Some musicians develop focal hand dystonia due to heavy practice.

Overflow is one of the characteristic features of focal hand dystonia.

Motor degradation in finger representations in S1 in focal hand dystonia.

Body movement and reflects a loss of specificity of motor command.

Question:

How does overflow in focal task-specific dystonia develop and why does it persist?

Background:

- Motor overflow is an unwanted movement with an intended movement and reflects a loss of specificity of motor command.
- Primary somatosensory cortex (S1) contains an orderly map of the body.
- Overflow is one of the characteristic features of focal hand dystonia.
- Multiple studies in primates and humans suggest that severe degradation in finger representation in S1 in focal hand dystonia (Byl et al., 1996; Elbert et al., 1998; Bama-Jimenez et al., 1998).
- Some musicians develop focal hand dystonia due to heavy practice.

What did we find?

Transient & correlated use of two distinct sensory regions is sufficient to cause development of motor overflow.

Focal task-specific dystonia is characterized by excessive muscle contraction producing abnormal postures during selective motor activity that often involve highly skilled, repetitive movements.

Physiological evidence:

- De-differentiation in cortical representation (Byl et al., 1997)
- Possibility of an enlargement and de-differentiation in tactile sensory receptive field (Sanger et al., 2002)
- Abnormal tactile form perception and spatial and sensory processing (Bama-Jimenez et al., 2000)
- Loss of muscle selectivity in fingers (Young et al., 2011)[1]

SDTP

STDP

Neural structure:
- Four synapses (w1, w2 are crosstalks)
- Four Izhikevich spiking neurons

What does the neural structure represent?

Sensory deficit hypothesis (S1 disorganized)
- n0, n3: sensory cortical neurons
- n1, n2: motor cortical neurons

Motor deficit hypothesis (M1 disorganized)
- n0, n2: sensory cortical neurons
- n1, n3: motor cortical neurons

Methods

Questions:

Can transient & correlated sensory activity develop crosstalk in with STDP + spiking neurons?

Stimulus response

Key results

- Growth of crosstalk
- Enlarged cortical representation
- Increase in receptive field

Conclusion

- STDP with spiking neurons are sufficient to explain the transient & correlated sensory activity in the sensory neurons to develop and perpetuate motor overflow.
- No treatment will have long-term benefit.

SangerLab

http://www.sangerlab.net

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