A Social Cognitive Neuroscience Approach to Emotion Regulation: Implications for Substance Abuse

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Our Research Village

Columbia (present)
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- Carl Hart
- Walter Mischel
- Hedy Kober
- Brent Hughes
- Ethan Kross
- Matthew Davidson

Stanford (past)
- James Gross
- John Gabrieli
- Becky Ray
- Elaine Robertson
- Jeff Cooper
How could he have controlled his substance-abusing impulses?
Affect Regulation & Substance Abuse

1. Describe research that builds a model of the brain bases of effective emotion regulation

2. Consider how this model might be translated to help understand mechanisms of substance abuse & its treatment
1. Mechanisms of Emotion Regulation

If you are distressed by anything external, the pain is not due to the thing itself, but to your estimate of it; and this you have the power to revoke at any moment.

-Marcus Aurelius
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-Aversive Stimulus/Event  →  Appraise Significance  →  Emotional Response

1. Mechanisms of Emotion Regulation

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1. Mechanisms of Emotion Regulation

<table>
<thead>
<tr>
<th>Aversive Stimulus/Event</th>
<th>Re-appraise Significance</th>
<th>Altered Response</th>
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1. Mechanisms of Emotion Regulation
Typical Design for Studying Re-appraisal

**Instructional cue**
- REAPPRAISE or LOOK

**Photo period**
- 10 secs

**Affect rating**
- ~4 secs

**Intertrial interval**
- ~4-5 secs

**Strength of Affect**
- 1 2 3 4 5
  - weak
  - strong

RELAX
Think about image in a way that makes you feel more negative.

*Increase Negative Affect*

“He’s in pain, is weak of heart, may die soon....”

Think about image in way that makes you feel less negative.

*Decrease Negative Affect*

“He’s just tired/annoyed, is hearty, will be right as rain....”
Building the Model

1. Why you reappraise
2. How you reappraise
3. What you reappraise
4. When you reappraise
Building the Model

Two goals:
1. Why you reappraise
2. How you reappraise

Common Core

Strategy-Specific

Stimulus or Emotion-Specific

Time Specific

Negative Affect

4. When you reappraise

3. What you reappraise
Increasing Neg Affect
(\textit{Increase} > \textit{Look})

Decreasing Neg Affect
(\textit{Decrease} > \textit{Look})

N = 23
Amygdala modulated up or down in accord with reappraisal goal

Increase > Look

Look > Decrease

% signal change

% signal change

0-2 3-4 5-6 7-8 9-10 11-12 13-14 15-16

-0.25 -0.15 -0.05 0.05 0.15 0.25

0-1 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

-0.2 -0.1 -0.05 0.05 0.1 0.15 0.2

-0.25 -0.15 -0.05 0.05 0.15 0.25

Increase

Look-neg

Look-neu

Decrease

Look-neu

Look-neg
Bilateral Activation for Decreasing Neg Affect

Wager, Ochsner, Hughes & Davidson (in prep)

WM / Language / Response Selection regions

Decrease > Look

N = 34, optimized
Bilateral Activation for Decreasing Neg Affect

Wager, Ochsner, Hughes & Davidson (in prep)

Activity in many regions correlates with Reappraisal Success

N = 34, optimized
Bilateral Activation for Decreasing Neg Affect

Wager, Ochsner, Hughes & Davidson (in prep)

Activity in many regions correlates with **Reappraisal Success**

\[ r = .63 \]

\[ r = .49 \]

**Decrease > Look**

\[ N = 34, \text{ optimized} \]
Core Prefrontal-Amygdala interactions Underlying the Cognitive Control of Emotion

Building the Model

1. Why you reappraise
2. How you reappraise
3. What you reappraise
4. When you reappraise

Goal-Specific
Strategy-Specific
PFC/ACC - Amyg
Stimulus or Emotion-Specific
Time Specific
1. Why you reappraise
Ochsner et al, 2002, 2004; Wager, Ochsner et al, *in prep*

2. How you reappraise

3. What you reappraise

4. When you reappraise

Building the Model

- PFC/ACC
- Amygdala
- DMPFC
- Right LPFC

Stimulus or Emotion-Specific

Time Specific

Strategy-Specific
Building the Model

1. Why you reappraise
   Ochsner et al, 2002, 2004; Wager, Ochsner et al, in prep

2. How you reappraise
   Ochsner et al, 2004

3. What you reappraise
   Time Specific
   Stimulus or Emotion-Specific
   PFC/ACC - Amyg

4. When you reappraise
   Medial PFC for self-focused strats
   DMPFC
   Right LPFC
1. Why you reappraise

Ochsner et al, 2002, 2004; Wager, Ochsner et al, in prep

2. How you reappraise

Ochsner et al, 2004

3. What you reappraise

Kross & Ochsner in prep

4. When you reappraise

Building the Model

PFC/ACC

- Amyg

DMPFC

Right LPFC

Medial PFC

for self-focused strats

Left PFC for memories, like images

Time Specific
1. Why you reappraise
   Ochsner et al, 2002, 2004; Wager, Ochsner et al, *in prep*

2. How you reappraise
   Ochsner et al, 2004

3. What you reappraise
   Wager, Ochsner *in prep*

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   Wager, Ochsner *in prep*

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Building the Model

**PFC/ACC**

- **DMPFC**
- **Right LPFC**
- **Medial PFC for self-focused strats**
- **Left PFC for memories, like images**

**Amyg**

Pre-appraisal = LPFC, like Reapp

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Kross & Ochsner *in prep*
Building the Model

1. Why you reappraise
   Ochsner et al, 2002, 2004; Wager, Ochsner et al, in prep

2. How you reappraise
   Ochsner et al, 2004

3. What you reappraise
   Kross & Ochsner in prep

4. When you reappraise
   Wager, Ochsner et al, in prep

5. Who reappraises
   Ray, Ochsner et al, 2006

DMPFC
Right LPFC
PFC/ACC - Amyg
Pre-appraisal = LPFC, like Reapp
Medial PFC
for self-focused strats
Left PFC for memories, like images

Ochsner et al, 2002, 2004; Wager, Ochsner et al, in prep
2. Translating the Model

How does affect regulation play a role in substance abuse?

- Cooling Reappraisals
- Arousing Appraisals

Aversive need states, drugs or related cues → PFC/ACC → Amyg/Striatum → Craving, Drug Use
How does affect regulation play a role in substance abuse?

2. Translating the Model

- **Cooling Reappraisals**
  - PFC/ACC
  - Aversive need states, drugs or related cues

- **Non-arousing Appraisals**
  - Amyg/Striatum
  - Craving, Drug Use
2. Translating the Model

How does affect regulation play a role in substance abuse?

Cooling Reappraisals

PFC/ACC

Aversive need states, drugs or related cues

Arousing Appraisals

Amyg/Striatum

Craving, Drug Use
How does affect regulation play a role in substance abuse?

2. Translating the Model

Cooling
Reappraisals

PFC/ACC

Aversive
need states, 
drugs or 
related cues

Arousing
Appraisals

Amyg/Striatum

Craving, 
Drug Use
2. Translating the Model

How does affect regulation play a role in substance abuse?

1. Drugs and drug cues “turn on” affective circuits (e.g. Breiter et al.; Grant et al.; Volkow et al.)
2. Long term use may damage control circuits (e.g. London et al.; Nordahl et al.)
3. Drug users have self-regulatory deficits
   • Childhood deficits predispose towards drug use (e.g. Mischel et al.)
   • Deficits in lab tasks following drug use (e.g. Garavan & Stout)
The Translational Future

A 2-step, translational social cognitive neuroscience approach to emotion regulation may be useful for understanding substance abuse……

Q: But will it be successful?

A: Yes.

1. Extant work has characterized cognitive and structural neural deficits, but has not examined socioemotional functions and the ability to regulate *per se*, which is central to treatment

2. Can show how specific regulatory mechanisms are dysfunctional – or effective – which may be useful for designing treatments that target them

3. The same 2-step process already has been successful in applying Cog Neuro models of memory and attention to Mood Disorders, Schizophrenia, and substance abuse
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