

BRIEF CURRICULUM VITAE (September 2018)

Robert Jorge Zatorre

Personal Data:

Date of birth: 11 January, 1955
Place of birth: Buenos Aires, Argentina
Citizenship: Canada and U.S.A.
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Languages:

English, Spanish and French

Education:

Ph.D. (1981) Brown University, Providence, Rhode Island
Experimental Psychology
Thesis advisor: Dr. Peter Eimas
M.Sc. (1978) Brown University
Experimental Psychology
A.B. (1976) Boston University, Boston, Massachusetts
Double major: Psychology and Music

Positions:

present: James McGill Professor of Neuroscience
Montreal Neurological Institute, McGill University;
Co-Director, BRAMS laboratory;
Associate Member, Department of Psychology, McGill University
1989-2001: Assistant/Associate Professor
Montreal Neurological Institute, McGill University
1983-1991: Staff Neuropsychologist
Montreal Neurological Hospital;
1981-1983: Postdoctoral Fellow
Montreal Neurological Institute (Supervisor: Dr. Brenda Milner)
1979-1981: Neuropsychology Technician
Veterans Administration Medical Center, Providence, RI

Honors and Awards:

2017: Elected to Royal Society of Canada
2014: Honorary Doctorate, Favaloro University, Buenos Aires, Argentina
2013: Hugh Knowles Prize, Northwestern University, Chicago, USA
2011: IPSEN Foundation Neuronal Plasticity Prize, Paris France
2007: Killam Scholar
2005: James McGill Professor
2002: CIHR Senior Investigator Award
2002: Oliver Sacks Award, Institute for Music and Neurologic Function, New York, NY

Selected Publications (total in peer-reviewed journals: 290)

- Zatorre, R.J., Evans, A.C., Meyer, E., and Gjedde, A. (1992) Lateralization of phonetic and pitch processing in speech perception. *Science*, 256, 846-849.
- Zatorre, R.J., Evans, A.C. and Meyer, E. (1994) Neural mechanisms underlying melodic perception and memory for pitch. *Journal of Neuroscience*, 14, 1908-1919.
- Penhune, V.B., Zatorre, R.J., MacDonald, J.D., and Evans, A.C. (1996) Interhemispheric anatomical differences in human primary auditory cortex: Probabilistic mapping and volume measurement from MR scans. *Cerebral Cortex*, 6, 661-672.
- Zatorre, R.J., Perry, D.W., Beckett, C.A., Westbury, C.F., and Evans, A.C. (1998) Functional anatomy of musical processing in listeners with absolute pitch and relative pitch. *Proceedings of the National Academy of Sciences (U.S.A.)*, 95, 3172-3177.
- Blood, A.J., Zatorre, R.J., Bermudez, P., and Evans, A.C. (1999) Emotional responses to pleasant and unpleasant music correlate with activity in paralimbic brain regions. *Nature Neuroscience*, 2, 382-387.
- Belin, P., Zatorre, R.J., Lafaille, P., Ahad, P., and Pike, B. (2000) Voice-selective areas in human auditory cortex. *Nature*, 403, 309-312.
- Petitot, L.A., Zatorre, R.J., Nikelski, E.J., Gauna, K., Dostie, D., and Evans, A.C. (2000) Speech-like cerebral activity in profoundly deaf people processing signed languages: Implications for the neural basis of human language. *Proceedings of the National Academy of Sciences (U.S.A.)*, 97, 13961-13966.
- Belin, P. and Zatorre, R.J. (2000) What, where, and how in auditory cortex. *Nature Neuroscience*, 3, 965-966.
- Zatorre, R.J. and Penhune, V.B. (2001) Spatial localization after excision of human auditory cortex. *Journal of Neuroscience*, 21, 6321-6328.
- Blood, A.J. and Zatorre, R.J. (2001) Intensely pleasurable responses to music correlate with activity in brain regions implicated in reward and emotion. *Proceedings of the National Academy of Sciences (U.S.A.)* 98, 11818-11823.
- Zatorre, R.J., Belin, P., and Penhune, V.B. (2002) Structure and function of auditory cortex: music and speech. *Trends in Cognitive Sciences*, 6, 37-46.
- Golestani, N., Paus, T., and Zatorre, R.J. (2002) Anatomical correlates of learning novel speech sounds. *Neuron*, 35, 997-1010.
- Zatorre, R.J., Bouffard, M., Ahad, P., and Belin, P. (2002) Where is 'where' in the human auditory cortex? *Nature Neuroscience*, 5, 905-909.
- Zatorre, R.J. (2003). Absolute pitch: a paradigm for understanding the influence of genes and development on neural and cognitive function. *Nature Neuroscience*, 6, 692-695.
- Zatorre, R.J., Bouffard, M., and Belin, P. (2004). Sensitivity to auditory object features in human temporal neocortex. *Journal of Neuroscience*, 24, 3642-3637.
- Gougoux, F., Lepore, F., Lassonde, M., Voss, P. Zatorre, R.J., Belin, P. (2004) Pitch discrimination in the early blind. *Nature*, 430, 309.
- Gougoux, F., Zatorre, R.J., Lassonde, M., Voss, P. Lepore, F. (2005) A functional neuroimaging study of sound localization: visual cortex activity predicts performance in early-blind individuals. *PLoS Biology*, 3, 324-333.
- Zatorre, R.J. and Halpern, A.R. (2005) Mental Concerts: Musical imagery and auditory cortex. *Neuron*, 47, 9-12.
- Dorsaint-Pierre, R., Penhune, V.B., Watkins, K.E., Neelin, P., Lerch, J.P., Bouffard, M. and Zatorre, R.J. (2006) Asymmetries of the planum temporale and Heschl's gyrus: Relationship to language lateralization. *Brain*, 129, 1164-1176.

- Zatorre, R.J., Chen, J.L., and Penhune, V.B. (2007) When the brain plays music. Auditory-motor interactions in music perception and production. *Nature Reviews Neuroscience*, 8, 547-558.
- Zatorre, R.J. and Gandour, J.T. (2007) Neural specializations for speech and pitch: Moving beyond the dichotomies. *Philosophical Transactions of the Royal Society of London*. 363, 1087-1104.
- Chen, J.L., Penhune, V.B., and Zatorre, R.J. (2008) Listening to musical rhythms recruits motor regions of the brain. *Cerebral Cortex*, 18, 2844-2854.
- Schönwiesner, M. and Zatorre, R.J. (2009) Spectro-temporal modulation transfer function of single voxels in the human auditory cortex measured with high-resolution fMRI. *Proceedings of the National Academy of Sciences (U.S.A)*, 106, 14611-14616.
- Foster, N.E.V. and Zatorre, R.J. (2010) A role for the intraparietal sulcus in transforming musical pitch information. *Cerebral Cortex*, 20, 1350-1359.
- Zatorre, R.J., Halpern, A.R., and Bouffard, M. (2010) Mental reversal of imagined melodies: A role for the posterior parietal cortex. *Journal of Cognitive Neuroscience*, 22, 775-789.
- Salimpoor, V.N., Benovoy, M., Larcher, K., Dagher, A., and Zatorre, R.J. (2011) Anatomically distinct dopamine release during anticipation and experience of peak emotion to music. *Nature Neuroscience*, 14, 257-262.
- Kim, J.-K. and Zatorre, R.J. (2011) Tactile-auditory shape learning engages the lateral occipital complex. *Journal of Neuroscience*. 31, 7848-7856.
- Voss, P. and Zatorre, R.J. (2012) Occipital cortical thickness predicts performance on pitch and musical tasks in blind individuals. *Cerebral Cortex*, 22, 2455-2465.
- Voss, P. and Zatorre, R.J. (2012) Organization and reorganization of sensory-deprived cortex. *Current Biology*, 22, R168-R173.
- Zatorre, R.J., Fields, R.D., and Johansen-Berg, H. (2012) Plasticity in gray and white: Neuroimaging changes in brain structure during learning. *Nature Neuroscience*, 15, 528-536.
- Zatorre, R.J., and Baum, S.R. (2012) Musical Melody and Speech Intonation: Singing a Different Tune. *PLoS Biology* 10(7): e1001372.
- Herholz, S.C. and Zatorre, R.J. (2012) Musical training as a framework for brain plasticity: Behavior, Function, and Structure. *Neuron*, 76, 486-502.
- Steele, C., Bailey, J.A., Zatorre, R.J., and Penhune, V.B. (2013) Early musical training and white-matter plasticity in the corpus callosum: Evidence for a sensitive period. *Journal of Neuroscience*, 33, 1282-1290.
- Kleber, B., Zeitouni, A.G., Friberg, A. and Zatorre, R.J. (2013) Experience-dependent modulation of feedback integration during singing: role of the right anterior insula. *Journal of Neuroscience*, 33, 6070-6080.
- Salimpoor, V.N., Van Den Bosch, I., Kovacevic, N., Mcintosh, A.R., Dagher, A. & Zatorre, R.J. (2013) Interactions between nucleus accumbens and auditory cortices predict music reward value. *Science*, 340, 216-219.
- Zatorre, R.J. and Salimpoor, V.N. (2013) From perception to pleasure: music and its neural substrates. *Proceedings of the National Academy of Sciences (U.S.A.)*, 110, suppl 2, 10430-10437.
- Zatorre, R.J. (2013). Predispositions and plasticity in music and speech learning: Neural correlates and implications. *Science*, 342, 585-589.
- Mas-Herrero, E., Zatorre, R.J., Rodríguez-Fornells, A. and Marco-Pallarés, J. (2014) Dissociation between musical and monetary reward responses in specific musical anhedonia. *Current Biology*, 24, 1-6.

- Voss, P., Pike, G.B. and Zatorre, R.J. (2014) Evidence for both compensatory-plastic and disuse-atrophy related neuroanatomical changes in the blind. *Brain*, 137, 1224-1240.
- Voss, P., Tabry, V. and Zatorre, R.J. (2015). Trade-off in the sound localization abilities of early blind individuals between the horizontal and vertical planes. *Journal of Neuroscience*, 35, 6051-6056.
- Shiell, M.M., Champoux, F., and Zatorre, R.J. (2015) Reorganization of auditory cortex in early-deaf people: functional connectivity and relationship to hearing aid use. *Journal of Cognitive Neuroscience*, 27, 150-163.
- Coffey, E.B.J., Herholz, S.B., Chepesiuk, A.M.P., Baillet, S., and Zatorre, R.J. (2016) Cortical contributions to the auditory frequency-following response revealed by MEG. *Nature Communications*, 7:11070.
- Martínez-Molina, N., Mas-Herrero, E., Rodríguez-Fornells, A., Zatorre, R.J., and Marco-Pallarés, J. (2016) Neural correlates of specific musical anhedonia. *Proceedings of the National Academy of Sciences (U.S.A)*, doi:10.1073/pnas.1611211113.
- Zatorre, R.J. (2016). Human Perception: Amazon Music. *Nature*, doi:10.1038/nature18913.
- Andoh, J., Ferreira, M., Leppert, I. R., Matsushita, R., Pike, B., & Zatorre, R. J. (2017). How restful is it with all that noise? Comparison of Interleaved silent steady state (ISSS) and conventional imaging in resting-state fMRI. *NeuroImage*, 147, 726-735.
- Albouy, P., Baillet, S., and Zatorre, R.J. (2017) Selective entrainment of theta oscillations in the dorsal stream causally enhances auditory working memory performance. *Neuron*, 94, 1-14.
- Coffey, E.B.J., Musacchia, G., and Zatorre, R.J. (2017) Cortical correlates of the auditory frequency-following and onset responses: EEG and fMRI evidence. *Journal of Neuroscience*, 37, 830-838.
- Mas-Herrero, E., Dagher, A., and Zatorre, R.J. (2017) Modulating musical reward sensitivity up and down with transcranial magnetic stimulation. *Nature Human Behaviour*. doi:10.1038/s41562-017-0241-z
- Du, Y and Zatorre, R.J. (2017) Musical training sharpens and bonds ears and tongue to hear speech better. *Proceedings of the National Academy of Sciences (U.S.A.)*.
- Misic, B., Betzel, R.F., Griffa, A., de Reus, M.A., He, Y., Zuo, X.-N., van den Heuvel, M.P., Hagmann, P., Sporns, O., & Zatorre, R.J. (2018) Network-based asymmetry of the human auditory system. *Cerebral Cortex*, 28, 2655-2664.
- Wollman, I., Penhune, V., Segado, M., Carpentier, T., & Zatorre, R. J. (2018). Neural network retuning and neural predictors of learning success associated with cello training. *Proceedings of the National Academy of Sciences*, 201721414.
- Puschmann, S., Baillet, S., and Zatorre, R.J. (in press) Musicians at the cocktail party: Neural substrates of musical training during selective listening in multi-speaker situations. *Cerebral Cortex*.

Invited scientific addresses (selected presentations from >200):

- Keynote speaker, Human Brain Mapping annual meeting, San Francisco, CA, June 2009
- Distinguished Lecturer, Massachusetts Institute of Technology, Cambridge, MA, April 2010
- Invited speaker, Neurosciences Institute, San Diego, California, October 2010
- IPSEN foundation invited speaker (prize winners' symposium), International Brain Research Organization Meeting, Florence, Italy, July 2011
- Invited speaker, "Journée Thématique sur la Création" INSERM/Université Claude Bernard, Lyon, France, October 2011
- Invited speaker, Machine Hearing Group, Google, Inc., Mountain View, CA, March 2012

Invited symposium speaker, National Yan-Ming University, Taipei, Taiwan, June 2012
Keynote speaker, Summer School in Affective Sciences, Geneva, Switzerland, Aug 2012
Invited speaker, Sackler Colloquium “In the Light of Evolution VII: The Human Mental Machinery, Irvine, CA Jan 2013
Invited speaker, British Neuropsychological Society Meeting, London UK, March 2013
Carl P. Duncan Lecturer, Northwestern University, Chicago, IL, April 2013
Keynote speaker and co-organizer: Music, Poetry, and the Brain, Lisbon Portugal May 2013
Invited seminar speaker, Brainglot Conference, Univ P Fabra, Barcelona, Spain, September 2013
Invited participant, Max Planck Institute for Empirical Aesthetics, Frankfurt, Germany, Dec 2014
Commencement Speaker, University of Trento, Italy, December 2015
Shaoul Fellow Speaker, University of Tel-Aviv, Israel, March 2016
Invited speaker, American Academy of Neurology Plenary Session “Frontiers in Neuroscience” Vancouver, BC, April 2016
Co-Principal Speaker, CIFAR “Our Musical Brain” event at Koerner Hall, Toronto, Canada, June 2016
Invited speaker, Humboldt Society Symposium, Mexico City, Mexico, October 2016
Invited speaker, NIH-Kennedy Centre Health Initiative Workshop, NIH campus, MD, Jan 2017
Keynote speaker, International Multisensory Forum, Nashville, TN, May 2017
Keynote speaker, The Voice Foundation, Philadelphia PA, June 2017
Keynote speaker, Society for Neurobiology of Language, Quebec, Aug 2018

Selected Public Lectures

Keynote speaker, Cosmo Caixa Museum of Science, Barcelona, Spain, Dec 2004
Speaker, Brainwave lecture series, Rubin Museum of Art, New York, NY, May 2008
Keynote speaker, Music and Brain symposium, Salzburg, Austria, sponsored by the Cleveland Clinic and the Cleveland Orchestra, August 2008.
Keynote speaker, Wellcome Collection symposium “Mapping the Musical Brain,” London, UK, Sept 2009
Invited speaker, The Science of the Arts Conference, Brain Sciences Institute, Johns Hopkins University, Baltimore Maryland, October 2010
Invited symposium participant, BrainForum 2011, Milan, Italy, April 2011
Invited speaker, “Claves Neurobiológicas de la Sociedad” series, Madrid, Spain, April 2012
Invited speaker, “The Cultural Brain” series, Karolinska Institut, Stockholm, Sweden, April 2014
Public lecture, Metropolitan Museum of Art, New York, July 2014
Invited speaker, Aspen Music Festival, Aspen, Colorado, June 2015
Keynote speaker, “Was Musik Kann” Symposium with Daniel Barenboim, Berlin, October 2015

Current Major Research Grants:

Operating Grants:

Canadian Institutes of Health Research:

Foundation grant “Auditory Cognitive Neuroscience: Pathways, Processes, Plasticity and Predispositions”

2015-2022 \$240,000/yr (PI: R. Zatorre, co-investigators V. Penhune and M. Schönwiesner)

Natural Sciences and Engineering Research Council:

Operating (Discovery) grant: “Modulating Human Auditory Cortex with Neurostimulation Approaches” 2016-2022 \$84,000/yr (PI: R Zatorre). Note: this grant was ranked first in the competition across all disciplines.

Canada-Israel Program IDRC:

“Deciphering the cognitive and neural mechanisms underlying auditory learning in the general population, musicians and individuals with dyslexia.”

2015-2018 \$130,000 (Canadian PI: R Zatorre)

Infrastructure Grant

Canadian Foundation for Innovation: New Initiatives Fund “Laboratory for Brain, Music and Sound Research (BRAMS): The Biological Foundations of Music” 2006-2016 \$13.8M P.I.: I Peretz. Co-P.I. R. Zatorre.

Centre Grant:

FRQSC/FRQNT: “Centre for Research in Brain, Language and Music” \$400,000/yr
2017-2023.PI: D. Klein; R Zatorre Co-investigator

Canada First Research Excellence Fund

“Healthy Brains for Healthy Lives.” 2016-2023. \$83M. (Scientific Director: A.C. Evans. Theme leader for Cognitive Neuroscience: R Zatorre)

Professional Activities:

Co-Founding Chief Editor

Frontiers in Auditory Cognitive Neuroscience, 2010-

Current Journal editorial boards:

Academic Editor, *Public Library of Science Biology*, 2004-

Board of Editors, *Journal of Cognitive Neuroscience*, 2004-

Board of Editors, *NeuroImage*, 2003-

Board of Editors, *Human Brain Mapping*, 2000-

Board of Consulting Editors, *Music Perception*, 1995-

Meeting Organization:

2000: Scientific advisor and organizer for The New York Academy of Science’s international meeting, held in New York City in May 2000, on the topic “The Biological Foundations of Music.” The conference proceedings were published as a regular series in the *Annals of the New York Academy of Science*.

Scientific adviser to the Fondazione Mariani, Milan Italy, for international meetings on music and the neurosciences held in Venice, Italy, October 2002, in Leipzig, Germany, May 2005, in Montreal, Canada in June 2008, in Edinburgh, UK. In June 2011, in Dijon, France in June 2014, and in Boston, USA, 2017.

Evidence of Impact (Google Scholar):

Total cumulative citations: >47,000 *h*-index: 110

Recent Media Coverage and Public Outreach:

February 2007: *Science* published a two-page news report concerning the establishment of the BRAMS laboratory, and the \$14 million grant from CFI that supports it. It featured interviews and photos with Professors Peretz and Zatorre.

2008- : the New York Museum of Natural History mounted a display on the role of music in human evolution which includes a diorama with images derived from our brain imaging studies of absolute pitch.

June 2009: Our lab participated in the PBS full-length documentary entitled “The music instinct”

January 2011: Our study on music and dopamine in *Nature Neuroscience* was covered by many media, including the Associated Press, CNN, Fox News, CBC, NBC, Manchester Guardian, Radio-Canada, German Public Radio, BBC, Swiss Radio, etc.

April 2013: our research published in *Science* on music purchasing and reward was covered by many news media, including BBC, CBC, Radio-Canada, Science Now, NY Times.

March 2014: our research on musical anhedonia was covered by Science News, Huffington Post, the CBC, Times of London, El Mundo (Madrid) and many others. I was interviewed for CBC radio’s “Quirks and Quarks” nationally syndicated program.