



Runnan Cao, Ph.D.

Department of Radiology
4525 Scott Ave, St. Louis, MO, 63110
Phone: 304-282-8906
Email: rncao90@gmail.com

HIGHLIGHTS

- Obtained multiple highly competitive awards, including **BRAIN Initiative Advanced Postdoctoral Career Transition Award (K99/R00)**, BBRF Young Investigator Award, Small Grant Program Award of the McDonnell Center for Systems Neuroscience
- Expertise in multimodal approach, including human single-neuron recordings, intracranial electrophysiology, high-resolution fMRI, and computational modeling.
- Research focuses on face perception and social cognition.

PROFESSIONAL POSITIONS

2025 - **Instructor**, Department of Radiology
Washington University in St. Louis, St. Louis, MO

EDUCATION AND TRAINING

2022 – 2025 **Postdoctoral Scholar**, Computational and social neuroscience
Advisor: Dr. Shuo Wang, Washington University in St. Louis, St. Louis, MO

2018 – 2022 **Postdoctoral Scholar**, Computational and social neuroscience
Advisor: Dr. Shuo Wang, West Virginia University, Morgantown, WV

2012 – 2018 **Ph.D.**, Cognitive Neuroscience
Advisor: Drs. Peng Zhang and Sheng He, Institute of Biophysics, Chinese Academy of Sciences, China

2008 – 2012 **B.S.**, Biotechnology
Advisor: Dr. Chengqiang He, Shandong Normal University, China

PUBLICATIONS (* equal contributions; #co-corresponding author)

- Cao R.**[#], Zhang J., Zheng J., Wang Y., Brunner P., Willie J. & Wang S.[#]. Computational single-neuron mechanism of visual object coding in the human temporal lobe. (accepted by *Nature Communications*)
- Cao R.**[#], Wang J., Lin C., De Falco E., Peter A., Rey HG., DiCarlo J., Todorov A., Rutishauser U., Li X., Brandmeir NJ., Wang S.[#] Feature-based encoding of face identity by single neurons in the human amygdala and hippocampus *Nature Human Behaviour*. 10.1038/s41562-025-02218-1 (2025)
- Cao R.**[#], Zhang J, Zheng J, Wang Y, Brunner P, Willie JT, Wang S.[#] A neural computational framework for face processing in the human temporal lobe. *Current Biology*. 10.1016/j.cub.2025.02.063. (2025)
- Cao R.**[#], Brunner P., Chakravarthula P., Wahlstrom K., Inman C., Smith E., Li X., Mamelak A., Brandmeir NJ., Rutishauser U., Willie J & Wang S.[#] A neuronal code for object representation and memory in the human amygdala and hippocampus. *Nature Communications*. 10;16(1):1510. (2025)
- Cao R.**[#], Brunner P., Brandmeir N., Willie J. & Wang S.[#]. A human single-neuron dataset for object recognition. *Scientific Data* 10.1038/s41597-024-04265-1. (2025)
- Wang Y., Brunner P., Willie J., **Cao R.** & Wang S. Single-neuron datasets for linguistic and semantic processing in the human amygdala and hippocampus. (in press in *Scientific Data*)
- Zhang J., **Cao R.**, Zhu X., Zhou H. and Wang S. Distinct attentional characteristics of neurons with visual feature coding in the primate brain. *Science Advances*. 10.1126/sciadv.adq0332. (2025)

- Cao R.**[#], Dubois J., Mamelak A., Adolphs R.^{*}, Wang S.^{*}, Rutishauser U.^{**} Domain-specific representation of social inference by neurons in the human amygdala and hippocampus. *Science Advances*. 10.1126/sciadv.ado616. (2024)
- Wang Y.^{**}, **Cao R.**^{**#}, Chakravarthula P., Yu H. & Wang S.[#] Atypical neural encoding of faces in individuals with autism spectrum disorder. *Cerebral cortex*. 10.1093/cercor/bhae060. (2024)
- Wang Y.^{*}, **Cao R.**^{*}, Li X., Wang S. Encoding of visual objects in the human medial temporal lobe. *Journal of Neuroscience*. 10.1523/JNEUROSCI.2135-23.2024. (2024)
- Wang J., **Cao R.**, Chakravarthula P., Brandmeir N.J., Li X., Wang S. A critical period for developing face recognition. *Patterns*. 10.1016/j.patter.2023.100895. (2024)
- Zhao S., **Cao R.**, Lin C., Wang S., & Yu H. Differences in the link between social trait judgment and socio-emotional experience in neurotypical and autistic individuals. *Scientific Reports*. doi.org/10.1038/s41598-024-56005-5. (2024)
- Cao R.**[#], Wang J., Brunner P., Willie J., Li X., Rutishauser U., Brandmeir N.J., & Wang S.[#] The neuronal population in the human amygdala and hippocampus encodes face familiarity and learning. *Cell Reports*. doi.org/10.1016/j.celrep.2023.113520. (2023)
- Cao R.**[#], Zhang N., Yu H., Webster P., Paul L., Li X., Lin C.[#] & Wang S.[#] Comprehensive social trait judgments from faces in autism spectrum disorder. *Psychological Science*. doi:10.1177/09567976231192236. (2023)
- Donoghue T.^{*}, **Cao R.**^{*}, Han C.^{*}, Holman C., Brandmeir, N., Wang S.[#] & Jacobs J.[#] Single neurons in the human medial temporal lobe flexibly shift representations across spatial and memory tasks. *Hippocampus*. 33(5): 600-615. doi: 10.1002/hipo.23539. (2023)
- Sun S., **Cao R.**, Wang S. A uniform human multimodal dataset for emotion perception and judgment. *Scientific Data*. doi.org/10.1038/s41597-023-02693-z. (2023)
- Wang S., Sun S., **Cao R.**, Kar K., Yu H., Multimodal investigations of human face perception in neurotypical and autistic adults. *Ann NY Acad Sci*. doi.org/10.1111/nyas.15084 (2023)
- Kao H., Yao Y, Yang T, Ziobro J, Zylinski M, Yaqub M, Hu S, **Cao R.** et al., Sudden unexpected death in epilepsy and respiratory defects in a mouse model of DEPDC5-related epilepsy. *Annals of Neurology*. doi: 10.1002/ana.26773. (2023)
- Han C., Donoghue T., **Cao R.**, Kunz L., Wang S.[#] & Jacobs J.[#] Using multi-task experiments to test principles of hippocampal function. *Hippocampus*. 33(5): 646-657. doi: 10.1002/hipo.23540. (2023)
- Cao, R.**[#], Lin C., Li X., Brandmeir N.J. & Wang S.[#] A neuronal social trait space of faces in the human amygdala and hippocampus, *Molecular Psychiatry*, doi:10.1038/s41380-022-01583-x. (2022)
- Cao, R.**[#], Lin, C., Brandmeir, N.J. & Wang S.[#] A human single-neuron dataset for face perception. *Scientific Data* 9, 365, doi: 10.1038/s41597-022-01482-4. (2022)
- Wang, J.^{*}, **Cao R.**^{*}, Brandmeir, N.J., Li X. & Wang S.[#] Face identity coding in the deep neural network and primate brain. *Communications Biology* 5, 611, doi: 10.1038/s42003-022-03557-9 (2022)
- Yu H. ^{*}, **Cao R.**^{*}, Lin C. & Wang S.[#]. Distinct neurocognitive bases for social trait judgments of faces in autism spectrum disorder. *Translational Psychiatry* 12, 104, doi: 10.1038/s41398-022-01870-9. (2022)
- Cao R.**[#], Li X., Brandmeir N.J., Wang S.[#]. Encoding of facial features by single neurons in the human amygdala and hippocampus. *Communications Biology* 4, 1394, doi: 10.1038/s42003-021-02917-1. (2021)
- Cao, R.**[#], Todorov, A., Brandmeir, N.J & Wang, S.[#] Task modulation of single-neuron activity in the human amygdala and hippocampus. *eNeuro*, doi: 10.1523/ENEURO.0398-21. (2021)
- Cao R.**^{*}, Qian C.^{*}, Ren S., He S. & Zhang P. Visual adaptation and 7T fMRI reveal facial identity processing in the human brain under shallow interocular suppression. *NeuroImage, Volume 244*, doi: 10.1016/j.neuroimage.2021.118622. (2021)
- Cao R.**[#], Li X., Todorov A., Wang S.[#] A flexible neural representation of faces in the human brain. *Cerebral Cortex Communications*, doi: 10.1093/texcom/tgaa055. (2020)
- He C., Ding N., Mou X., Xie Z., Si H., Qiu R., Ni S., Zhao H., Lu Y., Y H., Gao Y., Chen L., Shen X., **Cao R.** *Virology* 427(1): 60-66, doi: 10.1016/j.virol.2012.01.012. (2012)

UNDER REVIEW AND PREPARATION (* equal contributions, [#]co-corresponding author)

- Wang Y., Brunner P., Willie J., **Cao R.**[#] & Wang S.[#]. Neural computations of visual, semantic, and memorability features in the human brain. (under revision)

- Li Y., Zhang J., Brunner P., Willie J., **Cao R.**[#] & Wang S.[#] Temporal coding of face familiarity through theta synchronization in the human brain. (in review)
- Mao A., **Cao R.**, Sun S., Wang S., Oh D. Physiological Encoding of Social Evaluation: Modeling Eye Movements, Pupillary, and Neuronal Responses to Faces. (under review)
- Chakravarthula P.N., **Cao R.**, Nicholas J.B., and Wang S. Neuronal Burst Dynamics in the Human Amygdala and Hippocampus During Memory Encoding and Retrieval. (in preparation)
- Shah A., Tian Y., Lin Q., **Cao R.**, Wang S., Yildirim I. Depth-of-processing-like computations explain visually-evoked activity in the human medial temporal lobe. (in preparation)

HONORS AND ACHIEVEMENTS

- 2026 – 2027 **BBRF Young Investigator Award**
- 2025 – 2026 MIR Pilot Fund, WUSTL
- 2024 – 2029 **BRAIN Initiative K99/R00 Award**
- 2023 – 2026 **FY24 Small Grants Program, The McDonnell Center for Systems Neuroscience**
- 2024 Finalist of the **O’Leary competition** at WashU
- 2015 **Excellent Ph.D. Student, Chinese Academy of Sciences (top 10%)**
- 2009 – 2011 **First Degree Scholarship, Shandong Normal University (top 5%)**

INVITED TALKS

- 2025 Department of Radiology, Washington University in St. Louis, MO, United States
- 2025 Department of Ophthalmology, The University of Tennessee Health Science Center, Virtual
- 2025 SANS Data Blitz and Symposium, Chicago, IL, United States
- 2025 IDDRC Data Blitz, Washington University in St. Louis, MO, United States
- 2025 OCEAN Lab, Washington University in St. Louis, MO, United States
- 2025 Dr. Yina Ma’s Lab, Beijing Normal University, Beijing, China
- 2024 SFN Nanosymposium (Insights into higher-order cognition from direct-brain recordings in humans)
- 2024 Department of Neurobiology, University of Alabama at Birmingham, Birmingham, United States
- 2024 Department of Psychology, York University, Toronto, Canada
- 2024 Dr. Tifei Yuan’s laboratory, Shanghai Jiao tong University, Virtual
- 2024 University of Science and Technology, Hefei, China
- 2023 Department of Psychology, Shenzhen University, Shenzhen, China
- 2023 Department of Psychology, Zhejiang University, Hangzhou, China
- 2023 NIH BRAIN Initiative ROH Young Investigators Meeting, MIT, MA, United States
- 2023 Dr. Ueli Rutishauser’s laboratory, Cedars-Sinai Medical Center, CA, United States
- 2022 7th Qilu Young Investigator Symposium, Shandong University, Shandong, China
- 2022 4th Jingshi Young Scholar Symposium, Beijing Normal University, Beijing, China
- 2022 Xin Young Investigator Symposium, Peking University, Beijing, China
- 2022 Dr. Haiyan Wu’s Laboratory, University of Macau, Macau, China
- 2022 Dr. James DiCarlo’s Laboratory, MIT, MA, United States
- 2021 Dr. Joshua Jacobs’s Laboratory, Columbia University, NY, United States
- 2020 Neuroscience Department Retreat, West Virginia University, WV, United States
- 2020 Dr. Ralph Adolph’s Laboratory, Caltech, CA, United States

CONFERENCE POSTERS

- Cao R.**, et al., (2025, Nov) Enhanced spike-field coherence for face familiarity in human amygdala and hippocampus neurons. Poster in SFN, San Diego, CA
- Cao R.**, et al. (2025, May) A neural computational framework for visual object coding in the human temporal lobe. Poster in VSS, Tampa, FL

- Cao R.**, et al. (2025, April) Computational single-neuron mechanisms of face coding in the human temporal lobe. Data Blitz and Poster in SANS, Chicago, IL
- Wang Y., **Cao R.**, et al. (2024, Oct) Neural representation of visual, semantic, and memorable information in natural objects in the human brain. Poster in SFN, Washington, D.C.
- Zhang J., **Cao R.**, et al. (2024, Oct) Multidimensional encoding of visual attention and objects in the primate brain. Poster in SFN, Washington, D.C.
- Chakravarthula P., **Cao R.**, et al. (2024 Oct) Neuronal dynamics during free-gaze visual memory recall in the human medial temporal lobe. Poster in SFN, Washington, D.C.
- Cao R.**, Dubois J., Mamelak A., et al. (2023, Nov) Single-neuron encoding of Theory of Mind in the human medial temporal lobe and medial frontal cortex. Poster in SFN, Washington, D.C.
- Cao R.**, Lin C., Li X., et al. (2022, Nov) Feature-based encoding of objects by single neurons in the human amygdala and hippocampus. Poster in SFN, San Diego, CA
- Cao R.**, Lin C., Li X., et al. (2022, Nov) Feature-based encoding of objects by single neurons in the human amygdala and hippocampus. Poster in Human Single Neuron Meeting, Los Angeles, CA
- Cao R.**, Lin C., Li X., et al. (2022, May). A neuronal social trait space of faces in the human amygdala and hippocampus. Poster in Vision Science Society Annual Meeting, Tampa, FL
- Cao R.**, Wang J., Lin C., et al., (2021, Nov) Feature-based encoding of face identity by single neurons in the human medial temporal lobe. Poster presented in 50th Annual Meeting of Society for Neuroscience (SFN)
- Cao R.**, Qian C., He S., Zhang P. (2017, July) Visual adaptation and 7T fMRI reveal facial identity processing in the human brain under shallow interocular suppression. Vision Science Conference, Qufu, China
- Cao R.**, He S., Zhang P. (2015, May) Identity-specific adaptation to invisible faces depends on the depth of interocular suppression. Oral talk in Vision Sciences Society meeting, Tampa, FL

MENTORSHIP

- 2025 Lilly Bailey, High school research assistant
- 2024 – Yilin Li, Graduate Student, Washington University in St. Louis
Topic: Neural mechanisms of face familiarity and learning
- 2023 – Dr. Jie Zhang, Postdoc, Washington University in St. Louis
Topic: Neural dynamics of visual objects in the human brain
- 2022 – Dr. Yue Wang, Postdoc, Washington University in St. Louis
Topic: Neural pathway of face and object coding in the human medial temporal lobe
- 2022 – Dr. Puneeth Chakravarthula, Postdoc, Washington University in St. Louis
Topic: Neural computations underlying visual memory
- 2019 – 2023 Jinge Wang, Graduate Student, West Virginia University
Topic: Computational Mechanisms of Face Perception
- 2018 – 2020 Savannah Hays, Undergraduate Student, Current: Ph.D. student in Johns Hopkins University
Topic: Individual difference in the lateralized processing of faces
- 2018 – 2020 Kingsly Jonathan, Undergraduate Student
Topic: Neural mechanisms of abnormal face processing in autism
- 2018 – 2020 Rakibul Hasan, Graduate Student Mentee, West Virginia University
Topic: Neuronal mechanisms of visual attention in the human medial temporal lobe
- 2018 – 2019 Amber Li, High school research assistant, Current: B.S. student in Cornell University

PROFESSIONAL MEMBERSHIP and SERVICE

- 2019 - Society for Neuroscience (SFN)
- 2023 - Association for Women in Science (AWIS)
- 2015, 2022- Vision Science Society (VSS)
- 2022- Social Affective Neuroscience Society (SANS)
- 2023 Review editor in Frontiers in Psychology
- 2019 Undergraduate student mentor, SURE Program in WVU

Invited Journal reviews: Nature Human Behavior, Communications Biology, Journal of Cognitive Neuroscience, Scientific Reports, Schizophrenia, Scientific Data, Communications Psychology, Progress in Neurobiology, Plos Biology

Grant review: UK Research and Innovation