

# Music: Its Evolution, Cognitive Basis, and Spiritual Dimensions

18, 19, and 20 September 2008  
Wolfson College, Cambridge University

A symposium sponsored by  
the John Templeton Foundation



Contact: Mary Ann Meyers, Ph.D., Senior Fellow

## Purpose

Music, the making and hearing of it, is found in all the world's cultures and is seemingly ubiquitous in our own. From archaeology, anthropology, biology, neuroscience, psychology, and theology, a growing literature is taking account of its centrality to our quest to understand human nature. Breakthroughs in technology across disciplines (e.g., neuroscience and bioacoustics, to name just two) have increased the pace of research, so it would appear to be an auspicious time for the fifteen scholars gathered at Wolfson College, Cambridge, to share new findings about what the French poet Lamartine called "the literature of the heart."

But there will always be new questions. The metaphysician George Steiner wrote that "in the face of music, the wonders of language are also its frustrations." What is the relationship between music and language? Music is clearly an immensely powerful way of communicating, but how and what does it communicate? How do humans make sense of complex and multi-dimensional sequences of patterned sound upon a first encounter? How are human musical preferences shaped? Steven Pinker famously described music as "auditory cheesecake." What do studies of child development have to say about the necessity of music? How does music facilitate and coordinate social interaction?

Only birds and whales among other species appear to learn to make sounds. What have proximate questions about mechanisms of song in birds, for example, taught us about the more fundamental issues of function and the evolution of vocal complexity? What do we know about the rhythmic capacities of other non-human species? Do accepted paradigms about human distinctiveness limit our understanding of music?

The archaeological record presents music as one of the earliest symbolic behaviors for which we have any material evidence. How much can we say about the role of music among early hominoids? What was its role in sustaining their communities and promoting their survival?





*Eighty-eight Birds with Pine, Bamboo, and Plum* (1906), a hanging scroll painted by Nakazumi Doun

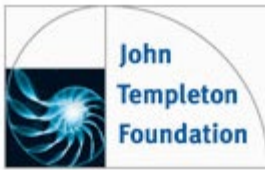
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The range and complexity of modern human rhythmic abilities certainly seem to be unique. What are we learning about the neuronal basis of musicality, particularly our capacity to react co-ordinatively in time with others? About how music impacts basic neuronal processes? Will mapping areas of the brain that process and track music tell us anything useful about the link between music and emotion—or the meaning of music in our lives?

Music has been persistent in worship for millennia. The psalmist entreats us to praise God with “the sound of the trumpet. Praise him with harp and lyre.” In his classic discussion of mysticism, William James wrote that “not conceptual speech, but music rather, is the element through which we are best spoken to by mystical truth.” Music has an essential role in ritual, and, like ritual, discards our ordinary experience of time even, on occasion, as the cultural critic Edward Rothstein has written, “suspending it altogether.” What are the qualities of music that invoke transcendence? In what ways, moreover, is music spiritually substantive? How does music enrich theological understanding? The conversation at the first Cambridge college to be established for both men and women, and one primarily for graduate students, takes place under the aegis of the John Templeton Foundation’s *Humble Approach Initiative*.

[home](#) | [approach](#) | [chair](#) | [participants](#)





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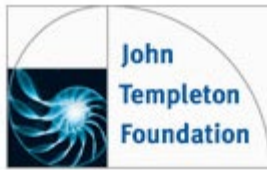


Manuscript leaf (circa 1450-1460) from a choir book illustrated by Cosmè Tura

© The Metropolitan Museum of Art / Art Resource, NY

## Approach

The symposium is part of the Templeton Foundation's *Humble Approach Initiative*. The goal of the initiative is to bring about the discovery of new spiritual information by furthering high-quality scientific research. The "humble approach" is inherently interdisciplinary, sensitive to nuance, and biased in favor of building linkages and connections. It assumes an openness to new ideas and a willingness to experiment. Placing high value upon patience and perseverance, it retains a sense of wondering expectation because it recognizes, in Loren Eiseley's haunting phrase, "a constant emergent novelty in nature that does not lie totally behind us, or we would not be where we are." A fundamental principle of the Foundation, in the words of its founder, is that "humility is a gateway to greater understanding and open[s] the doors to progress" in all endeavors. Sir John Templeton believes that in their quest to comprehend foundational realities, scientists, philosophers, and theologians have much to learn about and from one another. The humble approach is intended as a corrective to parochialism. It encourages discovery and seeks to accelerate its pace.



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The putative flute is a femur of a cave bear found in the Divje Babe site in Slovenia. It is thought to be some 55,000 years old. If the bone is a flute, it would be evidence of the making of music by Neanderthals. A three-hole flute made from a mammoth tusk, dated to 30,000 to 37,000 years ago, was excavated from a cave in the German Swabian Alb.

© National Museum of Slovenia  
(Photo: Tomaž Lauko)

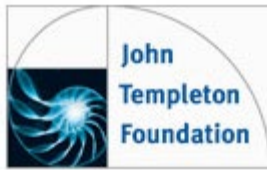
## Chair

**Simon Conway Morris** is widely acknowledged as one of the foremost paleontologists of his time. A professor of evolutionary paleobiology at Cambridge University, he has devoted his research career to the study of the 520-million-year-old Burgess Shale, found between two peaks in the Canadian Rockies, and related fossil-rich formations. In his acclaimed 1998 study, *The Crucible of Creation*, he re-interpreted the soft-body fauna found in fissile rock as evincing the preeminent role of convergence in evolution. His demonstration that many of the fantastic Burgess Shale animals are related, albeit remotely, to modern forms supports the theory that similar solutions are found to the same kind of environmental challenges in independent lines and places and impugns, as seriously incomplete, the reductionist viewpoint that the present-day world arises as the result of chance past events. In his most recent book, *Life's Solution: Inevitable Humans in a Lonely Universe* (Cambridge University Press, 2003), he extends his argument and builds his case for the inevitability of numerous evolutionary outcomes on a foundation laid by Charles Darwin himself in *Origin of the Species*, the epochal work to which critics have compared *Life's Solution*. Dr. Conway Morris concludes that large-scale features of the history of evolution “are congruent with a Creation”—and he helps restore humanity’s place at its center by his insistence that intelligence is not a fluke, though a life-friendly planet like Earth may be unique. A graduate of the University of Bristol, where he took first-class honors in geology, Dr. Conway Morris went on to Cambridge and studied at Churchill College with Harry Whittington, the first re-interpreter of the Burgess Shale, on a Natural Environment Research Council (NERC) Studentship. He was elected a research fellow of St. John’s College in 1975 and received his Ph.D. in evolutionary paleobiology the next year. Appointed a lecturer in earth sciences at The Open University in 1979, he returned to Cambridge as a lecturer four years later and was promoted to his current chair in 1995. Dr. Conway Morris is a fellow of the Royal Society and an honorary fellow of the European Union of Geosciences and serves on the board of advisors of the John Templeton Foundation. His work has been supported by research grants from the society as well as from the Nuffield Foundation, the Carlsberg Foundation, the NERC, the National Geographic Society, and the Leverhulme Foundation. He has delivered numerous invited lectures throughout the United Kingdom, Europe, Asia, Canada, and

the United States, including the Gifford Lectures at the University of Edinburgh last year. Among many honors, he has been awarded the Walcott Medal of the National Academy of Sciences, the Charles Schuchert Award of the Paleontological Society of the United States, Yale University's George Gaylord Simpson Prize, the Lyell Medal of the Geological Society of London, the Kelvin Medal of the Philosophical Society of Glasgow, and the Ide and Luella Trotter Prize given by Texas A&M University. Dr. Conway Morris holds an honorary doctorate from the University of Uppsala. He contributes frequently to general magazines and encyclopedias and to radio and television programs on science and is a member of the editorial board of *Geology*. The author of some ninety research papers, he has served as editor of five books, including *The Deep Structure of Biology: Is Convergence Sufficiently Ubiquitous to Give a Directional Signal?* which was published earlier this year by the Templeton Press. The first version of his study of the Burgess Shale and the rise of animals, *Journey to the Cambrian* (1997), was printed in Japanese and has been reprinted seven times. Dr. Conway Morris brings to music the ear of an appreciative listener.

[home](#) | [approach](#) | [chair](#) | [participants](#)





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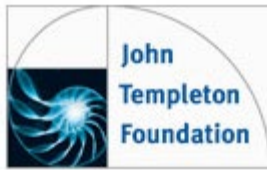
**Jeremy S. Begbie** is the inaugural Thomas A. Langford Research Professor of Theology at the Duke Divinity School and, through the end of the year, associate principal of Ridley Hall, the Church of England theological college in Cambridge. Founder and former director of Theology Through the Arts, an international research program, he is a professionally trained musician who has performed extensively as a pianist, oboist, and conductor. Dr. Begbie is also an Anglican priest. His research and writing has focused on the interplay between theology and the arts, especially music. A graduate of the University of Edinburgh, he earned a diploma in piano performance at the Royal College of Music and went on to take first-class honors in systematic theology at the University of Aberdeen. He prepared for the priesthood at Ridley Hall and was ordained in 1983. He received his Ph.D. in theology from Aberdeen in 1987. Dr. Begbie began his teaching career at Ridley Hall as director of studies and lecturer in Christian doctrine. He was named an affiliated lecturer in the Faculty of Divinity at Cambridge University in 1994 and Ridley Hall's associate principal in 2000, the same year he was appointed honorary reader in divinity at the University of St. Andrews, where he also was named honorary professor of theology at the Institute for Theology, Imagination, and the Arts at St. Mary's College in 2003. He assumed his current position at Duke University this past summer. Dr. Begbie is a fellow of the Royal School of Church Music. He has been an invited lecturer at colleges and universities throughout North America and Britain. At the invitation of the Archbishop of Canterbury, he served for seven years as a member of the Doctrine Commission of the Church of England. A member of the editorial board of *Veritasse Magazine* and co-editor (with Trevor Hart and Roger Lundin) of *Ashgate Studies in Theology, Imagination, and the Arts*, he has published some twenty-five papers as articles in scholarly journals or chapters in volumes of collected works. He is the editor of three books, *Beholding the Glory* (2000), *Sounding the Depths: Theology Through the Arts* (2002), and *Musical Theology*, which will be published by Wm. B. Eerdmans next year, and the author of four other books: *Music in God's Purposes* (1988), *Voicing Creation's Praise: Towards a Theology of the Arts* (1991), the highly-praised *Theology, Music and Time* (2000), and, most recently, *Resounding Truth: Christian Wisdom in the World of Music*, which was published by Baker Academics in 2007 and



won a *Christianity Today* Book Award. Oxford University Press will publish his *Music: Words and the Future of Theology* in 2009.

[home](#) | [approach](#) | [chair](#) | [participants](#)





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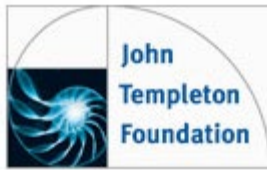


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Reader in music and science and director of the Centre for Music and Science at Cambridge University, **Ian Cross** is a fellow of Wolfson College. He studied classical guitar and earned diplomas in performance and teaching from, respectively, the Royal Academy of Music and the Royal College of Music before taking his undergraduate degree at City University, London, where he also earned a Ph.D. in music psychology in 1989. Dr. Cross had joined the Faculty of Music at Cambridge three years earlier as a lecturer in musical acoustics and a studio director. Appointed assistant director of research in 1992, he became a University lecturer in music in 1997 and was named to his current position five years later. Dr. Cross has long been involved in experimental investigations of the perception of tonal structures as well as of the role of culture and formal education in shaping musical cognition. He has explored the general limits and constraints on scientific accounts of music and also the relation between music and cognitive evolution. With funding from the Leverhulme Trust and the AHRC (Arts and Humanities Research Council), he has for the past four years studied the perceptual correlates of violin acoustics, perceptions of non-adjacent relationships in music, and the development of interfaces for live music performance. Dr. Cross is the author of some ninety articles published in academic journals and chapters in volumes of collected work and the co-editor (with Peter Howell and Robert West) of two books on the psychology of music, *Musical Structure and Cognition* (1985) and *Representing Musical Structure* (1991), both published by Academic Press. He is also co-editor (with Susan Hallam and Michael Thaut) of the forthcoming *Oxford Handbook of Music Psychology* and (with Patrick Rebuschat, Martin Rohrmeier, and John Hawkins) of another new book, the forthcoming *Language and Music as Cognitive Systems*, which will be published by Oxford University Press.





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**W. Tecumseh Fitch** is a reader in psychology at the University of St. Andrews. His research concerns the evolution and neural basis of cognition in human beings and other animals with a special focus on communication systems, including speech, language, and music. He emphasizes the value of an empirical, comparative approach, using data from many species to study peculiarly human characteristics. A graduate of Brown University, where he was elected to Sigma Xi and earned a bachelor's degree with honors in biology, he went on to take a Ph.D. in cognitive and linguistic sciences at Brown in 1994 and received a National Institutes of Health (NIH) Postdoctoral Fellowship to continue his studies at the Harvard-Massachusetts Institute of Technology Program in Speech and Hearing Science and Biotechnology. In 1999, he was appointed a lecturer in organismic and evolutionary biology and in psychology at Harvard, and three years later, he was named a visiting fellow at the European Institute for Advanced Study in Berlin. He became a lecturer at St. Andrews in 2003 and was promoted to his present position earlier this year. Dr. Fitch has been the Leibniz (Visiting) Professor at the University of Leipzig and a visiting scholar at the Max Planck Institute for Evolutionary Anthropology in Leipzig. He also has held a visiting fellowship at the British Columbia Advanced Systems Institute in Victoria, B.C. A scientific advisor to the American Museum of Natural History for its new permanent exhibition on Human Origins and to the BioMusic Museum Exhibition at the University of North Carolina at Greensboro, he serves as an associate editor of *PloSOne* and of the *Journal of Experimental Psychology: General*. Dr. Fitch is the author of some seventy papers published in scientific journals. He has studied Ghanaian drumming and performed with a salsa band. He plays the guitar, piano, and percussion as well as composing music.



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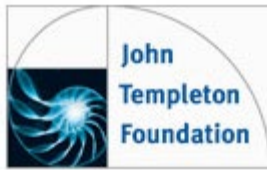
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**Jonathan Harvey**, one of Britain's foremost contemporary composers, is honorary professor of composition at the University of Sussex and composer-in-residence with the BBC Scottish Symphony Orchestra. He works on the cutting edge of electronic music and also writes music that is cherished and widely sung by choirs. His compositions evoke both Western and Eastern spirituality and are celebrated for their originality and luminous beauty. The association of Dr. Harvey's music with ritual (and the many works intended for liturgical use rather than concert performance) has been traced to his early days as a chorister at St. Michael's College in Tenbury Wells, where his duties included singing two services every day in chapel and where he began piano, organ, and cello lessons. Winning a scholarship to Repton School, he met Benjamin Britten, the English composer. After he went up to Cambridge, where he read music at St. John's College, it was Britten who suggested he study composition with Erwin Stein, an émigré student of Schonberg's then living in London. After Stein's death, he studied composition and analysis with another Viennese musician and critic, Hans Keller, and went on to earn a Ph.D. in music at Glasgow University in 1964. He then joined the music faculty of the University of Southampton as a lecturer. In 1966, Dr. Harvey went to Darmstadt, the German city renowned for its international summer courses in new music, where he was greatly influenced by Karlheinz Stockhausen, the German composer who became the subject of his first book, *The Music of Stockhausen* (1966). Two major compositions written in 1969, *Ludus Amoris*, a cantata for choir and orchestra based on the mystical writings of the Spanish Carmelites, and *Four Images after Yeats* for piano, marked a major turning point in his work, at once serial in technique and suggestive of spiritual questing. He went to Princeton University as a Harkness Fellow to study serialism with the American composer Milton Babbitt in 1969. His compositions in the 1970s, notably two orchestral works, *Persephone Dream* (1972), a symphonic poem, and *Inner Light 3* (1975), a cycle commissioned by the BBC, as well as *I Love the Lord* (1976), an anthem for a cappella chorus, confirmed his preoccupation with a search for transcendence that draws on Christian and Buddhist texts, Hindu thought, and Sufi as well as English poetry. Dr. Harvey was named professor of music at the Sussex in 1977, and in the early 1980s, at the invitation of Pierre Boulez, he worked at the IRCAM (Institut de Recherche et Coordination

Acoustique/Musique) in Paris, an association that produced eight commissions, including the celebrated tape piece *Mortuos plango, vivos voco* (1980) and another work for chamber ensemble and electronics, *Bhakti* (1982), as well as *Ritual Melodies* (1989-90) for computer-manipulated sounds, *Advaya* (1994) for cello and electronics, and *Speakings* (2008) for orchestra. He retired from full-time teaching at Sussex in 1993, and in 1995 he was appointed professor of music at Stanford University, a post he held for five years. He was subsequently a visiting professor of music at Imperial College, London, and accepted his BBC position in 2005. An honorary fellow of St. John's College, Cambridge, and a member of the Academia Europaea, he is the recipient of the Britten Award for composition and holds honorary doctorates from the universities of Southampton, Bristol, Sussex, and Huddersfield. Dr. Harvey is the author of a score of essays for academic journals or volumes of collected works and of two other books, both published in 1999, in addition to his work on Stockhausen, *Music and Inspiration* (an updating of his Ph.D. thesis on composers' inspiration edited by Michael Downes) and *In Quest of Spirit: The Musical Thought of Jonathan Harvey*, which was published by the University of California Press. His latest musical compositions include his third opera, *Wagner Dream* (2007), based on Richard Wagner's consuming interest in Buddhist thought. Among forthcoming works are two commissioned for the Rundfunkchor and the Berlin Philharmonic Orchestra, *Messages* and *Eine Vision in Musik* for Hans Küng's Global Ethic Foundation.





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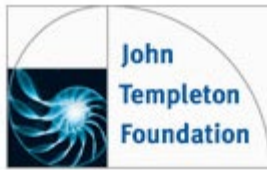
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An associate professor of psychology at the University of California, Davis, **Petr Janata** studies how music impacts neural processes at UC/Davis's Center for Mind and Brain. He is currently using fMRI and EEG recordings to investigate music's interaction with emotion and why people like different types of music. A graduate of Reed College, he earned a Ph.D. in biology at the University of Oregon in 1996. He served as a visiting assistant professor of biology at Reed for a semester before going on to a postdoctoral fellowship at the University of Chicago where he studied how birds learn to sing. Dr. Janata became a research assistant professor at Dartmouth College in 2000 and accepted his present position in 2004. He has studied at the University of Vienna on a Fulbright Fellowship, held a fellowship at the McDonnell Summer Institute in Cognitive Neuroscience at UC/Davis, and been a visiting fellow at the Max Planck Institute for Cognitive Neuroscience in Leipzig. His research has been supported by grants from the National Institutes of Health and by a John Templeton Foundation/Metanexus research grant. A former reviewing editor for *Brain Research*, he has published more than twenty-five papers in scientific journals or in volumes of collected works.



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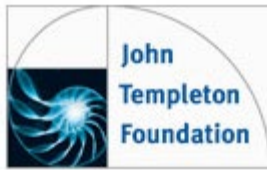
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**Mari Riess Jones** is professor of psychology emerita at Ohio State University. For more than thirty years, she has investigated the role of time and rhythm in perception and attention as these states relate to listening to music and to other auditory events. A *magna cum laude* graduate of the University of California, Riverside, she earned a master's degree with high honors at Boston University and a Ph.D. in experimental psychology at the University of Massachusetts in 1967. Dr. Jones joined the psychology faculty at Ohio State as a visiting assistant professor, was appointed an assistant professor in 1969, and named a full professor in 1976, a post she held until her retirement two years ago. She currently serves as an adjunct professor of psychology at the University of California, Santa Barbara. Her research has been supported by the National Science Foundation, the American Psychology Association (APA), and the International Foundation for Research in Music. She has been a fellow at the Netherlands Institute for Advanced Study, served on the board of directors of the International Society of Ecological Psychology, and is a past president and former member of the board of the Society for Music Perception and Cognition. Dr. Jones is a fellow of the APA, the American Psychological Society, and the American Association for the Advancement of Science and the recipient of two awards, the Joan Huber Distinguished Scholar Award and the Fred Brown Research Award, given by Ohio State. A consulting editor of *Perception and Psychophysics*, she also serves on the editorial board of *Psychomusicology* and *Music Perception*. She is the author or co-author of some eighty papers published in scientific journals and volumes of collected works as well as the co-editor (with Susan Holleran) of the *Cognitive Bases of Musical Communication*, which was published by the APA in 1991.



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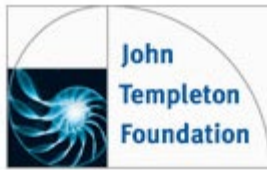
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**Steven J. Mithen**, professor of early prehistory and dean of the Faculty of Science at the University of Reading, has undertaken a wide range of research on late Pleistocene and early Holocene hunter-gatherers and has written extensively on the evolution of the modern mind with particular regard to the origins of creative intelligence, language, and music. He directs two field projects—one concerning Mesolithic settlement in western Scotland and one on the emergence of the Neolithic in southern Jordan that involves the excavation of the pre-pottery Neolithic A site of WF16. He is also the lead investigator on the inter-disciplinary water, life, and civilization project that is exploring the impact of changes in the hydrological climate on societies of the past, present, and future in the Near East. After initially studying at the Slade School of Art, Dr. Mithen went on to earn a bachelor's degree from the University of Sheffield where he took first-class honors in prehistory and archaeology. He received an M.Sc. in biological computation from the University of York and a Ph.D. in archaeology from Cambridge University in 1987. He remained at Cambridge as a research fellow in archaeology at Trinity Hall and then as lecturer in archaeology and a research associate in archaeology at the McDonald Institute. Joining the Reading archaeology faculty in 1991 as a lecturer, he was named a reader in early prehistory in 1998 and a professor in 2000. He was appointed as the first head of the School of Human and Environmental Sciences, a grouping of disciplines covering archaeology, geography, and environmental science, in 2002 and named to his present position as dean of the Faculty of Sciences last year. In the autumn, he will be the Rayson Huang Visiting Lecturer in Music at Hong Kong University. Dr. Mithen has lectured widely in Britain, continental Europe, and North America, as well as in Jordan and Turkey, and he regularly participates in BBC radio and television science programs. His research has been supported by various organizations and institutions, including Historic Scotland, the British Academy, which awarded him a research readership, the Natural Environment Research Council, the Humanities Research Board, the Arts and Humanities Research Board, the Council for British Research in the Levant, the McDonald Institute, and the European Science Foundation. A fellow of the British Academy as well as of the Society of Antiquaries of Scotland, the Society of Antiquaries of London, the New England Institute of Cognitive Science, and the Institute for



Cultural Research, he serves on the editorial boards of the *Cambridge Archaeological Journal*, the *Journal of Social Archaeology*, the *Journal of Cognition*, and *Culture*, and the *Journal of Evolutionary Psychology*. Dr. Mithen has published more than one hundred scientific articles and essays in collected volumes and served as the editor of four books, including (with William Finlayson) a volume on their excavations of the Neolithic site of WF16 in Wadi Faynan, Jordan, and their archaeological survey of the region. He is the author of *Thoughtful Foragers: A Study of Prehistoric Decision Making* (1990), *The Prehistory of the Mind: A Search for the Origins of Art, Science and Religion* (1996), a volume translated into five languages besides English, and *After the Ice: A Global Human History, 20,000-5,000 B.C.* (2003), which was named by *Discover Magazine* as one of the best science books of the year. Dr. Mithen's most recent book, *The Singing Neanderthal: On the Evolution of Music, Language, Body and Mind*, was published by Weidenfeld & Nicolson (in the UK) and Harvard University Press (in the United States) in 2005 and has subsequently been published in several foreign languages. He is currently writing a book entitled *The Eileanach of the Stone Age*.

[home](#) | [approach](#) | [chair](#) | [participants](#)



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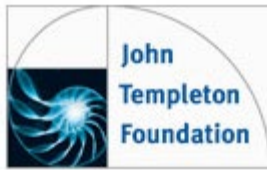
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A research fellow at Darwin College, Cambridge, **Iain Morley** has investigated the evolutionary origins and archaeology of music as part of a larger research agenda that involves an ongoing study of the development of modern human cognitive capacities and behaviors. He holds a Wenner-Gren Foundation Hunt Post-Doctoral Fellowship and is a fellow of Cambridge University's McDonald Institute for Archaeological Research. A first-class honors graduate of Stirling University, Dr. Morley earned a master's degree, with distinction, in cognitive evolution at the University of Reading and received his Ph.D. in archaeology from Cambridge in 2004. He held a John Templeton Foundation research fellowship while working as a co-investigator with Colin (Lord) Renfrew on a Templeton-funded project exploring the global prehistory of behaviors fundamental to ritual and religion. As a field archaeologist, he has worked in Libya, Moravia (Czech Republic), and Croatia, as well as his native Britain. In addition to publishing more than a dozen papers as articles in scholarly journals or chapters in volumes of collected works, he is the co-editor (with Colin Renfrew) of three books, *Image and Imagination: A Global Prehistory of Figurative Representation*, which was published by the McDonald Institute in 2007, *Becoming Human: Innovation in Prehistoric Material and Spiritual Culture*, which will be published later this year by Cambridge University Press (CUP), and *Measuring the World and Beyond: The Genesis of Quantification and Cosmology*, which CUP will publish next year. His *Evolutionary Origins and Archaeology of Music* will be published in 2009 by Oxford University Press.



# Music: Its Evolution, Cognitive Basis, and Spiritual Dimensions

18, 19, and 20 September 2008  
Wolfson College, Cambridge University

A symposium sponsored by  
the John Templeton Foundation



## Participants

Jeremy S. Begbie  
Ian Cross  
W. Tecumseh Fitch  
Patricia Gray  
Jonathan Harvey  
Petr Janata  
Mari Riess Jones  
Stefan Koelsch  
Steven J. Mithen  
Iain Morley  
**Stephen Nowicki**  
Aniruddh D. Patel  
Elizabeth D. Tolbert  
Sandra E. Trehub

**Stephen Nowicki**, Bass Fellow, professor of biology, and dean of Undergraduate Education at Duke University, studies the ecology and evolution of animal behavior with a special emphasis on questions related to the diversity and complexity of animal communication signals. He uses bird song as a model system and has focused on trying to understand how birds sing and what they do with their songs. His research involves both field studies and laboratory experiments. Dr. Nowicki also holds appointments in the psychology and neurosciences department in Duke's Trinity College and in the neurobiology department in the university's School of Medicine. A *summa cum laude* graduate of Tufts University, where he was elected to Phi Beta Kappa, he had earlier aspired to be a classical musician. But he went on to earn a master's degree in biology at Tufts and, in 1985, a Ph.D. in neurobiology and behavior at Cornell University, where he held Andrew White and Henry Sage fellowships and was elected to Sigma Xi. After a postdoctoral research fellowship at the Rockefeller University, he joined the faculty there as an assistant professor. In 1989, he moved on to Duke and was appointed Anne T. and Robert M. Bass Professor in 1999. Five years later, Dr. Nowicki was named dean of Natural Sciences, a post he held until 2007 when he accepted his present position. A former Guggenheim Fellow, he has also held a Mary Flagler Cary Charitable Trust Fellowship and an Alfred P. Sloan Foundation Fellowship. He was elected a fellow of the Animal Behavior Society in 1998 and served as its president for four years. Dr. Nowicki is the recipient of a teaching award from Duke. His research has been primarily supported by the National Science Foundation. He has delivered invited lectures throughout the United States and in Canada, Germany, the Netherlands, Sweden, and Switzerland. The author of more than eighty papers published in scientific journals or in volumes of collected works, he is the co-author (with W.A. Searcy) of *The Evolution of Animal Communication: Reliability and Deception in Signaling Systems* (2005). His *Biology*, a high school textbook, was published by McDougall-Littell earlier this year. From time to time, Dr. Nowicki plays the trombone and tuba in the Duke Pep Band.





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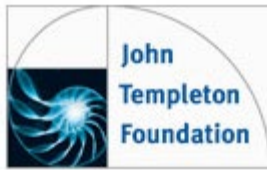


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The Esther J. Burnham Senior Fellow at The Neurosciences Institute in San Diego, California, **Aniruddh D. Patel** is a pioneer in the use of new concepts and technology to investigate the neural correlates of music. The goal of his research is to increase understanding of how the human brain processes structured sound. He has focused recently on the relationship between music and language, especially what the similarities and differences between the two reveal about each other and about the brain itself. His work employs a broad range of methods, ranging from brain imaging of syntactic processing to studying acoustical patterns to determine how a culture's language is reflected in its instrumental music. A clarinetist as a youth, Dr. Patel earned a bachelor's degree in biology with distinction at the University of Virginia, where he was elected to Phi Beta Kappa. After a year studying ecology at the National Taiwan University as a Luce Scholar, he went on to Harvard University, as a National Science Foundation Fellow, where he earned a Ph.D. in organismic and evolutionary biology in 1996. He did a joint postdoctoral fellowship at Harvard and at Tufts University before joining The Neurosciences Institute as a junior fellow in 1997. Appointed an associate fellow three years later, Dr. Patel was named to his present position in 2005. He has held a grant from the Roger Tory Foundation to conduct ethnomusicology research in Papua New Guinea and a McDonnell-Pew Fellowship to attend a McDonnell Summer Institute in Cognitive Science at Dartmouth College. When teaching animal behavior as a graduate student at Harvard, he received a Danforth Teaching Award, and he continues to lecture in the Harvard Museum of Natural History Travel Program. Dr. Patel has delivered invited lectures throughout the United States as well as in Mexico, Britain, France, Germany, Italy, India, Japan, and Australia. The author or co-author of some forty papers published in scientific journals, he is also the author of the highly-praised *Music, Language, and the Brain*, which was published by Oxford University Press last year. His book, which *Nature* called "an intellectual tour de force," is the first comprehensive study of the relationship between music and language from the perspective of cognitive neuroscience and argues that these uniquely human abilities share deep and critical connections.





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**Sandra E. Trehub**

Professor of psychology emerita at the University of Toronto at Mississauga, **Sandra E. Trehub** has spent more than three decades studying infant listening skills, particularly as they relate to music, as part of an ongoing investigation of developmental and cross-cultural similarities in human musical ability. In addition to her research on auditory perception, she has explored the nature of maternal singing in the course of care-giving, an activity that seems to be universal, with the aim of identifying cultural similarities and differences and of determining the effect of singing on infant listeners. Dr. Trehub is a graduate of McGill University where she earned both her baccalaureate degree and a Ph.D. in psychology in 1973. She then joined the Toronto psychology faculty as an assistant professor and was named a full professor in 1983, a position she held until her retirement five years ago. Her research has been supported by the Natural Sciences and Engineering Research Council of Canada, the Social Sciences and Humanities Research Council of Canada (SSHRC), and the Canadian Institutes for Health Research. An invited fellow of the British Psychological Society, she is the recipient of a Creative Talents Award given by the American Institutes for Research and a SSHRC fellowship. She has delivered invited lectures throughout North America, as well as in South America, Europe, and Asia. Dr. Trehub serves as a consulting editor to *Music Perception*, *Music Scientiae*, and *Psychology of Music*. She has published some 140 papers in scientific journals or in volumes of collected works and is the co-editor of three books, (with F.I.M. Craik) *Aging and Cognitive Processes* (1982), (with Gerald Young, Carl M. Corter, and Sidney J. Segalowitz), *Manual Specialization and the Developing Brain* (1983), and (with B.A. Schneider) *Auditory Development in Infancy*, which was published in 1985 by Plenum Press.