

Electroencephalographic Correlates of System Two Decision Making

Olav E. Krigolson and Cameron D. Hassall

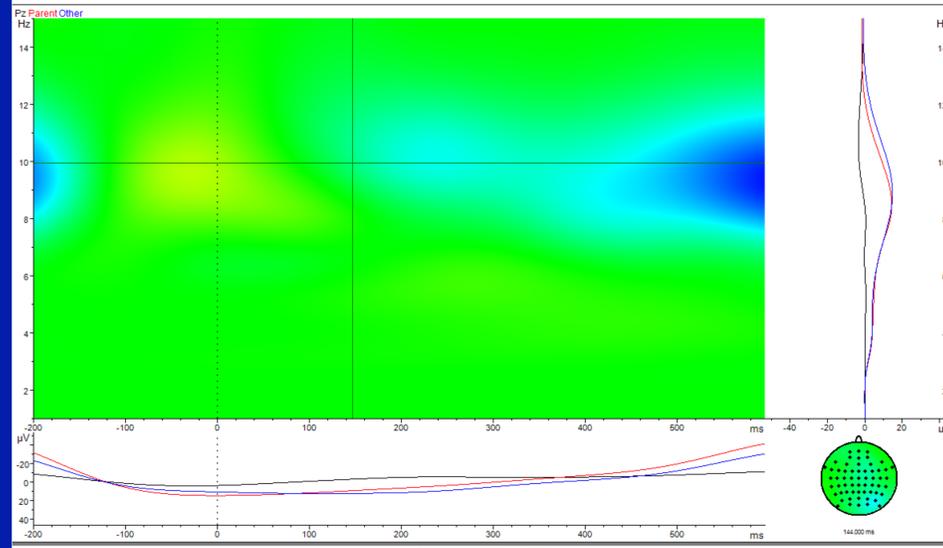
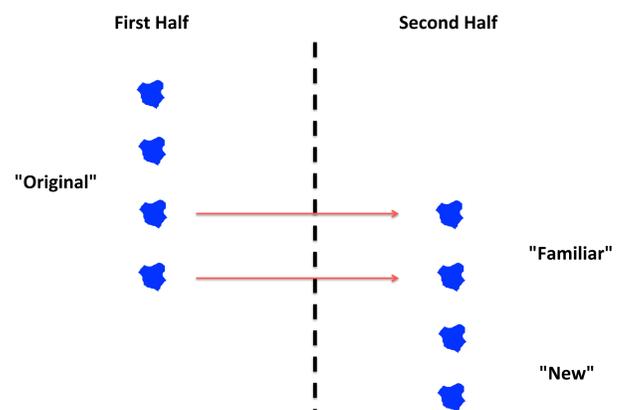
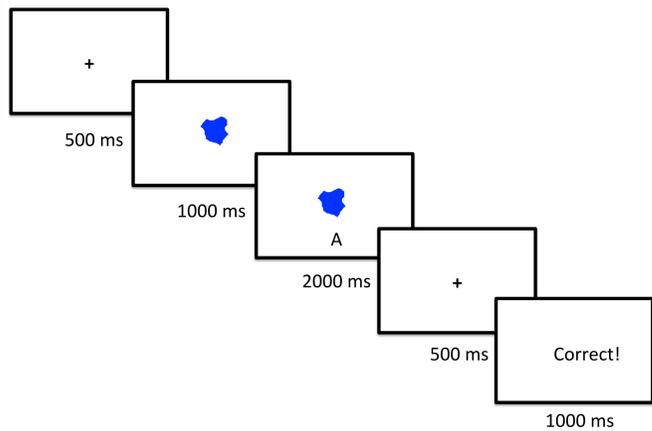
The Neuroeconomics Laboratory, University of Victoria

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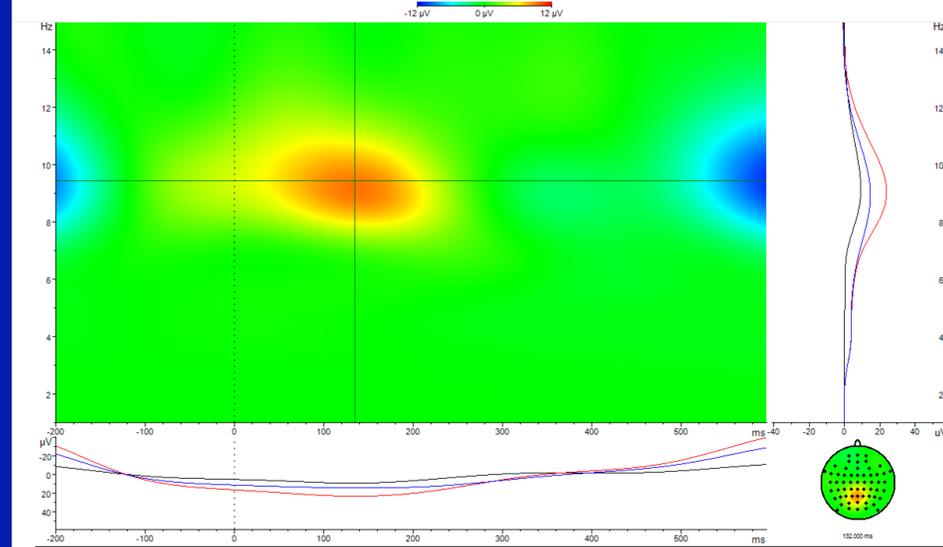
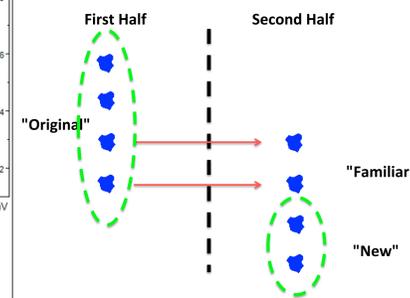
ABSTRACT

Evidence suggests that human decision-making is the product of two distinct systems - a fast system that supplies well known or reflexive answers (System I) and a slow system that supplies more deliberative answers (System II)(Kahneman, 2011). Extending from this, decision making theory posits that early in learning System II is engaged as one works to link decision options to outcomes. However, with learning, and as the linking of decision options to outcomes becomes automated, there is a shift to rely on System I to provide intuitive responses. Here, we hypothesized that early in learning decisions made by System II would be characterized by enhanced alpha activity in the human electroencephalogram over pre-frontal and medial-frontal cortex, and that with learning, a decrease in alpha activity would reflect a shift in reliance to System I. To test this, we had participants perform a perceptual learning task that required them to categorize "blobs" based on a subordinate level naming structure. Initially, participants had to classify the blobs into one of four families. In a key manipulation, at the midpoint of the experiment two new families of blobs were added while two were removed - thus, at this juncture in the experiment, there were "new" and "familiar" blobs. Our analysis of the EEG data revealed a decrease in alpha activity from the start of the experiment to the midpoint at the time of the blob classification decision. After the midpoint, enhanced alpha activity was observed over pre-frontal and medial-frontal cortex when classifying new blobs but the alpha activity associated for the classification of familiar blobs was still reduced. We suggest that the decrease in alpha activity with learning reflects a diminishment in the activation of the System II decision network and thus is reflective of a shift to the System I decision network. Importantly, our results provide novel electroencephalographic evidence for the two system model of decision making proposed by Kahneman and others.

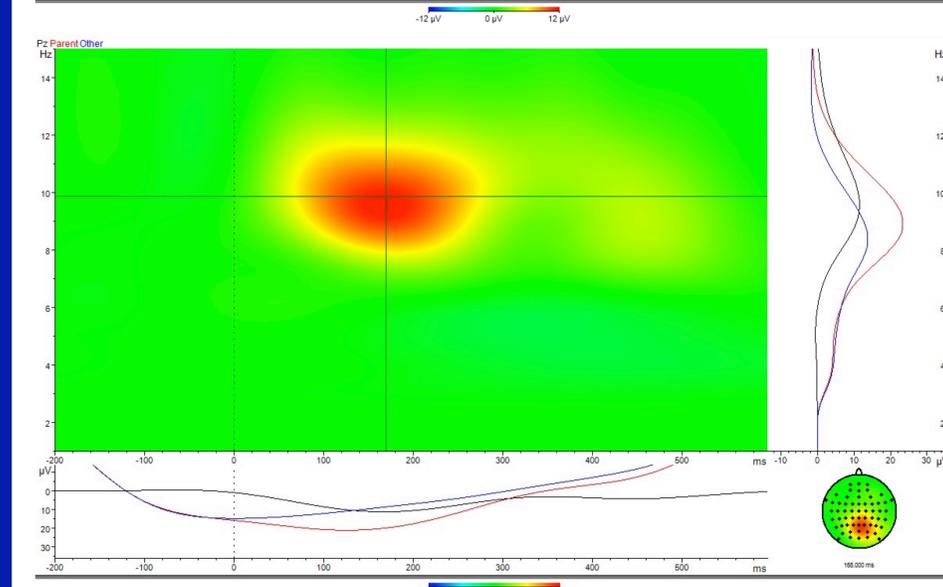
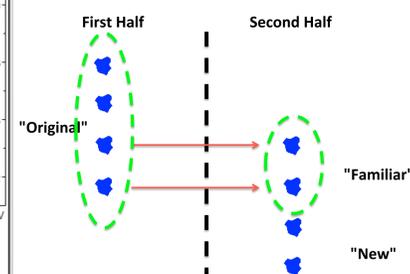
METHODS



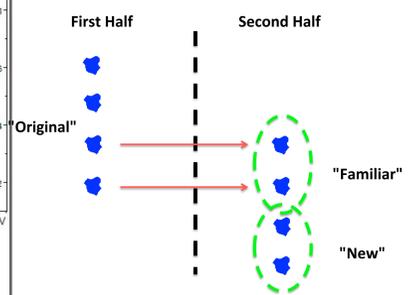
Difference in Alpha Between Late New and Original Blobs
Late New = Original



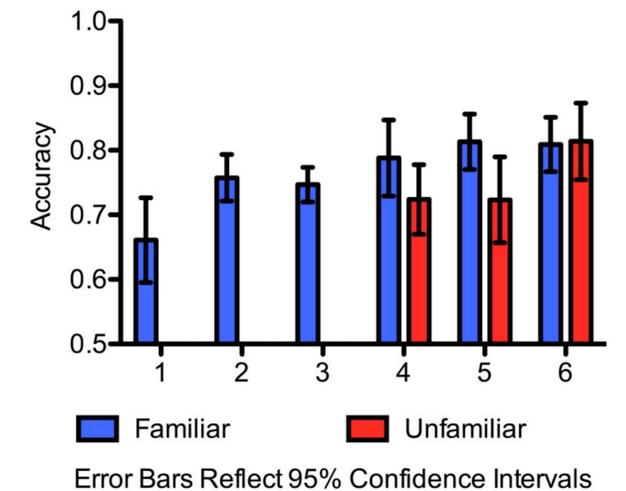
Difference in Alpha Between Late Familiar and Original Blobs
Late Familiar > Original



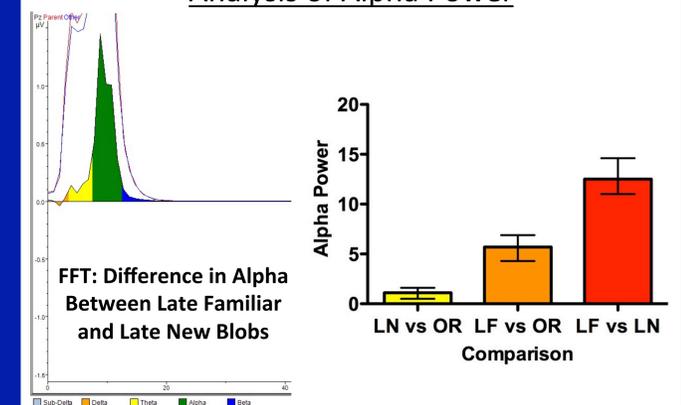
Difference in Alpha Between Late Familiar and Late New Blobs
Late Familiar > Late New



Behavioural Performance



Analysis of Alpha Power



CONCLUSIONS

Here we provide novel evidence that System II decision making may be indexed by parietal alpha, or more correctly, by an absence of parietal alpha. The increased parietal alpha seen in the Late Familiar vs Late New wavelet comparison may reflect the release of resources that are no longer needed when processing familiar blobs.

CONTACT

Olav E. Krigolson, PhD
Principle Investigator, Neuroeconomics Laboratory
Email: krigolso@uvic.ca