

# LOVE & HATE

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LIFESCI 4M03 | Research Seminar  
Instructor | Dr. Daniel Yang

*RESEARCH PRESENTATION #2*

# CASE STUDY

Hi I'm Miguel,



I was **madly in love** with Miley Cyrus, we went on tour together & travelled the world. Most of her love songs were about me, except for 7 things I hate about you. Then I wasn't able to come to one tour, ONE TOUR, that took place in Australia. That's when it **all fell apart...** she met Liam Hemsworth and, well the rest is history. To say **I hate him and am heartbroken** would be the understatement of the century.

Enjoy your wrecking ball Miley!





# WHAT IS LOVE?

*"What is love? Baby don't hurt me, don't hurt me, no more!"*

# WHY DO WE FALL IN LOVE?

1

**SEX DRIVE**  
or **LUST**

2

**ROMANTIC**  
**LOVE** or  
**ATTRACTION**

3

**ATTACHMENT**

(Fisher H, 2018)



# **BIOLOGY OF LOVE**

*What is happening in the body when you are in love?*

# WHY DO WE FALL IN LOVE?



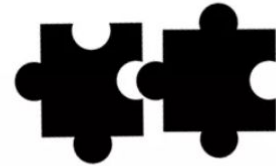
## Lust

Testosterone  
Estrogen



## Attraction

Dopamine  
Norepinephrine  
Serotonin



## Attachment

Oxytocin  
Vasopressin

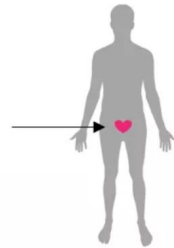
# LUST & ATTRACTION

Increased feelings of lust are associated with the release of **testosterone & estrogen**

Attraction is the result of increased **norepinephrine & dopamine** and decreased **serotonin**

a

Lust

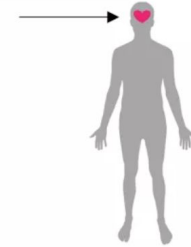


Sex hormones  
(Testes and Ovaries)



b

Attraction



Dopamine  
(Hypothalamus)

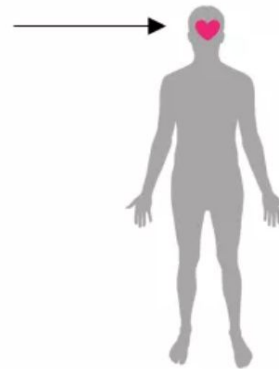


(Wu, 2018)

# ATTACHMENT

C

Attachment



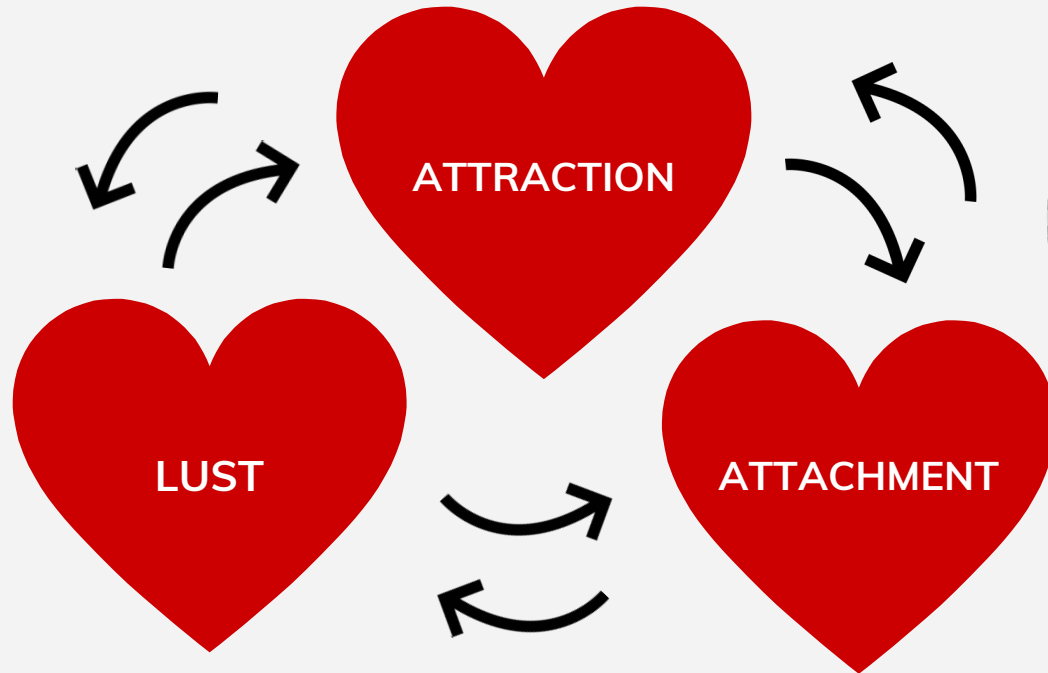
Oxytocin/Vasopressin  
(Hypothalamus)



(Wu, 2018)



# REWARD SYSTEM FEEDBACK LOOP



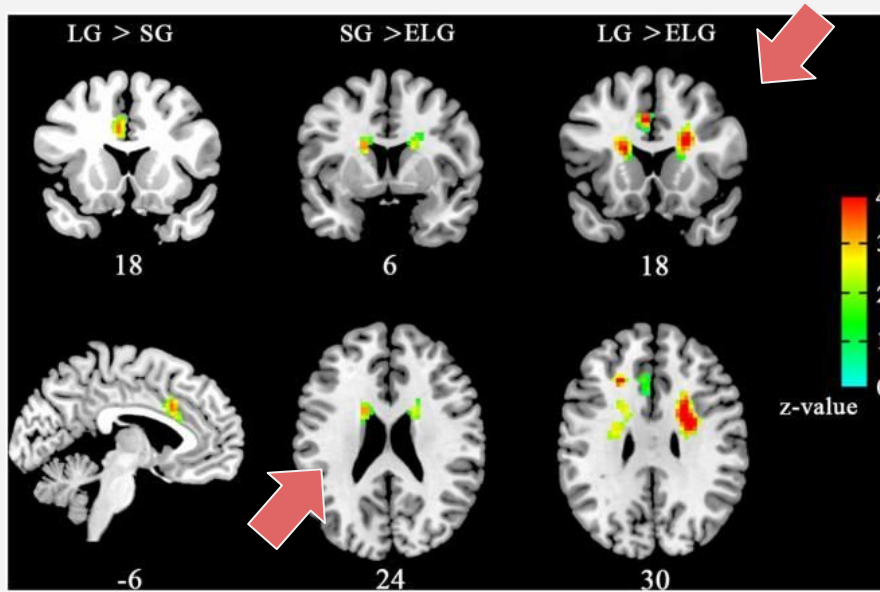
(Fisher H, 2018)



# **THE BRAIN ON LOVE**

*What is happening in the brain when you are in love?*

# FUNCTIONAL MRI



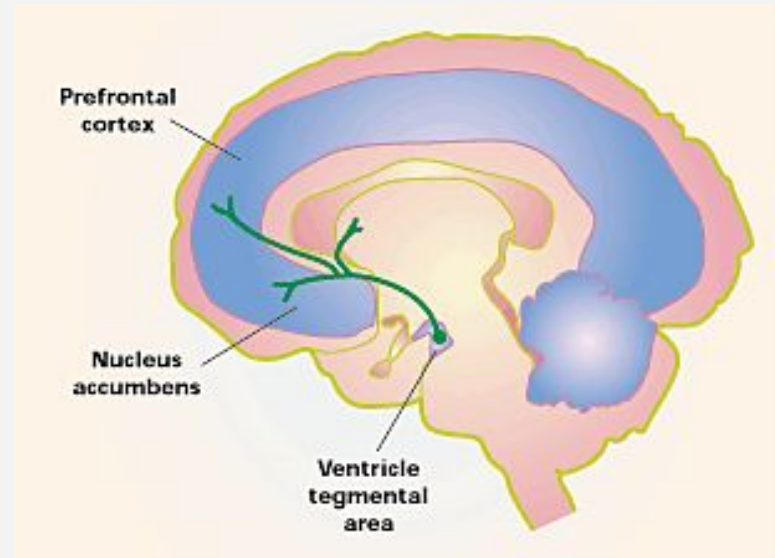
fMRI images of individuals shown  
a **picture of their loved ones**

- Activity in **caudate nucleus region**  
& **ventral tegmental area**
- Rich with **dopamine**  
“feel-good neurotransmitter”

# VENTRAL TEGMENTAL AREA

Known as **“Reward Circuit”**

- Links with **nucleus accumbens**
  - Other structures contributing: **amygdala, hippocampus and prefrontal cortex**
- Chemicals associated with the brain producing emotional responses
  - **Racing hearts**
  - **Sweaty palms**
  - **Flushed cheeks, etc.**



(Piomelli, 2001)

# CHEMICALS ASSOCIATED WITH LOVE



TESTOSTERONE



ESTROGEN



DOPAMINE



NOREPINEPHRINE



SEROTONIN



VASOPRESSIN



OXYTOCIN



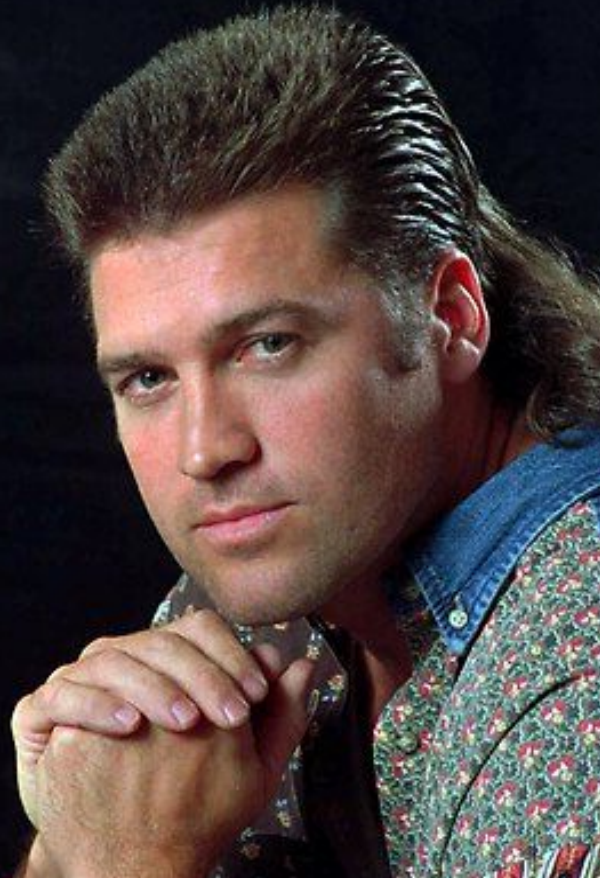
**HEART**

**BREAK**

*Some good things have to come to an end, heartbreak being one of them*

*“Don’t break my heart,  
my achy breaky heart.”*

**- BILLY RAY CYRUS, 1992**





# **WHAT IS HEARTBREAK?**

*Something traumatic just happened and you're now feeling uneasy - why?*



# WHAT IS HEARTBREAK?

- Heartbreak syndrome aka **Takotsubo Cardiomyopathy** (TC)
  - Weakened heart triggered by emotional stress
- Symptoms
  - Chest pain
  - Shortness of breath
  - Sweating



(Takotsubo cardiomyopathy, 2010)

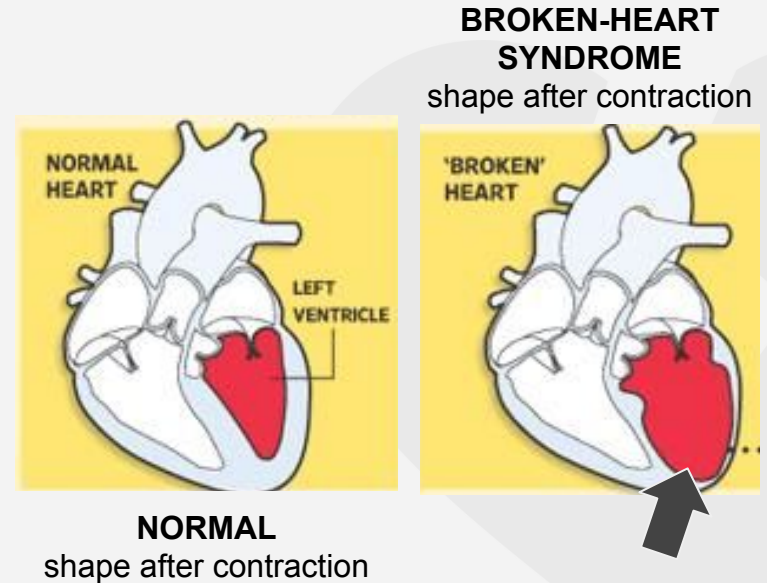


# **BIOLOGY OF HEARTBREAK**

*The physiological effects and theorized brain activity when you're heartbroken*

# TAKOTSUBO CARDIOMYOPATHY (TC)

- Weakening of **left ventricle**
- Exact cause unknown
- Experts think:
  - Surging stress hormones (ex. adrenaline)
  - Triggering change in heart muscle cells
  - Prevent left ventricle from contracting effectively



(Takotsubo cardiomyopathy, 2010)

# STRESSING THE HEART

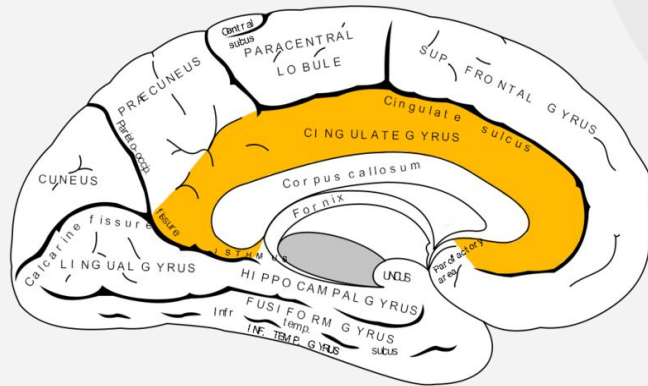


- Raising **blood pressure**
- Suppresses the immune system
  - Induce clinical depression
  - Lead to suicide
  - Fatal heart attack / strokes

(Takotsubo cardiomyopathy, 2010)

# BRAIN ACTIVITY

- Exact neurological process unknown
- Thought to involve **anterior cingulate cortex of brain**
  - During stress **vagus nerve** overstimulated
    - Pain
    - Nausea
    - Muscle tightness in chest



("Broken heart", 2018)

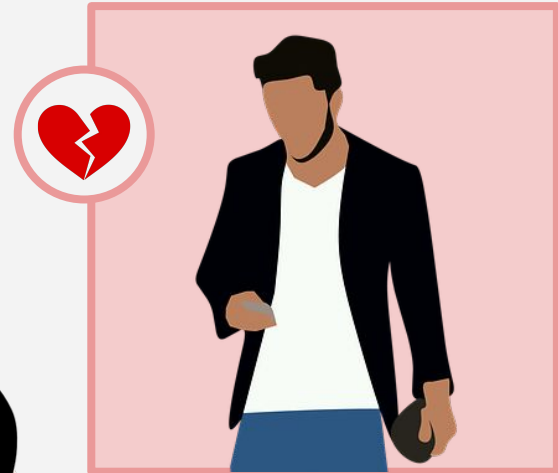
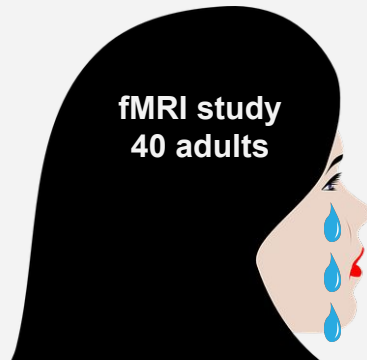
# BRAIN ACTIVITY

- **Research Study**

- Participants viewed **photo of their ex**
- Told to think of the breakup
- Under neuroimaging

- **Findings**

- **Same regions of brain** become active as response to physical pain



(Vastag, 2003)



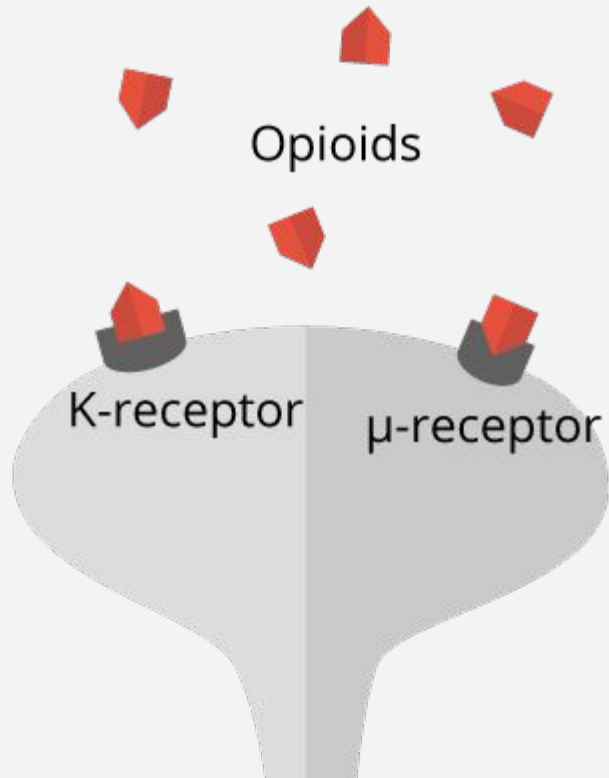
# THE MECHANISM

*The neurological theories behind the symptoms of heartache and heartbreak*





# μ-OPIOID RECEPTOR



## The endogenous **opioid system**

- Regulation physical/emotional pain
- Mediate social attachments

## **Social separation distress causes**

- Painful low-opioid state
- Motivates social proximity seeking

## **μ-Opioid receptor studies**

- Evidence in humans and animals
- Opioid receptor antagonists



# WHAT IS HATE?

*The physiological effects and theorized brain activity when fueled with hate*

# WHAT IS HATE?

Strong emotional response  
of **extreme dislike**

Associated with:



Aggressive behaviour  
Motor behaviour  
Neuronal activation

The word 'HATE' is displayed in a stylized, blocky font. The letters are filled with a dark blue color and have a red outline. The letters are set against a light yellow background. The 'H' and 'E' are solid blue with red outlines, while the 'A', 'T', and 'V' are solid red with blue outlines.

# ORIGIN OF HATE



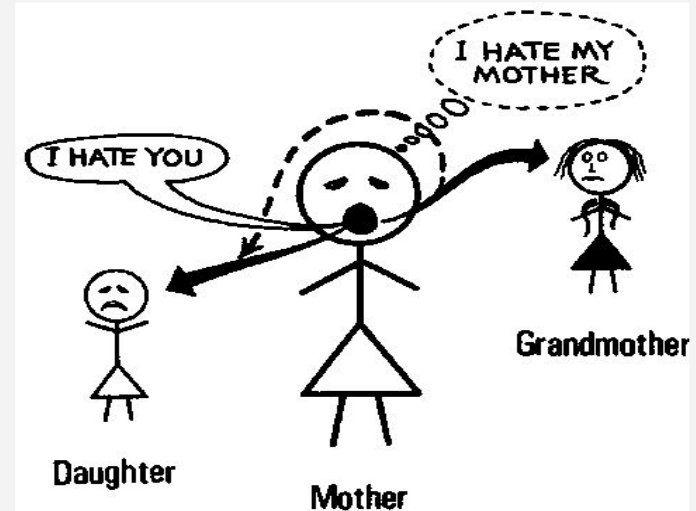
# REASONS WHY WE HATE

## Fear of the Unknown

### In-group/ Out-group Theory



## Fear of Self- Projection



(Govorun et al., 2006)





# THE BRAIN ON HATE

*The physiological effects and theorized brain activity when fueled with hate*

# THE 'HATE CIRCUIT'



fMRI study  
17 adults

(Zeki & Romava, 2008)

# THE 'HATE CIRCUIT'



fMRI study  
17 adults

(Zeki & Romava, 2008)



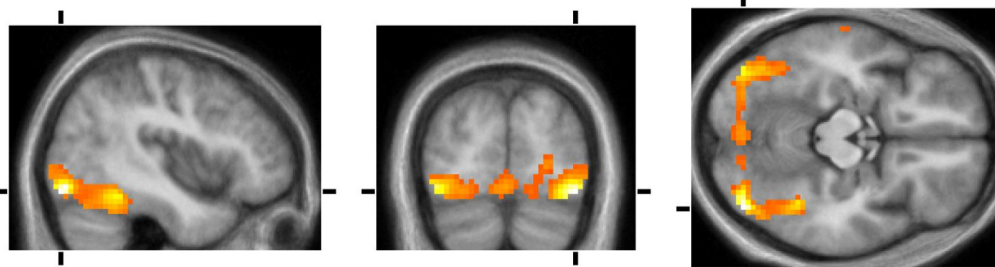
# THE 'HATE CIRCUIT'

(a) Fusiform face area:- Voxel (39, -48, -18)  $T_{15} = 8.66$   $p = 8.36e-03$



FUSIFORM  
FACE AREA

(b) Right fusiform gyrus:- Voxel (42, -81, -15)  $T_{15} = 12.35$   $p = 7.60e-05$

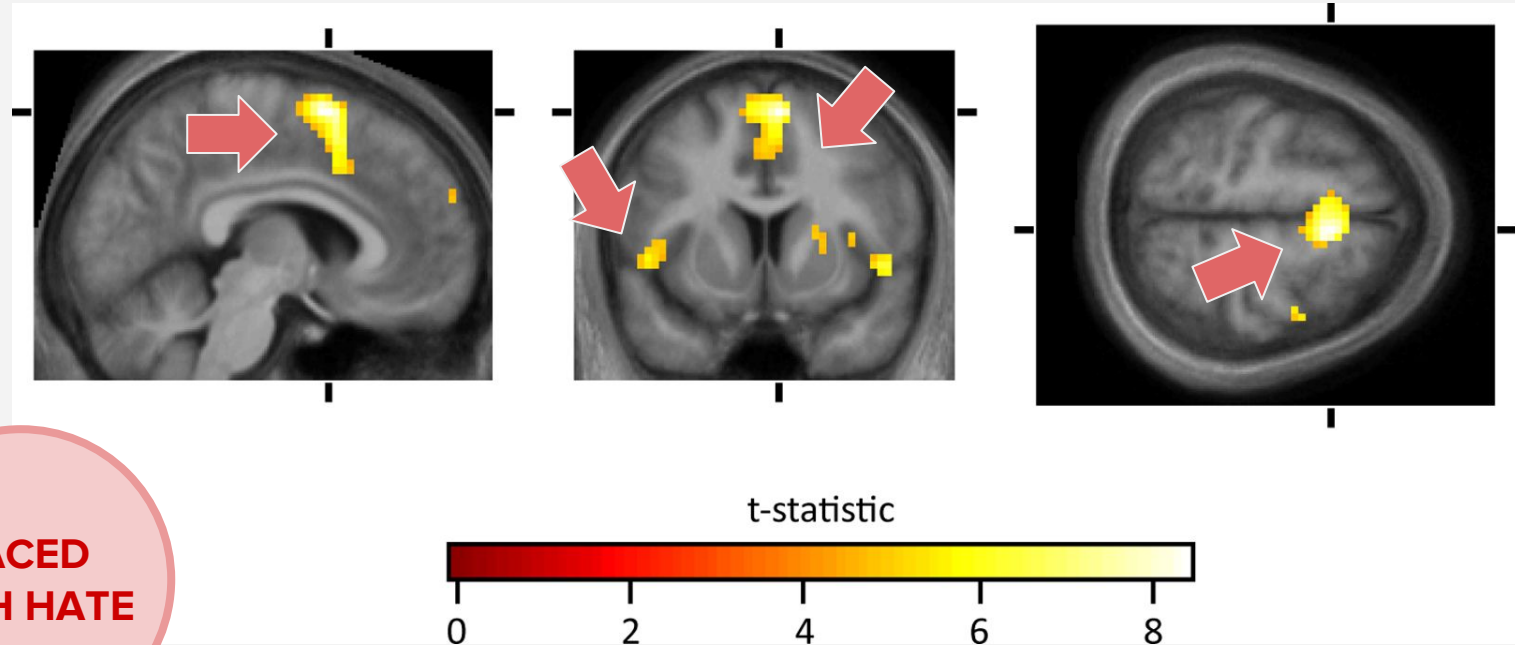


RIGHT & LEFT  
FUSIFORM  
GYRUS

NEUTRAL  
FACES

(Zeki & Romava, 2008)

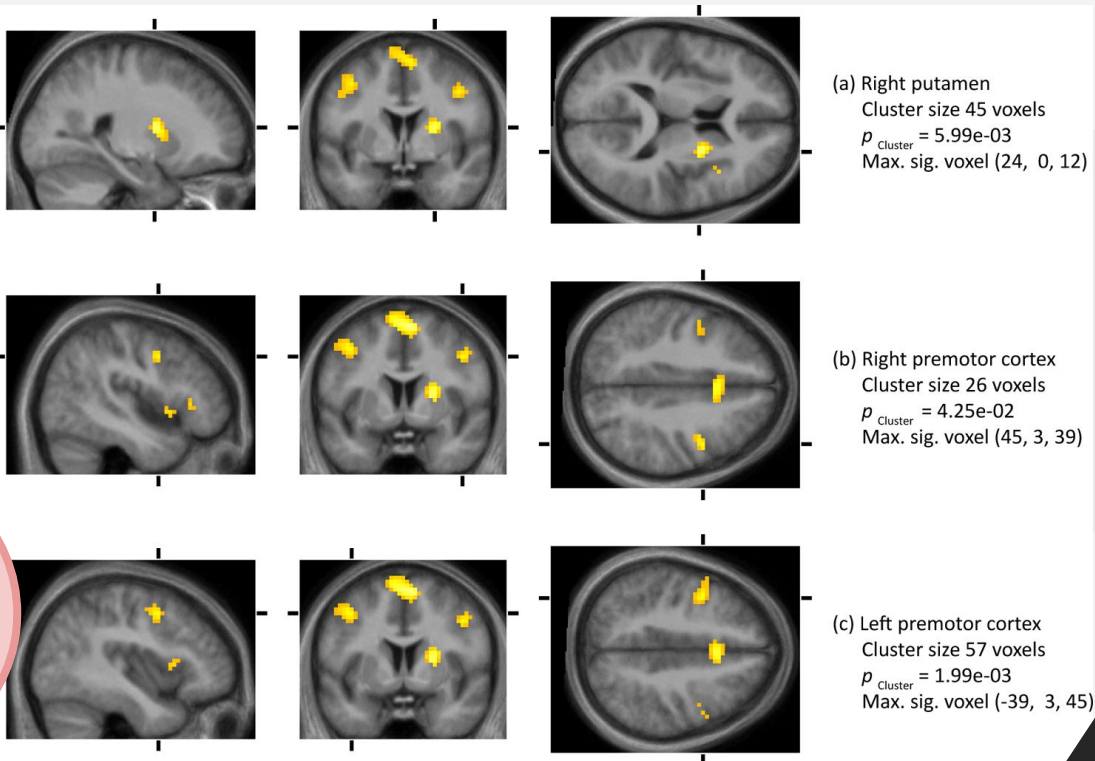
# THE 'HATE CIRCUIT'



**FACED  
WITH HATE**

(Zeki & Romava, 2008)

# THE 'HATE CIRCUIT'



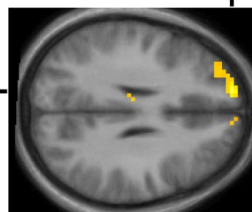
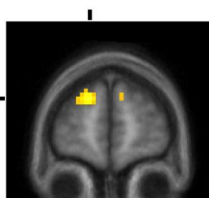
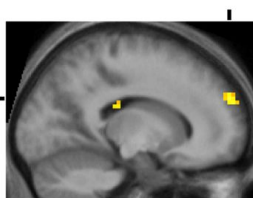
**RIGHT PUTAMEN**

**RIGHT & LEFT  
PREMOTOR  
CORTEX**

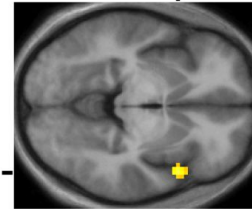
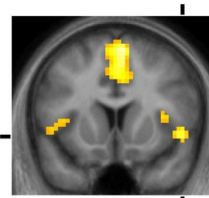
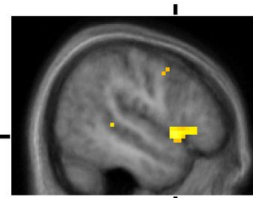
**FACED  
WITH HATE**

(Zeki & Romava, 2008)

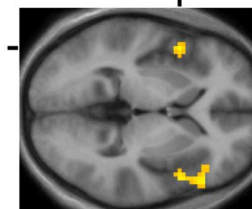
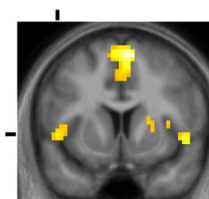
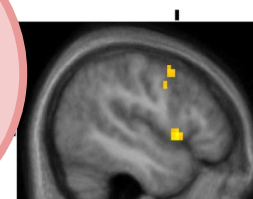
# THE 'HATE CIRCUIT'



(d) Frontal pole  
Cluster size 62 voxels  
 $p_{\text{Cluster}} = 1.29\text{e-}03$   
Max. sig. voxel (-15, 57, 27)



(e) Right medial insula  
Cluster size 65 voxels  
 $p_{\text{Cluster}} = 9.98\text{e-}04$   
Max. sig. voxel (51, 12, -6)



(f) Left medial insula  
Cluster size 37 voxels  
 $p_{\text{Cluster}} = 1.32\text{e-}02$   
Max. sig. voxel (-48, 9, 0)

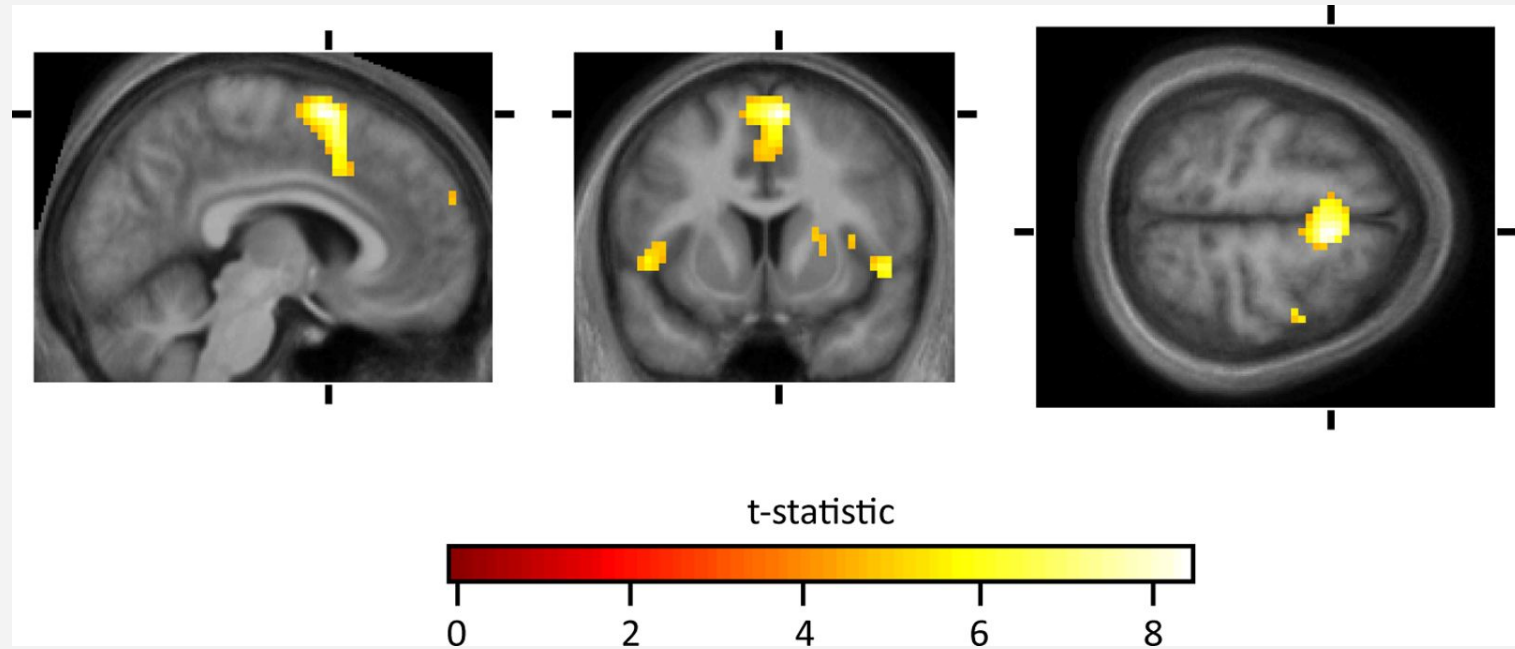
**FRONTAL POLE**

**RIGHT & LEFT  
MEDIAL INSULA**

**FACED  
WITH HATE**

(Zeki & Romava, 2008)

# THE 'HATE CIRCUIT'



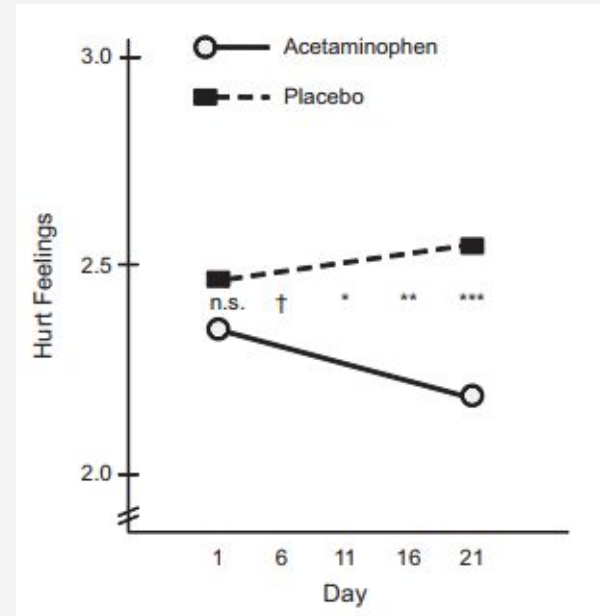
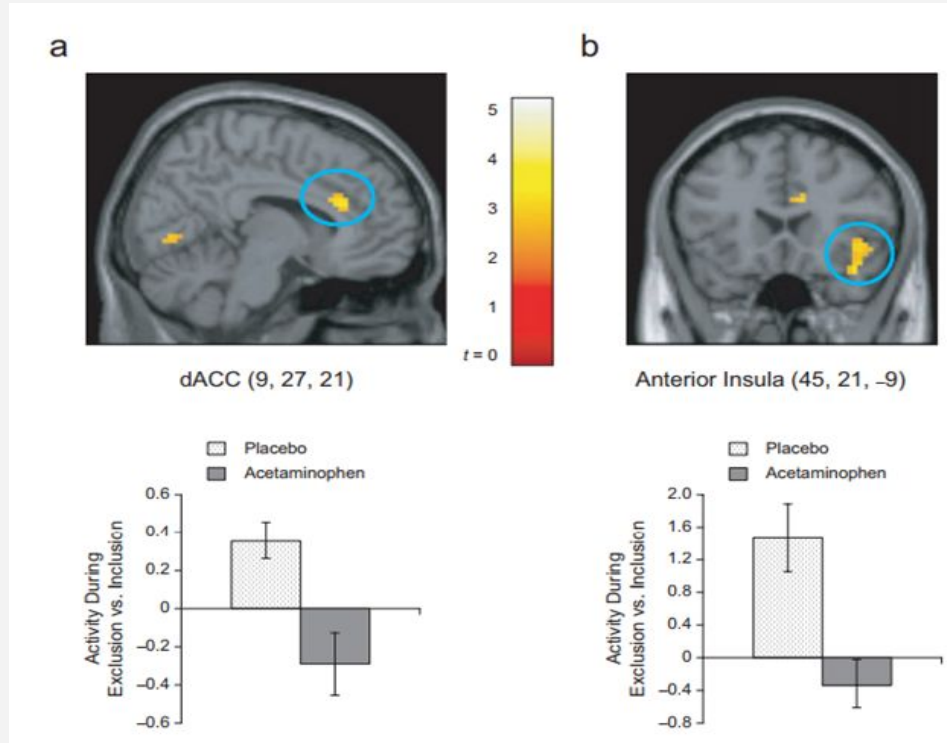
(Zeki & Romava, 2008)



# TREATMENTS

*What can we do to combat hate, heartbreak, and everything in between?*

# OPIOIDS & PAINKILLERS

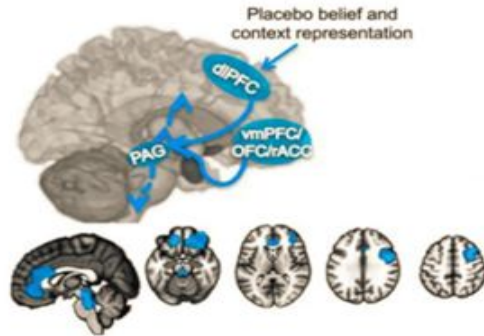


(DeWall et al., 2010)

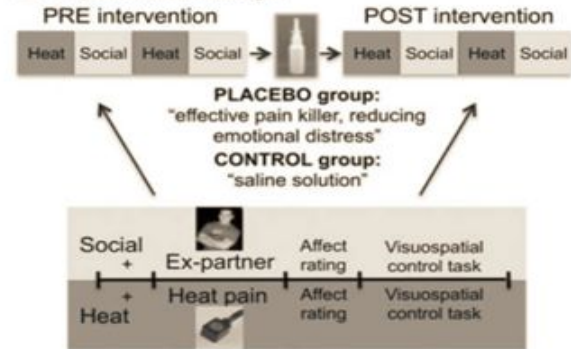


# PLACEBO EFFECT

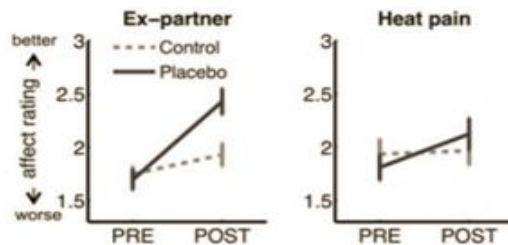
## A Hypothetical brain model and ROIs



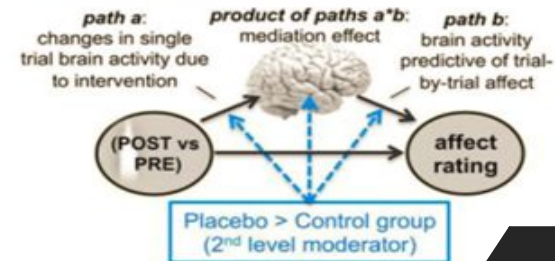
## B Experimental design



## C Behavioral results



## D Multilevel mediation approach





# SOCIAL SUPPORT & FOOD



**Chocolate makes everything better**

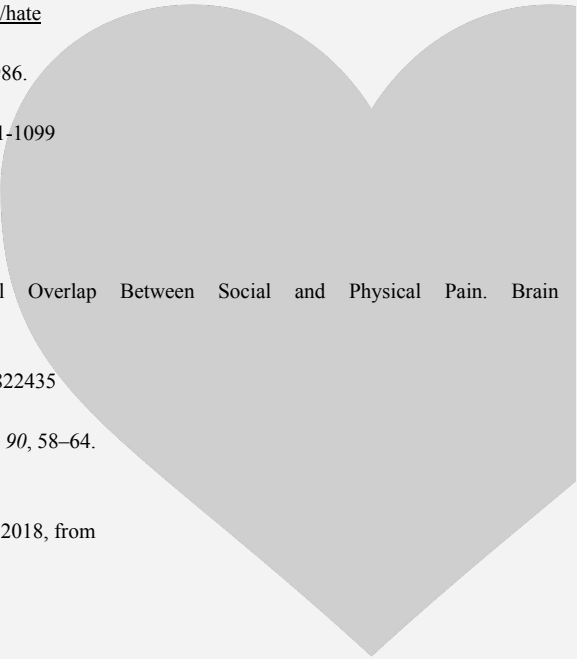
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- 

# QUESTION 1

Which of the following is not a component of love?

- A)** Lust
- B)** Libido
- C)** Attachment
- D)** Attraction
- E)** All the Above

# QUESTION 1

Which of the following is not a component of love?

- A) Lust
- B) Libido**
- C) Attachment
- D) Attraction
- E) All the Above



# QUESTION 2

Which chemical is associated with love?

- A) Dopamine
- B) Oxytocin
- C) Cortisol
- D) Adrenaline
- E) All the Above

# QUESTION 2

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- E) All the Above**



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