

Prediction errors and human threat conditioning

2020-07/Area: cognitive psychology/computational neuroscience

Background

Learning about the presence of threat is thought to be a fundamental ability of many mammal species, including humans. While associative learning theory and, more recently, cognitive-computational neuroscience have developed abstract models of this process^{1,2}, it is unclear whether they also describe the actual computations that the brain performs. A particular role in most learning models is played by prediction errors. It has been suggested that some autonomic nervous system measures reflect prediction errors during learning which would lend credence to the idea that the brain uses such quantities, but evidence is mixed^{3,4}.

The goal of this project is to re-analyse an existing data set, and to record new data, in order to identify possible prediction error signals. You will record pupillometry, ECG, and skin conductance data, and analyse them with psychophysiological modelling techniques.

What you can learn

- Background knowledge in associative learning theory, signal processing methods, threat conditioning neuroscience
- Model-based analysis of biophysical signals with the Matlab-based software PsPM (bachlab.org/pspm)
- Experimental skills in human psychophysiology and learning research
- Reinforcement learning modelling skills
- Coding skills

Your profile

Your background is in neuroscience, psychology, biology, or related fields, and you have experience with data analyses (e.g. in Python, R, or MATLAB).

Supervision

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Literature

1. Gershman, S.J., Radulescu, A., Norman, K.A. & Niv, Y. Statistical computations underlying the dynamics of memory updating. *PLoS computational biology* **10**, e1003939 (2014).
2. Rescorla, R.A. & Wagner, A.R. A theory of Pavlovian conditioning: Variations in the effectiveness of reinforcement and nonreinforcement. in *Classical conditioning II: Current research and theory* (ed. A.H. Black & W.F. Prokasy) 64-99 (Appleton-Century-Crofts, New York 1972).
3. Bach, D.R. & Friston, K.J. No evidence for a negative prediction error signal in peripheral indicators of sympathetic arousal. *Neuroimage* **59**, 883-884 (2012).
4. Spoormaker, V.I., *et al.* The neural correlates of negative prediction error signaling in human fear conditioning. *Neuroimage* **54**, 2250-2256 (2011).