Graded Motor Imagery

The Science, Theory and Practice

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Pain – A primer 1

- Pain is a protective response to threat
- Threat may be to bodily tissues, but also to the organism as a whole, to the “self”
- ALL pain is real ALL the time.

Pain – A primer 2

- Pain is an OUTPUT of the brain
- Pain doesn't happen in the tissues
- The presence of body tissue is neither necessary nor sufficient for a pain experience - PLP

Pain – A primer 3

- Pinch yourself – get your brain fizzing
- 300-400 different regions of your brain have been activated
- A complex network of distributed and parallel communication and activation

Pain – A primer 4

- The distributed, simultaneous activation of many parts of the brain that when activated construct a pain experience can be considered as a unique 'signature'; a brain signature, a neurosignature or a "neurotag" (Butler and Moseley 2013)
- Neurotags will exist for all experiences (not just pain)
- There IS a fine line between pleasure and pain

Neurotags are dynamic

- The brain is dynamic and constantly changing
- As we learn, neurotags are strengthened, enhanced, "embedded"
- This is very useful if you are learning to walk, drive a manual car or hit the perfect tee shot in golf.
- Not so useful with pain (or the yips) – "the dark side of neuroplasticity" Norman Doidge

Pain neurotags change as pain persists

- Pain neurotags become sensistised
  - Increase in excitability
  - “wound up”
- Pain neurotags become disinhibited
  - Loss of fine definition and precision of the neurotag

Sensitised neurotags

- Pain persists
- Pain worsens
- Pain is evoked more easily by wider array of internal and external stimuli
- Allodynia and Hyperalgesia

Disinhibited neurotags

- Pain spreads
- Pain moves
- Pain defies anatomical structures
- Pain defies diagnosis
- Other body related neurotags can be affected

Smudgy, blurry neurotags

- Body maps become smudged and blurry
- Movement maps, “templates”, become imprecise and lose function
  - Still defensive: “I’ll look after you, I wont even let you move the bit that hurts”
- Perception of body parts can change – size, shape, even ownership and sense of “self”

Just a little bit more neuroscience

- Glia
  - More than just “glue” – the “Other Brain”
- Immune activation – a powerful defender after nerve or tissue injury
- Quite likely largely responsible for the disinhibition, sensitisation, smudging and blurring (as well as for general learning in pain free states)

Some tricky pain states: the context for GMI

- Complex Regional Pain Syndrome
- Phantom Limb Pain
- Brachial Plexus Avulsion
- All exhibit signs of sensitisation and disinhibition
- Traditionally very hard to treat

Some tricky (?) pain states: the future for GMI?

- Carpal Tunnel Syndrome
- Tennis Elbow
- “Tendonitis”
- Plantar Fasciitis
- Back pain? 85% non-specific
- Knee osteoarthritis?
- Emerging evidence of significant neuroimmune (brain) changes and adaptations with these conditions too.

Graded Motor Imagery

- Graded brain exercise
- Retraining the brain
- Desensitising neurotags
  - Winding the nervous system back down
- Reinhibiting neurotags
  - Retraining for precision, definition and fine control

Graded Motor Imagery

- Left/Right Discrimination
- Explicit Motor Imagery
- Mirror Therapy

Graded

- Pain neurotags can become so sensitised in chronic pain states that imagining, or even watching a movement hurts
- That is, the command (thought) to move fires off the pain neurotag
- Movement will be reduced, even stopped (defensive output) and “pushing through” will act to increase sensitivity and further disinhibit neurotags
- What could be less threatening than imagining a movement?

Graded

- The principle of graded exposure and response prevention
- Activating a little bit of the movement neurotag without activating the defensive outputs (pain).
- Slowly, gradually activating more of the movement neurotag while continuing to avoid defensive and protective outputs.

Left/Right Discrimination

- Implicit motor imagery
- Judging whether a seen limb is a left or right hand, foot etc
- You are not aware that you are mentally moving
- Brain areas activated are those that get you ready to move

Lets give it a go

Left/Right Discrimination

- How do we judge left or right?
  - Spontaneous, unconscious judgment
  - Unconscious movement of body part in our minds into the position
  - Confirmation of correct judgment or start again

Left/Right Discrimination

- "Normal"?
  - Accuracy of 80% and above
  - Response time of 2 +/- .5 seconds
  - Reasonably equal left and right
  - Not influenced by handedness, age, gender

Left/Right Discrimination

- What about when we are in pain?
  - Differs between acute and chronic
  - Tend to be faster on the injured side with acute pain
  - Tend to be slower (even much slower) on the injured side with chronic pain and less accurate

Left/Right Discrimination

- Powerful assessment tool
  - Very sensitive, repeatable and diagnostic value
- Can be retrained for accuracy and speed

Explicit Motor Imagery

- Imagined Movements
- You consciously know you are moving
- More of the neurotag for movement is activated
- Brain areas activated are the same ones activated when you actually move

Explicit Motor Imagery

Explicit Motor Imagery

Mirror Therapy

Mirror Therapy

- Increased brain activation again
- Less than actually moving but more than imagining movements
- Graded within stage
  - Looking at reflection
  - Moving hand outside of box
  - Moving hand outside of box and matching
  - Add tools, functional activity

Bonus!

- Virtual body exercises
- Fit during/after mirror therapy and prior to functional rehabilitation (traditional strengthening/exercise)
- Get the body and virtual body working
  - Change the light globe and pat the dog
  - Catch the butterflies
  - Release the bird
  - No more dishes
  - Check your shoes for poo

Does it work?

- Yes
- "At the highest level of evidence (systematic reviews), GMI is considered effective for reducing pain and disability in people with acute and chronic CRPS or Phantom Limb pain." (Butler, Moseley, Beames, Giles 2012)
- "GMI and mirror therapy alone may be effective for chronic pain" (Bowering, O'Connell et al 2013)
- Growing anecdotal and clinical evidence base for use in other pain states

Final thoughts on the theory and the science

- GMI is still new
- It's different
- GMI benefits from (needs?) high quality explanations and pain/neuroimmune education
- Progress can be slow – patience and perseverance are essential
- But, it can offer hope to the hopeless and always provides "somewhere to go" clinically

Resources

- noigroup.com
- gradedmotorimagery.com
- Recognise ™ Online
- Recognise ™ Apps
- bodyinmind.org

Selected References

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An employer perspective

- Robyn Cook from The Adelaide Casino

Thanks for hanging in there

- Questions?