

# PATRICK CRUTCHLEY

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**RESEARCH INTERESTS** Machine learning and big-data analysis of human language & behavior, clinical data (structured and unstructured); correlation of naturalistic language to psychometrics; machine learning and graph theoretic analysis of human brain activity, especially during cognition and language processing; computational modeling of memory and decision-making cognitive processes.

**EDUCATION** **University of Pennsylvania**, Philadelphia, PA  
Master of Science in Engineering Candidate, Bioengineering *completing May 2017*  
*Thesis topic:* Functional dynamics of the language system while processing emotionally-valenced text during fMRI. Advisor: Danielle Bassett, Ph.D.  
*Relevant coursework:* Probability, Brain-Computer Interfaces, Machine Learning, Bayesian Methods & Computation, Theoretical Neuroscience, Network Neuroscience, From Lab to Marketplace (Translational Research).  
Bachelor of Science in Engineering, Bioengineering  
*Senior design project:* Implementing an automated method for electrode placement in Parkinson's deep brain stimulation surgery (see RESEARCH PROJECTS section below).  
**Auburn High School**, Auburn, AL  
International Baccalaureate Diploma Programme

**WORK AND RESEARCH EXPERIENCE** **Qntfy Corp.**  
• **Software Developer** December 2016–present  
Data science & psychology research & software development for purposes of quantifying human behavior and mental health from social media activity and other open data, with a focus on text and network analytics.  
**Third Frederick Jelinek Memorial Summer Workshop**, Johns Hopkins University  
• **Graduate Student Participant** Summer 2016  
Research workshop *Detecting Risk and Protective Factors of Mental Health using Social Media Linked with Electronic Health Records*. Work included temporal modeling of dimensionally-reduced language with Gaussian Processes, forecasting and classifying health system encounters from social media, and validation of self-stated diagnosis language models with electronic health records. ([link](#))  
**World Well-Being Project**, Positive Psychology Center, University of Pennsylvania.  
**Social Media & Health Innovation Lab**, University of Pennsylvania.  
• **Senior Application Developer** November 2014–December 2016  
Python-based big-data research programming and application development for language insight and prediction of health, personality, and mood outcomes from social media data.

**Computational Memory Laboratory**, Department of Psychology, University of Pennsylvania. PI: Michael J. Kahana, Ph.D.

- **Research Project Manager** June 2014–November 2014  
Project startup and management of \$22.5M multi-site DARPA “Restoring Active Memory” cooperative agreement (PI: Kahana). General lab administration and oversight; see **Research Coordinator** below.
- **Research Coordinator/Lab Manager** July 2011–June 2014  
Grant, IRB, and budget administration (multiple NIH R01 awards); coordinating & conducting multisite ECoG testing; designing and implementing human experimental protocols; use, training, and maintenance of lab hardware and software, including EEG equipment, workstations, databases, servers, and computing clusters; Python (PyEPL) and MATLAB programming; personal research projects.  
Planned and coordinated annual Context and Episodic Memory Symposium (CEMS) 2012–2014. Host campus coordinator for 2013 & 2014 CEMS.  
Coordinated submission of \$22.5M multi-site DARPA “Restoring Active Memory” grant application (awarded).
- **Research Specialist** July 2009–July 2011  
Assisting in designing and running large-scale human memory and electrophysiology experiment protocols; Python (PyEPL) and MATLAB programming; personal research projects.

**Brain and Behavior Laboratory**, Department of Psychiatry, University of Pennsylvania. PI: Bruce I. Turetsky, M.D.

- **Programmer/Analyst** Aug 2007–July 2009  
MATLAB and Brain Vision Analyzer scripting; MRI morphometry analysis; assisting in designing and running combined TMS-EEG experiment with schizophrenia patient population and healthy controls.

#### PAPERS

Merchant, R. M., Crutchley, P., Ungar, L., Asch, D. A., Hill, S., Padrez, K., Smith, R. J., and Schwartz, H. A. (submitted). Facebook language predicts medical record disease diagnoses.

Smith, R., Crutchley, P., Schwartz, H. A., Ungar, L., Shofer, F., Padrez, K. A., and Merchant, R. M. (2016). Variation in patient language and posting patterns on Facebook across health conditions validated in the electronic medical record. *J Med Internet Res*, in press. doi:10.2196/jmir.6486

Carpenter, J., Crutchley, P., Zilca, R. D., Smith, L. K., Cobb, A. M., and Parks, A. C. (2016). Seeing the “big” picture: Big data methods for exploring relationships between usage, language, and outcome in internet intervention data. *J Med Internet Res*, in press. doi:10.2196/jmir.5725

Padrez, K. A., Ungar, L., Schwartz, H. A., Smith, R. J., Hill, S., Antanavicius, T., Brown, D. M., Crutchley, P., Asch, D. A., and Merchant, R. M. (2016). Linking social media and medical record data: a study of adults presenting to an academic, urban emergency department. *BMJ Quality & Safety*, **25**(6): 414–23. doi:10.1136/bmjqs-2015-004489

Healey, M. K., Crutchley, P., and Kahana, M. J. (2014). Individual differences in memory search and their relation to intelligence. *Journal of Experimental Psychology: General*, **143**(4), 1553–1569. doi:10.1037/a0036306

Turetsky, B. I., Crutchley, P., Walker, J., Gur, R. E., and Moberg P. J. (2009). Depth of the olfactory sulcus: a marker of early embryonic disruption in schizophrenia? *Schizophrenia Research*, **115**(1), 8–11. doi:10.1016/j.schres.2009.09.005

- CONFERENCE TALKS Schwartz, H. A., Crutchley, P. (presenting), Zamani, M., and Buffone, A. (2016). A model of generalized trust in big data and its association with personality and online behavior. Presented at the Association for Psychological Science Annual Convention, Chicago, Illinois.
- POSTER PRESENTATIONS Crutchley, P., Healey, M. K., and Kahana, M. J. (2013). Individual differences in memory search and their relation to intelligence. Presented at the Context and Episodic Memory Symposium, Philadelphia, Pennsylvania.
- Crutchley, P., Healey, M. K., and Kahana, M. J. (2012). Individual differences in free recall and intelligence. Presented at the Meeting of the Society for Mathematical Psychology, Columbus, Ohio.
- OTHER RESEARCH PROJECTS *(in reverse chronological order; recent first)*
- Predicting diagnosis of depression from Facebook. With Johannes Eichstaedt, H. Andrew Schwartz, Raina Merchant, Lyle Ungar.
- Signals of empathy in med school admissions essay language. With David Yaden, Anneke Buffone, Lyle Ungar.
- Language of trustfulness in social media. With Anneke Buffone, Mohammadzaman Zamani, H. Andrew Schwartz.
- Using TMS-evoked potentials to probe neural response mechanisms in schizophrenia. With Bruce Turetsky, M.D. and Mahendra Bhati, M.D. Presented at *ICOSR 2009* by BT.
- Real-time MATLAB implementation of functional localization and visualization of the STN from microelectrode recordings acquired during DBS surgery with unsupervised machine learning. Senior design project. With Charles Li and John Paulett; advised by Stephen Wong, M.D., Shabbar Danish, M.D., and Leif Finkel, M.D., Ph.D. Published in *J. Neural Eng.* (Wong et al., 2009.)
- SKILLS *Software/scripting/tools:* Python (pandas, NumPy, SciPy, scikit-learn, StatsModels, Matplotlib); MySQL; R; MATLAB;  $\text{\LaTeX} 2_{\epsilon}$ ; git; `bash/zsh` shell scripting; SPSS; BrainVisa; OsiriX; EGI NetStation; Adobe Photoshop, Illustrator, and InDesign; MS Office; iWork.
- Operating systems:* Mac OS X, Mac OS X Server, Linux (Ubuntu, RedHat), MS Windows.
- Other:* application of Electrical Geodesics, BioSemi, Neuroscan EEG systems; MagStim transcranial magnetic stimulator operation. Electroencephalography data collection using Nihon-Kohden clinical EEG and Neuralynx high-frequency/single-unit recording systems.
- OTHER *Hobbies:* Southern-style pit barbecue ([link](#)), modernist cooking techniques, road biking.
- REFERENCES Available upon request.