Restoration and Reorganization in Word Retrieval Treatments for Aphasia

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Disclosures:

Portions of our research were funded by the NIH (NIDCD).

The author receives a salary from ODU and is receiving an honorarium and travel support for this presentation.

The author is president of the Academy of Neurologic Communication Disorders & Sciences (ANCDS). She receives no compensation for this role.

WHO International Classification of Functioning, Disability, & Health (2001)
http://www3.who.int/icf/

Whole Person Approach for any health condition

Health condition (e.g., stroke)

Body Structures ---- Activity ---- Participation
/FUNCTIONS

Contextual Factors
Environmental Personal

Aphasia Treatment: WHO

Language Functions
Direct Restorative & Reorganization treatments for language abilities

Activities/ Communication in ADLs, personal & Participation social interactions, education, employment
Compensatory and functional communication strategies

Environment/Personal Facilitators/Barriers to Language Use
Modify communication environment:
support systems/technology
Medical interventions
- Impacts on our treatment choices and outcomes measured

Cognitive Neuropsychological Perspective

Normal System: Representations and Processes

Word Retrieval Impairments: Systematic disruption of this system

Word Retrieval Mechanisms

"Word is an event, able to be remembered"
Neural Correlates of Lexical Processing

Antimici et al., 2005; Damasio et al 1993; Tranel et al 1997; Cammazza & Hillis, 1991; Shapiro et al., 2006

Phonologic vs Semantic Anomia

<table>
<thead>
<tr>
<th></th>
<th>Phonologic</th>
<th>Semantic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture Naming Nouns</td>
<td>48.3%</td>
<td>21.7%</td>
</tr>
<tr>
<td>Verification Nouns</td>
<td>98.3%</td>
<td>46.7%</td>
</tr>
<tr>
<td>Picture Naming Verbs</td>
<td>40.0%</td>
<td>53.3%</td>
</tr>
<tr>
<td>Verification Verbs</td>
<td>93.3%</td>
<td>20.7%</td>
</tr>
</tbody>
</table>

Treatment Implications

- Treatment effects may differ depending on pattern of word retrieval impairment: semantic vs phonologic
- Word retrieval training effects may differ for nouns versus verbs
- Restorative treatments: Relearning address semantic and/or phonologic aspects of word retrieval
- Reorganization approaches: Attempt to engage alternative cognitive systems, e.g., gesture, to facilitate word retrieval

Principles to Guide Evidence Based Practice: Neuroplasticity

"...neurons, among other brain cells, possess the remarkable ability to alter their structure and function in response to a variety of internal and external pressures, including behavioral training." (Kleim and Jones, 2008)

Principles of Neuroplasticity:

Animal Models
Turkstra et al., APMR 2003;
Kleim & Jones, JSLHR 2008;
Kleim JCD 2011; Kerr et al., JCD 2011

- Use it or Lose it
- Use it and Improve it
- Specificity necessary
- Repetition Matters
- Intensity Matters
- Time Matters
- Salience Matters
- Age Matters
- Transference happens
- Interference happens

Raymer et al., 2008
Restorative Word Retrieval Training: Cueing Hierarchies

Systematically present cues of increasing potency
(Linnaug, 1983; Linnaug et al., 2005)

- Semantic category cue
- Rhyme cue
- Initial phoneme cue
- Repetition cue

Patterson (2001) reviewed evidence
9 studies (17 total subjects)

Improves retrieval of trained words (nouns)
Little generalization to untrained words
Effects for conversational abilities untested

Semantic Cueing Treatment
Wambaugh et al., 1999, 2001-2003

Prestimulation: Which of these is used to make juice in Florida?
Cueing hierarchy: picture presented alone
What is this?
Semantic cue:
To make juice we squeeze a juicy ripe Florida orange

Phonologic Cueing Treatment
Wambaugh et al., 1999, 2001-2003

Prestimulation: Which of these sounds like ‘kell’?
Cueing hierarchy: picture presented alone
What is this?
Phonologic cue:
It sounds like ‘kell’; it starts with ‘k’.
Repetition cue: “bell”

Semantic & Phonologic Cueing Treatment
Wambaugh et al., 2001-2003

- Small number of cases
- Both treatments led to improved naming of trained words – use it to improve it
- Improvements occur for nouns and verbs
- Improvements occur in individuals with semantic, phonologic, and mixed anamias
- Little generalized improvement in discourse measures

Cueing Hierarchy Training: Personalized Cues (salience)
Marshall, Freed and colleagues 2001, 2002

Contrasted word retrieval training effects when using:
- Personalized cues (i.e. phrase developed by client)
- Phonologic cues (i.e. provided by clinician)

Both types effective for improving picture naming
Personalized > Clinician Chosen Phonologic

Personalized cues with semantic information
(e.g. my whiskers need a... razor)
better than
Personalized cues with phonologic information
(e.g. sun rays... razor)

Cueing Hierarchy Training:
Computer Application: MossTalk Words
Fink et al. (2002)

- 6 patients with mod to severe phonologically-based naming impairments
- Computerized phonologic cueing hierarchy training
- Clinician guided versus Partial Self-guided
- 5/6 improved trained picture naming
- 2/6 small improvements for untrained
Cueing Training: Predicting Treatment Response
Conroy et al. (2012)

22 patients with aphasia from 3 prior studies:
mild to severe naming impairments

Training: progressive phonemic & orthographic cues

Examined:
1) Length of phonemic cues needed to facilitate accurate naming at baseline
2) Naming accuracy at end of treatment
3) Naming accuracy at 5 wk follow up

Results:
- Words learned following tx had shorter phonemic cues needed at baseline
- Words maintained at follow up had shorter phonemic cues needed at baseline
- Suggests successful cueing may be used as a predictor of which words to select for communicative success in treatment

Alternative Restorative Treatments: Semantic Comprehension Training

Treatment tasks:
- Answer yes/no Qs: semantic attributes
  e.g. Does this have to do with a quarterback?
- Spoken word/picture matching*
- Written word/picture matching*
  *related distractors
    (e.g., basketball, bat, helmet)
- Category sorting (sports/clothing)

Semantic Comprehension Training: Evidence
Reviews by Ennis (2001); Nickels (2002)
7 studies (35 subjects)

Improved naming of trained nouns 17/20 (one group study)
Little generalization to untrained words
No evidence of effects in conversation

Treatment effects greatest when comprehension paired with production, i.e. semantic-phonologic training (Drew & Thompson, 1999)

Patients with semantic and phonologic word retrieval impairments respond in treatment

Semantic-Phonologic Training for Verbs (Rodriguez et al., 2006)
Noun vs Verb Retrieval (Raymer et al., 2007)

Answer yes/no Qs: pounding

- semantic attributes
  e.g. Is this similar to knocking?
  Does this have to do with a carpenter?

- phonologic attributes
  e.g. Does this start with /p/?
  Does this sound like mound?

Rehearsal phase: repeat 3 times

Semantic-Phonologic Training Effects for Noun versus Verb Retrieval in Aphasia
Raymer et al. (2007)

- 8 individuals with aphasia and word retrieval impairments for nouns and verbs
- Single participant multiple baseline design:
  One phase noun training; one phase verb training (order counterbalanced)

Main outcome measure: Picture Naming
Trained/Untrained Nouns
Trained/Untrained Verbs

Predict differences between nouns and verbs
Picture naming accuracy/Effect sizes: d = Mean A2 - Mean A1/SD A1

>2.5 small effect  >5.8 large effect

Pre-treatment predictors  **p<.01

<table>
<thead>
<tr>
<th></th>
<th>Effect Size Verb Tx</th>
<th>Effect Size Noun Tx</th>
</tr>
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<tbody>
<tr>
<td>WAB Aph Quotient</td>
<td>.31</td>
<td>.42</td>
</tr>
<tr>
<td>WAB Naming</td>
<td>.87**</td>
<td>.91**</td>
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<tr>
<td>WAB Repetition</td>
<td>.26</td>
<td>.36</td>
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<tr>
<td>WAB Aud Comp</td>
<td>.34</td>
<td>.38</td>
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<tr>
<td>BNT</td>
<td>.63*</td>
<td>.86**</td>
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<tr>
<td>ANT</td>
<td>.79*</td>
<td>.91**</td>
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<tr>
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Relationship to Changes on Secondary Outcome Measures  **p<.01

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<thead>
<tr>
<th></th>
<th>Effect Size Verb</th>
<th>Effect Size Noun</th>
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<tbody>
<tr>
<td>WAB</td>
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<td>BNT</td>
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<tr>
<td>FOQ</td>
<td>-.14</td>
<td>.60</td>
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<tr>
<td>CETI</td>
<td>.94**</td>
<td>-.60</td>
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<tr>
<td>ASHA-FACS Basic</td>
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<td>-.41</td>
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<tr>
<td>ASHA-FACS Social</td>
<td>.21</td>
<td>.66</td>
</tr>
<tr>
<td>% Nouns</td>
<td>.02</td>
<td>-.87*</td>
</tr>
<tr>
<td>% Verbs</td>
<td>-.14</td>
<td>.14</td>
</tr>
</tbody>
</table>

3 Nonresponders

- Severity of word retrieval impairment influential 3 severe naming impairments
- Broca's: severe apraxia of speech/fluency
- Nature of impairment partly important 2/3 severe semantic impairment

By the way ....
- Time post stroke: not influential 2/3 earliest post stroke in the sample

Computerized Semantic Training: MossTalk Words MultiMode Matching

Raymer et al. (2006)
2 patients with severe semantic anoma
3 with phonologic access anoma

12 sessions training: Word/picture matching modules written/picture matching spoken word/picture matching spoken word/written word matching *semantically-related distractors

- trained 3-4 times per week on one phase
- trained 1-2 times per week in other phase

With clinician assistance
Multi-Modal Matching Tasks
- 4 choices: Semantically related foils
- E.g. "banana"
  - Touch screen for correct picture
  - Say the word aloud 3 times with clinician assistance

Computerized Semantic Training: MossTalk Words MultiMode Matching
Raymer et al. (2006)
Results:
- Improved comprehension for trained and untrained words in 1/2 when trained 1-2 times/wk
- Improved picture naming for trained words
  5/5 when trained 3-4 times/wk
  2/5 when trained 1-2 times/wk

Contextual Priming
Martin et al., 2004, 2006; Renvall et al., 2007
- Semantically related context
  - Match spoken name to picture – then repeat name several times
- Phonologically related context

Contextual Priming
Martin et al., 2004, 2006; Renvall et al., 2007
- Premise: thru massed repetition priming, leads to spreading of activation to semantically and phonologically related words
- Initially during training - may lead to interference in naming across related items
- Over time – see improved naming of trained items
- Best effect in patients with preserved semantic abilities

Semantic-Phonologic Treatments
Summary
Large effects for trained words
Less potent generalized training effects to untrained words
Greater effects for phonologic anomia than for semantic anomia
Despite neural differences, no apparent differences between nouns and verbs
Limited activity/participation outcomes

Semantic Feature Analysis Training
- Group
- Use
- Action
  - Target Picture
    - Properties
    - Location
    - Association
### Semantic Feature Analysis Training

**Noun Retrieval**

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample Size</th>
<th>Condition</th>
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</thead>
<tbody>
<tr>
<td>Boyle &amp; Coelho, 1995</td>
<td>n=1</td>
<td>Bro</td>
</tr>
<tr>
<td>Boyle, 1997</td>
<td>n=2</td>
<td>anom/Wern</td>
</tr>
<tr>
<td>Coelho et al, 2000</td>
<td>n=1</td>
<td>fluent</td>
</tr>
<tr>
<td>Lowell et al, 1995</td>
<td>n=3</td>
<td>2 cond/1 anom</td>
</tr>
<tr>
<td>Boyle, 2004</td>
<td>n=2</td>
<td>Wern.</td>
</tr>
<tr>
<td>Rider et al, 2008</td>
<td>n=3</td>
<td>nonfluent</td>
</tr>
<tr>
<td>Hashimoto &amp; Frome, 2011</td>
<td>n=1</td>
<td>nonfluent/AoS</td>
</tr>
<tr>
<td>Wallace &amp; Kimelman, 2013</td>
<td>n=3</td>
<td>2 nonfluent/1 fluent</td>
</tr>
</tbody>
</table>

### Semantic Feature Analysis Training

- Trained picture naming: 15/16 improved
- Untrained picture naming: 9/16 improved
- Connected speech: 7/10 improved

*All studies trained noun retrieval*

### SFA Group Training

Antonucci, 2000

- 3 participants with aphasia
- SFA provided during group format (2x/wk) in discourse tasks
- Results: 2 improved lexical use in discourse measures

### Semantic Feature Analysis Training: Verbs (Wambaugh & Ferguson, 2007)

- **Subject**: N=1 anomic aphasia
- **Purpose**: Improved trained verbs and discourse measures
- **How**: Properties, Location, Association

### Surprise: Training with Atypical Exemplars

Kiran & Thompson, 2003; 2007; Waters et al., 2006

- e.g. Kiran & Thompson 2003
- 4 individuals with fluent aphasia and word retrieval deficits

Semantic training within categories: (birds, vegetables)
Contrasted training targets: typical vs atypical examples
- typical (n=8): robin, carrot
- atypical (n=8): ostrich, artichoke

Results:
- Typical trained: little generalization to untrained atypicals
- Atypicals trained: greater generalization to untrained typicals!

### Computerized Training across Semantic Categories: MossTalk Words

Raymer et al. (2009)
- 2 pts with phonologic anomia; 2 pts mild semantic anomia

10 sessions training: Multi-mode modules
- (written and spoken word/pictures)
- Trained two categories of words at a time
- Most typical exemplars

Results:
- 3/4 Improved naming trained words
- 1/4 improved naming across semantic category
- No clear within category generalization
- 3/4 Improved on WAB (comprehension subtests)
Repetition Matters: Train for Many Sessions

Some studies report generalized improvement in picture naming for untrained words
McNeil et al 1998
Richards et al 2002
Spencer et al 2000

Common element?
Many, many training sessions

Intensity Matters
Baker (2012); Warren, Fey & Yoder (2007)

Dose/Tries

Session
Duration

Days

Dose
Frequency

Intensity
Duration

Cumulative Intensity = 30 trials x 5 days/wk x 3 wks
= 450 productions

Intensity of Treatment
Hinckley & Craig (1998)

Retrospective group analyses of aphasia treatment
No therapy
Intensive speech therapy (23 hrs/wk for 6 wks)
Non-intensive therapy (2-3 hrs/wk for 6 wks)

Outcome: Boston Naming Test scores

Result: Effect sizes
Intensive therapy: very large effect sizes
Non-intensive therapy: no effect to small effect
No therapy: small effect

Problem: Confounded amount/cumulative intensity and intensity/dose frequency

Intensity of Treatment
MossTalk Computerized Semantic Comprehension Training
Raymer et al. (2006)
n=5 participants with aphasia
12 sessions of training – 2 intensities (dose freq)
Improved picture naming
Trained words 2/5 ↑ when trained 1-2 times/wk
5/5 ↑ when trained 3-4 times/wk
Untrained words 3/5 ↑ for untrained during 3-4 times/wk
*Higher dose frequency potent

Intensity of Treatment
MossTalk Cueing Hierarchy Training
Ramsberger & Marie (2007)

4 participants: varied forms of aphasia
Independent computer training
compared 5 times/wk vs 2 times/wk - 10 sessions
*Dose frequency varied

3/4 Improved trained picture naming int & non-int
2/3 greater improvements for intensive tx
1/4 generalized to untrained picture naming
- during intensive tx
*More ambiguous dose frequency

Intensity of Treatment
Maintenance of Effects
Sage et al., 2011

Case Series: n=8 pts with aphasia
Training for 10 sessions:
phonemic and orthographic cues
5x/wk for 2 wks vs 2 x/wk for 5 wks

Results: Picture Naming
Acquisition: Intensity effect: Both improved
No intensity difference
Maintenance: Non-intense > Intense
### Amount of Training: Dose

**How many words to train?**

- Laganaro et al., 2006
- Snell et al., 2010

**Case series:** participants with aphasia

- Laganaro et al.: n=8
- Snell et al.: n=13

Training with phonemic and orthographic cues

**2 Training phases:**

- Snell et al.: 20 words vs. 60 words
- Laganaro et al.: 48 words vs 96 words

### Amount of Training: 

**How many words to train?**

- Laganaro et al., 2006
- Snell et al., 2010

**Results:** Picture Naming – both studies similar pattern

- Significant improvement only for trained words
- No difference for proportion of words learned in low vs high # of items trained
- Significantly more words learned for high over low
- Snell et al.: Severity of anomia
  - Severe had smaller gains than mild

### Increasing Dosage: Independent Home Practice

**Mason et al., 2011**

**Home practice using PowerPoint presentation of 60 personally selected words/pictures with embedded audio file of object name:** repetition practice

- 28-30 words for 8 sessions over 2 weeks – 2 tx phases

**3 participants with aphasia:**

- 1 phonologic anomia
- 2 semantic anomia

### Increasing Dosage: 

**Independent Home Practice**

**Mason et al., 2011**

**Results:** Naming

- trained words: 2 of 3 improved
- control words: 0 of 3 improved

- Less improvement in pt with severe semantic anomia
- Naming improvements not as great as clinician-directed treatment
- Pt with phonologic anomia improved in use of target words in conversation

### Errorless Training: Origins

- Animal literature teaching pigeons to discriminate colors (Terrace, 1963)

- Children with mental retardation teaching concepts (Sidman & Stoddard, 1967; Walsh & Lamberts, 1976)

- First applied in acquired brain damage for individuals with severe memory impairments (amnesia) by Wilson and colleagues (Beddowley & Wilson, 1994; Wilson & Evans, 1996)

- Errorless training effects > Errorful training

### Implicit/Procedural vs Explicit/Declarative Neural Mechanisms
Error Production During Naming Training
Fillingham and colleagues (2003)
- first examined impact of error production in aphasic word retrieval training
- Rationale: Hebbian Learning
  (different rationale from the one used in memory rehabilitation)

Errorless Training and Aphasia
Fillingham and colleagues (2003)
- under conditions of brain damage, Hebbian learning principles become predominant.
  - If so, trial and error learning may reinforce errors
  - It may be preferable to avoid error production during rehabilitation

Errorless Training Literature Review
Fillingham et al 2003
- Reviewed studies: divided into methods that were ‘error-reducing’ (somewhat errorless) vs ‘errorful’
- Studies employing error-reducing methods were just as effective as errorful treatments for improving word retrieval in patients with aphasia.
- Treatment effects best in individuals with ‘expressive’ impairments; more limited in ‘expressive-receptive’ impairments

Errorless Training Literature Review
Fillingham et al (2005a,b; 2006)
- Patient views a target picture and written word; the clinician also provides the spoken name of the picture
- Patient has multiple opportunities to rehearse the correct name of the target
- Patient told not to say word unless sure they are producing it correctly
- Picture allows activation of semantic mechanisms and name repetition draws upon phonologic skills, therefore approach generally considered restorative

Errorless naming treatment
Fillingham et al (2005a,b; 2006)
Results:
- Naming improvements for trained words
- No improvements for control words
- No difference for errorless vs errorful conditions
- Most patients improve, tho a few patients do not
- Executive/problem-solving skills and monitoring abilities correlated with improvements

Errorless naming treatment:
Nouns vs Verbs
Conroy et al. (2008)
Case series: n=9 pts. w/ aphasia; noun and verb retrieval impairments
- Only included pts. who could repeat words well
- Compared effects of errorless and errorful training for nouns and verbs
  - Results: Picture naming
    - Both errorless and errorful training improved naming for trained nouns and verbs
    - Most severe pts - gains nouns > verbs
    - No generalized improvements
  - Conclude that errorless training more time efficient method
Variation of errorless training:
Spaced retrieval training
Fridriksson et al. 2005; Morrow & Fridriksson, 2006
- Approach also comes from memory rehab literature
- Recall information over systematically longer time intervals
- Train naming of 3 personally relevant words per session
- Repeat names
- 1 minute later re-attempt naming
- If correct, double the time – 2 min, 4 min, 8 min, 16 min
- If incorrect, halve the time

Spaced Retrieval Training
Fridriksson et al 2005
N=3 pts w/mild-mod aphasia/anomia
Repetition training: 2 sessions/wk
Practice 3 words per session (15 words total)
name correctly, then reattempt at 1 min, 2 min, 4 min, 8 min, 16 min
if remember at next session, introduce new words
Results: Spaced retrieval > Cueing hierarchy
fewer sessions needed
more words learned
Labor intensive for the clinician

Restorative Word Retrieval Treatments:
for Aphasia: Meta-Analysis
Wisniewski & Mahoney (2009)
Purpose/Questions
- What therapies work best for word-finding?
  Trained versus Untrained Words?
- Maintenance of gains?
- What is relationship between TPO and gains?

Restorative Word Retrieval Treatments:
Synthesizing Evidence thru Meta-Analysis
Wisniewski & Mahoney (2009)
- Reviewed 47 treatment studies for word retrieval in aphasia (3 eventually excluded)
- Coded treatments as primarily semantic (n=17),
  primarily phonologic (n=15), or mixed sem+phon (n=16)
- Examined words stats in picture naming:
  trained, exposed-related, exposed-unrelated,
  unexposed-related, unexposed-unrelated
- Calculated unbiased effect sizes (d)
  107 effect sizes across 44 studies

Restorative Word Retrieval Treatments:
Synthesizing Evidence: Meta-Analysis
Wisniewski & Mahoney (2009)
Effect size results:
- Trained words (n=45): 2.66 ± 3.23
- Related-exposed (n=9): 1.73 ± 1.06
- Unrelated-exposed (n=14): 1.78 ± 2.02
- Unexposed-unrelated (n=37): 0.44 ± 0.52
- Unexposed-related (n=2): 0.44 ± 0.13
Trained Words
- Semantic tx (n=17): 1.90 ± 1.42
- Phonologic tx (n=14): 4.06 ± 5.30
- Mixed sem+phon tx (n=15): 2.17 ± 1.31

Restorative Word Retrieval Treatments:
Synthesizing Evidence: Meta-Analysis
Wisniewski & Mahoney (2009)
Follow-up effect sizes:
- Immediate post-treatment (n=79): 1.61 ± 2.52
- 1 month post-treatment (n=18): 2.39 ± 2.69
- 2 months post-treatment (n=6): 1.04 ± 0.64
- 3 months post-treatment (n=4): 0.48 ± 0.33
Months post aphasia onset
- >6 (n=7): 0.53 ± 0.40
- 7-12 (n=22): 1.55 ± 2.04
- 13-18 (n=9): 1.78 ± 1.33
- >19 (n=12): 1.71 ± 1.62
- 25-36 (n=15): 1.57 ± 1.32
- 37-48 (n=10): 0.73 ± 0.65
- >49 (n=18): 1.66 ± 1.44
Quality of the Review
Wisenbume & Mahoney (2009)

- Criteria pertaining to Systematic Review: fair
- Criteria pertaining to Meta-analysis: better
- Fairly confident in the statistical conclusions of the review favoring word retrieval training, particularly phonologic approaches, for trained picture naming
- Notice – no review of the methodologic quality of the studies included in the meta-analysis

Cognitive Neuropsychological Model of Limb Praxis (Rothi et al., 1997; Heilman et al., 2006)

Use of Gesture to Facilitate Communication

- Reorganization approach to treatment to facilitate improvement of language abilities
- Compensatory strategy to circumvent blocks in communication
- Problem to consider: Limb Apraxia

- Important to consider limb apraxia, as it may impede the use of gesture for compensatory communication
  - Severe ideomotor apraxia
  - Conceptual apraxia

Reorganization Approaches: Verbal + Gestural Treatment

Raymer 2001 reviewed 9 studies n=16 participants
Rose et al 2002 n=1 Improvements

- Naming (nouns) 14/17
- Gestures 15/15

Who didn't improve? Severe apraxia of speech

Pair pantomime + word to facilitate word retrieval
Rehearse pantomime: pounding the nail
-manipulate limb if necessary
Rehearse spoken word production: pound
Pair pantomime and spoken word production
**Reorganization Approaches: Verbal + Gestural Treatment**

- Prior research focused on noun retrieval
- Neural networks for gesture tend to be more tightly linked to verbs than nouns (Druks, 2001)
- Are verbal+gestural treatment effects greater for verbs than nouns?

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**Verbal+Gestural Training Effects for Nouns versus Verbs**

- 9 individuals with aphasia and word retrieval impairments for nouns and verbs
- Single participant crossover design (order counterbalanced)
- Verbal+Gestural Training 10 sessions: verbs vs nouns
- Outcomes:
  - Picture naming, Gesture production:
    - trained and untrained nouns and verbs
  - Videotaped Conversations

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**Naming: Nonresponders vs Responders**

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<th>Noun retrieval Impairment</th>
<th>Verb retrieval Impairment</th>
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<tr>
<td>Respond</td>
<td>Respond</td>
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<tr>
<td>Sem Phon</td>
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<table>
<thead>
<tr>
<th>Treatment effects</th>
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<tr>
<td>Phonologic impairment &gt; Semantic impairment</td>
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<tr>
<td>Within semantics: Mild &gt; Severe</td>
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- No improvement:
  - fluent aphasia/ severe semantic impairment

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**Influence of Limb Apraxia**

- No significant correlation between treatment outcomes and limb apraxia
- Most participants improved gesture production, regardless of apraxia severity
- That is, limb apraxia is amenable to treatment
**Conversational Gestures**

**Significant Correlations**

Raymer et al 2006

- Effect sizes for Untrained Verb Gestures & Total Gesture Use ($r=.76$, $p=.02$)
- Effect sizes for Untrained Noun Gestures & Total Gesture Use ($r=.94$, $p=.00$)
- If participant generalized gesture use in constrained picture naming task, also saw increased gesture use in conversations

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**Problem: Pantomime treatment confounds symbol & movement**

Hanlon et al., 1990

- Nonsymbolic limb movements may enhance word retrieval
  - nonfluent named better when producing distal flexing movements of right hand

Rose & Douglas, 2001

- Iconic gestures > visualization, pointing or cued articulation gesture (pointing to mouth)
  - only in patients with phonologic retrieval impairments

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**Think about MIT**

- In addition to intonation during training, the clinician taps with the patient’s left hand.
- Is tapping playing an important role in MIT effects?
- Boucher et al 2001
  - Tones vs rhythmic hand tapping effects during sentence repetition training
  - Hand tapping was as effective as intonation alone during training
  - Is simply movement of the limb sufficient to incite word retrieval changes, without an actual pantomime?

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**Intentional Treatment for Word Retrieval**

Richards, Crosson et al., 2002; Crosson et al., 2007

**Premise:**

- Left hemisphere mesial frontal region (pre-SMA) critical during initiating of language
- If damaged or disconnected from left frontal language regions, disrupts ability to initiate language production

**SMA**

If move left limb in a complex action, can activate right pre-SMA regions.

If use left limb movements during word retrieval, perhaps right pre-SMA might facilitate initiation of production – intentional treatment

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**Intentional Treatment for Word Retrieval**

Richards, Crosson et al., 2002; Crosson et al., 2007

During naming practice, patients perform complex movement:
- reach into a box and push button, eventually reduce movement to a circular movement
- left hand in left space

Richards et al. 2002: 8 patients with nonfluent aphasia

7 of 8 improved picture naming for trained words
Some improvements for untrained words
Intentional Treatment for Word Retrieval
Crosson et al. (2007)

34 patients with mod-profound word retrieval impairments
10 intentional treatment sessions: 5x/wk

Results:

<table>
<thead>
<tr>
<th></th>
<th>% improvement picture naming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trained</td>
<td>20.23%</td>
</tr>
<tr>
<td>Untrained</td>
<td>15.86%</td>
</tr>
<tr>
<td>Mod-severe group</td>
<td>9.50%</td>
</tr>
<tr>
<td>Profound group</td>
<td>2.73%</td>
</tr>
</tbody>
</table>

Conclusion: Complex limb movement, not necessarily pantomime, may be sufficient to incite training effects

Contrasting Pantomime and Intention Treatments
Ferguson et al. 2012

- n=4 pts with aphasia/anomia
  2 Bro, 1 TMA, 1 cond; 3 of 4 with signif limb apraxia
- Single-pt crossover design:
  10x sessions/phase 2-3 sessions/wk
- Verbal+Gestural tx vs Intentional tx - counterbalanced

Outcomes:
- Picture naming - nouns
- Gesture production
- Standardized aphasia tests

Contrasting Pantomime and Intention Treatments
Ferguson et al. 2012

Results
- Picture Naming Improvements:
  Trained: 2 of 4 intention tx; 0 of 4 pantomime tx
  Untrained: No Improvements
- Gesture Prod Improvements:
  Trained: 3 of 4 pantomime tx; 1 of 4 intent tx
  Untrained: 1 of 4 pantomime tx; 1 of 4 intent tx
- Standardized Aphasia Tests:
  WAB: 2 of 4 improved
  BNT: 1 of 4 improved

No relationship between Naming Gains and Test scores

Reorganization Gesture Treatments:
Results
Rose et al. (2013)

- 134 participants: 83.6% nonfluent aphasia
- Symbolic movements: 19 studies
- Nonsymbolic movements: 4 studies
- Gestures trained in isolation in 4 studies
- Most trained gestures along with verbal production
- Treatment administered 2-3 x/wk: 6.5-32 hrs total

Symbolic Gesture Training Results:
Rose et al. (2013)

Verbal+Gesture Training Verbal Improvements:
- Picture naming trained nouns: 22/42 subjects
- trained verbs: 11/15 subjects
- Untrained nouns & verbs: 3/51 subjects
- Standardized naming test: 9/30 subjects
- Standardized aphasia battery: 18/35 subjects
- Narrative tasks incr verb use: 7/10 subjects
- Incr noun use: 4/6 subjects

Improvements greater for V+G > Gesture only treatments

Conversations of 7 Crosson et al subjects coded for gesture use; Predicted increased use of filler gestures – but found somewhat fewer gestures

Conversational Gestures/Minute
Pre vs Post Intentional Training

T-test: No significant differences pre vs post
Nonsymbolic Gesture Training Results:
Rose et al. (2013)

Verbal+symbolic Gesture Training Verbal Improvements:
Picture naming trained nouns: 57 subjects & 1 grp study
Untrained nouns: 3/7 subjects & 1 grp study
Standardized naming test: 1/4

Verbal+Gesture vs Verbal Training Results: Gesture Improvements
Rose et al. (2013)

Picture task trained wds: 13/19 subjects —
Untrained wds: 4/16 subjects —

Quality of the Review
Rose et al. (2013)

- Criteria pertaining to Systematic Review: fair
- Criteria pertaining to Meta-analysis: fair
- Fairly confident in the conclusions of the review favoring verbal+gesture training for improvement of naming for trained words, verbal communication and gesture use
- Whether V+G better than verbal only is not clear at all
- Effects best in pts. with retained semantic abilities

To summarize....

- Aphasic word retrieval can be facilitated through use of
  - Gestural pantomimes – verbal-gestural treatment
  - Nonsymbolic left limb movements – intentional treatment
  - Possibly intentional-gestural for naming
- Advantage of pantomimes: compensatory communication
- Advantage of nonsymbolic movements: more generalizable; can be use for any conversational topic
- Need to be aware of limb apraxia as it may disrupt ability to use gesture as a compensatory strategy.

Semantic-phonologic vs Gestural Pantomime Treatments
Raymer et al. 2007 - Nouns
Rodriguez et al. 2006 - Verbs

- Verb study: n=4  Noun study: n=4
- Single participant crossover design
- Sem/Phon and Gesture Tx phases counterbalanced
- Outcomes:
  - Picture naming; Gesture production
  - Conversational word use (del Toro et al.)

Semantic-phonologic vs Gestural Pantomime Treatments
Raymer et al. 2007 - Nouns
Rodriguez et al. 2006 - Verbs

Results

<table>
<thead>
<tr>
<th>Verb study</th>
<th>Noun study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trained picture names</td>
<td>Sem/phon tx</td>
</tr>
<tr>
<td></td>
<td>gesture tx</td>
</tr>
<tr>
<td>Untrained picture names</td>
<td>0</td>
</tr>
<tr>
<td>Trained gestures</td>
<td>gesture tx</td>
</tr>
<tr>
<td></td>
<td>Untrained gestures</td>
</tr>
</tbody>
</table>
Semantic-Phonologic vs Gestural Pantomime Treatments
Discourse Changes
del Toro et al. 2008
Evaluated conversational discourse from pts in prior studies of sem/phon tx (n=6) and gesture tx (n=8) for nouns and verbs
Conversational measures: hobbies, events
Picture discourse: famous people, events
Coded samples for:
Proportions of nouns & verbs, lexical diversity, units of new information (UNI), grammatical sentences

Results:
Proportions of
nouns no changes
verbs no changes
lexical diversity no changes
Gram. Sent. ↑ sem/phon tx
UNIs ↑ sem/phon tx ↑ gesture tx

Errorless Naming Tx vs Verbal+Gesture tx
Raymer et al. 2012
- N=8 pts with aphasia;
  3 sem anomia/5 phon anomia
- Single pt crossover design: 20 tx sssions/phase
- Compared ENT and V+G Training
- Outcomes:
  Naming, gesture production, standardized aphasia tests; communication rating scales

Results:
<table>
<thead>
<tr>
<th>ENT tx</th>
<th>V+G tx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trained picture names 6/8 ↑ 3/8 ↑</td>
<td></td>
</tr>
<tr>
<td>Untrained picture names 2/8 ↑ 2/8 ↑</td>
<td></td>
</tr>
<tr>
<td>Trained gestures 0 6/8 ↑</td>
<td></td>
</tr>
<tr>
<td>Untrained gestures 1/8 ↑ 3/8 ↑</td>
<td></td>
</tr>
<tr>
<td>WAB Aphasia Quotient 4/8 ↑ 3/8 ↑</td>
<td></td>
</tr>
<tr>
<td>Boston Naming Test 2/8 ↑ 5/8 ↑</td>
<td></td>
</tr>
</tbody>
</table>

Verbal+Gesture vs Verbal Training
Results: Verbal Improvements
Rose et al. (2013) systematic review

| Picture naming trained wds: 18/28 subjects 23/28 subj |
| Untrained wds: 3/22 subjects 2/22 subj |
| Standardized naming test: 5/8 subjects 2/8 subj |
| Standardized aphasia battery: 3/8 subjects 2/8 subj |
| Comm. questionnaire: 2/6 subjects 2/6 subj |

Restorative Sem/Phon vs Reorganization Gesture Treatments
No clear difference between treatments in verbal improvements for noun retrieval, although some suggestion of sem/phon > gesture tx for verb retrieval

Treatments associated with modest improvements in discourse measures

Factors that Limited Verbal Improvements
Severe semantic impairment
Severe apraxia of speech
Constraint Induced Language Therapy (CILT)  
Pulvermuller et al. 2001

- Forced verbal language use
  - Verbalization required
  - Compensatory strategies discouraged

- Intensive treatment schedule
  - 3 hrs/day 5 days/week 2 weeks
  - Massed practice

- Shaping verbal responses
  - Begin with words or short phrases
  - Move to longer and more complex utterances
  - Barrier games - *Go Fish*-like activity; pictures selected for individual participants; response components predetermined

Constraint Induced Language Therapy (CILT)  
Pulvermuller et al., Stroke, 2001

Compared Intensive forced language group vs nonintensive traditional bx group

Results: CILT > traditional aphasia battery, auditory comp and naming

Are the results due to forced language use or intensive treatment schedule?

Forced Language Use?  
CILT versus PACE: Intensive  
Maher et al. 2006

PACE=Promoting aphasics' communicative effectiveness  
(Davis & Wilcox, 1983)

CILT: N = 4  
PACE: N=5

TX: 4 days/week, 3 hours/day, 2 weeks = 24 hrs total

i.e., intensity the same, differ in whether using compensatory strategies

Forced Language Use?  
CILT versus PACE: Intensive  
Maher et al. 2006

CILT: N = 4  
PACE: N=5

WAB improved: 3/4 CILT, 1/5 PACE  
BNT improved: 3/4 CILT, 0/5 PACE  
ANT improved: 2/4 CILT, 1/5 PACE

*Intensity also plays a role

Here's Some Evidence....

Several effective methods available for treatment of word retrieval impairments:  
restorative and reorganization

Effects are mostly training specific unless provided in intensive or extended schedules

How can we extend our treatment effects given limited treatment resources?  
computers  
groups  
caregiver training
Raymer Partial References


