Jeffrey Cockburn

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Research and teaching interests

My interests center on the computational properties of human learning and decision making. In pursuit of this, I combine multiple levels of computational modelling, behavioural experiments, brain imaging techniques, and work with special populations to better understand the algorithms embodied by the brain to tackle complex real-world decision making tasks.

Education & Experience

Aug 2024	University of Iowa Assistant Professor Department of Psychological and Behavioral Sciences
2019-2024	California Institute of Technology Senior Postdoctoral Research Associate in Neuroscience Advisor: John P. O'Doherty
2015-2019	California Institute of Technology Postdoctoral Scholar Advisor: John P. O'Doherty
2009-2015	Brown University PhD; Cognitive, Linguistic and Psychological Sciences Advisor: Michael J. Frank
2007-2009	University of Victoria MSc; Interdisciplinary studies (Computer science and Psychology) Advisors: Clay Holroyd & Jens Weber
1999-2004	University of Victoria BSc; Computer Science (major) and Philosophy (minor)

Publications

Charpentier, C.J., Wu, Q., Min, S. *et al.* Heterogeneity in strategy use during arbitration between experiential and observational learning. *Nat Commun* **15**, 4436 (2024).

Man, V., Cockburn, J., Flouty, O. *et al.* Temporally organized representations of reward and risk in the human brain. *Nat Commun* **15**, 2162 (2024)

Nussenbaum K, Martin RE, Maulhardt S, Yang YJ, Bizzell-Hatcher G, Bhatt N, Scheuplein M, Rosenbaum G, O'Doherty JP, Cockburn J, Hartley C (2023). Novelty and uncertainty differentially drive exploration across development. *eLife*

Gera, R., Bar Or M., Tavor, I., Roll, D., Cockburn, J., Barak, S., Tricomi, E., O'Doherty, J., Schonberg, T. (2023). Characterizing habit learning in the human brain at the individual and group levels: a multi-modal MRI study. *NeuroImage*

Aquino, T. G., Cockburn, J., Mamelak, A. N., Rutishauser, U., & O'Doherty, J. P. (2023). Neurons in human pre-supplementary motor area encode key computations for value-based choice. *Nature Human Behaviour*, 1-16.

Cockburn, J., Man, V., Cunningham, W. A., & O'Doherty, J. P. (2022). Novelty and uncertainty regulate the balance between exploration and exploitation through distinct mechanisms in the human brain. *Neuron*, *110*(16), 2691-2702.

O'Doherty, J. P., Lee, S., Tadayonnejad, R., Cockburn, J., Iigaya, K., & Charpentier, C. J. (2021). Why and how the brain weights contributions from a mixture of experts. *Neuroscience & Biobehavioral Reviews*.

Collins, A. G., & Cockburn, J. (2020). Beyond dichotomies in reinforcement learning. *Nature Reviews Neuroscience*, *21*(10), 576-586.

Cross, L., Cockburn, J., Yue, Y., & O'Doherty, J. P. (2020). Using deep reinforcement learning to reveal how the brain encodes abstract state-space representations in high-dimensional environments. *Neuron*.

Pauli, W. M., Cockburn, J., Pool, E. R., Pérez, O. D., & O'Doherty, J. P. (2018). Computational approaches to habits in a model-free world. *Current Opinion in Behavioral Sciences*, *20*, 104-109.

Cockburn, J., & Holroyd, C. B. (2018). Feedback information and the reward positivity. *International Journal of Psychophysiology*, *132*, 243-251.

O'Doherty, J. P., Cockburn, J., & Pauli, W. M. (2017). Learning, reward, and decision making. *Annual Review of Psychology*, 68, 73-100.

Cockburn, J., Collins, A. G. E., & Frank, M. J. (2014). A Reinforcement learning mechanism responsible for the valuation of free choice. *Neuron*, *83*(3), 551–557.

Doll, B. B., Waltz, J. A., Cockburn, J., Brown, J. K., Frank, M. J., & Gold, J. M. (2014). Reduced susceptibility to confirmation bias in schizophrenia. *Cognitive, Affective, & Behavioral Neuroscience*, *14*(2), 715–728.

Tanaka, J. W., Wolf, J. M., Klaiman, C., Koenig, K., Cockburn, J., Herlihy, L., … Schultz, R. T. (2012). The perception and identification of facial emotions in individuals with autism spectrum disorders using the Let's Face It! Emotion Skills Battery. *Journal of Child Psychology and Psychiatry*, *53*(12), 1259–1267.

Cockburn, J., & Holroyd, C. (2010). Focus on the positive: Computational simulations implicate asymmetrical reward prediction error signals in childhood Attention-Deficit/Hyperactivity Disorder. *Brain Research*, *1365*, 18–34.

Tanaka, J. W., Wolf, J. M., Klaiman, C., Koenig, K., Cockburn, J., Herlihy, L., … Schultz, R. T. (2010). Using computerized games to teach face recognition skills to children with autism spectrum disorder: the Let's Face It! program. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *51*(8), 944–52.

Wolf, J. M., Tanaka, J. W., Klaiman, C., Cockburn, J., Herlihy, L., Brown, C., … others. (2008). Specific impairment of face-processing abilities in children with autism spectrum disorder using the Let's Face It! skills battery. *Autism Research*, *1*(6), 329–340.

Cockburn, J., Bartlett, M., Tanaka, J., Movellan, J., Pierce, M., & Schultz, R. (2008). SmileMaze: A tutoring system in real-time facial expression perception and production in children with Autism Spectrum Disorder. *Proceedings from the IEEE International Conference on Automatic Face & Gesture Recognition, 978* (Vol. 986).

Presentations

Invited lectures

University of California, Los Angeles; Department of Psychology (2016)
Title: Exploration and structure learning.

University College London; Department of Psychology (2015)
Title: Behavioral signatures of latent structure learning

California Institute of Technology; Department of human and social sciences (2013)
Title: Simple decisions, complex states

Conference Talks

Cockburn, J., O'Doherty, J. P. (2016) Novelty and uncertainty as separable exploratory drives. *Society for Neuroscience*. Chicago, Illinois.

Cockburn, J., Frank, M. J., (2015) Probing for latent states during reinforcement learning. *Society for Neuroscience*. Chicago, Illinois.

Cockburn, J., Holroyd, C., (2009) Focus on the positive: Computational simulations implicate asymmetrical reward prediction error signals in childhood Attention-Deficit/Hyperactivity Disorder. *Computational Cognitive Neuroscience Conference*. Boston, Massachusetts.

Cockburn, J., Tanaka, J., Pierce, M., (2008) SmileMaze: Linking the production and perception of facial expressions. Presentation: *17th International Meeting of the Perceptual Expertise Network*. Chicago, Illinois.

Cockburn, J., Krigolson, O., Holroyd, C., (2008) The ERN, TD errors, and sequence learning. Presentation: *16th International Meeting of the Perceptual Expertise Network*. Banff, Alberta.

Posters and abstracts

Aquino, T., Cockburn, J., Mamelak, A., Rutishauser, U., O'Doherty, J. (2019). Novelty and Uncertainty as hierarchically separable exploratory drives. *4th bi-annual conference on reinforcement learning and decision making*. Montreal, Canada.

Man, V., Cockburn, J., Flouty, O., Kovach, C., Kawasaki, H., Oya, H., Howard, M., O'Doherty, J. (2019). Local Field Potentials in Human Insula and Orbitofrontal Cortex Encode Risk and Risk Prediction Error. *4th bi-annual conference on reinforcement learning and decision making*. Montreal, Canada.

Cross, L., Cockburn, J., Yue, Y., O'Doherty, J. (2019). Combining deep-learning RL with fMRI to probe the encoding of state-space representations in the human brain. *4th bi-annual conference on reinforcement learning and decision making*. Montreal, Canada.

Cockburn, O'Doherty, J (2017). Novelty and Uncertainty as separable exploratory drives. *3rd bi-annual conference on reinforcement learning and decision making*. Ann Arbor Michigan, USA.

Cockburn, J., Collins, A. G., Frank, M. J. (2012). Why do we value freedom? Genetic polymorphism predicts the impact of choice on learning. *Society for Neuroscience*. New Orleans, LA.

Cockburn, J., Collins, A. G., Frank, M. J. (2012). Why do we value freedom? Genetic polymorphism predicts the impact of choice on learning. *Annual Neuroeconomics conference.* Miami Fl.

Laubach, M., Cockburn, J., Frank, M. J., Kimchi, E. (2011). Neuronal basis of context-dependent updating of action values in the striatum: *Computational and Systems Neuroscience*. Salt Lake City, USA.

Cockburn, J., Frank, M. J. (2011). Why do we value freedom? Genetic polymorphism predicts the impact of choice on learning. *44th annual Winter Brain meeting*. Keystone, USA.

Cockburn, J., Frank, M. J. (2010). The value of volition: Genetic polymorphism predicts the impact of choice on learning. *40th annual meeting of the Society for Neuroscience*. San Diego, USA.

Cockburn, J., Holroyd, C., Frank, M. J. (2010). How wrong was I?: The impact of corrective information on electrophysiological correlates of error processing. *17th annual meeting of the Cognitive Neuroscience Society*. Montreal, Canada.

Cockburn, J., Holroyd, C. (2009). What's all the Hype About? Dopamine's Role in ADHD. *3rd annual Meeting of the Canadian Association for Neuroscience*. Vancouver, Canada

Cockburn, J., Krigolson, O., Holroyd, C. (2008) Sequence Learning: Internal vs. External Error Evaluation. Poster Presentation: *15th annual meeting of the Cognitive Neuroscience Society*. San Francisco, California.

Cockburn, J., Pierce, M., Tanaka, J., Bartlett, M., Movellan, J., Schultz, B. (2008) Perceptual and motor learning in the recognition and production of dynamic facial expressions. Poster Presentation: *2nd annual Temporal Dynamics of Learning Center Meeting*. Nashville, Tennessee.

Cockburn, J., Tanaka, J., Wolfe, J., Schultz, B. (2007) Plasticity of the neural mechanisms underlying face processing in children with ASD: A computer-based face training intervention. Poster Presentation: *1st annual Temporal Dynamics of Learning All Hands Meeting*. San Diego, California.

Teaching, mentorship, and community

Community engagement

- *Diversity, Equity, and Inclusion postdoctoral representative (2022 ~ present)*
  Acting representative through which individuals can voice concerns and offer suggestions pertinent to workplace culture.
  Spearheading the development of a funding program through which scholars at Caltech can obtain funding to pursue DEI-related programming.

- *diversifySTEM: (June 2020 ~ present)*
  A self-organized group of faculty and postdocs focused on identifying impediments to increasing diversity in STEM at Caltech, and how those hurdles can be minimized.

- *Science for March: (2017 ~ present)*
  Organizing activities and presentations for annual science outreach events at Caltech.

Teaching assistant
Responsibilities include developing class materials, leading discussions, guest lectures, supervising labs, grading assignments, and meeting with students individually.

- *Computing as done in the brain*: Brown University ~10 students (2014)
- *Moral Psychology*: Brown University ~300 students (2013)
- *Computational Cognitive Neuroscience*: Brown University ~30 students (2012)
- *Computational Cognitive Neuroscience*: Brown University ~30 students (2011)
- *Computational Cognitive Neuroscience*: Brown University ~30 students (2010)
- *Cognitive Neuroscience*: University of Victoria ~30 students (2009)
- *Computer Vision:* University of Victoria ~100 students (2007)

Guest lecturer

- Brains, Minds, and Society. CalTech (2021)
- Computational reinforcement learning. CalTech (2020)
- Brains, Minds, and Society. CalTech (2019)
- Brains, Minds, and Society. CalTech (2018)

Pedagogical training

- Brown University Sheridan Center teaching certificate (2013-2014)
- Caltech Project for Effective Teaching Certificate of Interest (2021-present)

Grants and Awards

Grant: R01MH121089-01
PI: John O'Doherty
Agency: National Institute of Mental Health
Amount: ~$5,000,000
Period: 2019-2024
Title: Determining the explanatory utility of computational reinforcement-learning theories of goal-directed and habitual control at behavioral and neural levels.
Role: (Co-I) Responsible for project conception, management, hiring, experimental design, analysis, and writing

Grant: R21MH120805-02
PI: John O'Doherty
Agency: National Institute of Mental Health
Amount: ~$200,000
Period: 2019-2021
Title: Toward a High Dimensional Computational Description of Variation in Human Decision-Making Across Psychiatric and Non-Psychiatric Populations.
Role: (Co-I) Responsible for project conception, management, hiring, experimental design, analysis, and writing

Grant: Chen center innovation award
PI: Jeffrey Cockburn
Agency: Tianqiao and Chrissy Chen Institute for Neuroscience
Amount: $77,000
Period: 2017-2019

Title: Identifying Transdiagnostic Dimensions in Human Decision-Making Across Psychiatric and Non-Psychiatric Populations.

Grant: PGS-D3
PI: Jeffrey Cockburn
Agency: National Science and Engineering Research Council
Amount: $63,000
Period: 2009-2011

Grant: NSERC Undergraduate award
PI: Jeffrey Cockburn
Agency: National Science and Engineering Research Council
Amount: $4,500
Period: 2007

Honors and awards

Thesis Fellowship	Brown University	$21,000	2013
Best presentation	Neuroeconomics Annual Conference	$100	2012
Tisch Fellowship	Brown University	$250,000	2008
Interdisciplinary Fellowship	University of Victoria	$12,500	2008
Health Fellowship	University of Victoria	$8,333	2008
Merit Award	University of Victoria	$1,527	2008
Interdisciplinary Fellowship	University of Victoria	$10,000	2007

Peer review

Biological Psychology; Brain Research; PLOS computational Biology; Cognitive, Affective, and Behavioral Neuroscience; eLife; Journal of Cognitive Neuroscience; Neuron; Neuropsychopharamcology; Proceedings of the National Academy of Sciences; Psychology & Aging; Journal of Experimental Psychology General