Dynamic prefrontal population coding of value and action during active defensive behavior

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Abstract

In mammals, coping with threatening situations requires both identifying stimuli predicting danger and selecting appropriate behavioral responses in order to survive. The dorso medial prefrontal cortex (dmPFC) is a critical structure involve in the regulation of threat-related behavior, yet it is still largely unclear how stimulus value- and action-related activity during aversive behavior are encoded within prefrontal networks. In this work, we used a combination of extracellular recordings and optogenetic manipulations to show that the value of relevant cues and the active decision to avoid aversive consequences are dynamically encoded in the overall population activity of dmPFC neurons. Although dmPFC population activity at stimulus onset discriminates threat- from non-threat predicting cues, it does not predict action outcome. In contrast, dmPFC population activity before action outcome reliably predicts avoided from non-avoided trials. Consistently, the optogenetic inhibition of prefrontal activity critically constraints the selection of appropriate fear responses by preventing value to action transfer. These results revealed that the adaptive selection of fear responses critically depends on dynamic population coding within prefrontal networks

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