

BIOGRAPHICAL SKETCH

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NAME: Gordon, Reyna

eRA COMMONS USER NAME (credential, e.g., agency login): gordonr1

POSITION TITLE: Assistant Professor of Otolaryngology

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 <i>(if applicable)</i>	Completion Date MM/YYYY	FIELD OF STUDY
Univ. of Southern California, Los Angeles, CA	B. Music	05/2011	Vocal Arts, Italian
University of Provence (Aix-Marseille-I), Marseille	M.S.	07/2004	Neuroscience
Florida Atlantic University, Complex Systems and Brain Sciences, Boca Raton, FL	Ph.D.	08/2010	Complex Systems & Brain Sciences
Vanderbilt University, Nashville, TN	Postdoctoral Fellow	06/2015	Neurodevelopmental Disabilities

A. Personal Statement

I am a cognitive neuroscientist interested in the brain mechanisms and genetic architecture of individual differences in music abilities and how they relate to the language and social skills that are crucial for effective human communication. To this end, I have pushed the boundaries of interdisciplinary knowledge of the role of rhythm in language by integrating approaches from Psychology, Neuroscience, Linguistics, Music Cognition, Communication Disorders, and Human Genetics. In my tenure-track Assistant Professor position at Vanderbilt University Medical Center, I direct the Music Cognition Lab where I mentor a vibrant group of trainees from Vanderbilt degree programs in Speech-Language Pathology, Audiology, Psychology, Neuroscience, Medicine, Engineering, and Education. These multi-disciplinary approaches are strengthened by the diverse academic and personal backgrounds of our lab members; my trainees identify with a wide range of races, religions, sexual orientations, socio-economic backgrounds, and nationalities. I have a strong track record of mentorship with several new manuscripts first-authored by graduate student trainees and an additional two manuscripts in preparation first-authored by undergraduate student trainees, in addition to having mentored several successful grant applications. I have served on six Vanderbilt dissertation committees (from Psychology, Neuroscience, Biological Sciences, and Hearing & Speech Sciences) and have been the primary research advisor for a total of 29 students (3 PhD students, 7 clinical graduate students, 17 undergraduates, and 2 high school students). I am currently the PI of several NIH grants (including a NIH Director's New Innovator Award and an R01 from NIDCD) that investigate the relationship between rhythm and language with a wide variety of methods, with an emphasis on applying cutting-edge genomic approaches to human rhythm traits and developmental language disorder.

I have sixteen years of experience with cognitive neuroscience methods with extensive expertise using behavioral and non-invasive brain imaging methods (primarily EEG) to investigate neural mechanisms of music and language. My graduate work used singing as a model to compare music and language cognition, and my interest in translational research led me to a postdoctoral position at the Vanderbilt Kennedy Center, where I contributed to a number of multi-disciplinary studies that investigate the relationship between auditory processing and social and language skills in individuals with neurodevelopmental genetic disorders. I also developed and implemented an EEG analysis workshop with a customized MATLAB-based EEG analysis

tutorial and toolkit, which I continue to use in the lab. I am currently supported by a K18 mentored career development award, which has provided me with extensive training in genomics methodology.

B. Positions and Honors

Positions and Employment

2015- Director, Music Cognition Lab, Vanderbilt University Medical Center
2015-2016 Research Assistant Professor, Department of Otolaryngology, Vanderbilt University
2015- Member, Vanderbilt Kennedy Center, Vanderbilt University Medical Center
2016- Faculty Member, The Graduate School
2016-2019 Associate Director, Program for Music, Mind & Society at Vanderbilt
2016- Assistant Professor, Department of Psychology, Vanderbilt University
2017- Training Faculty, Vanderbilt Brain Institute, Vanderbilt University School of Medicine
2017- Investigator, Vanderbilt Genetics Institute
2016- Assistant Professor (tenure-track), Department of Otolaryngology, Vanderbilt University Medical Center

Other Experience and Professional Memberships

2008- Ad-hoc reviewer for: PLoS ONE, Cortex, Journal of Speech, Language & Hearing Research, Developmental Neuropsychology, Psychological Research, Archives of Medical Research, PsychoMusicology: Music, Mind, & Brain, Music Perception, Journal of Neurolinguistics, Speech Language and Hearing, Psychology of Music, Frontiers in Auditory Cognitive Neuroscience, Research in Intellectual Disabilities, Child Development, JEP General, Annals of the NY Academy of Sciences, Child Development Perspectives, and Musicae Scientiae.
2008-2012 Member, American Association of University Women
2009- Member, Society for Music Perception and Cognition
2010-2015 Consumer Member, State of Tennessee Council of Certified Profession Midwifery
2010-2015 Member, Society for the Neurobiology of Language
2013-2014 Co-Organizer, Vanderbilt University Music and Brain Seminar and Discussion Series
2014-2014 Program Committee, Vanderbilt Music and Mind: Melding Music and Mind in Music City
2014-2014 Participant, ASHA Lessons for Success
2015- Steering Committee, Program for Music, Mind, and Society at Vanderbilt
2015-2015 Conference Co-Chair, Society for Music Preparation and Cognition
2016- Ad-hoc Reviewer for Funding Agencies: National Science Foundation, Israeli Binational Funding Agency, Canadian Foundation for Innovation
2016-2018 Founding Member: Board of Directors, American Foundation for Science of Music
2016- Review Editor, Frontiers in Auditory Cognitive Neuroscience
2016 Symposium Chair, The Program for Music, Mind and Society at Vanderbilt Annual Symposium: The Science of Song, September 2016
2016-2016 Scientific Advisory Board, International Conference for Music Perception and Cognition
2016-2018 At-large (elected) Board Member, Society for Music Perception and Cognition
2017- Member, GenLang Consortium
2017- Member, ENIGMA Consortium: EEG working group
2018 Course faculty, Cold Spring Harbor Laboratory Genetics and Neurobiology of Language
2018 Participant, Brain Imaging Genetics Workshop – Cognomics, Nijmegen, Netherlands
2018 Women in Leadership Certificate, Cornell University
2019 Participant, AAMC Early Career Women Faculty Leadership Seminar
2018-2019 Participant, International Workshop on Statistical Genetics, Boulder, Colorado
2019 Member, Behavioral Genetics Institute

Honors

2001 USC Renaissance Scholar, Excellence in Multidisciplinary Studies
2004 Best Poster Award, Conference of Interdisciplinary Musicology

2006-2007	Pre-doctoral Trainee Fellowship, National Institute of Mental Health (support on T31 to Center for Complex Systems & Brain Sciences at Florida Atlantic University)
2007-2008	Dissertation Fellowship, American Association of University Women
2008-2009	Dr. Daniel B. and Aurel B. Newell Doctoral Fellowship, Florida Atlantic University
2012	Theodore Tiossem Travel Award, Gatlinburg Conference
2013	Honorable Mention, Poster, Vanderbilt Kennedy Center Science Day
2018	NIH New Innovator Awardee

C. Contributions to Science

Links to full Bibliography:

<http://orcid.org/0000-0003-1643-6979> (includes pre-prints)

<https://www.ncbi.nlm.nih.gov/sites/myncbi/1f3Hgqa7cCdQt/bibliography/51388021/public>

Student/trainee authors are underlined in publications listed below.

a) Rhythm and Language Development in Children

My work on rhythm and language development in children has received international recognition. During my postdoctoral training, I designed a study that investigated the relationship between grammatical competence and rhythm in children with typical and atypical language development. A key aspect of this project was the development of a new computer-based rhythm skills assessment tool that is appropriate for children, in collaboration with Devin McAuley at Michigan State University. The results (published in *Developmental Science*) showed that 48% of the variance in grammar skills was predicted by musical rhythm perception abilities in children with typical development, even after controlling for differences in IQ and socio-economic status. My current NIDCD R03 and R01 projects extend this work to children with language impairment and investigate underlying cognitive mechanisms, as well the biological underpinnings of rhythm and language using genetic and EEG methods. Our new studies have also shown that listening to musical rhythms affects subsequent grammar task performance in children.

- a. **Gordon RL**, Shivers CM, Wieland EA, Kotz SA, Yoder PJ, McAuley J.D. (2015) Musical rhythm discrimination explains individual differences in grammar skills in children. *Developmental Science* Jul;18(4):635-644. PubMed PMID: [25195623](#).
- b. **Gordon RL**, Jacobs MS, Schuele CM, McAuley JD. (2015) Perspectives on the rhythm-grammar link and its implications for typical and atypical language development. *Annals of the New York Academy of Sciences*. Mar;1337:16-25. PubMed Central PMCID: [PMC4794983](#). PubMed PMID: 25773612.
- c. Chern, A., Tillmann, B., Vaughan, C., **Gordon, R.L.** (2018). New evidence of a rhythmic priming effect that enhances grammaticality judgments in children. *Journal of Experimental Child Psychology*. 173 (371-379) <https://doi.org/10.1016/j.jecp.2018.04.007> . PubMed PMID: [29778278](#).
- d. Myers, B., Lense, ML, **Gordon, RL**. (2019) Pushing the Envelope: Developments in Neural Entrainment to Speech and the Biological Underpinnings of Prosody Perception. *Brain Sciences*, 9:3. PubMed PMID: [30909454](#).

b) Communication endophenotypes in neurodevelopmental genetic disorders

A central focus of my postdoctoral training was on using EEG to investigate communication endophenotypes in children with neurodevelopmental disabilities. My collaborators and I have used time-frequency and Event-Related Brain Potentials (ERP) analyses of EEG data to examine on the dynamics of auditory perception and their relation to social cognition. In one study, we showed that the emotional valence of musical primes influenced the perception of emotionally-valenced facial targets in people with Williams Syndrome. These modulations were reflected in both behavioral data and EEG gamma oscillations, which are markers of cross-modal integration. We then examined autism spectrum features in children with single-gene disorders (Rett Syndrome and *MECP2* duplication syndrome), demonstrating that brain responses reflecting sensitivity to the mother's voice were associated with higher social functioning, and differentiated patterns of responses for over- vs. under-expression of MeCP2 protein. I developed and implemented an EEG analysis workshop with a customized MATLAB-based EEG analysis tutorial toolkit,

which I then utilized in multiple studies and continue to use for data analysis and EEG training tool in my lab. More recently, we have developed a new algorithm to automate the identification of the developmental language disorder phenotype in large-scale electronic health record systems.

- a. Peters S.U., **Gordon R.L.**, Key A.P. (2014) Induced gamma oscillations differentiate familiar and novel voices in children with *MECP2* duplication and Rett syndromes. *J Child Neurol.* 2014 Feb;30(2):145-152. PMID: [PMC4406405](#).
- b. Magne, C., **Gordon, R.L.**, Midha, S. (2010). Influence of Metrical Expectancy on Reading Words: An ERP Study. *Proceedings of the Fifth International Conference on Speech Prosody.* Chicago, May 11-14, 2010, pp. 1-4.
- c. Lense M.D., **Gordon R.L.**, Key A.P., Dykens E.M. (2014) Neural correlates of cross-modal affective priming by music in Williams syndrome. *Soc Cogn Affect Neurosci.* 2014 Apr;9(4):529-537. PMID: [PMC3989136](#).
- d. Walters, C.E., Margulis, K., Below, J., Cox, N.J., Camarata, S.M. **Gordon, R.L.** A new phenotyping algorithm for identifying cases of developmental language disorder in large-scale electronic health record systems. Poster presented at American Society of Human Genetics 2018 meeting, San Diego, CA, October 16-20, 2018.

c) Neural bases of linguistic and musical aspects of song perception

Singing is ubiquitous in human cultures. Songs contain both words and melodies and are thus an interesting model for comparing the neural basis of language and music. My graduate research was focused on the neural basis of song using imaging methods, making a significant contribution to a literature that was very small during the time the work was undertaken. We reported an exciting finding that the N400 effect, a well-established marker of semantic processing, was modulated by musical melody in song, suggesting that variations in musical features affect word processing in sung language. These results, showing interactions between the linguistic and musical dimensions of song, coincided with results obtained in the fMRI study showing widespread, interactive involvement between brain areas recruited to perceive words and melodies, and thus argued against functional specificity of brain areas for language and musical processing. My PhD dissertation research expanded upon these findings by investigating the neural mechanisms of rhythmic attention to the linguistic and musical dimensions of song, showing evidence for shared oscillatory activity between speech rhythm and musical rhythm perception. In addition, we have used EEG in adults to show that individual differences in musical rhythm skills are predictive of neural responses to the rhythms of speech.

- a. **Gordon RL**, Schön D, Magne C, Astésano C, Besson M. (2010) Words and melody are intertwined in perception of sung words: EEG and behavioral evidence. *PLoS One.* Mar 31;5(3):e9889; 1-11. PMID: [PMC2847603](#).
- b. Schön D, **Gordon R**, Campagne A, Magne C, Astésano C, Anton JL, Besson M. (2010) Similar cerebral networks in language, music and song perception. *NeuroImage.* May 15;51(1):450-461. PMID: [20156575](#).
- c. **Gordon RL**, Magne C.L., Large E.W. (2011) EEG Correlates of Song Prosody: A New Look at the Relationship between Linguistic and Musical Rhythm. *Front Psychol.* 2(352): 1-13. PMID: [PMC3225926](#).
- d. Magne C, Jordan DK, **Gordon RL.** (2016) Speech rhythm sensitivity and musical aptitude: ERPs and individual differences. *Brain Lang.* Feb(153-154):13-19. PubMed PMID: [26828758](#).

d) Program for Music, Mind & Society at Vanderbilt: Research and Infrastructure

I am strongly committed to building research infrastructure and community engagement in my past role leading the Program for Music, Mind & Society at Vanderbilt, a trans-institutional incubator program that has engaged key players from more than 15 Departments and 8 Centers across Vanderbilt. Complementing the rapid growth of my own research on rhythm and language, I carefully fostered new research on music and social engagement, and provided consultation to scholars across our campus

working on the science of music from different perspectives. My team has implemented a large array of community outreach and engagement activities including public lectures, symposia, partnerships with music industry and community organizations, along with social media efforts and international media visits, capitalizing on the powerful public interest in music and the brain as a vehicle for science outreach. Projects resulting from these networking initiatives include a meta-analysis of studies on the effects of music training on reading-related skills and a new guide to measuring treatment fidelity in active music interventions.

- a. **Gordon RL**, Fehd HM, McCandliss BD. (2015) Does Music Training Enhance Literacy Skills? A Meta-Analysis. *Front Psychol.* 6(1777): 1-16. PubMed Central PMCID: [PMC4664655](https://pubmed.ncbi.nlm.nih.gov/29727027/).
- b. **Gordon, R.L.** & Magne, C. (2017). *Music and the brain: Music and cognitive abilities*. In (Eds R. Ashley & R. Timmers) *Routledge Companion to Music Cognition*. Chapter 5; p 49-62. Routledge.
- c. Wiens, N., & **Gordon, R.L.** (2018). The case for treatment fidelity in active music interventions: Why and How. *Annals of the New York Academy of Sciences*, 1423, 219-228. Pubmed ID: 29727027.

D. Additional Information: Research Support

Ongoing Research Support

K18DC017383, National Institute of Deafness and Other Communication Disorders, Gordon (PI)
3/1/2018-2/28/2020
Mapping the Genetic and Neural Architecture of Human Rhythm and Communication Traits
Role: PI

DP2HD098859, NIH Director's New Innovator Award (DP2), Gordon (PI)
9/30/18-6/30/23
Biomarkers of Rhythmic Communication: Integrating Foundational and Translational Approaches
Role: PI

R01DC016977 NIH NIDCD R01
2/1/2019-1/31/2024
Neurobiological markers of rhythm: risk and resilience for language acquisition
Role: PI

National Science Foundation 1926794
10/1/19-9/30/23
Collaborative Research: NCS-FO Biology and Function of Prosody: Integrative approach to individual differences
Role: PI (MPI with Magne)

Completed Research Support

Vanderbilt Kennedy Center Hobbs Discovery Award, Gordon (PI)
01/08/18-6/08/19
Uncovering the genetic etiology of developmental language disorder
Role: PI

R03DC014802, National Institute of Deafness and Other Communication Disorders, Gordon (PI)
07/15/15-06/30/19 (no-cost extension).
Rhythm in Atypical Language Development: Mechanisms and Individual Differences
Role: PI

Trans-Institutional Programs Grant (TIPs), Vanderbilt Chancellor, Gordon (PI)
07/01/17-12/30/18. *Making Music City a Magnet for Music Research*
Role: PI