Strategies and mechanisms of rehabilitation after brain lesions: motor systems

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Motor learning

There are different stages of motor learning

- Learning during training
- Learning during sleep
- Long term retention

Fast and slow learning

Fast learning is mediated by a network of regions that differs from those involved in slow learning

Reconsolidation

One crucial learning stage in systems neuroscience research and rehabilitation is to understand and become able to modify memories

Censor, Sagi and Cohen *Nature Rev Neurosci* 2012

Reconsolidation

- When a previously consolidated memory is reactivated, it undergoes modification :
  - Stabilization
  - Enhancement
  - Degradation

Censor et al *Current Biology* 2010
Neuron 2014

Reconsolidation after stroke

Reconsolidation after stroke

- Motor skills are shaped through consolidation and reconsolidation of memories
- Rehabilitative protocols likely engage consolidation and reconsolidation processes
- The goal of this study was to evaluate consolidation and reconsolidation after stroke

Reconsolidation

Stroke patients may experience worsened reconsolidation than elderly controls

Long-term retention

Importance of context of training

Reward and punishment can influence in different ways stages of motor learning

Reward can influence, during training, long term retention of the newly acquired memory

Abe et al, *Curr Biol* 2011

Practice and sleep form different aspects of skill

Song and Cohen *Nature Communications* 2014

Importance of sleep on motor learning

- Declarative learning is better encoded during sleep while procedural memories are better formed during practice.

Possible strategies to influence behavior after brain lesions

There are now multiple ways being tested to influence neurorehabilitation

Brain stimulation

For example, brain stimulation is being tested as a way to enhance the beneficial effects of training.

Do we all respond to training protocols equally?

Interindividual differences
BDNF

A BDNF polymorphism may influence the outcome of training protocols, an issue that is presently under investigation.

Fritsch et al, *Neuron* 2010

Need to individualize interventions?