

## 2 Single units in the medial prefrontal cortex with anxiety-related firing patterns are preferentially influenced by ventral hippocampal activity.

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#### NEW FINDING

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This is an interesting study into the neural correlates of anxiety-related behaviour in mice, revealing a complex interaction between the ventral hippocampus, medial prefrontal cortex and individual differences in anxiety. It helps to integrate two bodies of research implicating this region in emotional regulation and instrumental control.

Considerable evidence implicates the prelimbic and infralimbic regions of the rodent ventromedial prefrontal cortex (vmPFC) in emotional regulation. They have been shown to play critical roles in the enhancement and extinction, respectively, of fear responses via their connections with the amygdala {1}. In addition, recent findings highlight the interactions of the vmPFC with the ventral hippocampus in the regulation of innate anxiety {2}. An important challenge, though, is to integrate these findings with another body of literature that implicates these regions in the dual mechanisms of instrumental control, namely, determining which behavioural response (habitual or goal directed) wins out {3}. The results from this study take us one step nearer to that integration.

Using electrodes targeting the deep layers of the prelimbic cortex, this study identifies a population of neurons, the activity of which distinguishes between the aversive and safe arms of an elevated plus maze (regardless of the nature of the anxiogenic stimulus). The finding that neurons with the greatest differential response are more strongly coupled to the theta rhythm in the ventral, but not dorsal, hippocampus implicates the ventral hippocampus in the facilitation of this discriminative representation. However, the finding of an inverse correlation between the extent to which the activity of these neurons differentiated between open and closed arms and an animal's tendency to avoid the open arms rules out the hypothesis that this discriminative representation guides anxious, avoidance behaviour. Instead, the authors hypothesise that the medial PFC representation may reflect a "...cognitive mechanism, capable of guiding exploratory behaviour only under conditions where the emotional imperative – avoidance – fails to trump cognition". This is not dissimilar from the proposal by Killcross and Coutureau {4} that behaviour is under the control of rat prelimbic cortex when goal-directed responses, e.g. exploratory behaviour, are far stronger than habitual processes, e.g. innate avoidance of open arms, and is consistent with the hypothesis that the prelimbic cortex is important in the contextual control of goal-directed actions {3}.

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#### Disclosures

None declared

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### Abstract:

#### ABSTRACT

The medial prefrontal cortex (mPFC) and ventral hippocampus (vHPC) functionally interact during innate anxiety tasks. To explore the consequences of this interaction, we examined task-related firing of single units from the mPFC of mice exploring standard and modified versions of the elevated plus maze (EPM), an innate anxiety paradigm. Hippocampal local field potentials (LFPs) were simultaneously monitored. The population of mPFC units distinguished between safe and aversive locations within the maze,

regardless of the nature of the... [more »](#)  
anxiogenic stimulus. Strikingly, mPFC units with stronger task-related activity were more strongly coupled to theta-frequency activity in the vHPC LFP. Lastly, task-related activity was inversely correlated with behavioral measures of anxiety. These results clarify the role of the vHPC-mPFC circuit in innate anxiety and underscore how specific inputs may be involved in the generation of behaviorally relevant neural activity within the mPFC.

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