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<AT>Characteristic and intermingled neocortical circuits encode different visual object discriminations

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<ABS-Head><ABS-HEAD>Graphical abstract

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<ABS-HEAD>Highlights► In a circuit encoding learning, activity-dependent imaging showed neuron locations ► Postrhinal cortex uses bilaminar encoding of visual images ► The superficial layer of neurons is in layers 2, 3, and the superficial part of layer 4 ► The deep layer of neurons is in the deeper part of layer 5 and in layer 6 ► Two image sets are encoded in characteristic and different circuits

<ABS-HEAD>ABSTRACT

<ABS-P>**Synaptic plasticity and neural network theories hypothesize that the essential information for advanced cognitive tasks is encoded in specific circuits and neurons within distributed neocortical networks. However, these circuits are incompletely characterized, and we do not know if a specific discrimination is encoded in characteristic circuits among multiple animals. Here, we determined the spatial distribution of active neurons for a circuit that encodes some of the essential information for a cognitive task. We genetically activated protein kinase C pathways in several hundred spatially-grouped glutamatergic and GABAergic neurons in rat postrhinal cortex, a multimodal associative area that is part of a distributed circuit that encodes visual object discriminations. We previously established that this intervention enhances accuracy for specific discriminations. Moreover, the genetically-modified, local circuit in POR cortex encodes some of the essential information, and this local circuit is preferentially activated during performance, as shown by activity-dependent gene imaging. Here, we mapped the positions of the active neurons, which revealed that two image sets are encoded in characteristic and different circuits. While characteristic circuits are known to process sensory information, in sensory areas, this is the first demonstration that characteristic circuits encode specific discriminations, in a multimodal associative area. Further, the circuits encoding the two image sets are intermingled, and likely overlapping, enabling efficient encoding. Consistent with reconsolidation theories, intermingled and overlapping encoding could facilitate formation of associations between related discriminations, including visually similar discriminations or discriminations learned at the same time or place.**

<KWD>Keywords: visual discrimination learning; neocortical circuits; characteristic circuits; overlapping encoding; activity-dependent gene imaging

<H1>1. **Introduction**

Essential information for performing advanced cognitive tasks is encoded in distributed networks that span multiple forebrain areas, and, further, synaptic plasticity and neural network theories hypothesize that the essential information for specific discriminations is encoded in specific circuits [1-3]. [For this study, essential