

# Daniel Liu Bowling, PhD

## Curriculum Vitae

Instructor

Department of Psychiatry and Behavioral Sciences – Stanford University  
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### EDUCATION

- |             |       |                                                                                      |
|-------------|-------|--------------------------------------------------------------------------------------|
| 02.2020     | Cert. | Translational Medicine<br>MCHRI Eureka, Asilomar, USA                                |
| 2008 – 2012 | Ph.D. | Neurobiology<br>Duke University, USA<br>Advisor: Dr. Dale Purves                     |
| 2007 – 2008 | Cert. | Cognitive Neuroscience<br>Duke University, USA                                       |
| 2002 – 2006 | B.S.  | Biological Psychology, Summa Cum Laude<br>University of California at San Diego, USA |
| 2002 – 2006 | B.A.  | Neurophilosophy*, Summa Cum Laude<br>University of California at San Diego, USA      |

\*A self-directed major combining upper division courses from the Departments of Cognitive Science and Philosophy. Sponsored and supervised by Dr. Patricia Churchland

### RESEARCH

#### RESEARCH POSITIONS

- |                          |                                                                                                           |
|--------------------------|-----------------------------------------------------------------------------------------------------------|
| Dec. 2018 -<br>Present   | Instructor<br>Department of Psychiatry and Behavioral Sciences<br>Stanford University, Palo Alto, CA      |
| Apr. 2015 -<br>Oct. 2018 | Lisa Meitner Research Fellow<br>Department of Cognitive Biology<br>University of Vienna, Vienna, AT       |
| July 2012 -<br>Mar 2015  | Postdoctoral Researcher<br>Fitch Lab, Department of Cognitive Biology<br>University of Vienna, Vienna, AT |

#### PEER-REVIEWED JOURNAL ARTICLES

Bowling DL (2020) Claims of categorical primacy for musical affect are confounded by using language as a measure. *Proceedings of the National Academy of Sciences USA*, In press.

- Filippi P, Hoeschele M, Spierings MJ, Bowling DL. (2019) Temporal Modulation in Speech, Music, and Animal Vocal Communication: Evidence of Conserved Function. *Annals of the New York Academy of Science*, 1453:99-113.
- Congdon JV, Hahn, AH, Filippi P, Campbell KA, Hoang J, Scully EN, Bowling DL, Reber SA, Sturdy CB. (2019) Hear Them Roar: A Comparison of Black-capped Chickadee and Human Perception of Arousal in Vocalizations Across All Classes of Terrestrial Vertebrates. *Journal of Comparative Psychology*, 133:520-541.
- Bowling DL, Graf Ancochea P, Hove MJ, Fitch WT. (2019) Pupillometry of Groove: Evidence for Noradrenergic Arousal in the Link Between Music and Movement. *Frontiers in Neuroscience*, 12:1039.
- Fritz TH, Bowling DL, Contier O, Grant J ... & Villringer A. (2018) Musical Agency During Physical Exercise Decreases Pain During Sports Exercise. *Frontiers in Psychology*, 8:2312.
- Bowling DL, Purves D & Gill KZ. (2018). Vocal Similarity Predicts the Relative Attraction of Musical Chords. *Proceedings of the National Academy of Sciences USA*, 115:216-221.
- Bowling DL, Hoeschele M, Gill KZ & Fitch WT. (2017). The Nature and Nurture of Musical Consonance. *Music Perception*, 35:118-121.
- Garcia M, Herbst CT, Bowling DL, Dunn JC & Fitch WT. (2017). Morphological Determinates of Fundamental Frequency in Primate Vocal Production. *Scientific Reports*, 7:10450.
- Filippi P, Ocklenburg S, Bowling DL, Heege L ... & de Boer B. (2017). Evidence for a Stroop Effect of Prosody in Emotion Word Processing. *Cognition and Emotion*, 31:879-891.
- Filippi P, Congdon JV, Hoang J, Bowling DL ... & Güntürkün O. (2017). Humans Recognize Emotional Arousal in Vocalizations Across All Classes of Terrestrial Vertebrates: Evidence for Acoustic Universals. *Proceedings of the Royal Society B*, 284: 20170990.
- Bowling DL. (2017). The Continuing Legacy of Nature vs. Nurture in Biolinguistics. *Psychonomic Bulletin & Review*, 24:140.
- Bowling DL, Garcia M, Dunn J, Ruprecht A ... & Fitch WT. (2017). Body Size and Vocalization in Primates and Carnivores. *Scientific Reports*, 41070.
- Herbst CT, Schutte HK, Bowling DL & Svec JG. (2016) The Electroglottographic Contact Quotient is Only a Limited Surrogate of the Closed Quotient. *Journal of Voice*, 31:401-409.
- Garcia M, Gingras B, Bowling DL, Herbst C ... & Fitch WT. (2016). Structural

Classification of Wild Boar (*Sus scrofa*) Vocalizations. *Ethology*, 122: 329-342.

Hoeschele M & Bowling DL. (2016). Sex Differences in Rhythmic Preferences in the Budgerigar (*Melopsittacus undulatus*): A Comparative Study with Humans. *Frontiers in Psychology*, 7:1543.

Bowling DL & Purves D. (2015). A Biological Rationale for Musical Consonance. *Proceedings of the National Academy of Sciences USA*, 112: 11155-60.

Bowling DL & Fitch WT. (2015). Do Animal Communication Systems Have Phonemes? *Trends in Cognitive Sciences*, 19:555-57.

Bowling DL. (2015). The Problem with Emotion. Comment on "The Quartet Theory of Human Emotions: An Integrative Neurofunctional Model" by S Koelsch et al. *Physics of Life Reviews*, 13:33-35.

Ravignani A, Bowling DL & Fitch WT. (2014). Chorusing, Synchrony, and the Evolutionary Functions of Rhythm. *Frontiers in Psychology*, 5:1118.

Bowling DL. (2014). Cognitive Theory and Brain Fact: Insights for the Future of Cognitive Neuroscience. Comment on "Toward a Computational Framework for Cognitive Biology" by WT Fitch. *Physics of Life Reviews*, 11:377-9.

Bowling DL, Gingras B, Han S, Sundararajan J & Opitz ECL. (2013). Tone of Voice in Emotional Expression: Relevance for the Affective Character of Musical Mode. *Journal of Interdisciplinary Music Studies*, 7:29-44.

Bowling DL, Herbst CT & Fitch WT. (2013). Social Origins of Rhythm? Synchrony and Temporal Regularity in Human Vocalization. *PLoS ONE*, 8: e80402.

Bowling DL. (2013). A Vocal Basis for the Affective Character of Musical Mode in Melody. *Frontiers in Psychology*, 4:464.

Award † Carter RM, Bowling DL, Reeck C & Huettel SA. (2012). A Distinct Role of the Temporal-Parietal Junction in Predicting Socially Guided Decisions. *Science*, 337: 109-111.

Bowling DL, Sundararajan J, Han S & Purves D. (2012). Expression of Emotion in Eastern and Western Music Mirrors Vocalization. *PLoS ONE*, 7: e31942.

Han S, Sundararajan J, Bowling DL, Lake J & Purves D. (2011). Co-Variation of Tonality in the Music and Speech of Different Cultures. *PLoS ONE*, 6: e20160.

Bowling DL, Gill K, Choi J, Prinz J & Purves D. (2010). Major and Minor Music Compared to Excited and Subdued Speech. *Journal of the Acoustical Society of America*, 127: 491-503.

## **PEER-REVIEWED BOOK CHAPTERS**

Ravignani A, Bowling DL, Kirby S. (2014). The Psychology of Biological Clocks: A New Framework for the Evolution of Rhythm. In E. Cartmill, S. Roberts, H. Lyn, & H.

Cornish (Eds.), *The Evolution of Language* (pp. 262–269).

Bowling DL & Purves D. (2012). A Biological Basis for Musical Tonality. In: B Barth, G Patrizia, H Klein (eds.), *Sensory Perception: Mind and Matter*. Springer Verlag, Heidelberg, DE.

## THESES

Bowling DL (2012). *The Biological Basis of Emotion in Musical Tonality*. (Ph.D. Thesis) Retrieved from Duke University Libraries, DukeSpace Theses and Dissertations. (<http://dukespace.lib.duke.edu/dspace/handle/10161/5522>)

## WORK IN PROGRESS

Bowling DL, Dunn JC, Smaers J ... & Fitch WT. Rapid evolution of the primate larynx? *PLoS Biology* (*Under Review*).

Wagner B, Bowling DL, Hoeschele M. Is consonance attractive to budgerigars? No evidence from a place preference study. *Animal Cognition* (*Under Review*).

Bowling DL, Gahr J, Hoeschele M ... & Fitch WT. Endogenous oxytocin, cortisol, and testosterone activity in response to collective vocal action. (*Manuscript preparation*).

Bowling DL, Bamford J, Troje N & Fitch WT. Pupillary Responses to Social and Non-Social Synchrony in Point-Light Motion Displays. (*Data Analysis*).

## INVITED RESEARCH TALKS

Bowling DL. Vocalization, Affect, and the Biology of Music. *Zoom Talk* presented at Department of Comparative Language Science, University of Zurich. May, 2020.

Bowling DL. Vocalization, Affect, and the Biology of Music. *Talk* presented at Stanford Psychology. Vienna, AT. January, 2020.

Bowling DL. A Biological Rationale for Musical Consonance. *Talk* presented at the 5th Meeting of the Carl Stumpf Society. Vienna, AT. October, 2015.

Award ‡ Bowling DL. Social Origins of Rhythm? *Talk* presented at Syntax of the Mind International Conference. Vienna, AT. April, 2014.

Bowling DL. The Problem of Musical Consonance. *Talk* presented at Duke-NUS Neurobiology and Behavioral Disorders Annual Retreat. Singapore. August, 2011.

Bowling DL. The Affective Impact of Major and Minor Music. *Talk* presented at Duke-NUS Early Career Scientists Association Symposium. Singapore. October, 2009.

## CONFERENCE & SYMPOSIUM PRESENTATIONS

Bowling DL, Purves D, Gill, K. Vocal similarity predicts the relative attraction of musical chords. *Talk* presented at the 15<sup>th</sup> International Conference on Music Perception and Cognition, Graz, AT. July, 2018.

Bowling DL, Graf Ancochea P, Fitch T. Pupillometry of Groove. *Talk* presented at the 15<sup>th</sup> International Conference on Music Perception and Cognition, Graz, AT. July, 2018.

Lesch R, Bowling DL, Fitch, WT. Born to Sing, Laryngeal Morphology in Rats Bred for High and Low Rates of Ultrasonic Vocalization. *Poster* presented at the 4<sup>th</sup> International Symposium on Acoustic Communication by Animals, 11, Omaha, NB. July, 2017.

Fillipi P, Ocklenburg S, Bowling DL, Heege ... de boar B. Multimodal Processing of Emotion: Prosody and Facial Expression. *Talk* presented at Evolang 11, New Orleans, LA. March, 2016.

Fillipi P, Cogden J, Hoang J, Bowling DL ... Güntürkün O. Humans Recognize Vocal Emotional Expression Across Species. *Poster* presented at Evolang 11, New Orleans, LA. March, 2016.

Horn L, Hungerländer N, Scheer C & Bowling DL. Work Together, Move Together: Cooperation Promotes Interpersonal Synchrony in Human Dyads. *Poster* at Behaviour, Cairns, AU. August, 2015.

Bowling DL, Garcia M & Fitch WT. Acoustic Allometry in 91 Primates and Carnivores. *Talk* presented at the International Bioacoustics Conference, Murnau, DE. September, 2015.

Bowling DL, Purves D. A Biological Rationale for Musical Consonance. *Talk* presented at the Society for Music Perception and Cognition Conference, Nashville, TN. July, 2015.

Bowling DL & Fritz TH. Musical Agency Modulates Pain. *Talk* presented at the Society for Music Perception and Cognition conference, Nashville, TN. July, 2015.

Bowling DL & Fritz TH. Musical Agency During Joint Exercise. *Poster* presented at the Joint Action Meeting 6, Budapest, HU. July, 2015.

Bowling DL & Fitch WT. Synchrony and Temporal Regularity in Human Vocalization. *Talk* presented at Evolang 10, Vienna, AT. April, 2014.

Bowling DL & Fitch WT. Social origins of rhythm? *Poster* presented at the 3<sup>rd</sup> Transfer of Knowledge Conference on Comparative Cognition. Vienna, AT. July, 2013.

Award § Bowling DL, Sundararajan J, Han S & Purves D. Emotional Expression in Music Mirrors Vocalization. *Poster* presented at Duke-NUS Neurobiology and Behavioral Disorders Annual Retreat, Singapore. August, 2011.

## FUNDING & AWARDS

### RESEARCH GRANTS

#### International

Principal Investigator	Lisa Meitner Fellowship, Austrian Science Fund (FWF) Vienna, AT. (2015-2017)
Co-Principal Investigator	Emerging Field Award, University of Vienna. Vienna AT. (2014-2016)

#### National

Principal Investigator	K01MH122730 (NIMH) Stanford, Ca. (2020-2024)
Co-Investigator*	Wu Tsai Neurosciences Institute Seed Grant Stanford, Ca. (2019-2021)

\*Authored in collaboration with Drs. Karen Parker, Jonathan Berger, and Michael Frank.

#### Awards

*Scholarship.* MCHRI Eureka 2020 Certificate Course. US\$3000 (2020)

*Young Investigator Award.* University of Vienna, Faculty of Life Sciences. Vienna AT. €7000 (2016).

*Travel Award.* Cold Spring Harbor Laboratory, New York, NY. (2016) US\$1000 (2016).

† *Innovation Award.* Social and Affective Neuroscience Society. Vienna, AT (2014).

‡ *Best Talk.* Syntax of the Mind International Conference. Vienna, AT. (2014).

§ *Best Poster.* Neuroscience and Behavioral Disorders Retreat. Singapore. (2010).

## SUPERVISION & TEACHING

### GRADUATE

#### Co-Supervised PhD students

- Rafaella Lesch. Effects of Domestication on Vocalization. (3rd year).
- Sabrina Bettoni. Vocal Communication in Otters. (3rd year).
- Maxime Garcia. Mammalian Vocal Production. (Completed 2016).

#### Co-Supervised MSc students

- Julia Gahr. Hormonal Effects of Choral Singing. (Completed 2018).
- Pablo Graf-Ancochea. Psychophysiology of Groove. (Completed 2018).
- Shahzad Afroozeh. Auditory Preferences in the Budgerigar (*M. undulatus*). (Completed 2018).
- Katerina Pera. Consonance Perception in Non-Human Primates. (Completed 2018).
- Rebecca Ruprecht. Vocal Allometry in Mammals. (Completed 2014).

### RESEARCH ASSISTANTS

- Maggie Rose Bruck. Emotional induction using scenarios (Summer 2019)
- Marlene Holtzhausen. Recording affective speech. (Summer 2019).
- Pamela Pacerová. Pupillometry of consonance. (Summer 2018).
- Isabella Decuntis. Consonance in musical chords. (Summer 2016).
- Johanna Köllner. Music, movement and exercise physiology. (Spring 2016).
- Joshua Bamford. Perceiving synchrony in biological motion (Fall 2016)
- Tamás Novak. Music, movement and exercise physiology. (2015-2016).
- Asha Stewart. Comparative bioacoustics. (2014-2016).
- Emma Opitz. Tonal properties of vocal affect expression. (Summer 2014).
- Shui'er Han. Co-variation of speech and music across cultures. (2010-2012).
- Janani Sundararajan. Co-variation of speech and music across cultures (2010-2012).

### CO-INSTRUCTOR

Winter 2017            Methods in Cognitive Biology  
Department of Cognitive Biology, University of Vienna.

Winter 2016            Methods in Cognitive Biology  
Department of Cognitive Biology, University of Vienna.

### GRADUATE TEACHING ASSISTANT

Winter 2009            Neuroanatomy Lab Course  
Duke University Medical School, Durham, NC, USA.

Winter 2010            Neuroanatomy Lab Course  
Duke University Medical School, Durham, NC, USA.

## PROFESSIONAL TRAINING & SKILLS

### COURSES & WORKSHOPS ATTENDED

Genetics and Neurobiology of Language Laboratory course. Cold Spring Harbor Laboratory. (July, 2016)

Phylogenetic Regression Workshop. University of Vienna. (June, 2015).

BIOPAC training seminar. University of Vienna. (June, 2014)

### SCIENTIFIC COMPUTING SKILLS

Experiment Programming & Data Collection	Matlab, LiveCode, BIOPAC Acqknowledge, Eyelink
Data Analysis	Matlab, R, Excel
Statistics	Matlab, R, SPSS
Acoustic Signal Processing	Matlab, Praat, Audacity,
Computer Music Production	Logic Pro
Computer Graphics	Illustrator, Photoshop

## ACADEMIC SERVICE

## INVITED REVIEWER FOR ACADEMIC JOURNALS

35 reviews total. Inviting editor(s) in brackets.

Speech Communication (Elisa Pellegrino); Science Advances (Kevin LaBar); Proceedings of the National Academy of Sciences (Dale Purves); Frontiers in Psychology (Bruno Gingras, Anjali Bhatara, Eduardo Coutinho); Frontiers in Human Neuroscience (Tamir Demiralp); Journal of Experimental Psychology (James Enns); Psychonomic Bulletin & Review (Tecumseh Fitch); Frontiers in Neurology (Peter Sörös); Music Perception (Lola L. Cuddy; Richard Ashley; Erin Hannon); Journal of Comparative Psychology (Dorothy M Fragaszy); Comparative Cognition & Behavior Reviews (Marisa Hoechele); Musicae Scientiae (Jane Ginsborg); Journal of Interdisciplinary Music Studies (Eduardo Coutinho).

## SELECTED MEDIA & PUBLIC RELATIONS

- Scientific American, podcast. (31.07.2017). Screams Heard Round the Animal World.
- Naked Scientists, podcast, BBC one. (13.11.2015) Sounds to Make You Emotional.
- NewScientist, magazine article (8.8.2015). Brain On Music Kills Pain of Workouts.
- Scientific American Mind, magazine article (7.6.2012). Musical Intervals Sway Moods.
- Science Update Podcast with Bob Hirschon, NPR (17.4.2012). Emotional Music.
- Scientific American, podcast. (21.3.2012). Emotion in Music Mirrors Speech.
- Science Daily, web article. (14.3.2012). Emotional Expression in Music and Speech Share Similar Tonal Properties.
- NewScientist, web article. (11.1.2010). Songs in the key of life: What Make Music

## RELEVANT NON-ACADEMIC ACCOMPLISHMENTS & INTERESTS

- Emotional?
- Nature News, web article (8.1.2010). Does a minor key give everyone the blues?
  - Science Daily, web article (3.12.2009). Music and speech based on human biology, new evidence shows
  - Piano & Music Theory. (8 years). The Royal Conservatory of Music, Toronto, ON.
  - Speech Arts & Drama. (5 years). Mount Royal University, Calgary, AB.
  - Coach and Player. UCSD Intermural Soccer Champions, San Diego, CA.
  - Coach, American Youth Soccer Organization (AYSO). Palo Alto (1 season) & San Diego (1 season)
  - Coaches Award. Gunn High School Varsity Soccer, Palo Alto, CA.
  - Other Interests: Human evolution, Natural History, Animal Behavior, Conservation



## REFERENCES

### Post-Graduate

#### Dr. Karen Parker (Faculty mentor)

Associate Professor of Psychiatry  
Stanford University, Palo Alto, CA.  
Phone: +1 650 736 9863  
Email: [kjparker@stanford.edu](mailto:kjparker@stanford.edu)

#### Dr. Tecumseh Fitch (Postdoc. mentor)

Professor of Cognitive Biology,  
University of Vienna, Vienna, AT.  
Phone: +43 1 4277 76111  
Email: [tecumseh.fitch@univie.ac.at](mailto:tecumseh.fitch@univie.ac.at)

### Graduate

#### Dr. Dale Purves (PhD advisor)

Professor of Neurobiology  
Duke University, Durham, NC.  
Phone: +1 919 684-6122  
Email: [purves@neuro.duke.edu](mailto:purves@neuro.duke.edu)

#### Dr. Richard Mooney (Committee chair)

Professor of Neurobiology  
Duke University, Durham, NC  
Phone: +1 919 684-5025  
Email: [mooney@neuro.duke.edu](mailto:mooney@neuro.duke.edu)

### Undergraduate

#### Dr. Patricia Churchland (Supervisor)

Professor of Philosophy  
University of California, La Jolla, CA.  
Phone: +1 858 822-4883  
Email: [pschurchland@ucsd.edu](mailto:pschurchland@ucsd.edu)

#### William Bechtel, PhD (Instructor)

Professor of Philosophy  
University of California, La Jolla, CA.  
Phone: +1 858 822-4461  
Email: [bill@mechanism.ucsd.edu](mailto:bill@mechanism.ucsd.edu)

#### Eric Watkins, PhD (Instructor)

Professor of Philosophy  
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#### Joan Stiles, PhD (Instructor)

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University of California, La Jolla, CA.  
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#### George Koob, PhD (Instructor)

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Scripps Research Institute, La Jolla, CA.  
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