Music and The Brain Research Network

Sound Health Initiative - a collaboration between NIH & the Kennedy Center

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National Institutes of Health

The Kennedy Center

Sound Health is an exciting initiative on Music and Health. This is a new collaboration between the NIH and the Kennedy Center, initiated by Dr. Francis Collins and the renowned opera singer Renée Fleming. The goal of this initiative is to increase our understanding of how music affects health, with emphasis on the basic neuroscience of music and potential clinical applications.

One of the first activities of the Sound Health initiative was the January 26-27, 2017 workshop "Music and the Brain: Research across the Lifespan", held at the main NIH campus in Bethesda, MD. The workshop focused on basic and mechanistic ways that music affects the brain as well as on music and healing (or how music therapy can change, restore, or improve non-music behaviors).

A listing of the invited panelists of that workshop along with their respective research interest statement is provided in this document titled "Music and the Brain Research Network".

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Bradt, Joke, PhD, MT-BC

Contact Information

Drexel University
Department of Creative Arts Therapies
1601 Cherry Street, 7th floor rm 7112
jbradt@drexel.edu

Research Interests

My research program focuses on the effects of interactive music therapy interventions on chronic pain, symptom management, and cancer care. Currently I am examining the impact of music therapy on psychosocial mediators of chronic pain management in people with chronic low back pain. Whereas my past research has predominantly employed self-report measures in the assessment of treatment benefits, we have started to include several biomarkers in our research studies. I am particularly interested in the role of the dopaminergic system in chronic pain and the impact of music therapy interventions on dopamine release in this population. I am also interested in the role of creative engagement in group music making in enhanced pain management.

Collaboration

I would welcome the opportunity to collaborate with neuroscientists with expertise in neurochemical responses to active music making as well as music listening. My research group is also exploring the impact of music therapy on neuro-inflammatory markers in people with chronic pain. I would welcome collaborative work in this area as well.

Frazier, Todd, PhD

Contact Information

Director, System Center for
Performing Arts Medicine
Houston Methodist
jtfrazier@HoustonMethodist.org
houstonmethodist.org/cpam
Direct: 713-562-5514
CPAM Patient Line 713-394-6088

Research Interests

Frazier believes the arts offer a unique and dynamic common denominator in strategic collaboration that inspires innovation and transformation, while keeping us firmly in tune with our humanity. He has spent 20+ years forging and supporting research, education and accessibility collaborations between the K-12 Education, University, Texas Medical Center, and the Arts and Culture communities in Houston, TX. Since joining Houston Methodist Hospital's Center for Performing Arts Medicine (CPAM) in 2011, he has helped the Center evolve into one that embraces the broadest potential of an arts and medicine relationship. The Center supports world class specialized health care and wellness education of the highest quality for performing and visual artists; the integration of the fine arts into the hospital environment through over 100 performances a year as part of the Margaret Alkek Williams Crain Garden Performances Series, a CPAM Hospital TV channel, Visual Art exhibits, and Music in Practice patient tours; and collaborative research and clinical Music Therapy divisions that seek to harness the broadest potential of the arts in therapy, rehabilitation, and human performance. Frazier has contributed to a wide range of publications and studies in the field of arts, education, and medicine ranging from music therapy for special needs children, to unique music applications in stroke and traumatic brain injury recovery, to the relationship of music theory and history of pipe organ construction to the resultant vibrations and resonating harmony of a continuous flow dual pump total artificial heart.

Collaboration

Yes, opportunity to collaborate on multi-site fMRI related basic research in music and health as well as clinical therapy applications.

Gold, Christian, PhD

Contact Information

GAMUT - The Grieg Academy Music Therapy Research Centre,
Uni Research Health, Uni Research,
Lars Hilles gate 3, 5015 Bergen, Norway.
Phone: +47-97501757.
Email: christian.gold@uni.no

Research Interests

My research program has contributed to the evidence base for the effectiveness of music therapy in mental health. I have been the principal investigator for several randomized controlled trials on music therapy, including international multicentre trials, in the fields of depression, autism, dementia, severe mental illness, and offenders. I have authored systematic reviews and meta-analyses of music therapy in mental health. In addition, I have published process-outcome research and reviews of research methodology.

Collaboration

Yes, of course. I would be particularly interested in creating a bridge towards neuroscience from our clinical research (i.e. finding biomarkers, examining mechanisms) for the clinical areas listed above, i.e. in mental health.

Hanna, Gay Powell, PhD, MFA

Contact Information

Director. Hanna Merrill, Inc.; Arts & Health – Research, Policy, Practice.
gphanna@merrillarts.net

Research Interests

Overarching research interests that I am addressing are related to arts and human development as described in The Arts In Human Development – Framing A National Research Agenda For The Arts, Lifelong Learning and Individual Wellbeing (Hanna et al, 2011). Currently, I am focusing on the arts in medicine including the role of the artists (including musicians); impact of the arts in medicine on caregiving; and, cost benefit analysis of the arts in medicine. Current work includes a literature review on Arts and Medicine with funding recommendations with a focus on research for Grantmakers in the Arts.

> Hanna, G,. Patterson, M., Rollins, J., & Sherman, A., (2011). The Arts and Human Development: Framing A National Research Agenda for the Arts, Lifelong Learning, and Individual Well-Being. Washington, DC: Office of Research National Endowment for the Arts.https://www.arts.gov/publications/arts-and-human-development-framing-national-research-agenda-for the-arts-lifelong.

Collaboration

Through a long term volunteer association with the University of Florida's Shands Health Arts in Medicine Program, I put forward the following research project for consideration in being part of this research collaboration.

> The University of Florida, through a partnership between the Department of Emergency Medicine and Center for Arts in Medicine and support from the State of Florida and the National Endowment for the Arts, is studying the impact of live preferential music on emergency department care and operations, including pain medication utilization, cost of care, patient and staff satisfaction, and other physiologic measures. The randomized controlled mixed-methods study, the first systematic investigation of its kind, utilizes highly trained professional musicians to provide live preferential music for patients in an emergency and level one trauma center setting. The trial's first two phases have demonstrated significant reductions in administration of morphine and morphine equivalents, reductions in systolic and diastolic blood pressures that persist for six hours after the music intervention, and reductions in heart rate that persist for 2-4 hours. Utilizing its qualitative findings, the study has produced an open-access Music in Emergency and Trauma Care Toolkit. Phase three of the study is scheduled to conclude in December of 2017. For more information, contact Jill Sonke, Director, UF Center for Arts in Medicine, jsonke@ufl.edu

Hanna-Pladdy, Brenda, PhD

Contact Information

Department of Neurology
University of Maryland School of Medicine
110 South Paca Street 3rd Floor
Baltimore MD 21201
Bhanna-pladdy@som.umaryland.edu
410-706-6763

Research Interests

Research interests: (i) Cognitive variability in aging and neurodegenerative disease related to experience-induced (musical training) neuroplasticity and cognitive reserve. (ii) Multisensory (audiovisual motor) networks in aging and stroke for cognitive compensation and cueing of spatiotemporal aspects of skilled movements. (iii) Dopaminergic modulation of cognitive aspects of skilled movement, and non-dopaminergic features of Parkinson's disease.

Collaboration

-Cognitive and neuropsychological assessment
-Functional magnetic resonance imaging

Holochwost, Steven, PhD

Contact Information

Senior Research Scientist & Associate Principal
WolfBrown
steven@wolfbrown.com
(919) 448-7795
Visiting Assistant Professor
School of Education
Johns Hopkins University

Research Interests

The common thread running through both my applied and basic research is the need to understand how risk impacts child development, and how programs that expand opportunities for children can mitigate those effects. In my applied work I focus on the use of mixed quantitative and qualitative methods in program evaluation and the application of advanced analytics to longitudinal data in two content areas: arts (and particularly music) education and early childhood education. My 'basic' research in early child development examines the effects of environment, and particularly poverty and parenting, on voluntary forms of self-regulation (e.g., executive functions) and the involuntary activity of neurophysiological systems that support self-regulatory abilities.

Collaboration

I am keenly interested in collaborating with colleagues who are studying the effects of music on child development (and particularly the self-regulatory development of children at risk). I have already engaged in correspondence with Drs. Robb, Iversen, and Roth to schedule conversations in the next couple of months.

Iversen, John, PhD

Contact Information

University of California, San Diego
Institute for Neural Computation, and
Center for Human Development
9500 Gilman Dr. #0559
La Jolla, CA 92093
(619) 757-6210
jiversen@ucsd.edu

Research Interests

I am interested in understanding neural mechanisms underlying music perception and production, with a focus on rhythm, as a means to provide foundation and further development of emerging uses of rhythm in developmental and therapeutic contexts. At present this includes MEEG/TMS studies defining brain networks involved in rhythm perception and production, as well as longitudinal studies of the impact of music training on child brain structure and language development.

Collaboration

Yes, I am willing to collaborate, particularly in the areas of
1) Nesting music-related questions and/or assessments within existing large scale, longitudinal studies. Such an approach has the potential for large return on investment. Initially, collaborate to develop a standard set of tests. This would add more large N, longitudinal populations to my current research program.
2) The impact of music on typical/atypical development, particularly, though not exclusively, with respect to rhythm and language. I imagine such collaboration would be with other researchers with existing or planned longitudinal study populations, and expertise in development and developmental disorders.
3) Deep understanding of the brain mechanisms of rhythm perception and production and their importance for movement therapy (e.g. Stroke, Parkinson's). I would like to add other advanced imaging methods to my program (e.g. fMRI) as well as connect with researchers with existing clinical programs, and expertise in movement disorders and the motor system.

Johnson, Julene, PhD

Contact Information

Professor of Cognitive Neuroscience and Associate Director
Institute for Health & Aging
and Center for Aging in Diverse Communities
University of California, San Francisco (UCSF)
3333 California St., Suite 340
San Francisco, CA 94118
Tel: 415.476.1106
Email: julene.johnson@ucsf.edu

Research Interests

My music research program at UCSF focuses on three primary themes. First, I am interested in the effects of music in older adults, especially how music is remembered and recalled in people with neurodegenerative disease. Second, I am interested in examining whether community music interventions (e.g., choir singing) can help promote health and well-being of older adults, particularly those from diverse racial/ethnic and socioeconomic backgrounds. My final interest focuses on nineteenth-century conceptions about music in neurology and psychology to explore the historical interrelationship of music and the brain.

Collaboration

I am willing to collaborate / discuss experimental research design, outcome measures, design of music interventions for older adults, brain mechanisms of music engagement / perception, and history of music in neurology and psychology (translations, book). I am interested in using biomarkers and new technologies to measure responses to music. I'm also interested in larger, multi-site (including longitudinal) studies that use identical outcome measures.

Kraus, Nina, PhD

Contact Information

www.brainvolts.northwestern.edu
Hugh Knowles Professor, Communication Sciences; Neurobiology; Otolaryngology
Northwestern University
2240 Campus Drive
Evanston, IL 60208
847 491-3181
nkraus@northwestern.edu

Research Interests

I investigate the biology of auditory learning. My interest in the auditory system stems from the recognition that sound is an invisible powerful force central to communication. With this recognition comes my interest in the question of how our life in sound, for better or worse, changes the listening brain. My team studies typical listeners throughout the lifespan, clinical populations (dyslexia, autism, concussion, hearing loss), auditory experts (musicians, bilinguals) and an animal model. Seeing first-hand the potential for biological change—from single neurons in animal models to aggregate brain activity in humans—galvanizes us to apply the principles of neuroscience to inform our knowledge of human communication and treatment of its disorders.

Collaboration

I am willing to collaborate with my excellent colleagues. I have an open mind.
I'm especially interested in developing and utilizing uniform, biological markers of the impact of music experience on the brain. I am also committed to communicating the influence of musical experience on the nervous system to the public.

LaBar, Kevin, PhD

Contact Information

Professor
Center for Cognitive Neuroscience
Duke University
Box 90999
Durham, NC 27708-0999
tel: (919) 681-0664
fax: (919) 681-0815
email: klabar@duke.edu

Research Interests

My research focuses on the cognitive neuroscience of emotion and memory. We use functional neuroimaging, patient-based approaches and psychophysiology to identify brain networks involved in affective processes and emotion-cognition interactions. We have identified how limbic regions such as the amygdala interact with cortical networks to bias cognitive processing during affect inductions. Recently we have applied multivariate decoding techniques to characterize how specific emotions are signaled in the brain and autonomic nervous system during the active processing of instrumental music and movie clips. Other work in the lab has investigated the neural substrates of emotion regulation and its impact on memory.

Collaboration

I am interested in collaborating on multidisciplinary projects related to music therapy in clinical populations as well as basic research on musical cognition, which would extend our recent fMRI and psychophysiological work on music listening in healthy adults.

Lane, Deforia, PhD, MT-BC

Contact Information

Director of Art & Music Therapy
University Hospitals Cleveland Medical Center/Seidman Cancer Center
11100 Euclid Avenue
Cleveland, OH 44106-5065
216 844-5298 – Office
216 262-3193 – Cell
216 291-4738 – Home
Deforia.Lane2@UHHospitals.org

Research Interests

My research interests are in the use of music therapy to address pain management, anxiety, and depression in adult hematology/oncology patients. How might music therapy interventions modulate immune function, medication dosage, patient compliance, and pain perception? Of great interest is to consider the best types of measures and assessment tools to determine outcomes, i.e., fMRI/MRI technology, standardized pain scales, immunology tests (blood, T-cells, IgA), and information technology.

Collaboration

I am quite willing to collaborate, especially with those who have an interest in replicating and fine-tuning research studies, exploring differences in passive vs. interactive music therapy techniques and the integration of music therapy into the healthcare continuum of oncology patients and their families, i.e., when is the best time to intervene, how long, dosage, types of monitoring and follow-up for outpatients.

Limb, Charles, MD

Contact Information

Francis A. Sooy Professor
Chief, Division of Otology, Neurotology and Skull Base Surgery
Director, Douglas Grant Cochlear Implant Center
Departments of Otolaryngology-Head & Neck Surgery and Neurosurgery
University of California San Francisco School of Medicine
San Francisco, CA
Cell (443) 690-1763
Office (415) 353-2870
Clinic (415) 353-2757
email: charles.limb@ucsf.edu

Research Interests

I have been studying the neuroscience of complex sounds using music as a model to help us understand the brain. I approach music as the most complex, challenging, and interesting form of sound in the world, and refer to it often as the pinnacle of hearing. From that perspective, my work branches in two related directions. The first is to understand how the brain gives rise to high level musical creativity, using improvisation as a prototypical creative behavior. This work involves high level jazz musicians, freestyle rap artists, and classical musicians skilled in improvisation, with an emphasis on creating scientific experiments that are firmly rooted in the real musical behaviors and practices of professional musicians. Through this work, I hope to unravel the mysteries of the creative brain, and to define a functional neural model of human creativity. The second major area of my work utilizes music as a tool to enable restoration of hearing in patients with deafness. In this work, I examine the difficulties faced by cochlear implant users in hearing music, whereas perception of speech is frequently excellent. I have examined neural substrates of musical perception in cochlear implant users, but also psychophysical investigations of pitch, rhythm, timbre, and harmony in this patient population. I firmly believe that music may provide highly useful experimental stimuli that will allow us to understand the limits of implant-mediated hearing, one day allowing us to restore 'perfect' hearing in individuals with severe to profound sensorineural hearing loss.

Collaboration

Absolutely!

Loui, Psyche, PhD

Contact Information

Assistant Professor
Department of Psychology
Program in Neuroscience & Behavior
College of Integrative Sciences
Wesleyan University
Judd Hall, 207 High Street
Middletown, CT 06459 USA
1(860)685-2313
ploui@wesleyan.edu
www.psycheloui.com
www.mindlab.research.wesleyan.edu

Research Interests

My lab studies the cognitive neuroscience of music perception, production, cognition, and emotion. Tools we use include behavior and psychophysics, sound analysis, human electrophysiology, and structural and functional neuroimaging, as motivated by the following goals: 1. To understand the source of musical knowledge and engagement, and 2. To use music to improve health and well-being.

Collaboration

I am willing to collaborate with other members of the NIH/Kennedy Center Research Network. I am currently interested in longitudinal and cross-sectional studies of the neural underpinnings of musical creativity, such as through engagement in musical improvisation. More generally, I am interested in helping build large-scale studies (multiple measures, large sample sizes) in the neuroscience of music, through establishing multi-site collaborations in which data and research tools (experimental stimuli, pipelines for behavioral and neuroimaging data acquisition and analysis) can be shared across sites.

McDermott, Josh, PhD

Contact Information

Fred & Carole Middleton Career Development Assistant Professor
Department of Brain and Cognitive Sciences
Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge MA 02139
jhm@mit.edu
617-253-7437

Research Interests

I study how people hear. My work combines behavioral experiments, human neuroscience, computational modeling, and signal processing tools for analyzing, manipulating and synthesizing sounds. We draw particular inspiration from machine hearing research: we aim to conduct experiments in humans that reveal how we succeed where machine algorithms fail, and to use approaches in machine hearing to motivate new experimental work. We also have strong ties to auditory neuroscience. Models of the auditory system provide the backbone of our perceptual theories, and we collaborate with neurophysiologists and engage ourselves with cognitive neuroscience methods. The lab thus functions at the intersection of psychology, neuroscience, and engineering. Current research in our lab explores how humans recognize real-world sound sources, segregate particular sounds from the mixture that enters the ear (the cocktail party problem), separate the acoustic contribution of the environment (e.g. room reverberation) from that of the sound source, and remember and/or attend to particular sounds of interest. We also study music perception and cognition, both for their intrinsic interest, and because music often provides revealing examples of basic hearing mechanisms at work.

Collaboration

I would be interested in collaborating with anthropologists or ethnomusicologists who study non-Western cultures.

Patel, Aniruddh, PhD

Contact Information

Professor
Dept. of Psychology
Tufts University
490 Boston Ave.
Medford, MA 02155
Sen*ior Fellow*
Canadian Institute for Advanced Research (CIFAR)
Azrieli Program in Brain, Mind, & Consciousness
a.patel@tufts.edu
http://ase.tufts.edu/psychology/people/patel/
617-627-4399

Research Interests

Basic research on the cognitive neuroscience of music. Special areas of interest include music-language relations, rhythmic processing, and cross-species studies aimed at exploring the evolutionary foundations and underlying mechanisms of music cognition.

Collaboration

Interested in collaborating with others to design & run training studies to examine the impact of instrumental (nonverbal) musical training on language processing, especially in populations with speech or language processing challenges, e.g., dyslexic children, adults with cochlear implants, etc.

Peretz, Isabelle, PhD

Contact Information

Full professor of Psychology, Department of Psychology, Université de Montréal
Founder and Co-Director of the International Laboratory for Brain, Music and Sound Research (BRAMS) jointly affiliated to the Université de Montréal and McGill University
Canada Research Chair in Neurocognition of Music
Casavant Chair in Neurocognition of Music
Adjunct professor, McGill University, Department of Neurology and Neurosurgery
Member of the Centre for Research on Brain, Language and Music (Executive Committee Member)
Fellow, Royal Society of Canada
(514) 343-5840
isabelle.peretz@umontreal.ca
www.peretzlab.ca

Research Interests

My research focuses on the musical potential of ordinary people, its neural correlates, its heritability and its specificity relative to language. I am renowned for my work on congenital and acquired musical disorders (amusia) and on the biological foundations of music processing in general. I have done fundamental research on a variety of topics in neurocognition of music, from perception, memory, and emotions to singing and dancing (for her publications see www.peretzlab.ca). I also have published a few studies on music intervention in stroke patients and patients with Alzheimer disease.

In addition, I have developed evaluation tools that are theoretically and clinically validated. For example, I have created and largely distributed the Montreal Battery of Evaluation of Amusia (MBEA; Peretz, Champod & Hyde, 2003, Annals of the NYAS). The MBEA is now used in more than 100 different labs around the world (e.g., Australia, Belgium, Brazil, France, Germany, Greece, India, Israel, Italy, Mexico, New Zealand, Poland, Portugal, Switzerland, Czech Republic, The Netherlands, U.K., U.S.A). Recently, I have standardized a child- friendly version of the MBEA that is now available to the research community (Peretz et al., 2013, Frontiers in Systems Neuroscience). In addition, I have also created and distributed musical clips for research on emotions (Vieillard et al., 2008, Cognition and Emotion). All the tools can be downloaded freely from my website.

Collaboration

I am interested in collaborating on the effects of musical interventions. At the very least, I can share my expertise and tools for neuropsychological evaluation.

Robb, Sheri, PhD, MT-BC

Contact Information

Associate Professor
Editor, Journal of Music Therapy
Director, Indiana CTSI KL2 Young Investigators Program
Indiana University School of Nursing
600 Barnhill Drive, NU E433
Indianapolis, IN 46202
317-274-3152 (Telephone)
shrobb@iu.edu

Research Interests

My program of research focuses on development and testing of music therapy interventions to diminish symptom distress, improve positive health outcomes, and prevent secondary psychosocial morbidity in pediatric/adolescent cancer patients and their parents. My Contextual Support Model of Music Therapy has guided development of two music therapy interventions: 1) an Active Music Engagement (AME) intervention for young children with cancer and their parents, and 2) a Therapeutic Music Video (TMV) intervention for adolescents/young adults (AYA) undergoing high risk cancer treatment. The AME uses music-based play to diminish young child/parent acute treatment distress, sustain healthy parent-child interactions, and improve quality of life during acute cancer treatment. Currently, we are conducting a multi-site RCT trial to identify mechanisms of action responsible for AME benefit (R01 NR015789). Through a previous multi-site RCT, we established TMV benefit for AYA undergoing stem cell transplant for cancer (R01 NR00853; U10 CA098543; U10CA095861), and through a subsequent RCT we are now examining TMV benefit for a broader population of AYA with high risk cancer and their parents, as well as a nurse delivered intervention to address parent communication and distress (R01 CA162181; U10CA098543; U10CA095861). Future studies will include a TMV implementation study to examine intervention delivery and whether benefits observed in the controlled trial are sustained in clinical settings. We also plan to conduct longitudinal studies of TMV and AME to determine whether these interventions prevent traumatic stress symptoms in survivorship.

Collaboration

Yes, I would like to explore opportunities for collaboration with colleagues who are studying music neuroscience. Areas that would align well with my current program of research include music and emotion-regulation, as well as music interaction and synchrony. With the AME intervention in particular, the music therapist tailors the music experience based on principles of optimal arousal and musical complexity – working to use interactive music experiences that have an optimal level of complexity to help children/parents regulate their emotions/distress. In addition, the focus is on supporting parent/child interactions through music – so studying their musical dialogues from a neurologic perspective would also be informative to how music supports interaction during times of distress, and contributes to emotion regulation. The addition of neuroimaging or biomarkers would help us augment our understanding/findings which are currently grounded in parent self-report, and intricate coding of child/parent behaviors (i.e., distress, coping, & interaction behaviors). I would also like to explore the identification of funding that would allow us to add this area of inquiry to our existing study, which would allow for greater efficiency and use of resources.

Roth, Edward, PhD

Contact Information

School of Music
Laboratory for Brain Research and Interdisciplinary Neurosciences (BRAIN)
Western Michigan University
Kalamazoo, MI 49008-5434
(269) 387-5415 (office)
(269) 271-3222 (cell)
edward.roth@wmich.edu

Research Interests

As a clinical music therapist whose research has primarily pursued the basic science of music perception and production, at least my research utilizing experimental designs, I am most interested in translational research at this point. That is to say, I'm interested in pursuing research that employs rigorous designs with appropriate dose and activity matched controls that is informed by clinical and sub-clinical real-world problems. More specifically, understanding the neurobiology of creative and interactive music improvisation should allow us to build better clinical improvisation interventions for a range of individuals with anxiety disorders, including those who have experienced trauma; from children who have been exposed to one or more adverse childhood experiences to active-duty and veteran military members living with post-traumatic stress disorder. Using information generated from clinical reports of improvisation with these populations, neuroimaging (fMRI) and neurochemical studies can be constructed to increase our understanding of the underling mechanisms associated with these exercises and provide clinicians with the critical information they need to deliver more robustly effective and reliable interventions. This line of research should also allow us to better understand the application of clinical improvisation to substance abuse disorders as much of the clinical literature in this area describes the motivational, pleasure, and social outcomes of therapy that coincide well with the biomarkers associated with creative and interactive behavior.

Collaboration

As the current director of the Brain Research and Interdisciplinary Neurosciences (BRAIN) lab at my university, my default method of pursuing knowledge through research is collaborative. Charles Limb and I have successfully pilot-tested an improvisation protocol with musically naïve children using fMRI to examine neural activity associated with creative "free" improvisation and interactive improvisation. Being able to scale up the study so that it is sufficiently powered would inform the translation to a clinical study and eventually provide information that would allow clinicians to provide more precise therapeutic applications of clinical improvisation.

I would also be very open to pursuing studies that examine musician and listener/audience interaction where biofeedback measures taken in real-time are aggregated and sent to a conductor to inform the ongoing musical performance so that it is responsive to the audience. These experiments hold the promise of being able to inform musical performance in a way that engages musicians and audiences in more robust interactive experiences, as well as provide musical experiences for those that have sensory regulation issues including individuals with autism and anxiety disorders. I recall Laurel Trainor describing that her lab had obtained the technological capabilities to pursue this research and invited participants at the January meeting to utilize her resources.

Schlaug, Gottfried, MD, PhD

Contact Information

Professor of Neurology at Harvard Medical School,
Co-Director of the Stroke-Center at Beth Israel Deaconess Medical Center,
Director of the Music, Neuroimaging, and Stroke Recovery Laboratories at BIDMC.
Tel: 617-632-8917
Fax: 617-632-8920
e-mail: gschlaug@bidmc.harvard.edu

Research Interests

My main research interests are centered on ways to induce and detect behavioral changes and brain plasticity in (1) patients recovering from a stroke, (2) individuals with impairments as a result of developmental disorders (e.g., Autism), as well as in (3) healthy subjects undergoing intense and long-time training of sensorimotor skills such as learning and playing a musical instrument. We also examine musical disorders such as (4) tonedeafness and (5) beatdeafness as well as (6) musicians with special skills (e.g., absolute pitch) to better understand the function and dysfunction of the auditory-motor system.

Collaboration

I am open to collaborate with anyone in the music, health, and neuroscience community. I am particularly interested in examining the use of music making in patients with acquired lesions or developmental disorders and in the use of EEG techniques and non-invasive brain-stimulation techniques to monitor brain changes and probe brain function.

Stegemoller, Elizabeth, PhD, MT-BC

Contact Information

Assistant Professor
Department of Kinesiology
Integrated Neuroscience Graduate Program
Graduate Program in Gerontology
Iowa State University
534 Wallace Rd.
Ames, IA 50011
esteg@iastate.edu

Research Interests

My research interests include understanding how music facilitates movement and the associated motor cortical activity in persons with Parkinson's disease (PD). To address this focus, I am pursuing two main lines of research. The first line is examining the effect of style of music on repetitive movement and associated motor cortical activity using EEG and TMS in healthy young adults, healthy older adults, and persons with PD. In addition, we are examining the effects of preferred music on gait and associated motor cortical activity in healthy young adults, healthy older adults, and persons with PD. The second line of research examines the effects of group therapeutic singing on voice, respiration, and swallow (and associated motor cortical activity) in persons with PD. In addition, we are examining the effects of singing on stress, inflammation, and depression in persons with PD.

Collaboration

I am open to collaboration. In particular, I would be interested in exploring auditory processing of music in persons with PD to further understand the impact of music in this population. I would also be interesting in exploring the cognitive benefits of music therapy in this population. Finally, comparisons across other populations (healthy or otherwise) that engage in therapeutic group singing would be interesting to explore.

Thaut, Michael, PhD

Contact Information

Music and Health Science Research Center MaHRC
Faculty of Music
University of Toronto
80 Queens Park Crescent
Toronto Ontario M5S2C5
Canada
Phone: 416 978 0535
Michael.thaut@utoronto.ca

Research Interests

My primary research interest is in investigating neural mechanisms and clinical outcomes of music-based interventions in neurorehabilitation. Main focus is on sensorimotor, speech/language, and cognitive functions. Research targeting clinical populations including stroke, idiopathic Parkinson's and Parkinsonism, TBI, AD, ASD CP, other neurologic and psychiatric disorders. Secondary research themes are in neural basis of music perception (especially rhythm) and musician dystonia.

Collaboration

Willing to collaborate. I would not add any new topics to the current research programs at MAHRC from above but would find it very useful to collaborate with other groups on similar topics, especially underlying neural mechanisms and under-researched clinical populations.

Tomaino, Concetta, DA, LCAT, MT-BC

Contact Information

Executive Director/co-founder
Institute for Music and Neurologic Function
612 Allerton Ave
Bronx, New York
Email: ctomaino@centerlight.org; concetta.tomaino@lehman.cuny.edu

Research Interests

My primary research interests are related to the role of music/sound/rhythm to benefit those with neurologic diseases (Alzheimer's and Parkinson's in particular) stroke/TBI and related impairments (e.g. gait, aphasia, memory). The primary goal of the Institute for Music and Neurologic Function, from its inception in 1993, is to promote dialogue between the neuroscience and music therapy communities to advance our knowledge of music and the brain to create more effective music based treatments to enhance development, rehabilitation, wellness, and quality of life.

Collaboration

Very interested in collaborations: I will be moving the IMNF to a new location in the coming months. The population served will include healthy aging, assisted living, memory care unit, outpatient rehabilitation and long term skilled nursing.

Tottenham, Nim, PhD

Contact Information

Associate Professor of Psychology
Columbia University
Department of Psychology (369 Schermerhorn Hall)
1190 Amsterdam Avenue, MC 5501
New York, NY 10027
212-854-1925
nlt7@columbia.edu
tottenhamlab.psych.columbia.edu

Research Interests

Our laboratory examines brain development associated with emotion learning and regulation with the goal of identifying sensitive periods of brain development. We started using childhood music as a probe for sensitive period learning in adults. The goal of this work is to identify the specific effects on emotion, cognition, and neurobiological process in adulthood associated with childhood music.

Collaboration

We would be interested in many aspects of people's work, but perhaps most immediately would be to work with clinicians to test/edit some of these ideas.

Trainor, Laurel, ARCT, PhD, FRSC

Contact Information

Director, McMaster Institute for Music and the Mind
Professor, Psychology, Neuroscience & Behaviour
McMaster University
1280 Main Street West, Hamilton, ON, Canada L8S 4K1
905-525-9140 x23007
LJT@mcmaster.ca
http://psycserv.mcmaster.ca/ljt/
Research Scientist, Rotman Research Institute, Baycrest Hospital, Toronto
Senior Fellow, Canadian Institute for Advanced Research

Research Interests

My research interests are broad, with overarching themes over the last 25 years including:
• Understanding the process of musical acquisition in infancy and childhood;
• Processing music in the brain, primarily using time- and frequency-based analysis of EEG (and MEG) recordings;
• Neuroplasticity and effects of early experience on auditory perception, cognition, and social development;
• Rhythmic structures as mechanisms for prediction and predictive timing;
• Timing and rhythmic deficits in developmental disorders;
• Social effects of music making;
• Measuring non-verbal information flow between people during musical making using multi-person motion capture and EEG; and
• Enhancing musical experiences in people with hearing loss.

A few examples follow. Our studies of musical acquisition have shown that children learn musical pitch structure through exposure to a particular musical system, similarly to how they learn language. Sensitivity develops first for relatively universal aspects of musical systems such as relative pitch and differentiation between consonance and dissonance, later for the particular musical scales used in the native musical system, and still later for understanding harmony. With respect to neural processes, a current focus has been uncovering that the phase of lower-frequency neural oscillations and the power in higher-frequency neural oscillations entrain to musical rhythms, set up predictions for coming musical events, and reflect interactions between auditory and motor regions. Our studies of the effects of musical experience have shown, for example, that active participation in infant-parent musical classes before one year of age enhances musical acquisition, pre-linguistic gesturing predictive of upcoming language acquisition, and social development. Our studies of social development show that when infants are bounced to music in sync with an experimenter, they are subsequently much more helpful to that experimenter compared to if they bounced out-of-sync, indicating that infants use synchrony as a cue to navigate their social world. Recently, we have used modeling techniques (Granger causality) to measure bi-directional information flow between members of musical ensembles, and we have shown that manipulations such as who is the leader, whether they can see each other, and characteristics of the music affect the dynamics of communication among the musicians. Finally, as current hearing assistive devices have been designed for speech comprehension and not music, we are working on devices and algorithms for enhancing music listening for people with hearing loss.

Collaboration

I am primarily a basic scientist, but am interested in working with others in applying my knowledge and techniques to applied situations. For example:

• There is high co-morbidity among the major developmental disorders and also evidence of timing or rhythm problems associated with each of them. I would like to participate in a large scale, multi-centre study of rhythm and timing deficits and interventions in developmental disorders, particularly Dyslexia, Autism, Attention Deficit Hyperactivity Disorder, and Developmental Coordination Disorder.

• I am interested in working with music therapists and others using music in interventions, to understand the perceptual, cognitive, emotional, social, and/or neural changes accompanying interventions.

• I am interested in applying models of information flow (such as Granger causality) to multi-person motion capture (and potentially EEG) data to quantify and evaluate communication between patient and therapist. For this, I might suggest that the LIVELab at McMaster University is a perfect research tool for this purpose (LIVELab.mcmaster.ca)

• The proportion of the population that is elderly is increasing, leading to an increasing number of people with hearing loss whose capacity to benefit from music is thereby impaired; I am interested in working with a consortium on improving hearing devices and algorithms for people with hearing loss.

Wang, Xiaoqin, Ph.D.

Contact Information

Professor
Dept. of Biomedical Engineering
Johns Hopkins University
720 Rutland Avenue, Traylor 410, Baltimore, MD 21205, USA
Tel: 410.614.4547 | Fax: 410.502.2826
Email: xiaoqin.wang@jhu.edu
Web: wanglab.johnshopkins.edu/lab/WangLabWebsite

Research Interests

My research focuses on the neural basis of sound perception and vocal production in the brain. I am particularly interested in how the brain processes music and neural representations of pitch, harmonicity, and rhythms. I am also interested in studying vocal control and feedback mechanisms that contribute to speaking and signing. My research uses a combination of neurophysiological, optical imaging and computational tools to reveal neural mechanisms both at single neuron in the primate brain. We also conduct human studies using psychophysical and EEG recording methods.

Collaboration

I am interested in collaborating with musicians and researchers studying music perception in human subjects. I'd like to establish a close tie with performing musicians and to conduct field studies in theaters and concert halls to study emotional modulations of the brain by music and performance.

Zatorre, Robert, PhD

Contact Information

Montreal Neurological Institute
McGill University
3801 University
Montreal QC Canada H3A2B4
Robert.zatorre@mcgill.ca

Research Interests

Our laboratory does basic cognitive neuroscience research into complex auditory processing. We use psychophysics, functional imaging methods (fMRI, MEG, EEG), structural imaging methods (voxel-based morphometry, cortical thickness, diffusion imaging), and brain stimulation (transcranial magnetic and direct current stimulation). Our goal is to uncover the neural mechanisms that allow us to perceive and produce complex auditory signals, including speech and music. Research themes include pitch perception, auditory spatial processing, auditory working memory, brain plasticity associated with music and speech learning, music reward processing.

Collaboration

I am willing to collaborate with those who have shared interests, or who wish to receive training in cognitive neuroscience and its methods.