

# Mirror, Mirror

Reflections on using mirror feedback in hand therapy

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**When have you used**

**mirror therapy**

**in hand rehabilitation?**

# Let's talk about the process of mirror therapy (MT)

Who

When

Why

What

How

# What is mirror therapy?

**Mirror imagery**

**Mirror visual feedback**

**Mirror augmented feedback**

**A component of graded motor imagery**

What



**Use of the mirror image of an unaffected hand to provide perceptual inputs representing the affected hand**

## Mirror (box) therapy or mirror visual feedback:

simply looking at the image

unilateral movement reflected in the mirror

[action observation = motor stimulation]

bilateral movements with the target limb behind the mirror

[motor practice] (McCabe, 2011)

## Graded motor imagery:

a formal, sequential program of laterality judgements [deciding if image is left or right], mental imagery [motor stimulation]

and mirror visual feedback [motor stimulation → motor practice] used for **pain syndromes** (Moseley, 2004)

# Motor imagery



mental rehearsal or simulation of an action or activity without any body movement (Harris & Hebert, 2015)

**AKA imagined movements**

inherent focus is on the kinesthetic sense of movement

**Motor stimulation paradigm**

# Mental imagery

**A perceptual experience in the absence of external stimuli**

**Can include multiple forms of sensory representation: touch, sight, smell, and sounds**

(Schmaltzl et al, 2013)

**Imagined movements are a subset of mental imagery** [motor stimulation]

**Other forms of mental imagery include guided visualization and hypnosis**



**Mental Imagery**

```
graph TD; A[Mental Imagery] --> B[Visual Imagery]; A --> C[Motor Imagery]; B --> D[Mental Practice]; C --> E[Mirror Visual Feedback]; F[Motor Practice] --> E;
```

The diagram is a flowchart on a teal background. At the top is a white box labeled 'Mental Imagery'. Two black arrows point downwards from it to two white boxes: 'Visual Imagery' on the left and 'Motor Imagery' on the right. From 'Visual Imagery', a black arrow points down to a white box labeled 'Mental Practice'. From 'Motor Imagery', a black arrow points down to a light gray box labeled 'Mirror Visual Feedback'. To the right of 'Motor Imagery' is a gray box labeled 'Motor Practice', with a black arrow pointing down to the same 'Mirror Visual Feedback' box.

**Visual Imagery**

**Motor Imagery**

**Motor Practice**

**Mental Practice**

**Mirror Visual Feedback**

# Other constructs to consider

## Functional equivalence

careful matching of motor imagery elements to desired action to stimulate the same brain areas & strengthen the memory trace of the task

## Bodily illusions

deliberate manipulation of perception of physical aspects of body size, shape or position, tactile & visual representation

(Boesch et al, 2016; Moseley & Weich, 2009)

# Other constructs to consider

## Cortical reorganization

alterations in the function of the somatosensory cortex leading to OR resulting from distorted or altered perceptual feedback

(H. Flor, C. Maier)

## Action observation

stimulation of the motor networks by observing movement

(Larsen et al, 2019; Zult et al, 2015)

## Cross education

preservation of strength in protected/immobilized muscles by targeted resistance training of contralateral side

(Green & Gabriel, 2018; Zult et al, 2015, Magnus et al, 2013 )

# Why would I use mirror imagery with my clients?

## Sensory factors

**Pain**

**To augment loss of proprioceptive input**

**Multisensory input to augment feedback**



Why

# Why would I use mirror imagery with my clients?

## Sensory factors

Pain

To augment loss of proprioceptive input

Multisensory input to augment feedback

## Motor factors

To assist in recruitment of weak muscles

To augment feedback during motor practice

To support motor learning

To optimize cross-education



Why

# How does it actually work?

**Changes in somatosensory processing and cortical activation**

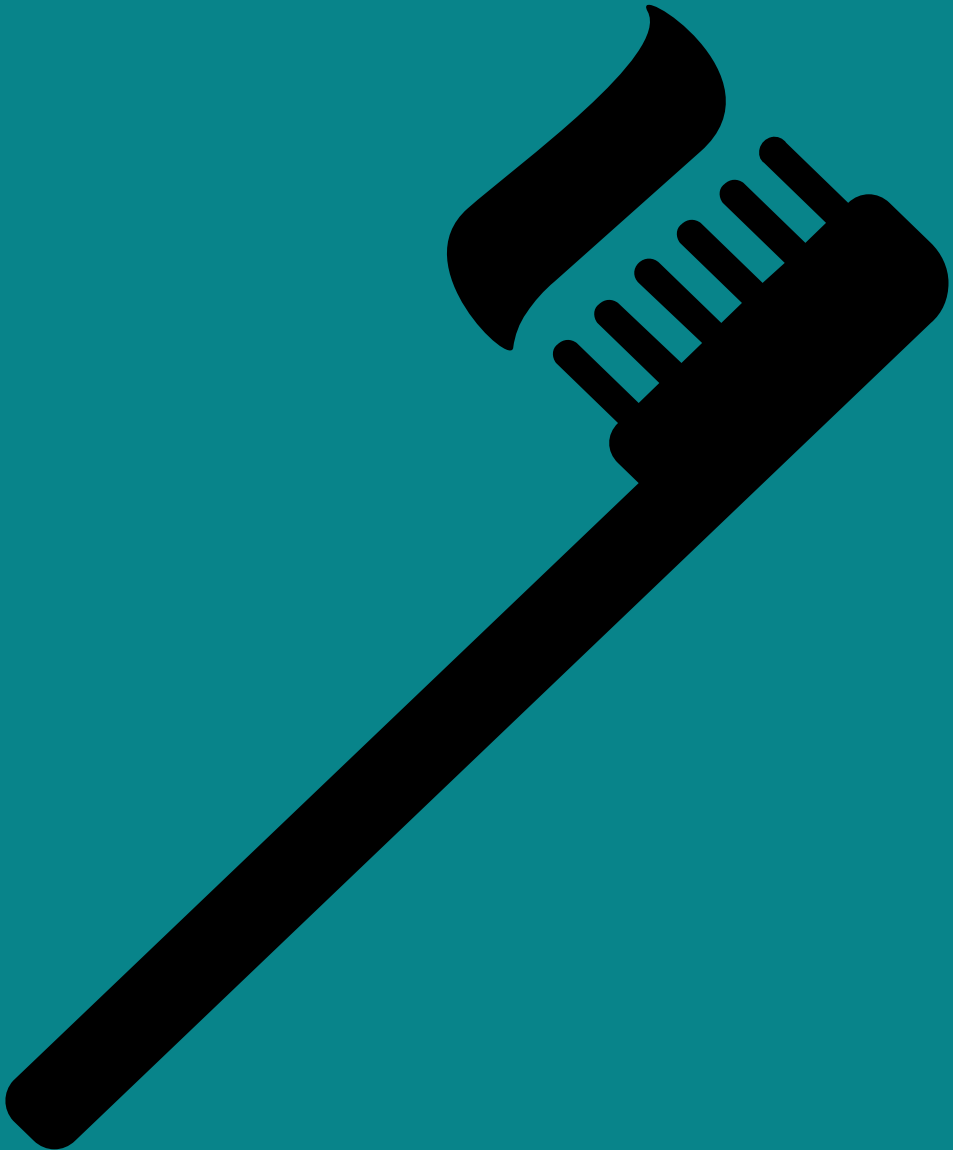
- **Where the signals travel (representations)**
- **How they interact with other signals (activation patterns)**
- **How the brain remembers & localizes (maps)**
- **How the body responds (physically and physiologically)**

Why

**Theories** are like  
toothbrushes...

Everyone has one, and  
nobody want to use anyone  
else's

(Source unknown)



# Theoretical underpinnings

**Sensorimotor incongruence?** Visual & motor networks are separate in the brain (McCabe, 2011)

**Body perception & ownership?** Correction of disrupted body schema? (Lewis & Schweinhardt, 2012)  
Unlearning 'learned paralysis' or motor extinction?

**Mirror neuron system ?** Activation of a neuroanatomical link between visual stimuli and motor neurons (Hendy & Lamon, 2017)

**Bilateral coupling of both arm movements ?** Activation of visual-motor cortex → pre-motor cortex → motor and somatosensory cortices → cerebellum and cross-hemisphere communication (Arya, 2016)





# Current evidence: syntheses

## Complex regional pain syndrome

O'Connell et al, 2013 ✓

Smart et al, 2016 ✓

## Stroke (motor function)

Rothgangel et al, 2011 ✓

Pollock et al, 2014 ✓

Theime et al, 2012 ✓

Perez-Cruzado et al, 2017 ✓

Who & Why

# Current evidence: single studies

## Complex regional pain syndrome

Moseley 2004, 2005, 2006, 2008

Tichelaar et al, 2007 (+CBT)

Grunert-Pluss et al, 2008

Selles et al, 2008

Moseley & Weich, 2009 (+TDT)

Reinersmann et al, 2010

Johnston et al, 2012 (+PT care)

Michenthaler 2013

Schreuders et al, 2014

Patru et al, 2013

Bayon-Calatayud, 2016

Lagueux et al 2012, 2018

Kotiuk 2019

Elomaa et al, 2019

Prevention of CRPS ?

McGee & O'Brien, 2018 (protocol)

Who & Why

# Current evidence: upper extremity trauma

**Rosen & Lundborg, 2005**    Nerve injuries

**Sumitani et al, 2008**    Brachial plexus / nerve injury

**Rostami et al, 2013**    Orthopedic hand injuries

**Dilek et al, 2018**    Distal radius fractures

**Yun & Kim, 2019**    Mutilating hand injuries

**Experimental evidence for increased efficacy of cross-education**

**Zult et al, 2015**

# Current evidence: single studies

## Stroke (motor function)

- ✓ Yun et al, 2011 The synergic effects of MT and neuromuscular electrical stimulation for hand function in stroke patients
- ✓ Yoon et al, 2014. Effect of constraint-induced movement therapy and MT for patients with subacute stroke
- ✓ Lee D et al, 2016. MT with NMES for improving motor function of stroke survivors.
- ✓ Lundquist & Nielsen, 2014. Left/right judgement does not influence the effect of MT after stroke.

Who & Why

# Current evidence: single studies

## Stroke (motor function)

- ✓ **Lim et al, 2016**  
**Efficacy of MT Containing Functional Tasks in Poststroke Patients**
  
- Park et al, 2014**
- ✓ **The effects of MT with tasks on upper extremity function and self-care in stroke patients**

Who & Why

# Consider using Mirror Therapy for:



**Pain**

**Motor (re) learning**

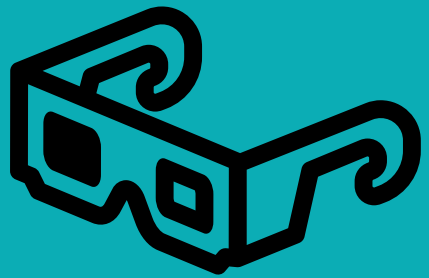
**Supplementing loss of  
proprioception**

**Sensory retraining**



# **Incorporating Mirror Therapy into Home & Clinic programs**

# Test for the illusion:

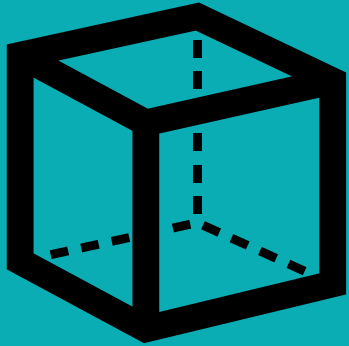


do they feel like they are

looking **through** the mirror ?



# Try a couple of short sessions in the clinic:



Can they concentrate?

Do they get any pain?

Does it make them dizzy or queasy?

Do you see a response inside the box?

# Grading and progressing: PATTLEP

**Sport model for imagery** (see Harris & Hebert, 2015)

## Physical

practice, positioning, NMES, intensity, facilitation by therapist

## Environment

reduce distractions, visual / auditory cues and feedback

(vanVliet & Wulf, 2006)

promote relaxation?

When & How

# Grading and progressing

## Task

object interactions, multisensory inputs

isolated movements vs. functional activities

## Timing

before or after physical practice?

Increasing dose & duration

When & How

# Grading and progressing

## Learning

Grading the task relative to mastery

## Emotion

Meaningful tasks, client choice/preference

## Perspective

Action observation vs. bilateral movement

Internal focus on bodily movement and limb position vs external focus on control/manipulation of objects (Harris & Hebert, 2015; vanVliet & Wulf, 2006)

When & How

# Contraindications

**Vision impairments**

**Reports of nausea or vestibular responses (i.e. dizzy, off-balance, falls or fear of falling)**

**Negative changes in limb temperature or weight**

**Pain invoked or increased**

**Profound hemi-neglect**

**When & How**

# Distortions



Fatigue

Falls risk

# Complimentary modalities to Mirror Therapy

**Motor imagery, mental imagery**

**Relaxation**

**Virtual reality reflection therapy (e.g. iPad camera)**

**NEMS: combined therapy**

**Augmented tactile feedback**

Synchiria

Bilateral sensory stimulation

*Localization, direction of stimulus*

*Mindful experience of stimulus*

**When & How**

# 'Reflective' Summary

**MT is helpful for upper extremity (re)training in both orthopedic and neurological conditions**

**Mirror visualization (action observation) is good for pain AND possibly as adjunct to cross-education**

**Mirror augmented bilateral training most effective when task-based**

**An alternative to conventional rehab if pain is a barrier**

**Sessions should be between 20-30 minutes for motor practice; shorter repeated sessions may be better for a painful limb**

**Daily practice is ideal – minimum number/week unknown, #/day unknown**

**When & How**



# Client education and home programs

Education is key to achieving an effective dose and duration of MVF; may need to engage family members as well

May need to understand some basic principles to get 'buy in'

Pick the examples and stories that work for you, and rehearse them, construct educational materials that utilize them, and reinforce regularly

Athletes use motor imagery to practice and train

Motion-sickness as an example of a sensory-mismatch

When & How

# LET'S TALK!

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