



MRRI
MOSS REHABILITATION
RESEARCH INSTITUTE

Annual Report 2022

Celebrating 30 years of MRRI, 1992-2022

Moss Rehabilitation Research Institute

From Theory-Driven Research to Clinical Treatments in Neurorehabilitation

 **MossRehab**
Now part of Jefferson Health



Mission

MRRI is devoted to improving the lives of individuals with neurological disabilities through research.

Research at MRRI occupies a unique position within a translational “pipeline” from basic neuroscience to clinical neuroscience and neurorehabilitation.

We perform basic research, framed by theoretical perspectives, that maintains contact with the complexities of real-world functioning and leads to advances in neurorehabilitation assessment and treatment.

We perform patient-based research that informs basic science theories of complex cognitive and motor functioning and their neural bases, and on the processes of change in these systems.

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2022 Update

Congratulations to the entire Moss Rehabilitation Research Institute community for 30 years of unparalleled contribution to the field of translational neurorehabilitation. Your significant scientific findings have changed practice in neurorehabilitation, advanced our understanding of the relationships between brain structure and function, and eased the burden of disease from neurological conditions that are endemic worldwide.

In fiscal year 2022 we published 70 peer-reviewed manuscripts in translational neuroscience and neurorehabilitation, many in high impact journals, and we participated in 50 scientific presentations, mostly invited. New and revised grant proposals were submitted at a steady pace, and several highly-competitive grants were awarded. Among these were a 5-year NIH-funded clinical trial of virtual reality treatment for phantom limb pain (\$2.8M, Dr. Buxbaum, MRRI and Dr. Coslett, University of Pennsylvania), and a study of motor learning after cerebellar damage funded by the NIH's National Center of Neuromodulation for Rehabilitation (Dr. Therrien). Other recently-awarded grants commenced this year, including an NIH award for new Institute Scientist Dr. Mailend to investigate speech entrainment practice for people with aphasia. Overall, the Institute maintains approximately 40 grants and contracts each year, with the majority of our competitive grant funding from the National Institutes of Health and the National Institute on Disability, Independent Living, and Rehabilitation Research.

The bridge between contemporary clinical practice at MossRehab (ranked among the nation's best by U.S. News and World Report for the past 29 years) and the ground-breaking translational research at MRRI continues to be a key strength of our organization. The longstanding Traumatic Brain Injury Model System, held since 1997, is integral to our high-quality research and clinical practice, bringing national reputation and visibility. A competitive renewal, which has since been awarded, was submitted under the new leadership of Dr. Rabinowitz, Institute Scientist at MRRI, and Dr. Watanabe, Clinical Director of the Drucker Brain Injury program at MossRehab. The MossRehab Aphasia Center, in its 26th year of operation, continues to serve the community through innovative virtual programs. This year, Aphasia Center Director Dr. Antonucci conducted a study supported by the Albert Einstein Society evaluating an intensive program for those living with primary progressive aphasia and their communication partners. The Klein Family Parkinson's Center successfully began its multidisciplinary rehabilitation clinic and secured renewed funding for expansion over the next 5 years (Dr. Wong, Scientific Director, MRRI, and Dr. Rajnarine, Clinical Director, MossRehab). Over this past year, MRRI is particularly grateful for the support of our donors, who share our vision and enable significant innovation for new programs and continuity of our existing programs.

Our Institute Forums continued with a monthly visiting scholar lecture series consisting of invited speakers presenting on novel research findings or new methodological approaches, peer feedback on grants and projects, and didactic lectures and readings associated with our NIH T32 post-doctoral training program (held with University of Pennsylvania). The Shrier Family Topics in Rehabilitation Science lecture series provided an opportunity for discussion of translational rehabilitation research by researchers and MossRehab clinicians.

MRRI Scientists in Residence Dr. Vigliocco (University College London) and Dr. Turkstra (McMaster University) provided valuable contributions to joint projects and grant submissions. Our Emeriti maintained important and diverse input, including guidance and advice on scientific projects, co-authorship on peer-reviewed publications, and both internal and external scientific presentations. The in-person meeting of the MRRI Scientific Advisory Board in fall 2022 provided guidance on individual programs of research as well as overall scientific and strategic direction of the Institute.

In 2021 our parent organization, Einstein Healthcare Network, merged with Jefferson Health, one of the region's leading health systems. Jefferson's academic arm, Thomas Jefferson University (TJU), is one of the oldest medical schools in the country and provides exceptional research infrastructure. TJU brings established research administrative support, software and computational resources, clinical trials management, interaction with multidisciplinary researchers, and much more that will be explored over the coming years. This will be in conjunction with maintaining proximity and interconnection with the health system of MossRehab that has been pivotal to the success of the Institute. Over recent years, the Institute has been afforded organizational flexibility and has adapted well to world events, maintaining a high level of energy, commitment, and productivity. The depth and quality of our scientific work is remarkable, as is the team science approach supporting our common mission. The ongoing success of Institute Scientists and their teams is facilitated by MRRI administration, MossRehab, and Einstein Healthcare Network, each contributing critical support for research, marketing, and development.

Well done MRRI on 30 years of excellence. We have strong momentum moving into our 4th decade of operation, and we can look forward to the tremendous opportunities ahead, overcoming challenges together, and maintaining our unique sense of community.

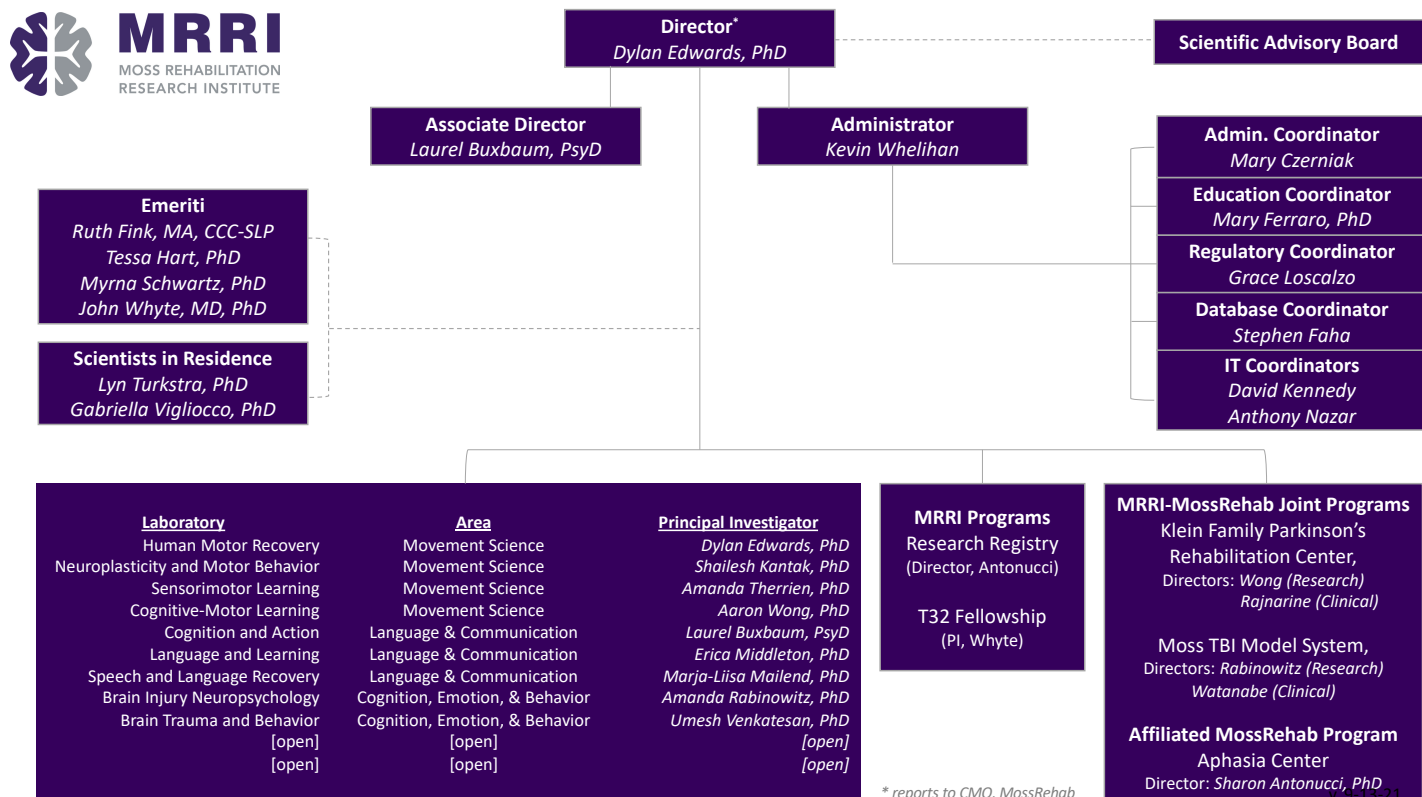


Dylan J. Edwards, PhD
Director, MRRI



Laurel J. Buxbaum, PsyD
Associate Director, MRRI

MRRI Organizational Structure



Staffing

Total FTEs	57
Institute Scientists	10
Scientist Emeriti	4
Scientists in Residence	2
Post-Doctoral Fellows	5
Research Support	30
Research Assistants	25.5
Participant Recruitment	4.5
Administrative	6
Adjunct Clinical-Research	5

Space

MRRI Building	sq ft
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1st Floor	6,590
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2nd Floor	2,370
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3rd Floor	8,000
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Subtotal	16,960
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Hospital – MossRehab – Elkins Park

2nd Floor West	410
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4th Floor - TBI	100
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Subtotal HEP	510
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Hospital – MossRehab – Tabor Road

4 th Floor Sley	100
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Subtotal	100
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Total Allocated Space	17,570
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Moss Rehabilitation Research Institute, MossRehab, and Albert Einstein Healthcare Network

Moss Rehabilitation Research Institute

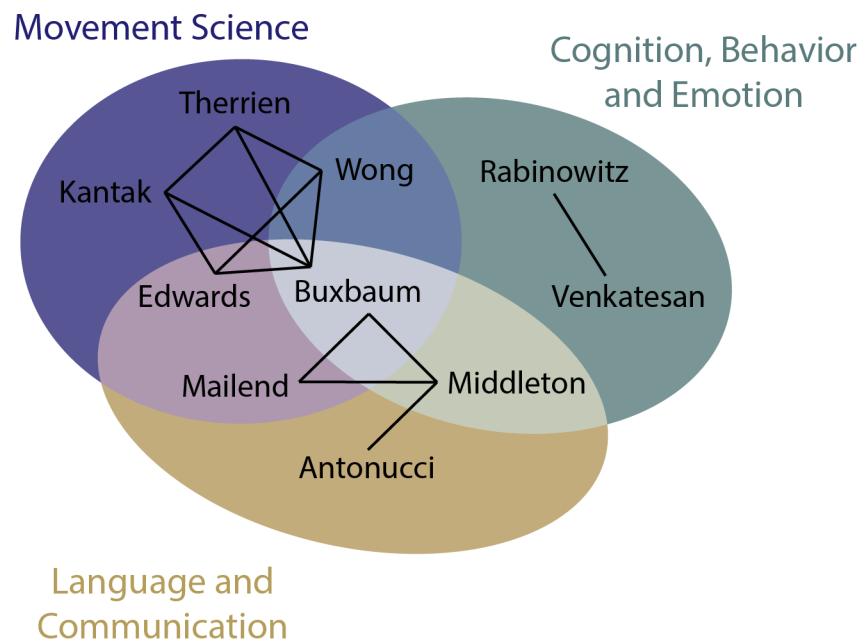
MRRI is an internationally recognized institute for rehabilitation and neuroscience research whose mission spans a translational “pipeline” from theory-driven research to clinical treatments in neurorehabilitation. The 10 scientists at MRRI and their laboratory staff of postdoctoral fellows, research assistants, and visiting students perform basic research, framed by theoretical perspectives that maintain contact with the complexities of real-world function and lead to advances in neurorehabilitation assessment and treatment. We also perform patient-based research that informs basic science theories of complex cognitive, perceptual, and motor functioning and their neural bases, and on the processes of change in these systems. MRRI occupies ~17,500 square feet in a renovated office building on the campus of MossRehab Hospital in Elkins Park, PA. Testing and office space is also available within the hospital (MossRehab, Elkins Park, and MossRehab at Einstein Medical Center Philadelphia).

MRRI Research Registry: MRRI has a unique and invaluable infrastructure for patient-based research. The MRRI Patient Research Registry, directed by Dr. Sharon M. Antonucci, currently includes approximately 1,235 active research volunteers with imaging-verified stroke and 624 individuals with traumatic brain injury from which we draw study participants. Research-quality MRI or CT scans and hand-drawn lesion reconstructions are available for 91 individuals with stroke; resting-state fMRI and diffusion data are available for 9 of these individuals. The Registry also includes 32 members with Parkinsonism, enrollment of whom began in fiscal 2020, and about 200 neurotypical volunteers. Administrative staff assist in recruiting participants into the Registry from MossRehab’s inpatient and outpatient facilities. Retention is aided by annual mailings with birthday letters.

Academic and Educational Forums: MRRI hosts numerous regular meetings of relevance to translational neurorehabilitation research, including the 1) Shrier Family Topics in Rehabilitation Science Lecture Series, a monthly presentation by a MRRI or outside researcher; 2) Institute Forum Grants Workshops, a monthly workshop for MRRI senior staff and postdoctoral fellows focused on grant-writing skills; 3) Institute Forum Visiting Scholar Lecture Series, a series of talks by influential external scientists; and 4) T32 Lecture Series, a monthly colloquium covering a broad variety of relevant topics. Research / clinical mixers are held by teams of individuals to foster collaboration and research inquiry.

Postdoctoral Training in Translational Neurorehabilitation Research: Since 2013, MRRI has been funded by a T32 grant from the NIH for postdoctoral training in translational neurorehabilitation research, to supplement postdoctoral training slots supported by research grants and institutional funds. This training grant, under the direction of Dr. John Whyte, involves mentors from MRRI and from behavioral neurology and neuroimaging at the University of Pennsylvania. The combination of NIH and internal funding provides support for 5 trainees for 3 years. We recruit basic scientists to learn rigorous methods of clinical research and clinical researchers to enhance the theoretical and methodologic sophistication of their research. Regardless of funding source, postdoctoral fellows affiliated with MRRI receive a rich didactic curriculum, along with structured career goal setting and mentored research. Trainees benefit from the clinical and technical resources available across the two institutions and from the existing programs of collaborative multidisciplinary research in which their mentors are engaged.

Translational Neurorehabilitation Research Focus Areas



Laboratories

Brain Injury Neuropsychology Laboratory: (Amanda Rabinowitz, PhD, director) The Brain Injury Neuropsychology Laboratory studies the neurobiological and psychosocial factors that influence recovery from traumatic brain injury (TBI) across the spectrum of injury severity. This lab houses the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR)-funded Moss Traumatic Brain Injury Model System, part of a 16-center network to study outcomes and treatment of TBI.

Programs of Research:

- The use of mobile technology for brain injury rehabilitation assessment and intervention
- Neuropathological substrates of chronic and neurodegenerative effects of brain injury
- Treatment of depression in persons with moderate-severe TBI
- Resilience after brain injury
- Chronic effects of moderate-severe TBI on functional outcomes and brain health
- Participation in contact sports as a risk factor for cognitive and emotional impairment in later life

Brain Trauma and Behavior Laboratory: (Umesh “Umi” Venkatesan, PhD, director) The Brain Trauma and Behavior Laboratory studies the cognitive and functional health of individuals with a remote history of moderate or severe traumatic brain injury (chronic TBI) as well as older individuals with new-onset TBI. One of its major goals is to characterize the potential for and optimize the detection of pathological brain aging in TBI. To this end, the lab uses cognitive neuroscientific approaches to identify or develop behavioral assessments and potential treatment interventions that are informed by neurobiological models of TBI and aging.

Programs of Research:

- Cognitive, functional, and neurobiological characterization of chronic TBI
- Neuropsychological methods for evaluating neurodegenerative disease risk or prodrome in chronic TBI
- Assessment of episodic memory in chronic TBI
- Pre-, peri-, and post-morbid health considerations for outcome in older adults with more recent TBI
- Social determinants of health and health behaviors

Cognition and Action Laboratory: (Laurel J. Buxbaum, PsyD, director) The Cognition and Action Laboratory investigates the interface between cognitive representations of objects, tasks, and action planning processes using behavioral testing with healthy and brain-damaged participants, support vector lesion symptom mapping (SVR-LSM, a machine learning approach), eye tracking, virtual reality, and fMRI. This work enables us to understand how conceptual representations may be “grounded”, and the aspects of object representations that may be disrupted after stroke to frontal, temporal, or parietal brain regions. In addition, the lab studies the role of spatial and body representations in the control of attention and action.

Programs of Research:

- The role of body representations and visual information in action production
- Task-related activation of tool-related actions
- Virtual reality treatment of phantom limb pain
- Representations of the body in phantom limb syndrome
- Functional and resting state connectivity of the skilled action network
- Action and non-action sequencing in the left hemisphere
- Apraxia rehabilitation using network-strengthening treatment
- Multimodal communication and co-speech gesture

Cognitive-Motor Learning Laboratory: (Aaron L. Wong, PhD, director) The goal of the Cognitive-Motor Learning Laboratory is to understand how interactions between the cognitive and motor systems allow us to acquire and maintain skilled actions and become movement experts. This includes identifying the processes that contribute both to the planning and the online control of actions. Using motion tracking of the eyes and arms in healthy individuals and in patients with neurological disorders, the aim is to not only gain a better understanding of the motor system from a neurological and theoretical standpoint, but to also identify new approaches to enhance rehabilitation efforts.

Programs of Research:

- The use of trajectory and body configuration representations in planning and on-line control during movement imitation
- The contribution of verbal, visual, and proprioceptive instructions in planning praxis actions
- Interactions between motivation, effort, and learning in neurotypical individuals and in patients with Parkinson’s disease

Human Motor Recovery Laboratory: (Dylan J. Edwards, PhD, director) The Human Motor Recovery Laboratory has several lines of research addressing recovery of voluntary movement control in humans following stroke or spinal cord injury. Quantitative clinical

neurophysiology, neuroimaging, and kinematic data are studied to understand the basis of motor symptoms and inform emerging physical rehabilitation strategies. Clinical treatment trials using intensive motor training are supplemented by experimental non-invasive neuromodulation.

Programs of research:

- Systems-level neurobiology of dysfunction and recovery
- Intensive robot-assisted training, combinatorial interventions
- Non-invasive stimulation technique development
- Outcome prediction
- Telerehabilitation

Language and Learning Laboratory: (Erica L. Middleton, PhD, director) The Language and Learning laboratory is dedicated to understanding the processes involved in language production as well as how such processes are disrupted in acquired language disorder (aphasia). A major focus is to develop efficacious treatments of aphasia grounded in a theoretical understanding of fundamental mechanisms of language use, learning, and language change.

Programs of Research:

- Monitoring of naming errors in aphasia
- Retrieval practice (i.e., testing) effects and distributed practice effects in rehabilitation of naming impairments in aphasia
- Retrieval practice and distributed practice effects in treatment of word comprehension deficits in aphasia
- Semantic context effects in naming
- Use-dependent language change (i.e., incremental learning) in lexical access

Neuroplasticity and Motor Behavior Laboratory: (Shailesh Kantak, PhD, director) The main goal of the Neuroplasticity and Motor Behavior Laboratory is to optimize motor recovery and learning in patients with neurological disorders (e.g., stroke, cerebral palsy) through a better understanding of the neural plasticity that underlies motor performance, recovery, and rehabilitation strategies. The research in this laboratory encompasses a spectrum from basic science experiments to understand motor behavior in healthy controls and patients at one end to exploring the effects of innovative treatment strategies to augment motor recovery at the other end. The research employs motion analyses to characterize and quantify movement strategies as they evolve with motor practice and time in patients with neurological disorders. Further, another goal is to probe noninvasive brain stimulation techniques applied through careful neuronavigation to probe specific brain regions to understand their role in motor learning and recovery. Finally, the acquired information is used to plan innovative strategies to promote learning and recovery in patients with neurological injuries.

Programs of Research:

- Brain-behavior correlates of motor skill learning and transfer following stroke
- Practice structure and motor skill learning
- Bimanual coordination after stroke
- Behavioral and neuroanatomic basis of arm use and nonuse after stroke
- Modulation of learning and recovery with noninvasive brain stimulation

Sensorimotor Learning Laboratory: (Amanda Therrien, PhD, director) The Sensorimotor Learning Laboratory studies how upper extremity movements are learned and controlled and how damage to specific brain areas may alter these processes. The lab uses a combination of 3-D motion capture, virtual reality, and robotic techniques to assess human behavior in both healthy individuals and neurologic populations with damage to the cerebellum. This work enables the investigation of (1) the neural mechanisms through which different sources of sensory information are integrated, (2) how this information is used to learn and control upper extremity movement, and (3) whether these mechanisms can be leveraged in the development of new rehabilitation therapies for individuals with motor impairment.

Programs of Research:

- Mechanisms of motor learning that are spared versus impaired by cerebellar damage
- Cerebellar contributions to somatosensory perception
- Interactions between adaptive and reinforcement motor learning
- Interactions between adaptive motor learning and sensory perception
- Validation of clinical outcome measures for cerebellar ataxia

Speech and Language Recovery Laboratory: (Marja-Liisa Mailend, PhD, director)

The Speech and Language Recovery Laboratory investigates the cognitive architecture of speech and language production and its disorders. With a primary emphasis on impairments of phonological encoding and speech motor planning, the long-term goal of our work is to develop theory-driven and evidence-based assessments and treatment programs to strengthen functional communication in people with aphasia and apraxia of speech. Research in our laboratory employs various methods including behavioral speech and language assessments, acoustic analysis, psycholinguistic reaction time studies, and support vector lesion symptom mapping.

Programs of Research:

- Underlying mechanism of speech motor planning and speech motor planning impairments
- Differential diagnosis of apraxia of speech
- Speech entrainment treatment for people with aphasia and apraxia of speech

MRRI Core Facilities

MRRI Virtual Reality Core Facility: This shared facility provides the infrastructure to support experiments conducted using virtual reality. Available equipment includes two head-mounted virtual-reality systems (Vive, HTC and Oculus Quest, Oculus) each with two hand-held controllers and associated optical tracking system, a magnetic tracking system (TrakSTAR, Ascension Technologies), an optical hand-tracking system (Leap Motion), and an integrated eye-tracking system (Pupil Labs), as well as a dedicated PC running custom-written software in Unity.

MRRI Eyetracking Lab: MRRI houses a dedicated eye-tracking suite, with state-of-the-art Eyelink® tracking system and computing equipment, used by several laboratories for clinical and translational research projects.

Clinical

MossRehab: MossRehab and Moss Rehabilitation Research Institute (MRRI) are part of Albert Einstein Healthcare Network, and merged with Jefferson Health, one of the region's leading health systems. Jefferson's academic arm, Thomas Jefferson University (TJU), is one of the oldest medical schools in the country and provides exceptional research infrastructure. Housed in the same campus in Elkins Park, MossRehab and MRRI have fostered a close collaboration to create a true "research culture informed by clinical needs" within the continuum of patient care for neurological rehabilitation, and an impressive array of resources to support clinical research. MossRehab is accredited by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and Commission on Accreditation of Rehabilitation Facilities (CARF), and has been recognized for 29 years as one of the nation's best rehabilitation hospitals in the U.S. News and World Report survey. MossRehab was recently named, for the 11th year, one of the "Best Workplaces" among large employers in the Philadelphia area. The inpatient programs admit more than 1,000 patients with stroke and TBI and nearly 250 persons with spinal cord injury and an equal number of persons with limb amputation annually across five sites: campuses at the Elkins Park Hospital, Jefferson Bucks Hospitals and Doylestown Hospital in suburban Philadelphia, and Tabor Road and Jefferson Frankford in Philadelphia. The outpatient stroke programs provide services to approximately 2,500 patients annually. Services are provided at 8 additional locations in the Philadelphia area, three in its suburbs. MossRehab is recognized for excellence in care, with outcomes that consistently exceed the national mean when measured by Functional Independence Measure (FIM) score change and percentage of patients returning home. In addition, MossRehab has high patient satisfaction. MossRehab is an early adopter of technology and is a leader in rehabilitation technology innovation, with a number of firsts in

the nation regarding the use of robotics in rehabilitation. MossRehab was first in introducing the REO®, Armeo® Power and the Tyromotion® upper limb robots to clinical use, and it was first in the nation with ReWalk®, Restore®, Geo-Evolution®, and Lyra®. MossRehab has designed and performed clinical trials with ReWalk®¹², Lokomat®¹³ Geo, ReStore, Lokomat, Armeo, and GloReha, and it recently completed a trial in robotics in acute stroke rehabilitation. MossRehab has an established, world-class technology and robotics in rehabilitation program.

MossRehab Aphasia Center: (Sharon M. Antonucci, PhD, CCC-SLP, director) Founded in 1996, the MossRehab Aphasia Center is a joint endeavor by MossRehab and MRRI to meet the long-term communication and psychosocial needs of individuals who have been affected by chronic and progressive aphasia. It is a warm and welcoming place where people can find information and peer support, as well as participate in research and treatment.

The Aphasia Center provides focused and meaningful intervention at strategic points in the recovery process. This can occur through short-term outpatient therapy in the Advanced Clinical Therapy (ACT) program, through the various groups and classes in the Aphasia Activity Center, or through participation in research at the Moss Rehabilitation Research Institute.

MossRehab Aphasia Center was founded on several basic principles:

- Recovery from aphasia involves a life-long process of re-education, adaptation, and support
- Under the right conditions, people with aphasia can continue to recover even years after the onset of aphasia
- Participating in social, recreational, and educational activities reduces isolation and helps people with aphasia and their families make psychosocial adjustments
- Individuals with aphasia and their families can play an important role in increasing public awareness of aphasia

Dr. Antonucci directs the Aphasia Center research program. Her work focuses on theoretically-motivated aphasia rehabilitation informed both by cognitive neuropsychological models of language and by the Life Participation Approach to Aphasia.

Klein Family Parkinson's Rehabilitation Center: (Aaron L. Wong, PhD, director-scientific; Tariq Rajnarine, MD, director-clinical) Founded in 2018 with the generous support of the Klein Family, the Klein Family Parkinson's Rehabilitation Center is dedicated to improving the lives of patients with Parkinson's disease by integrating clinical, rehabilitation, and research efforts throughout MossRehab and MRRI.

The Center has three primary aims:

- Increasing opportunities for patients to engage in research by expanding the current MRRRI Research Registry to include patients with Parkinson's disease
- Improving care for patients with Parkinson's disease by offering a multidisciplinary clinic. This clinic brings together a team of experts typically involved in the care of individuals with Parkinson's Disease, including an Occupational Therapist, Physical Therapist, Speech Language Pathologist, Physician, and Social Worker. Together, this team evaluates individuals using a collaborative approach to coordinate care and address goals that might otherwise be challenging to recognize or achieve by one clinical discipline alone, and the clinic tracks outcomes longitudinally over time.
- Increasing interaction amongst clinicians, therapists, and researchers to facilitate collaborative efforts across departments and to collectively identify new approaches for improving patient care. This will be fueled by the awarding of clinical-research integration grants (beginning in fall 2022) to support novel research projects and clinical programs aimed at improving the lives of individuals with Parkinson's disease.

Ruth Fink, MA, CCC-SLP: Ruth Fink, a cofounder and former Clinical Director of the MossRehab Aphasia Center and MRRI clinician researcher, remains involved with the Aphasia Center as an informal consultant. She promotes external relationships and supports ongoing Development efforts, providing input to annual campaigns, maintaining contact with supporters, and lending her name to solicitation letters and follow-ups as needed. Outside of MRRI, Ruth continues her involvement with Aphasia Access, an organization of which MossRehab Aphasia Center is a founding member, and whose mission is to transform services and environments so people with aphasia can participate fully in life. In 2018 and 2019, Ruth served as Board President and has continued to serve on the board through 2021.

Tessa Hart, PhD: Dr. Hart directed the Traumatic Brain Injury Clinical Research Laboratory at MRRI and the Moss Traumatic Brain Injury Model System until her transition to Emerita status in January, 2019. Dr. Hart continues to work with TBI Model System investigators on collaborative projects, including a clinical trial of Behavioral Activation for depression/anxiety in chronic moderate to severe TBI. She also remains site Principal Investigator for the NIDILRR-funded multi-center trial, "Multicenter Evaluation of Memory Remediation after Traumatic Brain Injury with Donepezil (MEMRI-TBI-D)," currently in the dissemination phase. Dr. Hart continues to serve on federal grant review panels and journal editorial boards, is active in the Rehabilitation Treatment Specification Working Group of the American Congress of Rehabilitation Medicine, and was an invited participant in the NINDS/NICHD Common Data Elements Working Group focused on neurorehabilitation interventions. As a Moody Prize recipient (2019), she was invited to join a group of distinguished TBI scientists in a two-year effort to reduce disparities in access to care and rehabilitation across the U.S., sponsored by the Moody Neurorehabilitation Institute and the National Association of Head Injury Administrators.

Myrna Schwartz, PhD: Dr. Schwartz, the former Associate Director of MRRI, provides consultation to several MRRI scientists. In The Language and Learning Laboratory directed by Dr. Erica Middleton, Dr. Schwartz is serving as a Co-Investigator on the NIH award to Dr. Middleton titled "Retrieval Practice Principles: A Theory of Learning for Aphasia Rehabilitation." In that capacity, Dr. Schwartz provides feedback on methodological and study design details, and she recently published a manuscript with Dr. Middleton examining spontaneous error monitoring and learning in aphasia.

John Whyte, MD, PhD: Dr. Whyte stepped down as Director of MRRI in 2018. He has remained involved in clinical research on recovery from moderate-severe brain injury, with a

particular emphasis on disorders of consciousness (DOC). He is a co-investigator on MossRehab's Traumatic Brain Injury Model System (TBIMS) and several other TBI-related projects. Dr. Whyte also led the development of the Rehabilitation Treatment Specification System (RTSS), which provides a standard framework for defining rehabilitation treatments of all kinds with respect to their known or hypothesized active ingredients. The *Manual for Rehabilitation Treatment Specification* (of which Dr. Hart is first author) now serves as the basis of RTSS implementation efforts, which are centered at the American Congress of Rehabilitation Medicine's (ACRM) Rehabilitation Treatment Specification Networking Group, of which Dr. Whyte is past chair. In addition to his research, Dr. Whyte serves as a career mentor to junior scientists at MRRI and beyond. He developed and now co-leads the Rehabilitation Medicine Scientist Training Program (RMSTP), which grooms promising physician scientists from around the country for careers in rehabilitation research. He also serves as Principal Investigator of the T32 postdoctoral research training program in Translational Neurorehabilitation Research, in collaboration with mentors at both MRRI and the University of Pennsylvania. In addition, Dr. Whyte serves as a peer reviewer for multiple journals and funding agencies.

Scientists in Residence

MRRI adjunct staff include two Scientists in Residence who each participate in several extended visits per year at MRRI. During this time, they give lectures, attend lab meetings, and provide consultative input to MRRI Senior Staff.

Gabriella Vigliocco, PhD: Dr. Vigliocco is a Professor at the University College London, where she directs the Language and Cognition Laboratory. In 2022, Dr. Vigliocco regularly attended scientific meetings, published, and submitted grant proposals with Institute Scientists and postdoctoral fellows in the language and action domains. In addition, she shares supervision of a University College London graduate student with Dr. Buxbaum.

Lyn Turkstra, PhD: Dr. Turkstra is a Professor in the School of Rehabilitation Science and Assistant Dean of the Speech-Language Pathology Program at McMaster University in Ontario Canada. She collaborates with both MRRI researchers and MossRehab clinicians on multiple research and clinical translation projects to improve the care of patients with acquired brain injury.

Scientific Advisory Board

Kathleen R. Bell, MD

Chair, Department of Physical Medicine and Rehabilitation, University of Texas Southwestern Medical Center, Kimberly-Clark Distinguished Chair in Mobility Research.

Pablo A. Celnik, MD

Director, Department of Physical Medicine and Rehabilitation; Professor of Physical Medicine and Rehabilitation, Johns Hopkins School of Medicine.

Leslie J. Gonzalez-Rothi, PhD

Professor Emeritus, Department of Neurology, University of Florida.

Argye Beth Hillis, MD

Director, Cerebrovascular Division of Neurology, Johns Hopkins School of Medicine; Professor of Neurology, Johns Hopkins School of Medicine.

Kenneth Pugh, PhD

President and Director of Research, Haskins Laboratory; Associate Professor, Department of Linguistics, Yale University

Eric L. Shipp, PhD, MBA

Associate Director, Finance and Administration, Glenn Biggs Institute for Alzheimer's and Neurodegenerative Diseases, University of Texas Health Science Center at San Antonio

Financial / Strategic Consultant

Robert Forrester, MBA

Consultant to research institutions, principally independent non-profits, on matters of organization, finance, affiliation, strategy, and regulation.

Publications Fiscal Year 2022

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* Clinician Investigator

Presentations Fiscal Year 2022

Antonucci, S., Rabinowitz, A., Whyte, J., Wong, A. Clinical practice and research: Ethical issues as the boundaries. T32 Lecture Series, Moss Rehabilitation Research Institute, November 10, 2021. (virtual)

Antonucci, S. Getting the message across: Discourse measurement in aphasia rehabilitation. Shrier Family Topics in Rehabilitation Sciences, Moss Rehabilitation Research Institute, March 16, 2022. (virtual)

Antonucci, S. Animal-Assisted Therapy. Live 'Ask the Expert' Webinar, National Aphasia Association, May 12, 2022.

Arnold, W., Burns, A., Herman, D., **Whyte, J.** Planning around a clinical fellowship. Panel Discussion, Rehabilitation Medicine Scientist Training Program (RMSTP) Workshop, New Orleans, LA, May 26, 2022.

Barhorst-Cates, E., **Wong, A.L., Buxbaum, L.J.** Determinants of navigation ability post-stroke. Annual Meeting of the Psychonomic Society, November 4-7, 2021. (virtual)

Buxbaum, L.J. The way(s) you do the things you do: Tool use representation and selection in the left hemisphere. Freda Newcombe Prize Talk of the British Neuropsychological Society, November 11, 2021.(virtual)

Buxbaum, L.J. Shared and distinct neurocognitive processes in language and tool use actions: Evidence from stroke lesion studies. Workshop on Perspectives on Pantomime: Evolution, Development, Interaction. Nicolaus Copernicus University, Torun, Poland, November 18, 2021. (virtual)

Buxbaum, L.B., Kantak, S., Potts, C. Understanding disparities between arm use and capacity in left hemisphere stroke. Shrier Family Topics in Rehabilitation Science Seminar, Moss Rehabilitation Research Institute, January 19, 2021. (virtual)

Buxbaum, L.J. The role of competition in motor planning. American Society of Neurorehabilitation, St. Louis, MO, March 31, 2022.

Coslett, H.B., **Edwards, D.J., Rabinowitz, A.** Three scientific autobiographies. T32 Lecture Series, Moss Rehabilitation Research Institute, September 8, 2021. (virtual)

Diandra, B., Favoretto, D.B., Bergonzoni, E., Nascimento, D.C., Louzada, F., Lemos, T.W., Batistela, R.A., Moraes, R., Leite, J.P., Rimoli, B.P., **Edwards, D.J., Santos, T.** High definition tDCS effect on postural control in healthy individuals: Entropy analysis of a crossover clinical trial. Poster presented at The 2nd International Electronic Conference on Brain Sciences, July 2021. (virtual)

Dresang, H.C., Metzgar, R., **Wong, A.L., Buxbaum, L.J.** The role of language and semantics in gesture imitation following left-hemisphere stroke. Society for the Neurobiology of Language, October 5, 2021. (virtual)

Duquette, K., Foley, T., **Middleton, E.** An examination of retrieval practice and production training in the treatment of word-comprehension deficits in aphasia. Poster presentation at the Academy of Aphasia, October 24, 2021. (virtual)

Edwards, D.J. Open TMS and TES modeling problems in clinical rehabilitation. Brain and Human Body Modeling Conference: From Fast and Accurate Computational Modeling to Clinical Practice. The Martinos Center for Biomedical Imaging at Massachusetts General Hospital, August 19-20, 2021. (virtual)

Edwards, D.J. Walking improvement in chronic incomplete spinal cord injury with exoskeleton robotic training (WISE): A randomized controlled trial. 60th International Spinal Cord Society Annual Scientific Meeting (ISCoS), September 30, 2021. (virtual)

Edwards, D.J. Contemporary TMS motor mapping. NC NM4R Introductory Workshop, October 26, 2021. (virtual)

Edwards, D.J. Panel discussion. NC NM4R Introductory Workshop, October 27, 2021.

Edwards, D.J. Neuromodulation in stroke rehabilitation. AVC 2021 - XIII Brazilian Congress of Cerebrovascular Diseases and II Alagoas Day of Neurology, November 12, 2021. (virtual)

Edwards, D.J. A career as a scientist in neuromodulation research: Challenges, rewards and opportunities. XIII International Symposium of Neuromodulation, November 22, 2021. (virtual)

Edwards, D.J. Robotics and neurostimulation in stroke recovery. Invited Speaker, 2nd Annual Medical Student Research Career Workshop, Thomas Jefferson University, Philadelphia, PA. March 23, 2022.

Edwards, D.J. Gait training in motor incomplete spinal cord injury using exoskeleton robotics. Robotics and Technology in Rehabilitation Symposium. MossRehab, Elkins Park, PA. April 29-30, 2022.

Edwards, D.J., Middleton, E., Venkatesan, U., Whyte, J. Becoming a peer reviewer: Approaches to reviewing manuscripts and grants. T32 Lecture Series, Moss Rehabilitation Research Institute, June 7, 2022. (virtual)

Ferraro, M., Packel, A., **Whyte, J.** Opening the Black Box: The rise of the Rehabilitation Treatment Specification System. Shrier Family Topics in Rehabilitation Science Seminar, Moss Rehabilitation Research Institute, October 20, 2021. (virtual)

Kantak, S. The 4-element movement system model to guide physical therapy education, practice, and research. Combined Sections Meeting of the American Physical Therapy Association, San Antonio, TX. February 3, 2022.

Kantak, S. Short-term effects of tDCS on quadriceps performance and corticospinal excitability in athletes after ACL reconstruction. Poster presentation, Combined Sections Meeting of the American Physical Therapy Association, San Antonio, TX. February 4, 2022.

Kantak, S., Coslett, H.B. Neuromodulation-transcranial magnetic stimulation. T32 Lecture Series, Moss Rehabilitation Research Institute, March 9, 2022. (virtual)

Kantak, S. Clinical application of robotics in neurorehabilitation. Panel discussion, Robotics and Technology in Rehabilitation Symposium. MossRehab, Elkins Park, PA. April 29-30, 2022.

Mayer, N.* Normal and pathological gait. Intercity Gait & Locomotion Course for PM&R Residents. MossRehab, Elkins Park, PA. December 21, 2021.

Mayer, N.* Brain to muscles: What's the connection? Shrier Family Topics in Rehabilitation Science Seminar, Moss Rehabilitation Research Institute, June 15, 2022. (virtual)

Middleton, E. An examination of retrieval practice learning principles in the treatment of lexical-semantic disorders in stroke aphasia. Shrier Family Topics in Rehabilitation Science Seminar, Moss Rehabilitation Research Institute, April 20, 2022. (virtual)

Nissim, N., Hamilton, R., **Edwards, D.J.** Content on neuromodulation. T32 Lecture Series, Moss Rehabilitation Research Institute, February 9, 2022. (virtual)

Nunn, K., **Middleton, E.,** Vallila-Rohter, S. Leveraging the rehabilitation treatment specification system to synthesize evidence on errorless learning, errorful learning, and retrieval practice for naming in aphasia. Poster presented at the Clinical Aphasiology Conference, Wrightsville Beach, NC. May 17-22, 2022.

Nunn, K., **Middleton, E.**, Vallila-Rohter, S. How can clinicians support learning during naming treatment for aphasia? A review of the learning mechanisms underlying errorless learning, errorful learning, and retrieval practice. Poster presented at the International Aphasia Rehabilitation Conference, Philadelphia, PA. June 22-24, 2022.

Patra, A., Kirkwood, J., **Middleton, E.**, Thothathiri, M. Variation in how cognitive control modulates sentence processing. The Architectures and Mechanisms for Language Processing Conference (AMLaP). Université de Paris, France, September 2-4, 2021 (virtual)

Patra, A., Kirkwood, J., **Middleton, E.**, Thothathiri, M. Variation in how cognitive control modulates sentence processing. Society for Neurobiology of Language, October 7, 2021. (virtual)

Patra, A., **Middleton, E.L.** How the past affects the present: An examination of use-dependent, error-based learning in lexical access. International Workshop on Language Production, November 2, 2021. (virtual)

Patra, A., Kirkwood, J., **Middleton, E.L.**, Thothathiri, M. Variation in how cognitive control modulates sentence processing. Poster presentation at the 62nd Annual Meeting of the Psychonomic Society, November 5, 2021. (virtual)

Potts, C., **Kantak, S., Buxbaum, L.J.** Virtual reality assessment of arm choice under cognitive load. Poster presentation, American Society of Neurorehabilitation, St. Louis, MO. March 31, 2022.

Segal, R., Celnik, P., **Whyte, J.** Budget and personnel Management. Panel Discussion at the Rehabilitation Medicine Scientist Training Program (RMSTP) Workshop, New Orleans, LA. May 26, 2022.

Therrien, A. From precise measurement to tailored intervention: How technology can benefit rehabilitation research. Robotics and Technology in Rehabilitation Symposium, MossRehab, Elkins Park, PA. April 29-30, 2022.

Thothathiri, M., Kirkwood, J., **Middleton, E.L.** Cognitive control and sentence processing in patients with agrammatism. Poster presented at the 29th Annual Meeting of the Cognitive Neuroscience Society, San Francisco, CA. April 23-26, 2022.

Whyte, J. Case examples in measuring the difficult-to-measure: Global neurologic function & pain in disorders of consciousness. Weill Cornell Medicine, Department of Rehabilitation Medicine Interdisciplinary Brain Injury Research Seminar Series, July 2021. (virtual)

Whyte, J., Van Stan, J. Advances in rehabilitation treatment specification. T32 Lecture Series, Moss Rehabilitation Research Institute, July 14, 2021. (virtual)

Whyte, J. The active ingredients of rehabilitation. Grand Rounds presentation, School of Health & Rehabilitation Sciences, The Ohio State University, September 3, 2021. (virtual)

Whyte, J. Disorders of consciousness: the changing landscape of research and care. 2021-2022 New York Society of PM&R CME Lecture Series, December 1, 2021. (virtual)

Whyte, J., Buxbaum, L. Grant writing 101. T32 Lecture Series, Moss Rehabilitation Research Institute, December 8, 2021. (virtual)

Whyte, J., Turner-Stokes, L., Weintraub, A. Systems of care for individuals with disorders of consciousness. International Brain Injury Association, December 9, 2021. (virtual)

Whyte, J. Disorders of consciousness: Impact of the US System of Care. NIDILLR virtual meeting on Disorders of Consciousness, February 28, 2022.

Whyte, J. Disorders of consciousness: Evolving research on prognosis, treatment, and policy. Invited Presentation, Brain Injury Alliance of CT, March 18, 2022. (virtual)

Whyte, J. Treatment specification in rehabilitation. Temple / Moss Students Grand Rounds, April 6, 2022. (virtual)

Whyte, J., Wong, A. Team science & interdisciplinary collaboration. T32 Lecture Series, Moss Rehabilitation Research Institute, May 11, 2022. (virtual)

Whyte, J. Introduction to the RMSTP – what to expect. Rehabilitation Medicine Scientist Training Program (RMSTP) Workshop, New Orleans, LA. May 26, 2022.

Whyte, J. Winding down-planning for late middle career end. Association of Academic Physiatrist (AAP) Annual Conference, New Orleans, LA. May 26, 2022.

Whyte, J. Basics of starting a successful research program. Association of Academic Physiatrist (AAP) Annual Conference, New Orleans, LA. May 26, 2022.

Whyte, J. Special challenges in rehabilitation research design. Neurorehabilitation Knowledge Center, Copenhagen, Denmark June 15, 2022. (virtual)

Whyte, J. Disorders of consciousness: Evolving research on prognosis and treatment. Neurorehabilitation Knowledge Center, Copenhagen, Denmark June 16, 2022. (virtual)

Whyte, J. Aphasia therapy: what does theory-driven treatment specification buy us. Keynote speaker, International Aphasia Rehabilitation Conference, Philadelphia, PA. June 24, 2022.

Wilson J, **Rabinowitz AR, Hart T.** Ecological momentary assessment of mood after moderate to severe traumatic brain injury. Presented at 41st Annual Conference of National Academy of Neuropsychology, December, 2021 (virtual)

Wong, A. Reaching under uncertainty. Colloquium of the Biopsychology & Cognitive Neuroscience Group, Bielefeld University, July 2021. (virtual)

Wong, A. Two movement goals underlying imitation. Invited speaker, Pennsylvania State University Action Club, State College, PA. November 5, 2021.

Wong, A. What do we really know about Parkinson's disease? Shrier Family Topics in Rehabilitation Science, Moss Rehabilitation Research Institute, February 16, 2022. (virtual)

* Clinician Investigator

Shrier Family Topics in Rehabilitation Science Lecture Series

Shrier Family Topics in Rehabilitation Science Lecture Series is a series of informal colloquia that bridge the clinical and research worlds. The goal is to inform MossRehab and Moss Rehabilitation Research Institute staff about ongoing projects of institute staff and adjunct scientists in an atmosphere that encourages discussion about methodological issues related to the research projects. Presentations focus on data and analysis from presenters' recent and ongoing studies, rather than syntheses and literature reviews. The hour-long colloquia are presented at noon on the third Wednesday of the month.

Date	Speaker	Title of Talk
10/20/21	Mary Ferraro, PhD, Andrew Packel, PT, John Whyte, MD, PhD,	Opening the Black Box: The Rise of the Rehabilitation Treatment Specification System
12/15/21	Roy Hamilton, MD	Stimulating Conversations: Employing Noninvasive Brain Stimulation Technologies to Characterize and Enhance Language Processing in Persons with Aphasia
1/19/22	Laurel Buxbaum, PsyD, Shailesh Kantak, PhD, PT, and Cory Potts, PhD	Understanding Disparities Between Arm Use and Capacity After Stroke
2/16/22	Aaron Wong, PhD	What do we really know about Parkinson's Disease?
3/16/22	Sharon Antonucci, PhD, CCP-SLP	Getting the Message Across: Discourse Measurement in Aphasia Rehabilitation
4/20/22	Erica Middleton, PhD	An Examination of Retrieval Practice Learning Principles in the Treatment of Lexical-Semantic Disorders in Stroke Aphasia
6/15/22	Nathaniel Mayer, MD	Brain to Muscles: What's the Connection?

Institute Forum Visiting Scholar Lecture Series

The Visiting Scholar Lectures are colloquia where invited speakers from national and international institutions present research spanning the fields of neuroscience and neurorehabilitation. The lectures are open to MossRehab and Moss Rehabilitation Research Institute staff, as well as individuals from other institutions via Zoom. These lectures are also made available to the public on our YouTube channel. The goal of this lecture series is to provide an educational forum that highlights new developments in the fields of research represented at the Moss Rehabilitation Research Institute. These 60-minute colloquia are presented at 3:30 pm on the fourth Wednesday of each month.

Date	Speaker	Title of Talk
7/28/21	Joseph I. Tracy, PhD, ABPP-CN	The Brain Architecture of Seizure and Cognitive Networks in Temporal Lobe Epilepsy
9/22/21	Vikram S. Chib, PhD	Subjective Valuation of Effort
10/27/21	Noah Silverberg, PhD, R. Psych, ABPP-CN	Graded Exposure Therapy for Fear Avoidance Behavior After Concussion
1/26/22	Alice Cronin-Golomb, PhD	Visual Perception and Cognition in Parkinson's Disease
2/23/22	Evelina Fedorenko, A.B., PhD	The Language System in the Human Brain
3/23/22	Adam Buchwald, PhD	Optimizing Stroke Recovery in Acquired Speech Impairment with Non-Invasive Brain Stimulation
4/27/22	Ella Striem-Amit, PhD	Perception and Action Without Hands
5/18/22	Adrian M. Haith, PhD	Habit Formation and Skill Acquisition
6/22/22	Wilsaan M. Joiner, PhD	Dynamic Sonomyographic Imaging Provides Potential Control Signals for the Upper-Extremity Prosthetics

Peer Review Committee

Each year, Moss Rehabilitation Research Institute earmarks seed money for internal research projects conducted by principal investigators at MossRehab and Moss Rehabilitation Research Institute. Research projects are typically preliminary studies intended to lead to extramural funding or clinical program development. The Peer Review Committee is composed of scientists from MRRI and clinicians from MossRehab. The Committee reviews research applications for scientific merit, institutional impact, and budget projections.

Projects approved for funding are considered promising, innovative, feasible, and consistent with the interests of the research institute and MossRehab. The proposed projects should demonstrate:

- clearly defined goals that are feasible given anticipated resources
- a realistic plan and budget that describe activities appropriate to meet project goals
- potential for significant impact or possible extramural funding.

Annual distributions and reviews for FY 2022:

One project was funded during FY 2022

- Modulation of cerebellar-connectivity in stroke: A feasibility study, Shailesh Kantak, PhD

One project was reviewed for scientific merit in FY 2022

- Bi-manual arm choice in individuals with chronic stroke, Laurel Buxbaum, PsyD, Cory Potts, PhD, and Shailesh Kantak, PhD

Grants and Contracts Fiscal Year 2022

COMPETITIVE FUNDING

Principal Investigator	Title of Project	Source of Funds
Antonucci, Sharon, PhD, CCC-SLP	Assessing an animal assisted treatment program for adults with aphasia. The persons with aphasia training dogs program	NIH / NICHD
Antonucci, Sharon, PhD, CCC-SLP	Translational and clinical implementation of a test of language and short-term memory in aphasia	NIH thru Temple
Antonucci, Sharon, PhD, CCC-SLP	Strategy, Training & Education Program for People Living with Primary Aggressive Aphasia	Einstein Society
Barhorst-Cates, Erica, PhD	Determinants of navigation ability post-stroke	Einstein Society
Buxbaum, Laurel, PsyD	Understanding action selection in the tool use network	NIH / NINDS
Buxbaum, Laurel, PsyD, Haley Dresang, PhD	Upregulating action semantics to facilitate naming in aphasia	PRC
Buxbaum, Laurel, PsyD	Virtual reality assessment of arm choice under cognitive load: Initial feasibility and piloting	PA Dept of Health
Buxbaum, Laurel, PsyD	Efficacy and mechanisms of virtual reality treatment of phantom limb pain	NIH / NICHD
Edwards, Dylan, PhD	TRANScranial direct current stimulation for Post-stroke motor Recovery - a phase II study (TRANSPORT 2)	NIH thru MUSC
Edwards, Dylan, PhD	National Center of Neuromodulation for Rehabilitation (NC NM4R)	NIH thru MUSC
Edwards, Dylan, PhD Kantak, Shailesh, PhD	Precision targeting for transcranial magnetic stimulation treatment in stroke	Chernowitz Foundation
Kantak, Shailesh, PhD	Perceptual motor interaction to improve bimanual coordination after stroke	NIH / NICHD
Kantak, Shailesh, PhD	Cognitive and neurophysiological mechanisms of arm action after stroke	Einstein Society
Mailend, Marja-Liisa, PhD	Efficacy and optimization of speech entrainment practices for people with aphasia	NIH / NIDCD
Middleton, Erica, PhD	Retrieval practice principles: A theory of learning for aphasia rehabilitation	NIH / NIDCD

Middleton, Erica, PhD	Transcranial magnetic stimulation for aphasia: efficacy and neural basis	NIH thru Penn
Middleton, Erica, PhD	Cognitive control and sentence processing in aphasia	NIH thru GWU
Middleton, Erica, PhD	Cognitive and neural basis of functional communication deficits in post-stroke aphasia	NIH thru UAB
Patra, Abhijeet, PhD	An electrophysiological investigation of speech error monitoring in individuals with aphasia	Einstein Society
Rabinowitz, Amanda, PhD	PACT: PA consortium in TBI	PA DoH thru UPenn
Rabinowitz, Amanda, PhD	The Moss Traumatic Brain Injury Model System	NIDLIRR
Rabinowitz, Amanda, PhD	Examining elderly traumatic brain injury and risk for neurodegeneration	Pa DoH thru PSU
Rabinowitz, Amanda, PhD	TBIMS national data and statistical center	Craig Hospital
Rabinowitz, Amanda, PhD	Positive personality attributes in TBI	Pa Dept of health
Rabinowitz, Amanda, PhD	Characterization and treatment of chronic pain after severe traumatic brain injury	NIDLIRR thru Craig Hospital
Rabinowitz, Amanda, PhD	RERC on ICT access for mobile rehabilitation (mRehab)	NIDLIRR thru Shepherd Center
Rabinowitz, Amanda, PhD	BeHEALTHY: Chronic disease management for traumatic brain injury (TBI)	NIDLIRR thru Indiana University
Rabinowitz, Amanda, PhD	Comparing treatment approaches to promote inpatient rehabilitation effectiveness for traumatic brain injury (CARE 4 TBI)	NIH thru Ohio State University
Therrien, Amanda, PhD	Static and dynamic state estimation in upper limb control	PRC
Venkatesan, Umesh, PhD	Adverse childhood experiences in adults with traumatic brain injury	Einstein Society
Venkatesan, Umesh, PhD	MRI markers of feedback timing during learning in individuals with TBI with and without clinical depression	NIH thru Kessler Foundation
Watanabe, Thomas, MD*	Improving transition from acute to post-acute care following TBI	PCORI thru Univ. Of Washington
Whyte, John, MD, PhD	Postdoctoral training in translational neurorehabilitation research	NIH / NICHD

Wong, Aaron, PhD	Effort costs and reward values in Parkinson's disease	PRC
Wong, Aaron, PhD	Investigating a dual-pathway framework for Praxis	NIH / NINDS

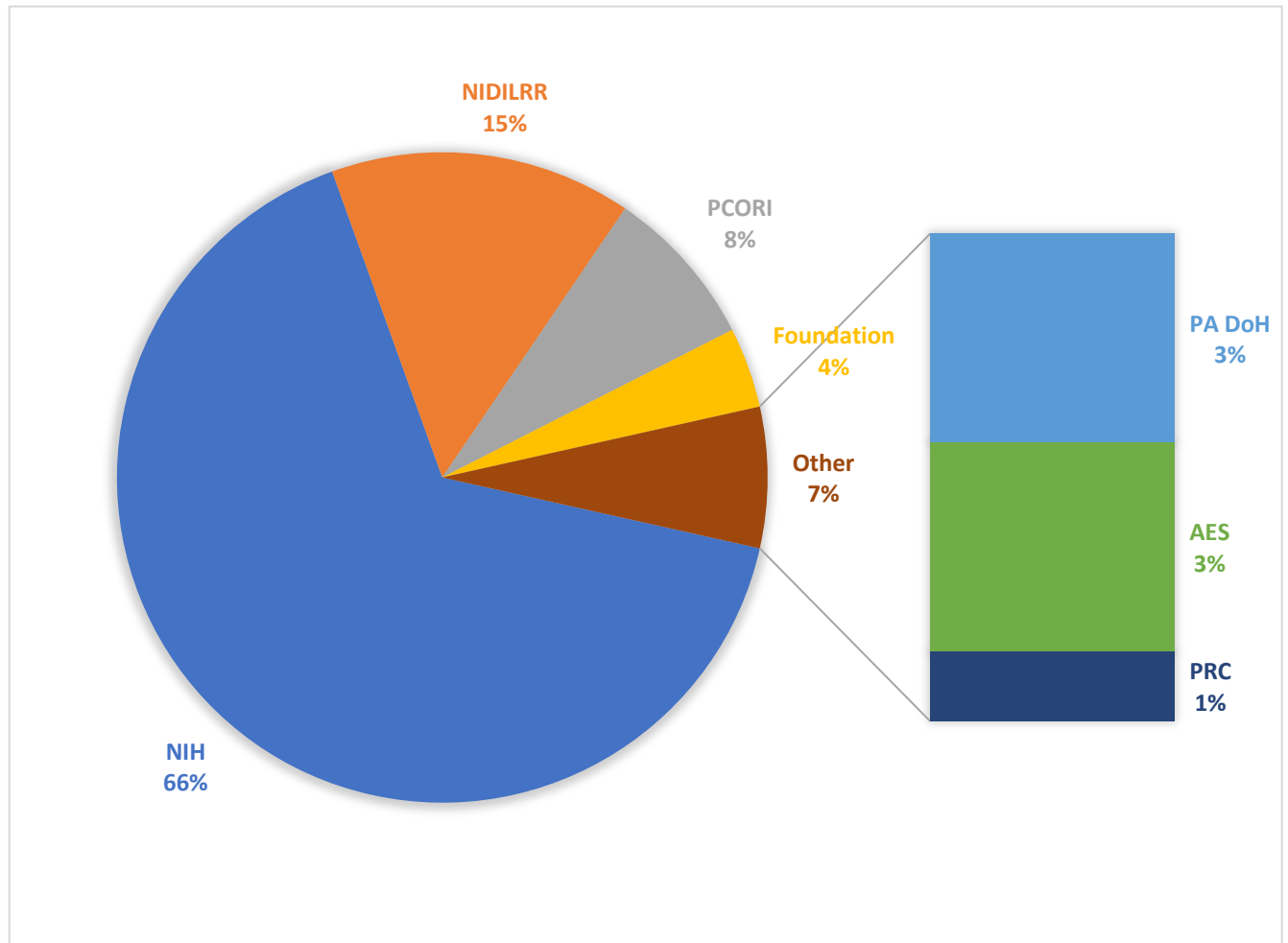
TOTAL COMPETITIVE AWARDS	\$3,862,568
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INDUSTRY SPONSORED TRIALS

Barcikowski, Jaclyn, MD* /Esquenazi, Alberto, MD*	The efficacy of a frequency-tuned electromagnetic field treatment in facilitating the recovery of subacute ischemic stroke patients – a pivotal study	BrainQ Technologies
Esquenazi, Alberto, MD*	Video and temporal spatial parameters assessment of gait after Dysport treatment: a pilot study	Ipsen Pharmaceuticals
Esquenazi, Alberto, MD*	Protocol No. F-FR-52120 an international, multicenter, observational prospective longitudinal study to assess the effectiveness of ABONONT-A injections for adult lower limb spasticity in a real-life cohort (ABOLISH)	Ipsen Pharmaceuticals
Esquenazi, Alberto, MD*	Effectiveness of a peer visitation program to improve patient activation and functional outcomes and quality of life during amputation rehabilitation	Prosthetic Design & Research
Moon, Daniel, MD*	Phase 2 randomized, double-blind, placebo controlled, parallel group dose ranging multi-center trial to evaluate the efficacy and safety of DaxbolulinumtoxinA	Revance Therapeutics, Inc
Moon, Daniel, MD*	Prospective, Open-label, Long-term, Multi-center, Registry to Assess the Safety and Efficacy of the Bioness Stimrouter Neuromodulation System in Subjects with Chronic Pain of Peripheral Nerve Origin	Bioness, Inc.

**Clinical Investigator*

Competitive Funding



NIH National Institutes of Health
NIDILRR National Institute on Disability, Independent Living, and Rehabilitation Research
PCORI Patient-Centered Outcomes Research Institute
PA DoH Pennsylvania Department of Health
AES Albert Einstein Society



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