Treatment Options for Speech Sound Disorders

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Abstract
This presentation outlines approximately 30 different approaches and programs for children with speech sound disorders for infants shortly after birth to school-aged students. During the first hour the presentation focuses on describing a model of the neurological basis of speech learning speech and speech disorders. The focus of the second and third hour is on describing treatment options for children with speech sound disorders. Topics addressed include Childhood Apraxia of Speech, motor learning approaches, and the efficacy of non-speech oral motor approaches.

Biography
Ken Bleile is a professor in the Department of Communication Sciences and Disorders, University of Northern Iowa. During periods in the last several years he has also served as a visiting scholar in Turkey, Singapore, Russia, and New Zealand. During summers Dr. Bleile often leads study abroad groups to provide speech and language services to children in orphanages and schools, most recently in Nicaragua. Dr. Bleile is an ASHA Fellow and Chair of the International Issues Board of the American Speech-Language-Hearing Association. He publishes widely on speech development, international issues, pediatric head injury, and communication disorders in children with medical needs and developmental disabilities. Recent publications include The Neurological Foundations of Language, The International Directory of Communicative Disorders, and The Late Eight. He is currently working on The Manual of Speech Sound Disorders: A Biological Perspective (Third Edition).
Neurological Foundations

The following major aspects of brain development occur as the child interacts with the environment:

**Selective Elimination**
**Function:** In areas of the brain responsible for speech learning as in other domains, a brain begins with “extra” cell connections. Those that are used are strengthened and retained, while those that are unused are eliminated.
**Growth:** Approximately one-third of cells are lost between birth and adulthood. Selective elimination occurs early in sensory areas and later in areas involved in higher cortical functions. The number of cell connections remains stable throughout much of adulthood.

**Growth and elaboration**
**Function:** The environment stimulates growth and elaboration of cell connections, including those needed for speech learning.
**Growth:** An enriched environment promotes increased numbers of synapses per neuron in both children and adults, and environmental deprivation decreases numbers of cell connections. In humans, numbers of cell connections increase in old age, indicating a capacity for life long learning and, perhaps, compensating for neuronal deaths that occur during middle and old age.

**Brain Weight**
**Function:** Brain size gives humans the capacity to grasp complex patterns, including those that underlie speech.
**Growth:** The human brain at birth is about 25% of its adult weight, grows maximally to 80% of its adult weight during the first few years of life, and reaches its mature size at adulthood.

**Myelin sheaths**
**Function:** A white fatty substance on axons that acts as an insulator and speeds electrical transmission of signals between cells. Myelin is critical for gross and fine motor movements, including speech.
**Growth:** Myelination of the brain begins near six months in utero, achieves its peak growth between birth and the end of the first year, and continues to grow until adulthood.

**Primary Auditory Cortex**
**Function:** A functional region in left temporal lobe critical for language comprehension.
**Growth:** Peak in number of cell connections during the first half of the first year and achieve mature number of cell connections during the second half of the first year. Girls young as nine have more dendritic connections in Wernicke’s area than do males. On average, persons with a university education have more dendritic connections in Wernicke’s area than do those with a high school diploma, who in turn have more than those with less than a high school education.
Broca’s Area
Function: A functional region in the left frontal hemisphere that controls speech.
Growth: Density of cell connections in Broca’s Area does not peak until 15 months, and does not reach a mature number of connections until 6 to 8 years old

Hippocampus
Function: The hippocampus is critical to working memory and such important speech activities as memory retention and word retrieval.
Growth: The hippocampus develops after the child is born, especially during the second year of life.

Prefrontal Cortex
Function: The prefrontal cortex is critically important to many cognitive activities that underlie speech, including reasoning, planning, judgment, and attention.
Growth: Cell connections in the prefrontal lobes develop slowly throughout childhood and do not reach maturity until after adolescence.
REFERENCES


Shaywitz, B., Shaywitz, S., Pugh, K., Mencl, W., Fulbright, R., Skudlarski, P., Constable, R.,


Major Speech Milestones in Infants

**Communication Understanding**

- **5-6 months**  Responds to "no" with inflection
- **6-7 months**  Moves or looks toward family member when named (e.g., "where's daddy?")
- **8 months**    Responds to "come-up"
- **8-9 months**  Responds to "no" without inflection
- **9-10 months** Follows simple commands with gesture (e.g., "come here")

**Expression**

- **5 months**    Takes turns with sounds
- **5-6 months**  Enjoys sound-gesture such as "peek-a-boo"
- **6 months**    May produces some idiosyncratic words (e.g., "wawa" for water)
- **9-10 months** Participates in speech routine games (e.g., "so-big," "pat-a-cake," etc.); initiates sound-gesture games
- **10 months**   Uses ritualized intentional gestures and short sound to obtain desired object
- **11-12 months** Covers own face in "peek-a-boo"
- **11 months**   First spoken word

**Vocal Development**

- **0 to 2 months** Vegetative sounds
- **3 to 4 months** Cooing is well established
- **4 months**     Vocalizations begin to be dominated by sounds produced at the front of the mouth, including raspberries and trills
- **7 to 8 months** Babbling well established
Major Speech Milestones in Toddlers

Communication

Understanding

___ 12 months  Responds to "give me" plus gesture.
___ 12-13 months Can respond to verbal request to say "bye-bye"
___ 13-14 months When asked to, will look at object (e.g., TV, ball, etc.)
___ 15-16 months Carries out request to select and bring some familiar object from another room
___ 17-18 months Lifts foot or points to shoe when asked, "Where are your shoes?"
___ 24 months Responds to "bye-bye" without gesture

Expression

Mode of Communication

___ 12-13 months Uses voice and gesture to get objects
___ 14-15 months Communicates using gestures, words, and vocalizations
___ 16-18 months Uses words to express wants and to communicate
___ 20 months Relates experience

Expressive Vocabulary

___ 12 to 13 months  2 to 3 words
___ 14 to 15 months  4 to 6 words
___ 16 to 17 months  7 to 20 words
___ 20 to 21 months  50 words

Syntax

___ 20-22 months Combines words
___ 24 months Uses two and three word combinations

Speech Production

Typical Consonant Inventories

___ 15 months
Initial  b d h
Final  t

___ 18 months
Initial  b d m n h w
Final  t

___ 24 months
Initial  b d g t k m n h w f s
Final  p t k n r s

Correct Sounds

___ 1;6 to 1;11 Approximately 82% of non-rhotic vowels are produced correctly
___ > 24 months [m n h w p b] correct in at least two of three word positions (initial, medial, final)
___ 24 months [m n h w p b η t k d g] correct in at least two of three word positions (initial,
medial, final)

24 months  70% of a child’s consonants correct relative to the adult language
Major Speech Milestones in Preschoolers

**Communication**

*Expressive Vocabulary*

- **24 months**: Vocabulary of 200-300 words
- **30 months**: Vocabulary of 450 words
- **36 months**: Vocabulary of 900-1000 words
- **42 months**: Vocabulary of 1200 words
- **48 months**: Vocabulary of 1500-2000 words
- **54 months**: Vocabulary of 1900 words

**Syntax**

- **24 months**: Uses two and three word combinations
- **36 months**: Speaks in short, telegraphic sentences
- **48 to 54 months**: Uses longer, more complex sentences

**Speech Production**

- **24 months**: Speech is 26 to 50% intelligible
- **< 36 months**: Stops, nasals, and glides acquired
- **36 months**: Speech is 75% intelligible
- **36 months**: Vowel development is largely complete
- **36 to 48 months**: Affricates, liquids, affricates, liquids, and most fricatives acquired
- **48 months**: Speech is 100% intelligible
- **54 months**: Interdental fricatives acquired
- **60 months**: All but most challenging word initial consonant cluster acquired
Major Speech Milestones in School-aged Students

Phonological Awareness

___ 4;6-4;11 Can segment a multisyllabic word into syllables
___ 5;0-5;5 Aware of rhyme and alliteration, can isolate a phoneme in a word
___ 6;6-6;11 Can segment a word into phonemes

Consonants

General Pattern

___ 5;0 50% of students have acquired all consonants
___ 6;0 75% of students have acquired all consonants

Specific Developments

___ 5;0 [s] and [ʃ] acquired by 75% of students
___ 5;6 [ð] and r-colored vowels acquired by 75% of students
___ 6;0 [θ], [z], [ɹ], [r], and [l] acquired by 75% of students

Consonant Clusters

General Pattern

___ 5 years 50% of students have acquired all word initial clusters
___ 8 years 75% of students have acquired all clusters

Specific Developments

___ 5;0 Two member [s] clusters acquired by 75% of students
___ 5;6 to 6;0 Two member liquid clusters acquired by 75% of students
___ 7;0 to 8;0 Three member clusters acquired by 75% of students
REFERENCES


