NeuroWatch

DOES THE BRAIN MODEL NEWTON'S LAWS?

McIntyre J, Zago M, Berthoz A *et al.* (2001)
Nature Neuroscience **4**, 693–694 (2000).

Weightless conditions were used by McIntyre *et al.* (2001) to investigate whether an implicit awareness of acceleration due to gravity contributes to the mechanism through which the nervous system synchronises movement to catch a falling ball. Their experiment suggests that theories which view visual sensory information alone as acting to estimate time-to-contact (TTC) wrongfully neglect the role that the internal modelling of Earth's gravity plays in initiating catching movements.

The human visual system is good at estimating velocity but poor at establishing the acceleration of a movement. Theoretically, an increased accuracy of TTC estimates can be facilitated through the inclusion of an internal model of gravity. McIntyre *et al.* (2001) examined the role of such an internal model using a catching task; subjects caught a 400 gram ball projected downwards at 0.7, 1.7 or 2.7 m/s from a starting point 1.6 m above their outstretched hand under different gravitational conditions. On Earth catching responses were well synchronised with the ball's arrival, with anticipatory forearm rotation occurring approximately 200 ms before contact. In 0 *g* the peak anticipatory biceps EMG occurred earlier relative to impact compared to 1 *g*. This suggests that that the nervous system is indeed modelling for an anticipated acceleration due to gravity. Adaptation to the altered gravitational conditions occurred slowly; some adaptation in forearm rotation developed over time in space, with later trials showing diminished amplitude of the premature erroneous movement and a later upward movement just before impact. McIntyre *et al.* (2001) propose that this slow adaptation is due to the set-up of the Spacelab that encourages astronauts to continue to use the Earth-valid model in 0 *g*, despite vestibular, pressure and visual cues, which indicate weightless conditions. Spacelab has identifiable floors, ceilings and overhead lighting and astronauts most commonly adopt an "upright" posture, providing a strong sense of up and down.

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MOTOR CORTEX: REVISITING POPULATION VECTORS

Scott SH, Gribble PL, Graham KM *et al*. Dissociation between hand motion and population vectors from neural activity in motor cortex. *Nature* **413**, 161–5 (2001).

One could be excused for being confused by the current literature on the role of primary motor cortex (M1) for the production of voluntary movements. According to the established view, cells in M1 encode both the force exerted during a movement, as well as movement direction and velocity [1]. The view that M1 codes for both movement execution (force production) and variables more consistent with motor planning (movement direction and velocity [2]) makes it somewhat difficult to interpret its functional role.

Scott and colleagues bring us a step closer to understanding the role of M1 for the control of movements by dissociating the population vectors (PV) based on neural activity in M1 from the direction of hand motion. Recording single-cell activity in M1 in monkeys performing a centre-out task similar to the one used in [2], the authors showed that although the PV did not point in the direction of movement the monkeys performed straight reaching movements similar to the ones observed previously. Crucially, they constrained the monkeys' arm to a horizontal plane at shoulder level, resulting in a well-controlled configuration of the arm. As a result, the consistent errors between the PV and the direction of movement could be explained by the mechanical anisotropy of the arm. The apparent contradiction with previous studies is resolved by the higher mechanical anisotropy of the constrained movements as compared to the previously studied movements using a more natural arm posture.

The question then remains what aspects of movement control are encoded in M1? Scott and colleagues find the best correlation of individual cell's firing behaviour with peak joint power, which can be seen as a first approximation to muscle activation. Interestingly, Todorov [3] has proposed a simple model of direct muscle activation by M1, which parsimoniously resolves most of the apparent contradictions of electrophysiological studies in M1. Although Scott and colleagues are right to be careful not to overstate the implications of their findings, their results make it clear that the role of M1 for movement generation cannot be explained without considering the details of the mechanics of the controlled limb.

Reference

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GLUTAMATE FACILITATES TUMOR GROWTH

Takano T, Lin JH, Arcuino G *et al.* Glutamate release promotes growth of malignant gliomas *Nature Med* **7**, 1010–1015 (2001).

Gliomas are the most common tumors of the CNS and are highly malignant. They quickly invade the host brain but despite improvements in early detection, little is known about their growth and invasion mechanisms. Recently, studies in cultures have documented that gliomas release a significant amount of glutamate,

suggesting that an excess of excitotoxin might mediate neuronal death in the area of tumor invasion.

In this study, the human glioma cell lines C6 and RG2 were used to investigate whether glutamate excitotoxicity contributes to tumor malignancy and expansion. Glutamate released from glioma cultures was shown to be neurotoxic to primary cortical cells *in vitro*. Moreover, a similar degeneration of the surrounding neurons was observed when glioma cell clones were implanted into striata of adult rats. By using a bioluminescence assay, a sustained secretion of glutamate was detected in striatal slices from rats injected with glioma implants. The elevation of extracellular glutamate levels correlated with a faster and aggressive growth of gliomas *in vivo*. Glutamate-facilitated tumor progression could be significantly slowed by the administration of two structurally unrelated NMDA receptor antagonists, MK-801 and memantine.

Because glutamate receptor antagonists could block both glioma expansion and excitotoxic degeneration, these findings may lead to a completely new approach for the therapy of CNS tumors. Treatment options may also include other steps of CNS glutamate processing, such as synthetic enzymes or release and re-uptake mechanisms.

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A FEEDBACK MECHANISM IN SENSORY INTEGRATION

Kennett S, Taylor-Clarke M and Haggard P. Noninformative vision improves the spatial resolution of touch in humans. *Current Biology* **11**, 1188–1191 (2001).

What determines what you feel on the skin of your arm? Of course the stimulus plays a role and also the amount of attention you devote to the arm. The latter determinant is somewhat vague. Is it the location you are attending to, or something more specific? To answer this question, the authors studied the spatial resolution by a two-point discrimination task in which they varied the visibility of the arm (the tactile stimulus was never visible).

As expected, vision of the arm improved discriminability relative to a no-vision condition. A more interesting result was that this improvement did not occur if the subject saw another object at the location of their arm. The third, probably most surprising result was that when the subjects saw a 2.5 times magnified image of their arm, their thresholds were reduced by 30% compared to the normal vision.

The improvement of the resolution cannot be the result of a direct combination of visual and somatosensory information. Also, visual attention to the arm's location is not enough; vision of the body is essential. The conclusion is thus that the combination of vision and touch is used to determine how an earlier stage of touch information processing is organised. The authors discuss the neural basis of this dynamic feedback control of touch sensitivity.

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