Cognitive-Linguistic Processes in Aphasia

Cognitive and linguistic Processes in Aphasia
- Attention
- Memory
  - Short term memory
  - Working memory
- Executive functions
- Cognitive impairments in aphasia

Language plays a role in Cognition.
Cognition is related to Language.
Attention

• “Cognitive process that concentrates mental effort on an external stimulus or internal thought/representation” (Ashcraft & Radvansky, 2010)

• Overlaps with other aspects of cognition

• If attention is weakened then language operations become less efficient
• Need attention to focus on communication partner’s speech, particularly when surrounded by competing stimuli

• Arousal –
  – Basic level of attention
  – Physiological state
  – General readiness to act/receive
  – Necessary for intentional communication to occur
  – Supports vigilance
• Vigilance
  – Attention sustained over long periods of time
  – Necessary to hold a conversation
  – Critical for language production and comprehension

• Intention --- Attention
  – I intend to carry on a conversation with you so I need to attend to what you say.

Attention and Aphasia

Symptoms of aphasia are due to impairments in attention mechanisms (Hula & McNeill)

Impaired linguistic & attention mechanisms contribute to symptoms present in aphasia (Crosson)
• Adults with aphasia have more difficulty with divided attention tasks →
  – Attention allocation inefficiency
• Damage to a diffusely-represented attentional network (frontal and posterior regions)
• Greatest decrements when linguistic processing demands are competing for verbal attentional resources
• Attention impairments negatively affect spoken language abilities in mild aphasia

Memory

• Retention beyond the “life” of the stimulus (Davis, 2012)
• Linking information from different parts of a sentence, different parts of a conversation, different parts of a story, etc... requires some type of memory
  – Short term memory
  – Working memory
  – Episodic & semantic memory

Memory Systems

STM
WM
LTM
Phonological STM
Lex/sem STM
Declarative
Procedural
Semantic
Episodic

Martin & Slevc (2012) p. 184, Fig. 9-1
• Short-term memory
  — Static store
• Working memory
  — Active memory
  — Limited capacity
  — “work space” for cognitive activity (Baddeley, 2009)

• WM and language comprehension
  — Discourse comprehension is WM demanding
  — Language comprehension breakdowns occur when WM capacity is “exhausted” by simultaneously holding and processing information
    • But... not always the case

• Declarative Memory
  — Semantic memory: shared knowledge
    • E.g., knowledge that cream and sugar are often added to coffee
  — Episodic memory: personal knowledge
    • E.g., knowledge that my Starbuck’s order is Grande Pike coffee with three Splendas and half-n-half
Memory and Aphasia

- Impaired on simple span tasks that involve word list recall
  - Normal: 7 digits, 5 words
  - Aphasia: 1-3 digits/words
  - Digits > words > nonwords

- Language-based approach to STM...
  - -> phonological and semantic information support word list retention
- STM deficits on comprehension
  - Phonological STM deficit has few consequences
  - Semantic STM deficit negatively affects sentence comprehension and production

- Adults with aphasia present with a WM deficit
  - -> contributes to their language processing impairments
- Across the severity continuum
  - Adults with mild aphasia present with impaired WM and verbal memory abilities (e.g., Ronenberg et al., 1996; Ween et al., 1996)
- Discourse comprehension is WM demanding
• Clinical implications for verbal memory impairments... consequences for functional communication
  – c/o of language difficulty in day-to-day conversation

Executive Functions

“little person in the head to direct behavior” (Andrewes, 2001)

• Elements of executive function include
  – Initiation
  – Goal maintenance/task persistence
  – Organization
  – Awareness, self-monitoring, flexibility

Norman & Shallice (1986)
• Frontal lobe plays a role in executive functions
  • Patients with left frontal lesions more likely to have impaired EF
    — Affects prognosis and recovery
    — Affects appropriateness of certain treatments
    — Affects prescribed amount of treatment
      • Typically patients with impaired EF take longer to reach treatment criterion levels

• Impaired cognitive flexibility
  — Resistant to using alternative modes to communicate
  — Affects functional communication

Cognitive Processes and Aphasia
• Adults with aphasia may present with
  — limited WM capacity
  — impaired attention-control processes
  — impaired inhibitory mechanisms
  — impaired cognitive flexibility and executive functions

  Affects language comprehension & production, and functional communication
Evidence-Based Methods for treating Cognitive-Linguistic Impairments in Aphasia

Evaluating Cognitive-Linguistic abilities

- Attention
- Memory
- Executive functions

- Cognitive impairments in memory, attention, and executive functions can affect functional communication
- Negative effects on rehab process
  - Less likely to benefit from behavioral treatment
  - Slower recovery
  - Poorer functional outcomes
• Assessment of cognitive disorders and communication impairments

  (1) Interview, observation, informal assessment
  (2) Standardized tests of cognitive processes
  (3) Standardized tests of language and communication
  (4) Non-standardized tests of language and communication

• During the interview
  – Compare information obtained
• When possible, observe patient in informal/unstructured environment
  – See how cognitive deficits impact in “non-pristine” environment

Screenings for Cognitive Disorders

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognistat</td>
<td>Kiernan et al. (1995)</td>
</tr>
<tr>
<td>Cognitive-Linguistic Quick Test</td>
<td>Helm-Estabrooks (2001)</td>
</tr>
<tr>
<td>Frontal Behavioral Inventory</td>
<td>Kertesz et al., (1997)</td>
</tr>
<tr>
<td>Mini-mental State Examination</td>
<td>Folstein et al. (2001)</td>
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</tbody>
</table>
General Cognitive Function Tests

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neuropsychological Assessment Battery</td>
<td>Stern &amp; White (2003)</td>
</tr>
<tr>
<td>Ross Information Processing Assessment - 2</td>
<td>Ross-Swain (1996)</td>
</tr>
</tbody>
</table>

Cognitive Domain Batteries

- Useful for evaluating a number of skills within one domain
- Provide detailed information
- Informative for identifying specific treatment goals

Attention

- Unstructured methods – interview and observational
- Structured methods – scales, standardized tests
- Potential challenge
  - Most attention measures are multifaceted
• Attention impairments are typical in most types of brain damage
• Criticisms of methods for assessing attention in aphasia
  – They use linguistic stimuli so may be confounded & invalid (Murray)
  – But... linguistic stimuli should be used to provide insight regarding influences of one process on another (McNeil & Hula)

• Attention test batteries
  – Brief Test of Attention (Schretlen, 1997)
  – Test of Everyday Attention (Robertson et al., 1994)

• Ecological outcome measures
  – Rating Scale of Attentional Behaviour (Ponsford & Kinsella, 1991)
  – Cognitive Failures Questionnaire (Broadbent et al., 1982)
Memory

- Wechsler Memory Scale-III or IV (Wechsler, 1997; 2009)
  - Episodic memory
  - Working memory
  - Nonverbal & verbal memory
- Rivermead Behavioral Memory Test-III (Wilson et al., 2008)
  - Everyday memory activities

- Temple Assessment of Language and Short Term Memory in Aphasia (Martin et al, 2010)
  - Part 1. Single and multiple word processing tasks with interval conditions
  - Part 2. Span measures with language variations


Verbal working memory

- Tompkins et al. (1994) Auditory-verbal working memory test

<table>
<thead>
<tr>
<th>2-sentences Set</th>
<th>5-sentences Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>You sit on a chair</td>
<td>Sugar is sweet</td>
</tr>
<tr>
<td>Trains can fly</td>
<td>Florida is next to Ohio</td>
</tr>
<tr>
<td>Birds can fly</td>
<td>Horses run in the sky</td>
</tr>
<tr>
<td>Twelve equals one dozed</td>
<td>Carrots can dance</td>
</tr>
<tr>
<td>Bicycles are slower than cars</td>
<td>Fish swim in water</td>
</tr>
<tr>
<td>A book can play</td>
<td>You sleep on a bed</td>
</tr>
<tr>
<td>Feathers can tickle</td>
<td>You eat breakfast at night</td>
</tr>
<tr>
<td>People have eyes</td>
<td>True</td>
</tr>
</tbody>
</table>

Sample stimuli from Tompkins et al’s A/V WM Test.
Executive Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Test</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>Maze subtest (CLOT)</td>
<td>Helm-Estabrooks (2001)</td>
</tr>
<tr>
<td>Organization</td>
<td>Tower Tests</td>
<td>E.g., Simon (1975)</td>
</tr>
<tr>
<td>Inhibition</td>
<td>Wisconsin Card Sorting Test</td>
<td>Grant &amp; Berg (1993)</td>
</tr>
<tr>
<td>Cog Flexibility</td>
<td>Comprehensive Trail Making</td>
<td>Reynolds (2002)</td>
</tr>
<tr>
<td></td>
<td>STROOP</td>
<td>Golden (2002)</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>TONI-3</td>
<td>Brown et al. (1997)</td>
</tr>
<tr>
<td></td>
<td>Ravens Progressive Matrices</td>
<td>Raven (1998)</td>
</tr>
</tbody>
</table>

Evaluating Cognitive Processes

- Adults with aphasia may present with concomitant cognitive deficits that negatively affect
  - Language abilities
  - Rehabilitation
  - Functional outcomes

Treatment of Cognitive-Linguistic Deficits in Aphasia

- Attention
  - Restorative approaches
    - Re-establish cognitive functions
  - Compensatory (specific-skills) approaches
    - Re-learning functionally important activities
- Memory
  - Direct treatments
  - Indirect treatments
Attention

- Commercially available attention training programs
  - Attention Process Training (Sohlberg & Mateer, 1986)
  - APT-II (Sohlberg et al., 2001)

- APT is
  - Theoretically motivated
  - Hierarchically organized

Following training with APT patients improved on standardized attention measures
- Patients early post stroke (Barker-Collo et al., 2009)
- Patients with ABI (Sohlberg & Mateer, 1987; Sohlberg et al., 2000)
- Patient with mild TBI [using APT-II] (Palmer & Raskin, 2000)

APT with Aphasia
- Coelho (2005) used APT-II with a 50 y.o. woman with aphasia
  - Improved on reading measures but not on WAB
- Sinotte & Coelho (2007) replicated the study with a 60 y.o. woman with mild aphasia
  - No remarkable change on measures
- Murray et al. (2006) used APT-II with a 57 y.o. man with conduction aphasia
  - No significant improvements
- Language-specific approach
  - Attention deficits associated with language processing require treatments that are language-based

**Principles for Language-Specific Attentional Training** *(Peach, 2012)*

1. Train attentional focus & resource management
2. Increase attentional demands
3. Automatize attentional recruitment for language
   a. practice
   b. focus
   c. feedback
4. Engage undamaged attentional mechanisms
5. Incorporate linguistic devices to focus attention

*Peach (2012), p. 265, Table 12-4*

1. Train attentional focus & resource management for language *(Hula & McNeil, 2008)*
   - Make sure tasks are language-based
2. Increase attentional demands *(Murray et al., 1998)*
   - Increase complexity of language-based tasks across intervention
   - Requirements of the task
3. Automatize attentional recruitment for language
   - Goal of treatment
   - Attended processing leads to automatic processing with practice (Carr & Hinckley, 2012)
   - Extensive repetition of language tasks to make language processes more automatic
   - Feedback: language tasks not attentional control

4. Engage attentional mechanisms in RH
   - With a simple task (picture naming) move stimulus presentation in left hemispace

5. Exploit linguistic devices known to focus attention
   - Alternate subject selection for sentence production
   - Sentence focus structure
   - Anaphoric reference

Example Treatment Exercise Hierarchy for Anaphoric Pronouns

1. John and Andy play and they make noise. (Step 1)

2. I saw two cookies. They were on the table. (Step 1)

3. Farmers like skunks because they eat bugs and mice. (Step 2)

4. Penguins have wings but they cannot fly. (Step 3)
   They use their wings to help them swim.
   Their legs are short and they walk funny.

Memory

• Theoretically...
  – Treating STM/WM impairments should remediate these impairments and indirectly improve cognitive and linguistic skills

• Because...
  – Overlap in neurophysiological circuitry

STM/WM Capacity Treatment

• Francis et al. (2003)
  – Sentence repetition treatment
  – Improved:
    • A/V Memory Span
    • Sentence repetition
    • Auditory comprehension
    • “catching on” faster at home
    • Decreased anxiety about memory problems

• Koenig-Brubin & Studer-Eichenberger (2007)
  – Sentence repetition treatment
  – Improved:
    • Sentence repetition
    • A/V span
    • Sentence length in discourse production increased
• Take home message...
  – STM/WM deficits respond to treatments with increasing repetition and delay
  – Why?
    • Increasing amount of information “stored”
    • Increasing time for “storing” and “rehearsing”

WM/CES Treatment
• Mayer & Murray (2002)
  – Multiple sentence tasks – grammaticality judgment & semantic category for final word
  – Improved:
    • A/V WM span
    • Reading rates
    • Reading comprehension

• Vallat et al. (2005)
  – Spoken manipulation tasks (e.g., naming from oral spelling, odd/even number of letters in words)
  – Improved
    • Span length
    • Math problem solving skills
    • ADLs (reading, writing, participation in social activities)
• Take home message
  – Manipulate treatment stimuli
  – Indirect effects on other cognitive & linguistic abilities

A little bit more...
• STM and WM are modifiable
• Indirect, positive effects on other cognitive-linguistic processes

Case Examples
Thank you!

Questions?