
Patryk Laurent, Ph.D.

Director of Engineering (AI)



Le Technology, Inc.

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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

- 2016-present **Director of Engineering (AI), LeEco US** (San Diego, CA).
- Applying machine learning and other AI technologies to LeEco’s smartdevices.
- 2014-2016 **Senior Scientist/Director of R&D, Brain Corporation** (San Diego, CA).
- Co-designed and investigated a large, recurrent neural network architecture that learns from continuous video via unsupervised learning (DARPA-funded).
 - Implemented and supported a vision-based gestural, machine learning prototype system (for a Fortune 500 consumer electronics company).
 - Documented, packaged and deployed learning software for a purchasable robot kit.
 - Designed and built an iOS user interface for controlling and teaching mobile robots.
 - Promoted to Director of R&D to manage a team of scientists and translate customer needs into research projects.
- 2012-2014 **Scientist, Brain Corporation** (San Diego, CA).
- 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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- Developed a machine learning prototype to remote control devices in response to learned visual cues and gestures (over WiFi and infrared) using mobile processors.
 - Designed and implemented a smartphone user interface for supervised learning on Brain Corporation's *eyeRover* robot.

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.
- Advised multiple fMRI projects on technical matters.
- Lectured on data processing and analysis.
- 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 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

- 2016 **Laurent, P. A.**, Passot, J-B-, Wildie, M., Izhikevich, E. (2016) Adaptive robotic interface apparatus and methods. United States Patent Office 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.

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- 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
- 2013 Ponulak, F., Kazemi, M., **Laurent, P.**, Sinyavskiy, O., Izhikevich, E. (2013). Apparatus and methods for haptic training of robots. U.S. Patent Application 14/102,410.
- 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))

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- 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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/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.

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- 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.
- 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).
- 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

- 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

- 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, Java, Python, Objective-C, PHP, bash, Perl.

Operating systems: Linux (Ubuntu), OS X, FreeBSD.

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

Editor: vim.