

Sam Hall-McMaster

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RESEARCH & TEACHING INTERESTS

Human intelligence is flexible, but where does this flexibility come from? My research investigates the neural coding schemes and computational algorithms that the brain uses to generate flexible and intelligent behaviour. To tackle this, I combine behavioural experiments in cognitive control, learning and decision-making, with neuroimaging (EEG/fMRI) and tools from machine learning. I also have a growing interest in how these approaches can be applied to understand psychiatric conditions. As an educator, I have experience in mentoring postgraduate students as they learn to conduct advanced research, and with teaching students about decision-making and neuroimaging. I am committed to open science practices and you can find open code and data from my projects on the [Open Science Framework](#) and [GIN](#).

RESEARCH EXPERIENCE

2023- Postdoctoral Fellow in Cognitive Neuroscience

Harvard University, United States

Advisor: Professor Samuel J. Gershman

2020-23 Postdoctoral Fellow in Cognitive Neuroscience

Max Planck Institute for Human Development, Germany

Advisor: Professor Nicolas W. Schuck

EDUCATION

2020 DPhil. in Experimental Psychology

The University of Oxford, United Kingdom

Supervisors: Professor Mark G. Stokes (decd.) & Assistant Professor Nicholas E. Myers

2015 BSc (Hons). in Neuroscience

The University of Otago, New Zealand,

with a semester at The University of California, Berkeley

PUBLICATIONS

Submitted

1. **Hall-McMaster, S.**, Wittkuhn, W., Verra, L., Hedrich, H.L., Irie, K., Dayan, P., *Gershman, S.J., & *Schuck, N.W. Entorhinal cortex signals dimensions of past experience that can be generalised in a novel environment. *joint senior authors. <http://bit.ly/4oEgsW2>

2. Musial, M.P.M., **Hall-McMaster, S.**, Shimomura, K., Kato, A., Bode, E.L., Grundmann, C., Ebrahimi, C., Morita, K., Gershman, S.J., Endrass, T., & Schlagenhauf, F. The successor representation in high-risk drinking and alcohol-related contexts. <https://bit.ly/3HC2TG1>
3. Carvalho, W., **Hall-McMaster, S.**, Lee, H., Gershman, S.J. Preemptive solving of future problems: Multitask preplay in humans and machines. <https://bit.ly/3HdKi39>

Senior Author

4. Chau, J.M. Ison, M.J., Muhle-Karbe, P.S., Stokes, M.G., ***Hall-McMaster, S.** & *Myers, N.E. (2025). Alpha and beta oscillations mediate the effect of motivation on neural coding of cognitive flexibility. *Biological Psychology*, 200, 109085, *joint senior authors. <https://bit.ly/4mIgryF>
5. Radzikowska, M., Pike, A. C., & **Hall-McMaster, S.** (2025). Computational perspectives on cognition in anorexia nervosa: A systematic review. *Computational Psychiatry*, 9(1), 100–121. <https://bit.ly/4jTfane>
6. Hedrich, N.L., Schulz, E., ***Hall-McMaster, S.**, & *Schuck, N.W. (2024). An inductive bias for slowly changing features in human reinforcement learning. *PLOS Computational Biology*, 20(11), e1012568. *joint senior authors. bit.ly/4ivOSYd

First Author

7. ***Hall-McMaster, S.**, & *Zika, O. (2025). Increasing response vigour under time pressure as a transdiagnostic marker of eating disorders. *Computational Psychiatry*, 9(1), 121-141. *equal contribution. <https://bit.ly/47y5iMt>
8. **Hall-McMaster, S.**, Tomov, M., *Gershman, S.J., & *Schuck, N.W. (2025). Neural evidence that humans reuse strategies to solve new tasks. *PLOS Biology*, 23(6), e3003174. *joint senior authors. <https://bit.ly/4moiMiK>
9. **Hall-McMaster, S.**, Stokes, M.G., & Myers, N.E. (2022). Integrating reward information for prospective behaviour. *Journal of Neuroscience*, 42(9), 1804-1819. <https://bit.ly/3ukNxfP>
10. **Hall-McMaster, S.**, Dayan, P., & Schuck N.W. (2021). Control over patch encounters changes foraging behaviour. *iScience*, 24(9), 1-10. <https://bit.ly/3Av1aJi>
11. **Hall-McMaster, S.**, Muhle-Karbe, P.S., *Myers, N.E., & *Stokes, M.G. (2019). Reward boosts neural coding of task rules to optimise cognitive flexibility. *Journal of Neuroscience*, 39(43), 8549-8561. *equal contribution. <https://bit.ly/3uzfrSw>
12. **Hall-McMaster, S.**, & Luyckx, F. (2019). Revisiting foraging approaches in neuroscience. *Cognitive, Affective, & Behavioral Neuroscience*, 19(2), 225-230. <https://bit.ly/3t55YC8>
13. **Hall-McMaster, S.**, Millar, J., Ruan, M., & Ward, R. D. (2017). Medial orbitofrontal cortex modulates associative learning between environmental cues and reward probability. *Behavioral Neuroscience*, 131(1), 1-10. <https://bit.ly/3uCJ4Cp>

14. **Hall-McMaster, S. M.**, Treharne, G. J., & Smith, C. M. (2016). Positive thinking and physical activity motivation: A qualitative case study. *New Zealand Journal of Physiotherapy*, 44(1), 26-32. <https://bit.ly/3mC5DUX>
15. **Hall-McMaster, S. M.**, Treharne, G. J., & Smith, C. M (2016). “The positive feel”: Unpacking the role of positive thinking in people with multiple sclerosis’s thinking aloud about staying physically active. *Journal of Health Psychology*. 21(12), 3026-3036. <https://bit.ly/3d0IqJ4>

Additional Publications

16. Pike, A. C., Atherton, K. E., Bauer, Y., Crittenden, B. M., van Ede, F., **Hall-McMaster, S.**, ... & Noonan, M. P. (2022). 10 simple rules for a supportive lab environment. *Journal of Cognitive Neuroscience*, 35(1), 44-48. <https://bit.ly/41ldrin>
17. Wittkuhn, L., Chien, S., **Hall-McMaster, S.**, & Schuck, N.W. (2021). Replay in minds and machines. *Neuroscience & Biobehavioral Reviews*, 129, 367-388. <https://bit.ly/3uQL8rS>

FELLOWSHIPS & AWARDS

Fellowships and Research Grants

- 2023 Philip Wrightson Fellowship (\$135,000NZD)
 2021 Alexander von Humboldt Postdoctoral Fellowship (€64,000 and a research budget of €19,000)

Scholarships

- 2016 William Georgetti PhD Scholarship (\$172,000NZD)
 2016 Rutherford Foundation PhD Scholarship (\$97,500NZD)
 2011 University of Otago Academic Excellence and Dux undergraduate scholarships (\$32,000NZD)
 2010 New Zealand Qualifications Authority Scholarships in English and Biology

Academic Recognition

- 2020 DPhil. awarded without corrections
 2015 University of Otago Neuroscience Prize: Best fourth year student of Neuroscience
 2015 University of Otago Medical School Summer Studentship Award: Best Project
 2014 University of Otago, Prestige Scholarship in Science
 2013 University of Otago Dostoevsky Prize: Best second year student of Psychology
 2012 University of Otago Janet Ferguson Memorial Prize: Best first year student of Psychology

Travel Awards

- 2018 Society for Neuroscience Trainee Professional Development Award
 2018 Guarantors of Brain Travel Award
 2014 Alumni of Otago in America Travel Scholarship and University of Otago Travel Grant, facilitating a semester exchange at The University of California, Berkeley

Additional Awards

- 2014 National first place in the Eureka Speech Competition (New Zealand), receiving the Sir Paul Callaghan Award for Young Science Orators and the MacDiarmid Institute Silver Scholarship. http://bit.ly/Hall-McMaster_Eureka

TEACHING & SUPERVISION EXPERIENCE

Teaching Assistant

MRI Graduate Course, The University of Oxford, 2018-20

- Responsibilities included adapting course materials, presenting content on MRI analysis, leading practical and tutorial sessions with around 20 students in each session, as well as designing and marking exam questions.

Guest Lecturer

LIFE Program, Max Planck Institute for Human Development, 2021

- Responsibilities included creating and delivering a seminar on Optimal Foraging Theory to 15 students, assigning reading and facilitating class discussion.

Supervision Experience

Successful supervision of two MSc students, Max Planck Institute for Human Development, 2020-23

- Responsibilities included guiding students on defining their research questions, designing experiments to test those questions, coding and analysis, writing, and in one case, thesis marking. Both students graduated from their respective Masters degrees with top honours and have first author publications based on their thesis work.

PRESENTATIONS

Invited Talks

What makes human intelligence flexible?

University of Glasgow, 2025

Victoria University of Wellington, 2024

Computational perspectives on cognition in anorexia nervosa

International journal club on eating disorders and computation

Reilly & Gorrell labs (UCSF), Berner lab (Mount Sinai) & Pike lab (York), 2025

Generalising solutions across tasks

Max Planck Institute for Biological Cybernetics, 2024

Agency team, Google DeepMind, 2024

Shenhav lab, Brown University, 2024

Motivational influences on cognitive control and decision-making

Collins lab, The University of California, Berkeley, 2021

Motivation, neural coding and cognitive performance

Shohamy lab, Columbia University, 2019

Schuck lab, Max Planck Institute for Human Development, 2019

Conference Talks

Generalising solutions across tasks

Convention on the Mathematics of Neuroscience and AI, Rome, 2024

New England Reinforcement Learning and Decision-making, Harvard University, 2023

(De)compositional neural representations

Max Planck Research Colloquium, Max Planck Institute for Human Development, 2022

Posters

Generalising solutions across tasks

Cognitive Computational Neuroscience Conference, Boston, 2024

Convention on the Mathematics of Neuroscience and AI, Rome, 2024

Harvard Reinforcement Learning Conference, Harvard University, 2023

Integrating reward information for prospective behaviour

Reinforcement Learning and Decision-Making, Brown University, 2022

Symposium on the Biology of Decision Making, virtual, 2021

Understanding why rewards improve cognitive performance

Society for Neuroscience Annual Conference, San Diego, 2018

Probabilistic Brain Workshop, Durham University, 2017

PROFESSIONAL SERVICE

Committee Experience

Ethics Committee Representative, Max Planck Institute for Human Development, 2021-2022

- Responsibilities included evaluating ethics applications for behavioural experiments conducted at the Max Planck Institute for Human Development, communicating with committee members to determine whether studies met appropriate ethical standards, and working with applicants to ensure standards were met.

Co-organiser of the New England Reinforcement Learning and Decision-making Conference, 2023

- This conference brought together 11 labs in the New England area for a day of talks on reward learning and decision-making. Responsibilities included creating the program, scheduling speakers, communicating with attending labs and running the event.

Co-organiser of the ‘Replay Journal Club’, 2020

- This journal club focused on the different functions of reactivating past experience in brains and machines, and included participating labs from the United States, Germany and the United Kingdom. The schedule can be found here: <https://bit.ly/3GBfhSM>

Educational Outreach

Mentor for Harvard Psychology's PREP Program, 2023-2024

- PREP is a mentoring scheme that provides support and feedback on PhD applications for students from marginalised groups. Responsibilities included reviewing application materials from four students and meeting with them to provide application guidance. I have provided similar application support for Masters students I supervised at the Max Planck for Human Development and a Masters student at The University of Otago.

Associate Editor for the Journal of Emerging Investigators, 2023-2025

- The Journal of Emerging Investigators is an educational journal that peer reviews and publishes scientific research from intermediate and high school students, so that students can experience the full scientific process. Responsibilities included screening manuscripts, inviting reviewers and providing editorial direction for students to revise their work.

Reviewing Experience

Ad hoc reviewer for *Cell*, *Translational Psychiatry*, *Nature Communications*, *PLOS Computational Biology*, *Cerebral Cortex*, *Cognitive Science*, *Scientific Reports*, *Journal of Health Psychology*

REFERENCES

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