
Patryk Laurent, Ph.D.

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Citizenship: American (USA)

Education

- 2009 Ph.D. in Neuroscience, Center for Neuroscience at the University of Pittsburgh ([CNUP](#)).
“*Basal ganglia involvement in the reinforcement learning of physical and cognitive actions*”
(Dissertation Supervisor: Dr. Erik Reichle)
- 2009 Certificate Program, Center for the Neural Basis of Cognition ([CNBC](#)) – a joint program
of Carnegie Mellon University and the University of Pittsburgh.
- 2001 B.A. in Cognitive Sciences with a minor in Mathematics, University of Virginia.

Positions held

- 2017-present **Advisor, Accel Robotics** (San Diego, CA).
- Advising on topics in computer vision and AI/machine learning for autonomous systems.
- 2016-2017 **Director of Engineering (AI), LeEco US** (San Diego, CA).
- Implemented AI-based applications on Android smartphones and Android TVs (TensorFlow and OpenCV on Android).
 - Designed novel UI/UX around recognizing naturalistic user behaviors and speech commands, minimizing false positives and maximizing user control over AI system.
 - Collaborated with software engineering towards productization.
- 2014-2016 **Senior Scientist/Director of R&D, Brain Corporation** (San Diego, CA).
- Designed and built an iOS user interface for controlling and teaching mobile robots.
 - Documented, packaged and deployed learning software for a purchasable robot kit.
 - Co-designed and investigated a novel large, recurrent neural network architecture that learns to robustly track objects in continuous video (DARPA-funded).
 - Implemented and supported a vision-based gestural, machine learning prototype system (technical services for a Fortune 500 consumer electronics company).
 - Promoted to Director of R&D to manage a team of scientists and translate customer or product needs into well-defined projects, and integrate the results.
- 2012-2014 **Scientist, Brain Corporation** (San Diego, CA).
- Designed and implemented a gamepad-based smartphone user interface for supervised learning on Brain Corporation’s *eyeRover* robot.
 - Developed a machine learning prototype to remotely control IoT devices in response to learned visual cues and gestures (over WiFi and infrared) using mobile processors.
 - Contributed to the design of an end-to-end spiking neural network “nervous system” for a robot to follow target objects and avoid obstacles (for Qualcomm Research).
 - Designed an annotation and graphing system for documenting the structure of large and complex engineered neural networks.

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- 2009-2012 **Postdoctoral Researcher, Department of Psychological and Brain Sciences, The Johns Hopkins University** (Baltimore, MD).
- Studied the Reinforcement Learning of visual attention focus and decision making using neuroimaging (fMRI) and behavioral methods.
 - Analyzed recurrent neural networks as a mechanism for reward discounting functions.
 - Provided technical support and advice to multiple fMRI/big data projects at Hopkins.
 - Initiated development of an integrative theory of basal ganglia function in Reinforcement Learning as a network with hippocampus, cerebellum, and neocortex.
- 2003-2009 **Graduate Researcher, Center for Neuroscience, University of Pittsburgh (CNUP) and Center for the Neural Basis of Cognition (CNBC)** (Pittsburgh, PA).
- Simulated Reinforcement Learning agents that learned to control their saccadic eye movements and visual attention during reading and survival tasks.
 - Designed, carried out, and modeled human behavioral Reinforcement Learning experiments.
 - Used fMRI to discover brain regions involved in rewarding motor and mental acts.
 - Developed real-time sound/echo cancellation technique to hear fMRI participants above fMRI scanner EPI noise.
 - Studied recurrent neural networks for continuous speech perception (w/ Jay McClelland).
- 2002-2003 **Software Developer, Super Natural Tools, Inc.** (Roanoke, VA)
- Co-wrote and deployed a streaming communications and data analysis system (Java).
 - Adopted agile development and extreme programming techniques.
- 2000-2002 **Co-Founder and CTO, Inductive Logic, Inc.** (Charlottesville, VA)
- Developed natural language processing sentiment analysis software.
 - Participated in the University of Virginia Darden School of Business Incubator program.
- 1997-2000 **Software Developer, ScholarOne, Inc.** acq'd by Reuters (Charlottesville, VA)
- Co-developed ManuscriptCentral and AbstractCentral online publishing systems.
 - Automated Macintosh software to convert and format uploaded manuscripts.
- 1997-2000 **Undergraduate Researcher, Laboratory of Systems Neurodynamics (Levy Laboratory), University of Virginia (Charlottesville, VA).**
- Researched sparse recurrent spiking neural networks and their capabilities for sequence learning and pattern completion.

Grants, honors & awards

- 2006-2008 NSF IGERT Training Grant Funding Recipient (Center for the Neural Basis of Cognition).
- 2003-2004 Predoctoral Fellowship, Center for Neuroscience (University of Pittsburgh).
- 2001 Batten Institute Business Incubator Award, Darden School of Business (University of Virginia).
- 1999 Harrison Award — (Center for Undergraduate Excellence, University of Virginia).
- 1997-2001 Jerome Holland Scholarship — (University of Virginia).
- 1997-2001 Echols Scholar Award — (University of Virginia).

Patents

- 2017 Ponulak, F., Kazemi, M., **Laurent, P.**, Sinyavskiy, O., Izhikevich, E. (2017). Apparatus and methods for haptic training of robots. United States Patent and Trademark Office Number Number 9,597,797.
- 2016 **Laurent, P. A.**, Passot, J-B-, Wildie, M., Izhikevich, E. (2016) Adaptive robotic interface apparatus and methods. United States Patent and Trademark Office Number 9,242,372.
- 2016 **Laurent, P. A.**, Passot, J-B-, Ponulak, F., Izhikevich, E. (2016) Discrepancy detection apparatus and methods for machine learning. United States Patent Office Patent and Trademark Office Number 9,248,569.
- 2016 **Laurent, P. A.**, Passot, J-B-, Sinyavskiy, O., Ponulak, F., Gabardos, B. I., Izhikevich, E. (2016) Predictive robotic controller apparatus and methods. United States Patent Office Patent and Trademark Office Number 9,314,924.
- 2016 **Laurent, P. A.**, Passot, J-B-, Izhikevich, E. (2016) Robotic control arbitration apparatus and methods. United States Patent Office Patent and Trademark Office Number 9,296,101.
- 2016 Passot, J-B-, Sinyavskiy, O., Ponulak, F., **Laurent, P.**, Gabardos, B. I., Izhikevich, E. (2016) Robotic training apparatus and methods. United States Patent Office Patent and Trademark Office Number 9,384,443.
- 2016 Meier, P., Passot, J-B-, Gabardos, B. I., **Laurent, P.**, Sinyavskiy, O., O'Connor, P., Izhikevich, E. (2016) Apparatus and methods for control of robot actions based on corrective user inputs. United States Patent Office Patent and Trademark Office Number 9,358,685.

Patent Applications (Published)

- 2016 **Laurent, P.**, Petre, C. and Izhikevich, E.M. (2016). Home animation apparatus and methods. U.S. Patent Application 20160075034.
- 2016 **Laurent, P.**, Petre, C., Izhikevich, E.M. and Polonichko, V. (2016). Apparatus and methods for removal of learned behaviors in robots. U.S. Patent Application 20160075017.
- 2016 **Laurent, P.**, Petre, C. and Izhikevich, E.M. (2016). Apparatus and methods for context determination using real time sensor data. U.S. Patent Application 20160075016.
- 2016 Izhikevich, E.M., **Laurent, P.**, Petre, C., Hylton, T. and Polonichko, V. (2016). Apparatus and methods for remotely controlling robotic devices. U.S. Patent Application 20160075015.
- 2015 Izhikevich, E. M., **Laurent, P.**, Richert, M., Petre, C. (2015) Learning apparatus and methods for control of robotic devices via spoofing 20150283702 A1
- 2015 Izhikevich, E.M., **Laurent, P.**, Petre, C. (2015). Apparatus and methods for remotely controlling robotic devices. U.S. Patent Application 20150283703.
- 2015 Izhikevich, E. M., **Laurent, P.**, Polonichko, V. (2015) Spoofing remote control apparatus and methods 20150283701 A1
- 2015 Izhikevich, E. M., **Laurent, P.**, Petre, C. (2015) Apparatus and methods for remotely controlling robotic devices 20150283703 A1

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- 2013 Passot, J.B., Sinyavskiy, O., Ponulak, F., **Laurent, P.**, Gabardos, B.I., Izhikevich, E. and Polonichko, V. (2013). Hierarchical robotic controller apparatus and methods. U.S. Patent Application 13/918,298.
- 2013 Passot, J.B., Sinyavskiy, O., Ponulak, F., **Laurent, P.**, Gabardos, B.I. and Izhikevich, E., Brain Corporation, 2013. Robotic training apparatus and methods. U.S. Patent Application 13/918,338.
- 2005 **Laurent, P. A.**, Lewis, B. M., & Poush, A. G. (2005). Analysis of time-series data from an electric power-producing asset for the inference of well-defined overlapping modes. United States Patent Office Patent and Trademark Office 20050209799 A1.
- 2005 Lewis, B. M., **Laurent, P. A.**, & Poush, A. G. (2005). Method for the automated quantification of power production, resource utilization and wear of turbines. United States Patent Office Patent and Trademark Office 20050171704 A1.

Publications

Peer-Reviewed Articles

- 2016 Tremel, J., **Laurent, P. A.**, Wolk, D. A., Wheeler, M. E., & Fiez, J. A. (2016) Neural signatures of experience-based improvements in deterministic decision making. *Behavioural Brain Research*. 315: 51-56. ([doi:10.1016/j.bbr.2016.08.023](https://doi.org/10.1016/j.bbr.2016.08.023))
- 2016 Guediche, S., Reilly, M., Santiago, C., **Laurent, P.**, Blumstein, S. E. (2016) An fMRI study investigating effects of conceptually related sentences on the perception of degraded speech. *Cortex*. 79: 57-74. ([doi:10.1016/j.cortex.2016.03.014](https://doi.org/10.1016/j.cortex.2016.03.014))
- 2015 **Laurent, P. A.**, Hall, M. G., Anderson, B. A., Yantis, S. (2015) Valuable orientations capture attention. *Visual Cognition*. 23 (1-2): 133-146. ([doi:10.1080/13506285.2014.965242](https://doi.org/10.1080/13506285.2014.965242))
- 2015 Guediche, S., Holt, L., **Laurent, P. A.**, Lim, S.-J., Fiez, J. (2015) Evidence for cerebellar contributions to adaptive plasticity in speech perception. *Cerebral Cortex*. 25 (7): 1867-1877. ([doi:10.1093/cercor/bht428](https://doi.org/10.1093/cercor/bht428))
- 2014 Anderson, B. A., **Laurent, P. A.**, Yantis, S. (2014) Value-driven attentional priority signals in human basal ganglia and visual cortex. *Brain Research*. 1587 (2014): 88-96. ([doi:10.1016/j.brainres.2014.08.062](https://doi.org/10.1016/j.brainres.2014.08.062))
- 2013 **Laurent, P. A.** (2013) A neural mechanism for reward discounting: Insights from modeling hippocampal-striatal interactions. *Cognitive Computation*. 5(1): 152-160. ([doi:10.1007/s12559-012-9178-8](https://doi.org/10.1007/s12559-012-9178-8))
- 2013 Cole, M. W., **Laurent, P. A.**, Stocco, A. (2013) Rapid instructed task learning: A new window into the human brain's unique capacity for flexible cognitive control. *Cognitive, Affective, & Behavioral Neuroscience*. 13(1): 1-22. ([doi:10.3758/s13415-012-0125-7](https://doi.org/10.3758/s13415-012-0125-7))
- 2013 Anderson, B. A., **Laurent, P. A.**, Yantis, S. (2013) Reward predictions bias attentional selection. *Frontiers in Human Neuroscience*. ([doi:10.3389/fnhum.2013.00262](https://doi.org/10.3389/fnhum.2013.00262))
- 2012 Anderson, B. A., **Laurent, P. A.**, & Yantis, S. (2012) Generalization of value-based attentional

priority. *Visual Cognition* 20(6): 647-658. (doi:10.1080/13506285.2012.679711)

- 2011 Anderson, B. A., **Laurent, P. A.**, & Yantis, S. (2011) Learned value magnifies salience-based attentional capture. *PLoS ONE* 6(11): e27926 (doi:10.1371/journal.pone.0027926)
- 2011 Anderson, B. A., **Laurent, P. A.**, & Yantis, S. (2011) Value-driven attentional capture. *PNAS*, 108(25):10367-10371. (doi:10.1073/pnas.1104047108)
- 2008 **Laurent, P. A.** (2008) The emergence of saliency and novelty responses from reinforcement learning principles. *Neural Networks*, 21:1493-1499. (doi:10.1016/j.neunet.2008.09.004)
- 2008 Reichle, E. D., Vanyukov, P. M., **Laurent, P. A.**, & Warren, T. (2008) Serial or parallel? Using depth-of-processing to examine attention allocation during reading. *Vision Research*, 48: 1831-1836. (doi:10.1016/j.visres.2008.05.007)
- 2006 Reichle, E. D. & **Laurent, P. A.** (2006) Using reinforcement learning to understand the emergence of 'intelligent' eye-movement behavior during reading. *Psychological Review*, 113: 390-408. (doi:10.1037/0033-295X.113.2.390)
- 2003 Mitman, K. E., **Laurent, P. A.**, & Levy, W. B (2003) Defining time in a minimal hippocampal CA3 model by matching time-span of associative synaptic modification and input pattern duration. *Proceedings of the International Joint Conference on Neural Networks (IJCNN)*. (doi:10.1109/IJCNN.2003.1223651)

Invited Articles and Book Chapters

- 2012 Yantis, S., Anderson, B. A., Wampler, E. K., & **Laurent, P. A.** (2012). Reward and Attentional Control in Visual Search. *Nebraska Symposium on Motivation 2011: The Influence of Attention, Learning, and Motivation on Visual Search*. Springer New York, 2012. 91-116.
- 2011 Reichle, E. D., Liu, Y., & **Laurent, P. A.** (2011). The emergence of adaptive eye movement control in reading: Theory and data. *Studies of Psychology and Behavior*, 9, 45-52.

Posters & Abstracts

- 2011 **Laurent, P. A.** & Bostan, A. C. (2011). Stabilizing Reinforcement Learning in the brain: A proposed function of the bidirectional cerebello-basal ganglia projection. *Annual Meeting of the Society for Neuroscience (Washington DC)*. 723.27.
- 2010 **Laurent, P. A.** & Reichle, E. D. (2010). Localization of physical and cognitive reinforcement signals in the striatum. *Annual Meeting of the Society for Neuroscience (San Diego, CA)* 801.4.
- 2010 Cho, S., **Laurent, P. A.**, & Yantis, S. (2010). Subcortical mechanisms of cognitive control in task switching. *Annual Meeting of the Society for Neuroscience (San Diego, CA)* 501.7.
- 2008 **Laurent, P. A.**, Reichle, E. D., & Fiez, J. A. (2008, November). Does parallel anatomy translate to parallel computation in the basal ganglia? *Annual Meeting of the Society for Neuroscience (Washington DC)* 680.9.

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- 2008 Warren, T., Patson, N. D., **Laurent, P. A.**, & Reichle, E. D. (2008, November). Revisiting length and predictability effects on eye movements in reading. 49th Annual Meeting of the Psychonomic Society (Chicago, IL).
- 2008 Cole, M. W. & **Laurent, P. A.** (2008, November). Neurevolution: an example of blogging to enhance scientific communication. Annual Meeting of the Society for Neuroscience (Washington DC). 227.6.
- 2007 **Laurent, P. A.** (2007). Using reinforcement learning to interpret the non-reward phasic dopamine response. Annual Meeting of the Society for Neuroscience (San Diego, CA). 530.10.
- 2007 Vanyukov, P. M., Reichle, E. D., **Laurent, P. A.**, Morales, F. J., & Warren, T. (2007). Serial or parallel? Using depth of processing to examine attention allocation during reading. European Conference on Eye Movements (ECEM 14) (Potsdam, Germany).
- 2006 **Laurent, P. A.** & Reichle, E. D. (2006). Using Reinforcement-Learning Agents to Examine the Allocation of Attention During Reading. Architectures and Mechanisms for Language Processing (AMLaP 2006) (Nijmegen, Holland).
- 2004 Phillips, J. P., **Laurent, P. A.**, Guediche, S. A., Bolger, D. J., Qin, L., Perfetti, C. A., & Fiez, J. A. (2004). Reliable word identification may modulate the response to visually presented words in the left fusiform gyrus. Annual Meeting of the Society for Neuroscience (San Diego, CA). 80.11.
- 2004 Reichle, E. D. & **Laurent, P. A.** (2004). The emergence of 'intelligent' eye-movement control during reading: a computational account. Architectures and Models of Language Processing (AMLaP 2004) (Aix-en-Provence, France).

Talks

- 2017 **Laurent, P. A.** (2017) Machine Intelligence in Everyday Devices. Xconomy Forum on the Human Impact of Innovation. (San Diego, CA)
- 2016 **Laurent, P. A.** (2016) Machine Vision: Clearer than Ever. Presenter and Panel Participant, RoboUniverse San Diego. (San Diego, CA)
- 2016 **Laurent, P. A.** (2016) Neural networks that learn physics for robot vision. Department of Physics Colloquium. University of California, San Diego (UCSD). (San Diego, CA)
- 2016 **Laurent, P. A.** (2016) Real-world immersion of artificial neural networks through robotics. Cognitive and Information Sciences Seminar. University of California, Merced. (Merced, CA)
- 2015 **Laurent, P. A.** (2015) Challenges for the Widespread Adoption of Robotics. *Interdisciplinary Challenges to Intelligent Systems Workshop*. Johns Hopkins Applied Physics Laboratory (JHU APL, Columbia, MD)
- 2012 **Laurent, P. A.** (2012) Understanding Reward Delay Discounting as Emerging from Interactions between Hippocampal and Striatal Neural Networks. Sixteenth International Conference on Cognitive and Neural Systems (ICCNS16) (Boston, MA).

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- 2010 Anderson, B. A., **Laurent, P. A.**, & Yantis, S. (2010) Reward-Driven Attentional Capture. 51st Annual Meeting of the Psychonomic Society (St. Louis, MO). 170.
- 2009 **Laurent, P. A.** & Reichle, E. D. (2009). Evaluating Reinforcement Learning of Hand Movements, Eye Movements, and Covert Shifts of Attention in Humans: A model-based fMRI study. 15th European Conference on Eye Movements (ECEM15) (Southampton, England).
- 2009 **Laurent, P. A.** & Reichle, E. D. (2009) Using reinforcement learning to examine word-parsing strategies in the reading of Chinese. 15th European Conference on Eye Movements (ECEM15) (Southampton, England).
- 2007 **Laurent, P. A.** & Reichle, E. D. (2007). Serial or parallel? Using Reinforcement Learning to examine attention allocation during reading. Symposium on Computational Models of Eye-Movement Control, 14th European Conference on Eye Movements (ECEM14) (Potsdam, Germany).
- 2006 **Laurent, P. A.** & Reichle, E. D. (2006). Using Reinforcement Learning to understand eye-movement control during reading. Invited Colloquium, Institute of Computing Science, Poznan University of Technology (Poznan, Poland).
- 2006 Reichle, E. D. & **Laurent, P. A.** (2006). Using Reinforcement Learning to understand eye-movement behavior during reading. Invited Colloquium, ECRP Workshop: Eye Movements in Reading: Computational Models & Corpus Analyses, University of Potsdam (Germany).
- 2005 **Laurent, P. A.** & Reichle, E. D. (2005). The emergence of ‘intelligent’ eye-movement control in reading: A Reinforcement Learning Model. Invited Colloquium at Department of Psychology, University of Pittsburgh.
- 2005 Reichle, E. D. & **Laurent, P. A.** (2005). Using Reinforcement Learning to understand the emergence of ‘intelligent’ eye-movement behavior during reading. 13th European Conference on Eye Movements (ECEM13) (Berne, Switzerland).

Teaching experience

- 2016, fall *Guest Lecturer*, Life in the Universe: *Artificial Intelligence* (Instructor: Shelley Wright; Department of Physics, University of California, San Diego).
- 2012, fall *Co-Instructor with Dr. Chase Figley*, Functional Neuroimaging Graduate Seminar AS 200.615 (Department of Psychological and Brain Sciences, The Johns Hopkins University).
- 2010-2011 *Instructor* (4 semesters). Functional Neuroimaging Graduate Seminar AS 200.614/5 (Department of Psychological and Brain Sciences, The Johns Hopkins University).
- 2010, spring *Instructor*, Tutorial Introduction to fMRI Analysis using AFNI (The Johns Hopkins University).
- 2008, fall *Guest Lecturer*, Psychology 0035: Research Methods (Instructor: Erik Reichle; University of Pittsburgh).
- 2006, spring *Teaching Assistant*, Neurophysiology 1012/2012 (Instructor: Jon Johnson; University of Pittsburgh).

2006, fall *Guest Lecturer, Psychology 0420/0421: Cognitive Psychology for Majors and Non-Majors* (Instructor: Erik Reichle; University of Pittsburgh).

Professional service

2017 Advisor, Neural Network Exchange Format Committee, The Khronos Group.

2010 Outside examiner, Ms. Sarah Orban's undergraduate honors thesis committee. (Department of Psychology, Honors College, University of Pittsburgh).

2010 Outside examiner, Mr. Steve Walenchok's undergraduate honors thesis committee. (Department of Psychology, Honors College, University of Pittsburgh).

2009 Symposium chairperson, European Conference on Eye Movements (ECEM15).

2009 Trainee, Society for Neuroscience Advocacy Training ("Capitol Hill Day", Washington DC).

2008 Student Representative, IGERT PI Meeting, National Science Foundation (Arlington, VA).

2004-2005 Student Representative, Education Committee, Center for the Neural Basis of Cognition (Pittsburgh, PA).

Preferred Development Environment

Languages: Scala, Objective-C, Java, Python, PHP, bash, Perl.

Operating systems: Linux, OS X, FreeBSD.

Cloud infrastructure: Amazon Web Services; Google Cloud.

Tools: TensorFlow, R, SQL (MySQL, postgresql), git, Jira.

Editor: vim.