Mirror, Mirror
Reflections on using mirror feedback in hand therapy

Tara Packham, OTReg.(Ont), PhD
packhamt@mcmaster.ca
@TaraLPackham
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
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

Visual Imagery

Mental Practice

Motor Imagery

Mirror Visual Feedback

Motor Practice
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 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
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 wants 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
- 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  Mutiliating 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.


Lundquist & Nielsen, 2014. Left/right judgement does not influence the effect of MT after stroke.
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: PETTLEP

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

**Who & Why**

**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)
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
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

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
LET’S TALK!

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REFERENCES & RESOURCES


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