Treatment for Lexical Retrieval Failures Following Aphasia

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Purpose

- Identify models of lexical processing that underlie recent approaches to treatment for word finding difficulties following aphasia
- Develop intervention plans for individuals with word finding problems based upon the unique characteristics of their aphasia.
- Describe the evidence associated with the described procedures and make informed decisions regarding their appropriateness

Levels of Evidence

Table 1: Levels of evidence for studies of treatment efficacy, ranked according to quality and credibility from higher to lower levels (adapted from the modified Cochrane Guidelines Network, www.cochrane.org).

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Well-designed randomized controlled trial</td>
</tr>
<tr>
<td>1b</td>
<td>Well-designed randomized controlled study</td>
</tr>
<tr>
<td>1c</td>
<td>Well-designed controlled study without randomization</td>
</tr>
<tr>
<td>2a</td>
<td>Well-designed quasi-experimental study</td>
</tr>
<tr>
<td>2b</td>
<td>Non-randomized quasi-experimental study, i.e., correlation and case studies</td>
</tr>
<tr>
<td>3</td>
<td>Expert committee report, consensus conference, clinical experience of respected authorities</td>
</tr>
</tbody>
</table>

American Speech-Language-Hearing Association, 2004
Guidelines for Coding Class of Study
(American Academy of Neurology, 2001)

<table>
<thead>
<tr>
<th>Class</th>
<th>Strength</th>
<th>Evidence provided by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Strongest</td>
<td>One or more well designed randomized control trials, including meta-analyses of such trials</td>
</tr>
<tr>
<td>2</td>
<td>Intermediate</td>
<td>Well designed observational studies with concurrent controls. Single subject multiple baseline studies across subjects.</td>
</tr>
<tr>
<td>3</td>
<td>Weakest</td>
<td>Expert opinion, case studies, case reports, studies with historical controls. Single subject multiple baseline studies across behaviors.</td>
</tr>
</tbody>
</table>

http://www.u.arizona.edu/~pelagie/irc/teacher.html

Treatment Approaches

- Impairment-based
  - Stimulation
  - Linguistic
  - Processing/Cognitive
- Based on Activity Limitations or Participation Restrictions
  - Functional (patient-oriented)
  - Social (partner-oriented)

Cognitive Approaches

- Make use of cognitive analyses and cognitive neuropsychological models
- Begin with identifying impaired cognitive processes and representations underlying language tasks
- Treatment focuses on remediation of impaired cognitive processes, compensation via the intact cognitive processes, or both

Hillis & Newhart, 2008

Kay, Lesser, & Coltheart, 1996

Kent, 2000

Wilshire & Coid, 2000
Semantic Treatment

- Lexical-semantic deficits characterized by two-way deficits incorporating production and comprehension
- Model-based treatments requiring patients to distinguish words on their semantic features likely to be effective
- Goal is to demonstrate generalization from treatment to spontaneous speech

(Howard et al., 1985; Visch-Brink et al., 1997; Drew & Thompson, 1999)

Semantic Treatment: Nouns

Semantic Treatment

- Matching spoken/written words with pictures
- Semantic judgment (yes/no, either-or questions)
- Matching definition to picture
- Sorting by category
- Identifying semantically-related words
- Matching words by syntagmatic (positioning) or paradigmatic (substitution) relationships
- Matching words with antonyms
- Determining implied meanings of adjectives and exclamations
- Identifying part-whole relationships
- Identifying semantically-anomolous sentences
- Semantic definitions
- Identifying text anomalies, types, and errors

(Howard et al., 1985; Visch-Brink et al., 1997; Boyle, 2004)

Semantic Feature Analysis

- Level IIb single subject design with replication
- Investigated outcomes of SFA in 2 participants (anomic, Wernicke aphasia) with breakdowns at different levels of lexical processing
- Examined whether greater numbers of exemplars promotes better generalization
- Assessed whether direct assessment of word retrieval difficulty in discourse would provide better estimate of across-context generalization than previous measures (i.e., CIU analysis)

(Boyle, 2004)
Method

- Stimuli
  - Confrontation naming – sets of treatment and probe items from Snodgrass and Vanderwart line drawings, supplemented for P1
  - Discourse – Nicholas & Brookshire (1993) stimuli for CIU analysis
- Design – Multiple baseline design across behaviors replicated across conditions for P2
- Treatment – SFA with either few (same set of pictures each session) or many (different sets of pictures) exemplars

Results

- SFA treatment improved ability of participants to name treated and untreated items
- Using many exemplars does not enhance generalization to untrained items
- Participants demonstrated improvement on some discourse measures
- Evidence of overt word finding difficulty in discourse did not decrease for either participant

Complexity effects: Semantics

- Semantic feature treatment applied to typical or atypical exemplars of category items
- Training on typical examples produced no generalization to intermediate or typical examples but training on atypical examples produced generalization to naming of intermediate and typical examples
- Suggests atypical examples convey more information about category than do typical examples

Kiran & Thompson, 2003
“Intensive semantic intervention in fluent aphasia: A pilot study with fMRI”

• Level IIb single subject design
• Treatment based on assumptions regarding widely distributed neuronal network supporting semantic processing
• 55 y/o RH AA Male 5 mos s/p L parietal-temporal stroke with diagnosis of Wernicke Aphasia
• Treatment - Semantic judgment tasks
  – Questions related to categorical, associative, structural or perceptual aspects
  – Sorting tasks based on subordinate and superordinate categories (no overt verbal response required)

Results

• Increased auditory comprehension (WAB classification: Wernicke → Conduction aphasia)
• Improved naming (quantitatively and qualitatively); generalized to untrained items
• Improved noun retrieval suggested in narrative sample
• fMRI
  – Verb generation task: Increase in sub-threshold activation on lesion side
  – Text-listening task: Strong R lateralization before treatment strong → L lateralization after treatment

Discussion

• Intensive decision-based semantic intervention resulted in improvements in naming and auditory comprehension
• Generalization to untrained items supports treatment targeting semantic networks
• fMRI results support behavioral results: Change in activation pattern for story listening task suggests peri-lesional recovery of a portion of Wernicke’s area corresponding to increase in auditory comprehension

Phonological Treatment

• Phonological question tasks
  – rhyming comprehension
  – syllable number verification
  – initial phoneme verification
• Oral word reading
• Word repetition
• Phonological cuing hierarchy (rhyming word, initial phoneme, repetition)

“Treatment for aphasic phonological output planning deficits”

• Level IIb single subject design
• Participant – 84 yo, RH woman w/single infarct of L posterior insula and parietal lobe operculum
• Symptoms
  – Disproportionate difficulty in oral expression
  – Better oral reading relative to naming and repetition
  – Writing superior to oral production

Phonological treatment: Nouns
Treatment

- Oral reading of bisyllabic words
- Patient writes items produced in error to increase phonological salience of target words through orthographic-phonological conversion
- All phonemes produced in error paired with phoneme in key word (another word with target phoneme in initial position that is read with high success)
- Word repetition
Method

- Eight participants with varying aphasias
- Materials
  - 200 pictures divided into 2 sets based on baseline naming accuracy, randomly assigned as treatment and control sets
  - Treatment set divided into two sets, 50 for phonologic cues, 50 for orthographic cues
  - 20 additional personal items identified
- Schedule
  - Once per week for 8 weeks
  - All treated items seen once each session

Cuing conditions

- Facilitation (one cue per picture)
  - Three conditions: Control - Extra time (5 sec.); Single cue; Choice (target & distractor)
  - Four cue types in each condition: CV spoken, CV written, rime, repetition
- Treatment (phonological & orthographic)
  - Three cues: first phoneme + schwa; if unsuccessful, then syllable; if still unsuccessful, then whole word; distractor provided after each cue; whole word modeled and repeated if necessary
  - Number of distractors increased gradually across sessions, i.e., one, two, or three distractors
  - Order of cues and stimulus type varied

Results

- Overall improvement in 7/8, statistically significant for treated vs. untreated items in 5/7
- Generalization to untreated items in 1/7
- Significant correlation between effects of facilitation and treatment outcome

“Phonological Therapy for Word Finding Difficulties: A Re-evaluation”

- Level IIb single case series
- Investigate “choice” as variable underlying improved outcomes following semantic vs. phonologic approaches
- Test effectiveness of two phonologic cuing techniques (word initial CV spoken, written letter cue)
- Identify relationship b/w responsiveness to cues in facilitation and treatment
- Assess generalization for phonologic treatment

“Phoneme-Based Rehabilitation of Anomia in Aphasia”

- Because all domains of a connectionist network of phonological function are heavily interconnected, assumed that input to any domain within network will engage all domains instantly
- If so, successful phonologival treatment should generate patterns of neural activity in corresponding domains (conceptual, articulatory, acoustic, orthographic) when a phoneme is inserted into any domain of the network
Kendall et al., 2008

Connectionist Model of Phonological Processing

Connectionist Model of Phonological Processing

Kendall et al., 2008

“Phoneme-Based Rehabilitation of Anomia in Aphasia”

- Tested hypothesis that word retrieval may be improved by training phoneme sequences
- May establish phoneme sequence knowledge and phonological awareness that can be engaged by concept representations for words containing those sequences
- Goal of treatment is to enable naming via the indirect concepts-articulatory motor pathway (pathway 4-3)

Kendall et al., 2008

Method

- Ten participants with aphasia due to single LH stroke and > 6 months post onset
- AOS excluded
- Evidence for impaired phonological function as demonstrated on Comprehensive Test of Phonologic Processing and Lindamood Auditory Conceptualization
- 96 total hours of treatment (2h/day, 4days/week x 12 weeks)

Kendall et al., 2008

Treatment

- Modified Lindamood Phonological Sequencing Program
- Seeks to instantiate multi-modal representations of phonemes via activities that build connections between acoustic, articulatory, orthographic, and concept representations
  - Trains development of concepts for individual phonemes
  - Trains phonological/orthographic sequence knowledge for 1-3 syllable nonwords

Kendall et al., 2008

Results

- For Object and Action Naming Test, ES=1.63 (SD=1.77), graphs visually judged to show generalization for 8/10 participants
- For Phonologic Production, ES=6.83 (SD=3.58), visual evidence for treatment effect for 10/10 participants
- For Discourse Production:
  - Word Count: ES=1.49 (SD=1.46), visual evidence for generalization in 4/6
  - CIU: ES=1.64 (SD=1.57), visual evidence for generalization in 4/6

Kendall et al., 2008

<table>
<thead>
<tr>
<th>Task</th>
<th>ES (SD) Post 1 Wk</th>
<th>ES (SD) Post 3 Mo</th>
<th>Visual Evidence of Generalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object and Action Naming Test</td>
<td>1.63 (1.77)</td>
<td>8/10</td>
<td></td>
</tr>
<tr>
<td>Phonologic Production</td>
<td>6.83 (3.58)</td>
<td>10/10</td>
<td></td>
</tr>
<tr>
<td>Nonword Repetition (Sequence Knowledge)</td>
<td>0.95 (1.33)</td>
<td>6/7</td>
<td></td>
</tr>
<tr>
<td>Discourse Production</td>
<td>1.12 (1.51)</td>
<td>4/7</td>
<td></td>
</tr>
<tr>
<td>Words</td>
<td>1.49 (1.46)</td>
<td>4/6</td>
<td></td>
</tr>
<tr>
<td>CIUs</td>
<td>1.47 (1.54)</td>
<td>1/5</td>
<td></td>
</tr>
<tr>
<td>Control (Limb)</td>
<td>0.64 (2.04)</td>
<td>2/8</td>
<td></td>
</tr>
<tr>
<td>Control (Limb)</td>
<td>0.93 (2.26)</td>
<td>3/7</td>
<td></td>
</tr>
</tbody>
</table>
Conclusions

• Tentative evidence to suggest focusing treatment at level of phonological processor may improve naming
• Improved BNT and COWA scores at 3 months post suggest once patients provided adequate phonological sequence knowledge, they may continue to build working vocabulary
• Auditory perception abilities may be at least one indicator of success with this treatment

Verb treatments

“Response to Contrasting Verb Retrieval Treatments…”

• Level IIb single subject design
• Greater verb retrieval impairments associated with nonfluent aphasia/left frontal opercular lesions
• Influenced by familiarity, semantic complexity, argument structure
• Verb retrieval failure may undermine sentence formulation leading to nonfluent output

Method

• Participant
  – 54 y/o woman with transcortical motor aphasia
  – Mildly impaired performance on naming and comprehension for nouns, verbs suggesting semantic dysfunction
• Stimuli – 60 verbs consistently misnamed on baseline testing w/comparable argument structure complexities
  – 20 in semantic treatment set
  – 20 in phonologic treatment set
  – 20 in control set (rehearsal)
• Generalization: Sentence production in response to sets of 60 verb pictures used for treatment

Treatment

• Picture presented for naming aloud followed by feedback re: response accuracy
• Followed by two yes/no questions to develop word retrieval strategy followed by rehearsal phase
  – Phonologic treatment (word sound):
    • Does ["target"] begin with …?
    • Does ["target"] rhyme with…?
  – Semantic treatment (word meaning):
    • Is ["target"] similar to…?
    • Is ["target"] have to do with …?
• Control phase items treated using repetition and rehearsal only; 10 new items to gauge spontaneous recovery
Conclusions

• Semantic, phonologic, and rehearsal treatments all induced verb naming improvements
• Manifested in increased ability to produce sentences using these verbs
• Suggests semantic activation whenever words retrieved in context of picture presentation regardless of treatment type

Comparing Treatments

• Semantic and phonologic treatments consisting of pre-stimulation phase and response-contingent cueing hierarchy ending with repetition of target word
• Object Naming
  – 4 participants with primarily either lexical-semantic, lexical-phonologic, or mixed lexical-semantic/lexical phonologic deficits
  – Positive responses to both treatments for object naming with apparent preference for semantic treatment.
• Action Naming
  – 4 participants with predominantly lexical-semantic deficits, 1 with mixed lexical-semantic/lexical phonologic deficits
  – Comparable but inconsistent positive effects for both treatments for action naming across participants.

“Application of semantic feature analysis to retrieval of action names in aphasia”

• Level Ib single subject design
• Addressed whether SFA would result in improved naming of trained and untrained action items
• Investigated potential of SFA to provide compensatory strategy for improving generalization of action word retrieval to untrained items
• Assessed the effects of SFA treatment on the production of content generally and verbs specifically during discourse

Method

• Participant
  – 74 yo, RH, Caucasian woman
  – 4 years, 2 months post onset
  – Single, left parietal CVA
• Naming Stimuli – 40 actions for Object and Action Naming Battery, divided into 4 lists
• Discourse Stimuli – Picture description and procedural discourse items from CIU analysis
• Design – Single-subject multiple baseline design across behaviors

Treatment

• Items presented in random order
• Participant asked to “use an action word to describe the picture”
• 30-second response window provided to employ feature strategy as compensatory strategy
• SFA modified to accommodate verbs by targeting lexical information and thematic information while adhering as closely as possible to original SFA features
Outcomes

- Improved accuracy of naming trained items (d-index: List 1=1.5, moderate effect; List 2=1.76, medium effect)
- No generalization to naming of untrained items
- Increases in accuracy of object naming on post-testing
- Absence of general retrieval strategy of reviewing features for failed verbs
- Substantial increase in discourse production likely due to general facilitating effect

Semantic Feature Analysis of Word Retrieval Failures in Discourse

- Treatment for improved retrieval of objects and actions in discourse might best be served by targeting such failures as they appear during discourse tasks
- Approach is appealing because:
  - it increases the ecological validity of the stimulus items
  - it relies on response generalization rather than stimulus generalization as in most previous studies
  - improvements in word retrieval should, by default, result in improved discourse production
- Potential for approach to have positive effects on picture naming, i.e., generalization in the reverse direction from which it is typically assessed

Peach & Reuter, 2008

Semantic Feature Analysis of Word Retrieval Failures in Discourse

- Connected speech probed to identify lexical retrieval errors (nouns and verbs) to serve as treatment items
  - Picture description
  - Procedural discourse
- Target words subjected to semantic feature analysis
- Daily homework assigned targeting retrieval failures in conversational speech

Peach & Reuter, 2008
Types of Lexical Retrieval Errors
(German, 1991)

- Verbal Paraphasia
- Semantic Paraphasia
- Superordinate
- Coordinate
- Subordinate
- Attribute
- Circumlocution
- Unrelated Verbal Paraphasia
- Verbal Phonological Paraphasia
- Penevevation
- Initial sounds
- Phonemic Paraphasia
- Neologism
- Repetition
- Reformulation
- Empty/Indefinite words
- Time fillers
- Delays
- Comment

VERB DIAGRAM

Object & Action Naming Battery

- Objects (List A) – 81 items
- Actions (List A) – 50 items

Correct Information Units (CIUs)

<table>
<thead>
<tr>
<th>Type</th>
<th>Participant 1</th>
<th>Participant 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>75</td>
<td>64</td>
</tr>
<tr>
<td>Gender</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Native language</td>
<td>Spanish</td>
<td>Filipino</td>
</tr>
<tr>
<td>Primary language</td>
<td>English</td>
<td>English</td>
</tr>
<tr>
<td>Education</td>
<td>High School</td>
<td>High School</td>
</tr>
<tr>
<td>Occupation before onset</td>
<td>Employee</td>
<td>Employee</td>
</tr>
<tr>
<td>Time post onset of aphasia (months)</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Site of lesion</td>
<td>Medial left parasagittal frontal lobe</td>
<td>Left lateral and posterior capsule genu</td>
</tr>
</tbody>
</table>

- Western Aphasia Battery
- Fluency
- Comprehension
- Repetition
- Naming
- Aphasia Quotient
- Reading
- Writing
- Language Quotient

- Left insula and internal capsule genu
- Medial left parasagittal frontal lobe

- Aphasia classifications
- Broca's
- Wernicke's
- Conduction Aphasia
- Convergent Aphasia

- Current Demographic Data (CID)
- Total Word Count
- Total Duration
- Total CIUs
- Total Treatment

- Naming Errors to Confrontation

- Session
- Words/T-Unit
- Baseline
- Treatment F/U

- Reading
- Writing

- Empty/Indefinite words
- Time fillers
- Delays
- Comment

- A1B = 10% increase
- A1A2 = 4% increase

- A1B = -0.42
- A1A2 = 0.28

- d1 (A1B) = 1.79
- d1 (A1A2) = 2.61

- d1 (A1B) = -0.62
- d1 (A1A2) = 0.00

- df = 10

- Session
- Treatment
- A1
“Treatment of naming in nonfluent aphasia through manipulation of intention and attention…”

- Intention – Ability to select among several competing actions for execution and initiation (“executive attention”)
- Attention – Ability to select one source of information among multiple competing sources for further processing
- Intention mechanisms associated with frontal action systems; attention closely associated with posterior sensory cortices

Crosson et al., 2007
“Treatment of naming in nonfluent aphasia through manipulation of intention and attention…”

- Language performance affected by attention deficits in patients with parietal lesions when stimuli presented on either left vs. right sides
- Left Pre-SMA areas underlying intention for word generation and complex hand movements found to overlap; pre-SMA connected to lateral prefrontal cortex (LPFC)
- May be possible to exploit role of right LPFC in recovery from aphasia by pairing complex hand movement of left hand with naming treatment

Table 1. Demographic variables and aphasia scores for naming severity strata

<table>
<thead>
<tr>
<th>Age M (SD)</th>
<th>Elia M (SD)</th>
<th>M/F</th>
<th>Months</th>
<th>WAIS AQ M (SD)</th>
<th>RNT M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate (n = 12)</td>
<td>56.13 (11.22)</td>
<td>6 M/6F</td>
<td>32.43 (22.10)</td>
<td>73.53 (9.70)</td>
<td>31.00 (8.43)</td>
</tr>
<tr>
<td>Severe (n = 13)</td>
<td>61.22 (16.38)</td>
<td>9 M/4F</td>
<td>41.22 (10.61)</td>
<td>56.74 (18.80)</td>
<td>12.82 (9.48)</td>
</tr>
<tr>
<td>Profound (n = 11)</td>
<td>57.25 (10.87)</td>
<td>7 M/4F</td>
<td>59.50 (9.09)</td>
<td>25.83 (12.36)</td>
<td>1.50 (1.32)</td>
</tr>
<tr>
<td>Total Sample (n = 34)</td>
<td>58.96 (12.85)</td>
<td>17M/17F</td>
<td>44.75 (47.80)</td>
<td>53.32 (62.47)</td>
<td>16.73 (72.32)</td>
</tr>
</tbody>
</table>

1Due to an oversight one participant (profound impairment) did not receive a baseline Boston Naming Test (BNT), and 5 participants (4 severe impairment, 1 profound impairment) did not receive a baseline Western Aphasia Battery Aphasia Quotient (WAIS AQ). Means (M) and standard deviations (SD) in the corresponding cells were calculated without these subjects’ data i.e., no missing value algorithms was used to replace missing values.

*Patients stratified by severity of word finding impairment using picture naming performance on a list of 40 words including similar numbers of high, medium, and low frequency items.

**Intention Treatment**

- Picture naming trials presented on computer monitor with alerting stimuli and correction procedures (as necessary)
- Accompanied by complex LH movement (lifting lid on a box and pressing button on a device within the box) to initiate picture presentation
- Three phases using unique sets of 50 items; complex movement replaced with non-meaningful circular hand gesture in trial 3 to allow use outside therapy

**Attention Treatment**

- Picture naming trials presented on computer monitor in left hemispace with alerting stimuli to left of center and correction procedures (as necessary)
- Alerting stimuli disappear, pictures appear immediately in upper, middle, or lower portion of left side
- Three phases using unique sets of 50 line drawings of objects with changes in number and duration of alerting stimuli over each phase
Moderate and Severe Word-Finding Impairment Only

Results:
Moderate to Severe Impairment
• Improved naming performance during both treatments
• Significantly greater increments between phases on intention vs. attention treatment
• Generalization to untrained stimuli, but greater on intention vs. attention treatment

Results:
Profound Impairment
• No differential response to two treatments
• Fewer patients with treatment gains and generalization to untrained items

Conclusions
• Greater incremental improvement observed for intention vs. attention treatment in nonfluent aphasia patients with moderate to severe naming impairment
• Intention component appears to be active treatment constituent
• Improvement during attention treatment confounds degree to which improvement after intention treatment is related to intention manipulation

Fig. 2: Average change in percent accuracy from baseline performance for picture-naming probes. The change in percent accuracy from baseline for both the intention and attention treatments is shown. Change in percent accuracy was calculated as the difference between average performance on daily picture-naming probes for each phase minus average baseline performance. During the intention treatment, patients showed a faster rate of gain (p < .05) in performance than in the attention treatment. Error bars represent the standard errors of the mean.