Emergence of novel representations in primary motor cortex and premotor neurons during associative learning

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Abstract:

Neurons in the motor areas of cortex play a key role in associating sensory instructions with movements. However, their ability to acquire and maintain representations of novel stimulus features, especially when these features are behaviorally relevant, remains unknown. We investigated neuronal changes in these areas during and after associative learning, by training monkeys on a novel reaching task that required associating target colors with movement directions. Before and after learning, the monkeys performed a well known center-out task. We found that during learning, up to 48% of the neurons developed learning-related responses, differentiating between the associative task and the center-out task, although movement kinematics were the same. After learning, on returning to the center-out task in which color was irrelevant, many of these neurons maintained their response to the associative task; they displayed novel sensitivity to the color of the target that was relevant during learning. These neuronal responses prevailed in both the primary motor cortex and the ventral and dorsal premotor cortices, without degrading the information that the neurons firing carried about movement direction. Our results show that motor cortical neurons can rapidly develop and maintain sensitivities to novel arbitrary sensory features such as color, when such features are behaviorally relevant.

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