BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Jessica Marie Ross

eRA COMMONS USER NAME (credential, e.g., agency login): JROSS8

POSITION TITLE: Postdoctoral Fellow

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of California, Davis, CA	B.A./B.A.	08/2008	Music/Italian
Sacramento City College, Sacramento, CA	A.S./A.A.	06/2011	Biology/ Psychology
University of California, Davis, CA	Graduate Coursework	12/2012	Neuroscience
University of California, Merced, CA	Ph.D.	08/2018	Cognitive & Information Sci.
Harvard Medical School/Beth Israel Deaconess Medical Center, Boston, MA	Postdoctoral	04/2021	Neurology
Veterans Affairs Palo Alto Healthcare System, Palo Alto, CA	Postdoctoral	Current	Data Science
Stanford University School of Medicine, Palo Alto, CA	Postdoctoral	Current	Neuroscience

A. Personal Statement

I want to be a world leader in non-invasive cognitive electrophysiology, using recordings from populations of neurons to investigate cognitive processes. In light of my research background and expertise in sensorimotor and multisensory interaction neuroscience and TMS-EEG, I believe I am uniquely and well-qualified to design and test methods that harness the principles of sensorimotor and multisensory neurosciences to improve TMS and TMS-EEG methods and to optimize them in a clinic-ready manner. ***This work will provide a Sensory Entrained TMS (seTMS) framework to optimally drive neural modulation and increase impact of TMS treatment protocols.*** 21 journal publications (12 first authored), a section in The Cognitive Neurosciences textbook (edition VI), and 10 invited talks serve as evidence of expertise in sensory neuroscience and neurophysiological methods, as well as a dedication to topics of cognition in aging adults. **In the past six months, I have published 5 new papers (2 first author) pertaining to depression and cognitive decline**. I aim to develop my multidisciplinary research program: using sensorimotor neuroscience to address clinical problems and improve patient care and treatment. To build this independent research program there are training gaps that need to be addressed--There are limitations in my understanding of the specific needs of patients, in clinical design, and in treatment development. Filling these gaps in clinical context will improve the impact of the work. Additionally, establishing this research program with a community of clinician-scientist mentors and collaborators will ensure that my future research will be impactful. This team includes **Corey Keller MD PhD** (personalized TMS), **Alan Schatzberg MD** (Major Depressive Disorder, career development), and **Alvaro Pascual-Leone MD PhD** (TMS for psychiatry). In turn, my specific areas of training in sensorimotor neuroscience, physiology, and mixed methodologies for human brain stimulation and recording, along with the expertise of **Takako Fujioka PhD** (oscillatory phase entrainment) and **Scott Makeig PhD** (EEG dynamics), will support development of rigorous scientific methodology for a deep understanding of induced neural modulatory dynamics. In summary, the current proposal puts forth an exciting and novel seTMS framework, that fits closely with my previous research experience and extends this training into new domains essential for my career goals. My mentoring team coupled with the neuroscientific facilities and community at Stanford will provide an exceptional environment to further my training and better position myself as a non-invasive cognitive electrophysiologist in the field of clinical neuromodulation.

B. Positions and Honors

Positions and Employment:

2021- Postdoctoral Research Fellow, Sierra Pacific Mental Illness Research Education and Clinical Centers (MIRECC), Veterans Affairs Palo Alto Healthcare System, Palo Alto, CA

2021- Postdoctoral Research Fellow, Stanford University School of Medicine, Palo Alto, CA

2021- Collaborator Status, Harvard Medical School, Berenson-Allen Center for Noninvasive Brain Stimulation, Beth Israel Deaconess Medical Center, Boston, MA

2018-2021 Postdoctoral Research Fellow, Harvard Medical School, Berenson-Allen Center for Noninvasive Brain Stimulation, Beth Israel Deaconess Medical Center, Boston, MA

2021 Frontiers of Science Institute, University of Northern Colorado

2018 Associate Specialist, Step I, UC Merced

2017-2018 Graduate Dean's Dissertation Year Fellow, UC Merced

2016-2017 Graduate Student Researcher, UC Merced: National Science Foundation: *Collaborative Research: Brain Mechanisms of Rhythm Perception: The Impact of the Motor System on Auditory Perception*

2016 Teaching Assistant, Animal Cognition, UC Merced

2016 Human motion capture systems training for COGS 180: Gesture, UC Merced

2015 TMS workshop for BIOE 113: Bioinstrumentation, UC Merced

2015 Teaching Assistant, Service Innovation, UC Merced

2015 Graduate Student Researcher, UC Merced: Blum Center for Economic Development: *Rhythmic Skills and Reading: An Intervention Study in the San Joaquin Valley*

2014 Teaching Assistant, Perception and Action, UC Merced

2014 Teaching Assistant, Cognitive Neuroscience, UC Merced

2013 Teaching Assistant, Speech Processing, UC Merced

2012-2013 Psychology Tech. GS-181-5, Dept. Veterans Affairs, Northern California Health Care System, Martinez, CA

2011-2013 Research Assistant, Elizabeth Disbrow Lab., Center for Neuroscience, UC Davis

2011-2012 Independent Living Facilitator, InAlliance, Sacramento, CA

2011-2012 Science Teacher, Resident Science Program, David Lubin Elementary, Sacramento, CA

2010 Junior Specialist, Petr Janata Lab., Center for Mind and Brain, UC Davis

2009-2010 Research Intern, Petr Janata Lab., Center for Mind and Brain, UC Davis

2003-2009 Biological Science Tech. GS-5, Davis Field Station, United States Geological Survey, Western Ecological Research Center, UC Davis

Additional Training:

2018 Intensive Course in Transcranial Magnetic Brain Stimulation, Harvard Medical School, Boston, MA

2018 Kavli Summer Institute in Cognitive Neuroscience, Tahoe, CA

2017 ERP Boot Camp, Center for Mind and Brain, UC Davis

2017 UC Music Experience Research Community Initiative (UC MERCI) Student Exchange, Swartz Center for Computational Neuroscience, UC San Diego

2016 UC Retreat Workshop, Research in Music Experience and Communication, Marconi, CA

2016 Kavli Summer Institute, Cognitive Neuroscience, UC Santa Barbara

2016 UC Music Experience Research Community Initiative (UC MERCI) Student Exchange, Swartz Center for Computational Neuroscience, UC San Diego

2015 UC MERCI Symposium/Workshop on Research on Music Experience and Communication, UCLA

2015 Transcranial Magnetic Stimulation (TMS) Methods and Practice, Division of Biokinesiology and Physical Therapy, University of Southern California, Los Angeles

2015 Generalized Linear Model Workshop, UC Merced

2014 Advanced Training Institute on Non-Linear Methods for Psychological Science, American Psychological Association, University of Cincinnati, Ohio

2014 Dynamics of Music and Language Summer School, UC Merced Center for Human Adaptive Systems and Environments (CHASE)

2012 Auditory Neuroscience (Graduate Coursework), UC Davis Extension

2011 Cognitive Neuroscience and Group Study (Graduate Coursework), UC Davis Extension

2008 Summer Abroad Folk Music Program in Ljubljana, Slovenia
2006 Spring Quarter Abroad Language and Culture Program in Syracuse, Sicily

Awards and Honors:

2021	Advanced Fellowship Program in Mental Illness Research and Treatment, Sierra Pacific Mental Illness Research Education and Clinical Centers (MIRECC), VA Palo Alto Health Care System
2017-18	Graduate Dean's Dissertation Year Fellowship, UC Merced
2017	Scholarship for the 2017 UC Davis ERP Bootcamp, UC Davis
2016-2017	GRAD-EXCEL Peer Mentorship Program Award, Graduate Division, UC Merced
2015	Graduate Student Fellowship Award from Mark S. Aldenderfer, Dean of the School of Social Sciences, Humanities, and Arts, UC Merced
2015	Graduate Dean's Fellowship from Marjorie Zatz, Vice Provost and Dean of Graduate Education, UC Merced
2015	UC Merced GradSLAM Finalist
2015	National Science Foundation Graduate Research Fellowship (NSF GRFP) Honorable Mention
2014	Graduate Fellowship Incentive Program Award, Graduate Division, UC Merced
2014	Travel grant from the American Psychological Association for the Advanced Training Institute on Non-Linear Methods for Psychological Science
2010-11	International Honor Society Phi Theta Kappa member
2009	Special Thanks for Achieving Results (STAR) award, United States Geological Survey, Biological Resources Division
10/09	Expert of the month, Allexperts.com

Professional Memberships:

Cognitive Neuroscience Society, Society for Music Perception & Cognition, Cognitive Science Society, American Psychological Association, Society for Neuroscience

Volunteer Work:

Reviewer	Numerous, including Journal of Cognitive Neuroscience, Gait & Posture, Experimental Brain Research, Human Movement Science, Music Perception, PLOS ONE, Attention, Perception, & Psychophysics, Society for Music Perception & Cognition research conference
Reviewer	Perception, Action, and Cognition program at NSF
2015-2018	Graduate Student Rep., Advisory Committee, UC Merced Transportation and Parking Services
2016	Experienced Teacher's Assistant Informational Panel, Graduate Student TA Orientation, Center for Engaged Teaching and Learning (CETL), UC Merced
2016	Public outreach, Mercy Hospital 5K Stroke Awareness Run
2009-2018	Expert, Entomology Question and Answer Service, Allexperts.com
2015	37th Annual Meeting of the Cognitive Science Society, Pasadena, CA
2014	Cognitive Science Student Association Meeting graduate applications, UC Merced
2014	Days & Nights Festival, Philip Glass Center for Arts, Science, and the Environment, Big Sur, CA
2014	"Child Triumphs and Troubles: Language and Learning in the Early Years" Professional Development and Research Lab Tours, UC Merced
2011-2012	Brain Awareness Week (K-6 brain education), Center for Neuroscience, UC Davis
2004-2008	Founding member of the One World Children's Fund, Davis Branch, Davis, CA

C. Contributions to Science

1. Non-invasive Brain Stimulation for Cognition and Aging. In modern psychiatry, dysfunctional brain networks are considered the neural substrates of mental disorders. These networks can be precisely targeted with TMS, a non-invasive, FDA-cleared treatment with minimal side effects. In one meta-analysis and one review paper, we assess the state of the field with regard to using repetitive TMS protocols to modulate brain networks and cognition. Another application of TMS is to probe the brain to identify dysfunctional brain networks, for example in the case of post-surgery delirium. This work is based on a conceptual model of delirium as the result of a stressor in an individual with pre-existing deficits in connectivity and/or atypical mechanisms of plasticity. The identification of pre-operative predictors of post-operative delirium can help stratify individual risk and identify novel therapeutic targets for interventions to prevent delirium or mitigate its

impact in predisposed individuals. This work demonstrates the feasibility of gathering EEG and TMS in individuals scheduled to undergo elective surgery to identify neurophysiologic signatures of vulnerability to post-operative delirium. We present preliminary experimental evidence that EEG and TMS-EEG of cerebral oscillatory activity and cortical plasticity, which are non-invasive and scalable neurophysiological measures, identify individuals at risk of post-operative delirium.

a. **Ross, J.M.**, Santarnecchi, E., Lian, S.L., Fong, T.G., Touroutoglou, A., Cavallari, M., Travison, T.G., Marcantonio, E.R., Libermann, T.A., Schmitt, E., Inouye, S.K., Shafi, M.M., & Pascual-Leone, A. (2022). Neurophysiologic predictors of individual risk for post-operative delirium after elective surgery. *Journal of the American Geriatrics Society,* 1-10*.*
b. Pabst, A., Comstock, D.C., Mede, B., Proksch, S., **Ross, J.M.**, & Balasubramaniam, R. (2022). A systematic review and meta-analysis of the efficacy of intermittent theta burst stimulation (iTBS) on cognitive enhancement. *Neuroscience and Biobehavioral Reviews*, 135, 104587.
c. Gogulski, J., **Ross, J.M.**, Talbot, A., Cline, C., Donati, F.L., Munot, S., Kim, N., Gibbs, C., Bastin, N., Yang, J., Minasi, C., Sarkar, M., Truong, J., & Keller, C.J. (2022). *Personalized rTMS for depression: a review. Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*. 10.1016/j.bpsc.2022.10.006
d. **Ross, J.M.**, Cline, C.C., Sarkar, M., Truong, J., Keller, C.J. (2023). *Neural effects of TMS trains on the human prefrontal cortex.* bioRxiv. Published online February 2, 2023:2023.01.30.526374.

2. Non-invasive Brain Stimulation Methods. Combining TMS with EEG can be very powerful in understanding normal brain network interaction as well as abnormal brain network activity, but there are numerous methodological hurdles to using TMS-EEG, cleaning the data, and interpretation of the data. I develop methods for analysis of TMS-evoked and -induced network activity. My work examines sensory contributions to the TMS-EEG signal, called the Vertex Potential (VP, also called the auditory evoked potential, AEP). We developed and tested an Independent Components Analysis-based technique for isolating the VP and show that the TEP remaining after removal of VP is unique to stimulation site and to individual subjects and can provide insight into TMS-evoked potentials as well as other-modulated oscillatory dynamics. Due to multisensory or non-model contributions to the VP, an ICA-based removal technique may not always be appropriate. For these cases, we provide another method for dealing with the VP. We show that additional multisensory masking, as well as using a predictable TMS pulse timing, can reduce the VP and reports of perception significantly more than the most commonly used masking protocol. We call this combination the ATTENUATE protocol. It uses concepts from sensory neuroscience to minimize the sensory potential in the TEP. We show superiority with ATTENUATE to standard masking techniques. In other work, we explore the importance of reliability and validity metrics in the development of TMS-EEG biomarkers, demonstrate TMS-EEG optimization and personalization, and examine EEG modulations after individual trains of rTMS.

a. **Ross, J.M.,** Ozdemir, R.A., Lian, S.J., Fried, P.J., Schmitt, E.M., Inouye, S.K., Pascual-Leone, A., & Shafi, M.M. (2022). A structured ICA-based process for removing auditory-evoked potentials. *Scientific Reports*, 12, 1391.
b. Ross, J.M., Sarkar, M., & Keller, C.J. (2022). Experimental suppression of transcranial magnetic stimulation-electroencephalography sensory potentials. Human Brain Mapping, 43(17):5141-5153.
c. Ashburn, S.M., Abugaber, D., Antony, J.W., Bennion, K.A., Bridwell, D., Cardenas-Iniguez, C., Doss, M., Fernández, L., Huijsmans, I., Krisst, L., Lapate, R., Layher, E., Leong, J., Li, Y., Marquez, F., Munoz-Rubke, F., Musz, E., Patterson, T.K., Powers, J.P., Proklova, D., Rapuano, K.M., Robinson, C.S.H., **Ross, J.M.**, Samaha, J., Sazma, M., Stewart, A.X., Stickel, A., Stolk, A., Vilgis, V., Zirnstein, M. (2020). Toward a socially responsible, transparent, and reproducible cognitive neuroscience. In M. Gazzaniga & R. Mangun (Eds.), *The Cognitive Neurosciences VI*. Cambridge, MA: MIT Press.
d. Parmigiani, S., **Ross, J.M.**, Cline, C., Minasi, C., Gogulski, J. Keller, C.J. (2022). Reliability and validity of TMS-EEG biomarkers. Biological Psychiatry: Cognitive Neuroscience and Neuroimaging. 10.1016/j.bpsc.2022.12.005

3. Predictive Neural Dynamics for Musical Beat Perception. A central focus of my work is on understanding how and why human brain networks used for control of body movements are affected by and involved with sound perception. Much of this work explores the role of prediction and motor simulation in musical rhythm perception. This work explores proposed networks for predictive timing perception in humans, and supports that the dorsal auditory stream, connecting premotor to auditory cortex through parietal projections, is critically involved in accurate phase timing when listening to music.

a. **Ross, J.M.,** Comstock, D., Iversen, J.R., Makeig, S., & Balasubramaniam, R. (2022). Cortical mu rhythms during action and passive music listening. *Journal of Neurophysiology*, 127, 213-224.
b. **Ross, J.M.** & Balasubramaniam, R. (2022). Time perception for musical rhythms: sensorimotor perspectives on *entrainment, simulation* and *prediction*. *Frontiers in Integrative Neuroscience,* 16:916220.
c. Comstock, D., **Ross, J.,** & Balasubramaniam, R. (2021). Modality-specific frequency band activity during neural entrainment to auditory and visual rhythms. *European Journal of Neuroscience*, 54(2), 4649-4669.
d. **Ross, J.M.**, Iversen, J.R., & Balasubramaniam, R. (2018). The role of posterior parietal cortex in beat-based timing perception: A continuous theta-burst stimulation study. Journal of Cognitive Neuroscience, 30(5), 634-643.

4. Sound and Balance Control. Multisensory perception dynamically and continuously influences human standing balance control behavior, but little is known about how sounds impact balance stability directly. This work shows that sound is incorporated into balance control mechanisms and that exposure to some types of sounds can improve stability in standing balance in healthy young adults and in aging adults with typical age-related balance instability. We show that music that is rhythmically predictable can entrain balance mechanisms, resulting in reductions in body sway variability related to standing stability. We also show that white noise, such as that which is currently being used in some types of hearing aids for improving speech signal clarity, can reduce body sway variability in young and aging adults, leading to less variability in standing stability. This work also contributes to understanding predictive and reactive balance movement control, and similar networks have been proposed for predictive balance control and musical rhythm perception.

a. **Ross, J.M.**, Will, O.J., McGann, Z., & Balasubramaniam, R. (2016). Auditory white noise reduces age-related fluctuations in balance. *Neurosci. Lett.* 630, 216-221.
b. **Ross, J.M.**, Iversen, J.R., & Balasubramaniam, R. (2016). Motor simulation theories of musical beat perception. *Neurocase 22(6)*.
c. **Ross, J.M.**, Warlaumont, A.S., Abney, D.H., Rigoli, L.M., & Balasubramaniam, R. (2015). Influence of musical groove on postural sway. *J. Exp. Psychol.- Hum. Percept. Perform*. 42(3), 308-19.
d. **Ross, J.M.**, & Balasubramaniam, R. (2015). Auditory white noise reduces postural fluctuations even in the absence of vision. *Exp. Brain Res*. 233(8), 2357-63.

5. Cognitive and Motor Rehabilitation and Development. Parkinson's disease has serious impacts on motor and cognitive function, leading to balance instability, isolation and reduced independence and quality of life. In this work, we show evidence for positive and translatable effects on multiple dimensions of Parkinson's disease symptom profiles with group exercise and dance training and on specific cognitive symptoms with daily computer based training. Networks affected by Parkinson's disease are also implicated in predictive and continuous control of body movement, and rhythm and timing. Rhythmic auditory stimulation is the most clinically effective application of music cognition research to date and has the potential to improve performance and quality of life of many individuals while also contributing to basic research on brain network architecture and dynamics and on neurodegenerative disease. In addition, I extended change point analysis methods, which I learned in Parkinson's disease rehabilitation and training research, to infant data in order to analyze the developmental trajectory of rhythmic limb and vocal behavior in a typically developing infant.

a. Nguyen, H.M., Aravindakshan, A., **Ross, J.M.**, & Disbrow, E.A. (2020). Time course of cognitive training in Parkinson disease. *NeuroRehabilitation*, 46, 311-320.
b. Ventura, M.I., Barnes, D.E., **Ross, J.M.**, Lanni, K.E., Sigvardt, K.A., & Disbrow, E.A (2016). A pilot study to evaluate multi-dimensional effects of dance for people with Parkinson's disease. *Contemp. Clin. Trials* 51, 50-55.
c. Lanni, K.E., **Ross, J.M.**, Higginson, C.I., Dressler, E.M., Sigvardt, K.A., Zhang, L., Malhado-Chang, N., & Disbrow, E.A. (2014). Perceived and performance-based executive dysfunction in Parkinson's disease. *Journal of Clinical and Experimental Neuropsychology* 36:4.
d. Abney, D.H., Warlaumont, A.S., Haussman, A., **Ross, J.M.**, & Wallot, S. (2014). Using non-linear methods to quantify changes in infant limb movements and vocalizations. *Front. Psychol.* 5:771.

Complete list of published work. For a full list of publications, see MyBibliography on NCBI: https://www.ncbi.nlm.nih.gov/myncbi/jessica.ross.4/bibliography/public/