Emotion Regulation through Meditation

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Emotion regulation through meditation

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Disclosures

- There is no money in mindfulness training
- There is no money for research
  - Write your congressperson!
  - Formed goBlue labs (Claritas Mindsciences)
    - Yale spin-off startup company
      - Working with social entrepreneurs to translate research into clinical practice
Center for Mindfulness in Medicine, Health Care, and Society

Therapeutic Neuroscience Lab

Investigating the mind to improve wellbeing and realize human potential
Automated Neutral Cue (get in your car)

Positive Cue (have a good meal or sex)

Neutral Cue (get in your car)

Negative Cue (get yelled at by your boss)

Positive Affect (happy or relaxed)

Negative Affect (stressed out)

Avoidance of Cues

CRAVING

Smoke

Maintain or Increase Positive Affect/Decrease Negative Affect

Reinforcement of Associative Memory/Habit (smoking makes you feel better)

“Just as a tree, though cut down, can grow again and again if its roots are undamaged and strong, in the same way if the roots of craving are not wholly uprooted sorrows will come again and again.”

-Dhammapada (338)
“I can't get no satisfaction
I can't get no satisfaction
'Cause I try and I try and I try and I try and I try
I can't get no, I can't get no…”

-Mick Jaggar
Self-control: competing systems

- **Affective (self-referential?)**/hot processing
  - involves self-referential valuation, is automatic and unplanned, and influences behavior through impulses (Weber 2004, Kable 2007).
  - fronto-striatal-limbic loop including the orbitofrontal cortex, ventromedial prefrontal cortex (vmPFC), posterior cingulate cortex (PCC), and ventral striatum (McClure 2004; Hare 2009; Kober 2010)

- **Deliberative/cold processing**
  - effortful, influences behavior through rules of logic and involved in inhibitory control (Weber 2004; McClure 2004; Ochsner 2005, Knoch 2007; Hare 2009)
  - dorsolateral prefrontal cortex (dLPFC), and posterior parietal cortex etc (McClure 2004; Hare 2009; Kober 2010; Steinbeis 2012)
How to improve the balance between cold and hot processing?
THE MINDFUL REVOLUTION
The science of finding focus in a stressed-out, multitasking culture
BY KATE PICKERT
Overview of Mindfulness

Two Component Definition:

1) Self-regulation of attention so that it is maintained on immediate experience, thereby allowing for increased recognition of mental events in the present moment.

2) Adopting a particular orientation toward one’s experiences in the present moment, characterized by curiosity, openness, and acceptance.

Bishop 2004
Mindfulness-based treatments

Effective for:

- **Anxiety** (Kabat-Zinn et al 1992, Goldin 2009, others)

- **Depression** (Teasedale et al 2000; Ma et al 2004, Eisendrath 2008, Segal 2010, others)

- **Pain** (e.g. Kabat-Zinn et al 1985, Kingston et al 2007, others)

- **Addiction** (e.g. Brewer 2009, Bowen 2009, Brewer 2011, Elwafi 2013, Carim-Todd 2013)

- **Boost immune system function** (e.g. Davidson 2003, Pace 2009, others)

- **Boost GRE scores!** (Mrazek 2013)
Does mindfulness training work for smoking cessation?
Nicotine dependence is difficult to treat

- 70% of smokers report wanting to quit (CDC, 2002)
- 5% of individuals achieve abstinence annually (CDC, 2002)
- High relapse rates (>70%)
The paradox of Mindfulness: less is more

Pay attention, and everything else will take care of itself (really).

Roz posted an update 1 week, 2 days ago

Mindful smoking smells like stinky cheese and tastes like chemicals.

YUCK!

Brewer Davis and Goldstein *Mindfulness* (2013)
Greater smoking abstinence with MT vs. Freedom from Smoking

**p = .063  **p = .012

Brewer et al Drug and Alcohol Dependence (2011)
Craving and cigarette use become dissociated during treatment

<table>
<thead>
<tr>
<th>Predictor of Smoking</th>
<th>Overall Model</th>
<th>Baseline Craving</th>
<th>Baseline Cigarette Use</th>
<th>End of Treatment Craving</th>
<th>End of Treatment Cigarette Use</th>
<th>6-Week Follow-Up Craving</th>
<th>6-Week Follow-Up Cigarette Use</th>
<th>3-Month Follow-Up Craving</th>
<th>3-Month Follow-Up Cigarette Use</th>
<th>4-Month Follow-Up Craving</th>
<th>4-Month Follow-Up Cigarette Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Craving (QSU) X Cigarette Use</td>
<td>r = 0.735</td>
<td>r = 0.540</td>
<td>r = 0.266</td>
<td>r = -0.053</td>
<td>r = 0.208</td>
<td>r = 0.515</td>
<td>r = 0.001</td>
<td>r = 0.591</td>
<td>r = 0.53</td>
<td>r = 0.652</td>
<td>r = &lt;0.0001</td>
</tr>
<tr>
<td></td>
<td>p = 0.591</td>
<td>p = 0.491</td>
<td>p = 0.209</td>
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</tr>
</tbody>
</table>

p = .04

Elwafi et al Drug and Alcohol Dependence (2013)
Reduction of craving scores with MT

Craving Score (QSU)

- Abstainers
- Non-Abstainers

Baseline | End of Trmt | 6-Week f/u | 3-Month f/u | 4-Month f/u

Elwafi et al Drug and Alcohol Dependence (2013)

$p = 0.03$
Neutral Cue
(get in your car)

Positive Cue
(have a good meal or sex)

Negative Cue
(get yelled at by your boss)

Avoidance of Cues

Positive Affect
(happy or relaxed)

Negative Affect
(stressed out)

CRAVING

Smoke

Maintain or Increase Positive Affect/Decrease Negative Affect

Reinforcement of Associative Memory/Habit
(smoking makes you feel better)

Mindfulness

Craving to Quit (Smartphone App)

- 21 day training for smoking cessation
- Daily modules
  - animations
- In vivo exercises
- Experience Sampling
  - Test efficacy
Overlap between DMN and Self-referential processing

Whitfield-Gabrieli *Neuroimage* (2011)
Resting state anti-coupling between monitoring (dACC) and default mode network

Castellanos et al. *Biological Psychiatry* (2008)
Decreased DMN activity during meditation in experienced meditators

(all meditations, Experienced > Novice)

Brewer et al. *PNAS* (2011)
Does practice make perfect?

- Relatively specific deactivation of DMN during meditation
  - Common to all 3 meditation types
  - Reproducible

- Do state changes during meditation correlate with changes in default brain activation patterns after (a lot of) practice?

- Functional connectivity
  - Seed-based using DMN (Andrews-Hanna 2010)
  - Helps to control for control state (i.e. what if experienced meditators are meditating during baseline)
Altered DMN connectivity in experienced meditators

Seed region

(PCC seed region)

Brewer et al. *PNAS* (2011)
Meditators vs. Controls

Connectivity $z$-score

(PCC seed region)

Meditation $z = 15$ $z = 24$

Baseline $z = 15$ $z = 24$

Meditator > control vs. control

Brewer et al. *PNAS* (2011)
State to trait?

Meditators have a different Default Mode!
“Science is a way of trying not to fool yourself. The first principle is that you must not fool yourself, and you are the easiest person to fool.”

-Richard Feynman
Real-time meditation feedback

Real-time Neurofeedback (PCC ROI, n=22/group)

Run 1

Novice

Decreased self-related activation

Run 4

Increased self-related activation

Expert

Correspondence: 7.7 ± 0.29

7.4 ± 0.16
Being mindful is not difficult. But it’s difficult to be continuously aware. For that you need right effort. But it does not require a great deal of energy. It’s relaxed perseverance in reminding yourself to be aware. When you are aware, wisdom unfolds naturally, and there is still more interest.

- Sayadaw U Tejaniya, "The Wise Investigator"
"NO! Try not! DO or DO NOT, There is no try."
Flow

a mental state when a person is fully immersed in the present in a feeling of energized focus.
There was a sense of flow, being with the breath...flow deepened in the middle.

- Experienced Meditator
Are you kidding?

I have to practice 10,000 hours to change my default mode?
"Practice does not make perfect. Only perfect practice makes perfect."

-Vince Lombardi
NOVICE MEDITATOR

RUN 1  

RUN 2  
Thinking about the breath

RUN 3  
"focused more on the physical sensation instead of thinking in and out"

RUN 4
Mindfulness may increase cold while decreasing hot processing.
Relation between Granger causal influences and behavioral performance during visual spatial attention task.
Cognitive control of behavior

Cigarette craving

Kober *PNAS* (2010)

Left dIPFC

\[ a = -2.95 (0.65) \]

\[ b = 0.10 (0.02) \]

\[ c' = 0.24 (0.10) \]

Ventral Striatum

\[ a b = -0.29 (0.08) \]

Food craving

Lu *Science* (2009)

\[ y = 42 \]

\[ x = 3 \]

Regulation-related decrease in craving

Activity decreases as craving decreases

Activity increases as craving decreases

Negative Interaction

Positive Interaction
Next steps to move into clinical utility:

EEG source-estimated neurofeedback from the PCC
FUNDING: NCCAM (R01 AT007922-01), NIDA (R03 DA029163-01A1, K12 DA00167, P50 DA09241), Mind and Life Institute (Varela award), Yale Center for Clinical Investigation (UL1 RR024139), Yale Stress Center (UL1 DE019586-02), VAMC MIRECC
Grey matter volume associated with mindfulness scale (MAAS)

Lu *Neuroscience* (2014)