

# Intensive cognitive-communication rehabilitation for college-bound young adults with brain injury

Natalie Gilmore, Lindsey Foo, & Swathi Kiran

Aphasia Research Laboratory, Sargent College, Boston University, Boston, MA



Aphasia Research Laboratory



## BACKGROUND

- Young adults (YA) are a frequently affected and growing group to suffer traumatic brain injury (TBI) and stroke.<sup>1,2</sup>
- Acquired brain injury (ABI) often negatively impacts cognitive-linguistic function (e.g., reading), activity participation (e.g., following a class syllabus), and overall well-being (e.g., satisfaction with life as unenrolled/unemployed).<sup>3,4</sup>
- Not surprisingly, YAs with ABI often struggle in an academic setting (e.g., ~80% of individuals with TBI).<sup>5</sup>
- Comprehensive, contextualized cognitive rehabilitation (CR) programs target cognitive-linguistic constructs, teach compensatory strategies, and provide contexts for learning implementation. Such programs have resulted in significant gains in cognition, community integration and independence for individuals with ABI.<sup>6</sup>
- **Yet, to date, none of these programs have focused directly on supporting YAs with ABI who want to pursue college, while also incorporating all relevant principles of experience-dependent neural plasticity to maximize rehabilitation progress (i.e., repetition, salience, specificity of training, enriched environment, intensity, age).<sup>7</sup>**

## RESEARCH QUESTIONS

After an Intensive Cognitive-Communication Rehabilitation (ICCR) program, do ICCR students...

- Show gains in cognitive-linguistic functioning?
- Exhibit progress in individual speech therapy?
- Show improved classroom performance?
- Demonstrate increased participation and quality of life?

## METHODS

### Assessment



#### Formal Assessments:

- Cognitive-Linguistic Function**
- Western Aphasia Battery - Revised (WAB-R)<sup>8</sup>
  - Scales of Cognitive and Communicative Ability for Neurorehabilitation (SCCAN)<sup>9</sup>
  - Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)<sup>10</sup>
  - Discourse Comprehension Test (DCT)<sup>11</sup>
- Participation and Quality of Life**
- Child and Adolescent Scale of Participation (CASP)<sup>12</sup>
  - TBI-QOL<sup>13</sup> and Neuro-QOL<sup>14</sup>

#### Informal Assessments:

- Daily classroom performance (e.g., answering questions)
- Performance on individual speech therapy goals (e.g., accurately spelling words)

### Sample Weekly Treatment Schedule

	Monday	Tuesday	Thursday	Friday
10:00	Economics Lecture	Biology Lecture	Economics Lecture	Biology Lecture
11:00	Review	Review	Review	Review
12:00	Practice Quiz ?'s	Practice Quiz ?'s	Practice Quiz ?'s	Practice Quiz ?'s
1:00	Lunch	Lunch	Lunch	Lunch
2:00	Statistics	English Literature	Statistics	English Literature
3:00	Tech	Tech	Tech	Tech

### Other Activities

Take quizzes & finals

Receive individual SLP targeting discrete skills & strategy training

Attend sessions about college transition process

**Note:** ~288 hours/semester; ICCR students may attend multiple semesters of the program until they are ready to transition to post-secondary education.

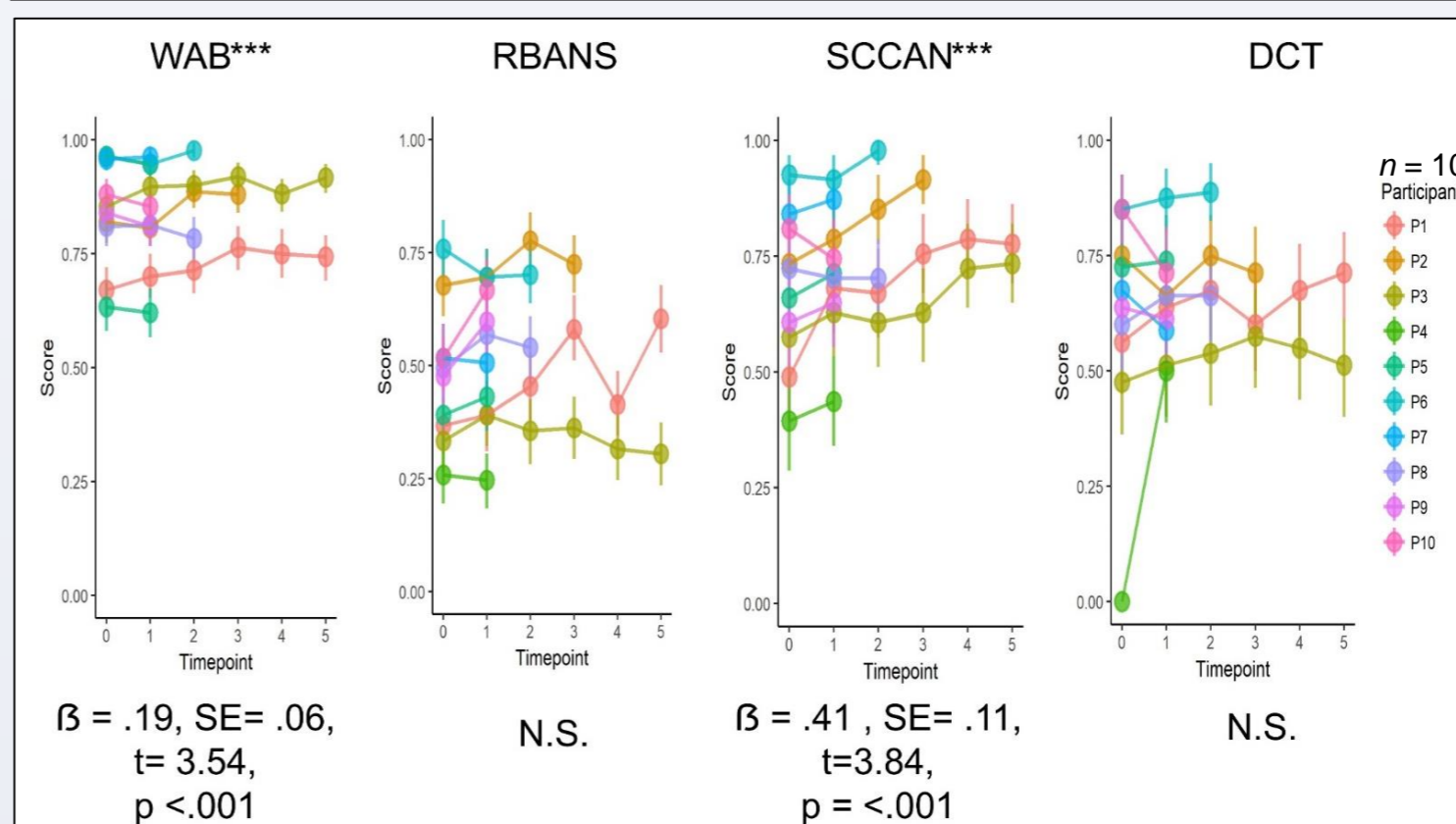
### Demographic Information

	Age	MPO	Etiology	Sex	Education Level	Pre-treatment WAB	Pre-treatment RBANS
ICCR students (n=10)	25.1 (4.1)	62.8 (33.4)	TBI = 6 Stroke = 3 Tumor = 1	M = 7 F = 3	14.0 (1.4)	70.3 (23.1)	52.8 (11.1)
Controls (n=2)	27.5 (6.4)	49 (15.6)	TBI = 1 Stroke = 1	F = 2	12.5 (0.7)	87.8 (4.9)	61.5 (13.4)

**Note:** Mean (SD); MPO = months post onset; Pre-treatment WAB = Aphasia Quotient (out of 100; higher score = less severe); Pre-treatment RBANS = Total Index Score (Standard Score: Mean = 85; SD = 10)

## RESULTS

### RQ 1: Show gains in cognitive-linguistic functioning?



Timepoint significantly predicted score over time on the WAB and SCCAN (see figure).

Controls showed no significant change in item-level accuracy on standardized cognitive linguistic assessments after a 12-week period without intervention (via McNemar's tests;  $p > .05$ ; not plotted)

**Summary:** Yes. As the number of semesters in ICCR increased, participants' scores on 2/4 tests of cognitive-linguistic function significantly improved. The lack of significant change on controls scores suggests the intervention resulted in the ICCR students' gains.

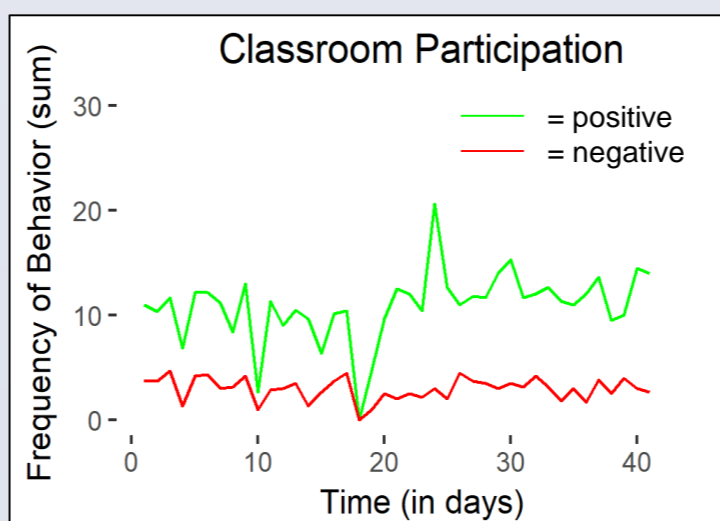
### RQ 2: Exhibit progress in individual speech therapy?

	Pre-treatment Sample Goal	Post-treatment Sample Goal
P1	Selective attention in a non-distracting environment with moderate cues	Alternating attention in a non-distracting environment with minimal cues
P3	1-5 minute sustained attention	5-10 minute sustained & selective attention
P6	Write functional information at a 2-3 paragraph level (i.e., email)	Write functional information at a 5-6 paragraph level (i.e., article summary)
P8	Read short sentence (i.e., 6 words) and match to picture	Read short paragraph (i.e., 3 sentences) and answer Wh-questions
P9	Recall 2-3 unassociated words given 5 minute delay	Recall 3-4 unassociated words given 5 minute delay
P10	Accurately spell 5/15 sight words using phoneme-grapheme correspondence	Accurately spell 12/15 sight words using phoneme-grapheme correspondence

**Summary:** Yes. Students were working on more complex goals and/or with less clinician support by the end of the ICCR semester. They also progressed on personal goals (e.g., navigating campus), which they developed with the clinician to increase their independence.

**Note:** Showing Spring semester cohort data (n = 6)

### RQ 3: Show improved classroom performance?

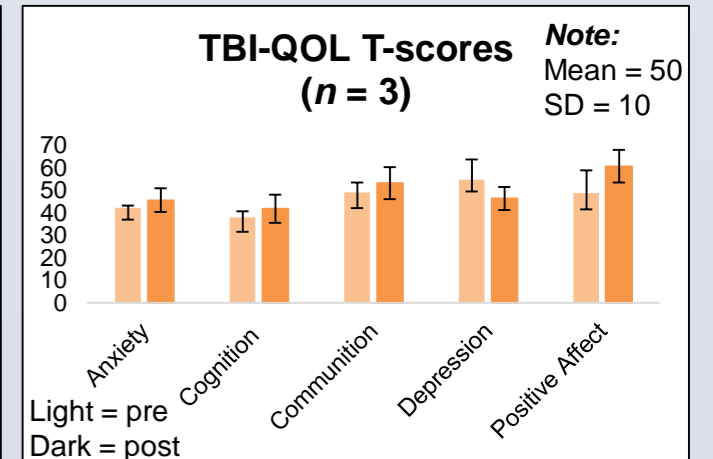
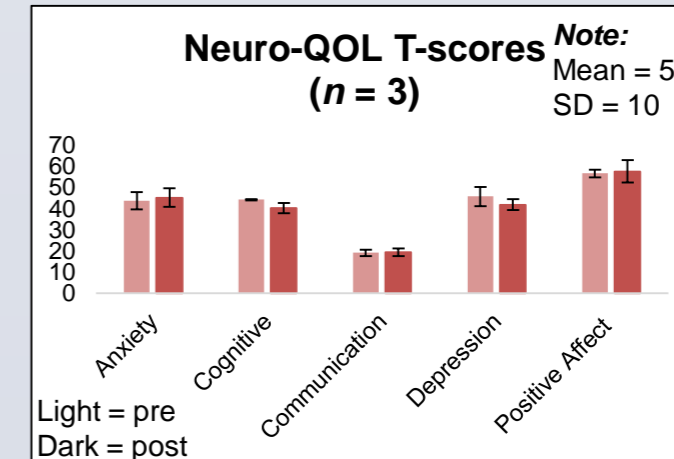
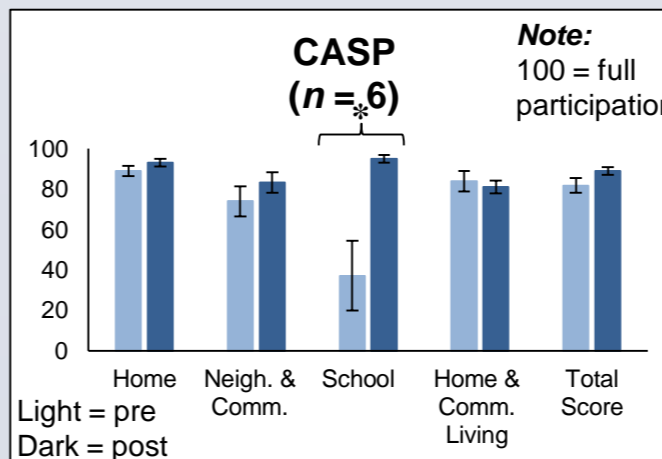


**Negative vs. Positive:**  $\beta = -7.63$ ,  $SE = 1.26$ ,  $t\text{-value} = -6.04$ ,  $p < .001$   
**Time\*Behavior interaction:**  $\beta = -0.06$ ,  $SE = 0.05$ ,  $t\text{-value} = -1.07$ ,  $p = 0.29$   
**Inter-rater reliability:** 25% of data was coded by a 2nd coder (70% reliable)

**Summary:** Not significantly over time. Positive behaviors (e.g., answering questions, asking questions, making comments accurately/appropriately) were significantly more common in the classroom than negative behaviors, but they did not increase significantly more than negative behaviors across the semester.

**Note:** Showing Spring semester cohort data (n = 6)

### RQ 4: Demonstrate increased participation and quality of life?



**Note:** Showing Spring semester cohort data (n = 6); QOL measures: Anxiety, Depression – Higher score worse; Cognitive, Communication, Positive Affect – Higher score better. Of note, Neuro-QOL Communication is a raw score (Max = 25), as no t-score is available. No statistics conducted on QOL measures due to small n and slight differences between Neuro-QOL and TBI-QOL versions making it inappropriate to collapse across versions.

**Summary:** Yes. ICCR students improved in the majority of participation metrics and significantly in the School domain. In terms of the QOL measures, pre- to post-treatment changes did not exceed the standard deviation. Yet, after ICCR, students demonstrated trends consistent with increased positive affect and communication, in addition to lower depression.

## DISCUSSION & FUTURE DIRECTIONS

- Consistent with current principles of neuroplasticity, ICCR provided intensive, repetitive, specific and salient training on cognitive-linguistic function within an academic context.
- ICCR students' standardized cognitive-linguistic assessment scores significantly improved as the number of semesters in ICCR increased, suggesting a cumulative benefit of ICCR.
- In terms of the classroom, ICCR students significantly improved in their participation at school (e.g., academic activities with other students). Furthermore, they contributed successfully in the classroom (e.g., answering questions accurately > inaccurately). Overall, the classroom environment was positive with limited inappropriate behaviors.
- ICCR students also showed gains in individual speech therapy (i.e., complexity of goals increased by the end of semester) and quality of life (e.g., higher positive affect).
- Corroborating our previous work,<sup>15</sup> these findings support ICCR's efficacy. Future work will investigate the specific cognitive-linguistic domains important for academic success that improve over time after ICCR and the neuroplasticity supporting such gains.

## SELECTED REFERENCES

1. https://www.cdc.gov/traumaticbraininjury/data/rates\_ed\_byage.html
2. George et al. *JAMA Neurol*. 2017;74(6):695.
3. Sinanovic et al. *Acta Clin Croat*. 2011;50(1):79-94.
4. Rabinowitz et al. *Psychiatr Clin North Am*. 2014;37(1):1-11.
5. Kennedy et al. *NeuroRehabilitation*. 2008;23(6):511-520.
6. Ciccone et al. *Arch Phys Med Rehabil*. 2011;92(4):519-530.
7. Kleim & Jones. *Speech Lang Hear Res*. 2008; 51(1):S225-S239.
8. Kertesz. San Antonio, TX: PsychCorp; 2007
9. Holland & Milman. Austin, TX: PRO-ED, Inc.; 2012.
10. Randolph. Bloomington, MN: PsychCorp; 1998.
11. Brookshire & Nicholas. Tucson, AZ: Communication Skill Builders; 1993.
12. Bedell. *Dev Neurorehabilitation*. 2009;12(5):342-351.
13. Tulsky et al. *J Head Trauma Rehabil*. 2016;31(1):40-51.
14. Gershon et al. *Qual Life Res*. 2012;21(3):475-486.
15. Gilmore et al. *Am J Speech Lang Pathol*. 2018. [preprint].

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