

# Charley M. Wu

## Curriculum Vitae

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Nationality: Canadian

## Academic Background

### Current Position

2019 **Post-Doctoral Research Fellow**, *Department of Psychology*, Harvard University, Cambridge, MA.

### Previous Positions

- 2019 **Post-Doctoral Research Fellow**, *Center for Adaptive Rationality (ARC)*, Max Planck Institute for Human Development, Berlin, Germany.
- 2018 **Visiting Research Fellow**, *Computational Cognitive Neuroscience Lab*; hosted by Samuel J. Gershman, Harvard University, Cambridge, MA.
- 2016-2019 **Pre-Doctoral Research Fellow**, *Center for Adaptive Rationality (ARC)*, Max Planck Institute for Human Development, Berlin, Germany.
- 2014-2015 **Research Assistant**, *Center for Adaptive Behavior and Cognition (ABC)*, Max Planck Institute for Human Development, Berlin, Germany.
- 2014 **Student Research Scientist**, *PetaByte Research*, Budapest, Hungary.
- 2013-2014 **Research Assistant**, *Intelligent Software Agents and New Media Group*, Austrian Institute for Artificial Intelligence (OFAI), Vienna, Austria.
- 2009 **Research Assistant**, *Center for Human Evolution, Cognition, and Culture (HECC)*, University of British Columbia, Vancouver, Canada.

## Education

- 2016-2019 **Dr. rer. nat. (Ph.D.) Psychology**, *Humboldt University of Berlin*, Berlin, Germany, *Summa Cum Laude*.
- 2013-2015 **M.Sc. Cognitive Science**, *University of Vienna*, Vienna, Austria, *with Distinction*.
- 2004-2009 **B.A. Philosophy**, *University of British Columbia*, Vancouver, Canada, *Dean's List*.

## Honors and Awards

- 2019 **Glushko and Samuelson Student Travel Grant**, *40th Annual Conference of the Cognitive Science Society*, Montreal, QC.
- 2016-2019 **Pre-Doctoral Fellowship**, *International Max Planck Research School on Adapting Behavior in a Fundamentally Uncertain World*, Joint PhD Fellowship in Psychology, Economics, and Law, Germany.
- 2014 **Interdisciplinary College (IK) Stipend**, Günne, Germany.

- 2011-2012 **Joseph-Armand Bombardier Canada Graduate Scholarship**, *Social Sciences and Humanities Research Council of Canada (SSHRC)*, Canada, Declined.
- 2004 **President's Entrance Scholarship**, *University of British Columbia*, Canada.

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## Publications

- 2019 Analytis, P. P., Wu, C. M., & Gelastopoulos, A. (2019). Make-or-break: chasing risky goals or settling for safe rewards? *Cognitive Science*, 43, e12743. doi:[10.1111/cogs.12743](https://doi.org/10.1111/cogs.12743)
- Schulz, E., Wu, C. M., Ruggeri, A., & Meder, B. (2019). Searching for rewards like a child means less generalization and more directed exploration. *Psychological Science*. doi:[10.1177/0956797619863663](https://doi.org/10.1177/0956797619863663)
- Tump, A. N., Wu, C. M., Bouhrel, I., & Goldstone, R. L. (2019). The evolutionary dynamics of cooperation in collective search. In A. Goel, C. Seifert, & C. Freksa (Eds.), *Proceedings of the 41st Annual Conference of the Cognitive Science Society* (pp. 883–889). Montreal, QB: Cognitive Science Society.
- Wu, C. M., Schulz, E., Gerbaulet, K., Pleskac, T. J., & Speekenbrink, M. (2019). Under pressure: The influence of time limits on human exploration. In A. Goel, C. Seifert, & C. Freksa (Eds.), *Proceedings of the 41st Annual Conference of the Cognitive Science Society* (pp. 1219–1225). Montreal, QB: Cognitive Science Society.
- Wu, C. M., Schulz, E., & Gershman, S. J. (2019a). Generalization as diffusion: human function learning on graphs. In A. Goel, C. Seifert, & C. Freksa (Eds.), *Proceedings of the 41st Annual Conference of the Cognitive Science Society* (pp. 3122–3128). Montreal, QB: Cognitive Science Society.
- Wu, C. M., Schulz, E., & Gershman, S. J. (2019b). Searching for rewards in graph-structured spaces. In *Proceedings of the 2019 Conference on Cognitive Computational Neuroscience*. doi:[10.32470/CCN.2019.1041-0](https://doi.org/10.32470/CCN.2019.1041-0)
- 2018 Bouhrel, I., Wu, C. M., Hanaki, N., & Goldstone, R. L. (2018). Sharing is not erring: pseudo-reciprocity in collective search. In T. T. Rogers, M. Rau, X. Zhu, & C. W. Kalish (Eds.), *Proceedings of the 40th Annual Conference of the Cognitive Science Society* (pp. 156–161). Austin, TX: Cognitive Science Society.
- Schulz, E., Wu, C. M., Huys, Q. J., Krause, A., & Speekenbrink, M. (2018). Generalization and search in risky environments. *Cognitive Science*, 42, 2592–2620. doi:[10.1111/cogs.12695](https://doi.org/10.1111/cogs.12695)
- Wu, C. M., Schulz, E., Garvert, M. M., Meder, B., & Schuck, N. W. (2018). Connecting conceptual and spatial search via a model of generalization. In T. T. Rogers, M. Rau, X. Zhu, & C. W. Kalish (Eds.), *Proceedings of the 40th Annual Conference of the Cognitive Science Society* (pp. 1183–1188). Austin, TX: Cognitive Science Society.
- Wu, C. M., Schulz, E., Speekenbrink, M., Nelson, J. D., & Meder, B. (2018). Generalization guides human exploration in vast decision spaces. *Nature Human Behaviour*, 2, 915–924. doi:[10.1038/s41562-018-0467-4](https://doi.org/10.1038/s41562-018-0467-4)
- 2017 Wu, C. M., Meder, B., Filimon, F., & Nelson, J. D. (2017). Asking better questions: how presentation formats influence information search. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 8, 1274–1297. doi:[doi:10.1037/xlm0000374](https://doi.org/10.1037/xlm0000374)

Wu, C. M., Schulz, E., Speekenbrink, M., Nelson, J. D., & Meder, B. (2017). Mapping the unknown: the spatially correlated multi-armed bandit. In G. Gunzelmann, A. Howes, T. Tenbrink, & E. J. Davelaar (Eds.), *Proceedings of the 39th Annual Meeting of the Cognitive Science Society* (pp. 1357–1362). Austin, TX: Cognitive Science Society.

- 2016 Barkoczi, D., Analytis, P. P., & Wu, C. M. (2016). Collective search on rugged landscapes: a crossenvironmental analysis. In A. Papafragou, D. Grodner, D. Mirman, & J. Trueswell (Eds.), *Proceedings of the 38th Annual Conference of the Cognitive Science Society* (pp. 918–923). Austin, TX: Cognitive Science Society.

## Invited Talks

- Nov. 2019 **Wu, C.M.**, *Domain General Principles of Efficient Human Exploration*, SimTech Colloquium, University of Stuttgart, Stuttgart, Germany.
- Nov. 2019 **Wu, C.M.**, *Domain general principles of generalization and exploration*, Cognitive Brain and Behavior Lunch, Harvard University, Cambridge, MA.
- May. 2019 **Wu, C.M.**, *Navigating Vast Decision Spaces with the Principle of Generalization*, Machine Learning in Cognition at UCL (MLCog-UCL) Academic Society, University College London, London, UK.
- Jan. 2019 **Wu, C.M.**, *Collective Search in Immersive Virtual Environments*, MPRG: iSearch Retreat, Ringberg, Kreuth, Germany.
- Jan. 2019 **Wu, C.M.**, *The Successor Representation*, MPRG: NeuroCode, Max Planck Institute for Human Development, Berlin, Germany.
- Nov. 2018 **Wu, C.M.**, *Guiding Exploration Through Generalization*, Cog Lunch, Department of Brain and Cognitive Sciences, MIT, Cambridge, MA.
- Nov. 2018 **Wu, C.M.**, *Generalization in Vast Spaces*, Concats, New York University, New York City, NY.
- Nov. 2018 **Wu, C.M.**, *Generalization Guides Exploration in Vast Spaces*, Fiery Cushman and Joshua Greene labs, Harvard University, Cambridge, MA.
- Sept. 2018 **Wu, C.M.**, *Guiding Exploration Through Generalization*, Samuel Gershman Lab, Harvard University, Cambridge, MA.
- May. 2018 **Wu, C.M.**, Schulz, E., Speekenbrink, M., Nelson, J.D., & Meder, B., *Generalization and Exploration: Insights from a spatial search task*, Department of Psychiatry and Psychotherapy, Charité - Universitätsmedizin, Berlin, Germany.
- Sept. 2017 **Wu, C.M.**, Schulz, E., Speekenbrink, M., Nelson, J.D., & Meder, B., *Generalization and Exploration in Vast Spaces*, Centre for Mind/Brain Sciences (CIMEC), University of Trento, Trento, Italy.
- May. 2017 **Wu, C.M.**, Schulz, E., Speekenbrink, M., Nelson, J.D., & Meder, B., *Active Learning and Search in Unexplored Environments*, MPRGL iSearch lab meeting, Max Planck Institute for Human Development, Berlin, Germany.
- Apr. 2017 **Wu, C.M.**, Schulz, E., Speekenbrink, M., Nelson, J.D., & Meder, B., *Generalization Across Vast State Spaces: Human Exploration in Unknown Environments*, Cognition Lab, University of Zürich, Zürich, Switzerland.
- Mar. 2017 **Wu, C.M.**, *Terra Incognita: Adaptive Learning and Information Search in Unknown Environments*, The Center for Adaptive Rationality (ARC), Max Planck Institute for Human Development, Berlin, Germany.

- Feb. 2017 **Wu, C.M.**, Nelson, J.D., & Meder, B., *Adaptive Learning for Language Education*, Babbel, Lesson Nine GmbH, Berlin, Germany.
- Nov. 2016 **Wu, C.M.**, Schulz, E., Speekenbrink, M., Nelson, J.D., & Meder, B., *Mapping the Unknown: Human Spatial Exploration-Exploitation*, Learning & Decision Making Lab, University College London, London, UK.
- Feb. 2016 **Wu, C.M.**, Nelson, J.D., & Meder, B., *Functional Entropy for Understanding Ruggedness in Fitness Landscapes*, Entropy Workshop (DFG SPP 1516), Ludwigsburg, Germany.

## Conference Presentations, Workshops, and Seminars

- Sep. 2019 **Wu, C.M.**, Schulz, E., & Gershman, S.J., *Searching for rewards in graph-structured spaces*, Poster presented at CCN 2019, Berlin, DE. [\[Poster\]](#).
- Jul. 2019 **Wu, C.M.**, Schulz, E., & Gershman, S.J., *Generalization as diffusion: human function learning on graphs*, Poster presented at CogSci 2019, Montreal, QB. [\[Poster\]](#).
- Jul. 2019 **Wu, C.M.**, Schulz, E., Gerbaulet, K., Pleskac, T.J., & Speekenbrink, M., *Under pressure: the influence of time limits on human exploration*, CogSci 2019, Montreal, QB.
- Jul. 2019 Tump, A.N., **Wu, C.M.**, Bouhlel, I., & Goldstone, R.L., *The Evolutionary Dynamics of Cooperation in Collective Search*, CogSci 2019, Montreal, QB.
- Jul. 2019 **Wu, C.M.**, Schulz, E., Gerbaulet, K., Pleskac, T.J., & Speekenbrink, M., *Time pressure influences attitudes towards uncertainty*, MathPsych 2019, Montreal, QB. [\[Slides\]](#).
- Dec. 2018 **Wu, C.M.**, *Inference over graph structures using a diffusion kernel*, Berlin Machine Learning Seminar, Berlin, Germany.
- Jul. 2018 **Wu, C.M.**, Schulz, E., Garvert, M.M., Meder, B., & Schuck, N.W., *Connecting conceptual and spatial search*, CogSci 2018, Madison, WI.
- Jul. 2018 Bouhlel, I., **Wu, C.M.**, Hanaki, N., & Goldstone, R.L., *Sharing is not erring: Pseudo-reciprocal sharing in collective search*, CogSci 2018, Madison, WI.
- Jul. 2018 **Wu, C.M.**, & Meder, B., Nelson, J.D., *Navigating uncertainty through information search*, Poster presented at CogSci 2018, Madison, WI. [\[Poster\]](#).
- Jul. 2018 **Wu, C.M.**, Schulz, E., Speekenbrink, M., Nelson, J.D., & Meder, B., *Guiding exploration through generalization*, MathPsych 2018, Madison, WI.
- Mar. 2017 **Wu, C.M.**, Schulz, E., Speekenbrink, M., Nelson, J.D., & Meder, B., *Mapping the Unknown: The spatially correlated multi-armed bandit.*, CogSci 2017, London, UK.
- Mar. 2017 **Wu, C.M.**, Schulz, E., Speekenbrink, M., Nelson, J.D., & Meder, B., *Mapping the Unknown: Model-based and Model-free Approaches Towards Spatial Reinforcement Learning*, TeaP 2017, Dresden, Germany.
- Mar. 2017 **Wu, C.M.**, *Everybody GANs Now: Tutorial on Generative Adversarial Networks*, Berlin Machine Learning Seminar, Berlin, Germany.
- Mar. 2017 **Wu, C.M.**, *Voyage into the Unknown: Adaptive Learning and Information Search*, IMPRS Thesis Workshop, Gut Gremmelin, Germany.
- Mar. 2017 **Wu, C.M.**, *Adversarial Training: Math and Methods Tutorial*, Center for Adaptive Behavior and Cognition (ABC), Berlin, Germany.
- Aug. 2016 **Wu, C.M.**, Jurányi, Z., Gulyas, L., & Kampis, G., *Blindfolded NLP: Unsupervised Learning for Automatically Generating Topic Labels*, Identification, Location and Temporal Evolution of Topics Workshop, Budapest, Hungary.

- Jul. 2016 **Wu, C.M.**, Schulz, E., Speekenbrink, M., Nelson, J.D., & Meder, B., *Exploring the Unknown: Modeling Human Exploration-Exploitation Behavior*, Poster presented at Computational and Mathematical Modeling of Cognition, Dobbiaco, Italy. [\[Poster\]](#).
- Mar. 2016 **Wu, C.M.**, *Gaussian Process Models: What do you do when you can't optimize?*, Berlin Machine Learning Seminar, Berlin, Germany.
- Feb. 2016 **Wu, C.M.**, *Exploring Fitness Landscapes: How to discover good solutions to complex problems*, IMPRS Thesis Workshop, Berlin, Germany.
- Feb. 2016 **Wu, C.M.**, Nelson, J.D., & Meder, B., *Characterizing Ruggedness in Fitness Landscapes*, ABC Conference, Berlin, Germany.
- Aug. 2015 **Wu, C.M.**, Meder, B., Nelson, J.D., & Filimon, F., *The effect of presentation formats on rational information search*, SPUDM 25, Budapest, Hungary..
- Jun. 2015 **Wu, C.M.**, Meder, B., Filimon, F., & Nelson, J.D., *The medium is the message: How presentation formats help people ask better questions*, MEi: CogSci Conference, Ljubljana, Slovenia.
- Feb. 2015 Meder, B., **Wu, C.M.**, Nelson, J. D., & Filimon, F., *Presentation formats and information search*, Workshop on "Information, search, and causes: Rational and cognitive approaches", Turin, Italy.
- Jun. 2014 **Wu, C.M.**, Skowron, M., & Petta, P., *Reading between the lines: a vector space model of language using semantic role structures*, Poster presented at MEi:CogSci Conference 2014, Kraków, Poland. [\[Poster\]](#).

## Teaching

- 2015-2019 **Berlin Machine Learning Seminar**, *Regular Speaker*, Berlin, Germany.
- 2018 **Introduction to Computational Modeling**, *Graduate and undergraduate workshop*, MPRG: iSearch Research Retreat, Bensdorf, Germany.
- 2018 **Intro to Cognitive Modeling**, *Course*, Max Planck Institute for Human Development, Berlin, Germany. (Teaching Assistant to Dr. Björn Meder).
- 2017 **Fast-and-frugal Trees and Models of Information Search**, *Workshop*, ABC Research Retreat, Schloss Ringberg, Germany.
- 2017 **Computational Models of Cognition**, *Graduate Lecture*, Berlin School of Mind and Brain (PhD Program), Humboldt University, Berlin, Germany.
- 2016-2017 **Math and Methods Tutorial Series**, *Organizer and regular speaker*, Center for Adaptive Behavior and Cognition (ABC), Berlin, Germany.
- 2016 **A Statistical Framework for Model Comparisons**, *Tutorial*, ABC Research Retreat, Gut Gremmelin, Germany.

## Supervision

### Graduate Student Projects

- Lucy Lai.** *Compositional sequence learning through generative structure learning*. Department of Neuroscience, Harvard University. (2019-Present)
- Marcel Binz.** *The emergence of compositional language through maximum entropy Reinforcement Learning*. Department of Psychology, Philipps-Universität Marburg. (2019-Present)
- Imen Bouhlel.** *Sharing is not erring: How environments can encourage pseudo-reciprocity in collective human search*. Department of Economics, Université de Nice. (2016-Present)

**Alan Novaes Tump.** *The evolutionary dynamics of cooperation in collective search.* Center for Adaptive Rationality, Max Planck Institute for Human Development. (2018-2019)

**Ahmad Dawud.** *Collective search and rugged landscapes.* Institute of Cognitive Science, University of Osnabrück. (2017-2019)

**Alexander Djamali.** *Information search: Finding better questions.* Department of Physics, Ludwig Maximilian University of Munich. (2016-2017)

#### Dissertations

**Kimberly Gerbaulet.** Institute of Cognitive Science, University of Osnabrück. Masters Thesis: *Under pressure: the effect of time pressure on directed and random exploration.* (2018-2019)

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### Professional Service

**Organizer** of the 17th annual Summer Institute on Bounded Rationality, Berlin, Germany (2018)

**PhD Representative** for the Max Planck Institute for Human Development (2017-2018)

**Ad-hoc Reviewer** for Nature Human Behaviour (1), Cognitive Computational Neuroscience (6), Cognitive Science Society (11), Mind & Society (1), and Futures & Foresight Science (1)

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### Technical Skills

**Programming Languages:** R, Python, Matlab, Julia, JavaScript, HTML, jQuery, PHP, CSS, and L<sup>A</sup>T<sub>E</sub>X.

**Additional Software Skills:** MongoDB, MySQL, Tensorflow, SKlearn, GenSim, NLTK, Redis, and Adobe Creative Suite.

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### References

Prof. Dr. Fiery Cushman  
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Prof. Dr. Samuel J. Gershman  
Department of Psychology and Center for Brain Sciences, University of Harvard  
Northwest Lab Building, 52 Oxford Street, Cambridge, MA 02138  
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Dr. Björn Meder  
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Prof. Dr. Jonathan D. Nelson  
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