Childhood Apraxia of Speech:  
From Research to Practice

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- Speaker fees
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Objectives

- Based on best available evidence, participants will:
  - Learn how to interpret responses during assessment to support differential diagnosis
  - Describe how dynamic assessment can contribute to assessment of speech sound disorders
  - Identify specific approaches and techniques to treat CAS in children of different ages and ability levels
  - Demonstrate knowledge of PML and how they inform decision-making in treatment
Introduction

Research to Practice: Why?
• Understanding
  • the physiology of the speech mechanism
  • interactions of cognitive, linguistic, and motor factors, and
  • effects of treatment factors
informs our clinical decision-making during assessment and treatment

Research to Practice: Evidence-Based Practice
• EBP does not require us to use information only from peer-reviewed studies
  • But we DO need to consider the level of evidence when empirical studies are lacking
    • “XYZ is an evidence-based practice” doesn’t really tell you anything

Levels of evidence range from expert opinion to random control trial

Where to find best available evidence:
✓ ASHA Systematic Reviews
✓ Cochrane Data Base
✓ Speech Bite
✓ ASHA Technical Reports
✓ Consultation with experts
✓ Current journal articles/reviews

Research to Practice: Assessment
• There are interactions among cognitive, linguistic, and motor aspects of development
  • The interactions of these aspects of development change over time
(Kent, 2004; Smith & Goffman, 2004; Nip, Green & Marx, 2010)

Research to Practice: Treatment
• There is a growing evidence base that can help to inform decisions about
  • “dosage” (frequency and length of sessions)
  • choice of targets
  • treatment approaches/treatment factors

Research to Practice: Personal
• Throughout the day, be thinking about:
  • What information you usually gather during assessment and treatment
  • Why you choose specific assessment tools or treatment techniques
  • How you use information to arrive at a diagnosis and to guide treatment
Assessment

Who is responsible for diagnosis of CAS?
A speech-language pathologist “...with specialized knowledge in motor learning theory, skills in differential diagnosis of childhood motor speech disorders…”

Challenges in Diagnosis
- Like LDs, autism, and SLI, there are no conclusive physiologic markers
  - Characteristics overlap with other disorders
  - No gold standard
- “Not talking” is not sufficient for diagnosis
- CAS can co-occur with many other primary disorders
  - Many/most children with CAS will have other issues
    - Interactions rather than causal
- CAS is a dynamic disorder
  - It may change as a result of neurologic maturation
  - It should change as a result of treatment
- Early dx may be difficult due to ability to cooperate for assessment, attention span, and/or limited verbal output
- Lack of adequately normed, standardized tests

Differential Diagnosis

What is CAS?
It is a neurologic pediatric speech sound disorder in which the precision and consistency of movements are impaired in the absence of neuromuscular deficits…The core impairment in planning and/or programming spatiotemporal parameters of movement sequences results in errors in speech sound production and prosody.” ASHA Technical Report, 2007

Phonological Disorder
- The primary factor is thought to be linguistic rather than motor
- Etiology is most often unknown

Childhood Apraxia of Speech (CAS)
- The primary factor is thought to be praxis: planning/programming movements
  - No obvious weakness or impaired ability to move articulators
  - Can be acquired (e.g., stroke, TBI) or “developmental

Dysarthria
- Difficulty with execution of movements
  - Weakness, paralysis, or abnormal tone resulting in decreased range of motion, decreased speed, or impaired movement of the articulators
  - Usually caused by impairment in the central or peripheral nervous system

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Assessment procedures are used to
- determine the relative contribution of motor planning/programming impairment
- assist in planning treatment

Research to Practice: Assessment
- There are developmental changes in speech motor and language skill (Smith & Goffman 2004; Nip, Green, & Marx, 2010)
- Cognitive factors influence speech development (Kent, 2004; Nip Green & Marx, 2010)
- There is evidence that observing or imagining movement activates motor systems (Kent 1984)
- Speech sound perception skills may be impaired in some children with severe speech sound disorders (Munson, Edwards, & Beckman, 2005)

Research to Practice: Assessment
- Assessment should include presentation of targets with hierarchical level of cueing using
  - different levels of complexity
    - Sound patterns
    - Word vs phrase or sentence
  - Have child attend to examiner’s face for visual cues
  - Be aware of possible speech perception deficit
    - For school-agers, consideration of phonologic awareness skills

Assessment Procedures

1. Developmental history, including hearing and neuromotor status
2. Observation of speech subsystems
3. Structural-functional exam
4. Speech perception
5. Language skills, including nonverbal communication and prosody
6. Analysis of speech sound inventory/patterns
7. Motor speech exam

Developmental history contributes to development of a hypothesis about the child’s communication disorder
- Birth history
- Family history
- Developmental milestones
  - First words, word combinations
  - Motor milestones
- Co-existing problems
  - Sensory function issues
  - Seizures, hearing loss, learning issues
  - Feeding history, abnormal reflexes

Observation of speech subsystems may help to identify indications of dysarthria
- Respiration
- Articulation
- Phonation
- Resonance
- Prosody

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Structural-Functional Examination can help to rule in/rule out nonverbal oral apraxia or dysarthria

- Structures
  - Range of motion
  - Coordination
  - Strength
  - Ability to vary muscular tension
  - Speed
- Tissue characteristics

Speech Perception: Phonologic Processing

- Formal tests such as the CTOPP, TOPA, etc.
- Informal measures such as the Locke task
- Evaluate the child’s understanding of phonemic categories and other phonologic awareness skills, which
  - can influence the interaction of speech and vocabulary development, and
  - literacy/academic skills

Evaluation of Language

- We need to understand the child’s speech in the context of their overall ability to communicate
- Include both formal and informal measures
- Consider functional use of language, nonverbal communication, and confidence
- Remember the range of variability in younger children
- Performance may vary across tasks
  - Does the child exhibit communicative intent
    - to comment, request, engage in social interaction?
    - to initiate interactions with expected frequency?
- Is there a discrepancy between receptive and expressive skills?
- Is there a discrepancy between estimated level of language and speech sound development? (e.g., acquiring sign language rapidly but remaining nonverbal)

Evaluation of Speech

- Sound system analysis is needed
  - To describe the current phonetic/phontactic inventory
  - To guide decisions regarding intervention approach and stimulus selection
  - To establish a baseline for progress monitoring
- There is no single test of articulation or phonology that is a fully adequate measure of a child’s phonetic inventory (Eisenberg, et al., 2010)
  - But tests can be a useful means for quickly probing a range of speech sounds

- Sound System Analysis (See Appendix A)
  - Phonetic Inventory
    - What sounds is the child producing spontaneously?
    - Helps to identify what the child can build on
  - Error Inventory
    - How does the child’s sound system map onto adult forms?
    - What syllable shapes does the child use?
Shriberg, 1993 and Lof, 2004 suggest a general progression in speech sound development:

<table>
<thead>
<tr>
<th>Progression Level</th>
<th>Sounds Acquired</th>
<th>Age Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early 8</td>
<td>m, b, j, n, w, d, p, h</td>
<td>acquired around 3 years of age</td>
</tr>
<tr>
<td>Middle 8</td>
<td>t, k, g, ŋ, f, v, ʧ, ʤ</td>
<td>acquired around 3-4 years of age</td>
</tr>
<tr>
<td>Late 8</td>
<td>ʃ, θ, ð, s, z, l, r, ʒ</td>
<td>acquired between 5 1/2-8 years of age</td>
</tr>
</tbody>
</table>

Evaluation of Motor Speech Skill

- Consider observations of physiology and structure made earlier
  - Precision and consistency of movements
  - Ability to vary rate and/or loudness
  - Ability to vary muscular tension (e.g., /b/ vs /m/)
- Evaluate the child’s ability to produce phonetic segments in different contexts and with different types of cues
  - Observe responses for characteristics that will contribute to differential diagnosis
  - Motor planning/programming vs motor execution/weakness
- Published tests vary significantly in the number of items that focus on
  - evaluating oral structures,
  - nonverbal oral movements and motor speech skills. (McCaugley & Strand, 2008)

What to do about the variation among tests?

- Learn about the theoretical basis for the test you are using and consider the norming sample.
  - Is the test consistent with your understanding of apraxia?
  - How does it inform your decision about diagnosis?
- Use test information to confirm findings based on other formal and informal measures

Motor Speech Exam (MSE)

Examine ability to sequence phonetic segments

- V, CV, VC, CVC (using various vowels)
- Monosyllable
- Multisyllable words/phrases
- Sequences of increasing length and phonetic complexity

Examine ability to sequence phonetic segments with different types of cues

- Simultaneous vs imitated productions
- Visual, tactile, and/or gestural cues
  - The tasks and order of presentation will depend on the child’s characteristics and your predictions about their ability

Use the MSE to
- Evaluate severity of impairment
- Begin treatment planning
Motor Speech Exam
Based on work by Edythe Strand, 2004, 2013)

We are looking for:
- Estimate of severity
- Where the breakdown occurs
- What type of cueing is needed for success

A good evaluation provides a starting point for treatment planning

See Appendix B
Why Use Dynamic Assessment?

- The child may produce a target differently in spontaneous versus volitional (directed) context
  - On standardized tests, binary scoring indicates they cannot say the utterance, but does not give information about why
  - The cueing involved in dynamic assessment enables us to observe what the child does when attempting specific movement gestures (more detailed than simple stimulability testing)
- For children with CAS, we may see
  - groping that is not evident in spontaneous speech, but occurs when trying to imitate specific movement gestures with cueing
  - inconsistency across trials as cueing occurs
  - segmentation of syllables which occurs only when attempting the correct articulatory movement gestures or when given unfamiliar sequences
- It is sensitive to changes that result from the child’s responses to cueing; in other words, acquisition of a new skill
- It is different from standardized tests which compare a child’s performance (e.g., articulatory accuracy) to a normative group
  - Two children to may have the same standard score on a test, but have very different levels of severity and different prognosis for change
  - Response to cueing is expected to be more informative about prognosis than total number of errors
- Dynamic assessment facilitates judgments of severity and prognosis because the clinician is providing different levels of support or cueing
- Judgments are made regarding the child’s response to types and levels of cueing
  - Those observations facilitate the clinician’s judgments regarding
    - how much cueing will be needed in early therapy to induce improvement in performance
    - how long it may take to achieve initial progress

Research to Practice: Dynamic Evaluation of Motor Speech Skill (DEMSS)

- Testing: 82 children between 36 and 79 months referred to the Mayo Clinic for diagnosis of speech sound disorders. Children were given the DEMSS and a standard speech and language test battery as part of routine evaluations.
- Agglomerative hierarchical cluster analysis showed total DEMSS scores largely differentiated clusters of children with CAS versus mild CAS versus other speech disorders.
- Positive and negative likelihood ratios and measures of sensitivity and specificity suggested that the DEMSS does not over-diagnose CAS, but sometimes fails to identify children with CAS.
Evaluation of Motor Speech Skill: What Are We Looking For?
(a) inconsistent errors on consonants and vowels in repeated productions of syllables or words,
(b) lengthened and disrupted coarticulatory transitions between sounds and syllables, and
(c) inappropriate prosody, especially in the realization of lexical or phrasal stress.

"Importantly, these three features are not proposed to be the necessary and sufficient signs of CAS."

“These and other reported signs change in their relative frequencies of occurrence with task complexity, severity of involvement, and age.”

(ASHA Technical Report)

A fourth candidate characteristic = vowel distortions  (Davis, Jacks, & Marquardt 2005)

Some “Red Flag” Characteristics in Toddlers (Davis & Velleman, 2000)
- quiet baby: did not play with sounds or babble much
- when babbling occurred, it was undifferentiated (included few or no consonant sounds)
- few attempts to imitate sounds or words
- resists attempts of adults/others to get him to imitate sounds/words
- limited vocabulary for age level
- poor intelligibility of words
- words tend to be general in use (e.g., “num num” may be used to represent anything edible.)
- attempts to communicate through gestures, vowel sounds or other means
- demonstrates frustration at not being understood, but seems to understand at an age-expected level

Some “Red Flag” Characteristics in Older Children
- Difficulties with sound sequencing
  - Sounds produced correctly in some sequences are produced incorrectly in others.
  - Why? Perhaps due to different motor requirements for allophones
- Difficulties with sound sequencing
  - Errors increase with length and complexity of utterance
- Disruption in temporal and spatial relationship of the articulators
  - Longer word and sentence durations
  - Difficulty achieving and/or maintaining articulatory configurations
- Disruption of prosody
  - Segmenting or substitution of glottal stops makes speech sound ‘choppy’
  - Resources are allocated to planning articulatory movement or loudness modulation and may not be available for planning appropriate prosody

Overall Sound System Analysis
- A child with phonologic disorder will usually have
  - Consistent patterns of error
    - “typical” patterns such as final consonant deletion, fronting, stopping, etc.
  - Intact prosody
  - Vowels intact
A child with CAS may have
- Restricted sound repertoire
- Poor differentiation of vowels
- Few/simple syllable shapes
- Atypical error patterns (e.g., initial consonant deletion, sound preference, epenthesis, etc.)

See comparison chart Appendix B. Also available at Apraxia-Kids.org

Summary: Differential Diagnosis
- We use our assessment information to:
  - determine if there is sufficient evidence to make a differential diagnosis
  - identify the relative contribution of factors
    - Linguistic-language
    - Linguistic-phonological
    - Motor speech
    - Other
  - Look at the “big picture” for this child
    - What other issues require attention/intervention?
    - What are the priorities?
      - e.g., communicative intent may need to precede work on speech sound production
    - What are important motivators for this child?

**Intervention**

Use best available evidence to answer:
- Why did I choose this treatment approach?
- Why did I choose these goals?

Approaches with Research Evidence (Murray, McCabe & Ballard, in press; Maas,Gildersleeve-Neumann, Jakielski & Stoeckel, submitted)
- Dynamic Temporal and Tactile Cuing (DTTC) /Integral Stimulation
- Rapid Syllable Transition (ReST)
- Biofeedback
- PROMPT
- Nuffield Dyspraxia Programme (NDP3)

Research to Practice
- Strongest evidence for DTTC/Integral Stimulation
  - Small scale studies
    - (Edeal & Gildersleeve-Neumann, 2011; Maas, Butalla & Farinella, 2012; Maas & Farinella, 2011; Maas, et al., 2008; Strand, Stoeckel, & Baas, 2006; Gildersleeve-Neumann, in press)
  - Randomized, Control Study of ReST and NDP3  (Murray, McCabe & Ballard, in press)
  - Biofeedback (Ultrasound) (Preston, Brick & Landi, 2013)
  - PROMPT (Grigos, Hayden & Eigen, 2010; Dale & Hayden, 2013)
• Nonspeech exercises
  • Babbling and early nonspeech oral behaviors are not related (e.g., Moore & Ruark, 1996)
    • Movements for eating and speaking are dissociated early in life
    • Speech is not a series of isolated movements (e.g., Nip, Green & Marx, 2010).

• Evidence-Based Systematic Review of NSOME: recommendations
  • McCauley, Strand, Lof, Schooling & Frymark, 2009
    1) Pursue treatments with established efficacy instead
    2) Look to basic research for evidence of a theoretical basis for the unproven treatment
    3) Use in clinically-based research

Research to Practice
• Encourage attention to face for visual cues
• Incorporate principles of motor learning
• Teach movement sequences vs isolated phonemes
• Use multisensory input (auditory, visual, tactile)
• Be conscious of frequency and intensity of practice
• Think about range of difficulty in stimuli -- challenge can facilitate motor learning
• Adjust the level of cueing carefully

Practice Notes for CAS Intervention:
• Communication is the priority
  ✓ For minimally verbal children, you may need to start with imitation, AAC, etc. (DeThorne, et al., 2009)
  ✓ The child needs to understand the task; intent to improve movement (Maas, et al., 2008)
  ✓ Promote early success – the child should be stimulable for targets (Maas, et al., 2008)
  ✓ Use of functional targets can increase motivation (Strand & Debertine, 2000)

✓ Minimally Verbal Children Review (DeThorne, et al., 2009)
  • Provide access to AAC
  • Minimize pressure to speak
  • Imitate the child
  • Use exaggerated intonation and slowed tempo
  • Augment auditory, visual, tactile and proprioceptive feedback
  • Avoid emphasis on nonspeech-like articulator movements: focus on function

✓ Understanding the Task
  • Emphasis is on movement versus sounds, however…
  • Communication involves cognitive and linguistic aspects as well as motor skill (Nip, Green & Marx, 2010)
    • Are we teaching strategies appropriate for developmental age and level of motor skill?
✓ Stimulability
  • The child should be able to produce the target with some level of cuing
    • Success can lead to increased motivation/effort
    • If the child is not stimulable, the result may be frustration and distrust

✓ Functional Targets
  • Think about the needs of the “whole child”
    • Build vocabulary and language as well as speech accuracy
    • Give the child ways to interact with others and with their environment

A Treatment Framework: Dynamic Temporal and Tactile Cuing (DTTC)
  • Adapted from Rosenbek, et al., 1973 by Strand (2004)
  • This technique
    • allows high levels of success
    • emphasizes extensive practice
    • uses meaningful, useful utterances for motivation and functional communication
    • maximizes proprioceptive input
    • can easily incorporate aspects of both “top down” and “bottom up” approaches
  • Allows opportunity for the child to take increasing responsibility for assembling, retrieving and executing motor plans with progressively less cueing
    • Easily accommodates principles of motor learning
Dynamic Temporal and Tactile Cueing :DTTC
(Adapted from Caruso & Strand, 2000)

- The child may be working on different stimuli at different levels of the cueing hierarchy
- The level of cueing is constantly changing within and between sessions, depending on the child’s responses
- Don’t forget to allow the child adequate processing time for their responses
  Treatment is continuously adjusted to adapt to changes in the child’s speech motor skill

Treatment Planning
- Decisions need to be made about
  - Conditions of practice
  - Number and length of sessions
  - Targets: number, type, length, complexity
  - Structure of Practice: How to organize practice of each target
  - When and how to change the treatment plan

Conditions of Practice
- Need focused attention, even if brief
- Develop the habit of child looking at clinician’s face
- Emphasize improving movement rather than sounds
- Challenge, but don’t frustrate
- Use activities that generate many opportunities for repetition
- We want good quality practice; shaping to accuracy

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Sessions

• “There is emerging research support for the need to provide **three to five individual sessions per week** for children with apraxia as compared to the traditional, less intensive, one to two sessions per week (Hall et al., 1993; Skinder-Meredith, 2001; Strand & Skinder, 1999).”

• Number of sessions per week should be adjusted based on
  - Severity of the CAS
  - Child’s ability to participate
  - Family/Educational support
  - Other interventions

• A child may benefit from some small group work to facilitate development of pragmatic skills

• Length of sessions may depend on
  - Child’s developmental ability to attend/participate
  - Tasks to accomplish (e.g., time to counsel/educate parent, demonstrate techniques, etc. in addition to intervention with child)
    - Allow time for a high number of repetitions per session (Edeal & Gildersleeve-Neumann, 2011)
  - Clinician preference and therapy style

Targets

• Target choices should include consideration of how to:
  - promote early success in therapy
  - promote generalization of learning
  - “use what the child gives you” in terms of phonetic repertoire and syllable shapes
  - improve movement gestures for accurate production of specific vowels and/or consonants
  - encourage good prosody
  - increase effectiveness of verbal communication

• Number of targets will depend on severity of child’s speech disorder
  - Increase number (and complexity) as skills improve
    - Use what the child has in their inventory and consider:
      - Single syllables vs syllable sequences
      - Types of syllables/sequences
        - phonetic complexity
          - be aware of, but not bound by, a general sequence of sound development (e.g., early, middle, late)
        - try varied syllable shapes (CV, VC, CVC, etc.)

• Functional Targets for Speech Needs

<table>
<thead>
<tr>
<th>Increase sound repertoire</th>
<th>Try new sounds in existing syllable shapes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase syllable repertoire</td>
<td>Use existing sounds in new syllable shapes</td>
</tr>
<tr>
<td>Improve prosody</td>
<td>Phrases as sequences</td>
</tr>
<tr>
<td></td>
<td>Accurate lexical stress</td>
</tr>
<tr>
<td></td>
<td>Accurate phrasal stress</td>
</tr>
</tbody>
</table>
• Remember to work on Vowels

• Functional Targets for Language Needs

- Vocabulary
  - Nouns
  - Verbs
  - Conceptual vocabulary

- Grammar/Syntax
  - Length of utterances
  - Complexity of utterances

- Social Interaction
  - Greeting
  - Requesting/directing
  - Commenting

• Functional targets based on movement patterns vs sound patterns

Treatment: Phonologic vs Motor

• Phonologic
  - Emphasizes the sound patterns of language
  - Emphasizes how changes in sound pattern affect meaning
  - Targets are single sounds or sound patterns
  - Coarticulation is not considered critical

• Motor
  - Emphasizes principles of motor learning; movement vs sounds
  - Emphasizes proprioception and how variations in movement affect output
  - Targets are movement sequences (syllable level or higher)
  - Coarticulation is critical

Structure of Practice: Principles of Motor Learning (Maas, et al., 2008)

• Choices need to be made about:
  - Organization of sessions
  - How many targets to include in treatment, depending on
    - severity and type of motor speech disorder
    - immediate goal (acquisition vs stabilization/transfer)

• Practice Distribution -- Mass vs Distributed
  - Mass practice = minimal time between trials or sessions
    - Facilitates acquisition
  - Distributed practice = a greater amount of time between trials or sessions.
    - Important for stabilization and generalization
    - Within a session, mass practice can mean a large number of repetitions of a single target. Distributed practice is fewer repetitions spread throughout the session
• Practice Variability
  • Constant practice = working on one specific exemplar of the target,
    • Helpful early in therapy when problem is more severe
    • May facilitate learning relative aspects of movement
  • Variable practice incorporates variations of the target, such as modifying rate, loudness, inflection, etc. or varying context (single word vs phrase, etc.)
    • Helpful to transfer skills later in the therapy process
    • May facilitate learning of absolute aspects of movement
  • Have the child practice movement sequences in different contexts and across conditions to facilitate motor learning
    • Vary rate, prosody, loudness etc.
    • Practice in various physical positions (standing, sitting, moving, etc.)
  • Have a particular movement sequence (e.g. lip closure to a vowel) represented in several stimuli, but with different coarticulatory contexts
    • E.g., me, my, boo, baby, etc.

• Practice Scheduling
  • Blocked practice means all practice trials of a given stimulus are practiced together before moving on to the next.
  • Facilitates improved performance
  • Random practice means that the order of presentation of the stimuli are randomly mixed up throughout the session.
  • Facilitates retention/motor learning

• Feedback
  • Knowledge of results: provided after completion of the movement that compares outcome to target
    • (e.g., That was what I want to hear! Those were all right!)
  • Knowledge of performance relates to the nature or quality of the movement gesture
    • (e.g., Close your lips tighter. Close your mouth just a little more)
  • Frequency and timing of feedback is different for children and adults (Sullivan, Kantak, & Burtner, 2008)

Summary Chart:

<table>
<thead>
<tr>
<th>Principle</th>
<th>Acquisition</th>
<th>Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice Distribution</td>
<td>Mass</td>
<td>Distributed</td>
</tr>
<tr>
<td>Practice Variability</td>
<td>Consistent context, consistent prosody, pitch, rate</td>
<td>Varied context, varied prosody, pitch, rate</td>
</tr>
<tr>
<td>Practice Schedule</td>
<td>Blocked, predictable order</td>
<td>Random unpredictable order</td>
</tr>
<tr>
<td>Feedback Type</td>
<td>Knowledge of performance</td>
<td>Knowledge of results</td>
</tr>
<tr>
<td>Feedback Frequency</td>
<td>Often, immediate</td>
<td>Inconsistent, delayed</td>
</tr>
<tr>
<td>Rate</td>
<td>Slow</td>
<td>Normal, varied</td>
</tr>
</tbody>
</table>
Adapting Treatment

- CAS treatment that addresses phonological errors
  - Motor principles and core vocabulary are emphasized, while stimuli may be chosen to include specific phonological targets (FCD, stopping, fronting, etc.)
  - ex. I see you, I want some, sit down, yes, my house = stimuli that purposefully include /s/
- Phonological treatment that addresses motor planning/programming
  - Linguistic approach (e.g., minimal pairs) incorporating principles such as slowed rate, multiple repetitions, mass/distributed practice, etc.
  - ex., a game board is developed with minimal pairs, and every time the child lands on a spot, they say the target word 10 times and point out (or say) the minimal pair contrast word that is also on the board.

- CAS + Phono + Language
  - Determine which one is the primary contributor to the child’s communication problem
  - Choose stimuli accordingly, to:
    - improve sequencing of sounds and syllables, and/or
    - extinguish phonological process errors, and/or
    - address language skills such as increasing MLU, correcting grammar & syntax, etc.
  - Incorporate principles of motor learning as appropriate

Associated Issues

Early Literacy: Research to Practice
- 20% of preschoolers with speech disorders required special services by the time they reached school age (Bishop & Edmundson, 1987; Shriberg & Kwiatkowski, 1988)
- Preschool children with moderate SSD performed worse on measures of PA, speech perception and speech production than language-matched peers (Anthony, et al., 2011)

Literacy: Research to Practice
- Many emergent literacy skills can be easily integrated into therapy activities
  #1 tip: Use books as part of therapy!
  - Orientation of pages
  - Cloze activities while child helps to “read”
  - Point out or match words/letters
  - Begin to work on awareness of rhyme, production of rhyme
- Story re-tell for generalization practice
- Picture cards with written words
  - Point out sound-letter correspondence for targets
- Have written homework; encourage child to take a share of responsibility for knowing what to do
  - Have child sign their name on homework

AAC: Research to Practice
- Myth: If a child is allowed to use AAC, they will choose to use that mode instead of talking (Schlosser & Wendt, 2008; Romski, et al., 2010)

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Alternative Treatments:  Research to Practice  

Know our SLP scope of practice 
- Fish oil, supplements, diet 
- Hippotherapy 
- Listening therapy 
- Etc. 

ASHA Brochure

Caregiver Issues:  Research to Practice (Miron, 2013)
- Across several studies, findings suggest that negative stress is highly related to external factors, e.g.:
  - Misdiagnosis
  - Lack of access to appropriate services
  - Lack of insurance coverage
  - Professionals lacking in knowledge of the disorder
- Having a child with a disability was not the primary stressor (Miron, 2013)

Caregiver Issues:  Research to Practice
- Solicit input to learn:
  - What child may want to talk about
  - What terms are used in the family for nicknames, for requesting, refusing, etc.
  - About the child’s temperament
  - Their goals as caregivers
- Give caregivers specific recommendations
  - How to cue effectively
  - How to balance practice with unstructured time
  - How to embed practice in “teachable” moments throughout daily activities

See Appendix E for sample “homework”

Data Collection

How do we know our treatment is working?
- Data collection is important
- You should expect to see some changes within a few sessions
- Rate of change may be slow at first
- Be conscious of criteria – it matters!
- Is the child’s functional ability to communicate improving?

Think about using cumulative criteria  (Deal et al., 1978)

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<thead>
<tr>
<th>0</th>
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<th>30</th>
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<tr>
<td>80% over 3 sessions</td>
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<table>
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<tbody>
<tr>
<td>37% over 1000 trials</td>
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</table>
3-point scoring
• Used in Strand, Stoeckel & Baas, 2006 and Baas, et al., 2008
  2 = correct production
  1 = mostly correct, with error in place, manner or voicing of 1 consonant sound in the syllable or phrase
  0 = vowel distortion and/or more than one error of consonant production

See Appendix D

Probe Testing
• Choose an interval (e.g., every 4th session)
• Elicit the targets the same way each session with no feedback (5-10 random imitations)
• Score each utterance
• Record scores over time
• For more powerful evidence, probe a list of similar, untrained items as well

Sample Goal
(Child) will improve motor planning/programming skills for speech production by increasing accuracy of production of a functional core vocabulary. Criteria: cumulative accuracy of 80% for each item.
  a. Accuracy in CV, VC, CVC syllable shapes: (EXAMPLES: me, no, more, mine, hi, up, on, etc)
  b. Syllable sequences (EXAMPLES: no more, go home, time to go, my turn, hi mom, etc.)

• Goal is written to expand both sound and syllable repertoire, with flexibility in the targets used.
• As the child meets criteria for one item from the stimulus set, it moves to “everyday use”; a new one is inserted from a list generated with the help of parents and/or teachers.
• Progress is reported in terms of accuracy for each individual item on the list and as number of stimulus items achieving criterion.

Progress Review Example
(Child) has met criterion for “me”, “no”, “up”, “go”, “my turn”, and “hi mom.”
Current targets:
  70% cumulative accuracy for “go home”
  60% cumulative accuracy for “sit”, “mine”
  40% cumulative accuracy for “computer”, “Thomas”
Treatment Review and Decision-Making

- There is no single management procedure or program that is most appropriate for CAS
  - But evidence base is beginning to grow
  - We can make use of best available evidence as rationale for incorporating some of these techniques:
    - Teach movement sequences vs isolated phonemes
    - Use multisensory input (auditory, visual, tactile)
    - Incorporate principles of motor learning
    - Be intentional in manipulating frequency and intensity of practice
    - Think about range of difficulty in targets (remember that challenge can facilitate motor learning)
    - Adjust the level of cueing carefully
    - Make thoughtful use of commercial materials
    - Include caregivers as much as possible

REFERENCES

Speech- and Literacy-Related websites


Net Connections in Communication Disorders  http://mnsu.edu/comdis/kuster2/welcome.html

Caroline Bowen’s Phonological Therapy website http://members.tripod.com/Caroline_Bowen/home.html

Phonological therapy listserv  http://healthgroups.yahoo.com/group/phonologicaltherapy

University of Iowa Phonetics Animations  http://www.uiowa.edu/~acadtech/phonetics/

ASHA – Questions for Consumers to Ask About Treatment  http://www.asha.org/public/speech/consumerqa.htm

Get Ready to Read: getreadytoread.org

Laura Justice’s literacy curriculum: Myreaditagain.com

Reading Rockets: readingrockets.org

National Reading Panel:  http://www.nationalreadingpanel.org/

Center for Early Literacy Learning (CELL):  http://earlyliteracylearning.org/
Text references


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MSHA April, 2014
Evidence. JSLHR, 56, 505-520.

## APPENDIX A

**Production/Error Analysis**

<table>
<thead>
<tr>
<th>Target</th>
<th>Independent (spontaneous)</th>
<th>Relational (elicited)</th>
<th>Omissions</th>
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<tr>
<td></td>
<td>initial</td>
<td>medial</td>
<td>final</td>
</tr>
<tr>
<td>/h/</td>
<td></td>
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<td></td>
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<td>/w/</td>
<td></td>
<td></td>
<td></td>
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<td>/j/</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>/p/</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>/b/</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>/n/</td>
<td></td>
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<td></td>
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<td>/l/</td>
<td></td>
<td></td>
<td></td>
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<td>/d/</td>
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<tr>
<td>/n/</td>
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<td></td>
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<tr>
<td>/ŋ/</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/k/</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>/ɡ/</td>
<td></td>
<td></td>
<td></td>
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<td>/ɾ/</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>/l/</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>/ʃ/</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>/tʃ/</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>/r/</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/l/</td>
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<td></td>
</tr>
</tbody>
</table>

**Vowels in inventory:** /i e æ a u o oʊ aʊ əʊ aɪ aʊ ɔɪ/  

**Syllable shapes:**

**Other errors (e.g., sequencing, assimilation, epenthesis, syllable deletion)**
### Appendix B

<table>
<thead>
<tr>
<th>Verbal Apraxia</th>
<th>Dysarthria</th>
<th>Severe Phonological Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>No weakness, incoordination or paralysis of speech</td>
<td>Decreased strength and coordination of speech musculature that leads to</td>
<td>No weakness, incoordination or paralysis of speech musculature</td>
</tr>
<tr>
<td>musculature</td>
<td>imprecise speech production, slurring and distortions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Difficulty with involuntary motor control for chewing, swallowing, etc.</td>
<td>No difficulty with involuntary motor control for chewing and</td>
</tr>
<tr>
<td></td>
<td>unless there is also an oral apraxia</td>
<td>swallowing</td>
</tr>
<tr>
<td>Inconsistencies in articulation performance—the</td>
<td>Articulation may be noticeably &quot;different&quot; due to imprecision, but</td>
<td>Consistent errors that can usually be grouped into categories</td>
</tr>
<tr>
<td>same word may be produced several different ways</td>
<td>errors generally consistent</td>
<td>(fronting, stopping, etc.)</td>
</tr>
<tr>
<td>Errors include substitutions, omissions, additions</td>
<td>Errors are generally distortions</td>
<td>Errors may include substitutions, omissions, distortions, etc.</td>
</tr>
<tr>
<td>and repetitions, frequently includes simplification</td>
<td></td>
<td>Omissions in final position more likely than initial position.</td>
</tr>
<tr>
<td>of word forms. Tendency for omissions in initial</td>
<td></td>
<td>Vowel distortions not as common.</td>
</tr>
<tr>
<td>position. Tendency to centralize vowels to a &quot;schwaa&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of errors increases as length of word/phrase</td>
<td>May be less precise in connected speech than in single words</td>
<td>Errors are generally consistent as length of words/phrases</td>
</tr>
<tr>
<td>Well rehearsed, “automatic” speech is easiest to</td>
<td>No difference in how easily speech is produced based on situation</td>
<td>increases</td>
</tr>
<tr>
<td>produce, “on demand” speech most difficult</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receptive language skills are usually significantly</td>
<td>Typically no significant discrepancy between receptive and expressive</td>
<td>Sometimes differences between receptive and expressive language</td>
</tr>
<tr>
<td>better than expressive skills</td>
<td>language skills</td>
<td>skills</td>
</tr>
<tr>
<td>Rate, rhythm and stress of speech are disrupted,</td>
<td>Rate, rhythm and stress are disrupted in ways specifically related to the</td>
<td>Typically no disruption of rate, rhythm or stress</td>
</tr>
<tr>
<td>some groping for placement may be noted</td>
<td>type of dysarthria (spastic, flaccid, etc.)</td>
<td></td>
</tr>
<tr>
<td>Generally good control of pitch and loudness, may</td>
<td>Monotone voice, difficulty controlling pitch and loudness</td>
<td>Good control of pitch and loudness, not limited in inflectional</td>
</tr>
<tr>
<td>have limited inflectional range for speaking</td>
<td></td>
<td>range for speaking</td>
</tr>
<tr>
<td>Age-appropriate voice quality</td>
<td>Voice quality may be hoarse, harsh, hypernasal, etc. depending on type of</td>
<td>Age-appropriate voice quality</td>
</tr>
<tr>
<td></td>
<td>dysarthria</td>
<td></td>
</tr>
</tbody>
</table>

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MSHA April, 2014
Appendix C - Motor Speech Exam
(Adapted from E. A. Strand [1996].)

Purpose: To examine the child’s ability to sequence phonetic segments in various contexts and to examine response to variations presentation that may facilitate production.

These observations will help to determine (1) the degree to which motor planning deficits may be contributing to the child’s difficulty with speech acquisition; (2) the severity of the problem; and (3) will help with determining phonetic content and size of the stimulus set.

Procedure:
- Ask the child to repeat utterances that get progressively longer and more phonetically complex
- Start just below the point at which you think the child will begin to have difficulty
- Follow a hierarchy:
  - isolated vowels (V) for children who have many vowel errors or only undifferentiated vowels
  - CV, VC, CVC syllables with varied vowels
  - monosyllable repetitions
  - multisyllable repetitions
  - repetitions of sentences of increasing length
- Vary the temporal relationship between the stimulus and the response
  - simultaneous
  - immediate repetition
  - delayed repetition
  - delayed consecutive repetition
- Vary the rate, as needed
  - slowed
  - conversational

Score according to response (I = direct imitation, S = simultaneous, T = Tactile Cue, G = Gestural cue)

1) Isolated Vowels:

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2) CV and VC syllables:

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</table>

3) CVC syllables
   Same first and last phoneme:

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<thead>
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4) Different first and last phoneme:

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</table>

5) Varied syllable shapes:

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</thead>
<tbody>
<tr>
<td>VCV (owie)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CV₁CV₂ (mommy)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CVCC (want)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C₁V₁C₂V₂ (bunny)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V₁C₁V₂C₂ (open)</td>
<td></td>
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6) Multisyllable sequences:

<table>
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<th>Multisyllable sequences:</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>my mommy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hi daddy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>go home</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>banana</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>alligator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hippopotamus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tomorrow</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I want</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Me too</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My turn</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Come here</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no more</td>
<td></td>
<td></td>
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</tbody>
</table>
7) Phrases of increasing length:
   Hi
   Hi mom
   Hi mommy
   Hi mommy and daddy

8) Automatic speech tasks
   - Counting to 10
   - Saying the alphabet

9) Observations in connected speech:

<table>
<thead>
<tr>
<th></th>
<th>Vowels</th>
<th>Consonants</th>
<th>Max syllable length/word</th>
<th>Syllable shapes noted</th>
<th>MLU</th>
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</thead>
<tbody>
<tr>
<td>Conversation</td>
<td></td>
<td></td>
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<td></td>
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<td>Picture Description</td>
<td></td>
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<td></td>
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<tr>
<td>Narrative</td>
<td></td>
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</table>
Possible targets for motor speech exam

**CV, VC**

*“early 8”*
me mo (more) hi bye pee Pooh whee! You
no in/on/up boo! ow!

*“middle and late 8”*
to go off ouch at/it/out ick cow toe shoe
show see zoo ear

**CVC same first/last phoneme**

*“early 8”*
min wow pop none poop

*“middle and late 8”*
cake coke cook toot sis roar shush

**CVC different first/last phoneme**

*“early 8”*
mine home peek boom yum more mad bed
tite (nite-nite)

*“middle and late 8”*
good hot bang five fish take come some love
shop dig wet yes house bus

**Multisyllable sequences**
cookie mommy daddy no more all done I do
my turn I see sit down go up me too
I want/I want______ go home my house
Hi dad/hi daddy  hi mom/hi mommy  my turn  this one
I want one  you do it  go up/out/in/on  bubbles
more ______  Where is ____?  I see ______

Other items to consider, depending on child’s phonetic and syllable repertoire:
Elmo, Dora, Thomas, Spiderman, Superman, Iron Man, Spongebob, computer, etc. (favorite characters, toys, foods, pets, etc.)
Appendix D

Name: ______________________

Scoring: 2 = accurate production
1 = mostly accurate, with error of place, manner or voicing on one consonant
0 = vowel distortion and/or more than one error of consonant production

<table>
<thead>
<tr>
<th>Date</th>
<th>Syllable/phrase</th>
<th>Responses in Direct Imitation</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<th>Date</th>
<th>Syllable/phrase</th>
<th>Responses in Direct Imitation</th>
<th>Total Points</th>
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</tbody>
</table>
Name: X Ample

Scoring:
2 = accurate production
1 = mostly accurate, with error of place, manner or voicing on one consonant
0 = vowel distortion and/or more than one error of consonant production

<table>
<thead>
<tr>
<th>Date</th>
<th>Syllable/phrase</th>
<th>Responses in Direct Imitation</th>
<th>Total Points</th>
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<tbody>
<tr>
<td>11/1/11</td>
<td>Hi</td>
<td>0 0 0 1 0</td>
<td>1</td>
</tr>
<tr>
<td>11/1/11</td>
<td>Me</td>
<td>1 1 1 0 1</td>
<td>4</td>
</tr>
<tr>
<td>12/4/11</td>
<td>Out</td>
<td>0 0 0 0 0</td>
<td>0</td>
</tr>
<tr>
<td>12/4/11</td>
<td>All done (aw done)</td>
<td>0 0 0 0 0</td>
<td>0</td>
</tr>
<tr>
<td>12/7/11</td>
<td>Hi</td>
<td>1 1 2 1 1</td>
<td>6</td>
</tr>
<tr>
<td>12/7/11</td>
<td>Me</td>
<td>2 2 1 2 1</td>
<td>8</td>
</tr>
<tr>
<td>12/15/11</td>
<td>Out (vowel is tough!)</td>
<td>0 0 0 2 0</td>
<td>2</td>
</tr>
<tr>
<td>12/15/11</td>
<td>All done</td>
<td>2 1 1 2 2</td>
<td>8</td>
</tr>
<tr>
<td>1/4/12</td>
<td>Hi</td>
<td>2 2 2 1 2</td>
<td>9</td>
</tr>
<tr>
<td>1/4/12</td>
<td>Me</td>
<td>2 2 2 2 2</td>
<td>10</td>
</tr>
<tr>
<td>1/11/12</td>
<td>Out (vowel is tough!)</td>
<td>2 2 0 2 0</td>
<td>6</td>
</tr>
<tr>
<td>1/11/12</td>
<td>All done (final consonant)</td>
<td>2 2 1 1 2</td>
<td>8</td>
</tr>
</tbody>
</table>

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MSHA April, 2014
Appendix E: Sample “Homework”

(Child)    Date: ____________   (younger child/early in therapy)
Sing Old McDonald slowly, encouraging (child) to vocalize along with you and make signs for the animals. As you sing the chorus, go extra slowly to see if (child) will sing along and make the vowels e-i-e-i-o sound different. Don’t correct, just encourage singing along!

Play your own version of Simon Says, including other kids in the home when possible. Have them do simple motor movements (clapping, tapping head, jumping, turning around, touch knees, etc.) and every 4th or 5th time they do something, try a sound (ah, ee, oh, boo, etc.). Accept ANY sound as a “correct” response and keep the game moving. Give (child) a chance to be the leader, if s/he is interested.

Read a lift-the-flap book, and every time you come to a flap, say OH-pen as you pull up the flap. After a few pages or a few times through the book (depending on your child), Start to pull up the flap but stop and look at them expectantly to see if they will try to say or gesture to say “open.” If they don’t do it, just continue on and keep the activity fun and lighthearted.

(Child)    Date:__________________   (Child who is ready for home practice of some targets)
Expect good productions all the time (for items in this area, if C says the word incorrectly, cue for improved accuracy 1-2 times as needed. Let me know if he isn’t able to correct with that kind of minimal cueing.)

- On
- “aw done” for “all done”
- “paepuh” for “grampa”
- Me
- No
- Moe (more)

Vowel differentiation
Out -- getting it when we do it slowly
“I” (hi/bye) – best when saying it slowly and starting with a “big mouth”

Targets for this week/notes
- Up – hope to move this one up to the top next week.
- Open – We lost the /p/ today ☹ He tried a number of times, and knows when it is expected in the context of the routines, just couldn’t do it
- Sissy – no work today – continue to encourage that final “ee”
- Yes -- several close productions today
Appendix F – Therapy Ideas

- Hop/jump over cards or spots on the floor as you say each word
- Small sand/rice box, find small toys or cards buried
- Blanket and flashlight to go on a “cave hunt” to find pictures of targets
- Use repetitive story books, make up an model that works for the story and includes the child’s target word or phrase
- Drop toys in a bucket
- Link “baby links” together as each word is said or to represent a multisyllable sequence
- Use colored counting bears to designate number of repetitions
- Use magnet chips/magnet
- Toss beanbags at pictures or as reinforcement for saying targets
- Have action figures/toys use targets in “dialogue”
- Look for games with many pieces (pop-up pirates, “feed the animals” box from Super Duper, Mr. Potato Head, Tumblin’ Monkeys, Poppa’s Pizza Pile, Acrobats, etc.)
- Shoot a disk short or nerf rocket
- Toss a soft ball (“to me”, “my turn”, etc.)
- Send matchbox cars down a tube from table to a box on the floor
- See the articles “How to Help Your Child with Speech Practice at Home” and “Some Ways to Elicit Multiple Repetitions from Children with Apraxia” in the Apraxia-Kids virtual library at www.apraxia-kids.org
Appendix G– Case Study: Child with severe apraxia

Evaluation 9/08
- Typical development other than talking, no ear infections
- No obvious difficulty with respiration, phonation, resonance
- No problems with range of motion, strength, speed of articulator movement (based on observation). Able to vary muscular tension based on /m,p,t,d/
- Language: REEL-3 Receptive score 95 (AE 27 mo), Expressive score <55 (AE 6 mo) at CA 29 mo. Stringing together 2-5 signs consistently. Very frustrated about inability to communicate effectively. Age-expected play skills.
- Phonetic inventory: /p,m,t,d/, ch, “ee”, “ah”, all in isolation. No CV, VC, or CVC in spontaneous output or imitation of a model. (Has acquired most of these sounds in individual therapy over the last 3 months. Dismissed by the treating SLP due to concern that he had poor attention and profound apraxia, impression that he may not have potential to be verbal)
- Unable to fully complete motor speech exam due to limited sound repertoire, poor cooperation for task. Did produce “oh” with assistance, willing to attempt “ma” multiple times with maximal cueing

Diagnosis: Probable apraxia

Treatment initiated X1/week for 3 months, with significant parent involvement and home practice

Diagnosis confirmed following this period of diagnostic therapy. Child was able to participate in motor speech exam. Treatment increased to X3/week from December, 2008 through the present. (One month break in Jan-Feb, 2009 due to parent inability to transport).

- September, 2008
  - Initial stimulus set: hi, yes, up, more, Dad, me, down

- December, 2008: (3 months)
  - Achieved: hi, yes, up, “moe” (more), me (began to use in home practice)
  - Added: ball, all done, mine, bye

- January, 2009: (4 months)
  - Achieved: hi, yes, up, moe, me, baw (ball), all done, mine, bye
  - Added: hi mom/dad, apple, open, whee!

- February, 2009:
  - Achieved: hi, yes, up, moe, me, baw, all done, mine, bye, hi mom/dad, bye mom/dad, whee!
  - Beginning to consistently use approximations for 1-2 syllable words and phrases spontaneously.
  - Added: more please, open please, in/on ___ (prompted to attempt imitation of names of containers), out (“ow” a difficult diphthong for him), “I” (also a difficult diphthong for him beyond his already-acquired words of hi, bye, mine), night-night, time to go
  - Continued: down, open
- March, 2009: (6 months)
  - Achieved: hi, yes, up, moe, baw, all done, mine, bye, hi mom/dad, bye mom/dad, whee!, open please, in/on ____ (with accurate production of “can”, “bag” and “box” in imitation), night-night
  - Continued: out, I, time to go, down.
  - Added: I want ____ (prompted for approximations).
  - Becoming highly verbal, using a combination of words, gestures and signs. Has added a number of words to inventory spontaneously, including wash, mommy, work, dog, duck, house, potty

- April, 2009, third birthday (7 months) starting to have some phonological emphasis, thinking about /k/ and vowels.
  - Continued: I want ____ (including longer utterances, such as “I want a guy”, “I want to play”, “I want to go”, “I want a marker”).
  - Added: /k/ words cookie and Keekoe (pet name), /e/ vowel in target words play, wait, take ______. Readily stringing together 3-4 word utterances with a model and/or sign language cues, intelligibility noticeably increased.

- May, 2009:
  - Emphasis on “ow” vowel in targets such as take out, go out, go down, mouse, my house.
  - Continuing work to expand length of utterance while maintaining intelligibility and including “small” words (e.g., “to”, “a”, “the”).
  - Working on 10-20 phrase level targets per session while reading books, playing and/or drill practice (I want a____, Time to go_____, Put it in_____, Where is _____?).

- June, 2009: (9 months after starting therapy)
  - Added: Cueing for final /n/, which he tends to omit, in targets including Ben (brother), open, mine, down, gone, done, fine, brown.
  - Continued: work on “ow” and “I” in multiple targets. Also continuing work on phrase-level targets as above.
  - Attempted Goldman-Fristoe for the first time, after realizing that he has a greatly expanded sound and syllable repertoire. Maintained appropriate number of syllables, marked most consonants. Many sound substitutions, simplification of consonant clusters and blends, vowel distortions. However, most attempts were recognizable approximations of target.

Ongoing after June, 2009 – Goals include improving accuracy of current targets, increasing MLU while maintaining intelligibility, addressing error patterns identified on Goldman-Fristoe and in spontaneous speech sample.
Appendix H -- Organizing Stimulus Presentation

What type of stimulus presentation is represented in each column? (Mass/ Distributed, Variable/Constant, Blocked/Random)

<table>
<thead>
<tr>
<th>I want one 10X</th>
<th>I want one 1X</th>
</tr>
</thead>
<tbody>
<tr>
<td>My turn 10X</td>
<td>puppy 1X</td>
</tr>
<tr>
<td>Thomas 20X</td>
<td>go home 1X</td>
</tr>
<tr>
<td>Puppy 10X</td>
<td>hi mom 1X</td>
</tr>
<tr>
<td>Go home 10X</td>
<td>Thomas 1X</td>
</tr>
<tr>
<td>I want one 10X</td>
<td>puppy 1X</td>
</tr>
<tr>
<td>My turn 10X</td>
<td>I want one 1X</td>
</tr>
<tr>
<td>Thomas 10X</td>
<td>Thomas 1X</td>
</tr>
<tr>
<td>Puppy 10X</td>
<td>go home 1X</td>
</tr>
<tr>
<td>Go home 10X</td>
<td>my turn 1X</td>
</tr>
<tr>
<td>I want one 10X</td>
<td>hi mom 1X</td>
</tr>
<tr>
<td>My turn 10X</td>
<td>repeat until each item practiced “X” times</td>
</tr>
<tr>
<td>Etc.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I want one X40</th>
</tr>
</thead>
<tbody>
<tr>
<td>My turn X 1</td>
</tr>
<tr>
<td>Thomas X50</td>
</tr>
<tr>
<td>My turn X1</td>
</tr>
<tr>
<td>Puppy X40</td>
</tr>
<tr>
<td>My turn X1</td>
</tr>
<tr>
<td>Hi mom X20</td>
</tr>
<tr>
<td>Time to go X5</td>
</tr>
</tbody>
</table>