

## RUTVIK H. DESAI

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### RESEARCH EXPERTISE AND INTERESTS

Topics: Cognitive science and neuroscience; neural basis of language, focusing on semantic memory, embodiment of meaning, reading; development, including language acquisition; speech perception; translational applications; machine learning; artificial intelligence.

Techniques: Functional MRI; Transcranial Magnetic Stimulation; connectionist and computational modeling; patient studies and lesion-symptom mapping; structural and functional connectivity.

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### EDUCATION

- Postdoctoral Fellow, Department of Neurology, Medical College of Wisconsin, Aug. 2002 – Dec. 2004. FMRI of language and speech.
- Ph.D., Computer Science and Cognitive Science, Indiana University, 2002. Dissertation: *Modeling Emergence in Language Acquisition*.
- M.S., Computer Science, Utah State University, 1995. Thesis: *Prediction of Archaeological Sites by Artificial Neural Networks*.
- B.E., Computer Engineering, Gujarat University, India. 1992. Project: *Transputer-Based Image Recognition*.

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### POSITIONS

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| Aug. 2012-              | Associate Professor, Psychology, University of South Carolina.   |
| Jan. 2007–<br>Aug. 2012 | Assistant Professor, Neurology, Medical College of Wisconsin, Milwaukee, WI. FMRI of language and speech.  |
| Jan. 2005–<br>Dec. 2006 | Instructor, Neurology, Medical College of Wisconsin, Milwaukee, WI. FMRI of language and speech.   |
| Sep. 1995–<br>May 2002  | Teaching Assistant, Computer Science Department and the Cognitive Science Program, Indiana University. Assisted in teaching several undergraduate and graduate courses in computer science and cognitive psychology. |
| Feb. 1995–<br>Aug. 1995 | Research Assistant, Los Alamos National Laboratory, Los Alamos, NM. Applications of machine learning and statistical pattern recognition.  |



## Peer-Reviewed Journal Articles

1. **Desai, R.**, Conant, L., Binder, J.R., Park, H., Seidenberg, M.S. (2013). A piece of the action: Modulation of sensory-motor regions by action idioms and metaphors. *NeuroImage* 83C, 862-869.
2. Fernandino, L., Conant, L., Binder, J.R., Blindauer, K., Hiner, B., Spangler, K., **Desai, R.** (2013). Where is the action? Action sentence processing in Parkinson's disease. *Neuropsychologia* 51(8), 1510-1517.
3. Fernandino, L., Conant, L., Binder, J.R., Blindauer, K., Hiner, B., Spangler, K., **Desai, R.** (in press). Parkinson's disease disrupts both automatic and controlled processing of action verbs. *Brain and Language*.
4. Mano, Q.R., Humphries, C., **Desai, R.**, Seidenberg M.S., Osmon, D.C., Stengel, B., Binder, J.R. (2013). The role of occipitotemporal cortex in reading: Reconciling stimulus, task, and lexicality effects. *Cerebral Cortex* 23(4), 988-1001.
5. Binder, J.R., **Desai, R.** (2011). The neurobiology of semantic memory. *Trends in Cognitive Sciences*, 15(11), 527-536.
6. **Desai R.**, Binder, J.R., Conant L., Mano, Q., Seidenberg, M.S. (2011). The neural career of sensory-motor metaphors. *Journal of Cognitive Neuroscience*, 23(9), 2376-2386.
7. Graves, W., Binder, J.R., **Desai, R.**, Conant, L., Seidenberg, M.S. (2010). Neural correlates of implicit and explicit conceptual combination. *NeuroImage*, 53(2), 638-646.
8. Lieberthal E., **Desai R.**, Ramachandran, B., Ellingson, M., Binder, J.R. (2010). Specialization along the left superior temporal sulcus for phonemic and non-phonemic categorization. *Cerebral Cortex*, 20(12), 2958-2970.
9. Graves, W., **Desai, R.**, Humpries, C., Seidenberg, M.S., Binder, J.R. (2010). Neural systems for reading aloud: A multiparametric approach. *Cerebral Cortex*, 20(8), 1799-1815.
10. **Desai R.**, Binder J.R., Conant L.L., Seidenberg M.S. (2010). Activation of sensory-motor areas in sentence comprehension. *Cerebral Cortex*, 20(2), 468-478.
11. Binder, J.R., **Desai, R.**, Graves, W., Conant, L.L. (2009). Where is the semantic system? A Critical Review and Meta-Analysis of 120 Functional Neuroimaging Studies. *Cerebral Cortex*, 19(12), 2767-2796.
12. Saad, Z., Glen, D., Chen, G., Beauchamp, M., **Desai, R.**, Cox R. (2009). A new method for improving functional-to-structural MRI alignment using local Pearson correlation. *NeuroImage* 44(3), 839-848.
13. **Desai, R.**, Lieberthal, E., Waldron, E., Binder, J.R. (2008). Left posterior temporal regions are sensitive to auditory categorization. *Journal of Cognitive Neuroscience* 20(7), 1174-1188
14. Sabri, M., Binder, J.R., **Desai, R.**, Medler, D.A., Leitl, M.D., Possing, E., Lieberthal, E. (2008). Attentional and linguistic interactions in speech perception. *NeuroImage* 39(3), 1444-1456.
15. **Desai, R.** (2007). A model of frame and verb compliance in language acquisition.

- Neurocomputing* 70(13), 2273-2287.
16. **Desai, R.**, Conant, L., Waldron, E., Binder, J.R. (2006). The effects of phonological complexity and task difficulty on past tense processing: An fMRI study. *Journal of Cognitive Neuroscience*, 18(2), 278-297.
  17. **Desai, R.**, Liebenthal, E., Possing, E., Waldron, E., Binder, J.R. (2005). Volumetric vs. surface-based intersubject alignment for localization of auditory cortex activation. *NeuroImage* 26(4), 1019-1029.
  18. Binder, J.R., Medler, D.A., **Desai, R.**, Conant, L., Liebenthal, E. (2005). Some neurophysiological constraints on models of word naming. *NeuroImage*, 27(3), 677-693.
  19. **Desai, R.** (2002). Bootstrapping in miniature language acquisition. *Cognitive Systems Research*, 3(1), 15-23.
  20. Cheng, H.D., and **Desai, R.** (1998). Scene classification by fuzzy local moments. *International Journal of Pattern Recognition and Artificial Intelligence*, 12(7), 921-938.

Submitted or in preparation

Graves, W., Binder, J.R., **Desai, R.**, Humphries, C., Stengel, B., Seidenberg, M.S. (submitted). Differences in reading strategy associated with differences in structural connectivity.

**Desai, R.**, Chambers, S., Binder, J.R., Medler, D.A., Arnoldussen, A., Conant, L., Seidenberg, M. (in preparation). Category-specific conceptual organization from sensory-motor attributes: A computational account.

### Book Chapter

21. Graves, W., Binder, J., Seidenberg, M., **Desai, R.** (2013) "Neural correlates of semantic processing in reading aloud." In M. Faust (Ed.), *Handbook of the Neuropsychology of Language* (1), 167-183, Malden, MA: Wiley-Blackwell.

### Peer-Reviewed Conference Papers

22. **Desai, R.**, and Patil, R. (1996). SALO: Combining simulated annealing and local optimization for efficient global optimization. *Proceedings of the Ninth Florida AI Research Symposium*, 233-237. Hillsdale, NJ: Erlbaum.
23. Cheng, H.D., and **Desai, R.** (1994). A fuzzy moment approach to character recognition. *Proceedings of the Third Annual Conference on Fuzzy Theory and Technology*, 421-424. Durham, NC.
24. **Desai, R.**, and Cheng, H.D. (1994). Pattern recognition by local radial moments. *Proceedings of the 12th International Conference on Pattern Recognition*, 2, 168-171. Jerusalem, Israel.

### Other Papers, Posters, Abstracts, and Conference Presentations

1. van Dam, W. and **Desai, R.H.** (2013). Effects of syntactic structure on concept grounding. Society for Neurobiology of Language.
2. Fernandino, L., Binder, J.R., **Desai, R.H.**, Pendl, S., Humphries, C.J., Conant, L., Seidenberg, M.S. (2013). Semantic word processing recruits cortical areas involved in the integration of sensory-motor information. Society for Neurobiology

- of Language.
3. Fernandino, L., Binder, J.R., **Desai, R.H.**, Pendl, S., Humphries, C.J., Conant, L., Seidenberg, M.S. (2013). The neural representation of word meaning reflects sensory-motor attributes. OHBM Meeting.
  4. Fernandino, L., Conant, L., Binder, J.R., Blindauer, K., Hiner, B., Spangler, K., **Desai, R.H.** (2012). Where is the action? Action sentence processing in Parkinson's disease. Cognitive Neuroscience Society Meeting. **Winner, Postdoctoral Fellow Award, L. Fernandino.**
  5. **Desai, R.H.**, Tadimeti, U., Binder, J.R. (2012). Anterior temporal response to familiar person names and places. Cognitive Neuroscience Society Meeting.
  6. Cox, C., Seidenberg, M. S., Binder, J. R., **Desai, R. H.**, Rogers, T. T. (2012). Are semantic representations of words radically distributed? Cognitive Neuroscience Society Meeting.
  7. Fernandino, L., Conant, L., Binder, J.R., Blindauer, K., Hiner, B., Spangler, K., **Desai, R.H.** (2011). Parkinson's disease selectively disrupts processing of action verbs. Neurobiology of Language Conference.
  8. Stengel, B., Binder, J.R., Humphries, C., **Desai, R.H.** (2011). Automated parcellation of the superior temporal sulcus using resting-state connectivity fMRI. Society for Neuroscience Meeting.
  9. **Desai, R.H.**, Tadimeti, U., Binder, J.R. (2011). Semantic neighborhood effects for concrete and abstract words. Cognitive Neuroscience Society Meeting.
  10. Liebenthal, E., **Desai, R.H.**, Humphries, C., Sabri, M. (2011). The functional organization of the left STS: a large scale meta-analysis of PET and fMRI studies. Human Brain Mapping Meeting.
  11. Binder, J.R., Stengel, B., Humphries, C., **Desai, R.H.** (2011). Functional parcellation of the superior temporal sulcus using resting state connectivity. Cognitive Neuroscience Society Meeting.
  12. Graves, W., Binder, J.R., **Desai, R.H.**, Humphries, C., Stengel, B., Seidenberg, M.S. (2011). Individual differences in reading aloud predict structural connectivity in the reading network. Human Brain Mapping Meeting (submitted).
  13. **Desai, R.**, Conant L., Binder, J.R., Park, H., Seidenberg, M.S. (2010). Neural correlates of idiomatic and non-idiomatic action metaphors. Human Brain Mapping Meeting.
  14. Graves, W., Baillet, S., **Desai, R.**, Binder, J.R. (2010). Cortical systems for early semantic processing in word recognition. Society for Neuroscience Meeting.
  15. **Desai, R.**, Chambers, S., Binder. J.R., Medler, D., Arnoldussen, A., Conant, L.L., Seidenberg, M.S. (2009). Category-specific deficits and sensory-motor knowledge: Connectionist models. Society for Neuroscience Meeting.
  16. Graves, W., Binder, J.R., **Desai, R.**, Conant, L.L., Seidenberg, M.S. (2009). Neural correlates of implicit and explicit conceptual combination. Society for Neuroscience Meeting.
  17. Stengel, B., Binder, J.R., Humphries, C., **Desai, R.**, Seidenberg, M.S. (2009). Distinct modality-specific knowledge systems identified with functional connectivity MRI. Society for Neuroscience Meeting.
  18. **Desai R.**, Binder, J.R., Conant L., Mano, Q., Seidenberg, M.S. (2008). Grasping sensory-motor metaphor processing. Society for Neuroscience Meeting.
  19. Graves, W., Medler, D., **Desai, R.**, Seidenberg, M., Grabowski, T., Binder, J.

- (2008) Neural network models of reading applied to analysis of fMRI data. Society for Neuroscience Meeting.
20. Cox, R., Saad, Z., Glen, D., Beauchamp, M., **Desai, R.** (2008). False sense of EPI-to-structural alignment with common cross-modality registration methods. Human Brain Mapping Meeting.
  21. Liebenthal, E., **Desai, R.**, Conant, L., Sabri, M., Humphries, C., Binder, J.R. (2008). A model for functional segregation of middle and posterior regions of the superior temporal sulcus for speech perception: A meta-analysis of the neuroimaging literature. Cognitive Neuroscience Society Meeting.
  22. Graves, W., **Desai, R.**, Humphries, C., Seidenberg, M.S., Binder, J.R. (2008). A multiparametric approach to reading aloud. Society for Neuroscience Meeting.
  23. **Desai, R.**, Conant, L., Binder, J.R. (2007). Friends and enemies of the past tense. Society for Neuroscience Meeting.
  24. Graves, W., Medler, D., **Desai, R.**, Seidenberg, M., Binder, J. (2007) Cluster analysis of a neural network hidden layer applied to fMRI data on reading. Computational Cognitive Neuroscience Conference/Dynamical Neuroscience XV, San Diego, CA.
  25. Graves, W., Medler, D., **Desai, R.**, Seidenberg, M., Grabowski, T.J., Binder, J.R. (2007). Neural network models of reading applied to analysis of fMRI data. Society for Neuroscience Meeting.
  26. **Desai R.**, Liebenthal E., Desai A., Humphries C., Ramachandran B., Ellingson M., Binder J.R. (2006). Correlations between categorical perception of sounds and white-matter integrity in the temporal lobe. Society for Neuroscience Meeting.
  27. Ellingson M., Liebenthal, E., **Desai, R.**, Ramachandran, B., Tirko, N., Mulcair-Jones, M., Binder, J.R. (2006). Dipole modeling of the P220 component after categorical training on phonemic and non-phonemic sounds. Society for Neuroscience Meeting.
  28. Binder J.R., Medler D.A., Arnoldussen, A., **Desai, R.**, Conant, L., Seidenberg, M. (2006). Neural organization of semantic knowledge reflects sensory-motor attributes. Human Brain Mapping Meeting.
  29. **Desai R.**, Liebenthal E., Ramachandran, B., Ellingson, M., Binder, J.R. (2006). Effects of categorization training on phonemic and nonphonemic perception: An fMRI study. Cognitive Neuroscience Society Meeting.
  30. Liebenthal E., Ellingson, M., **Desai R.**, Ramachandran, B., Binder, J.R. (2006). ERP correlates of learning to categorize speech-like sounds. Cognitive Neuroscience Society Meeting.
  31. **Desai R.**, Binder, J.R., Medler, D.A., Conant L., Seidenberg, M.S. (2006). Activation of sensory areas by sentences. *Fifth International Conference on Development and Learning*.
  32. Simpson, M., Witton, C., Barnes, G., Fisher, A., Furlong, P., **Desai, R.**, Liebenthal, E. (2005). Time-frequency analysis of continuous and categorical sinewave speech perception: An MEG study. Human Brain Mapping Meeting.
  33. **Desai R.**, Liebenthal, E., Waldron, E., Binder, J.R. (2005). The left superior temporal sulcus is sensitive to categorical but not to acoustic properties of speech. Cognitive Neuroscience Society Meeting.
  34. Liebenthal E., **Desai, R.**, Waldron, E., Binder, J.R. (2005). Neural substrates of

- phonemic categorization in the left temporal lobe. Cognitive Neuroscience Society Meeting.
35. Binder J.R., Medler, D.A., **Desai, R.**, Conant, L., Possing, E., Liebenthal E. (2005). Testing dual-route models of word naming with fMRI. Cognitive Neuroscience Society Meeting.
  36. Sabri M., Binder, J.R., **Desai, R.**, Leidl, M.D., Medler, D.A., Possing, E., Liebenthal, E. (2005). Attentional and linguistic interaction in speech perception. Cognitive Neuroscience Society Meeting.
  37. **Desai, R.**, Liebenthal, E., Waldron, E., and Binder, J.R. (2004). Neural correlates of continuous and categorical sinewave speech perception: An fMRI study. Society for Neuroscience Meeting.
  38. **Desai, R.**, Liebenthal, E., Possing, E.T., and Binder, J.R. (2004). Volumetric vs. surface-based alignment for localization of auditory cortex activation. Cognitive Neuroscience Society Meeting.
  39. Conant, L., **Desai, R.**, and Binder, J.R. (2004). The effects of phonological complexity on past tense processing: An fMRI study. Cognitive Neuroscience Society Meeting.
  40. Medler, D.A., Arnoldussen, A., Binder, J.R, **Desai, R.**, Conant, L., and Seidenberg, M.S. (2004). Activation of semantic regions by the printed word: An fMRI study. Cognitive Neuroscience Society Meeting.
  41. **Desai, R.** (2002). Item-based language learning in children and connectionist networks. *Proceedings of the 38<sup>th</sup> Annual Conference of the Chicago Linguistic Society*, Chicago. **Winner, Best Student Paper Travel Award.**
  42. **Desai, R.** (1998). Learning syntactic frames with simple recurrent networks. Twentieth Annual Conference of the Cognitive Science Society.
  43. **Desai, R.** (1997). Structure-mapping vs. high-level perception: Why the fight is not mistaken. Nineteenth Annual Conference of the Cognitive Science Society.
  44. Dhar, A., and **Desai, R.** (1995). High-dimensional modeling with wavelets. Los Alamos National Labs Technical Report LA-UR-95-4437.

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## TEACHING

- PSYC 888 The Neurobiology of Meaning (USC)
- PSYC 507 Cognitive Neuroscience (USC)
- Fundamentals of Neuroscience (Language and memory sections, MCW)
- Advanced Systems Neuroscience (Language section, MCW)
- AFNI Workshop (Surface modeling section, MCW)
- C212 Introduction of Software Programming (IU)

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## INVITED PRESENTATIONS

- University of South Carolina (Psychology). Feb. 2012. A piece of the action: Sensory-motor systems in semantics.

- University of Maryland, College Park (Hearing and Speech Sciences). Mar. 2011. A piece of the action: Sensory-motor systems in semantics.
- Ohio State University (Psychology). Feb. 2011. A piece of the action: Sensory-motor systems in semantics.
- TN Medical College and Nair Hospital, Mumbai, India (Audiology and Speech Therapy). June 2010. Speech perception in the brain.
- Jaslok Hospital and Research Center, Mumbai, India (Neurology). June 2010. Sensory-motor correlates of semantic memory.
- Georgia State University (Psychology). Mar. 2007. Sensory-motor correlates of semantic memory.
- Medical College of Wisconsin (Neuropsychology). Jan. 2003. Introduction to connectionist modeling.

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#### **SOFTWARE** *(available through home page)*

- Created probabilistic macro-label brain atlases for cortical and subcortical areas based on the Destrieux, Desikan-Killiany, and Freesurfer parcellation schemes. The atlases are publicly available and have been integrated with AFNI ([afni.nimh.nih.gov](http://afni.nimh.nih.gov)), a major neuroimaging data analysis package.
- Wrote connectionist (neural network) software COHELD (Contrastive Hebbian Learning with Delays). Implements the Contrastive Hebbian Learning algorithm in a flexible framework, allowing detection of nonlinear temporal as well as spatial patterns with biologically plausible learning.

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#### **AWARDS**

- Best Student Paper Travel Award, 38<sup>th</sup> Annual Conference of the Chicago Linguistic Society, 2002.
- Cognitive Science Summer Research Award, Indiana University, 2000, 2001, 2002.
- National Metric Scholarship Certificate, Ahmedabad, India, 1988.

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#### **POSTDOCTORAL AND GRADUATE STUDENTS SUPERVISED**

Omid Kardan, Graduate Student, 2013-

Wessel van Dam, Postdoctoral Fellow, 2012-

FMRI and behavioral studies of embodiment

Leonardo Fernandino, Postdoctoral Fellow, 2010-2012

TMS and behavioral studies of embodiment healthy and patient populations

Usha Tadimetri, M.S. student (Thesis Committee Chair), 2010-2013

Anterior temporal lobe sensitivity to associations with proper and common names

William Gross, M.D./Ph.D. student (Thesis Committee Member), 2008-2010

Using fMRI to improve outcome in the surgical treatment of temporal lobe epilepsy

Benjamin Stengel, Ph.D. student (Thesis Committee Member), 2006-2010

Organization of conceptual knowledge within the cerebral cortex

Quintino Mano, Ph.D. student, 2007-2009

Orthography and objects in the posterior occipitotemporal sulcus



Shawn Chambers, M.D. summer student, 2007  
Computational models of category-specific semantic deficits  
Brian Matysiak, M.D. summer student, 2004  
Surface measures for predicting language lateralization

### Graduate Student Committees

Wanze Xie, 2012- (advisory)  
Jing Wang, 2013 (dissertation)  
Tim Boiteau, 2013 (comprehensive exam)  
Jimmy Nye, 2013- (oral exam, advisory)  
Omid Kardan, 2013- (advisory)

### Undergraduate Research Assistants Supervised

Carl Brzorad, 2012-  
Caroline Young, 2013-

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## **SERVICE**

- Experimental Psychology Admissions Committee, 2013-2014
- Graduate Student Day judge (oral presentations), April 2013
- Grant reviewer, USC ASPIRE II program, April 2013
- Institute of Mind and Brain Colloquium Committee, 2012-
- Grant reviewer, *South Carolina Clinical & Translational Research Institute*, 2013.
- Ad-hoc reviewer for *Trends in Cognitive Sciences*, *NeuroImage*, *Journal of Cognitive Neuroscience*, *Cerebral Cortex*, *Annals of Neurology*, *Journal of Neuroscience*, *Quarterly Journal of Experimental Psychology*, *Human Brain Mapping*, *Cortex*, *Journal of Neurophysiology*, *Brain and Language*, *PLoS Biology*, *Frontiers in Cognition*, *Journal of Neurolinguistics*, *Cognitive Science Society Annual Meeting* (various years).
- Book reviewer, *Psychology Press*, 2010, 2011.
- Grant reviewer, *The Dutch Council for the Humanities*, 2008.
- Co-chair, MCW Research Day Committee, 2012
- Admissions Committee Member, Computer Science Department, Indiana University, 2000-2001.
- Panelist and advisor, International Teaching Assistants' Forum, Indiana University, 1998.
- Interviewed in the *Milwaukee Magazine*, August 2007.

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## **MEMBERSHIPS**

Cognitive Neuroscience Society  
Society for Neuroscience  
Organization for Human Brain Mapping  
Society for Neurobiology of Language