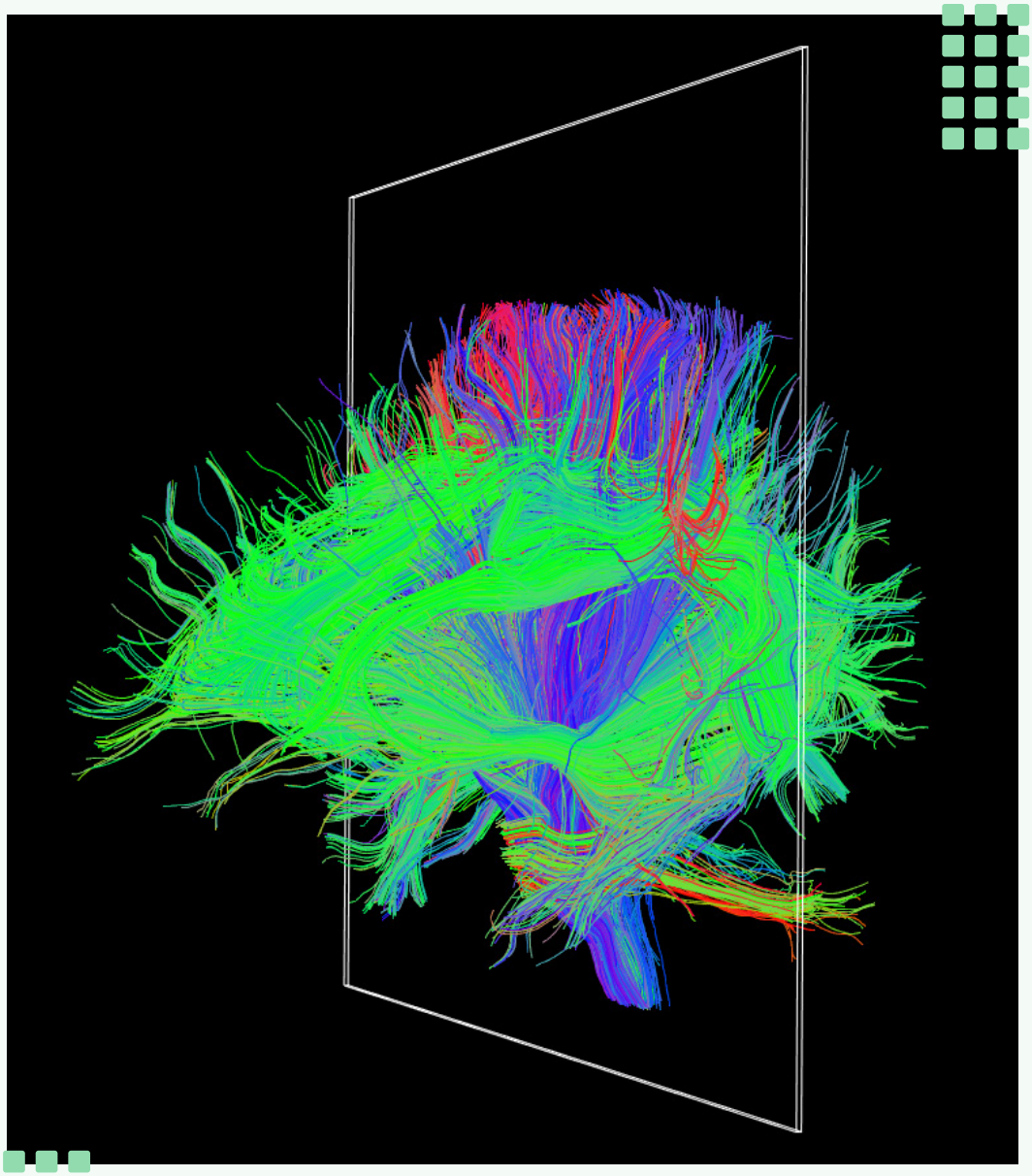
Boston University Center for Brain Recovery

Unveiling Hope

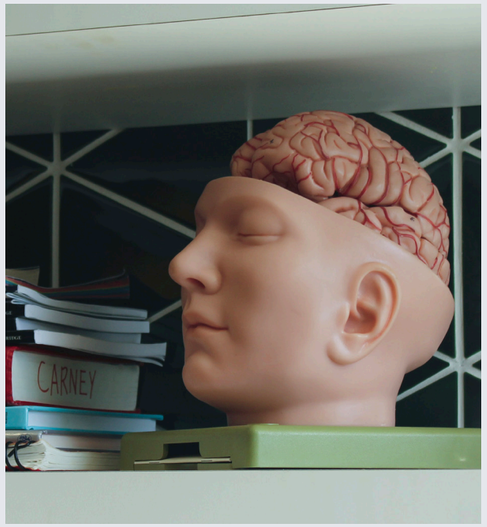
Brain Research: To Prevent, Treat, and Cure Neurological Disorders

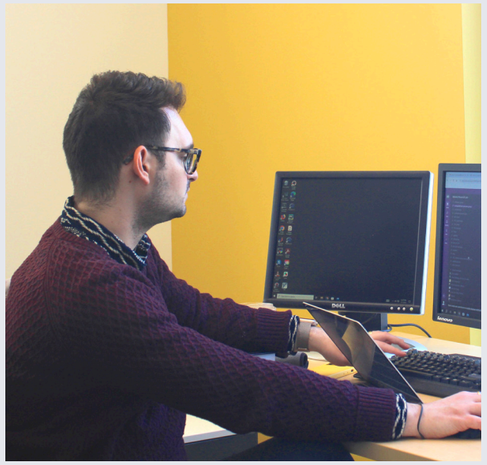


Annual Report 2023

BOSTON UNIVERSITY

Table of Contents





Letter from the Director

"Boston University's Center for Brain Recovery conducts groundbreaking research to enhance diagnosis and improve treatments for people with neurological disorders, including stroke, traumatic brain injury, and dementia."

Dear Colleagues,

It is my pleasure to present to you the highlights of our annual report at the Center for Brain Recovery. Over the past year, our team has made significant strides in advancing our understanding and treatment of neurological disorders through interdisciplinary research initiatives.

One large collaborative project has focused on utilizing functional near infra-red spectroscopy (fNIRS) to measure brain activity during real-world tasks in both healthy individuals and those with post-stroke aphasia. Through experiments involving walking, perceiving, and interaction, we aim to shed light on the neural mechanisms underlying these activities. This work is now extended to investigate early language changes in individuals with Alzheimer's disease and related dementias.

In addition to our neuroimaging efforts, we have been actively engaged in identifying biomarkers of brain health, disease, and recovery. Through advanced computational models, we have made significant progress this past year in extracting clinically relevant information from neuroimaging scans to aid in diagnosis and treatment. Further, our research endeavors have included the utilization of data science and AI methods to predict cognitive function and patient trajectories, as well as understanding the social determinants of health disparities among underrepresented minorities.

Lastly, our commitment to clinical trials remains steadfast, with a focus on rehabilitation for various neurological disorders, including stroke and primary progressive aphasia.

As we reflect on our achievements and look toward the future, I extend my heartfelt gratitude to each member of our research community for their dedication and contributions to advancing brain recovery.

Dr. Swathi Kiran

Founding Director, Dr. Swathi Kiran

2023 at a Glance

34
Publications and Presentations

72%
Increase in Newsletter Subscribers

$7.5M+
In Funding

13
Events Held

8,000+
Social Media Followers

4,000+
Attendees

20+
Countries of Engagement

Highlights of the Year

April

Release of the Center for Brain Recovery's **first monthly newsletter**, featuring Neuroimaging in the Everyday World and the announcement of our updated website.

June

Anne Billot and **Emily J Braun** graduate after presenting their PhD. theses at the Center for Brain Recovery, completing their doctorate programs.

August

Inaugural **Neuroscience of the Everyday World Conference** at Boston University, co-hosted by Chen Institute

September

PhD. students **Erin Carpenter** and **Isaac Falconer** receive NIDCD-Funded F31 and F30 Research Training Grants to support their research at the Center for Brain Recovery.

October

Student-led workshop sponsored by Hariri Institute about **Machine Learning**, Brain and Behavior Data is held in the Center for Data and Computing Sciences Building, organized by the Center for Brain Recovery.

November

The Center for Brain Recovery's ICCR program is selected as **American Speech and Hearing Association (ASHA) 2023 Convention Changemaker** session. **Meredith MacEachern, Christianna Gilbert**, and **Jacquelyn Moynihan** present at the conference.

NEW Conference Reception, August 2023.

Our Mission

At the Center for Brain Recovery (CBR), our mission is clear: to convene a diverse group of experts spanning various disciplines—clinicians, neuroscientists, engineers, and beyond—to understand the complexities of neurological conditions such as stroke, brain injury, Alzheimer's disease, Parkinson's disease, and more. These devastating illnesses not only alter brain function but also have profound and lasting impacts on individuals and their families.

Recent advances in clinical research, drugs and other therapies, neuroscientific methods, and computational modeling have made landmark discoveries in understanding these neurological diseases. Despite this, we still do not know how, when and why brain disorders occur. To tackle such complex and intractable problems, we need a wide range of expertise and experience across many disciplines (sciences, medicine, and engineering) to come together.

Our center serves as a nexus for innovative and interdisciplinary research, leveraging cutting-edge technologies and methodologies to unravel the mysteries of the brain. The Center will also work to develop interventions to improve brain function and harness mechanisms of brain plasticity to restore neurological function. Through collaborative efforts, CBR will focus on the advancement of neuroimaging techniques, the identification of neural and behavioral biomarkers, the application of data science and AI in predicting cognitive function, and the exploration of social determinants of health disparities. We are also working with companies such as Constant Therapy Inc, an online health system that provides ongoing rehabilitation services. The ultimate goal of CBR is to strive to make meaningful contributions to the field of neuroscience and ultimately improve the lives of countless individuals worldwide.

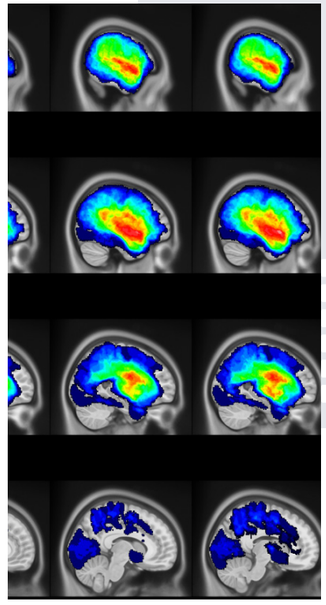
"Brain research to identify, diagnose, and treat neurological disorders"

Accelerating Impact

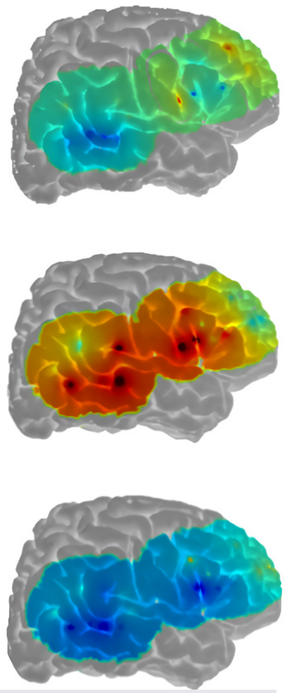
Boston University Researchers Blend Disciplines to Create Technology for Neuroimaging in the Everyday World

The human brain is a complex system that is incredibly important to study in order to further our understanding of neurological functions, behaviors, and disorders. However, current technology limits our ability to capture data and images of the brain in the everyday world. That is why researchers across disciplines at Boston University including Dr. Swathi Kiran, Dr. David Boas, Dr. Meryem Yucel, Dr. David Somers, and others are combining their efforts to improve neuroimaging tools in the everyday world to continuously track human brain function and behavior in real-time to further understand how a healthy brain works and how and when failures in simple human actions occur.

The technology is possible with the help of a variety of techniques. One of them is functional near-infrared spectroscopy (fNIRS), a non-invasive brain imaging technique that measures blood oxygenation changes based upon the changes in absorption of light emitted by sources onto the surface of the head measured by special sensors. This can be used to view changes in blood flow as responses to brain activity.



CBR Neuroimaging: Brain Scans, 2023



CBR Neuroimaging: Brain Scans, 2023

Researchers at BU are working together to create a wearable fNIRS system to capture and study the brain signal in naturalistic environments. A wearable system could help study the brain during social interactions, outdoor activities, and reactions to other stimuli, which could also create more efficient monitoring of patients with neurological disorders or provide insight into normal or abnormal brain development.

fNIRS is a significant advancement from traditional neuroimaging methods like MRI and fMRI as individuals can move around while wearing the cap. This has given researchers at CBR and across BU the ability to study the brain while participants are walking and talking. Preliminary studies have involved healthy individuals and individuals who have had a stroke, and now work is extending to individuals with dementia.

There is so much more to learn and understand about our brain, and doing so could help us find better treatment options for people with neurological disorders, help diagnose them earlier, or maybe even prevent them.

Spotlight: Student Research

Multilevel factors predict treatment response following semantic feature-based intervention in bilingual aphasia

Scimeca, M., Peñaloza, C., & Kiran, S. (2024). Multilevel factors predict treatment response following semantic feature-based intervention in bilingual aphasia. Bilingualism: Language and Cognition, 27(2), 246–262. doi:10.1017/S1366728923000391

The results of this study demonstrate that a variety of multilevel factors (e.g., baseline naming severity, treatment language, and psycholinguistic properties of the stimuli) influence treatment outcomes in both a treated and untreated language when therapy is only provided in one language in bilingual individuals with post-stroke aphasia. Additionally, we suggest that these results have theoretical and clinical implications for treatment design and delivery in bilingual rehabilitation and should be of broad interest to language researchers and clinicians alike.

Michael Scimeca, February 2024

Manuel Marte, February 2024

Association Between Social Determinants of Health and Communication Difficulties in Poststroke U.S. Hispanic and Non-Hispanic White Populations.

Marte, M. J., Addesso, D. & Kiran, S. (2023). Association Between Social Determinants of Health and Communication Difficulties in Poststroke U.S. Hispanic and Non-Hispanic White Populations. American Journal of Speech-Language Pathology doi: 10.1044/2023_AJSLP-23-00232.

This study underscores the influence of social determinants of health (SDOH) on disparities in post-stroke communication outcomes. Future research should focus on evaluating the effectiveness of addressing disparities in SDOH to address disparities in outcomes among diverse ethnic and socioeconomic post-stroke populations.

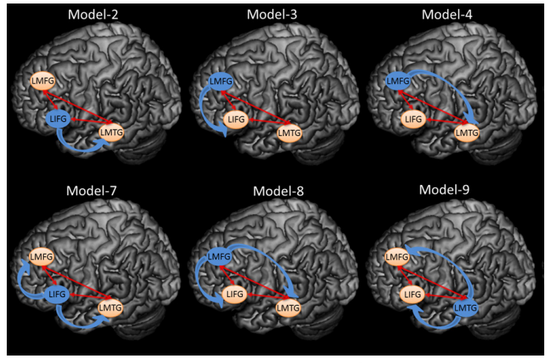
Resting-state brain network connectivity is an independent predictor of responsiveness to language therapy in chronic post-stroke aphasia

Falconer, I., Varkanitsa, M., & Kiran, S. (2024). Resting-state brain network connectivity is an independent predictor of responsiveness to language therapy in chronic post-stroke aphasia. Cortex, 173, 296-312. https://doi.org/https://doi.org/10.1016/j.cortex.2023.11.022

Because individuals with aphasia follow a wide range of recovery trajectories, and treatment strategies may vary depending on the probability of benefiting from a given treatment, it is important to understand the neural and cognitive mechanisms that support treatment-induced recovery. This study sought to investigate functional connectivity in four predefined brain networks (i.e., language, default mode, dorsal attention, and salience networks), in relation to aphasia severity and response to language therapy. The findings highlight the prognostic value of resting-state functional connectivity in chronic treatment-induced aphasia recovery.

Isaac Falconer, March 2024

Erin Carpenter in her new office, February 2024



CBR Brain Scans, 2023

"By utilizing computational modeling, BU researchers aim to enhance our understanding of language rehabilitation efficacy and its impact on brain recovery in bilingual individuals with aphasia."

Recent Development: Advancing Bilingual Aphasia Treatment With Researchers' PROCoM Projects

"PROCoM is a Randomized Control Trial (RCT) that uses computational modeling to predict how a bilingual person with aphasia will respond to therapy provided in both languages based on their baseline assessment scores, bilingual language experience, and other demographic information. Based on this information the model 'assigns' which language is most optimal for treatment to promote direct treatment gains and cross-language generalization.

Each patient was then randomly assigned to a treatment language (either model assigned or model opposite) and received 40 hours of therapy. We then compared how the patients actually improved in therapy to what the model predicted for that given language."

- Erin Carpenter, December 2023

Center Initiative

The Intensive Cognitive Communication Rehabilitation Program

Created in 2016 and run by Dr. Swathi Kiran, Natalie Gilmore, Christianna Gilbert, and Meredith MacEachern, the ICCR Program provides care for young adults with ABI who wish to go to college or return to higher education.

Boston University's Intensive Cognitive Communication Rehabilitation (ICCR) program is helping young adults with acquired brain injury (ABI) return to college or higher education by improving their cognitive and communication skills in academic environments. The program combines lecture-based, technology-focused therapy, and individual cognitive rehabilitation sessions that have been adapted to a virtual format, making it available to students remotely. ICCR's group program focuses on metacognition and integration of executive function and memory strategies, while individual therapy targets short-term goals and personally relevant outcomes.

In addition to helping students with ABI, the program also helps graduate students in the speech, language, and hearing sciences department attain clinical skills within the field of brain recovery. In the words of one clinician, "My favorite part of ICCR was the camaraderie forged between the students. For many of them, this was the first time they had peers with similar experiences, who were in the same stage of life and working towards the same goals. To see them celebrating the successes of their fellow students and flourishing with the supportive environment of this functional, intensive, and contextualized treatment program is something I am always grateful I got to be a part of."

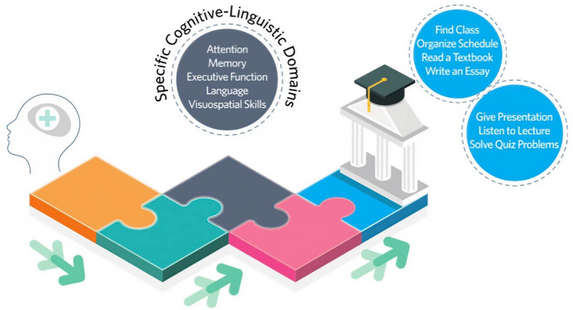
"Over 50% of Students Return to College upon Completion of the ICCR Program"

Overall, the ICCR program is making a significant impact on the lives of young adults with ABI, providing them with the necessary skills to return to higher education and pursue their goals. The ICCR has received attention for their work helping students recover and return to school, more articles about their efforts can be read online. The program's integration of lecture-based and seminar-based courses, technology-focused therapy, and individual cognitive rehabilitation sessions helps students strengthen their cognitive-linguistic skills in a structured and encouraging environment before they can succeed in a typical classroom.

visit **bu.edu/cbr/iccr/** *for more information*

We Are Recruiting for The ICCR Program

The ICCR Program accepts clients on a periodic basis during each semester. Young adults under the age of 35 with ABI can join the program as a stepping stone to return back to college.



ICCR program structure and themes

ICCR staff with participants in the program

Graduate Student Opportunities and Higher Education: Hands-on Training and Experience

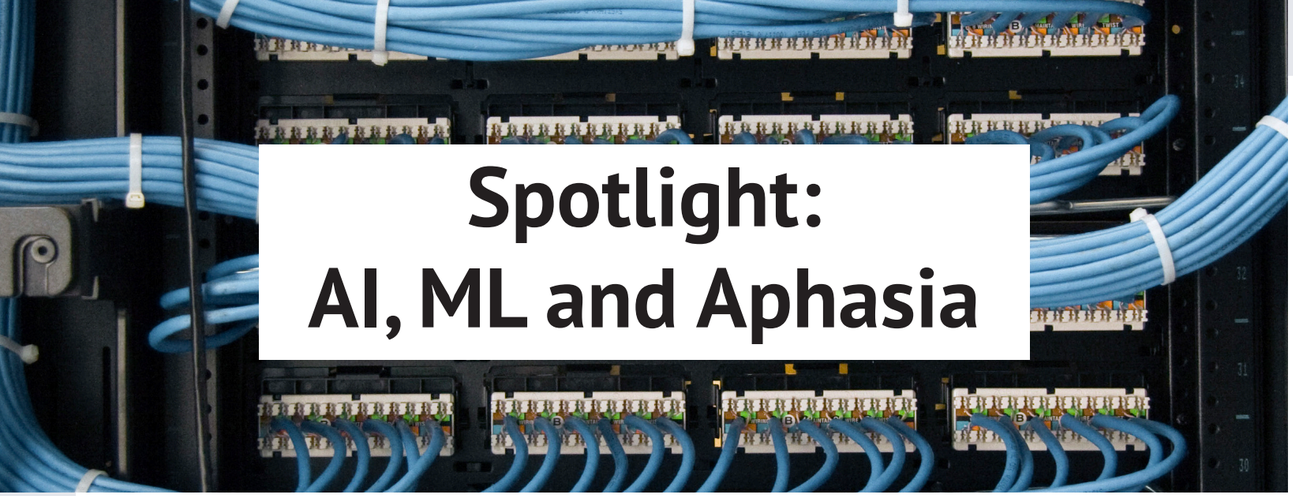
ICCR utilizes impairment-based treatment, providing students with direct therapy for specific cognitive-linguistic goal areas.

The program measures the functional goal of return or entry to higher education through close transitional coaching and support to participants upon their discharge from the program. In the first six months in particular, the ICCR team offers coaching to program graduates through videoconference, phone, and email, as well as provides written and verbal documentation to institutions to support the establishment of academic accommodations.

Program alumni are also contacted intermittently to assess status of college enrollment, solve problems related to access, and make recommendations for additional therapeutic and/or community resources.

"The goal of the ICCR program is to provide contextualized and intensive, integrated rehabilitation to young adults with ABI, who would be successful and have the ability to pursue their goals and contribute meaningfully to society."

visit **bu.edu/cbr/contact-us/** *to get in touch*



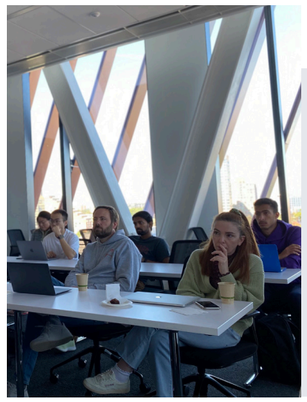
Spotlight: AI, ML and Aphasia

A large research focus at the CBR is to use machine learning and AI approaches to understand neurological disorders. In a project funded by the Hariri Institute, BU Researchers ***Swathi Kiran***, ***Alan Liu***, ***Claire Cordella***, ***Margrit Betke*** and ***Prakash Ishwar***, are using a vast mHealth dataset provided by **Constant Therapy** to advance personalized healthcare by developing a personalized prediction algorithm for speech, language, and cognitive recovery in patients with neurological disorders. This project employs machine learning techniques, with an aim to provide tailored recommendations for patients' rehabilitation journeys, including information about how often, how much, and for how long an individual should practice to reach desired treatment goals. The findings have the potential to facilitate optimized brain recovery, paving the way for individualized therapy plans that consider diverse clinician profiles.

In a significant step towards personalized rehabilitation, this study analyzes real-world data from over **600,000 users** of the Constant Therapy app. Users of this app often have speech, language, and cognitive difficulties following stroke or other neurological disorders and use the app as a way of rehabilitating functional capabilities across a wide range of domains, such as reading, verbal expression, or auditory comprehension. Because this therapy can be practiced at home via an app, patients and their caregivers often wish to know how often, how much, and for how long they should practice to meet their goals. The current study aims to answer such questions using cutting-edge machine learning algorithms.

Specifically, researchers are developing machine learning algorithms that utilize user-specific information to predict improvement on functional therapy milestones (e.g., going from reading single words to reading long paragraphs). With this information, a new user can identify functional skill(s) they desire to improve, provide background demographic information about themselves, and then receive a personalized practice plan suggesting the amount, frequency and duration with which they might practice app-based tasks to reach each functional milestone.

The study represents a promising advancement in the field of neurological rehabilitation, bridging the gap between data-driven insights and personalized therapy. By understanding the nuances of each patient's condition and progress, healthcare professionals can optimize treatment plans and maximize the chances of successful recovery.



ML Workshop Audience, October 2023.

Consistent long-term practice leads to consistent improvement: Benefits of self-managed therapy for language and cognitive deficits using a digital therapeutic

Liu H, Cordella C, Ishwar P, Betke M, Kiran S. Consistent long-term practice leads to consistent improvement: Benefits of self-managed therapy for language and cognitive deficits using a digital therapeutic. Front Digit Health. 2023 Apr 11;5:1095110. doi: 10.3389/fdgth.2023.1095110. PMID: 37114182; PMCID: PMC10126684.

Background

Although speech-language therapy (SLT) is proven to be beneficial to recovery of post-stroke aphasia, delivering sufficiently high amounts of dosage remains a problem in real-world clinical practice. Self-managed SLT through the Constant Therapy Health Program was introduced to solve the problem. Previous research showed in a 10-week period, increased dosage frequency could lead to better performance, however, it is uncertain if dosage still affects performance over a longer period of practice time and whether gains can be seen following practice over several months.

Claire Cordella, PhD.
Center for Brain Recovery Alumni
Recently Promoted to Associate Director of Research at Boston University

Hantian (Alan) Liu, October 2023.

Q&A With Claire Cordella

What is this paper about?

This study showed a higher dosage amount is related to greater therapy outcomes in over 6 months of digital self-managed therapy. It also showed that regardless of the exact pattern of practice, self-managed SLT using the Constant Therapy Health Program leads to significant and sustained performance gains.

How is this related to the brain?

Stroke is the most common disease that causes serious neurological disorders. Every year, over 795,000 people in the United States have a stroke, and aphasia or other communication disorders develop in approximately one-third of cases. Compared to other patients, patients with aphasia are facing higher mortality and a higher degree of functional limitation, communication limitation, and social isolation, making the need for effective rehabilitative approaches especially acute. Because aphasia is a chronic condition, survivors need to find ways to continue to improve their skills and studies like this provide evidence that long term practice leads to sustained improvement in communication.

To learn more about this reasearch, read our recent publications, or meet our key members of these projects please visit our website's PROCoM page at:

bu.edu/cbr/procom/

Our People

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Erie Shivers
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Kelvin Fang
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Yashvi Grover
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Looking Ahead

Unveiling Hope with the Center for Brain Recovery

Understanding social determinants of health **(SDOH)**

Advocacy and research efforts to enable awareness and success for brain injury survivors

Clinical trials for neurological disorders

Continuous brain monitoring in real world settings

Data science and AI approaches predict human cognitive function and patient trajectories

Identifying biomarkers of brain health, disease and recovery

The Center for Brain Recovery Moves to a New Space, Expanding their Team and Research

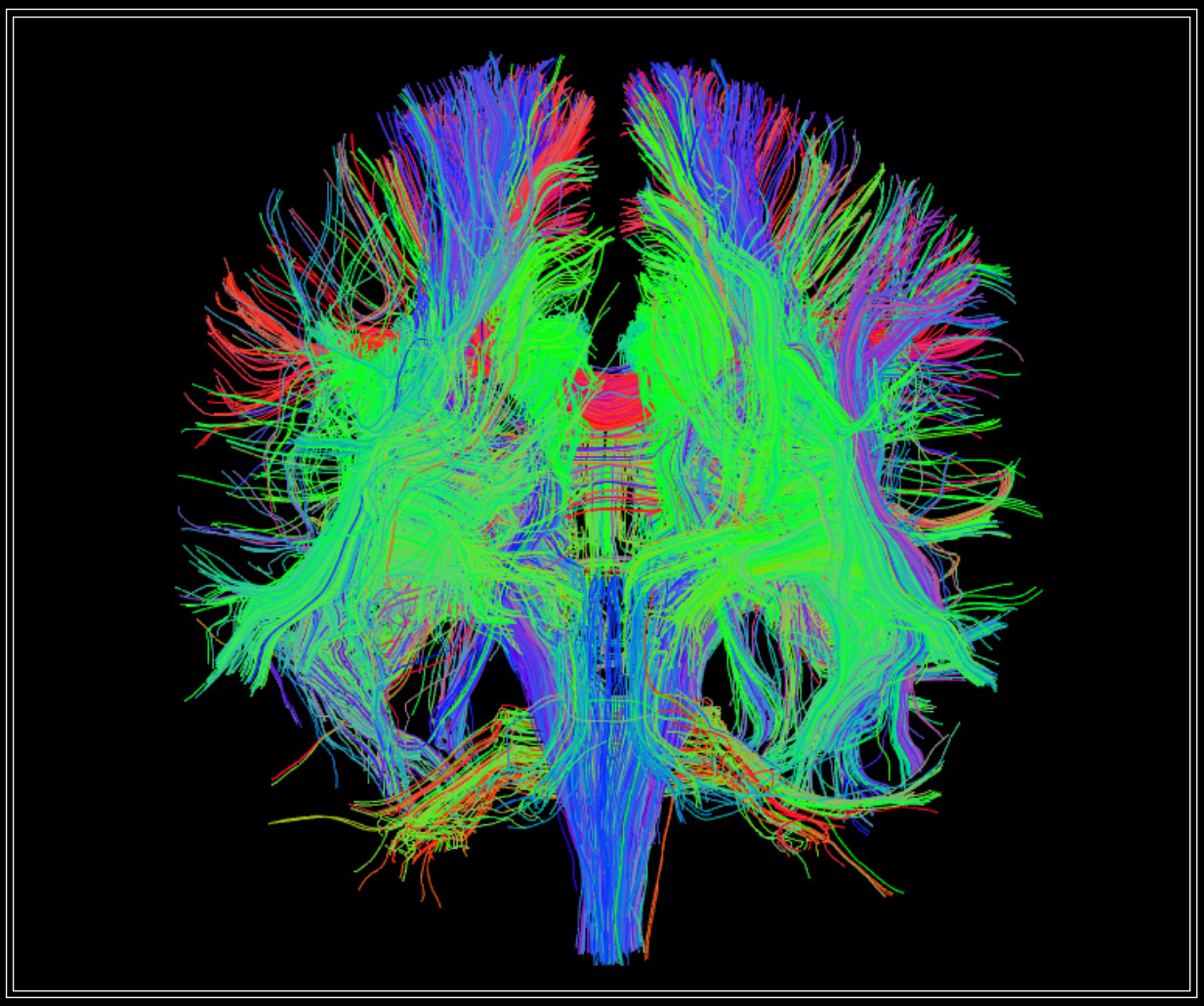
From Left: Matthew VanDemark, Michael Scimeca, Maria Varkanitsa, Berk Tellioglu, Manuel Marte, Danielle Rich, Swathi Kiran, Erin Carpenter, Nicole Carvalho

As we look to the future of brain recovery research, Boston University's Center for Brain Recovery will continue to focus on understanding the brain's remarkable ability to recover from injury or trauma. Through continued research we hope to develop more effective interventions that can improve outcomes for individuals affected by brain injury or disease.

Our center has moved to a new office space on 111 Cummington Mall, allowing us to expand our work with more projects, events and collaborations. Notably, our expansion will continue to allow our collaborative activities to flourish as we have over 20 events scheduled for 2024. In addition, in the coming year we will expand our interdisciplinary collaborative efforts to develop advanced neuroimaging approaches to study the brain, sophisticated computational and AI models to predict brain function and continue to provide high-quality clinical care. We look forward to expanding our team with talented graduate students and post-doctoral fellows and actively invite other researchers and industry collaborators to join us in this mission.

Our work is important, and it is important to us that we work diligently to advance the field of brain recovery. We look forward to seeing you in 2024!

CBR Office/ Team Photography and Report Design by Charlotte Derose
Written Content by Swathi Kiran and Charlotte Derose
NEW Conference Photography by Daniel Giancioppo
Hariri Sponsored Event Photography by Melody Ou
Candid Photography by BU Sargent College



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