  – Divided into two major categories:
    - Minimal contrast training
    - Maximal contrast training
  – Focusses on the child’s perception of linguistic contrasts and/or production of these contrasts
  – Example: If a child’s error is final consonant deletion, the clinician can place pictures of minimally contrasted words in front of the child: bow and boat, bee and beet. When the clinician says, “Hand me the picture of the bow,” the child must listen carefully and choose the correct picture. When it is the child’s turn to request the picture, the clinician only picks up the picture of the word the child actually says and trains the child to add the final consonant when trying to say “boat” or “beet”
  – Most frequently used to treat phonological disorders; however, has been incorporated into articulation treatment as well

• Embedded approach
  – In a small study conducted in the United States with 6 children aged 42 to 66 months with functional articulation disorders, researchers investigated the efficacy of a speech sound intervention that was embedded in shared storybook reading. The format of the intervention was intended to be hybrid in nature – a combination of a naturalistic and drill-based intervention styles
  – All sessions were conducted in the speech and language services room in the public school the participants attended
  – Each participant was assigned to one of three possible “book groups” that was based on the individual child’s speech sound errors; books in each group contained high concentrations of the target phoneme(s) and there were 2 children per group
  – Group A: initial /s/ cluster reduction
  – Group B: velar stopping (i.e., /t/ or /k/ and /d/ for /g/)
  – Group C: final consonant deletions
  – During the intervention phase of the study, speech cues were embedded within the context of the storybook reading activities. Each child was asked to produce target words individually, and hierarchical speech cues (i.e., beginning with the least intrusive) were provided after incorrect productions. During each 30-minute intervention session, participants were given 15 opportunities to produce target phoneme(s). Group A completed 33 sessions, Group B completed 27 sessions, and Group C completed 18 sessions
  – Results
    - Group A: Participant 1 increased correct productions from 10% to 20% at baseline to an average of 71% following the intervention; participant 2 increased correct productions from 10% at baseline to an average of 67% following the intervention
- Group B: Participant 3 increased correct productions from 0% to 20% at baseline to an average of 75% following the intervention\(^{(33)}\)

- Group C: Participant 5 increased correct productions from 10% to 30% at baseline to an average of 53% following the intervention; participant 6 increased correct productions from 0% to 10% at baseline to an average of 76% following the intervention\(^{(33)}\)

- Researchers considered the intervention successful for 5/6 participants; only participant 4 did not respond to intervention\(^{(33)}\)

**Systematic Articulation Training Program Accessing Computers (SATPAC)**

- In a study conducted in the United States with 18 children (ages 6;9–11;10) with functional articulation disorders, researchers investigated the effectiveness of SATPAC for normalizing productions of interdentalized /s/ and /z/\(^{(30)}\)

- In the SATPAC program, the stimulus items for drills are generated by a computer and delivered by a clinician and involve using a sequence of phonetic placement and/or oral-motor placement cues as appropriate to establish the target sounds. Once established, drills are structured around producing the sounds in nonsense words and slowly advancing to more natural contexts\(^{(30)}\)

- Treatment sessions were conducted by an SLP and sessions were 10 minutes in length occurring once per week for 15 weeks; participants were divided into group A and group B, with group B delaying treatment so that between-group comparisons could be made

- At baseline, group A scored an average of 3.3% correct in SATPAC phrases with /s/ and /z/ and 4.4% in spontaneous conversation. After group A underwent 15 weeks of therapy, accuracy improved significantly to 97.8% in phrases and 76.9% in spontaneous conversation. During that time period, there were no significant changes in correct productions of /s/ and /z/ in group B (who did not receive treatment at that time). After group B underwent 15 weeks of therapy, their scores improved significantly as well, from 18.9% to 100% in phrases and from 10.7% to 73.8% in spontaneous conversation\(^{(30)}\)

**Biofeedback therapy**

- Ultrasound: ultrasound can provide images of the tongue during speech production; during treatment sessions, child can view midsagittal and coronal images of his or her tongue\(^{(21)}\)

- Authors of a case study involving 2 adolescents described an articulation biofeedback program in which the therapist attempted to increase awareness of accurate tongue placement for /r/ and moves through hierarchy of production tasks\(^{(21)}\)

- Treatment with ultrasound lasted for 13 sessions, 1 hour each

- Three SLPs unfamiliar with the subjects rated significantly more accurate occurrences of /r/s in single words and some phrases post treatment

- Acoustic analyses showed the expected lowering of the third formant after treatment, indicating a more accurately produced /r/ sound

- A qualitative observation of posttreatment ultrasound images for /r/ revealed tongue shapes to be more similar to those of typical adults than had been observed before treatment

- Electropalatography (EPG): EPG can provide visual feedback to the child regarding accurate tongue placement for certain sound productions\(^{(23)}\)

- Clinicians can use the EPG data collected from typically developing subjects to serve as normative data\(^{(24)}\)

- Authors of a case study described an intensive treatment program that included both EPG and traditional facilitative techniques with an 11-year-old girl who had a persistent lateralized /s/

- Treatment included 12 sessions over the course of 4 weeks followed by a 6-week home program

- Authors of the study noted improvements in both the perceptual and spectral characteristics of /s/ articulation post therapy

- For this study, the child was fitted for an individually molded acrylic palate that was embedded with touch-sensitive electrodes; the child was able to see her tongue placement on the computer screen and adjust placement as necessary to achieve correct placement

- Tactile feedback: in order to achieve proper tongue placement for the child to produce a specific sound, it can be useful to use tactile feedback on the tongue; many Food and Drug Administration (FDA) approved products are available commercially to achieve tactile feedback and proper tongue placement\(^{(25)}\)

**Oral motor approach**: based on the theory that improving oral motor skills will also improve speech\(^{(26)}\)
-- General facilitation techniques: include gross motor activities, body positioning, jaw stability, and “face wake-ups” (face pats, manual slide)
-- Direct facilitation techniques include lip closure, lip rounding and protruding, tongue tip/front elevation and spreading, tongue back elevation, tongue lateral margin elevation and spreading, and tongue retraction
-- Research results do not support the efficacy of the oral motor approach/nonspeech oral motor therapy for functional articulation disorders (26,31,32)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Goal</th>
<th>Intervention</th>
<th>Expected Progression</th>
<th>Home Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced intelligibility of speech due to incorrect articulation of sounds</td>
<td>Increase intelligibility of speech</td>
<td>Facilitative techniques&lt;br&gt;Phonetic placement (5)&lt;br&gt;Successive approximation (5)&lt;br&gt;Modelling (5)&lt;br&gt;Contingency management program (2)&lt;br&gt;See Treatment summary, above</td>
<td>Once the sound is established in isolation, the clinician guides the client to produce the sound at the syllable, word, sentence, and conversation levels (5)</td>
<td>None specified; as with any speech therapy, greater progress is anticipated with home practice; to be determined by SLP based on individual</td>
</tr>
<tr>
<td>Reduced intelligibility of speech due to incorrect articulation of multiple sounds</td>
<td>Increase intelligibility of speech</td>
<td>Sensorimotor approach (2)&lt;br&gt;See Treatment summary, above</td>
<td>Once the sound is established in isolation, the clinician guides the client to produce the sound at the syllable, word, sentence, and conversation levels (5)</td>
<td>None specified; as with any speech therapy, greater progress is anticipated with home practice; to be determined by speech therapist based on individual</td>
</tr>
<tr>
<td>Reduced intelligibility of speech due to incorrect articulation of multiple sounds</td>
<td>Increase intelligibility of speech</td>
<td>Multiple-phoneme approach (5)&lt;br&gt;See Treatment summary, above</td>
<td>Progression moves stepwise from establishment phase to transfer phase and, finally, to maintenance phase (5)</td>
<td>None specified; as with any speech therapy, greater progress is anticipated with home practice; to be determined by speech therapist based on individual</td>
</tr>
<tr>
<td>Reduced intelligibility of speech due to incorrect articulation of sounds</td>
<td>Increase intelligibility of speech</td>
<td><strong>Programmed Conditioning for Articulation</strong> (5)</td>
<td>The program gradually trains the child to produce the sound in isolation, nonsense syllables, words, phrases, sentences, contextual reading, story narration, and conversation(2)</td>
<td>Transfer phase of the program involves training at home with the parents and at school with the child’s teacher(2)</td>
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<tr>
<td>Reduced intelligibility of speech due to phonological or articulation errors</td>
<td>Increase child’s awareness of the semantic difference between his or her error productions</td>
<td><strong>Contrast therapy approach</strong> (5,10)</td>
<td>Once the sound is established at the syllable level, the clinician guides the client to produce the sound at the word, sentence, and conversation levels(2)</td>
<td>None specified; as with any speech therapy, greater progress is anticipated with home practice; to be determined by speech therapist based on individual</td>
</tr>
<tr>
<td>Reduced intelligibility of speech due to incorrect articulation of sounds</td>
<td>Increase intelligibility of speech by increasing awareness of tongue placement</td>
<td><strong>Biofeedback</strong></td>
<td>Progress through productions of the target sound at the sound level and move to syllable and word level, noting the placement of the tongue and the biofeedback received with correct placements</td>
<td>Ultrasound: At the end of each session, clients were given 10 minutes of exercises to practice without the ultrasound to do as homework</td>
</tr>
<tr>
<td>Phonological disorder</td>
<td>Increase intelligibility of speech</td>
<td><strong>Phonological therapy</strong></td>
<td>Intelligibility of speech will improve</td>
<td>As with any speech therapy, greater progress is anticipated with home practice; to be determined by speech therapist based on individual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For additional information on assessment and treatment of phonological disorder, see <em>Clinical Review ...Speech Sound Disorders: Phonological</em>, referenced above</td>
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</tr>
</tbody>
</table>
Desired Outcomes/Outcome Measures

› Increased intelligibility of speech
  • Assessment Link Between Phonology and Articulation
  • Assessment of Phonological Processes
  • Bankson-Bernthal Test of Phonology
  • Fisher-Logemann Test of Articulation Competence
  • Goldman-Fristoe Test of Articulation-3
  • Khan-Lewis Phonological Analysis
  • Natural Process Analysis
  • Phonological Process Analysis
  • Photo Articulation Test
  • Syllable Repetition Task (SRT)
  • Templin-Darley Tests of Articulation
  • Test of Minimal Articulation Competence
  • A recalculation of intelligibility of speech should be completed at the conclusion of therapy

› Increased speech sound inventory
  • Goldman-Fristoe Test of Articulation-3
  • Khan-Lewis Phonological Analysis

› Improved confidence with speech and conversation

Maintenance or Prevention

› Throughout therapy, the SLP might ask the parents to bring in pictures or objects from home that contain the target sounds. The parents are then trained to use these items daily in order to remind the child to use his or her correct articulation.

› After the child finishes therapy, the SLP can provide follow-up and, if necessary, a “booster” program.
  • Follow-up consists of periodic evaluations of the target sounds to ensure maintenance over time
  • If the SLP notes decline from the child’s performance at the end of treatment, the child can start a “booster” treatment program that is less intensive than the original therapy and is intended to increase the accuracy to dismissal criterion

Patient Education

› The American Speech-Language-Hearing Association (ASHA) is dedicated to the mission of helping people with speech, language, and hearing disorders receive services to help them communicate successfully. Resources for parents about communication and communication disorders are located at http://www.asha.org/public/speech/

Coding Matrix

References are rated using the following codes, listed in order of strength:

- M Published meta-analysis
- SR Published systematic or integrative literature review
- RCT Published research (randomized controlled trial)
- R Published research (not randomized controlled trial)
- C Case histories, case studies
- G Published guidelines
- RV Published review of the literature
- RU Published research utilization report
- Q Published quality improvement report
- L Legislation
- PGR Published government report
- PFR Published funded report
- PP Policies, procedures, protocols
- X Practice exemplars, stories, opinions
- GI General or background information/texts/reports
- U Unpublished research, reviews, poster presentations or other such materials
- CP Conference proceedings, abstracts, presentation

References


