The Effectiveness of Conversational Script Training for Acquired Apraxia of Speech

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Kalamazoo 2012

Today's Session

- Treatment Approaches
- Motor Learning - Principles and Theories
- Question & Answer
- Client Background
- Script Training
- Video Clips
- Question & Answer

Definition of Apraxia - (Duffy 2005)

- A neurologic speech disorder reflecting an impaired capacity to plan or program sensorimotor commands necessary for directing movements that result in phonetically and prosodically normal speech. It can occur in the absence of physiologic disturbances associated with the dysarthrias and in the absence of disturbance in any component of language.

AOS Treatment Guidelines from Academy of Neurologic Communication Disorders & Sciences

Treatment Guidelines for Acquired AOS - ANCDS

- Academy of Neurologic Disorders & Sciences (ANCDS) developed documents describing AOS practice guidelines
- Available on website: www.ancds.org
- Document published in 2006
- Comprehensive & extensive literature review of available evidence for treatment of acquired AOS
- Guidelines are based on reviews and assessments of scientific levels of evidence

Acquired AOS Treatment Approaches

- The following ***general*** categories of AOS treatment were found:
  - Articulatory kinematic
  - Rate and/or rhythm
  - Alternative/Augmentative communication (AAC)
  - Intersystemic facilitation/reorganization, and
  - Other (described later in presentation)

Levels of Evidence

Level of Evidence	Grading Criteria	Grade of Recommendation
1a	Systematic review of RCTs including meta-analysis	A
1b	Individual RCT with narrow confidence interval	A
1c	All and none studies	B
2a	Systematic review of cohort studies	B
2b	Individual cohort study and low quality RCT	B
2c	Outcome research study	C
3a	Systematic review of case-control studies	C
3b	Individual case-control study	C
4	Case-series, poor quality cohort and case-control studies	C
5	Expert opinion	D

Articulatory-Kinematic Treatment

Articulatory Kinematic Treatments

- Rationale:
  - Half of investigations by ANCDS were considered to be this type of treatment category
  - Based on assumptions consistent with Rosenbek, Lemme, Ahern, Harris, & Wertz's (1973) definition of AOS
  - "Nonlinguistic sensorimotor disorder of articulation…Therefore, therapy should concentrate on the disordered articulation….(and) emphasize the regaining of adequate points of articulation and the sequencing or articulatory gestures"
  - Techniques of AK treatment focuses on improving spatial & temporal components of speech production

Articulatory Kinematic Techniques

- Consists of motoric practice of speech targets
- Verbal production is required
- Most techniques also rely on modeling/repetition tasks
- Variation of modeling – 'integral stimulation'
  - Better known as "watch me, listen to me, say it with me"
- Articulation placement cues also component of AK treatment; typically provided for error sounds
- Prompts for restructuring oral and muscular phonetic targets (PROMPT) example of AK treatment

AK Treatment Targets

- Most of participants in guidelines study presented Relatively wide range of stimuli utilized; frequently short sentences or phrases
  - Limited number of functional target utterances
  - Consisted of personal productions, e.g., “My name is _____”; “I want to eat”
- Single, real words also utilized
- Selection of target sounds varied; all perceived problematic for AOS speaker
- Isolated nonwords/syllables chosen as treatment targets

Outcomes of AK Treatment

- In most AK investigations, probes of targeted stimuli used to evaluate effectiveness
- Outcomes usually reported as positive
- Data suggests that training sufficient number of exemplars (e.g., 8-10 phonetic targets) likely to result in progression to untrained exemplars of specific sound
- Production of untrained sounds not likely to occur; treatment effects ‘sound specific’
- Treatments targeting words, phrases, sentences generally resulted in item specific improvements

AK Treatment Candidacy

- All patients within AK literature were diagnosed with severe AOS
- Patient should wish to improve speech production
- Some research participants were mute or produced significantly limited verbal stereotypes
- Basic candidacy includes disrupted speech production
- Patients were noted to present with sufficient auditory comprehension for following instructions

Conclusions of AK Treatment Studies

- More than half of AK studies were ‘experimental’ in nature, e.g., single subject designs
- AK studies, as a whole, assigned Level B
- Considered “probably effective”
- AK treatments for AOS likely to produce speech production gains, even for chronic and/or severe AOS

Rate/Rhythm Treatment

Rate and/or Rhythm Treatments

- Rationale:
  - Underlying premise is that AOS is disruption in timing of speech production
  - Rhythm control treatments may facilitate re-establishment of temporal patterns
  - Hypothesized central pattern generators (CPGs) involved in speech production; may be dysfunctional in AOS
  - Rhythmic treatments may help ‘reset’ the CPGs
  - Further slowing AOS speech rate thought to provide additional motor planning/programming time and sensory feedback processing

Rate/Rhythm Techniques

- An external source of control was provided , e.g., metronome
- Rates of production varied across and within investigations
- Target productions were trained to the beat of a metronome
- Additional techniques such as verbal feedback, clinician modeling, computer display, and hand tapping noted
- Rate control research also included the use of a pacing board

Treatment Targets

- Types of productions systematically manipulated in terms of perceived increased complexity
  - For example, use of nonspeech movements (tongue elevation) to rhythm/beat of metronome documented
  - Progressed to AMR practice, then multisyllabics, and sentence production
  - Other targets have included reiterative nonsense syllables, isolated vowels, and vowel combinations

Outcomes in Rate/Rhythm Control

- Improvements in speech production reported even when no direct sound training occurred
- Positive changes occurred for trained words as well as for untrained words with same stress pattern
- Results mixed in regard to generalization to untrained words with different stress patterns

Conclusions for Rate/Rhythm Treatment

- Participants generally had less severe AOS
- Candidates demonstrated need to improve behaviors amenable to rate/rhythm practice
- Evidence suggested Level C rating
- Treatment is “possibly effective”
- Gains may be seen as improvement of articulation, increased fluency, reduced rate or decrease in overall AOS symptoms

Intersystemic Facilitation/Reorganization Treatment

Intersystemic Facilitation/Reorganization Treatments

- Rationale:
  - Involves utilization of relatively intact system/modality to facilitate functioning of impaired modality
  - Treatment effects probably derived from provision of afferent or efferent cues
  - Use of limb gestures in reorganization may provide additional organizational framework for speech production

Intersystemic Facilitation Techniques

- Gestural reorganization most frequently studied technique
  - Limb gesture approach
  - Meaningful gestures (e.g., Amer-Ind)
  - Nonmeaningful gestures (e.g., finger-counting)
- In all but one study, gestures were paired with verbalizations
- Singing has also been technique for AOS
- Using graphic stimuli considered to be form of intersystemic facilitation
- Treatment has targeted verbal production at word, phrase, and sentence levels.

Outcomes of IF/R Treatment

- In most investigations, IF/R appeared to improve verbal productions
- Improvements documented as improved accuracy of articulation and increase in test scores
- Improvements in articulation may be sound dependent; generalization to untrained sounds was variable
- Maintenance of gains measured in only 1 investigation; decrease in accuracy during treatment withdrawal phases noted
- Rated as Level C; “possibly effective”

AAC Treatment

Alternative/Augmentative Communication (AAC) Approaches

- Common motivation for using AAC was perceived need to improve communication through other modalities than speech
- AAC approaches largely individualized for each participant
- Comprehensive systems may include:
  - Incorporation of natural speech
  - Communication book
  - Spelling system
  - Drawing system
  - Gestural system
  - Communication partner training
  - Writing/orthographic systems

Outcomes for Use of AAC with AOS

- Positive outcomes reported for most of subjects using AAC
- Outcome measures varied and included increases in:
  - Formal speech/language test scores
  - MLU
  - Adequacy in conveying predetermined utterances
  - Communicative success
  - Acquisition of symbols
  - Self-initiation of writing strategy
- Outcomes can be negatively affected by potential AAC user not readily accepting the system

Candidacy Issues

- Majority of participants were considered to have ‘severe’ or ‘moderate-severe’ disorder
- Issues for candidacy in AAC use not restricted to individuals with AOS
- Individuals must be motivated to use AAC system
- Must have adequate motor skills to access AAC; presence of limb apraxia may be limiting factor
- Must also possess sufficient visual perceptual skills
- Impairments in comprehension, reading and writing must also be considered

Conclusions from AAC/AOS Research

- Overall, quality and levels of evidence inadequate to determine treatment effects
- AAC approaches may be appropriate for some individuals with AOS in these situations:
  - Extremely limited verbal output
  - Communication needs not likely to be met through speech production skills
- Insufficient data to determine success of AAC use
- Successful use of AAC may be heavily dependent on nature of individual's aphasia

Other Treatment from Research

Other Treatments

- Sentences alone and in pseudoconversations with significant other (SO)
- SO taught communication strategies to use with person with AOS
- Head movements paired with nonspeech & speech production
- Biofeedback for increased tension interfering with speech/language production
- Imitation versus silent rehearsal
- Limited studies above not of sufficient quality from which to draw adequate conclusions

Principles of Motor Learning in MSDs

Principles of Motor Learning in Treatment of Motor Speech Disorders

- Speech production is a motor skill
  - Motor learning literature may valuable information on facilitation of (re)learning/organization of speech motor system
  - Ultimately, may improve quality of life for persons with MSD
- Clinical decisions for treatment must include the following factors:
  - Practice structure
  - Stimulus selection
  - Nature of feedback

Maas et al (2008)

- Speech production, as a motor skill, is governed by similar principles of motor learning
- Consistent with EBP philosophy:
  - “Treatment of MSDs must be guided by the best available knowledge about motor skill learning, and that this knowledge base includes evidence from nonspeech motor learning research.”
- Unknown whether impaired motor systems are sensitive to same principles of learning as intact systems
- In absence of evidence to the contrary, principles of intact motor learning can provide framework for treatment efforts.

Learning vs Performance

- Important to consider distinction between performance during *acquisition* and *retention/transfer*
- Learning, which is a permanent change in capability for skilled movement, must be measured by retention and/or transfer tests
- Retention = performance levels after practice completion
- Transfer (generalization) = whether practice on one movement affects related but untrained movements

Schema Theory Information

Schema Theory

- Assumes motor programs are generalized (GMP)
- GMP is abstract movement pattern that specifies relative timing and relative force of muscle contractions, whereas the absolute timing and force are specified by *parameters*
- To select optimal instructions to the musculature and control the body in a wide range of situations, the motor system must know:
  - The relations among the initial conditions
  - The generated motor commands
  - The sensory consequences of these motor commands
  - The outcome of the movement

Schema Theory (cont)

- Schemas = memory representations that encode the relations among types of information based on past experience with producing similar actions involving the GMP
- These types of information temporarily available in short-term memory and used to update or create 2 different schemas:
  - Recall schema
  - Recognition schema

Recall Schema

- Encodes the relations among the initial conditions, the parameters used to execute the movement, and the outcome of the movement.
- In order to produce movement, system supplies recall schema with the movement goal (intended outcome) and information about current conditions
- From this, recall schema computes appropriate parameters

Recognition Schema

- Encodes the relations among initial conditions, sensory consequences of movement, and outcome of movement
- Given movement goal and initial conditions, recognition schema predicts sensory consequences that will occur if movement goal is reached
- Allows the system to evaluate movements by comparing actual sensory consequences with expected sensory consequences
- Mismatch between actual & expected consequences represents error signal used to update recall schema
- Before recognition schema can be used to judge accuracy of movement, system must first learn which sensory consequences are considered “correct”
- In some cases, the reference to “correct” depends on feedback from an instructor, e.g., clinician to client so that internal error signal may serve to correct errors in the future w/o external feedback

Schema Theory (cont)

- Schema Theory assumes series of GMPs occur in a particular serial order and become integrated or "chunked" into a single, larger GMP with large amounts of practice
- If any of these are unavailable following movement, no schema updating can occur:
  - Relations among the initial conditions
  - Generated motor commands
  - Sensory consequences of these motor commands
  - Outcome of the movement
- Schema Theory appears to provide framework for speech motor programming

Speech Motor Learning Principles

MSDs and Speech Motor Learning

- Schema Theory emphasizes motor programming and appears particularly applicable to MSDs
- AOS may involve deficit in activating and/or parameterizing GMPs due to any of the following:
  - Damage to GMP
  - Schema that supplies the parameter settings is impaired
  - Both of the above
- Disruptions in processing somatosensory feedback:
  - Information about initial conditions is unavailable or incorrect
- Damage to recognition schema may lead to poor error detection:
  - Augmented (clinician-provided) feedback about accuracy especially critical

Principles of Motor Learning

- Prepractice
- Structure of Practice
- Practice Distribution
- Practice Variability
- Practice Schedule
- Attentional Focus
- Movement Complexity
- Feedback Type
- Feedback Frequency
- Feedback Timing

Prepractice

- Largely independent of specific training program employed
- Intended to prepare learning for the practice session
- Important goals to ensure:
  - Proper motivation to learn
  - Adequate understanding of task (including “correct” responses)
  - Stimulability for expected responses (to avoid frustration due to complete inability to produce target)

Prepractice (cont)

- Motivation enhanced by understanding the relevance of practice tasks and treatment activities toward overall goal, e.g., improved speech
- Reduce risk of communication breakdown
- Select functionally relevant targets
- Include client in target-selection process
- Set specific goals vs asking client to “do your best”
- Task understanding important for learning
- Avoid lengthy or complex task instructions, especially with comprehension disorders

Structure of Practice

- Practice amount: refers to amount of time spent practicing movements
- Large number of practice trials provide more opportunities to establish relationships among various types of movement information
- Large practice trials thought to enhance stability of recall and recognition schemas
- Large practice trials requires many occurrences of motor program retrieval; may automatize the activation of GMPs
- This evidence available in research involving nonspeech motor skills

Practice Distribution

- Refers to how a given (fixed) amount of practice is distributed over time, regardless of 'blocked' or 'random' schedule
- Evidence suggests distributed practice (more time between practice trials or sessions) results in greater learning than massed practice (less time between trials/sessions)
- Distribution across several days is frequently encountered in clinical settings
- LSVT is example of "massed" practice
- Distributed practice facilitates both short-term performance and long-term learning in nonspeech domain

Practice Variability

- Constant practice refers to practice on only 1 variant (parameterization) of a movement (GMP)
- Variable practice targets more than 1 variant of a given movement
- Experiences with wide range of movement outcomes, initial states, and sensory consequences for a particular GMP should result in more reliable schema
- A more reliable schema should facilitate transfer to other movements of same general class, but not to movements that require different GMP.
- Variable practice appears to benefit learning of absolute aspects of movements (schema rules)
- Constant practice early in practice benefits learning of relative aspects of movements (GMPs)

Practice Schedule

- Random practice – practice schedule in which different movements (GMPs) are produced on successive trials and where target for upcoming trial is not predictable to learner
- Blocked practice – practice schedule in which learner practices a group of same target movements before beginning practice on next target
- Random practice may reduce occurrence of overgeneralization & facilitate maintenance
- Random practice resembles daily life situations, e.g., conversation
- Evidence that random practice enhances motor learning as documented in retention & transfer tests in nonspeech motor domain

Attentional Focus

- Internal focus: involves concentrating on aspects of movements, e.g., kinematic, somatosensory (articulatory placement cues)
- External focus: concentrating on external task-relevant aspects of movements to achieve a goal (CV production)
- Speakers with MSDs may benefit from using an external focus not only during practice but also in everyday communication
- External focus has strong learning advantage over internal focus in nonspeech motor domains
- External focus promotes movement automaticity and greater retention/transfer

Movement Complexity

- Motor skills typically involve multiple components (complex)
- Intuitively appealing to segment complex movement into component parts during practice
- Targeting complex behaviors promotes learning relative to targeting simple behaviors, although evidence of this in MSD research is just emerging
- Targeting nonspeech oral motor movements does not transfer to complex speech acts
- If person's goal is speech production, important to provide treatment trials in speech-like productions
- Effects of part vs whole practice depend on nature of speech task

Feedback Type

- Two types of augmented feedback:
  - Knowledge of results (KR)
  - Knowledge of performance (KP)
- KR – information about the movement outcome after completion of a movement
  - "You missed the target"
  - "Correct" vs "Incorrect" verbal feedback from clinician
  - Clinician decision to try sound again or move to different target
- KP – refers to nature or quality of movement pattern
  - "Your lips did not close for that sound"
  - Inherently provided at levels of cueing hierarchy more specific to performance error
- KR & KP appear to be equally effective in most cases
- KP feedback appears useful for novel tasks or if person cannot distinguish correct vs incorrect productions

Feedback Frequency

- Refers to how often augmented feedback is provided during practice
- Appears to interact with other factors such as, practice variability, task complexity, and attentional focus
- Effects of feedback frequency also depend on skill complexity
- Simple skills benefit from reduced frequency; more frequent feedback may be needed during complex skill learning
- Reduced feedback frequency appears to benefit GMP learning but not parameter learning
- External focus feedback provided frequently *may* benefit learning
- Clinicians typically provide high-frequency, immediate feedback
- Recent research supports reduced frequency in intact speakers and those with AOS

Feedback Timing

- Refers to when feedback is provided relative to task performance
- Typically given after completion of a movement but can be provided simultaneously
- Delaying feedback for a few seconds after end of movement can benefit learning:
  - Learners spontaneously evaluate their own performance based on intrinsic feedback
  - Instructing participants to estimate own errors after task completion shown to enhance learning
- Summary feedback – information about performance after several trials; both delayed & reduced frequency feedback

TABLE 1. Practice conditions.

Condition	Options	Description	Notes	Evidence in speech
Practice amount	Small vs. **large**	Small: low number of practice trials or sessions Large: high number of practice trials or sessions	Potential interaction with practice variability (high number of constant practice trials may be detrimental to learning)	No systematic evidence
Practice distribution	Massed vs. **distributed**	Massed: practice a given number of trials or sessions in small period of time Distributed: practice a given number of trials or sessions over longer period of time		No systematic evidence
Practice variability	Constant vs. **variable**	Constant: practice on the same target, in the same context (e.g., syllable-initial /f/) Variable: practice on different targets, in different contexts (e.g., syllable-initial and final /f/, /z/, /b/)	Potential interactions with practice schedule, amount, complexity, and feedback variables Opposite effects on GMP vs. parameter learning	Limited evidence for benefit of variable practice in unimpaired speech motor learning; no evidence from MSD
Practice schedule	Blocked vs. **random**	Blocked: different targets practiced in separate, successive blocks or treatment phases (e.g., treatment on /f/ before initiating treatment on /z/) Random: different targets practiced intermixed (e.g., practice on /f/ and /z/ in each session)	Potential interactions with practice amount and complexity Opposite effects on GMP vs. parameter learning	Limited evidence for benefit of random practice, in unimpaired speech motor learning and treatment for AOS
Attentional focus	Internal vs. **external**	Internal: focus on bodily movements (e.g., articulatory placement) External: focus on effects of movements (e.g., acoustic signal)	Focus must be task-related Difficult to define external for speech	No systematic evidence
Target complexity	Simple vs. **complex**	Simple: easy, earlier acquired sounds and sound sequences (e.g., plosives, CV-syllables) Complex: difficult, later acquired sounds and sound sequences (e.g., affricates, CCV syllables)	Potential interactions with practice schedule, feedback variables, and learner's skill level	Limited evidence for benefit of targeting complex items in treatment for AOS

Note. Options that may be expected to enhance learning are indicated in bold. GMP = generalized motor program; MSD = motor speech disorder; AOS = apraxia of speech.

TABLE 2. Feedback conditions.

Condition	Options	Description	Notes	Evidence in speech
Feedback type	KP vs. **KR**	KP: knowledge of performance, how a sound was produced (e.g., biofeedback) KR: knowledge of results, whether a sound was correct or incorrect	Potential interactions with learner's error detection abilities	No systematic evidence
Feedback frequency	High vs. **low/summary-KR**	High: feedback after every attempt at production (regardless of accuracy) Low: feedback only after some attempts at production (regardless of accuracy)	Potential interactions with practice variability, attentional focus, complexity, and learner's skill level and error detection abilities Opposite effects on GMP and parameter learning	Some evidence for benefit of reduced feedback frequency in treatment for AOS and speech motor learning in hypokinetic dysarthria
Feedback timing	Immediate vs. **delayed**	Immediate: feedback immediately following attempt at production Delayed: feedback provided with a delay (e.g., 5 s)	Potential interactions with attentional focus	Some evidence for delayed feedback in treatment for AOS and hypokinetic dysarthria

Note. Options that may be expected to enhance learning are indicated in bold.

Clinical Implications

- Distinction between performance during practice versus retention & transfer critical
- Performance during practice does not necessarily predict retention/transfer
- Clinicians should not be misled by changes observed during treatment
- Relative (GMP) and absolute (parameter) aspects of movement respond differently to practice & feedback variables
- In order to implement optimal conditions of practice & feedback, must determine whether selected targets involve GMPs (lexical stress patterns) or parameters (pitch level, speech rate, loudness)

Client Information for Current Study

Participant

- Mr. J – Caucasian, middle-age male; lives in rural area of Michigan
- Sustained cerebral vascular accident (CVA) in 2005
- Diagnosed with mild receptive/expressive aphasia; severe apraxia; right hemiplegia
- Mr. J received treatment through an outpatient facility until 2006 until insurance coverage was maximized
- Mr. J initiated speech-language services at the Carls Center for Clinical Care & Education/Speech-Hearing Clinic (CMU Speech-Hearing Clinic) at Central Michigan University in May 2009
- At time of initial evaluation at the CMU Speech-Hearing Clinic, Mr. J relied heavily on writing telegraphic messages with his left/nondominant hand, gestures & facial expressions
- Mr. J was able to communicate during initial assessment that he desired to verbally interact with others socially in daily interactions

Speech & Language Skills

- Spontaneous speech noted to be laborious with overt oral groping on verbal attempts to open-ended questions
- Used nonverbal modalities to communicate via facial expressions, head nods, and writing telegraphic responses
- Verbal responses consisted of “yeah,” “no,” and “wow”
- Receptively, understood questions & statements if modified for rate and complexity
- Able to communicate during initial assessment that he desired to verbally interact with others socially in daily interactions

Standardized Test Results - 2009

- Aphasia Diagnostic Profiles (ADP) Standard Scores:
  - Lexical Retrieval – 7 – Aphasic
  - Phrase Length – 5 – Nonfluent
  - Auditory Comprehension – 9 – Mixed Nonfluent
  - Aphasia Severity – 88
  - Alternative Communication – 101
  - Behavioral Profile – 110
- Scores were at least 1-2 SDs below the mean, with exception of auditory comprehension
- Many subtests greatly affected by language deficits
- Test of Nonverbal Intelligence – 3 (TONI-3) – raw score of 27/Deviant Quotient = 94 (Average)

Reading Comprehension Battery for Aphasia (RCBA)

- Word Visual 90%
- Word Auditory 100%
- Word Semantic 100%
- Functional Reading 60%
- Synonyms 90%
- Sentence-Picture 90%
- Paragraph-Picture 30%
- Paragraph-Factual 80%
- Paragraph-Inferential 80%
- Morpho-Syntax 30%

Apraxia Battery for Adults – 2 (ABA-2)

Subtest	Impairment
Diadochokinetic Rate	Severe
Increasing Word Length	Moderate
Limb Apraxia	Moderate
Oral Apraxia	Moderate
Utterance Time Polysyllabic Words	Severe
Repeated Trials	Severe

- No. of observable articulation characteristics of apraxia – 8/15
- Diagnosed with moderate-severe apraxia of speech (AOS)

Multimodal Communication Screening Task for Persons with Aphasia (MCST-A)

Subtest/Skill	Accuracy	Response Types	Cueing Provided
1-Symbol messages to request basic needs or answer biographical information	100%	Picture, Spell	Expansion
Combining 2-3 symbols	60%	Picture, Spell	Repetition, direct visual attention, confirmation
Categorizing	100%	Picture	None needed
Using environmentally-stored phrases in context	100%	Picture	Repetition
Storytelling using descriptive scene sequence	0%	Picture, Spell	Repetition, Expansion
Story retelling using descriptive scene sequence	0%	Picture, Spell	Repetition, Expansion
Telling about locations from a map	100%	Picture, Gesture, Spell	None needed
Spelling	100%	Spell	None needed

Quality of Communication Life Scale (QCLS) - 2009

- Tool used to determine impact of communication disorder on:
  - Relationships/interactions with communication partners
  - Participation in social, leisure, work & education activities
  - Overall quality of life (QOL)
- Designed as 5-point rating scale (5 is highest rating/improved perception of QOL)
- Mr. J's ratings averaged 4.4/5.0 – overall QOL perceived as 'good'
- High QOL ratings for self-acceptance, independence, confidence, humor, & hobbies
- Reduced QOL for telephone use and being included in others' conversations

Initial Treatment Outcomes Using AK Treatment Approach

Initial Treatment Approach

- Treatment focused on:
  - CV/VC word imitation
  - Verbally imitate names of daily living objects
  - Follow written contextualized one-step directions
  - Respond to functional questions and initiate question forms via an AAC device (owned device recommended from previous therapy setting)
- Cueing hierarchy for imitative verbalizations based on the *Integral Stimulation Method/Eight-Step Task Continuum* (Rosenbek et al, 1973)

Integral Stimulation Method

- Step 1 – “Watch me”; “Listen to me” – simultaneous production
- Step 2 – “Watch & listen”; client imitates after a delay; clinician ‘mimes’ utterance silently
- Step 3 – “I’ll say it first & you say it after me”; no simultaneous cues provided by clinician
- Step 4 – Clinician produces utterance once; client produces several times consecutively w/o cues
- Step 5 – Written stimuli with simultaneous production by client; client reads target utterance from card
- Step 6 – Written stimuli with delayed production by client; written stimuli removed before verbal production by client
- Step 7 – Appropriate utterance elicited by question; imitative model abandoned
- Step 8 – Target utterance produced in ‘role-play’ situation

Treatment Outcomes with AAC Approach

AAC Goals - 2009

- Use AAC device to ask 3 “wh”-questions on 3 occasions:
  - Used device appropriately in structured situation on 2 occasions
  - Clinician programmed questions into device for Mr.. J
  - Mr. J frequently used device as a ‘model’ and verbally imitated the words typed rather than as AAC
- Use AAC device to answer 3 “wh”-questions on 3 occasions:
  - Required very frequent assistance/cueing to access device correctly
- Use AAC to repair communication breakdown on 3 occasions:
  - Consistently used only the delete key to repair breakdown

Goals and Progress

Goals & Progress - Fall 2009

- Imitate CV words at 65% accuracy from baseline 56% accuracy:
  - Progressed to 92% accuracy immediate repetition; working toward verbal production of written target stimuli
- Imitate VC words at 65% accuracy from baseline 59% accuracy:
  - Progressed to 85% accuracy; working toward immediate & successive repetition of VC words
- Imitate name of daily living activity objects at 80% accuracy from 70% with verbal/visual cues:
  - Ranged from 69%-79% over the treatment period. Verbal/visual cues necessary for articulator placement. Errors noted consisted of voicing difficulties & vowel distortions
- Follow written contextualized 1-step directions at 70% accuracy from baseline 60%:
  - Progressed to 80% accuracy if reading direction silently; 87% accuracy when written direction was also read aloud by clinician

Goals & Progress - Spring 2010

- Correctly produce CV & VC words, at 85% accuracy:
  - CV – progressed from baseline 40% to 65%
  - VC – progressed from baseline 50% to 83%
- Correctly imitate CVC words – 65% accuracy:
  - Progressed from 27% to 63% accuracy
- Goal for verbal imitation of common objects discontinued this treatment period
- Goal for use of AAC device to repair communication breakdowns:
  - Discontinued once Mr. J communicated he was not interested in using the AAC device in everyday situations
- Introduced Anagram & Copy Treatment (ACT) and Copy & Recall Treatment (CART)

Goals & Progress - Summer 2010

- Correctly produce CV & VC words 80% of the time, given up to 2 visual/auditory cues:
  - Progressed from baseline 64% to 72% accuracy; performance varied significantly from 38%-90%
  - Added cueing from *Moving Across Syllables* (Kilpatrick, Stohr, & Kimbrough, 1990)
  - Continued vowelization & voicing errors noted
- Correctly produce CVC words 65% of the time, with up to 3 visual/auditory cues:
  - Progressed from baseline 43% to average 74%; performance ranged from 36%-94%
  - Added cueing from *Moving Across Syllables* (Kilpatrick, Stohr, & Kimbrough, 1990)
- Verbally imitate 10 functional 2-3 word phrases containing core words chosen by Mr. J with up to 5 verbal & motoric cues, 50% of the time:
  - Progressed from baseline 20% to 66% accuracy; performance ranged from 20-90% over the semester

Quality of Life Issues

- During Summer 2010 semester, Mr. J communicated feelings of isolation & loneliness due to communication barriers
- He also expressed desire for companionship
- Clinician assisted him in joining online stroke support forums and discussion boards
- Computer use new skill for Mr. J; constant assistance and modeling required in therapy to access internet sites
- When provided written instructions for computer navigation, independence in computer use increased
- Unfortunately, computer use discontinued when Mr. J was unable to afford home internet services

Summation of Previous Therapy Outcomes:

- Therapy conducted 2-3 times/week, dependent on client-clinician-supervisor availability
- Duration of therapy approximately 6-8 months
- Clinic followed academic calendar, so ‘breaks’ in therapy every 12-14 weeks
- Verbal production had not progressed beyond immediate and delayed imitation skills of single syllable words & short phrases
- Discontinuation of AAC
- Discontinuation of computer/internet support networks

Conversational Script Training for Acquired Apraxia of Speech

Script Training Principles

- Based on the Instance Theory of Automatization (Logan, 1988)
  - Automaticity occurs due to retrieval from memory of complete, context-bound, skilled performances
- Script Training was initially developed to promote verbal communication on client-selected topics (Holland, Milman, Munoz, & Bays, 2002)
  - Goal is for individuals for whom speech is no longer automatic to produce islands of fluent speech in conversation
- Previously used as a treatment approach to improve automatic language production in adults with aphasia
- To become automatic, scripts must be practiced as phrase or sentence-length units vs. syllable or 'one word at a time' approach (Youmans, Holland, Munoz, & Bourgeois, 2005)
  - For individuals with aphasia resulting in expressive speech difficulties, repeated practice of phrases and sentences can lead to automatic and effortless speech productions

Acquired Apraxia of Speech

- **Apraxia & Script Training**
  (Youmans, Youmans, & Hancock, 2011)
  - Apraxia of speech is associated with disturbance in the automaticity of fluent speech production
  - Script training is hypothesized to be a functional therapy approach for individuals with acquired apraxia of speech in order to improve ease of speech production in the functional contexts targeted

"Script Training Treatment for Adults with Apraxia of Speech"

(Youmans et al., 2011)

- Accepted through *American Journal of Speech-Language Pathology* in August 2010
- Published in *American Journal of Speech-Language Pathology*, February 2011
- Previous published research revealed script training is functional treatment approach successful for persons with aphasia (Youmans et al., 2005)
- Had not been applied to persons with apraxia of speech.
- This study revealed script training was successful & functional for 3 subjects with apraxia of speech.

Effectiveness of Conversational Script Training for Acquired Apraxia of Speech

Purpose of Current Study

- This case study was intended to provide further support for the use of conversational script training for a client with acquired apraxia of speech & mild non-fluent aphasia.

Rationale

- Youmans et al. (2011) provided convincing evidence for use of script training for adults with apraxia of speech
- Decision made to replicate study based on participant's:
  - Desire to communicate verbally
  - Indication that traditional apraxia treatment was not motivating
  - Limited progress beyond immediate and delayed imitation of single syllable words & short phrases
  - Refusal to use AAC device (given to him by previous clinic) to communicate

Procedure

- Therapy conducted 2-3 times/week, dependent on client-clinician-supervisor availability
- Script training therapy was conducted from September 2010 - Present
- Clinic followed academic calendar with breaks in therapy every 12-14 weeks

- **Therapy Sessions Included:**
  - 10 minutes of unstructured conversation
  - 40 minutes of blocked/random practice of phrases
    - Breaks as needed based on client frustration level
  - 10 minutes targeting other goals (sentence writing, computer use)

Treatment Sequence

Modified from Youmans et al. (2011)

- Script Development
  - Client and clinician formulated scripts (4-8 sentences in length) to use in personally relevant contexts
- Phrase Acquisition
  - Scripts were trained one phrase at a time in *blocked* practice
  - After 90% accuracy was achieved for 3 phrases in blocked practice, phrases were rehearsed in *random* trials
  - Continued practice of mastered phrases to promote maintenance

Treatment Sequence Continued

- Feedback
  - Opportunity to correct errors independently before given feedback
  - Specific feedback on articulator placement and accuracy of production
  - Knowledge of performance (KP) and knowledge of results (KR) feedback
  - Positive reinforcement of verbal attempts
- Data Collection
  - Data collected at baseline, treatment, and maintenance periods
  - Based on number of words correct independently in blocked and random trials

Cueing Hierarchy

Modified from Youmans et al. (2011)

- **Blocked Practice**
  - Clinician model of target phrase
  - Target phrase in unison with visual cues
  - Target phrase with clinician fading voice
  - Independent productions with visual cues
  - Independent productions
- **Random Practice**
  - Random trials with visual cues
  - Independent productions in structured conversation
  - Random trials with unfamiliar communication partners given visual cues
  - Independent productions in structured conversation with unfamiliar communication partners

Types of Visual Cues

- Sentence Strips
- Silent Posturing
- *Moving Across Syllables* Visual Cues (Kirkpatrick, Stohr, & Kimbrough, 1990)
- Individualized cues for vowel production

Moving Across Syllables: Training Articulatory Sound Sequences

- *Moving Across Syllables: Training Articulatory Sound Sequences* - Therapy tool developed for children with difficulty sequencing sounds
- Created by Jill Kirkpatrick, Pamela Stohr, and Debora Kimbrough (1990)
- Designed to assist in training sequencing skills within and across syllables
- Visual cuing techniques used and modified for use with client
- Example: /t/ /d/ - Touch lightly above your upper lip with your index finger. Remove your finger as you say the sound
- No vowel cues included, therefore visual cues were developed by clinicians as needed

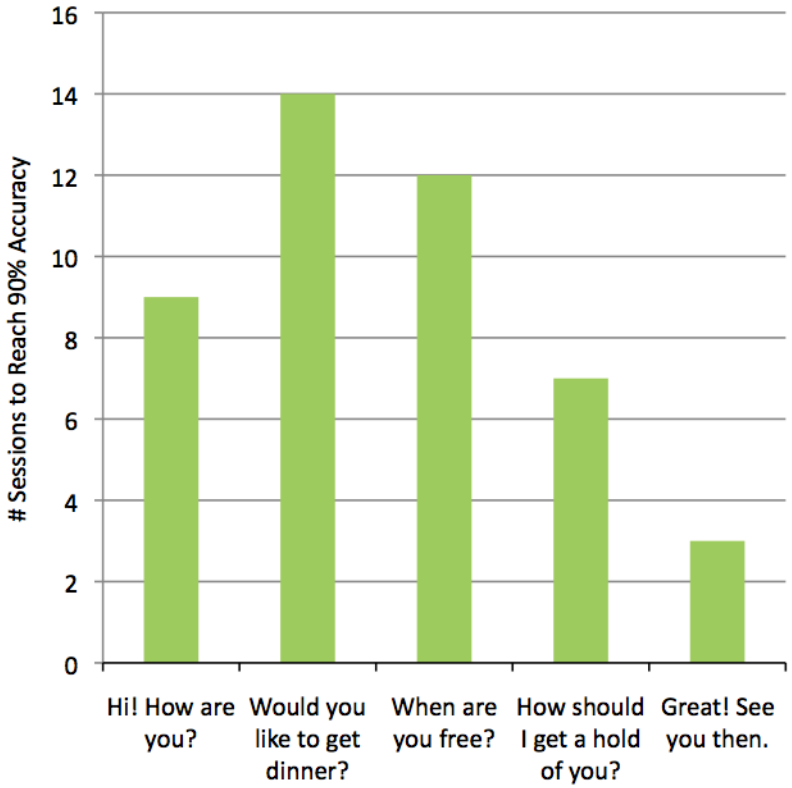
Client's Scripts

Client determined settings that he would most like to communicate and created meaningful phrases that could be used in his environment.

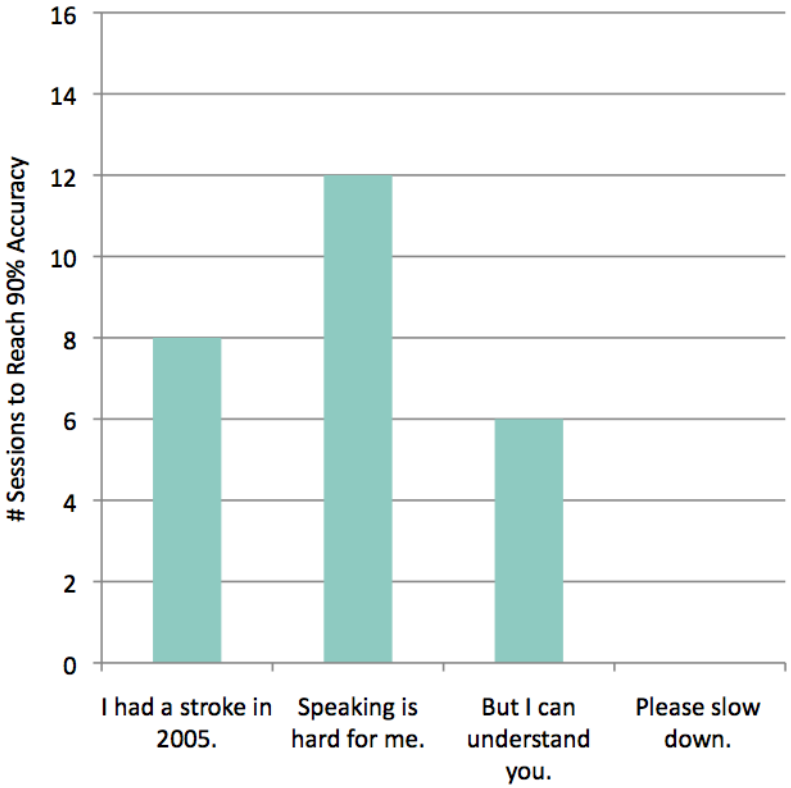
- **Conversation Starters**
  - Hi! How are you?
  - Would you like to get dinner?
  - When are you free?
  - How should I get a hold of you?
  - Great! See you then.
- **Aphasia**
  - I had a stroke in 2005.
  - Speaking is hard for me.
  - But I can understand you.
  - Please slow down.

Script Acquisition

Conversation Starters



Aphasia



Summary of Script Acquisition

Conversation Starter

- Hi! How are you?
  - Met 90% accuracy in 7 sessions
- Would you like to get dinner?
  - Met 90% accuracy in 14 sessions
- When are you free?
  - Met 90% accuracy in 12 sessions
- How should I get a hold of you?
  - Met 90% accuracy in 7 sessions
- Great! See you then.
  - Met 90% accuracy in 3 sessions
- **Script Mastery**
  - **Met 90% accuracy of all 5 lines in 34 sessions**

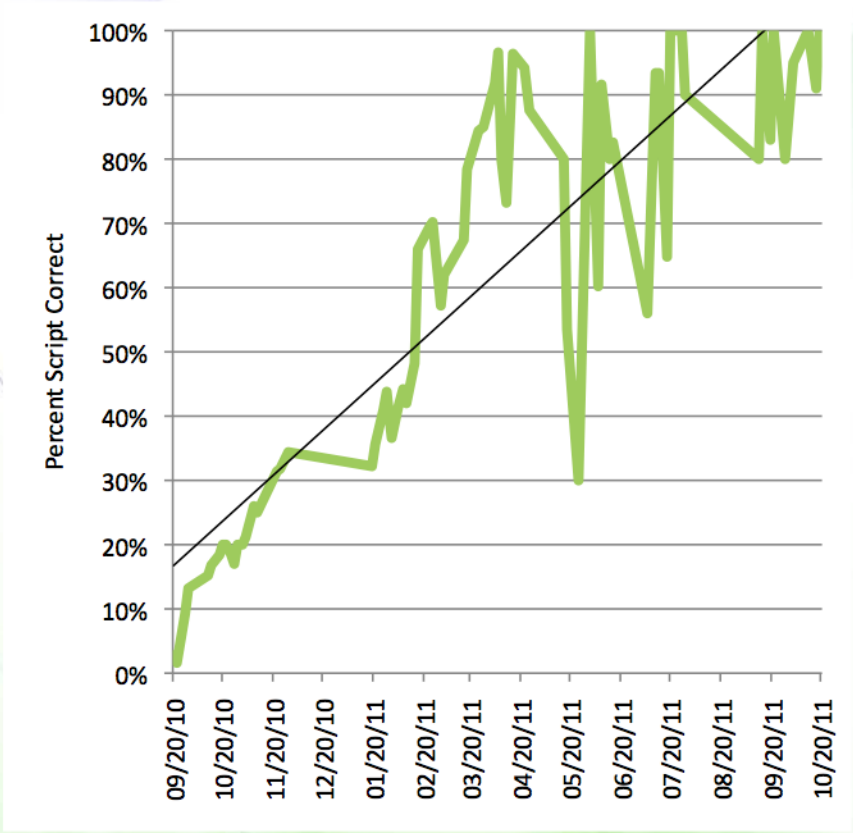
Summary of Script Acquisition

Aphasia

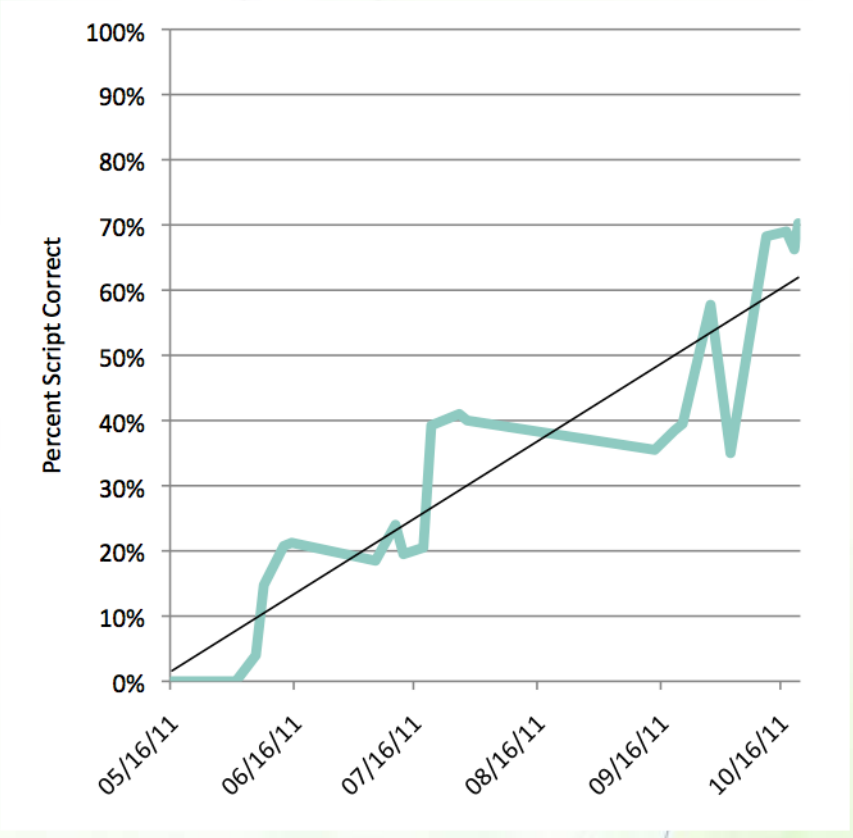
- I had a stroke in 2005.
  - Met 90% accuracy in 8 sessions
- Speaking is hard for me.
  - Met 90% accuracy in 12 sessions
- But I can understand you.
  - Met 90% accuracy in 6 sessions
- Please slow down.
  - Mastery still in progress
- **Script Mastery**
  - **Mastery of the script is still in progress**

Script Accuracy

Conversation Starters



Aphasia



Effect Size

- Effect size calculated to contrast pre-treatment and post-treatment levels of performance (Cohen, 1988)
- Benchmarks used for determining degree of effect (Beeson & Robey, 2006):

- Small Effect- 6.0
- Medium Effect- 12.0
- Large Effect- 18.0

Conversation Starters

- 111.96 (large effect)

Aphasia

- 38.26 (large effect)

Conclusions

- Overall, script training was a functional, effective treatment for this client
- Met objective of obtaining relatively fluent and errorless production of the "conversation starters" script and the first 3 phrases of the "aphasia" script
  - "Hi! How are you?" was mastered relatively quickly
    - May be attributed to automaticity of the phrase prior to his CVA and/or previous treatment targeting the phrase in isolation
  - Subsequent lines were mastered with gradually fewer sessions over time
    - 14 sessions for "Would you like to get dinner?" – 3 sessions for "Great! See you then."
- Often self-corrected errors during independent productions

Conclusions

- Demonstrated generalization of script production in other settings with clinicians present
  - Began producing the scripts outside of the clinic setting with a significant other
  - Generalization to other non-therapy environments is minimal
- Maintained mastery of phrases over a 6 month period including breaks in therapy
  - Maintenance of each phrase was highly variable session to session and was likely influenced by:
    - Client frustration level, fatigue, and/or illness reducing accuracy of verbal productions
    - Frequent breaks in therapy due to academic calendar
    - Limited trials of phrases in random practice when new lines were introduced in blocked practice

Conclusions

- Client's productions continue to contain minor errors during maintenance periods and random practice
  - However, he is able to use self-monitoring to restart and correct error phrases
- Often has difficulty initiating lines of the script
  - Once initiated, script is typically executed fluently due to motor automaticity
- Client's prosody continues to have limited inflection
  - Prosody continues to sound more natural with random practice

Limitations

- Although script training was proven effective for this client, continued research is suggested in order to determine the overall effectiveness of script training for all individuals with apraxia of speech
- Scripts are limited to one context, making generalization to other speaking contexts difficult
- Breaks in therapy negatively influenced motor automaticity and rate of script acquisition for this client
- Clinician changes each academic semester may have led to variability in cueing, feedback provided, and data collection during script acquisition

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Type of Practice

- Blocked Practice
- Random Practice

Attentional Focus

- Internal Focus
- External Focus

Feedback Type

- Knowledge of Performance
- Knowledge of Results

Feedback Frequency

- Immediate Feedback
- Reduced Feedback