

GAZE-CENTERED DECISION-MAKING

Rubén Moreno-Bote¹, Benjamin Hayden² & Demetrio Ferro¹

¹Universitat Pompeu Fabra, Barcelona, Spain;

²Baylor College Medicine, Houston, TX, USA

Grant 106/22

Background: Economic decisions often involve sequential evaluation of options. However, traditional neuroeconomic models underexploit the dynamic interplay between gaze behavior and neural encoding. Evidence suggests that gaze biases both attention and valuation, particularly in the orbitofrontal cortex (OFC), a region central to value-based decision-making. The “look-at-nothing” effect, in which subjects fixate empty locations of previously shown stimuli, may serve to reactivate value representations even without visual input.

Aims: This study examined: (i) when and how offer values are encoded in OFC in relation to gaze, (ii) whether encoding occurs sequentially or simultaneously across the neural populations, and (iii) how gaze-driven neural activity influences final choice behavior.

Methods: Two male rhesus macaques performed a sequential two-offer gambling task. Each offer, defined by probability p and reward m , was followed by a delay with no visual stimuli. Neural activity was recorded from OFC ($n = 248$ cells) and analyzed using regression models linking spike counts to expected value ($EV = m \cdot p$), gaze direction, and choice. Logistic and linear models assessed behavioral and neural correlations of gaze-modulated valuation.

Results: Monkeys preferred higher-EV offers. During delay periods, subjects often gazed at the empty location of offers, showing a clear “look-at-nothing” pattern, and longer fixations predicted subsequent choice. Neural analyses revealed gaze-contingent encoding: OFC neurons encoded the value of the offer located on the gazed side, even when the stimulus was absent. Value encoding decayed when gaze shifted away but was reactivated when gaze returned to the original offer location. OFC cells encoded one offer at a time, supporting sequential rather than parallel encoding. Reactivation-related neural fluctuations predicted subject’s choices, indicating that gaze-induced reactivation reflects reevaluation of offer value guiding behavior.

Conclusions: Gaze actively shapes value-based decision-making by dynamically gating and reactivating neural representations in OFC. Even without visual input, gaze toward previously viewed locations reinstates offer-specific value encoding that biases subsequent choices. These findings suggest that gaze functions as a spatial index for value recall and reevaluation, bridging perception, memory, and choice.

Keywords: Decision-making, Gaze modulation, Neural encoding of value

Publications:

Ferro, D., Cash-Padgett, T., Wang, M. Z., Hayden, B. Y., & Moreno-Bote, R. (2024). Gaze-centered gating, reactivation, and reevaluation of economic value in orbitofrontal cortex. *Nature Communications*, 15(1). <https://doi.org/10.1038/s41467-024-50214-2>

Ferro, D., Rifé-Mata, A., Cash-Padgett, T., Wang, M. Z., Hayden, B. Y., & Moreno-Bote, R. (2023, August). *The role of gaze for value encoding and recollection in orbitofrontal*

cortex. In Conference on Cognitive Computational Neuroscience (CCN 2023), Oxford, UK. <https://2023.ccneuro.org/proceedings/0000615.pdf?s=W&pn=1122>

E-mail contact: ruben.moreno@upf.edu; benhayden@gmail.com;
demetrio.ferro@upf.edu