Incorporating Newly Learned with Established Information within the Prefrontal Cortical Network

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Introduction

Learning does not occur in isolation, but often requires us to incorporate newly acquired information with previously established knowledge. To investigate the neural process by which this may occur, we trained macaques to learn the transitive relation between items and then subsequently incorporate new transitive relations across various branched paths, while recording from their ventral (vlPFC) and lateral (dlPFC) prefrontal cortices.

Methods

We designed a foraging task, in which Rhesus macaques learned the transitive relationship between different presented items (e.g., A>B>C>D>E). The monkeys began by learning initial B-C associations, called the 'Stem'. After learning the "Stem," the monkeys learned one of two "Branch" associations. In "Branch: Related" trials, in which the learned associations built upon the "Stem" (eg C>D or A>B). In the other, termed "Branch: Unrelated," the new association was novel and did not build upon the stem (eg D>E).

Results

We find that both the vlPFC and dlPFC displayed changes in neural activity that correlated with learning. However, only changes in dlPFC activity distinctly responded to the incorporation of new information. At the network level, interaction between the two areas gradually increased when incorporating new information but decreased when acquiring new but unrelated information.

Conclusions

These findings reveal a ventral-dorsal functional circuit in the prefrontal cortex that may allow for the integration of new and old information. These findings are an important step in characterizing the pathology of learning disabilities, such as Autism and Executive Function Disorder.

Learning Objectives

By the conclusion of this session, participants should be able to:

1. Understand how dlPFC and vlPFC activity differs when novel information is learned from when integrated information is learned

2. Contrast the activity of the dlPFC and vlPFC during learning integration

3. Appreciate how dlPFC and vlPFC communication is a unique component of learning integration

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