

# Motor control—how the brain responds to unexpected situations

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Warning -- unexpected sensory feedback can have devastating consequences if not adequately corrected.  
Credit: FMI

Scientists have demonstrated that the motor cortex is necessary for the execution of corrective movements in response to unexpected changes of sensory input, but not when the same movements are executed spontaneously. Signatures of differential neuronal usage in the cortex accompany these two phenomena. The study by researchers from the University of Basel's Biozentrum and the Friedrich Miescher Institute for Biomedical Research (FMI) has recently been published in *Neuron*.

In mammals, movement is controlled by circuits spanning throughout the central nervous system from the cortex to the spinal cord. The role of motor cortex in the control of movement is still unclear.

In humans, lesions to the motor cortex can result in a loss of voluntary control of movement. Building on studies of motor circuits and the control of movement conducted by the laboratory of Prof. Silvia Arber (University of Basel/FMI) and the expertise in vivo physiology and cortical processing

of the laboratory of Dr. Georg Keller (FMI), the authors teamed up to shed new light on the function of the motor cortex.

## Movement control in response to unexpected situations

The aim of the study was to test how and under which conditions the motor cortex is required for movement control. The authors developed an assay in which they trained mice to navigate a virtual tunnel, a task requiring the adjustment of the heading direction by spontaneous turning on a spherical treadmill.

They also probed the response to unexpected changes in [visual feedback](#) that mice had to correct for—for example, by suddenly shifting the direction in which the mouse is running within the virtual environment. This allowed them to compare the same movements mice executed either spontaneously, or as induced by unexpected changes to the visual feedback.

The authors found that the motor cortex is only necessary for movement control when movements are executed in response to unexpected sensory feedback.

## Specific activity patterns in the motor cortex

Recording neuronal activity in the motor cortex as the mice corrected for unpredicted sensory perturbations, the authors found that the activity patterns observed during the resultant motor corrections were different from those when the mouse executed the same movement spontaneously. This is consistent with a role of the motor cortex in the corrective motor response, during which it is required to engage in triggering an appropriate movement in response to the unexpected event.

"We believe that these findings change the way we

think about how [motor cortex](#) functions from a view that it 'simply' controls movement to a role in which [motor cortex](#) is needed for sensory-guided control of movement in instances where the sensory processing is also cortically dependent," says Matthias Heindorf, first author and former Ph.D. student in the Arber and Keller laboratory.

**More information:** Matthias Heindorf et al, Mouse Motor Cortex Coordinates the Behavioral Response to Unpredicted Sensory Feedback, *Neuron* (2018).  
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