

Braxton B. Boren

Assistant Professor (2017-present)
Phone: (718) 704-6247
Email: boren@american.edu

American University
Department of Performing Arts
Washington, DC 20016

Education

Ph.D. Music Technology, **New York University**, 2014.

M.Phil. Physics, Gates Cambridge Scholar, **University of Cambridge**, 2010.

B.A. *Summa Cum Laude*. Music Technology, **Northwestern University**, 2008.

Work Experience

Math Teacher, **Uncommon Collegiate Charter High School**, Brooklyn, NY, 2016-2017.

Postdoctoral Research Associate, **Princeton University** 3D Audio and Applied Acoustics Laboratory, 2014-2016.

Adjunct Professor, **New York University** Music Technology Program, 2012-2016.

Grants and Fellowships

American University Faculty Research Support Grant (2019) - "Hearing Bach's Music as Bach Heard It (Supplemental)," \$6,900.

American University Mellon Research Support Grant (2018) - "Development of Distortion-Free Equalization for Headphone Transfer Functions," \$2,000.

National Endowment for the Humanities Digital Humanities Startup Grant (2018-2020) - "Hearing Bach's Music as Bach Heard It," \$50,000.

NYU Steinhardt Research Travel Grant (2013) - \$1,000.

Acoustical Society of America Student Conference Grant (2013) - \$400.

NYU Steinhardt Doctoral Fellowship (2010-2014).

Gates Cambridge Scholarship (2009-2010).

Northwestern University Undergraduate Research Grant (2007) - \$3,000.

Publications

Refereed Journal Articles

- Boren, B.** (2019). Computational Acoustic Musicology. *Digital Scholarship in the Humanities* 34/4, December 2019, pp. 707-715.
- Boren, B.** (2018). Acoustic Simulation of Julius Caesar's Battlefield Speeches. *Acoustics* 1(1), pp. 3-13; (Special Issue) Historical Acoustics: Relationships between Man and Sound over Time.
- Tylka, J., **Boren, B.** & Choueiri, E. (2017). A Generalized Method for Fractional-Octave Smoothing of Transfer Functions that Preserves Log-Frequency Symmetry. *Journal of the Audio Engineering Society*. 65(3), pp. 239-245.
- Boren, B.**, Longair, M., & Orłowski, R. (2013). Acoustic Simulation of Renaissance Venetian Churches. *Acoustics in Practice*, 1(2), pp. 17-28.
- Bonsi, D., **Boren, B.**, Howard, D., Longair, M., Moretti, L., & Orłowski, R. (2013). Acoustic and Audience Response Analyses of Eleven Venetian Churches. *Acoustics in Practice*, 1(1), pp. 39-52.
- Boren, B.** (2012). Sounds of the City: The Colonial Era. *The Encyclopedia of Greater Philadelphia*.
- Boren, B.** (2011). Motion Simulation in the Environment for Auditory Research. *Army Research Lab Publication ARL-TM-2011* 1, pp. 41-51.

Refereed Book Chapters

- Boren, B.** (in progress). History of Immersive Sound Experiences. In *The Immersive sound experience: Design concepts and applied technologies*, A. Roginska & P. Geluso, eds.
- Boren, B.** (2017). History of 3D Sound. In *Immersive Sound*, A. Roginska & P. Geluso, eds. Focal Press, pp. 40-62.
- Boren, B.** (2016). Whitefield's Voice. In *George Whitefield: Life, Context and Legacy*. D. Jones & G. Hammond, eds. Oxford University Press, pp. 167-189.

Refereed Conference Proceedings

- Boren, B.** (2020 - in review). Teaching Acoustics to Audio Students: A Middle Path. *AES Conference on Audio Education*, Murfreesboro & Nashville, TN.
- Boren, B.** (2019). Acoustic Simulation of Elizabeth I at Tilbury. *International Congress on Acoustics (ICA-2019)*, Aachen, Germany.
- Boren, B.**, Genovese, A. (2018). Acoustics of Virtually Coupled Performance Spaces. *International Conference for Auditory Display (ICAD-2018)*, Houghton, MI.
- Boren, B.**, Musick, M. (2018). Spatial Organization in Musical Form. *Proceedings of the International Computer Music Conference*, Daegu, South Korea.
- Boren, B.**, Caro, G., Calixto, D., Gonzalez, J., Mendoza, V., Salazar, F., Padilla, P., Perez, G., Ramos, A., Rivera, A., Tapia, R., Paz, C., & Zamudio, J. (2016). Mexico City's cathedral: An archaeoacoustical and musicological analysis. *22nd International Congress on Acoustics*, Buenos Aires, Argentina.
- Boren, B.**, Geronazzo, M., Brinkmann, F., & Choueiri, E. (2015). Coloration Metrics for Headphone Equalization. *International Conference for Auditory Display (ICAD-2015)*, Graz, Austria.

Boren, B., Musick, M., Grossman, J., & Roginska, A. (2014). I Hear NY4D: Hybrid Acoustic and Augmented Auditory Display for Urban Soundscapes. *International Conference for Auditory Display (ICAD-2014)*, New York, NY.

Boren, B., Roginska, A., & Gill, B. (2013). Maximum Averaged and Peak Levels of Vocal Sound Pressure. *135th Audio Engineering Society Convention*, New York, NY.

Boren, B., Andreopoulou, A., Musick, M., Mohanraj, H., & Roginska, A. (2013). I Hear NY3D: Ambisonic Capture and Reproduction of an Urban Sound Environment. *135th Audio Engineering Society Convention*, New York, NY.

Forsyth, J., **Boren, B.**, Feynburg, R., & Park, T. (2013). NYU Music Technology Studio Report. *Proceedings of the 2013 International Computer Music Conference*, Perth, Australia.

Boren, B. & Roginska, A. (2013). Sound radiation of trained vocalizers. *Proceedings of Meetings on Acoustics: 21st International Congress on Acoustics*, Montreal, Canada.

Boren, B. & Longair, M. (2012). Acoustic simulation of the church of San Francesco della Vigna. *Proceedings of Meetings on Acoustics: 164th Conference of the Acoustical Society of America*, Kansas City, MO.

Boren, B. (2007). Music in Real-Time Interactive Video Games. *College of Arts and Sciences Research Conference*, Indiana University Northwest, Gary, IN.

Invited Seminar Papers

Boren, B. (2016). Word and Mystery: Religion and Acoustic Space. *Religiosity, Relationality, and Musicality in the Twenty-First Century*, Yale Institute of Sacred Music, New Haven, CT.

Boren, B. (2016). Space as the Missing Link in Historical Performance Practice. *Sounding Spaces: A Workshop on Music, Urban Space, Landscape, and Architecture*, Northwestern University, Evanston, IL.

Conference Proceedings Based on Précis or Abstract Review

Boren, B., Abraham, D., Naressi, R., Grzyb, E., Lane, B., & Merceruio, D. (2019). Acoustic Simulation of Bach's Performing Forces in the Thomaskirche. *1st EAA Spatial Audio Signal Processing Symposium*, Paris, France.

Boren, B. (2016). Technology and Incarnational Tension. *The Wonder and Fear of Technology Conference*, New York, NY.

Boren, B., Geronazzo, M., Majdak, P., & Choueiri, E. (2014). PHOnA: A Public Dataset of Measured Headphone Transfer Functions. *137th Audio Engineering Society Convention*, Los Angeles, CA.

Tylka, J., Sridhar, R., **Boren, B.**, & Choueiri, E. (2014). A New Approach to Impulse Response Measurements at High Sampling Rates. *137th Audio Engineering Society Convention*, Los Angeles, CA.

Boren, B. (2014). George Whitefield's Voice. *George Whitefield at 300*, Oxford, UK.

Musick, M., Andreopoulou, A., **Boren, B.**, Mohanraj, H., & Roginska, A. (2013). I Hear NY3D: an ambisonic installation reproducing NYC soundscapes. *135th Audio Engineering Society Convention*, New York, NY.

Boren, B. & Roginska, A. (2012). Analysis of noise sources in colonial Philadelphia. *Internoise 2012*, New York, NY.

Boren, B. & Longair, M. (2011). A Method for Acoustic Modeling of Past Soundscapes. *The Conference on the Acoustics of Ancient Theatres*, Patras, Greece.

Boren, B. & Roginska, A. (2011). Multichannel Impulse Response Measurement in Matlab. *131st Audio Engineering Society Convention*, New York, NY.

Boren, B. & Roginska, A. (2011). The Effects of Headphones on Listener HRTF Preference. *131st Audio Engineering Society Convention*, New York, NY.

Madden, A., Blumenthal, P., Andreopoulou, A., **Boren, B.**, Hu, S., Shi, Z., & Roginska, A. (2011). Multi-Touch Room Expansion Controller for Real-Time Acoustic Gestures. *131st Audio Engineering Society Convention*, New York, NY.

Invited Conference Talks and Presentations

Boren, B. & Anthony, J. (2019). Acoustical and Architectural History of the Thomaskirche in Leipzig. *International Congress on Acoustics*, Aachen, Germany.

Boren, B. (2019). Applications of Acoustic Propagation Simulation for Historical Research. *Music Informatics, Cognition and Acoustics Seminars*, School of Music, University of Edinburgh, Edinburgh, UK.

Boren, B. & Allen, J. (2019). Mystery and Clarity: Liturgical Space in Counter-Reformation Italy. *Sounding (Out) Italy Seminar*, Faculties of Architecture, Italian Studies, and Music, University of Cambridge, Cambridge, UK.

Boren, B. (2019). Computer Simulation of Past Soundscapes. *Computer Science Department Colloquium*, American University, Washington, DC.

Boren, B. (2018). Acoustic Simulation of Soundscapes from History. *Physics Department Symposium*, United States Naval Academy, Annapolis, MD.

Boren, B. (2018). Breaking Out: How to Explore the Wider World. *Early Identification Program Opening Dinner*, Office of Merit Awards, American University, Washington, DC.

Boren, B. (2018). Julius Caesar's Speech at the Battle of Pharsalus. *Euronoise 2018*, Hersonissos, Greece.

Boren, B. (2017). A generalized version of the Lubman-Kiser theory of historical acoustics and worship spaces. *Acoustics '17*, Boston, MA.

Ramos-Amezquita, A., Padilla, P., Jaramillo, A., **Boren, B.**, Caro, G., Gonzalez, J., Mendoza, V., Salazar, F., Perez, G., Rivera, A., Tapia, R., Paz, C., & Zamudio, J. (2017). Archaeoacoustics of Mexico City's Cathedral. *Acoustics '17*, Boston, MA.

Boren, B. (2016). Hearing the Past. Faculty of Music, National Autonomous University of Mexico (UNAM), Mexico City, Mexico.

Boren, B. (2015). Outdoor Oratory and Performance Space. *169th Conference of the Acoustical Society of America*, Pittsburgh, PA.

Boren, B. (2014). Acoustic reconstruction of architectural and musical space. *Pallas and the Muses Conference: Dialogues Between Science and Art*, Guanajuato, Mexico.

Boren, B. (2014). Acoustic Simulation of George Whitefield's Open-Air Oratory. NYU Steinhardt Scholarship Day, New York, NY.

Boren, B. (2013). Using Acoustic Archaeology to Simulate George Whitefield's Voice. McNeil Center for Early American Studies Seminar, University of Pennsylvania, Philadelphia, PA.

Longair, M. & **Boren, B.** (2011). Music, Architecture, and Acoustics in Renaissance Venice: Recreating Lost Soundscapes. The Royal Society, London, UK.

Contributed Conference Presentations

Boren, B. (2015). Computational Acoustic Musicology. *2015 Joint Congress of the International Association of Music Libraries and the International Musicological Society: Music Research in the Digital Age*, New York, NY.

Boren, B. (2013). The maximum intelligible range of the unamplified human voice. *166th Conference of the Acoustical Society of America*, San Francisco, CA.

Boren, B. (2013). Archaeoacoustics of Outdoor Oratory. NYU Music and Audio Research Laboratory Seminar Series, New York, NY.

Boren, B., & Roginska, A. (2012). Computer simulation of Benjamin Franklin's acoustic experiment on George Whitefield's oratory. *164th Conference of the Acoustical Society of America*, Kansas City, MO.

Boren, B. (2012). Benjamin Franklin's Estimate of George Whitefield's Audible Range. *44th Conference of the Pioneer America Society*, Philadelphia, PA.

Boren, B. & Longair, M. (2011). Acoustic Simulation of Renaissance Venetian Churches. *162nd Conference of the Acoustical Society of America*, San Diego, CA.

Boren, B. & Ericson, M. (2011). Motion Simulation in the Environment for Auditory Research. *162nd Conference of the Acoustical Society of America*, San Diego, CA.

Boren, B. (2011). Motion Simulation in the Environment for Auditory Research. Army Research Lab Summer Symposium, Aberdeen Proving Ground, MD.

Longair, M. & **Boren, B.** (2010). Music, Architecture, and Acoustics in Renaissance Venice: Recreating Lost Soundscapes. Cavendish Physical Society Lecture, Cambridge, UK.

Boren, B. (2010). Listening to the Festival of the Redentore 400 Years Later. Gates Scholars' Society Internal Symposium, Cambridge, UK.

Longair, M. & **Boren, B.** (2009). Sound and Space in the Ospedaletto. Cavendish Astrophysics Seminar, Cambridge, UK.

Boren, B. & Kendall, G. (2008). Real-Time Multichannel Spatial Reverberation. *Northwestern University Acoustic Space Seminar*, Evanston, IL.

Patents

Choueiri, E., Tylka, J., Sridhar, R., & **Boren, B.** (2017). METHOD AND SYSTEM FOR PRODUCING LOW-NOISE ACOUSTICAL IMPULSE RESPONSES AT HIGH SAMPLING RATE. US Patent No. 20170098454 A1. Allowed January 19, 2018.

Selected Press Coverage

- 'The best bookshelf speakers for home audio, according to experts,' *NBC News*, March 26 (2020).
- 'How to restore the legendary acoustics of Notre Dame', *Science News*, January 12 (2020).
- 'How audio researchers preserved Notre Dame's treasured acoustics before the fire', *Los Angeles Times*, April 21 (2019).
- 'Listen Critically! Part 3: Monitors and Mixing', *Recording Magazine*, March Issue (2019).
- 'The Physics Behind Daredevil's Sense of Hearing', *The Scholar Magazine*, Vol. 16, Gates Scholar Alumni Association (2019).
- 'This American University Professor Won a Grant to Bring Bach's Acoustics to Life', *Washingtonian Magazine* (2018).
- 'The Science of Sound', *Faculty Research Profile*, American University (2017).
- 'Recreating the acoustics of historical speeches', *Science Magazine Podcast* (2015).
- 'Ben Franklin: Sonic Explorer', *Science Friday*, Public Radio International (2014).
- 'Legendäre Stimme auf dem digitalen Prüfstand', *Neue Zürcher Zeitung* (2013).
- 'How many people heard the Sermon on the Mount? Or the Gettysburg Address?', *Fox News Science* (2013).
- 'Venetian Acoustics Rediscovered', *Science Now* (2011).
- 'Der Doge genoss in Stereo', *Frankfurter Allgemeine Zeitung* (2011).
- 'Chock-Full Church Made Choral Clarity', *Scientific American Podcast* (2011).
- 'Was "Stereo" Born 400 Years Ago in Venice?', *National Geographic News* (2011).
- 'Acoustic Archaeology', *The Naked Scientists*, BBC Radio (2009).

Academic Honors

- Audio Engineering Society Certificate of Appreciation for Service to the AES (2015, 2017, 2018).
- Best Student Paper Award for "I Hear NY4D: Hybrid Acoustic and Augmented Auditory Display for Urban Soundscapes," International Conference on Auditory Display (2014).
- 3rd place, Army Research Lab Summer Symposium, Graduate Research Division (2011).
- National Science Foundation Graduate Research Fellowship, Honorable Mention (2011).
- Valedictorian, Northwestern University Bienen School of Music (2008).
- Outstanding Student Paper Award for "Music in Real-Time Interactive Video Games," College of Arts and Sciences Research Conference, Indiana University Northwest (2007).
- National Merit Scholar (2004).
- Eagle Scout, Boy Scouts of America (2003).

Teaching Experience

Courses

Taught

Digital Signal Theory, American University (Fall 2019, Spring 2020)

Designed and taught course on the scientific and engineering side of audio, from the basics of computer representation of sound through Fourier Transforms and Filter Theory, including significant programming components in Matlab.

Audio Technology Seminar, American University (Spring 2019)

Designed and taught hybrid in-person and online research methods course to Audio Technology graduate students. Covered qualitative and quantitative research approaches in the field of audio.

3D Audio, American University (Spring 2018)

Designed and taught graduate-level course on spatial auditory perception and 3D audio technologies for creating spatial effects in music, film, and gaming environments.

Sound Synthesis I, American University (Spring 2018, Fall 2018, Spring 2019)

Taught intro to digital audio, basic signal processing and sound synthesis/sequencing, and programming in PureData, an open-source audio coding language, and Max/MSP.

Acoustics: Physics of Sound, American University (Fall 2017, 2018, 2019)

Designed and taught graduate-level acoustics course from a calculus-based perspective. Similar to *Advanced Musical Acoustics* at NYU, but with a greater focus on hands-on experiments.

Honors Geometry, Uncommon Collegiate Charter High School (2016-2017)

Used Common Core-aligned Geometry curriculum to create daily lectures, group work, and exploration-based learning for two sections of 9th and 10th graders learning Euclidian Geometry.

Music Theory, Uncommon Collegiate Charter High School (Fall 2016)

Designed and taught UCC's first music course offering, a one-semester introduction for students with no prior background in Music Theory. Incorporated performance, pop music analysis, freestyle hip-hop, and vocal percussion into a new rendition of the school song that was performed at the end of the semester.

Musical Acoustics, New York University (Summer 2013)

Designed and taught required Bachelor's level course in Music Technology program. Covered fundamentals of physics of sound, room acoustics, and acoustics of musical instruments from an algebra-based perspective.

Advanced Musical Acoustics, New York University (Summer 2012, 2014, 2015; Spring 2016; Summer 2016)

Designed and taught required Master's level course in Music Technology program. Covered fundamentals of physics of sound, room acoustics, and acoustics of musical instruments from a calculus-based perspective.

Assisted or Co-Taught

AP Calculus (co-taught), Uncommon Collegiate Charter High School (2016-2017)

Supported senior AP Calculus teacher by helping students with example problems and holding after school office hours in preparation for AP Exam.

3D Audio, New York University (Spring 2014, Spring 2016)

Teaching assistant for advanced Master's course in Music Technology program. Gave lectures, hosted office hours, and graded student assignments and exams.

Digital Signal Theory, New York University (2011-2015)

Tutor graduate students in Digital Signal Theory I and II with conceptual understanding, problem sets, and programming assignments. Give guest lectures on signal processing.

Academic Supervision

Undergraduate Research Supervisor: **Elizabeth Grzyb**, "Acoustic Measurement and Modeling of the Katzen Performing Arts Center." (2019)

Graduate Research Supervisor: **Jackson Anthony**, "Computer Simulation of Bach's Thomaskirche," American University (2018).

External Dissertation Reader: **Joseph Tylka**, "Virtual Navigation of Higher-Order Ambisonics Sound Fields Containing Near-Field Sources," (Mechanical and Aerospace Engineering), Princeton University (2018).

Member, PhD Dissertation Committee: **Shashank Aswathanarayana** (Media Arts and Technology), UC Santa Barbara (2017-present).

Graduate Research Supervisor: **Rebeca Lindenfeld**, "Robust Binaural Reproduction Over Headphones," American University (2017-2018).

Academic Service*International Committees*

Member, "Acoustics and Soundscape" Task Force, Notre-Dame Cathedral Restoration Committee, Paris, France (June 2019-present)

Academic Chairperson

Session Organizer, *Archaeoacoustics*, International Congress on Acoustics, Aachen, Germany, 2019.

Invite papers and approve submissions for special session of ICA's program on Acoustics and History.

Papers Chair, Audio Engineering Society 147th Convention, 2019

Coordinate paper submissions, engineering reports, peer reviewers, paper selection, and research awards for the 2019 AES American Convention in New York City.

Papers Chair, Audio Engineering Society 145th Convention, 2018

Coordinate paper submissions, engineering reports, peer reviewers, paper selection, and research awards for the 2018 AES American Convention in New York City.

Papers Chair, Audio Engineering Society 143rd Convention, 2017

Coordinate paper submissions, engineering reports, peer reviewers, paper selection, and research awards for the 2017 AES American Convention in New York City.

Papers Chair, Audio Engineering Society 139th Convention, 2015

Coordinate paper submissions, engineering reports, peer reviewers, paper selection, and research awards for the 2015 AES American Convention in New York City.

Sponsorship Chair, International Conference on Auditory Display (ICAD-2014), 2013-2014

Secured sponsorship of ICAD-2014 from public and private entities and charitable foundations.

Open House Chair, NYU Music Technology Program, 2013

Organized the Spring 2013 Open House, consisting of a research symposium and musical performance series for undergraduate and graduate students in NYU's Music Technology program.

Peer Reviewer

Journals

Peer Reviewer, *Journal of the Acoustical Society of America*, 2018-present
Review journal articles on room acoustics modeling and measurement.

Peer Reviewer, *Wireless Communications and Mobile Computing*, 2019
Reviewed journal article on the evaluation of networked audio systems and telematic music performance.

Peer Reviewer, *Acoustics*, 2018
Reviewed journal article on the use of acoustical modeling in historical and archaeological studies.

Peer Reviewer, *Bulletin of the American Schools of Oriental Research*, 2018
Reviewed journal article on the intersection of history and acoustics.

Peer Reviewer, *Ergonomics in Design*, 2018
Reviewed journal article on acoustics, noise, and auditory issues in ergonomics and human factors research.

Grants

Grant Review Panelist, National Endowment for the Humanities Digital Humanities Grants, 2019
Reviewed Level II and Level III Digital Humanities Grant Applications for Federal Agency.

Conferences

Peer Reviewer AES 148th Convention, 2020

Peer Reviewer International Conference on Auditory Display (ICAD), 2019

Peer Reviewer, Audio Engineering Society 146th Convention, 2018

Peer Reviewer, International Computer Music Conference, 2018

Peer Reviewer, AES International Conference on Audio for Virtual and Augmented Reality, 2018

Peer Reviewer, Audio Engineering Society 142nd Convention, 2017

Peer Reviewer International Conference on Auditory Display (ICAD), 2015

Peer Reviewer IEEE 2nd VR Workshop on Sonic Interactions for Virtual Environments (SIVE), 2015

Books

Chapter Reviewer, "The Technology of Binaural Understanding" (Springer), 2019
Review academic press book chapter on room acoustics and spatial hearing.

Open Textbook Initiative Reviewer: University Physics, Volume I, American University Center for Teaching, Research, and Learning (CTRL), 2017
Review calculus-based physics textbook for online open textbook resource.

Academic Committees

Merit Committee, American University Department of Performing Arts, 2019.
Read and rate Faculty Activity Reporting System (FARS) reports and narratives for all DPA faculty as part of American University's merit pay raise system.

British Fellowships Faculty Advisor, American University Office of Merit Awards, 2017-present.
Help select and prepare outstanding undergraduates for the application and interview process for the Rhodes, Marshall, and Gates Scholarships for graduate study in the United Kingdom. Prepare feedback and serve on mock interview panels for Marshall and Rhodes Scholarship finalists.

Graduate Admission Committee, American University Audio Technology Program, 2017-2018.
Read and rate graduate applicants based on portfolio and academic work.

Dean Search Committee Member, 2013-2014
Graduate student representative on faculty search committee to select the new Dean of the Steinhardt School at New York University.

Professional Affiliations

Audio Engineering Society

Acoustical Society of America