Successful Cognitive-Communication Rehabilitation for Young Individuals with Acquired Brain Injury

Presented at BIA-MA’s 37th Annual Brain Injury Conference
March 29, 2018

Natalie Gilmore, M.S. CCC-SLP, Lindsey Foo, M.A. CF-SLP, and Swathi Kiran, Ph.D. CCC-SLP
Workshop Goal

• To inform clinicians and caregivers about specific therapeutic activities for young individuals with acquired brain injury interested in pursuing higher education.
Learning Objectives

Following this presentation, participants will be able:

1. To learn evidence-based practice techniques for language and cognitive rehabilitation for young individuals with acquired brain injury
2. To assess outcomes of academic instruction in young individuals with acquired brain injury
3. To understand a few methods for teaching college-level material to young individuals with acquired brain injury
4. To use metacognitive strategy training in a functional context with young individuals with acquired brain injury
 Agenda

1. State of cognitive rehabilitation and transition to college services for young adults with acquired brain injury

2. Details of Intensive Cognitive-Communication Rehabilitation (ICCR) program
   1. Assessment
   2. Treatment
   3. Preliminary data from current participants

3. Question/Answer session
Acquired Brain Injury (ABI)

• ABI, due to stroke or traumatic brain injury (TBI), typically results in impairments of:
  • *Language* - e.g., speaking, listening, reading, writing
  • *Cognition* - e.g., attention, memory, executive functioning

    (Chapey, 2008; Cicerone et al., 2011; Kennedy et al., 2008; Sohlberg & Mateer, 1989)

• Deficits are often chronic (i.e., >6 months post onset; Cicerone et al., 2011; Kennedy & Coehlo, 2005)

• Young adults are a frequently affected and growing population within ABI (“TBI: Get the Facts,” 2017; “Young Stroke Survivors,” 2016)
  • This age-group would typically be involved in higher education, but that is often precluded by injury
Young adults with ABI and college

• College is difficult for this population due to cognitive-linguistic deficits
  • E.g., Executive dysfunction interferes with following a schedule and planning a study schedule

• College classroom and environment provides learning context
  • Can target discrete cognitive-linguistic skills, functional problem-solving, social communication, and independence

• Unfortunately, students with ABI who do return don’t seek out support services (Kennedy, Krause & Turkstra, 2008)

• Currently, Cognitive Rehabilitation (CR) is the gold standard therapeutic program for this population
Practice Standards/Guidelines for Cognitive Rehabilitation (CR)  
(Cicerone et al., 2011)

• Attention:
  • Direct attention training & metacognitive training after TBI

• Language & Communication:
  • Cognitive-linguistic therapy for language deficits post left hemisphere (LH) stroke
  • Interventions for functional communication impairment, including pragmatics post-TBI
  • Cognitive interventions for specific language impairments (e.g., reading comprehension & language formulation) post LH stroke or TBI
  • Treatment intensity = key factor in language rehabilitation post-stroke

• Memory:
  • Strategy training (i.e., internal or external) for mild impairments
  • Use of external support with direct application in functional environments for severe memory defects post-stroke or TBI

• Executive Function:
  • Metacognitive strategy training (i.e., self-monitoring, self-regulation) post-TBI
  • Problem-solving strategy training and application to everyday, functional contexts post-TBI

• Comprehensive-Holistic Neuropsychologic Rehabilitation:
  • Recommended to reduce cognitive and functional disability for persons with moderate-to-severe TBI
Impairment-Based and Restorative CR

- Impairment-based approaches seek to strengthen cognitive-linguistic skills at the precise level of breakdown to maximize neurological gains (Kleim & Jones, 2008; Laatsch & Krisky, 2008; Lesniak, Polanowska, Seniow, & Członkowska, 2014)

<table>
<thead>
<tr>
<th>COGNITION</th>
<th>LANGUAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Attention Process Training (APT; Sohlberg, McLaughlin, Pavese, Heidrich, &amp; Posner, 2000)</td>
<td>• Semantic Feature Analysis (SFA; Boyle, 2004; Wambaugh, Mauszycki, Cameron, Wright, &amp; Nessler, 2013)</td>
</tr>
<tr>
<td>• Visual scanning training to remediate hemispatial neglect (Cicerone et al., 2011)</td>
<td>• Phonological Components Analysis (PCA; Leonard, Rochon, &amp; Laird, 2007)</td>
</tr>
<tr>
<td>• Categorization Program (CP; Constantinidou, Thomas, &amp; Robinson, 2008) for problem solving</td>
<td>• Verb Network Strengthening Treatment (VNeST; Edmonds, Mammino, &amp; Ojeda, 2014)</td>
</tr>
<tr>
<td>• Multi-step sequence training for problem solving and executive function (Ehnhart, et al., 2008)</td>
<td>• Melodic Intonation Therapy (MIT; van der Meulen, et al., 2012)</td>
</tr>
</tbody>
</table>
Functional and Compensatory CR

• Functional approaches support cognitive-linguistic improvements in everyday, personally meaningful contexts (Elman & Bernstein-Ellis, 1999; Johnson, Hough, King, Vos, & Jeffs, 2008; Kagan, 2011)

• Compensatory approaches help individuals adapt to their ABI

---

COGNITION

• Memory books, automatic electronic reminders, and other external aids (Cicerone et al., 2011; SIGN, 2013)

• Metacognitive strategy training, e.g., Time Pressure Management (Fasotti, Kovacs, Eling, & Brouwer, 2000), Brain Budgeting (Mayer, Mitchinson, & Murray, 2016), and TEACH-M (Ehlhardt, Sohlberg, Giang, & Albin, 2004)

• Errorless learning techniques (Bertens, Fasotti, Boelen, & Kessels, 2015)

• Caregiver training and environmental adaptations (Cicerone et al., 2011; SIGN, 2013)

LANGUAGE

• Activity-level training, e.g. practice reading a menu (Simmons-Mackie & Kagan, 2007)

• Promoting Aphasics’ Communicative Effectiveness (PACE; Davis, 2005) and Oral Reading for Language in Aphasia (ORLA; Cherney, 2010)

• Script Training (Cherney, Kaye, & van Vuuren, 2014)

• Constraint Induced Language Therapy (CILT; Raymer, 2009)

• Conversation Partner Training (Simmons-Mackie et al., 2010) and environmental adaptations
Comprehensive CR

• The gold-standard CR combines these approaches in order to provide comprehensive, holistic, integrated treatment.

• To maximize outcomes, CR should also account for principles of neural plasticity (Kleim & Jones, 2008):
Experience-dependent neural plasticity

Brain reorganization happens as a result of behavioral, sensory, and cognitive experiences that encourage specific skill use, and repetitive, intensive practice (Kleim & Jones, 2008).

Especially important for CR for young adults with ABI

Table 1. Principles of experience-dependent plasticity.

<table>
<thead>
<tr>
<th>Principle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Use It or Lose It</td>
<td>Failure to drive specific brain functions can lead to functional degradation.</td>
</tr>
<tr>
<td>2. Use It and Improve It</td>
<td>Training that drives a specific brain function can lead to an enhancement of that function.</td>
</tr>
<tr>
<td>3. Specificity</td>
<td>The nature of the training experience dictates the nature of the plasticity.</td>
</tr>
<tr>
<td>5. Intensity Matters</td>
<td>Induction of plasticity requires sufficient training intensity.</td>
</tr>
<tr>
<td>6. Time Matters</td>
<td>Different forms of plasticity occur at different times during training.</td>
</tr>
<tr>
<td>7. Salience Matters</td>
<td>The training experience must be sufficiently salient to induce plasticity.</td>
</tr>
<tr>
<td>8. Age Matters</td>
<td>Training-induced plasticity occurs more readily in younger brains.</td>
</tr>
<tr>
<td>9. Transference</td>
<td>Plasticity in response to one training experience can enhance the acquisition of similar behaviors.</td>
</tr>
<tr>
<td>10. Interference</td>
<td>Plasticity in response to one experience can interfere with the acquisition of other behaviors.</td>
</tr>
</tbody>
</table>
• 16 TBI Model System Centers are medical facilities that provide various levels rehabilitation
  • All have outpatient follow-up appointments, 5 have vocationally focused outpatient day programs, and 2 have community re-entry programs

• TIRR Memorial Hermann Challenge Program
  • Vocationally focused with academic options

• However, TBIMS Centers are primarily focused on acute rehabilitation and are all within a hospital environment
Comprehensive CR: Aphasia

- Intensive Comprehensive Aphasia Programs (ICAPs) are efficacious and popular treatments for people with aphasia (PWA) (Babbitt et al., 2016; Rodriguez et al., 2013; Rose et al., 2013; Hoover et al., 2017; Persad et al., 2013; Winans-Mitrik et al., 2014)

- College-age individuals may participate

- However, most participants have already graduated college and had professional careers (Persad et al., 2013)
Comprehensive CR: TBI

- Simulated college experience (MacLennan and MacLennan, 2008)
- 16 60-minute sessions
  - 12 lectures
    - 7 focused on brain injury
    - 5 focused on study skills
  - Benefits of compensatory strategies
  - Quizzes
- 2 students did not enroll; 3rd encouraged to pursue vocation - enrolled/successful
Study of Cognitive Rehabilitative Effectiveness (SCORE; Cooper et al. 2017) was developed as an outpatient CR program for individuals with mild TBI:
- One of the four arms was comprehensive.

However, SCORE is limited in that:
- It only addresses mTBI
- Only one arm is truly comprehensive
- Formal results have not been published
- It does not focus on academic transition
Comprehensive CR: TBI

- College Program for Students with Brain Injury (Kennedy & Krause, 2011)

- Eligibility criteria: accepted to 2- or 4-year college
- Academic coach (SLP) meets with student 1x/week
- Self-learning, management, and advocacy goals
Comprehensive CR: TBI

• Community colleges may provide some services
  • Bunker Hill Community College, MassBay Community Colleges, Roxbury Community College, and Massosolt Community college

• Specific programs for individuals with ABI
  • Coastline Community College
    • 2-year post-acute educational CR (e.g., verbal, memory, critical thinking, attention, & psychosocial skills) 4 days/week across 16-weeks
What is ICCR?

### Intensive Cognitive-Communication Rehabilitation (ICCR)

<table>
<thead>
<tr>
<th>Time</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:30</td>
<td>Extra Quiz Time</td>
<td>Extra Quiz Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:00</td>
<td><strong>The Brain &amp; Mental Health (Quiz)</strong></td>
<td>Human A &amp; P (Quiz)</td>
<td><strong>The Brain &amp; Mental Health</strong></td>
<td>Human A &amp; P</td>
</tr>
<tr>
<td>1:00</td>
<td><strong>Lunch</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2:00</td>
<td><strong>Statistics</strong></td>
<td><strong>English</strong></td>
<td><strong>Statistics (Quiz)</strong></td>
<td><strong>English (Quiz)</strong></td>
</tr>
<tr>
<td>3:00</td>
<td><strong>Tech Time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Young adults with ABI who want to return to college
- College-level courses half-pace
- Impairment-based 1:1 intervention of discrete cognitive-linguistic skill areas
- Functionally-based application of skills and strategy training in classroom setting
How do we assess gains?

**Standardized Assessments**
- Impairment-based
- Participation/Quality of Life (QOL)

**Informal Assessments**
- Classroom participation
- Academic performance
- 1:1 therapy session data

- Pre- and post-ICCR
- Daily and weekly
Standardized Assessments: Impairment-based measures

- Western Aphasia Battery – Revised (WAB-R; Kertesz, 2007)
- Discourse Comprehension Test (DCT; Brookshire & Nicholas, 1997)
- Test of Everyday Attention (TEA; Robertson, Ward, Ridgeway, & Nimmon-Smith, 1994)
- Repeatable Battery for the Assessment of Neuropsychological Status - Update (RBANS; Randolph, 2012)
- Scales of Cognitive and Communicative Ability for Neurorehabilitation (SCCAN; Milman et al. 2008)
Standardized Assessments: Participation/QOL

• Child and Adolescent Scale of Participation (CASP, McDougall, Bedell, & Wright, 2013)
  • Captures students’ and caregivers’ current perception of ability
  • Involves home, school, and community participation
  • Metric of insight

• TBI-QOL (Tulsky, 2016) and Neuro-QOL (Gershon et al., 2012)
  • Self-reported measures of health-related QOL
    • anxiety, depression, communication, cognitive function

• Goal Attainment Scaling (GAS) (Ertzgaard et al., 2011)
  • Client sets 1-2 personal goals for the semester outside of cognitive-linguistic therapy goals
  • Performance measured concretely with -2 to +2 scale
Standardized Assessments: Participation/QOL

- Assessment rating scales
  - CASP
  - QOL
  - GAS

### Cognition: General Concerns – Short Form 10a

Please respond to each question or statement by marking one box per row.

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely (once)</th>
<th>Sometimes (two or three times)</th>
<th>Often (about once a day)</th>
<th>Always (several times a day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the past 7 days...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I had trouble remembering things...</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I had trouble keeping track of what I was doing if I was interrupted...</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>I had trouble keeping my mind on what I was doing...</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

### Compared to others your age, what is your current level of participation in the following activities?

**HOME PARTICIPATION**

1. Social, play or leisure activities with family members at home (e.g., games, hobbies, “hanging out”)
2. Social, play or leisure activities with friends at home (can include conversations on the phone or internet)
3. Family chores, responsibilities and decisions at home (e.g., involvement in household chores and decisions about family activities and plans)
4. Self-care activities (e.g., eating, dressing, bathing, combing or brushing hair, using the toilet)
5. Moving about in and around the home
6. Communicating with others at home

<table>
<thead>
<tr>
<th>Participation</th>
<th>Full part ipation</th>
<th>Somewhat Limited</th>
<th>Very Limited</th>
<th>Unable</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Informal Measures:
Classroom Participation & Academic Performance

Impairment- and functionally-based

• Participation (+/-)
  • Answered questions accurately
  • Comments made appropriately
  • Asked questions appropriately

• Weekly Quizzes
  • Core classes (i.e., Human A&P/Psychology): 5-item quiz
  • Elective classes (i.e., Statistics/English Literature): 3-item quiz

• Metacognitive exercise
  • Self-correction and reflection on quiz performance
### What is the therapy?

<table>
<thead>
<tr>
<th>Time</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:30</td>
<td>Extra Quiz Time</td>
<td>Extra Quiz Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:00 -1:00</td>
<td><strong>The Brain &amp; Mental Health (Quiz)</strong></td>
<td><strong>Lecture Preview (10-11am)</strong></td>
<td><strong>The Brain &amp; Mental Health</strong></td>
<td><strong>Lecture Review a.k.a “Brain Dump” (11-12:30pm)</strong></td>
</tr>
<tr>
<td>1:00 -2:00</td>
<td>Lunch</td>
<td><strong>Human Anatomy</strong></td>
<td><strong>Human Anatomy</strong></td>
<td></td>
</tr>
<tr>
<td>2:00 - 3:00</td>
<td><strong>Statistics</strong></td>
<td><strong>Quiz Review (12:30-1:00pm)</strong></td>
<td><strong>Statistics (Quiz)</strong></td>
<td><strong>English (Quiz)</strong></td>
</tr>
<tr>
<td>3:00 - 4:00</td>
<td><strong>Tech</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Lecture Preview (10-11am)**
  - Take quiz 2/4 days of the week
  - Watch lecture with minimal clinician interference
  - Incremental increase in content (1 min./class)
  - Target sustained attention and inhibitory control

- **Lecture Review a.k.a “Brain Dump” (11-12:30pm)**
  - Clinician-guided review of lecture information
  - Target short-term memory, language, problem-solving
  - Allows for metacognitive strategy instruction/modeling/application

- **Quiz Review (12:30-1:00pm)**
  - Answer practice potential quiz questions re: lecture content as a group
  - Application of test-taking strategies (e.g., process of elimination, application of memory strategies, etc.)
How is what you are doing in the ICCR classroom therapy?

Processing
• Attention: redirecting students during lecture preview
• Executive function: self-monitor, self-correct, self-advocate throughout session
• Memory: recall lecture content immediately and with delay
• Problem Solving: during moments of confusion, irritability, hypersensitivity, and academic tasks

Language
• Auditory comprehension
  • Repetition of information
• Scaffolding communication barriers
  • Facilitating word retrieval with semantic, phonemic, orthographic cueing, and self-cueing with letter tiles or, fingerspelling
• Reading
  • Oral reading during quiz review, electives, and individual sessions
• Writing
  • Writing lecture notes
  • Answering short-answer questions about English Literature novel
How is what you are doing in the ICCR classroom therapy?

Metacognition aka “Thinking about thinking”
• Strategy instruction, modeling, and application
• Self-monitoring/self-correction
• During every aspect of ICCR

Pragmatics
• Appropriateness
  • E.g., Turn taking, topic, timing
• Decreasing negative behaviors
  • E.g., Physical and emotional self-harm, yelling, leaving session angrily/abruptly
• Increasing social communication
  • E.g., Date, join social groups, email/text
Metacognitive strategies

**Executive Function and Mindfulness Strategies**

**STEP BACK** for energy conservation:

<table>
<thead>
<tr>
<th>Letter</th>
<th>Stands for</th>
<th>How to</th>
</tr>
</thead>
</table>
| S      | Self-care  | - Figure out your priorities and goals  
|        |            | o Try to take care of your mind and body (sleep, hygiene, eat and drink enough, hobbies, etc.) |
| T      | Take breaks| - Every 15-30 minutes, engage in mindfulness  
|        |            | o Stretch and move your body, drink water, close your eyes, look out the window |
| E      | Exercise   | - Find a type of physical activity that brings you joy and challenges you |
| P      | Pace yourself| - Break tasks up into multiple steps, days, opportunities  
|        |            | o Do the most difficult work when you are most alert |
| B      | Be open to help| - Family, friends, and your team are here for you  
|        |            | o We all want you to succeed – we will find out how to achieve that best together |
| A      | Avoid interruptions| - Try to stick to what you are doing for as long as you have decided to work on it  
|        |            | o Let people around you know that you are trying to focus (e.g., “do not disturb” sign, turn off phones) |
| C      | Cut distractions| - Change your environment to support focus  
|        |            | o Move to quieter or more supportive area |
| K      | Keep it simple| - Make your expectations, goals, and tasks clear  
|        |            | o Try to avoid over-complicating things and multi-tasking |
Metacognitive strategy instruction/application

- **Lecture review**
  - Strategy instruction, modeling, and application of Skill Book strategies

- **Quizzes**
  - Reflection questions to anticipate performance and planning to improve performance

- **Individual session using APT-3**
  - Discrete attention training and applying memory strategies

---

**Classes**

- **Autocrine hormones** = function at the cell that makes them
  - Auto = self
- **Paracrine hormones** = function regionally
  - When using a parachute, we want to land in a specific region
- **Endocrine hormones** = function at a distance
  - End

**Reflection:**

1. How many questions do you think you will get right? _______
2. How many questions did you think you got right? _______
3. How many questions did you get right? _______
4. What will you do differently next time?

---

**How hard did your brain work on that exercise?**

- Super Easy
- 1
- 2
- 3
- 4
- Hard to Think
- 5
- 6
- 7
- 8
- 9
- Crazy Hard

**How motivated were you to complete that exercise?**

- I gave up
- I spaced out for some of it
- I was pretty focused
- I was in the zone
But, your SLPs not teachers...creating Core course content

• Choosing online video lectures
  • Undergraduate introductory-level courses (e.g., Biology) Accessibility online
  • Includes subtitles, stop, and replay functions
  • Enough content for 12 weeks

Yale Open Courses

Khan Academy
What about electives? English Literature

**Reading-focused class**
- Read assigned chapter for the following week by using text-to-speech
- Take notes on story elements while reading:
  - Setting
  - Characters
  - Key Terms
  - Predictions

**Writing-focused class**
- Write answers to questions about story elements
- Review main ideas and supporting details of each paragraph
- Writing-focused class
- Read a chapter using text-to-speech on tablet
- Review main ideas and supporting details of each paragraph
- Write answers to questions about story elements
- Setting
- Characters
- Key Terms
- Predictions
What about electives? Statistics

• Condensed version of approach to core classes
  • Watch lecture video
  • Review statistical methods (e.g., mean and range)
  • Application of mathematical skills
    • Follow steps to answer problems as a group
Technology skills session

• Constant Therapy
• Use of ICCR website
  • Similar model to current university systems (e.g., blackboard or canvas)
• Use of text-to-speech
  • For notes and assigned English Literature book
Daily Individual therapy

• Impairment- and functionally-based
  • Target attention, memory, speaking, reading, and writing for academic success
  • Address GAS goals to increase independence (e.g. Pt will navigate through familiar to unfamiliar spaces to increase navigation independently)

<table>
<thead>
<tr>
<th>(-2) Unable to follow directions</th>
<th>(-1) Will navigate through familiar building with directions</th>
<th>(0) Will navigate to near by building with directions</th>
<th>(1) Will navigate home taking public transportation</th>
<th>(2) Will navigate to school taking public transportation</th>
</tr>
</thead>
</table>

Daily Individual therapy

• Computer-based intervention
  • Attention Process Training (APT-3)
    • 2x/week targeting sustained attention
    • Metacognitive exercise (i.e., insight questions)
    • Strategy instruction/application
    • Measure accuracy, ease, and motivation
  • Aphasia Scripts
    • 1-2x/week targeting oral production, short-term memory, and reading of personally-relevant scripts
    • Measure # of words produced accurately, level of cueing needed
Next steps: College Transition process

• Student/family meetings to discuss higher education goals
• Resource packet
• Lunch & Learn Series
  • Overall college experience
  • Student Rights
  • College application steps
  • High education options
  • Disability Services
  • Employment with Disabilities

• Project Career
ICCR Research Questions

Do participants...

- ...demonstrate changes in cognitive-linguistic skills?
- ...improve in their classroom participation?
- ...increase complexity of therapy goals?
- ...demonstrate changes in participation/quality of life?
**Participants**

- Different etiologies
- Young (21-35)
- Females and males
- High school and some college education pre-injury
- Chronic phase of recovery
- Mild-severe language and/or cognitive deficits

<table>
<thead>
<tr>
<th></th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
<th>P6</th>
<th>P7</th>
<th>P8</th>
<th>C1</th>
<th>C2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Etiology</strong></td>
<td>TBI</td>
<td>CVA</td>
<td>TBI</td>
<td>TBI</td>
<td>CVA</td>
<td>TBI</td>
<td>TBI</td>
<td>CVA/TBI</td>
<td>CVA</td>
<td>TBI</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>21</td>
<td>29</td>
<td>25</td>
<td>35</td>
<td>25</td>
<td>22</td>
<td>28</td>
<td>25</td>
<td>32</td>
<td>23</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>F</td>
<td>F</td>
<td>M</td>
<td>M</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td><strong>Education (years)</strong></td>
<td>12</td>
<td>15</td>
<td>10</td>
<td>16</td>
<td>15</td>
<td>12</td>
<td>14</td>
<td>12</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td><strong>MPO</strong></td>
<td>49</td>
<td>70</td>
<td>96</td>
<td>97</td>
<td>44</td>
<td>15</td>
<td>13</td>
<td>69</td>
<td>60</td>
<td>38</td>
</tr>
</tbody>
</table>

- Experimental subjects
- Control subjects

Darker shade = multiple semesters
Lighter shade = single semester
Results: Standardized Assessments (Pre-Post) – Summary Scores

- Significant gains in language skills (i.e., WAB-LQ)
- Perhaps underpowered to capture significant gains on other metrics

- Positive improvements across ALL measures at final time-point
- Significant gains in language skills (i.e., WAB-LQ)
  - Perhaps underpowered to capture significant gains on other metrics
Results: Standardized Assessments (Pre-Post) – Domain Scores

- Significant gains post-treatment: p < .05
  - SCCAN Oral Expression, Speech Comprehension
  - WAB Writing

- Trending: p = .05
  - SCCAN Attention & Memory
  - WAB Spontaneous Speech

- Overall, positive gains post-treatment for most measures
- Again, may be underpowered to capture significant gains on other metrics
### Results: Standardized Assessments (Pre-Post) – Item-level scores

<table>
<thead>
<tr>
<th>Etiology</th>
<th>TBI</th>
<th>Stroke</th>
<th>TBI</th>
<th>CVA</th>
<th>TBI</th>
<th>TBI</th>
<th>CVA</th>
<th>TBI</th>
<th>C2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-Semester</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cum</td>
<td>Cum</td>
<td>Cum</td>
<td>Cum</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>WAB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p&lt;.01</td>
<td>p&lt;.01</td>
<td>p&lt;.01</td>
<td>p&lt;.01</td>
<td></td>
</tr>
<tr>
<td>RBANS</td>
<td>0.01</td>
<td>p&lt;.01</td>
<td>0.01</td>
<td>0.01</td>
<td>p&lt;.01</td>
<td>p=.045</td>
<td>p&lt;.01</td>
<td>p=.05</td>
<td></td>
</tr>
<tr>
<td>SCCAN</td>
<td>0.01</td>
<td>p&lt;.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p&lt;.01</td>
</tr>
</tbody>
</table>

- Statistically significant gains noted for exp. participants after multiple semesters of ICCR and for patients with different etiologies
- Controls made no significant gains after period of no-treatment
Results: Classroom Participation

- Significantly more positive behaviors (e.g., asking appropriate questions) over time than negative behaviors (e.g., asking inappropriate questions) in the classroom
- Suggests positive influence of integrated rehabilitation in the classroom context!

**Diagram:**

- Graph showing time-by-behavior type interaction effect: \( F(1, 119) = 5.64, p = 0.02 \)
- Negative behaviors < positive behaviors \( (\beta = -2.07, SE = .87, t = -2.37, p = 0.02) \)
Results: Life Participation and Quality of Life

- Positive gains in all domains of participation!
- Organized lunch at local restaurants
- Significant gains in school domain
  - Invited one another to spend time together outside of therapy
  - Returned for Associate’s Degree, independent living, and driving
- Join social groups with non-ICCR BU students (i.e., Bible study)
## Results: SLP outcomes

<table>
<thead>
<tr>
<th></th>
<th>Example of goal area at <em>intake</em></th>
<th>Example of <em>current</em> goal area</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>• Selective attention in a non-distracting environment with moderate cues</td>
<td>• Alternating attention in a non-distracting environment with minimal cues</td>
</tr>
<tr>
<td>P2</td>
<td>• 1-2 paragraph auditory comprehension</td>
<td>• 3-4 paragraph auditory comprehension</td>
</tr>
<tr>
<td>P3</td>
<td>• 1-5 minute sustained attention</td>
<td>• 5-10 minute sustained and selective attention</td>
</tr>
<tr>
<td>P4</td>
<td>• Spoken word to picture matching with 3 items</td>
<td>• Spoken word to picture matching with 4 items</td>
</tr>
<tr>
<td>P5</td>
<td>• Generate 3 agent/patient pairs given a verb</td>
<td>• Generate 5 agent/patient pairs given a verb</td>
</tr>
<tr>
<td>P6</td>
<td>• Write functional information at 2-3 paragraph level (i.e., email)</td>
<td>• Write functional information at 5-6 paragraph level (i.e., article summary)</td>
</tr>
<tr>
<td>P7</td>
<td>• Recall 2-4 digit/word sequences</td>
<td>• Recall 5-7 digit/word sequences</td>
</tr>
<tr>
<td>P8</td>
<td>• Read short sentence (i.e., 6 words) and match to picture</td>
<td>• Read short paragraph (i.e., 3 sentences) and answer Wh questions</td>
</tr>
</tbody>
</table>
Final Thoughts

• Principles of experience-dependent neural plasticity were beneficial for rehabilitation (Persad et al. 2013)

• Classroom setting = context for metacognitive strategy instruction/application and generalization of discrete skills

• Statistically significant gains in cognitive-linguistic function with cumulative semesters

• Future directions:
  • Larger, more diverse participant sample
  • Scale to other colleges and rehabilitation clinics
  • Examine effects of ICCR on brain reorganization
Q&A session

Questions for us???
Thank you!

• Dean’s Funding from Sargent College of Health and Rehabilitation Sciences

• Current ICCR Team at BU Aphasia Research Laboratory
  • Natalie Gilmore, Lindsey Foo, Maria Dekhtyar & Swathi Kiran

• MS students: Maria Abdo, Kate Barrett, Caitlin Kelleher, Abbie King, Allie Mcfee

• ICCR students, families, and caregivers
• Past lab members and MS students (Katrina Ross, Natalie Albrittain-Ross, Carrie Des Roches, Deirdre McLaughlin, Heather Wolfe, Laura Milmed)

ACTIVELY recruiting participants!
aphasiaresearchlaboratory@gmail.com
617-353-2706
References


References (cont’d)


References (cont’d)


References (cont’d)


References (cont’d)


References (cont’d)

References (cont’d)


