Profiles of Women in Science: Laurel Trainor, Professor, McMaster University, Hamilton, Ontario, Canada

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September 01, 2024

Abstract

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Profiles of Women in Science: Laurel Trainor, Professor, McMaster University, Hamilton, Ontario, Canada

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Abbreviations (in order of appearance):

EEG: electroencephalography

MEG: magnetoencephalography

MIMM: McMaster Institute for Music and the Mind

Data availability statement: Considering this is an editorial article, only bibliographic data was used and is listed in the References section.

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A BRIEF DESCRIPTION OF DR. TRAINOR'S BACKGROUND & WORK

Laurel Trainor received her Ph.D. in Experimental Psychology from the University of Toronto and is a Professor of Psychology, Neuroscience, and Behaviour at McMaster University. She has received the Lifetime Achievement Award from the Society for Music Perception and Cognition and the YWCA Woman of Distinction Award for Arts Culture and Design, and is a fellow of the Royal Society of Canada. Trainor is a prolific researcher and has been a long-time supporter of the European Journal of Neuroscience (He et al., 2009; Fujioka et al., 2011; Slugocki & Trainor, 2014; Flaten et al., 2022; Prete et al., 2022; Poikonen et al., 2024). Trainor's research focuses on the role of music in development and social behaviors. Her lab has shown how infants learn the structure of the music in their culture similarly to how they learn the language in their environment. Her studies on rhythm perception demonstrate that listening to rhythms activates brain networks associated with motor control, reflecting multisensory interactions measurable by EEG and MEG. She also explores how rhythm and timing facilitate communication, increasing prosocial behavior through synchronous movement. Trainor founded and directs the McMaster Institute for Music and the Mind (MIMM) and its LIVELab, a research concert hall for studying music's influence on the brain and mind, including performer-audience and performer-performer interactions. Additionally, she holds a Bachelor of Music Performance from the University of Toronto and is the principal flutist in the Burlington Symphony Orchestra.

EJN: How did you decide to become a neuroscientist? I'm particularly interested in your response to this because I know your education started with a bachelor's in music performance, and then you shifted to experimental psych. I'd love to learn what sparked that shift for you.

TRAINOR: I had a bit of a convoluted route to becoming a neuroscientist. In high school, I was very much into music. And I was also into math and science. I was having some trouble deciding between those subjects, but I actually initially went to university in math and physics. I completed two years of that, and then I decided I really wanted to be a musician. So, I switched, and I did my degree in music, but with

a minor in math. I then worked for a few years as a musician. This was the late 70s and at that time, computers were really evolving and there was a lot of interest in human-computer interfaces. I got interested in that and was taking some computer science courses on the side. My interests were philosophical in a way because I became interested in the difference between a computer and a human brain. I had never taken any psychology or neuroscience, but I decided I really wanted to explore these questions. And so I ended up doing a PhD in psychology. It was wonderful because I was able to combine my interest in music - I studied auditory perception and musical development - and my interest in the brain, and also my interest in the physics of sound and neural signal processing. I was very lucky because at that time, the neuroscience of music was hardly even a field. At the time, I would always preface any talk I gave with why I thought we should be studying music. Everyone knew that language is important for many aspects of behavior and memory and attention. Whereas music was generally considered just a frill, of no real importance. But that view has really changed over the last decades as we've come to understand the fundamental role of music and rhythmic behaviour in development, perception, and social interaction!

EJN: Did you have a particular mentor or role model, on your music side or your science side, that helped you get to where you are today?

TRAINOR: That's a good question. I've been influenced by many people, but I'd have to say the main one was my PhD supervisor, Sandra Trehub. She was really a pioneer. She was first and foremost a developmental psychologist, and she wasn't afraid to look at how development took place in the real world outside the laboratory. What are parents doing and what are infants responding to? Rather than only figuring out how does an infant process sound, for example, she wanted to know how interactions between mothers and infants take place in real social settings. She was not trained in music, but it became obvious that music was a really important part of pretty much every infant's early environment. Since that time, very broad demographic studies have shown that across all cultures people sing to infants. It is a part of every culture that we can find. Sandra was a pioneer for not only noticing that, but then thinking: If this is so prevalent, it must be important. So, why are parents engaging in this behavior? Why are infants responding to music? This creative way of thinking was really inspirational for me. It might be hard for younger scientists today to imagine, but 50 years ago, such questions regarding musical behaviour were not even on the radar for most neuroscientists.

EJN: What has been, in your opinion, your most exciting result or finding?

TRAINOR: Well, that is hard to answer, I'lI have to give a few! In a general sense, I think the most exciting and surprising finding is how important music is across domains, including emotional wellbeing, social interaction, and language development, as reflected in how musical people are and how music is used by caregivers around the world in their earliest interactions with babies. My research is suggesting that a large part of the power of music has to do with its temporal structure, in how it is organized over time. This affects essentially every part of what it is to be human. Everything that we experience in the world unfolds over time. You can't stop time! And so, one of the main things that the brain needs to do is organize incoming information into meaningful units (e.g., words, melodies, actions) in real time. It's a daunting task when you think about it. One of the ways the brain copes with this is to continually make predictions about what will happen next, so it can focus future attention optimally, and react when its predictions are not borne out. The regularity of rhythms enhances the ability to predict when future sounds are likely to occur. Rhythms are fundamental to how we move and all of our physiological systems, such as heart rate and breathing. Even cognition and social interactions are rhythmically organized. Our thoughts take place over time, and how we interact with other people takes place over time. And there's so much exciting work now on how rhythms mediate interpersonal interactions by enabling synchronization. For me, the fundamental role of rhythm is absolutely fascinating.

One of our discoveries that I find the most interesting is that infants use interpersonal rhythmic synchrony to decide who to trust and befriend. If adults move in synchrony to music with each other, even for a short time, afterwards they like each other more, they trust each other more, and they feel more affiliated. If you give them a game to play in which they can compete or cooperate, they will cooperate more. So, movement

synchrony between people has a profound effect on social relations, and the regular beat of music is the perfect stimulus for inducing movement synchrony between people. And we've shown that this occurs in children as young as 14 months! After being bounced to music in-sync with a stranger for only three minutes, infants are much more likely to help that stranger by picking up an object she "accidentally" dropped that she needed for a task (e.g., a clothespin to pin clothes on a line), compared to infants who were bounced out-of-sync with a stranger. To me, this is absolutely fascinating because not only do infants use musical rhythms to understand music and language, but they also use them to decide who they should trust, help and befriend in their social environment. Furthermore, our studies show that infants' brain oscillations track the frequency (or tempo) of the basic beat in musical rhythms, as well as its metrical (grouping) structure (e.g., what differentiates a waltz from a march). And we've shown that this is present already in infants born two months prematurely. Thus, rhythm tracking appears to be a fundamental neural organizing principle, which might explain why deficits in rhythm and timing are associated with most developmental disorders.

EJN: We talked about big or surprising findings, but those kinds of results take a lot of hard work and a lot of time. What is your favorite thing about the day-to-day of being a neuroscientist that keeps you going?

TRAINOR: I have to say what I enjoy most is working with my graduate students and postdocs - on an individual basis, and also in our lab meetings. I have people in my lab from a number of different backgrounds: some have a music background, some a neuroscience background, and others come from computer science or computational fields. They all bring different perspectives to a problem. Especially during lab meetings, when people present what they're proposing to do, or are interpreting the results of their data analyses, we are able to bring all these different perspectives to the table. I find that so exciting because these days the complexity of what we're trying to study requires this multidisciplinary lens. What I enjoy the most in those conversations is trying to figure out the answer to some question, and being able to look at it from all these different perspectives. The field has really changed in this way. Forty years ago, people tended to work more in their own little areas. I find it really exciting how multidisciplinary we've become.

EJN: What has your experience been as a woman in science and academia? Do you have any memorable moments surrounding that piece of your scientific identity?

TRAINOR: Oh, that's a complex question. I would say that in general, I have been lucky. I have not experienced some of the really terrible things that I know some of my colleagues have experienced. At the same time, my department is less than a third women, and that's not a good thing. There are definitely barriers for women. When I first took my job at McMaster University, it was 1992. At the time, I had just finished my PhD and I was in my mid-30s, because I had taken a circuitous route to becoming a neuroscientist, and I was pregnant. When I was offered the position, I did not tell them that I was pregnant until everything was signed; I was afraid that they wouldn't hire me if they knew that. It turned out the policy was that you had to have been working at McMaster for a year before you were entitled to maternity leave. So I ended up going into work with my infant so I could breast feed, and hiring a baby sitter so they could play in my lab as I was setting it up. The good side of it was that my department was wonderful. They made accommodations like putting my teaching into the second term, rather than the first one when the baby was younger. They helped me through that period, so I'm very grateful for that. But, at the same time, it was hard not to have a maternity leave. Things have improved since then, but women still face barriers and are more likely to have to make decisions that sacrifice their careers.

Canada has experienced large immigration over the last while, and we have a very multicultural society. Our students reflect this and are increasingly diverse. This is a good thing, but women who are from an equity-seeking group may have a particularly difficult time. I try to look for those students in the classes I teach, who might not feel like they belong, and encourage them to engage in research courses. I think we can all contribute at the individual level to making academia more inclusive.

EJN: Do you have any advice for younger scientists who want to pursue a career in academia, or is there something you wish you would have known at that stage?

TRAINOR: One of the things I've learned through interacting with my students and others is that everyone's

path is individual. Everyone's needs are a little bit different. Everyone's coming from a bit of a different place. Academia can be competitive, with expectations to publish lots of papers in high level journals, to teach classes well, to do outreach, and to engage in administrative roles. I often find that students early in their careers can get discouraged and overwhelmed. My advice is always to stay true to your ideas. What questions do*you* think are most interesting and important, and why; and then, how can they be answered? If you can get caught up in the excitement of the work, a lot of the rest will follow. If you aren't passionate about the questions you are addressing, the work will become tedious. If you spend too much time worrying about outcomes like number of papers, you're taking away from the joy of actually doing the science, which is why you're here. Easier said than done of course! But I think one of the most important things is to gain that inner confidence of knowing what is an important scientific question and figuring out how to study it. In my experience the rest will follow.

EJN: Earlier, you talked a little bit about the boom of neuroscience, especially music and neuroscience, over the last couple of decades. Looking forward, what do you think will be different about either the field of neuroscience in 10-15 years?

TRAINOR: One direction I think the field is going is toward conducting research in more naturalistic settings to better understand human behaviour. Another is to understand not just individuals, but how individuals interact with each other. And both of these directions will be fueled by advances in, and miniaturization of, mobile wearable sensors, as well as advances in real-time machine learning (AI) processing. One thing I haven't mentioned yet is that I direct the McMaster Institute for Music in the Mind. Ten years ago, I led the opening of the LIVELab, which is a 106-seat concert hall equipped with tools for measuring all kinds of responses, in which we are trying to embody these new directions. First, it is totally sound isolated from the outside and has a naturally dead acoustic. We have virtual sound system of 76 loudspeakers 28 microphones, that can instantaneously change the acoustics from, for example, simulating a concert hall, a subway station, a noisy restaurant, or an outdoor space. We can make sounds appear to be localized anywhere in space. We do studies examining at how musicians and audiences of over 100 are interacting through their movements using our motion capture system. We can measure brainwaves in multiple people at the same time to see when their brains synchronize and under what conditions. We can measure heart rates and other physiological responses. We have mobile eye-tracking glasses that attach to a cell phone, and can measure where audiences are attending during performances. In the future, I think we'll see more research of this type.

I also think we're only at the beginning of how we can use music for health and wellbeing. For example, using music with children with autism, using music to treat depression, studies in the elderly with hearing impairment to see how we can better help them so they're less socially isolated, using auditory rhythms to improve motor performance. I think there's so many ways in which music can make a huge difference, and we're really just starting to explore them.

EJN: So, what do you do in your free time and how do you make sure that you have that time well balanced with your work?

TRAINOR: I'm not sure I always do achieve a good work-life balance! As I mentioned, I have a music background and my main hobby outside of work is playing flute – I'm the principal flute of the Burlington Symphony Orchestra and I enjoy also playing chamber music concerts. I try to practice first thing in the morning, and then go about my day. I guess it is kind of like meditation for me. I also have a new grandchild that my husband and I are spending a lot of time with! It's important to make sure that there's time for family and friends. But I will say that during the years when my kids were young, it was difficult to fit in work, and also make sure that I was there for my kids, which was the most important thing. I remember I would come home from work, spend time playing, helping with homework, have dinner, put them to bed and then go back to work. Because that was the only way I felt I could get everything done. I'm not sure I would recommend that. It was crazy and I hope that there is now more understanding about the time people need when they have young families.