Rajeev Raizada

Computational cognitive neuroscientist, data scientist.

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Summary

My research applies machine learning to human fMRI data, seeking to understand how the brain is so successful. Recently I have concentrated especially on how the brain represents linguistic meaning, and its possible relevance for improving semantic models.

Appointments

Assistant Professor, Dept. of Brain & Cog.Sci., Univ. of Rochester	2013 - present
Research Scientist, Dept. of Psychology, Cornell University	2011 - 2013
Research Scientist, Neukom Inst. for Comp. Science, Dartmouth College	2008 - 2011

Education & Training

Univ. of Washington, Seattle. Postdoc. Advisor: Patricia Kuhl	2003 - 2008
MGH-NMR Center, Charlestown. Postdoc. Advisor: Russell Poldrack	2000 - 2003
Boston Univ. Ph.D. in Cog. & Neural Systems. Advisor: Stephen Grossberg	1996 - 2000
Univ. of Birmingham, England. M.Sc. in Cognitive Science	1994 - 1995
Univ. of Oxford, England. B.A. in Mathematics & Philosophy	1991 - 1994

Research Interests

- What are the neural representations that underlie skilled task performance, and how are they learned?
- How the brain represents language (words, sentences, and across languages), and its possible relevance for improving semantic models and machine translation.
- Similarity-based representation and computation in the brain, and its possible relation to kernels in machine learning.

Referee Duties

- Review Editor for a special issue of Frontiers in Psychology on socio-economic status (SES) and the brain. Special issue webpage
- Review panelist for National Science Foundation
- Ad hoc reviewer for: National Science Foundation, Natural Sciences and Engineering Research Council of Canada, Trends in Cognitive Sciences, NeuroImage, Developmental Science, Cerebral Cortex, UK Medical Research Council, Journal of Cognitive Neuroscience, Frontiers in Human Neuroscience, Neural Networks, Neuropsychologia, American Educational Research Association (AERA), IEEE Transactions on Robotics, IEEE Transactions on Autonomous Mental Development, Wiley Interdisciplinary Reviews in Cognitive Science, American Journal of Public Health.

Publications

Google Scholar profile: https://scholar.google.com/citations?user=PJWjx8gAAAAJ

Under review

Anderson, A.J., Binder, J., Fernandino, L., Humphries, C., Conant, L., Raizada, R.D.S., Lin, F., Lalor, E. (2019) An integrated neural decoder of linguistic and experiential meaning. *Under review*.

Wu, M.H., Kleinschmidt, D., Emberson, L., Doko, D., Edelman, S., Jacobs, R., Raizada, R.D.S. (2019) Cortical transformation of stimulus-space in order to linearize a linearly inseparable task. *Under review*.

Published

Anderson, A. J., Lalor, E., Lin, F., Binder, J.R., Fernandino, L., Humphries, C., Conant, L., Raizada, R.D.S., Grimm, S. and Wang, X. (2018) Multiple regions of a cortical network commonly encode the meaning of words in multiple grammatical positions of read sentences. *Cerebral Cortex*, Advance Online Publication: https://doi.org/10.1093/cercor/bhy110. PDF.

Wang, X., Ren, P., Baran, T.M., Raizada, R.D.S., Mapstone, M., Lin, F. and the Alzheimer's Disease Neuroimaging Initiative (2017) Longitudinal functional brain mapping in supernormals. *Cerebral Cortex*, Advance Online Publication: https://doi.org/10.1093/cercor/bhx322. PDF.

Wang, X., Ren, P., Mapstone, M., Conwell, Y., Porsteinsson, A.P., Foxe, J.J., Raizada, R.D.S., Lin, F. and the Alzheimer's Disease Neuroimaging Initiative (2017) Identify a shared neural circuit linking multiple neuropsychiatric symptoms with Alzheimer's pathology. *Brain Imaging and Behavior*, Advance Online Publication: https://doi.org/10.1007/s11682-017-9767-y. PDF.

Zinszer, B.D., Bayet, L., Emberson, L.L., Raizada, R.D.S. and Aslin, R.N. (2017) Decoding semantic representations from functional near-infrared spectroscopy signals. *Neurophotonics* 5 (1), 011003. PDF.

Shay, E.A., Grimm, S. and , R.D.S. (2017) Commentary on Kemmerer: the challenges and rewards of trying to combine linguistics and cognitive neuroscience. *Language, Cognition and Neuroscience*, 32, 433-437. PDF.

Anderson, A. J, Binder, J, Fernandino, L., Humphries, C., Conant, L., Aguilar, M., Wang, X., Doko, D. and Raizada, R.D.S. (2016) Predicting neural activity patterns associated with sentences using a neurobiologically motivated model of semantic representation. *Cerebral Cortex*, 27, 4379-4395. PDF.

Zinszer, B.D., Anderson, A.J., Kang, O., Wheatley, T. and Raizada, R.D.S. (2016) Semantic structural alignment of neural representational spaces enables translation between English and Chinese words. *Journal of Cognitive Neuroscience*, 28, 1749-1759. PDF.

Shahbazi, R., Raizada, R.D.S. and Edelman, S. (2016) Similarity, kernels, and the fundamental constraints on cognition. *Journal of Mathematical Psychology*, 70, 21-34. PDF.

Anderson, A.J., Zinszer, B. and Raizada, R.D.S. (2016) Representational similarity encoding for fMRI: Pattern-based synthesis to predict brain activity using stimulus-model-similarities. *NeuroImage*, 128, 44-53. PDF.

Raizada, R.D.S. and Lee, Y.S. (2013) Smoothness without smoothing: why Gaussian Naive Bayes is not naive for multi-subject searchlight studies. *PLoS ONE, PLoS ONE 8(7): e69566. doi:10.1371/journal.pone.0069566* PDF.

Mackey, A.P., Raizada, R.D.S. and Bunge, S.A. (2012) Environmental influences on prefrontal development. *In: Principles of frontal lobe function (2nd Edition), edited by Donald Stuss and Robert Knight. Oxford: Oxford University Press.* PDF.

Lee, Y.S., Turkeltaub, P., Granger, R.H. and Raizada, R.D.S. (2012) Categorical speech processing in Broca's area: An fMRI study using multivariate pattern-based analysis. *Journal of Neuroscience, 32(11), 3942-3948.* PDF.

Raizada, R.D.S. & Connolly, A.C. (2012) What makes different people's representations alike: neural similarity-space solves the problem of across-subject fMRI decoding. *Journal of Cognitive Neuroscience, 24(4), 868-877.* PDF. Matlab and Python analysis code. Webpage describing code. Supp.Info.

Raizada, R.D.S. and Kriegeskorte, N. (2010) Pattern-information fMRI: new questions which it opens up, and challenges which face it. *International Journal of Imaging Systems and Technology*, 20(1), 31-41. Special issue on recent developments in neuroimaging, guest edited by Dae-Shik Kim. PDF.

Raizada, R.D.S., Tsao, F.M., Liu, H.M., Holloway, I.D., Ansari, D. and Kuhl, P.K. (2010) Linking brain-wide multivoxel activation patterns to behaviour: examples from language and math. *NeuroImage*, 51, 462-471. PDF. Supplementary Material.

Raizada, R.D.S. and Kishiyama, M. (2010) Effects of socioeconomic status on brain development, and how Cognitive Neuroscience may contribute to leveling the playing field. *Frontiers in Human Neuroscience*. doi:10.3389/neuro.09.003.2010. PDF.

Raizada, R.D.S., Tsao, F.M., Liu, H.M. and Kuhl, P.K. (2009) Quantifying the adequacy of neural representations for a cross-language phonetic discrimination task: prediction of individual differences. *Cerebral Cortex,* 20(1), 1-12. Advance Online Publication: April 22, 2009. PDF. Supplementary material.

Raizada, R.D.S., Richards, T.L., Meltzoff, A.N. and Kuhl, P.K. (2008) Socioeconomic status predicts hemispheric specialisation of the left inferior frontal gyrus in young children. *NeuroImage,* 40(3), 1392-401. PDF. Supplementary Material.

Raizada, R.D.S. and Poldrack, R.A. (2007) Challenge-driven attention: interacting frontal and brainstem systems. *Frontiers in Human Neuroscience*, 1, 3. PDF.

Raizada, R.D.S. and Poldrack, R.A. (2007) Selective amplification of stimulus differences during categorical processing of speech. *Neuron,* 56(4), 726-40. PDF. Supplemental Material.

Raizada, R.D.S. and Grossberg, S. (2003). Towards a theory of the laminar architecture of cerebral cortex: computational clues from the visual system. *Cerebral Cortex* , 13(1), 100-13. PDF.

Raizada, R.D.S. and Grossberg, S. (2001). Context-sensitive binding by the laminar circuits of V1 and V2: A unified model of perceptual grouping, attention, and orientation contrast. *Visual Cognition*, 8(3-5), 431-466. PDF

Grossberg, S. and Raizada, R.D.S. (2000). Contrast-sensitive perceptual grouping and object-based attention in the laminar circuits of primary visual cortex. *Vision Research*, 40, 1413-1432. PDF.

Raizada, R.D.S. (2000). "A fruitful blend, or a trinket-box? A book review of The MIT Encyclopedia of the Cognitive Sciences." *Neural Networks*, 13(3), 397-398. PDF.

Peer-reviewed conference pubs

Zinszer, B.D. and Anderson, A. J. and Kang, O. and Wheatley, T. and Raizada, R.D.S. (2015). You say potato, I say tudou: How speakers of different languages share the same concept. *Proceedings of the 37th Annual Meeting of the Cognitive Science Society.* PDF.

Kleinschmidt, D.F., Raizada, R.D.S. and Jaeger, T.F. (2015). Supervised and unsupervised learning in phonetic adaptation *Proceedings of the NIPS 2011 workshop on machine learning and interpretation in neuroimaging.* PDF.

Casey, M.A., Thompson, J., Kang,O., Raizada, R.D.S., and Wheatley.T (2011) Population codes representing musical timbre for high-level fMRI categorization of music genres. *Proceedings of the NIPS 2011 workshop on machine learning and interpretation in neuroimaging.* PDF.

Campbell, A.T., Choudhury, T., Hu, S., Lu, H., Mukerjee, M.K., Rabbi, M. and Raizada, R.D.S. (2010) NeuroPhone: Brain-mobile phone interface using a wireless EEG headset. *2010 ACM SIGCOMM Workshop on Networking, Systems, and Applications on Mobile Handhelds - MobiHeld '10.* PDF.

Grants and awards

Currently funded

NSF CAREER Award #1652127: "Testing models of semantic spaces in the brain." PI. $513k. 2017 - 2021

Previously funded

Google Faculty Award: "Good representations of meaning enable good inferences: Bridging between word2vec and analogical reasoning in the human brain." PI. $66k. 2015 - 2016

NSF Award #1228261: "Measuring and modeling object similarity in the brain: combining conceptual and perceptual representations." PI. $480K. 2012 - 2015

NY State Center of Excellence in Data Sci: funding for Ph.D. student 2015 - 2016

IARPA Award: "Knowledge representation in neural systems." Co-PI. $400K. 2014 - 2015

NSF Award #1058753: "EAGER: Brain-mobile interfaces: Exploratory research into the development of networked NeuroPhones." Co-PI. $250K. 2010 - 2012

NSF 0121950 Cognitive Neuroscience Pilot Grant. Co-PI. "Enhancing human cortical plasticity: Visual psychophysics and fMRI." $50K. 2001 - 2001

Postdoctoral Fellowship from the McDonnell-Pew Program in Cognitive Neuroscience. "Cross-modal processing and its relations to dyslexia: Psychophysics, fMRI, and neurophysiology." PI. $150K. One of only 25 awarded each year. 2000 - 2003

Invited talks

Keynote, Pattern Recognition in Neuroimaging workshop, Toronto June 2017

Cognitive Science colloquium, Hobart & William Smith Colleges	April 2016
Cognitive Science colloquium, University at Buffalo	April 2015
Lake Ontario Visionary Establishment conference, Niagara Falls	Feb. 2014
Dept. of Linguistics, University of Texas at Austin	Jan. 2012
Dept. of Cognitive Science, UCSD	June 2011
Integrated Brain Imaging Center, University of Washington	Oct 2010
Dept. of Human Development, Cornell	June 2010
Symposium, Association for Psychological Science, Boston	May 2010
Center for Cog.Neuro., Bangor University	Feb. 2010
Center for Cog.Neuro., Medical University of South Carolina	Feb. 2010
Dept. of Communication Sciences & Disorders, Northwestern University	Feb. 2010
Bernstein Centre For Comput. Neuro., Berlin	Jan. 2010
Dept. of Cognitive Science, Johns Hopkins University	Oct. 2009
Neuroscience colloquium, University of Western Ontario	May 2009
Mind, Brain and Education Colloquium, Univ. of Texas at Arlington	Apr. 2009
CELEST Colloquium Series, Boston University	Jan. 2009
Chaired and presented symposium at Cognitive Neuroscience Society Meeting: "Pattern-based fMRI analyses as a route to revealing neural representations"	June 2008
Computational and Systems Neuroscience (CoSyNe) workshop, Snowbird	March 2008
Department of Psychology, Temple University	Jan. 2007
Department of Cognitive Science, Case Western Reserve University	Jan. 2007
Brain & Math workshop, Vanderbilt University	Nov. 2006
Institute of Cognitive Neuroscience, UCL	May 2006
MRC Cognition and Brain Sciences Unit, Cambridge, UK	May 2006
Stanford NSF-LIFE Center Workshop	2005
BrainMap Colloquium Series, MGH-NMR Center	2002
Computation in the Cortical Column, NIPS workshop, Breckenridge	2000

References

Available upon request