APOORVA BHANDARI

CLPS, Brown University, 190 Thayer St., Providence RI 02912
Phone: +1-310-463-1179, E-mail: *apoorva_bhandari@brown.edu*

EMPLOYMENT

2022 – Present	**Assistant Professor (Research)** CLPS, Brown University, Providence, RI, USA.
2021 – 2022	**Visiting Professor of Psychology** Ashoka University, India
2018 – 2022	**Investigator (Research Scientist)** CLPS, Brown University, Providence, RI, USA.
2013 – 2018	**Postdoctoral Research Associate** Badre lab, CLPS, Brown University, Providence, RI, USA.
2005 – 2007	**Data Scientist and Senior Executive** Educational Initiatives, Ahmedabad, India

EDUCATION

2013	**PhD in Cognitive Neuroscience** MRC Cognition and Brain Sciences Unit, University of Cambridge, UK
2008	**M.Sc. (Research) in Neuroscience** School of Biomedical Sciences, University of Edinburgh, UK
2004	**Graduate Research Scholar in Biology** National Centre for Biological Science, TIFR, India
2003	**B.Sc. in Biochemistry and Biotechnology** St. Xavier's College, Gujarat University, India

AWARDS & HONORS

2013	**INCF and CSHL Fellowships** for attending the Cold Spring Harbor Computational and Cognitive Neuroscience Summer School in Beijing, China.
2008	**Gates Cambridge Scholar** (Full tuition and stipendiary support ~$150,000) for graduate studies at University of Cambridge, United Kingdom.

2008 **Overseas Research Scholar** ($50,000) for graduate studies at the University of Edinburgh and the University of Cambridge, United Kingdom.

2004 **Junior Research Scholar** (Full tuition and stipendiary support) for graduate studies at the National Centre for Biological Sciences, India.

GRANT FUNDING

2024 **NIH (NIGMS) R01 Grant** ($100,000) *Investigating the role of noise correlations in learning*. (Role: Co-PI with Matthew Nassar)

2021 – 2026 **NIH (NIMH) R01 Grant** ($2,426,109) *Human prefrontal representational Geometry and cognitive control function*. (Role: Co-author & Co-Investigator; PIs: David Badre, Stefano Fusi & Ulrich Mayr)

2021 – 2024 **NSF NCS-FO Grant** ($775,948): *Cognitive maps as a framework for organizing relationships in large-scale real social networks*. (Role: Co-author & Co-Investigator; PIs: Oriel FeldmanHall, Matthew Nassar)

2020 – 2021 **Zimmerman Fund for Scientific Innovation grant** ($100,000): *Human prefrontal representational geometry and cognitive control function.* (Role: Co-author & Co-Investigator; PI: David Badre).

2018 – 2020 **NIH (NINDS) R21 Grant** ($275,000): *Mapping representational format across the human brain.* (Role: Co-author & Co-Investigator; PIs: David Badre & Stefano Fusi).

PUBLICATIONS

(**equal contribution as first author, §equal contribution as senior author)*

Kikumoto, A, **Bhandari, A**, Shibata, K, Badre, D (2023) "A transient high-dimensional geometry affords stable conjunctive subspaces for efficient action selection" *bioRxiv* (link) (in review at *Nature Communications*)

Son, J, **§Bhandari, A**, §FeldmanHall, O (2023) "Abstract cognitive maps of social network structure aid adaptive inference" *PsyArXiv* (link) (in press at *PNAS*)

Vives, M, de Bruin, D, van Baar, JM, §FeldmanHall, O, **§Bhandari, A** (2023) "Aversion to uncertainty predicts the neural expansion of semantic representations", *Nature Human Behavior* (link)

Son, J, **§Bhandari, A**, §FeldmanHall, O (2021) "Cognitive maps enable prediction of unseen relationships in social networks" *Proceedings of the National Academy of Sciences*, 118 (39) (link)

Nassar, MR, Scott, D. & **Bhandari, A.** (2021) "Noise correlations for faster and more robust learning" J. Neuroscience 4(31), 6740-6752 (link)

Badre, D., **Bhandari, A.**, Keglovits, H., Kikumoto, A. (2021) "The dimensionality of neural representations for control" *Current Opinion in Behavioral Science*, 38, 20-28 (link)

Bhandari, A., Badre, D. (2020) "Fronto-parietal, cingulo-opercular and striatal contributions to learning and implementing control policies" *bioRxiv* (link)

Son, J., **Bhandari, A.,** FeldmanHall, O. (2019) "Crowdsourcing punishment: Individuals reference group preferences to inform their own punitive decisions" *Scientific Reports*, 9(1), 11625 (link)

Bhandari, A., Gagne, C., Badre, D. (2018) "Just above chance: is it harder to decode information from human prefrontal cortex hemodynamic activity patterns" *Journal of Cognitive Neuroscience*, 30(10), 1473-1498 (link)

Bhandari, A., Badre, D. (2018) "Learning and transfer of working memory gating policies" *Cognition*, 172(1), 89-100 (link)

Duncan, J., Chylinski, D., Mitchell, DJ, **Bhandari, A.** (2017) "Cognitive compositionality and fluid intelligence: solving complex problems in simple parts" *Proceedings of the National Academy of Sciences*, 114(20), 5295-5299 (link)

Bhandari, A, Badre, D., Frank, MJ (2017) "Learning Cognitive Control" in T. Egner (Ed.), The Wiley Handbook of Cognitive Control. Oxford: John Wiley & Sons.

Bhandari, A, Duncan, J (2014) "Goal neglect and knowledge chunking in the construction of novel behavior" *Cognition*, 130(1), 11-30 (link)

PUBLICATIONS IN PREPARATION

Bhandari, A., Keglovits, H., Chicklis, E., Fusi, S. & Badre, D. **"**Task structure shapes the geometry of neural representations in human lateral prefrontal cortex" (in preparation)

Son, J., Vives, M., [§]**Bhandari, A.,** [§]FeldmanHall, O. **"**Offline rest reshapes the structure of social cognitive maps and behavior" (in preparation)

Keglovits, H., **Bhandari, A.,** Chicklis, E., Fusi, S. & Badre, D. **"**The geometric landscape of task representations across the human brain" (in preparation)

Son, J., [§]**Bhandari, A.,** [§]FeldmanHall, O. **"**Hippocampus encodes compositional structural features of social networks" (in preparation)

Bhandari, A., Braverman, Y., Badre, D. "Denoising task fMRI data for pattern analysis: evaluation of available approaches" (in preparation).

INVITED TALKS

"Structured Representations for a flexible cognition"
Indian Institute of Technology, Gandhinagar, India, April 2023

"Structured Representations for a flexible cognition"
Ashoka University, India, March 2023

"Task structure shapes the geometry of control representations in PFC"
Carney Institute for Brain Science, Providence, USA, March 2023

"What's a good SDL anyway: Residual error analysis for tracking learning"
Educational Initiatives, India, February 2023

"Cognitive maps of social features enable flexible inference in social networks"
Indian Institute of Technology, Gandhinagar, India October 2021

"The dimensionality of neural representations for control"
Brown unconference, Providence, June 2020

"Building representations for learning novel tasks"
Educational Initiatives Inc, India, September 2019

"fMRI adaptation vs MVPA: Measuring human prefrontal representational geometry"
Data Blitz at the Control Processes Conference 2019, Providence, May 2019

"Estimating representational dimensionality with repetition suppression"
Fusi Laboratory at the Zuckerman Institute, Columbia University, June 2018

"Parsing complex tasks into distinct attentional parts"
Cognitive, Linguistic, Psychological Sciences, Brown University, February 2013

"Parsing complex tasks into distinct attentional parts"
Oxford Centre for Human Brain Activity, Oxford University, January 2013

"Parsing complex tasks into distinct attentional parts"
Department of Psychology, Princeton University, November 2012

"Investigating the assembly of task sets"
Cambridge Neuroscience, Cambridge, UK May 2010.

"Multi-voxel pattern analysis in the prefrontal cortex"
Imaging Interest Group, MRC Cognition & Brain Sciences Unit, Cambridge, UK May 2009

PUBLISHED ABSTRACTS

Keglovits, H., **Bhandari, A.,** Chicklis, E., Badre, D. "Task structure shapes the geometry of control representations in PFC." *Annual Cognitive Neuroscience Society meeting*, San Francisco, USA, April 2023.

Keglovits, H., **Bhandari, A.,** Chicklis, E., Badre, D. "The relationship between task demands and the dimensionality of control representations." *Annual Society for Neuroscience meeting*, San Francisco, USA, November 2022.

Son, J., **Bhandari, A.,** & FeldmanHall, O. (2022). "The Successor Representation Explains How People Infer Unobserved Relationships in Social Networks". *Annual Reinforcement Learning & Decision-Making conference*, Providence, RI, USA.

Son, J., **Bhandari, A.**, & FeldmanHall, O. (2019). Crowdsourcing punishment: Individuals reference group preferences to inform their own punitive decisions. *6th Annual Meeting of the Society for Affective Science*, Boston, MA.

Bhandari, A., Benna, M., Rigotti, M., Fusi, S., Badre, D. (2019) "fMRI Adaptation vs pattern analysis: evaluating methods for measuring human representational geometry and dimensionality." *Annual Society for Neuroscience meeting*, Chicago, USA, November 2019 (submitted).

Bhandari, A., Benna, M., Rigotti, M., Fusi, S., Badre, D. (2019) "Measuring PFC representational geometry: fMRI Adaptation vs pattern analysis." *3rd Cognitive and Computational Neuroscience*, Berlin, Germany

Bhandari, A., Badre, D. (2018) "Two distinct processes underlie control policy learning." Poster presentation at the *Annual Society for Neuroscience meeting*, San Diego DC, USA

Bhandari, A., Rigotti, M., Gagne C., Fusi, S., Badre, D. (2017) "Characterizing prefrontal cortex representations with fMRI." Poster presentation at the *Annual Society for Neuroscience meeting*, Washington DC, USA

Bhandari, A., Badre, D. (2016) "Learning working memory gating thresholds via reinforcement learning." Poster presentation at the *Annual Society for Neuroscience meeting*, San Diego, CA, USA

Bhandari, A., Badre, D. (2016) "Discovering gating policies: dissociating frontal & striatal contributions." Poster presentation at the *23rd Annual Cognitive Neuroscience Society meeting*, New York, NY, USA

Bhandari, A., Badre, D. (2015) "Sampling improves short-term, but not long-term, memory of exceptions to rules during the learning of abstract rule structures", at *the 57th Annual Meeting of the Psychonomics Society*, Chicago, IL, USA

Bhandari, A., Badre, D. (2015) "Early practice effects reflect the learning of the dynamic structure of the task" at the *22nd Annual Cognitive Neuroscience Society meeting*, San Francisco, CA, USA

Bhandari, A., Kusonoki, M., Sigala, N., Stokes, M., Gaffan, D., Duncan, J. (2013) "Prefrontal activity rapidly adapts to code task-role of novel objects." Poster presentation at the *Annual Society for Neuroscience meeting*, San Diego, CA, USA

Bhandari, A., Duncan, J. (2012) "Effects of task demands on task relevant coding in MD regions." Poster presentation at the *19th Annual Cognitive Neuroscience Society meeting*, Chicago, IL

PEER REVIEW

eLife, Neuron, Nature Neuroscience, Journal of Experimental Psychology (General), Cognition, Neuropsychologia, Journal of Cognitive Neuroscience, Journal of Neurophysiology, Human Brain Mapping,Scientific Reports, Neuroscience & Biobehavioral reviews, Intelligence, Memory & Cognition, Quarterly Journal of Experimental Psychology, Frontiers in Psychology, Frontiers in Neuroimaging, Annual Conference on Cognitive Computational Neuroscience, National Science Foundation

TEACHING AND MENTORING EXPERIENCE

MENTORING

2018 – present	Co-advised graduate (PhD) students (Jae-Young Son, Haley Keglovits, Alice Xia) at CLPS, Brown University
2016 – present	Co-advised undergraduate honors thesis students (Celia Ford, now graduate student at UC Berkeley; Yael Braverman, currently at Boston Children's Hospital)
2013 – present	Mentored several undergraduate research assistants for Independent Study at CLPS, Brown University and Department of Psychology,
2015 – present	Co-supervised summer research students from underrepresented background as part of the BP-ENDURE program

TEACHING

2022 - 2023	Designed & taught an online undergraduate course on "Computational Modelling of Behavior" for two semesters at the Department of Psychology, Ashoka University, India (53 students)
2009 - 2011	Conducted Oxbridge-style seminars (small-group teaching) for Department of Experimental Psychology: Natural Sciences Tripos & Medical Sciences Tripos students at the University of Cambridge (Total: 16 undergraduates ~100 sessions).
Spring 2017	Invited lecture on "Artificial neural networks as tools in neuroscience" for the Neural Dynamics course taught by Prof. Chris Moore at Brown University.
Summer 2012	Invited lectures for the Neuroimaging Methods course taught at MRC Cognition & Brain Sciences Unit, University of Cambridge.

Fall 2006	Designed and taught a lecture module on Drosophila Development, for the Development and Evolutionary Biology course at the Department of Biochemistry, Maharaja Sarajevo University, India.
2005 – 2007	Senior K12 Teacher Trainer for Educational Initiatives plc. Designed and conducted over 20 two-day teacher training workshops on student misconceptions and the use of diagnostic assessment data for high school and middle school teachers.
2005 – 2006	Adjunct Instructor at the Department of Biotechnology, St. Xavier's College, Ahmedabad. Supervised revamp of a commercial biotechnology simulation course.
Summer 2003	Adjunct Instructor at the Xavier Research Foundation, St. Xavier's College, Gujarat University, Ahmedabad. Designed and taught an undergraduate summer course on Natural Selection mechanisms (14 students).
2018 – 2019	Consultant to Riverside School, Ahmedabad, India for developing curriculum and pedagogy for the "Thinking rationally" program for K12 students.

SERVICE

2016 - 2018	Managing committee of *Postdocs in Brain Science* at the Carney Institute of Brain Science, Brown University, Providence, USA.
2016 - 2017	Postdoctoral representative on the Diversity and Inclusion Committee of the Cognitive, Linguistics, and Psychological Sciences department at Brown University, Providence, USA.
2009 - 2010	Graduate student representative on the Management Committee of the MRC Cognition and Brain Sciences Unit, Cambridge, UK.

OUTREACH

2022 - 2023 programs	Research mentor for high school students through the Jinso & CMP research
2018 - 2019	Consultant to Riverside School, Ahmedabad, India for developing curriculum and pedagogy for the "Thinking rationally" program for K12 students.
2019	Public talk on "Building representations for learning novel tasks" at Educational Initiatives Inc, India, September 2019.
2007	Outreach activities for children as part of Brain Awareness Week at the University of Edinburgh

PROFESSIONAL ASSOCIATIONS

Cognitive Neuroscience Society, Society for Neuroscience, Association for Psychological Science

REFERENCES

John Duncan, David Badre, Oriel FeldmanHall, Matthew Nassar, Stefano Fusi, Emma Wood, K. Vijayraghavan, Upinder Bhalla, Sridhar Rajagopalan, Venkat Krishnan N, Kiran Sethi