

# Carlos A. Velázquez-Vargas

cavargas@princeton.edu

## EDUCATION

---

<b>PhD in Psychology</b>	Expected September 2024
Princeton University, Princeton, NJ, USA.	
<b>MA in Psychology</b>	2021
Princeton University, Princeton, NJ, USA.	
<b>BA in Psychology</b>	2019
National Autonomous University of Mexico (UNAM), Mexico City, Mexico.	

## ACEDMIC EXPERIENCE

---

<b>Princeton University</b>   <i>Graduate Student</i>	2019 Aug - Present
Supervisors: Professor Jordan Taylor and Professor Nathaniel Daw.	
<ul style="list-style-type: none"><li>Built and evaluated <b>reinforcement learning (RL)</b>, <b>Bayesian</b>, and <b>tree search algorithms</b> to study human learning and planning. This research was recognized with a travel grant and presented as a talk at the Cognitive Science Society conference in 2023.</li><li>Utilized <b>Bayesian Inference</b> to build and evaluate cognitive models, including the development of <b>Hierarchical</b> and <b>Latent Mixture models</b> of working memory. This work was accepted as a talk at a main conference of the field (MLMC, 2023).</li><li>Currently leading a cutting-edge Deep Learning project that employs recurrent policies, specifically <b>Long Short-Term Memory networks</b> and <b>Proximal Policy Optimization</b> to understand how humans and machines learn from different action spaces.</li><li>Designed interactive web (HTML, JavaScript, CSS) and in-person (Matlab psychtoolbox) experiments to study human learning and planning.</li></ul>	
<b>University of Arizona</b>   <i>Visiting researcher</i>	Jan 2023 - Present
Supervisor: Professor Robert Wilson	
<ul style="list-style-type: none"><li>Developed Bayesian and <b>model-free RL</b> algorithms to study human decision-making in multi-arm bandit problems.</li></ul>	
<b>National Autonomous University of Mexico</b>   <i>Undergraduate student</i>	Aug 2016 - Feb 2019
Supervisor: Professor Arturo Bouzas.	
<ul style="list-style-type: none"><li>Employed model-free RL algorithms (<b>temporal difference models</b> and <b>extended Kalman filters</b>) to study human learning in dynamic environments. This work was published as a first-author paper.</li><li>Implemented Bayesian methods to evaluate pigeons' <b>decision-making in multi-arm bandit</b> problems. This work was published as a second author paper.</li></ul>	

## GRANTS AND FELLOWSHIPS

---

Cognitive Science Society (Cogsci) travel grant, Sydney, Australia.	2023
Graduate student fellowship in Cognitive Science, Princeton University.	2022
Walker McKinney '50 Life Sciences Fellowship, Princeton University.	2019
Computational and Systems Neuroscience (COSYNE) undergraduate travel grant award, Salt Lake, Utah.	2017
SEP-UNAM-FUNAM research fellowship at the University of Arizona.	2016
Fellowship at the Program for the Support of Research Projects and Technological Innovation (PAPIIT, UNAM).	2018
Fellowship at the Program for the Support of Projects for Innovation and Improvement of Teaching (PAPIME, UNAM).	2017 - 2018

## PREPRINTS

---

- **Velázquez-Vargas, C. A.**, Christian, I., Taylor, A. J., Kumar, S. (under review). Learning to Abstract Visuomotor Mappings using Meta-Reinforcement Learning. [Link]
- **Velázquez-Vargas, C. A.**, Taylor, A. J. (under review). Working memory constraints for visuomotor retrieval strategies.
- **Velázquez-Vargas, C. A.**, Daw, N.D., Taylor, A. J. (under review). Learning generalizable visuomotor mappings for *de novo* skills. [Link]
- Poli, F., Koolen, M., **Velázquez-Vargas, C.**, Ramos-Sanchez, J., Meyer, M., Mars, R. B., Rommelse, N., Hunnius, S. (under review). Autistic traits foster effective curiosity-driven exploration. [Link]

#### PEER-REVIEW JOURNAL PUBLICATIONS

---

- **Velázquez-Vargas, C. A.**, Villarreal, M., and Bouzas, A. (2019). Velocity estimation in reinforcement learning. *Computational Brain and Behavior*. [Link]
- Villarreal, M., **Velázquez, C.**, Baroja, J. L., Segura, A., Bouzas, A., Lee, M.D. (2019). Bayesian methods applied to the generalized matching law. *Journal of the Experimental Analysis of Behavior*. [Link]

#### CONFERENCE PROCEEDINGS AND EXTENDED ABSTRACTS

---

- **Velázquez-Vargas, C. A.**, Bejjanki, V. R., Taylor, A. (2023) Precision and capacity limitation of retrieval strategies for visuomotor adaptation. *Advances in Motor Learning & Motor Control*. [Link]
- **Velázquez-Vargas, C. A.**, Taylor, J. (2023). Exploring human learning and planning in grid navigation with arbitrary mappings. *Proceedings of the Annual Meeting of the Cognitive Science Society, 45.* [Link]
- **Velázquez-Vargas, C. A.**, Taylor, J. (2022). Learning novel sensorimotor mappings in a grid navigation task. *The Multi-disciplinary Conference on Reinforcement Learning and Decision Making*. [Link]

#### CONFERENCE TALKS

---

- **Velázquez-Vargas, C. A.**, Bejjanki, V. R., Taylor, A. (2023) Precision and capacity limitation of retrieval strategies for visuomotor adaptation. *Advances in Motor Learning & Motor Control*, Washington, DC.
- **Velázquez-Vargas, C. A.**, Taylor, A. (2023) Exploring human learning and planning in grid navigation with arbitrary mappings. *Cognitive Science Society*, Sydney, Australia.
- Wilterson, S. A., Wilterson, A. I., **Velázquez-Vargas, C.**, McDougle, S., Taylor, J. A. (2020) Acquisition and adaptation of *de novo* sensorimotor mappings. *Neural Control of Movement Conference*.
- **Velázquez-Vargas, C. A.**, Bouzas, A. (2018). Velocity of change in the environment in the delta-rule model of reinforcement. 51st Annual Meeting of the Society for Mathematical Psychology. Madison, Wisconsin.
- Villarreal, M., **Velázquez-Vargas, C. A.**, Baroja, J.L., Segura, A., Bouzas, A. (2018). Bayesian analysis of the Generalized Matching Law in a concurrent random-interval random-ratio schedule. Biennial Meeting of the International Society of Comparative Psychology. Los Angeles, California.
- **Velázquez-Vargas, C. A.**, Bouzas, A. (2017). Prediction in a gradually changing environment. At the symposium *Models of adaptability in changing environments. Studies on detection, preference and probability*. International Seminar of Behavior and its Applications. Tlaxcala, Mexico.
- Bouzas, A., **Velázquez, C. A.** (2017). Behavioral adaptation to changes in the statistical properties of the environment. Mexican Society of Behavior Analysis Meeting. Aguascalientes, Mexico.

#### INVITED TALKS

---

- Immersive Cognition Lab, Leeds University. Mar 2022
- Skill, Learning and Performance Lab, Case Western University Feb 2022
- Baby and Child Research Center, Donders Institute for Cognition, Netherlands June 2021
- Center of Studies and Research of Behavior, University of Guadalajara, Mexico. June 2021

#### CONFERENCE POSTERS

---

- Kim, O., A. **Velázquez, C.**, Taylor, J. A. (2022). Mental rotation incurs a cognitive cost in a visuomotor adaptation task. *Society for Neuroscience*.
- **Velázquez, C.**, Taylor, J. A. (2022). Learning novel sensorimotor mappings in a grid navigation task. *The Multi-disciplinary Conference on Reinforcement Learning and Decision Making*

- **Velázquez, C.**, Taylor, J. A. (2022). Effects of training variability on the use of flexible sensorimotor mappings. Society for the Neural Control of Movement Conference.
- Kim, O. A., **Velázquez, C.**, Taylor, J. A. (2022). The use of mental rotation strategies in a visuomotor adaptation task incurs a distinct cognitive effort cost. Society for the Neural Control of Movement Conference.
- **Velázquez, C.**, Taylor, J. (2021). Contextual cues can form separate motor memories in a novel action-outcome association task. Society for the Neural Control of Movement (Virtual Meeting).
- **Velázquez, C.**, Villarreal, M., and Bouzas, A. (2019). Prediction in the face of gradual and abrupt changes in the environment. 52nd Annual Meeting of the Society for Mathematical Psychology. Montreal, Canada.
- Villarreal, M., **Velázquez, C.**, Bouzas, A. (2019). Choice behavior in dynamic Random-Interval Random-Ratio schedules of reinforcement. 52nd Annual Meeting of the Society for Mathematical Psychology. Montreal, Canada.

## BOOK CHAPTERS

---

- Bouzas, A., **Velázquez, C.**, Villarreal, M. (2019). The future of Behavioral Sciences. *Especulaciones y certezas en torno al futuro de la ciencia*. Instituto de Matemáticas UNAM.

## PROGRAMMING SKILLS

---

- Python with experience using TensorFlow, stable baselines and gym environments to model RL agents.
- R including JAGS (Just Another Gibbs Sampler) to perform Bayesian inference.
- Matlab to perform data analysis and modeling.
- HTML, CSS and JavaScript for web design.

## TEACHING EXPERIENCE

---

- Assistant of Instruction in the class **Cognitive Psychology** at Princeton University. *Spring 2024*
- Assistant of Instruction in the class **Cognitive Psychology** at Princeton University. *Fall 2022*
- Assistant of Instruction in the class **Computational Models of Cognition** at Princeton University. *Fall 2021*
- Assistant of Instruction in the class **Introduction to Psychology**, at Princeton University. *Fall 2020*
- Assistant of Instruction in the class **Learning and Adaptive Behavior**, at UNAM. *Spring 2017*