# FRANK TONG

# **CURRICULUM VITAE**

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# **EDUCATION**

1990–1995	Queen's University, Canada	B.S. in Psychology
1995–1998	Harvard University	M.A. in Experimental Psychology
1998–1999	Harvard University	Ph.D. in Experimental Psychology Awarded on November 16, 1999

# **ACADEMIC APPOINTMENTS**

1999 – 2000	McDonnell-Pew Post-Doctoral Research Fellow University of California, Los Angeles, Department of Psychology
2000 – 2004	Assistant Professor Princeton University, Department of Psychology
2004 – 2007	Assistant Professor Vanderbilt University, Department of Psychology
2007 – 2012	Associate Professor Vanderbilt University, Department of Psychology
2012 – present	Full Professor Vanderbilt University, Department of Psychology

# **RESEARCH INTERESTS**

• Human neural bases of perception, attention, object recognition, and working memory

# **Specific Topics**

- Neural decoding of perceptual and mental states using brain imaging
- Neural representations of visual features and objects in the human visual system, and their role in conscious perception
- Neural mechanisms of binocular rivalry, bistable perception, perceptual filling-in
- Neural bases of top-down attentional selection and visual working memory

# **AWARDS AND HONORS**

1990 – 1995	Full undergraduate scholarship plus stipend, Queen's University
1992 – 1993	NSERC Summer Research Award
1994	Ann Adamson Award in Psychology, Queen's University
1995	Medal in Psychology for highest GPA, Queen's University
1995 – 1997	Merit-Based Graduate Fellowship, Harvard University
1995 – 1999	NSERC Post-Graduate Scholarship
1999 – 2002	McDonnell-Pew Training Fellowship in Cognitive Neuroscience
2003 – 2004	Robert K. Root Preceptorship, Princeton University
2004 – 2005	Scientific American 50. Award to honor 50 individuals, teams, companies or other organizations for accomplishments in research, business, or policy making in 2004 – 2005
2006	Young Investigator Award, Cognitive Neuroscience Society
2008	Chancellor's Award for Research, Vanderbilt University
2009	Young Investigator Award, Vision Sciences Society
2010	Troland Research Award in Psychology, National Academy of Sciences

### **PUBLICATIONS**

- Tong, F., Nakayama, K., Vaughan, J. T., & Kanwisher, N. (1998). Binocular rivalry and visual awareness in human extrastriate cortex. *Neuron*, *21*, 753-759.
- Kanwisher, N., Tong, F., & Nakayama, K. (1998). The effects of face inversion on the human fusiform face area. *Cognition, 68*, B1-B11.
- Tong, F., & Nakayama, K. (1999). Robust representations for faces: Evidence from visual search. *Journal of Experimental Psychology: Human Perception and Performance, 25,* 1016-1035.
- Tong, F., Nakayama, K., Moscovitch, M., Weinrib, O., & Kanwisher, N. (2000). Response properties of the human fusiform face area. *Cognitive Neuropsychology*, *17*, 257-279.
- Cohen, J. D., & Tong, F. (2001). The face of controversy: Science, 293, 2405-2407.
- Tong, F. (2001). Brain at work: Play by play. Nature Neuroscience, 4, 560-562.
- Tong, F. (2001). Competing theories of binocular rivalry: A possible resolution. *Brain and Mind*, 2, 55–83.
- Tong, F., & Engel, S. A. (2001). Interocular rivalry revealed in the human cortical blind-spot representation. *Nature*, *411*, 195-199.
- Tong, F. (2003). Out of body experiences: From Penfield to present. *Trends in Cognitive Sciences*, *7*, 104-106.
- Tong, F. (2003). Primary visual cortex and visual awareness. *Nature Reviews Neuroscience*, *4*, 219-229.
- Tong, F. (2004). Splitting the spotlight of visual attention. Neuron, 42, 524-526.

- Meng, M. & Tong, F. (2004). Can attention bias bistable perception? Differences between binocular rivalry and ambiguous figures. *Journal of Vision, 4,* 539-551.
- Awater, H., Kerlin, J. K., Evans, K. K., & Tong, F. (2005). Cortical representation of space around the blind spot. *Journal of Neurophysiology*, *94*, 3314-3324.
- Kamitani, Y., & Tong, F. (2005). Decoding the visual and subjective contents of the human brain. *Nature Neuroscience*, *8*, 679-685.
- Meng, M., Remus, D. R., & Tong, F. (2005). Filling-in of visual phantoms in the human brain. *Nature Neuroscience*, *8*, 1248-1254.
- Kamitani, Y, & Tong, F. (2006). Decoding seen and attended motion directions from activity in the human visual cortex. *Current Biology*, 16, 1096-1102.
- Tong, F., Meng, M., & Blake, R. (2006). Neural bases of binocular rivalry. *Trends in Cognitive Science*, *10*, 502-511.
- McKeeff, T. J., Remus, D. R., & Tong, F. (2007). Temporal limitations in object processing across the human ventral visual pathway. *Journal of Neurophysiology*, *98*, 382-393.
- McKeeff, T. J., & Tong, F. (2007). The timing of perceptual decisions for ambiguous face stimuli in the human ventral visual cortex. *Cerebral Cortex*, *17*, 669-678.
- Meng, M., Ferneyhough, E., Tong, F. (2007). Dynamics of perceptual filling-in of visual phantoms revealed by binocular rivalry. *Journal of Vision*, *7*(13):8, 1-15.
- Pearson, J., Clifford, C., & Tong, F. (2008). The functional impact of mental imagery on conscious perception. *Current Biology, 18,* 982-986.
- Yamashita, O., Sato, M.-A., Yoshioka, T., Tong, F., Kamitani, Y. (2008). Sparse estimation automatically selects voxels relevant for the decoding of fMRI activity patterns. *Neuroimage*, 42, 1414-1429.
- Brouwer, G. J., Tong, F., Hagoort, P., van Ee, R. (2009). Perceptual incongruence influences bistability and cortical activation. *PLoS ONE*, *4*(e5056), 1-14.
- Dux, P. E., Tombu, M. N., Harrison, S., Rogers, B. P., Tong, F., & Marois, R. (2009). Training improves multitasking performance by increasing the speed of information processing in human prefrontal cortex. *Neuron*, *63*, 127-138.
- Harrison, S. A., & Tong, F. (2009). Decoding reveals the contents of visual working memory in early visual areas. *Nature*, *458*, 632-635.
- McKeeff T. J., McGugin, R. W., Tong, F., Gauthier I. (2010). Expertise increases the functional overlap between face and object perception. *Cognition, 117*, 355-360.
- Swisher, J. D., Gatenby, J. C., Gore, J. C., Wolfe, B. A., Moon, C.-H., Kim, S.-G., & Tong, F. (2010). Multiscale pattern analysis of orientation-selective activity in the primary visual cortex. *Journal of Neuroscience*, *30*, 325-330.
- Genç, E., Bergmann, J., Tong, F., Blake, R., Singer, W., & Kohler, A. (2011). Callosal connections of primary visual cortex predict the spatial spreading of binocular rivalry across the visual hemifields. *Frontiers in Human Neuroscience*, *5*(161), 1-12.

- Jehee, J. F. M., Brady, D. K., & Tong, F. (2011). Attention improves encoding of task-relevant features in the human visual cortex. *Journal of Neuroscience*, 31, 8210-8219.
- McGugin, R. W., McKeeff T. J., Tong, F., Gauthier I. (2011). Irrelevant objects of expertise compete with faces during visual search. *Attention, Perception and Pscyhophysics*, 73, 309-317.
- Pearson, J., Rademaker, R. L., & Tong, F. (2011). Evaluating the mind's eye: The metacognition of visual imagery. *Psychological Science*, *22*, 1535-1542.
- Tong, F. (2011). Aligning brains and minds. *Neuron*, 72, 199-201.
- Hong, S. W., Tong, F., & Seiffert, A. E. (2012). Direction-selective patterns of activity in human visual cortex suggest common neural substrates for different types of motion. *Neuropsychologia*, *50*(4):514-21.
- Jehee, J. F. M., Ling, S., Swisher, J. D., Tong, F. (2012). Perceptual learning selectively refines orientation representations in early visual cortex. *Journal of Neuroscience*, *32*, 16747-16753.
- Kietzmann, T. C., Swisher, J. D., König, P., & Tong, F. (2012). Prevalence of selectivity for mirror-symmetric views of faces in the ventral and dorsal visual pathways. *Journal of Neuroscience*, *32*, 11763-11772.
- Swisher, J. D., Sexton, J. A., Gatenby, J. C., Gore, J. C., & Tong, F. (2012). Multishot versus single-shot pulse sequences in very high field fMRI: a comparison using retinotopic mapping. *PLoS One*, *7*(4), e34626, 1-12.
- Tong, F., Harrison, S., Dewey, J., & Kamitani, Y. (2012). Relationship between BOLD amplitude and pattern classification of orientation-selective activity in the human visual cortex. *Neuroimage*, 63, 1212-1222.
- Tong, F., & Pratte, M. S. (2012). Decoding patterns of human brain activity. *Annual Review of Psychology*, *63*, 483-509.
- Rademaker, R. L., Tredway, C. H., Tong, F. (*In press*). Introspective judgments predict the precision and likelihood of successful maintenance of visual working memory. *Journal of Vision*.

#### **BOOK CHAPTERS**

- Tong, F. (2005). Investigations of the neural basis of binocular rivalry. In D. Alais & R. Blake (Eds.), *Binocular rivalry and perceptual ambiguity*, Cambridge, MA: MIT Press.
- Wolfe, J. M., Seiffert, A. E., & Tong, F. (2006). Perception. In E. E. Smith & S. M. Kosslyn (Eds.), *Cognitive Psychology: Mind and Brain*, Prentice Hall.
- Tong, F. & Pearson, J. (2007). Vision. In Baars & Gage (Ed.) *Cognition, Brain, and Consciousness*, Academic Press, London.

#### MEDIA COVERAGE OF LAB RESEARCH

New York Times, April 25, 2005. Improved scanning technique uses brain as portal to thought.

New York Times Sunday Magazine, May 8, 2005. Of two minds.

New Scientist, April 25, 2005. Mind-reading machine knows what you see.

Scientific American, Science News, April 25, 2005. Brain scans help scientists "read" minds.

Science Now, Apr 25, 2005. A new angle on mind reading.

New Scientist, Cover article on May 6, 2006 issue. Through the mind's eye, pp 32-36.

Popular Mechanics, Cover article on Nov 2007 issue.

Nature (2009), Abstractions: Last author profile in Nature issue 458, 548.

#### **GRANTS FUNDED**

Project Title: The Neural Basis of Binocular Rivalry and Visual Awareness in Human

Visual Cortex

Funding Agency: J. S. McDonnell Foundation and Pew Charitable Trusts

Grant Type: McDonnell-Pew Grant in Cognitive Neuroscience

Investigator Role: PI

Dates of Funding: 09/01/99 - 05/01/03

Project Title: Conflict and Control in Perception (Project 2)

Funding Agency: National Institute of Health

Grant Type: NIH Silvio O. Conte Center Grant for Neuroscience Research

Investigator Role: Co-PI

Dates of Funding: 09/22/00 - 08/31/05

Project Title: Neural Mechanisms of Human Visual Perception Funding Agency: National Institutes of Health, National Eye Institute

Grant Type: R01 Investigator Initiated Grant Application

Grant Number: R01 EY14202-01

Investigator Role: PI

Dates of Funding: 09/15/02 – 09/15/06

Project Title: Neural representations of objects across the human visual pathway

Funding Agency: National Science Foundation
Grant Type: Cognitive Neuroscience Initiative

Grant Number: BCS-0642633

Investigator Role: Principal Investigator Dates of Funding: 04/15/07 – 09/31/12

Project Title: Neural representation of features in the human visual cortex

Funding Agency: National Institutes of Health, National Eye Institute

Grant Type: R01 Investigator Initiated Grant Application

Grant Number: R01 EY017082

Investigator Role: PI

Dates of Funding: 09/01/07 – 08/31/13

Project Title: Integrated imaging of brain function at 7 Tesla

Funding Agency: National Institutes of Health, National Institute of Biomedical Imaging and

Bioengineering

Grant Type: R01 Bioengineering Research Partnerships Grant Application

Grant Number: 2R01 EB000461-07

Investigator Role: co-PI

Dates of Funding: 2/01/2008 – 01/31/2013

Project Title: Advances to Decode the Mammalian Visual Pathway: Attentional

Mechanisms for Object Recognition

Funding Agency: Defense Advanced Research Projects Agency (DARPA)

Grant Type: DARPA Grant Application

Grant Number: N10AP20003

Investigator Role: PI

Dates of Funding: 03/24/2010 – 23/03/2013

Project Title: Cortical representations of visually specific information in working

memory

Funding Agency: National Science Foundation
Grant Type: Cognitive Neuroscience Initiative

Grant Number: BCS-1228526

Investigator Role: PI

Dates of Funding: 09/15/2012 – 08/31/2015

#### **INVITED TALKS AND COLLOQUIA**

1998 June Invited speaker, McDonnell-Pew Annual Meeting in Cognitive Neuroscience,

Montreal, Canada

1998 November Beckman Laboratories, California Institute of Technology, Pasadena, CA

1999 October Cognitive Forum, UCLA, Los Angeles, CA2000 December NEC Research Institute, Princeton, NJ

2001 February Vision Sciences Series, Harvard University, Cambridge, MA
 2001 February Brain and Cognitive Sciences Seminar, MIT, Cambridge, MA

2001 June Special Symposium on *The Neural Correlates of Awareness*, Cambridge

Medical Research Council, Cambridge, UK

2002 April Chair and speaker of Symposium on The Role of V1 in Human Visual

Awareness, Cognitive Neuroscience Society, San Francisco, CA

2002 June Invited speaker, Workshop on Binocular Rivalry and Perceptual Ambiguity,

San Miniato, Italy

Vision Sciences Laboratory, Harvard University, Cambridge, MA
 April Departmental Colloquium, McMaster University, Hamilton, Canada
 May Invited speaker, *Time Colloquium* for Princeton Alumni, Washington DC
 June Invited speaker, Association for the Scientific Study of Consciousness,

Memphis, TN

2004 March Departmental Colloquium, University of Pennsylvania, Philadelphia, PA
2004 March Departmental Colloquium, John Hopkins University, Baltimore, MD
2004 April Satellite Symposium on *Visual Attention and Awareness*, Cognitive

	Neuroscience Society, San Francisco, CA
2004 September	Invited speaker, Opening of new MRI center, University of Rochester
2004 October	Departmental Colloquium, Psychology Dept, Cornell University
2004 November	Cognitive Neuroscience Seminar, California Institute of Technology
2005 June	Visual Neuroscience Seminar, Salk Institute
2005 June	Invited speaker, Neurophilosophy conference, California Institute of Technology
2005 December	Invited Tutorial Speaker, Neural Information Processing Systems Conference, Vancouver, Canada
2006 January	Workshop on Brain and Cognition, Taiwan ministry of education,
	(Invited speakers: Shinsuke Shimojo, Frank Tong, Anne Treisman)
2006 May	Departmental Colloquium, Department of Neurobiology and Anatomy, University of Texas Medical School
2006 June	Speaker for Symposium on <i>Imaging Consciousness: New Methods and Approaches</i> , Human Brain Mapping Conference, Florence, Italy
2006 June	Dartmouth Summer Institute in Cognitive Neuroscience, Hanover, NH
2006 November	Departmental Colloquium, Psychology Dept, University of Louisville
2006 April	Colloquium, Center for Cognitive Sciences, University of Minnesota
2007 May	Invited speaker, International Conference on Cognitive and Neural Systems, Boston University (Organizer: Prof. Stephen Grossberg)
2007 June	Invited speaker, Centre for Vision Research International Conference, York University (Organizer: Prof. Hugh Wilson)
2007 October	Colloquium, Cognitive Science, University of Arizona
2007 November	Vision Sciences Seminar, Harvard University
2007 November	Departmental Colloquium, Psychology Dept, Boston University
2008 March	Mind, Brain and Behavior Seminar, Harvard University
2008 May	Invited speaker, Symposium of the Center for Visual Science, Rochester University
2008 June	Invited speaker, Computational Neuroscience of Vision course, Cold Spring Harbor
2008 July	Departmental Colloquium, Psychology Dept, University College London
2008 September	Departmental Colloquium, Psychological and Brain Sciences Dept, Dartmouth University
2009 April	Colloquium, Center for Vision Research, York University, Canada
2009 June	Panel speaker, World Science Festival, New York, NY
2010 April	Colloquium, Center for Brain Science, Harvard University
2010 April	Departmental Colloquium, Brown University
2010 April	NSF Workshop on Hybrid Neuro-Computer Vision, Columbia University
2010 June	Tutorial on fMRI Decoding, Association for the Scientific Study of Consciousness, Toronto, Canada
2010 June	Symposium on Brain Decoding, Human Brain Mapping Conference, Barcelona, Spain
2010 Aug	Panelist for Board on Behavioral, Cognitive, and Sensory Science, National Academy of Sciences

2010 Sept	Invited Speaker, Opening reception of the Spinoza Neuroimaging Center, University of Amsterdam
2010 Oct	Departmental Colloquium, Psychology Dept, Queen's University, Canada
2010 Dec	Invited speaker, symposium on Neurotechniques, Italian Academy, NYC
2011 Feb	Departmental Colloquium, Cambridge University, UK
2011 Feb	Invited Talk, University College London, UK
2011 Apr	Departmental Colloquium, UC Berkeley
2011 Sept	Departmental Colloquium, Johns Hopkins University
2011 Oct	Invited Talk, Workshop on High and Ultra-high Field Imaging, University of Minnesota
2012 April	Departmental Colloquium, UC Davis
2012 Sept	MacArthur Neurolaw workshop, Cambridge, MA

# PROFESSIONAL ACTIVITIES AND MEMBERSHIPS

1997 – 1998	Organizer of the Vision Science Seminar, Harvard University
2001 Fall	Organizer of the Cognitive Seminar Series, Princeton University
2002 April	Chair of Symposium on "The Role of V1 in Human Visual Awareness", Cognitive Neuroscience Society, San Francisco, CA
2003 – 2004	Ad Hoc Study Section Member, National Institutes of Health, Sensory, Motor, and Cognitive Neuroscience (ZRG1 F02B)
2004 – 2005	Ad Hoc Study Section Member, National Institutes of Health, Cognitive Neuroscience Study Section (COG)
2007	Ad Hoc Study Section Member, National Institutes of Health, Special Emphasis Panel, Sensorimotor Integration Study Section
2010 Aug	Invited panel member for National Research Council, Board of Behavioral, Cognitive, and Sensory Sciences
2011 May	Invited panel member for national review committee at National Eye Institute
2012 June	Ad Hoc Study Section Member, National Institutes of Health, Sensory, Perceptual and Cognitive Neuroscience (SPC) Study Section
2012 –	Board member, Vision Sciences Society

# **Professional Memberships**

American Physiological Association
Association for Psychological Science
Association for Scientific Study of Consciousness
Cognitive Neuroscience Society
Human Brain Mapping Organization
Society for Neuroscience
Vision Sciences Society

### Ad Hoc Reviewing

General Science Journals Psychology Journals

Current Biology Cognition

Nature Journal of Experimental Psychology: PLOS: Biology Human Perception and Performance

PNAS Journal of Vision

Science Journal of Personality and Social Psychology

Perception

Neuroscience and Neuroimaging Journals Perception and Psychophysics

Cerebral Cortex Psychological Science

Cognitive Neuropsychology Trends in Cognitive Science

Journal of Cognitive Neuroscience Vision Research
Journal of Neurophysiology

Journal of Neuroscience Organizations and Funding Agencies
Nature Neuroscience Organization for Human Brain Mapping

Nature Reviews Neuroscience National Science Foundation

Neuroimage National Institutes of Health Neuron Wellcome Trust

Neuropsychologia

# **Department and University Service**

2002 – 2003 Member of Institutional Review Board, Princeton University

2006 – present Member of steering committees for 3T MRI and 7T MRI, Vanderbilt

University Institute for Imaging Science

2007 – present Psychology Major Advisor, Vanderbilt University, Vanderbilt University

2008 – 2009 Chair of search committee for assistant professor position in social

neuroscience

2009 – present Computer module director for Vanderbilt Vision Research Center

2012 – present Member of steering committee, Vanderbilt Brain Institute

### **TEACHING AND ADVISING**

2001 spring Graduate Quantitative Methods for Psychology, Princeton University

2001 – 2003 Cognitive Psychology, Princeton University

2002 fall Graduate Proseminar in Cognitive Psychology, Princeton University

2002 – 2003 Freshman and Sophomore Faculty Advisor, Mathey College, Princeton

University

2004 fall Vision, Brain, and Consciousness, Vanderbilt University

2004 – present *Mind and Brain*, Vanderbilt University

2006 – present Social Cognition and Neuroscience, Vanderbilt University

2008 fall The Visual System, Vanderbilt University

2011 spring Honors seminar: Thinking like a neuroscientist, Vanderbilt University

#### **Graduate Student Advisees**

Ming Meng. PhD received in May 2006, Princeton University.

Thesis title: Neural mechanisms underlying rivalry, perceptual filling-in, and their interactions

Current position: Assistant Professor, Psychology Department, Dartmouth University

Thomas McKeeff. PhD received in May 2009, Princeton University

Thesis title: Temporal limitations of visual object processing

Current position: Postdoctoral Fellow, Psychology Department, Harvard University

Rosanne Rademaker, visiting Master's student, Maastricht University

Thesis title: Picture perfect: the training of visual imagery

Current position: PhD student, Maastricht University

Young Eun Park, Vanderbilt University (current advisee)

Sonia Poltoratski, Vanderbilt University (current advisee)

#### **Postdoctoral Fellows**

Yukiyasu Kamitani (2003-2004), supported by Japan Society Promotion of Science Grant Current position: Head of Department of Neuroinformatics, ATR Computational Neuroscience Laboratories; Professor, Nara Institute of Science and Technology.

Holger Awater (2003-2005)

Current position: Medical Project Manager, Neuroscience section of AstraZeneca, Germany.

Joel Pearson (2006-2008), supported by CJ Martin Postdoctoral Fellowship *Current position:* Tenure-track assistant professor, University of New South Wales, Sydney, Australia.

Janneke Jehee (2007-2010), supported by Rubicon Fellowship from the Netherlands *Current position:* Tenure-track assistant professor, Donder's Institute, University of Nijmegen, The Netherlands

Sang Wook Hong (2009-2011), supported by NIH ARRA grant supplement

Jascha Swisher (2007-2012), supported by an NRSA F32 fellowship *Current position:* Research Scientist at Digital Reasoning Systems

Elias Cohen (2008-present), supported by PI's NSF and DARPA grants

Philip Ko (2010-2011), postdoctoral fellow and Vanderbilt senior lecturer

Michael Pratte (2010-present), postdoctoral fellow, supported by an NRSA F32 fellowship

Samuel Ling (2010-present), postdoctoral fellow

Jocelyn Sy (2011-present), postdoctoral fellows, supported by an NEI T32 training grant

### **Undergraduate Full-Time Research Assistants**

Karla Evans (2000-2002), currently a postdoctoral fellow at Harvard Medical School David Remus (2002-2004), PhD graduate in Psychology at Stanford University

Emma Ferneyhough (2004-2006), now a postdoctoral fellow at UC Berkeley Benjamin Wolfe (2008-2010), now a PhD student at UC Berkeley Elizabeth Counterman (2010- 2012), now a PhD student at UC Berkeley Chris Angeloni, (2012-present)

# **Undergraduate Thesis Advisees**

Amy Wong (2000-2001)

Thesis title: Human brain activity during attempts to control perception of ambiguous figures: An fMRI study. Awarded the *Class of 1943 Senior Thesis Prize in Neuroscience*, Department of Psychology, Princeton University.

Sharon Fox (2001-2002)

Thesis title: Caravaggio in a new light: theories of light in his paintings and the scientific basis for its emotive effects. Awarded the *George A. Miller Senior Thesis Prize in Cognitive Science*, Princeton University.

David Kim (2002-2004)

Thesis title: Classification of subordinate-level objects using distributed representations in human occipital-temporal cortex. Awarded the *Class of 1943 Senior Thesis Prize in Neuroscience*, Department of Psychology, Princeton University.

# **Undergraduate Neuroscience Advisees**

Caroline Tredway (2009-2010)

Research topic: Precision and reliability of human visual working memory

Cameron Neely (2010-2011)

Research topic: Perception of human faces in complex natural scenes

Recipient of the Vanderbilt Undergraduate Summer Research Program Fellowship