

# Development of music perception and cognition research: An autobiographical account from a Canadian perspective

LOLA L. CUDDY  
*Queen's University, Canada*

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**ABSTRACT** — *There were not many opportunities for music perception and cognition research during the first half of the 20th century. The author traces the development of the field from a bare landscape to a discipline with journals, laboratories, institutions, meetings and societies worldwide, with particular emphasis on developments in Canada. The story is told from the personal viewpoint of the author describing her education and experiences in music and psychology. The author discusses the influence on her own work of early researchers in the field, as well as her collaborations with many prominent music perception and cognition researchers.*

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## EARLY YEARS (1939-1955)

When I started out in the field of psychology, the landscape for music perception and cognition was very bare. There were no dedicated journals, laboratories, institutions, meetings, and societies world wide as there are today. Canada has been a foremost component of this development. I have been asked to relate my personal experiences from these early times in Canada to present times.

I was brought up in a musical household in Winnipeg, Manitoba where music has always held a central place in the city's cultural activities. Since the turn of the 20th century, Winnipeg had developed a strong choral tradition under the influence of many British choirmasters, organists and composers who chose to settle in the city. Later, after World War II, arriving European musicians enhanced the instrumental scene with solo performance and chamber music. Musical theatre was also important. My mother, a choreographer, worked with Winnipeg theatre groups including university



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operetta productions—all of the Gilbert and Sullivans, even the least well known, and later, Broadway musicals. My aunt was director of music for the Winnipeg school system, director of the Daniel McIntyre Alumni Choir, and at a later time, president of

the Canadian Music Educators Association. The music program in the schools, both choral and instrumental, was extensive.

My father, a Winnipeg lawyer and alderman, died when I was five and my sister Melba was two. I do remember him well; the offices of Sullivan and Cuddy overlooked one of the main streets of Winnipeg and as children we were taken in winter to watch civic parades in relative comfort and warmth. The Cuddys, with a few notable exceptions such as Jim Cuddy of Blue Rodeo fame, were not professional musicians. However, love of music, singing, and church choirs were of foremost importance. When I visit relatives in Ireland, I am delighted to see the younger generation gaining top marks in music exams.

A major activity was participation in the annual Manitoba (now the Winnipeg) Music Competition Festival, the first Canadian music competition affiliated with the Federation of British Music Festivals. In those days, by tradition, the adjudicators were

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Lola L. Cuddy, Professor (Emerita), Department of Psychology, Queen's University, Kingston, Ontario, Canada.

Correspondence concerning this article should be addressed to: Professor Lola L. Cuddy, Department of Psychology, Queen's University, Kingston, Ontario, K7L 3N6, Canada. E-mail: Lola.Cuddy@queensu.ca

brought from Britain. The festival was, and still is, held over several weeks and is one of the largest music festivals in Canada. I recall that the evening competitions of finalists attracted an enthusiastic audience that packed the Winnipeg Auditorium.

My piano teacher was Miss Jean Broadfoot, who had studied with Leonard Heaton (of the Busoni line of piano pedagogy) and in London with Harold Samuel (of the Moscheles line). “Broadie” was demanding but fiercely supportive of her students. Through her mentoring, I won the Intermediate Piano trophy and I accompanied numerous choirs, instrumentalists and voice students at the festival. I also performed solo pieces at various concerts and performed with Bill Cuddy (also a Jean Broadfoot pupil) the *Carnival of the Animals* with the Winnipeg Symphony in the season of 1954/55.

Another influence on my early life was a great aunt—a Victorian lady who had decided after marrying at 18 that she was in permanently frail health. At some point before she was married Auntie studied virtuoso technique with a pupil of Leschetizky; I well remember her flawless home performances of Liszt, Chopin, numerous orchestral transcriptions, and so on. Auntie rarely left her property, occupying herself with gardening, carpentry, medication, and, of course, piano practice. But she also read voraciously and apart from ordering everything from England she could find on piano technique, she asked me to find books from the library that we later discussed—in particular I recall ordering Sir James Jeans’ *Science and Music* (1937) and Carl Seashore’s *Psychology of Music* (1938). Despite her frail health, Auntie enjoyed her 60th wedding anniversary with Uncle Jack and died at 101.

#### INTERLUDE

These books made me realize that there were other fields “out there” beyond the usual curriculum for piano students. Musical acoustics and psychoacoustics in the earlier part of the last century were far from music perception and cognition as we know it today. For its times, however, the technology was ingenious, and in some cases remarkable. The books offered compelling reasons, it seemed to me as a

high school student, to study different dimensions of understanding musical experience. There was a science of music to be discovered. The attempts to address rigorous quantitative measurement of phenomena of pitch, scales, and timbres, for example, however technologically outdated today, were intriguing.

#### UNIVERSITY STUDENT YEARS (1955-1965)

At United College of the University of Manitoba (now University of Winnipeg) I decided to pursue psychology but, apart from one lab in first year psychology on the Seashore tests, there was no mention of the psychology of music. I studied psychology and mathematics and, as did my sister Melba while we were pursuing undergraduate arts degrees, fulfilled the requirements for the Associate Diploma in Music, Manitoba. I won the Governor General’s medal for highest graduation grades at the College, but overall my memories of my undergraduate studies are rather routine. Looking for a challenge, I opted to study clinical psychology in graduate school and went to the University of Toronto.

Toronto was indeed a great challenge. United College not having an honors program in Psychology, it was necessary to complete a Qualifying Year before being fully accepted to the graduate program. This was a good thing. The year was a kind of finishing school for the rough edges of the assorted classmates (and finished some of them). I learned about, and found out how to work in, experimental psychology and the idea of pursuing clinical work faded away. Graduate school required much greater breadth and depth of critical reading, serious attention to experimental design, and the ability to handle masses of data—the latter exercise being very different from the equation-solving problems I was used to. The graduate students, and most of the faculty, I believe, performed data analysis on Monroe calculators, then renowned for the ability to compute sums of squares. The gears on the calculator often slipped so that each statistical analysis had to be performed at least two or three times to ensure reliability.

In some of my letters home (kept by my mother), I am especially excited about seminars in auditory

perception with Endel Tulving, recently returned from doctoral studies at Harvard with a dissertation on visual perception. He was just at the beginning of his illustrious career and internationally acclaimed contributions to the study of human memory. At the time, Tulving was still engaged in perception research, and I completed a master's thesis under his direction on word recognition.

Many professors in my graduate studies were brilliant and supportive—I studied with George Mandler (cognition and emotion), Doug Creelman (psychoacoustics), John Ogilvie (statistical methods), Abram Amsel (animal behavior) and Dan Berlyne (experimental aesthetics)—but it was Endel who was my first and most lasting influence. He spent countless hours with his students patiently explaining the need for precision and accuracy in lab work and also correcting in great detail our logic and our prose (much to our shame and embarrassment as we were native English speakers and Endel was not). Knowing my interest in auditory phenomena, he asked, when I was considering a doctoral topic, “What about absolute pitch? There is a man in the music faculty who thinks it can be trained.”

We went to the Faculty of Music to visit the man, Myron Schaefer, the first director of the first electroacoustic studio in North America (founded 1959). Later that term, I was to record all my thesis materials in his studio and learn much about the sound production and recording technology of those days. One device I recall was based on the Pattern Playback machine. Built in the 1940s by Franklin S. Cooper and colleagues at the Haskins Laboratory, the original device converted pictures of the acoustic patterns of speech back into sound. Here the device had been adapted to convert pictures to sounds for musical compositions.

Myron's idea was that a reference pitch could be held in memory (Hindemith had also written on this idea) and all other notes referred to it. Endel and I did not accept the notion that this was necessarily absolute pitch; the idea, however, that pitch perception could be improved with practice on a referent tone was worth investigating. In my thesis, I found such practice effects and presented the data to the Acoustical Society of America (1965).

The *New York Times* published a report of the talk. That meeting was particularly memorable in that I met and discussed research with the main developers of signal detection theory, including W.P. Tanner, Jr., Dave Green, John Swets, and also W. Dixon Ward who, along with Spike Tanner, was to become a life-long friend. Subsequently, Paul T. (Pete) Brady applied the training method of my thesis to himself and in 1970 published “Teach Yourself Absolute Pitch in 365 Hard Lessons” in the *Journal of the Acoustical Society of America*. It was also at an Acoustical Society meeting that I first met Andrzej Rakowski, the beginning of a long acquaintance.

#### INTERLUDE

The cognitive revolution, though it was well underway at this time, had not yet had a major impact on the regular graduate curriculum. The topic of my thesis reflects the thinking that was still predominant—behaviorism and the triumph of nurture over nature. Discovery of appropriate training methods was paramount. The training of a reference pitch was based on “shaping” techniques borrowed from the behavioral literature. The reference tone (A<sub>4</sub>) was presented for recognition, along with other nearby tones, a high proportion of the time. Recognition was required only for the reference tone, and feedback given only for the reference tone. Once recognition was established for a given proportion of reference tones, the proportion was gradually decreased until it was the same as for all the other tones.

For some participants, on a later test of recognition for all tones presented, recognition of all tones had improved, not just recognition of the reference tone. This finding suggested that more than just reinforcement contingencies were operative; a mental structure representing the relationship among the tones must be invoked. The absolute judgment technique was amenable to information processing measures—the quantification of transmitted information. I was to pursue the implications of this notion in later work.

#### AT QUEEN'S UNIVERSITY (1965-1980)

In 1965, my husband Mel Wiebe and I left Toronto with job offers. Mel's field was Victorian literature which led to his later involvement with, and general editorship of, the Benjamin Disraeli Letters Project. The academic world was very different from the way it is now. Job talks were not required; the criteria seemed to be where and with whom one had trained. We applied for positions at the same institutions and among our options were three offers for us both. Later the situation for academic appointments and opportunities severely changed and in the 70s there were few opportunities whatsoever. Queen's at that time had an enrolment of around 5,000 students. The Psychology department had about a dozen faculty located in offices in vintage houses. Classes were small. Laboratory and equipment facilities for research were scarce. I taught Perception and Advanced Statistics to the undergraduates and Perception to the graduate students, many of whom were older than me

One spring day a student knocked on my door and asked if I might have any work for a summer student. It was Annabel Cohen, then completing undergraduate studies at McGill, and she was home in Kingston for the summer. We worked together wonderfully; Annabel's enthusiasm for research was infectious. Eventually she applied to Queen's for graduate studies where she obtained her master's and doctoral degrees. Doug Mewhort joined the latter project while I was on sabbatical in Oxford. Annabel and I worked with tape recorders, oscillators, timers, vacuum-tube frequency counters, and custom-built gating switches, all of the highest professional quality. Computer delivery for experimental methods and procedures was not yet developed. Much work was done by hand. For data analysis, I was allowed access to the Queen's main frame, where I could walk over to the site with punch cards and operate the machine myself.

In 1969 the Psychology Department moved to a newly constructed building, Humphrey Hall (named after George Humphrey the Oxford-Harvard educated philosopher who initiated the study of psychology at Queen's in 1925). I was given responsibility to found and design a psychoacoustics

laboratory. The generous budget allowed for three sound-isolated testing chambers and new equipment. We still relied on digibit technology and the Queen's main frame; in the 70s we shared a PDP-8 facility in the department laboratories. (Another development of this time was the birth of our son Alexander in 1971; he obtained university degrees in physics and also in music. Though he did not pursue music professionally he still performs in Toronto as a baritone.)

Along with many branches of acoustics, musical acoustics always found a welcome home at the Acoustical Society of America. During the 70s new opportunities began to arise to attend conferences completely devoted to music research—in particular the start of the series of International Workshops on the Physical and Neuropsychological Foundations of Music (the Ossiach conferences) and conferences at IRCAM, Paris. These conferences included musical acoustics but also provided a wider scope of interactions. In 1979, I co-edited with Mel a special issue of the *Humanities Association Review* focused on music and the experimental sciences. Contributors of articles were Juan Roederer, Andrzej Rakowski, Ernst Terhardt, Jay Dowling, Alf Gabrielsson, and Campbell Searle. Examples were provided from psychoacoustics, auditory perception, neurobiology, engineering, and cognitive psychology. The benefit of a strongly interdisciplinary approach to research in music perception was becoming evident.

A national society, the Society for Research in Psychology of Music and Music Education (now SEMPRE) was founded in the UK in 1972 followed by the founding of its journal *Psychology of Music* in 1973. This development was very welcome. The field now had a specialist journal devoted to music and music education with an interdisciplinary perspective. Both basic and applied studies were published.

But looking back, I recall a sense among researchers that on a day-to-day basis we worked very much alone in our pursuits. We were not part of the mainstream of psychological inquiry and, although there were exceptions, not given much attention by the field at large. We could not have predicted the burst of conference activity, collegiality, and publication results that grew exponentially from 1985.

## INTERLUDE

The work with Annabel Cohen included an exploration of the concept of tonality in music and how it could be approached on an empirical basis. We were first interested in studying sensitivity to structure in melodic sequences to demonstrate that such sequences were not perceived as merely strings of tones but rule-governed patterns. We developed recognition memory and rating techniques. This was an excursion into understanding mental representations for music; the music-theoretic constructs of tonality were for us valuable tools for predicting, interpreting, and assessing experimental outcomes. There was not a great deal of guidance in the psychological literature at the time, but in music psychology there was theory, direction and creative experimental work from Jay Dowling and from Robert Francès. The structural approach of W. R. Garner was inspirational. The major seminal contributions of Shepard and Krumhansl were about to appear.

Our quest did not proceed without difficulty. There was a certain resistance to filling the research gap described to me by the late Frank Restle as occurring “between the psychophysics of the single tone, and speech perception”. The functions of melody, harmony, rhythm, and tonality seemed too complex for generations accustomed to a psychoacoustic approach to elemental phenomena. Restle, however, encouraged us to pursue our approach. I realized that for music perception and cognition to be placed properly in a research agenda, there needed to be a change in psychologists’ thinking about the response of the mind and the brain to music.

### AT QUEEN’S SINCE 1981

I cannot begin to cover the multitude of events that have led up to the present. These events and their participants deserve their own history and will be covered in different ways by the pioneers represented in this issue. My own career followed a standard path of publications and promotions. The lab from the early 80s onward was outfitted with increasingly sophisticated computerized facilities.

My department encouraged the creation and development of courses in Psychology of Music and Psychology and the Arts, courses that became popular among undergraduates. The university grew to accommodate some 21,000 students, with about 14,000 undergraduates, and developed a much larger graduate/research base. Its size was modest but nevertheless very different from its origins.

I have been fortunate to have mentored many excellent graduate students. Some took differing career paths but for those who continued in music perception and cognition research, as well as Annabel Cohen, there was W. F. (Bill) Thompson, the late Helen Lyons, Nicholas Oram, Mike Lantz, Frank Russo and Christine Koh. We benefited greatly from the post doctoral appointments of Alex Galembo, Sylvie Hébert, and Laura-Lee Balkwill. Research funding from government sources has been strong and consistent (for me, primarily the Natural Sciences and Engineering Research Council of Canada and also the GRAMMY® Foundation and the Alzheimer Society of Canada through a special award, the Dr. and Mrs. Albert Spatz Special Award for Music and Dementia Studies; my students have also been supported by the Social Sciences and Humanities Research Council of Canada, the former Medical Research Council of Canada (now CIHR), and the Ontario Institute for Mental Health.)

I will now mention a few significant milestones. The journal *Psychomusicology* was founded, the first issue appearing in 1981, and I was honored to be invited to the consulting board. In the introduction to the first issue, David Brian Williams described its mission, to “improve communication among those actively engaged in science as it pertains to the study of human response to music” (p. 3). Special topic issues were included among the regular publications; I was happy to be invited by Mari Jones to contribute to a special issue she edited in 1991 on Musical Prototypes.

*Psychomusicology* was followed by the founding by Diana Deutsch in 1983 of the interdisciplinary journal *Music Perception*, of which I am the current editor. Incidentally, I was congratulated at the University of California press for being the very first Canadian to edit any of the journals published by the press. As editor of *Music Perception*, I have moved

the publication schedule from four to five issues per year and have seen representation from countries all over the world. The job of editor is exceptionally rewarding and educational. Later in 1997, a new multilingual journal, *Musicae Scientiae*, was founded by the European Society for the Cognition of Music (ESCOM). Irène Deliège, whom I met at the early Ossiach conferences, was for many years the editor; she invited me to be a consulting editor. So, the field is well served by our specialist journals.

Also in 1981, my colleague at the Queen's Faculty of Music, David Keane, and I hosted the 1981 Queen's Symposium on Musical Perception. Our programme contained symposia in which we paired speakers from different disciplines on each of three topics: Jonathan Kramer (music theory) and Annabel Cohen (psychology) on Structure in Music; Al Bregman (psychology) and Floyd Toole (musical acoustics) on Sound Sources; and Wayne Slawson (composition and theory) and Cam Searle (electrical engineering) on Timbre. The meeting included two evening concerts. Attendees included Carol Krumhansl, Jamshed Bharucha, and David Huron, all of whom were to make outstanding contributions to music research.

The first meeting of the International Conference for Music Perception and Cognition (ICMPC) was held in 1989; the fourth meeting was held in Montreal, Canada, and I was invited to be one of the keynote speakers. At a local level, I enjoyed laboratory exchanges between my students and Krumhansl's group at Cornell, and through those meetings met graduate students Caroline Palmer and Mark Schmuckler, now professors at McGill and University of Toronto, respectively.

The Society for Music Perception and Cognition (SMPC) was founded by Diana Deutsch in 1990 as a national society for North America. I was honored to be elected President of SMPC in 2000-2001 during which time the Society hosted two conferences—Toronto 2000 and SMPC 2001 (Kingston, Ontario). The conferences were exceedingly well attended and at the SMPC conference we were privileged to hear one of the last conference addresses from the late Leonard B. Meyer. An obituary and tributes to Meyer have been published in 2008 (February and June respectively) in *Music Perception*.

As well as having individual research laboratories, Canada now boasts three large interdisciplinary centres or institutes dedicated to music research: the International Laboratory for Brain, Music, and Sound Research (BRAMS), founded by Isabelle Peretz (U. de Montréal) and Robert Zatorre (McGill) in 2005 in Montreal, and of which I am an associate member; The Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT), a multi-disciplinary research group centred at McGill University and directed until recently by Stephen McAdams; and the McMaster Institute for Music and the Mind (MIMM) directed by Laurel Trainor. Thus opportunities for students and faculty are now rich and varied.

Other national societies have emerged since 1996, including the Australian Music and Psychology Society, where Sandra Trehub (University of Toronto) and Bill Thompson (then at York University) played catalyst founding roles; the Korean Society for Music Perception and Cognition; the Japanese Society for Music Perception and Cognition; the Asia-Pacific Society for the Cognitive Sciences of Music; and the Argentinian Society for the Cognitive Sciences of Music. As well as operating at a national level, all societies provide solid strength and support for the international meetings of ICMPC.

In sum, over more than the last 25 years, the field has seen the development of conferences, books, and publications too numerous to mention here, and, in particular, increased interdisciplinary cooperation that includes both the traditional domains of music such as melody, harmony, rhythm, and tonality, and new domains that include performance skills and expressivity. New approaches have been appropriated from the methods of neuropsychology and neuroscience, biology, and computational/mathematical modeling.

#### FINALE

It is premature to explain the rapid expansion of music perception and cognition research. One could point to the hard work of its devotees, increased technological facilities for research generally, Internet communication among researchers, and, in

a somewhat more speculative vein, increased musical sophistication among students and colleagues in other fields even if they have not been formally musically trained. Among other plausible accounts, the latter may have alerted colleagues who work outside music psychology that the study of music is essential to understanding brain organization. In psychology itself, a dramatic shift has occurred in psychologists' thinking about the response of the mind and the brain to music. A fundamental idea—that the understanding of music and musical behavior is enriched by the analytic approaches of the sciences—has prevailed.

For me, the critical writings of music theorists Leonard Meyer, Fred Lerdahl and Eugene Narmour, and the psychologists Diana Deutsch, Carol Krumhansl, Jamshed Bharucha, Jay Dowling, John Sloboda, Mari Jones, and others, have been signal. They all contributed to a firm, lucid, theoretical basis for research on musical structure. Especially, in my work on tonal structure, Carol Krumhansl's articles and 1990 monograph have provided intellectual support, methodological instruction, and creative insights.

My former students and I explored statistical as well as acoustical accounts of structure. For example, with Alex Galembo and Frank Russo, I have investigated the extent to which a sense of tonality is influenced by the acoustical properties of complex piano-like tones. With Nicholas Oram and Mike Lantz, I followed Krumhansl's emphasis on statistical properties of musical contexts and the extension of the construct of tonality to tone distributions beyond the Western European framework. Bill Thompson and I explored tonal modulation.

Subsequently I became intrigued by individual differences in musical sensitivity such as may occur in patient populations, and I consulted Isabelle Peretz for advice. Among her extensive studies of brain damage, Isabelle Peretz had presented an analysis of a patient with selective loss of tonal sensitivity and had confirmed earlier theoretical positions that tonal knowledge was central to melody discrimination. Her work informed, and continues to inform, debates regarding the existence of specialized neural pathways for music that are isolable from those dedicated to language.

Queen's colleague Lorna Jakobson (now at Manitoba) and I, with our student Willi Steinke, presented the case of KB who became amusic following right hemisphere stroke. KB was unable to perform musical discrimination and recognition tasks, including those involving the sense of tonality, with one exception. Though recognition of instrumental melodies was completely lost, he was able to recognize song tunes presented without lyrics. This finding led to further theoretical speculation regarding the representation of song in memory.

Most recently I have enjoyed multiple collaborations with Peretz, Hébert and students, including work on congenital amusia or "tone-deafness", which may occur in otherwise normally functioning individuals, and music dyslexia, a musical form of text dyslexia. Another project in our laboratory focuses on dementia, particularly that of the Alzheimer type, and the possible sparing of musical memories among some patients. My medical friend and colleague Jackie Duffin and I had the opportunity to test a severely demented elderly woman and to find remarkable sparing of her musical memory and her ability to detect errors in melodies. In 2005 we published the findings in *Medical Hypotheses* where it won the Horrobin prize as the journal's exemplary publication for that year. We are continuing this research with a larger database of patients in collaboration with a Queen's colleague, Sudeep Gill, and graduate students, Ashley Vanstone and Ritu Sikka.

All told, the patient-based approach, studying the so-called "experiment of nature", has a great deal to contribute to understanding the causal links between brain and behavior. A recent special issue of *Music Perception* (25.4, April 2008) that I co-edited with Isabelle Peretz and Gottfried Schlaug was devoted to music and neurological disorders.

Yet it is impossible to relate, or even to be aware of, the multiple influences that direct one's research or the developments of the field. In writing this brief account, I apologize to any persons or research areas I may have inadvertently overlooked. I do know that I have been privileged to witness a remarkable phenomenon in the growth of music perception and cognition research, and I am very proud of the Canadian contributions to this growth and presence.

As I am not retired from research (though required to retire from undergraduate teaching at Queen's due to a then-operative mandatory retirement policy) and am currently enjoying mentoring graduate students and research assistants, I will end with "To be continued..."

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Manuscript received: 30/04/2008

Revision received: 3/05/2008

Accepted 3/05/2008

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