

Ask an Acoustician: W. Owen Brimijoin

W. Owen Brimijoin and Micheal L. Dent

Meet W. Owen Brimijoin

In this installment of “Ask an Acoustician,” we learn more about an acoustician in industry. W. Owen Brimijoin is the Perception Research Lead for the Audio Team at Facebook Reality Labs Research (FRL-R), Redmond, WA. He received his PhD in brain and cognitive sciences from the University of Rochester, Rochester, NY. Owen participates in the Psychological and Physiological Acoustics Technical Committee of the Acoustical Society of America (ASA) and regularly gives talks at ASA meetings on his work determining the role of movement in our perception of auditory space. Let Owen tell you the rest in his own words.

A Conversation with Owen Brimijoin, in His Words

Tell us about your work.

We don't spend our lives listening to the world over headphones, hearing sounds that move with us as we move, nor do we carry on conversations with loudspeakers while clamped into a bite bar in an anechoic chamber. Because the head is never still, hearing and communication always involves movement. If we are going to properly understand hearing and truly help people communicate in difficult environments, we need to understand how listeners actually listen and what fundamental cues the brain uses in making sense of its acoustic world.

Describe your career path.

I was raised in Minnesota, the son of a genuinely gifted history teacher and an eccentric neuropharmacologist. I was deeply lucky to have my family's support, education, and encouragement in science. I was given every opportunity to follow in my dad's footsteps in the laboratory, but I loved the guitar a bit too much. I was sure I would forge my own path, learning about music, vibration, and language, anything but neuroscience,



really. But in college, the course in musical acoustics I had enrolled in was canceled on the first day. The only other class that even remotely interested me and met at that same time was Intro to... Neuroscience. I gave it a shot and was utterly hooked when I first heard amplified spikes coming from a cockroach leg proprioceptor. I didn't know that this fascination with neuroscience would eventually combine with my love of sound. After college, I worked as an exhausted prep cook, a novice language tutor, and a seriously bad receptionist and office worker but then decided to return to school because you can't do neuroscience with an undergraduate degree. I worked in Bill O'Neill's laboratory because he is a brilliant teacher and he was doing really clever work in neurophysiology. It was through him that I developed my lifelong desire to understand how the brain makes sense of the acoustic world. My PhD attempted to reveal something about what makes a neuron sensitive to the way in which speech-like sounds change over time. Afterward, I did a postdoc examining how this sensitivity changes with hearing impairment, research I embarked on because my wife has difficulty hearing. Things were going well, but I was having increasing problems personally justifying my animal work, so I made a big switch. A change is something I entirely recommend, but you must be prepared for a rather precipitous drop in your reputation. I moved into human perception, where nobody knew who I was.

The laboratory at the Institute of Hearing Research in Glasgow, Scotland, UK, happened to have a motion tracking system. I used it to investigate where people with

ASK AN ACOUSTICIAN

hearing impairment pointed their heads while listening. From there, I began work on how listeners make use of their own motion to understand speech and to inform their percept of the acoustic world. Together, these projects led me to work with Alan Archer Boyd on an augmented reality (AR) hearing aid that took advantage of natural listener behavior. This work hit some funding stumbling blocks and seemed to attract only passing interest from the hearing aid industry.

Just as I was getting rather fed up with the lack of institutional enthusiasm for this work, I got an email from Tony Miller at what was then called Oculus Research (now FRL). He wanted to talk about AR and how moving listeners perceive moving sounds. Here was a chance to work with technology that is a great perceptual research tool, a fundamentally new way of interacting with language, with music, with sound in general, and what I felt was our best chance of helping people who experience difficulty understanding speech in noisy environments. I got the job, and I consider myself very lucky to be here, as I have felt at every stage of my research career.

What is a typical day for you?

I am not sure I have a typical day. Some days are head down, working on some intractable puzzle and some days are peppered with meetings and brainstorming sessions, and the time around our twice yearly internal research symposium is a thrilling, all-engrossing, mile-a-minute ride. This is when all of FRL gets together to discuss and demonstrate our work across all of AR/virtual reality (VR), and it's mind-blowing, sci-fi level stuff. The depth and scope of the work being done here is staggering, so you can't help but put everything you've got into your part of it.

How do you feel when experiments/projects do not work out the way you expected them to?

Sure, there is a momentary deflation, but finding out that your very reasonable hypothesis isn't supported by the data can be one of the most exciting moments in research. It often leads to some new understanding of underlying mechanisms, some novel insight, or even a whole new line of research. You think that the head tracking you are using in your VR system is lagging? Turns out that it's our perception of acoustic space that is distorted. But sometimes, yeah, it was a bad idea, it didn't work, and you didn't design the experiment in such a way that a null result would be even remotely informative. Don't beat yourself up, move on.

Do you feel like you have solved the work-life balance problem? Was it always this way?

I hadn't solved this problem before the COVID pandemic, and I am certainly no closer to solving it now. Today, there exists only a gossamer barrier between work and home, easily broken, easily ignored. The work culture here does help a bit, and managers are immensely supportive. Work-related messages and chat notifications automatically shut off at the end of your work day. I have a guitar in my home office that I make sure I pick up at least once a day, sometimes even doing some recording (see soundcloud.com/owen-brimijoin/sets). Many of the members of the audio team are, or could easily be, professional musicians, and we occasionally play together, which is lovely. But back to the subject: probably the biggest obstacle between me and proper balance is that the work is often too exciting for me to be able to ignore.

What makes you a good acoustician?

I happened on the right equipment and the right questions at just the right time. I lucked into a line of research that had really only just been made possible due to development in lower cost motion-tracking technology. Combine motion tracking with low-latency signal processing and you can break the basic rules that govern how sounds move around you when you move your head. Once you can do that, there is low-hanging fruit everywhere you look. I am very good at plucking this fruit.

How do you handle rejection?

Nobody can make my blood boil quite as well as Reviewer 2 can. But it happens to everyone, so you have to take a beat and remember that you are also Reviewer 2. We're all in this together, trying to advance as a group, an institution, a research field, and as human beings.

What are you proudest of in your career?

This is a toss-up between the work I do in AR hearing assistance and work on how our perception of acoustic space isn't uniform across angle.

What is the biggest mistake you've ever made?

I have been surpassingly lucky in my research. Some paths and some ideas work brilliantly, others don't, and I've been fortunate to be able to recognize which was which pretty quickly. My organizational skills are not at the same level. The day before I was due to leave for an ASA meeting in Boston, I was putting the finishing

touches on my talk. I was getting awfully excited about the chance to give a podium presentation to that brilliant audience when I saw an email from Expedia asking me how my travels were going. “That’s a funny bug in their system,” I thought. I’d idiotically had the wrong day in my calendar for months. Last minute flights from Scotland to the United States are not cheap, nor are they covered by a grant that paid for one already.

What advice do you have for budding acousticians?

Work in AR. VR is a fascinating technology for any number of reasons, but AR is a step change beyond that. From its remarkable utility as a perceptual research tool to its promise as a future way in which we will interact with technology, its importance will only increase over time. What’s more, I believe that pairing hearing assistance devices with AR will give them capabilities that utterly eclipse those of small form factor hearing aids.

Have you ever experienced imposter syndrome? How did you deal with that if so?

I absolutely experience imposter syndrome. Performance expectations at FRL are very high. While getting lunch, I might find myself standing behind someone who wrote substantial portions of Windows. I have regular meetings with the person who invented digital hearing aids. I go to conferences alongside researchers who have shaped our understanding of how the brain works. I sit among any number of blindingly clever people whose work is genuinely magical to me; really, it’s impossible *not* to ask yourself, “Why on Earth am I here too?”

The only thing that works for me is to fully accept that there will *always* be someone much better than you at everything. Are you really good at Matlab programming? Sorry, there are literally thousands of people out there who are 10 times better than you. But that’s OK. It’s always best to be operating at the bleeding edge of your competence; that is how you learn. What you bring to that research project, to that journal article, to that meeting of terrifyingly smart people is a particular *combination* of skills and backgrounds that result in an insight that is uniquely yours. What’s more, why spend hours trying to fit a function to some crazy data when there’s a brilliant person two meters away who got her degree in mathematics? The most interesting and

important problems facing auditory research are too complex for one person to tackle anyway; it’s what you can accomplish as a group that matters. Find that group, ask the questions, be naïve, be curious, and be generous with what you do know because odds are someone has imposter syndrome around you too.

What do you want to accomplish within the next 10 years or before retirement?

There is so much sophisticated signal processing that can be done to enhance a signal of interest for someone who is having trouble hearing in a noisy environment, and careers are made on enhancing it by even a few decibels. But the often-ignored problem is, *what* is the signal of interest? How do we know what someone is listening to and how do we tell whether they are having trouble doing so? If we can correctly estimate these things on a moment-to-moment basis, we can build devices that continually adjust themselves and do so in such an intuitive manner that you won’t even know they are on. I believe that such technology would be genuinely transformative, helping people have natural, relaxed conversations in environments in which they had no chance before. Only time will tell whether we get there, but this is a puzzle worth spending a career on.

Bibliography

- Brimijoin, W. O. (2018). Angle-dependent distortions in the perceptual topology of acoustic space. *Trends in Hearing* 22, 2331216518775568.
- Brimijoin, W. O., Boyd, A. W., and Akeroyd, M. A. (2013). The contribution of head movement to the externalization and internalization of sounds. *PLOS ONE* 8, e83068.
- Town, S. M., Brimijoin, W. O., and Bizley, J. K. (2017). Egocentric and allocentric representations in auditory cortex. *PLOS Biology* 15, e2001878.

Contact Information

W. Owen Brimijoin owen.brimijoin@fb.com

Facebook Reality Labs Research
9845 Willows Road NE
Redmond, Washington 98052, USA

Micheal L. Dent mdent@buffalo.edu

Department of Psychology
University at Buffalo
State University of New York (SUNY)
B76 Park Hall
Buffalo, New York 14260, USA