

# New Insights Into The Neuroscience of Anger

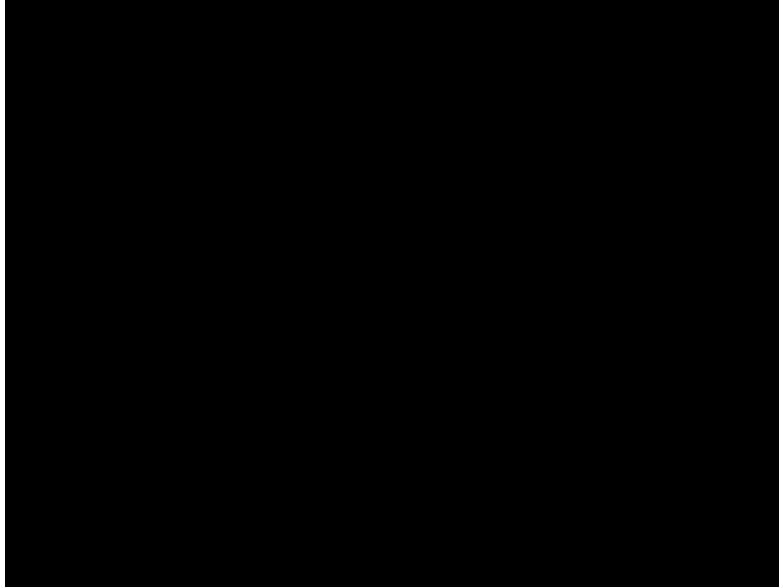
Marc Milstein PhD  
[www.drmarcmilstein.com](http://www.drmarcmilstein.com)

## Cucumbers and Grapes



*Nature* **425**, 297-299 (18 September 2003) | doi:10.1038/nature01963; Received 14 May 2003; Accepted 23 July 2003  
Monkeys reject unequal pay  
Sarah F. Brosnan<sup>1</sup> & Frans B. M. de Waal<sup>1</sup>

## **Cucumbers and Grapes**



**What Does This Have To  
Do With My Brain?**

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## You Have 3 Brains!

Midbrain

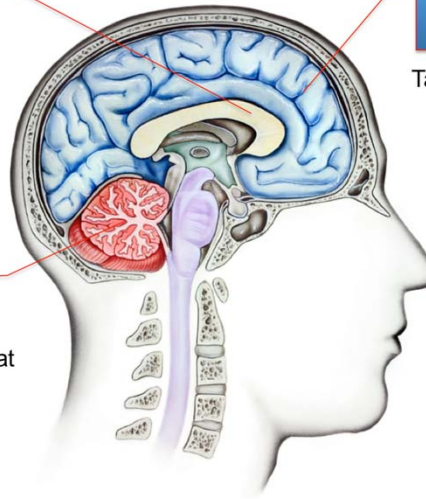
Feel – Remember  
Interact with others

Neocortex

Talk – Think – Move  
Create - Learn

Reptilian Brain

Survive – React – Repeat  
Repeat-Repeat



What happens in your brain is similar to what happens in an animal's brain at the initiation of anger

## One Minute BRAIN REVIEW: The Brain Is About Three Pounds



How many brain cells?

**How Big Is  
80 Billion?**

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**3,171 Years!**

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## How Do We Figure Out Anger In The Brain?

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- What Is the anger response in the brain?
- How can we use this new info?

## New Information Because Of New Techniques



**Redefining and Reclassifying Anger Based On Brain Studies**

# What Makes Humans Angry?

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A LOT of Things!

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## Why Is This Monkey Angry?



## Causes of Anger: Two Main Categories

- 1. Violation of expectation
- 2. Blockage of goals.



Silly to serious things fall into these categories.

For example.....

## Someone Cuts You Off On The Road

- Both categories!
- 1. violation of expectation
- 2. Blockage of goals.



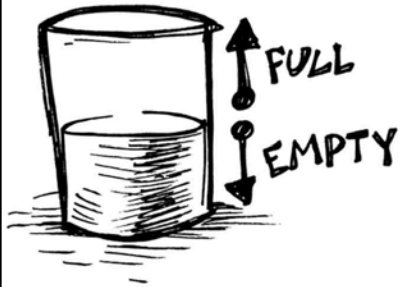
## The Upside Of Anger?

- Motivate.
- Take charge
- Restore the balance of right and wrong.
- Creative, problem solve.
- This is when anger is used correctly.





## Does Anger Make You More Or Less Optimistic?

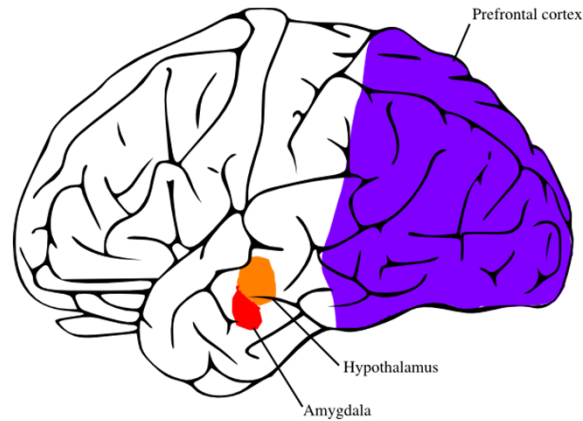


Lerner. Journal of Personality and Social Psychology 2001. Vol. 81. No. 1, 146-159

### Take Home Message: Anger Is NOT Good Or Bad

- Far more complex.
- Anger is a normal emotion to be understood, utilized and controlled.
- **So, what is happening in the brain?**

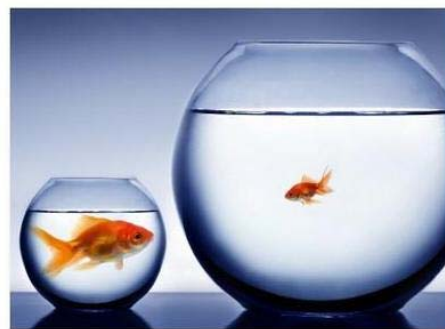
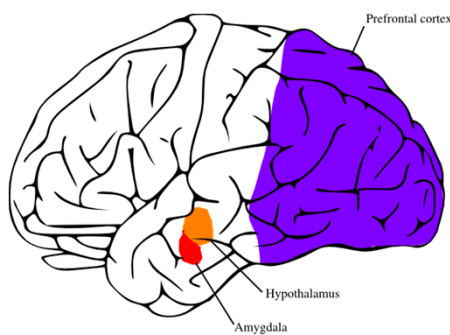
## What Is Going On In The Brain During Anger?



The **amygdala**, the part of the brain that deals with emotion is activated.

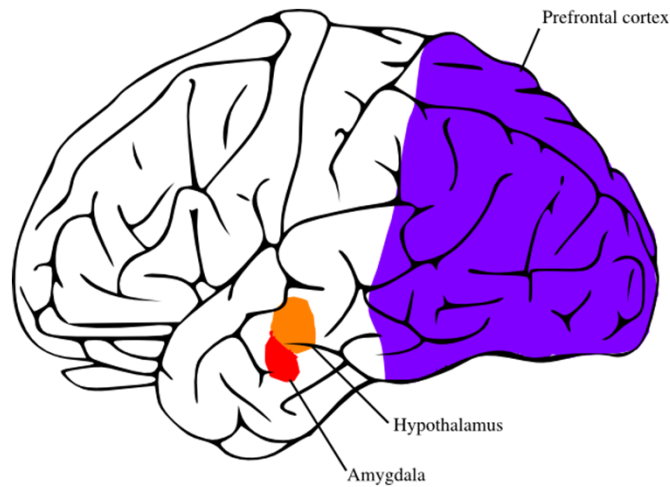
Amygdala wants you to take action! Most likely to fight...

## Is Life Fair?



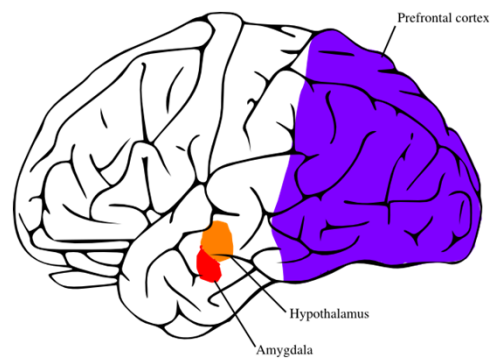
What are we told from a very young age?

## Anger Activates Other Parts Of The Brain



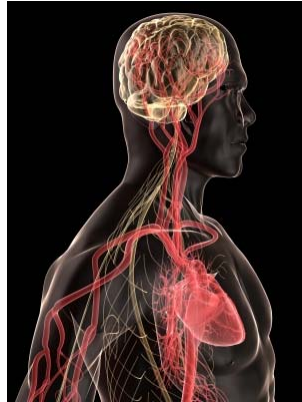
## Hypothalamus

- Hormones are released, such as **adrenaline**, which causes the fight response.



- **This is all hardwired.**

## When Anger Is Triggered A Flood Of Chemicals Enter The Brain



Dopamine, adrenaline flood the brain.

Effects?

## Chemicals In Body Cause....

- Heart goes from pumping blood at 4 liters/minute to 20 liters per minute.
- You are ready to fight!
- This is a primitive response.



**It makes sense if.....**

## Time To Fight This Lion



## But What About When....



## Another Part Of The Brain Becomes Active – Orbital Frontal Lobe

Blood flows to the frontal lobe, specifically the part of the brain that's over the left eye.



**Why?**

## What Does The Orbitofrontal Cortex Do?



**OFC is the brakes!**

## Put Someone In An fMRI And Have Them Make A Decision...

With rewards or punishment.

OFC activated.

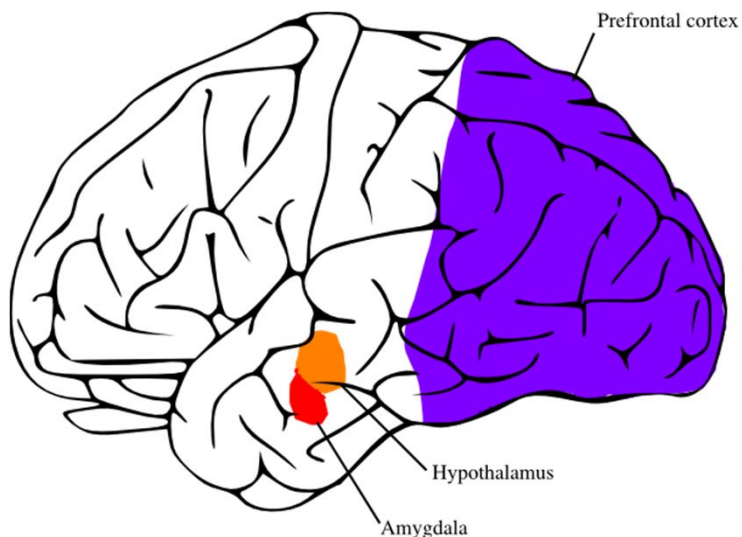
This is the “is it worth it?” part of your brain

Also activated when you get angry.

Very interesting.....



## Now If I Ask You, Is Life Fair?



## What Happens If Someone Damages OFC?



## Phineas Gage – Destroyed OFC



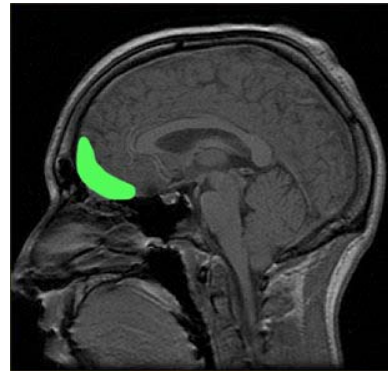
- In 1848, Gage, a nice, dependable railroad worker suffered an accident in which a rod went through his skull, right above the left eye.



## Consequences of Damage to the OFC

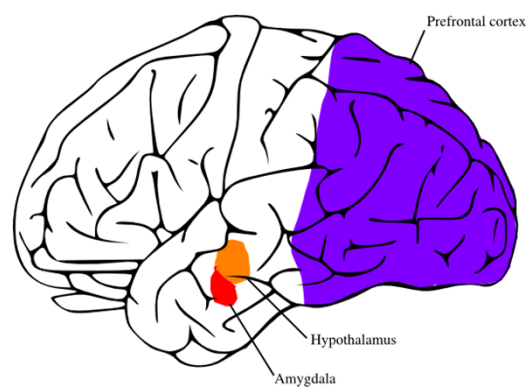
Typically leads to:

- Swearing excessively
- hypersexuality
- poor social interaction
- compulsive gambling
- drug use (including alcohol and tobacco),
- and poor empathizing ability.



Stroke, Dementia, Head Injury

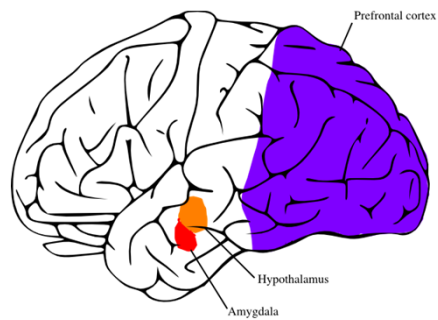
## Anger Ignites A Battle Inside Your Brain!



But how do these parts of the brain develop?

# This Understanding Sheds Light On...

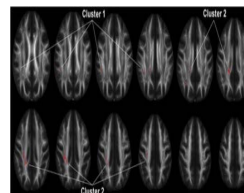
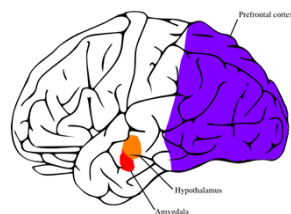
## Children's Behavior Makes Sense.



## Sometimes It's Not Kids....



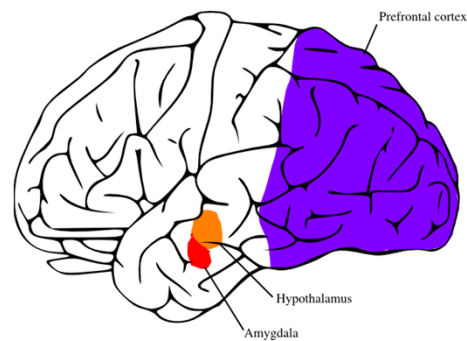
People with anger disorder have decreased connectivity between regions of the brain  
(Think of a Highway)



People with intermittent explosive disorder (IED), or impulsive aggression, have a weakened connection between regions of the brain associated with sensory input, language processing and social interaction.

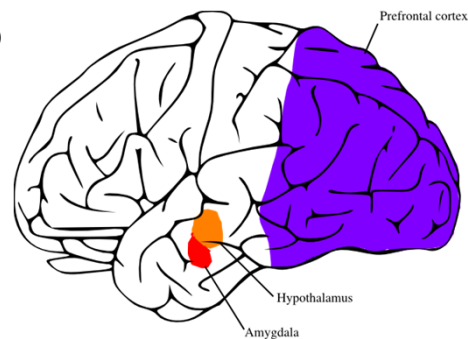
Royce Lee, Konstantinos Arfanakis, Arnold M Evia, Jennifer Fanning, Sarah Keedy, Emil F Coccaro. **White Matter Integrity Reductions in Intermittent Explosive Disorder.** *Neuropsychopharmacology*, 2016; DOI: [10.1038/npp.2016.74](https://doi.org/10.1038/npp.2016.74)

## How Long Does Anger Last In The Brain?



## Anger Is A Quick Sudden Burst

- Neurological response to anger lasts less than two seconds.
- **After that it takes a commitment to amplify or continue.**



**This is why you get a lot of advice  
about deep breaths and counting  
to 10 when angry.**



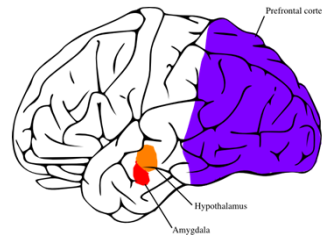
## **The Brain Body Connection**



**What Is Going On In Our Bodies When We Get Angry?**

## Anger Leads To Release Of Adrenaline

- **Blood pressure rises.**
- Real situation or imagined?



## Chronic Anger and Heart Attacks



- Risk of a heart attack is **8.5 times higher** in the two hours following a **burst of intense anger.**

Geoffrey H Tofler et al. **Triggering of acute coronary occlusion by episodes of anger.** *European Heart Journal: Acute Cardiovascular Care*, February 2015 DOI: [10.1177/2048872615568969](https://doi.org/10.1177/2048872615568969)

## Risk Of Stroke When Angry

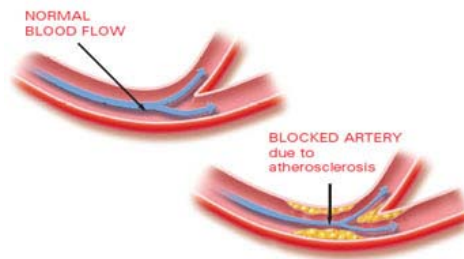
- Stroke risk rose by three times within 2 hours after an angry outburst.



E. Mostofsky, E. A. Penner, M. A. Mittleman. **Outbursts of anger as a trigger of acute cardiovascular events: a systematic review and meta-analysis.** *European Heart Journal*, 2014; DOI: [10.1093/eurheartj/ehu033](https://doi.org/10.1093/eurheartj/ehu033)  
 S. V. Arnold, J. A. Spertus, B. K. Nallamothu. **The hostile heart: anger as a trigger for acute cardiovascular events.** *European Heart Journal*, 2014; DOI: [10.1093/eurheartj/ehu097](https://doi.org/10.1093/eurheartj/ehu097)

## What Is Going On In Our Bodies When We Get Angry?

- Higher levels of glucose and fat in the blood vessels.
- Frequent anger may speed up the process of fatty plaques build up in arteries.



## **“Change of Mind Can Lead To A Change Of Heart”**

- Anger is not as easy test for as cholesterol or blood sugar.
- But it needs to be part of the treatment process.



The bottom line: "A change of mind can lead to a change of heart," - Kiffer.

## **How Long Do You Think The Circulating Hormones Last In Your System After An Intense Burst Of Anger?**





## A Blow Up Over Nothing....

- With the surge of hormones lasts for **several hours** circulating through our system.
- Think of gasoline and fire.



## Hunger and Anger? A Unique Study

- In married couples....
- How to test??



## Experiment: Measure Glucose In The Blood

- 21-day study with 107 married couples.
- Couples complete a relationship satisfaction measure.
- Each person measured glucose levels before breakfast and every evening before bed.
- **BUT.....How to measure anger?????**



Blood Test: Glucose

Brad J. Bushman, C. Nathan DeWall, Richard S. Pond, Jr., and Michael D. Hanus. **Low glucose relates to greater aggression in married couples.** *PNAS*, April 14, 2014 DOI: [10.1073/pnas.1400619111](https://doi.org/10.1073/pnas.1400619111)

## Measured Anger With Voodoo Dolls

- All participants were given 51 pins.
- **Results?**

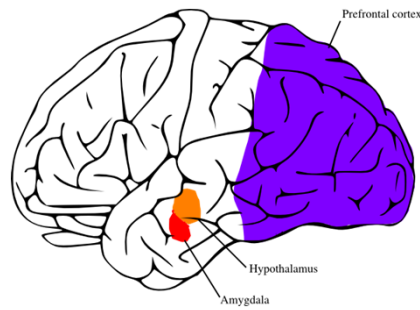


**Hungry = More Pins In Voodoo Doll**



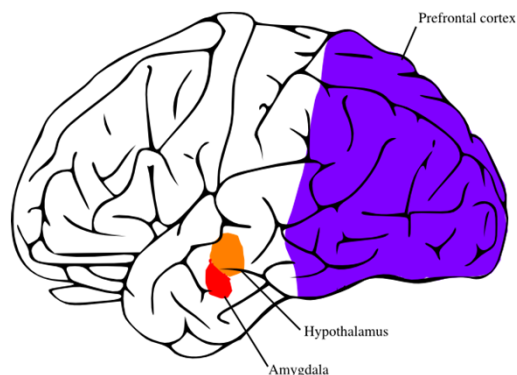
**3 People Put All 51 Pins In The Doll**

## Why Does Anger Flare Up Easier When We Are Hungry?



Low levels of serotonin make the neural circuits between the limbic system and the cortex weaker, making it more difficult to regulate anger.

## BACK TO THIS IDEA: Anger Ignites A Battle Inside Your Brain!



What if one side is stronger than the other?

## Scan Brains Of Those With Anti-Social Personality Disorder

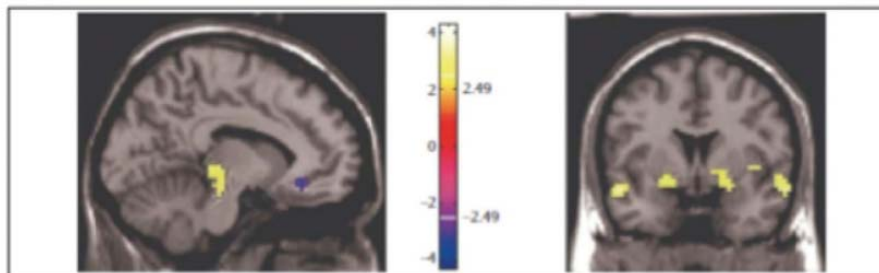
- Anti-social personality disorder

Aggressive, impulsiveness, lack of remorse



- Are their brains physically different?

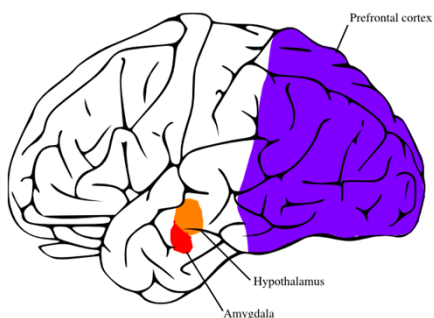
## Scan Brains Of Those With Anti-Personality Disorder



- 11% percent less neurons in prefrontal cortex in those with anti-social pre-frontal cortex

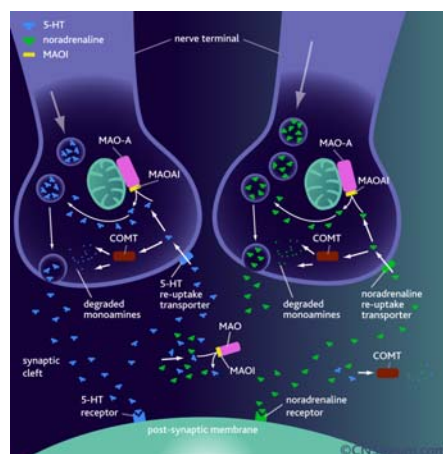
Dr. Adrian Raine - USC

## Is Anger In Your Genes?



## Gene Mutation In Humans That Makes One More Aggressive

- Mutation in Monoamine oxidase.
- Predisposes people to aggression.

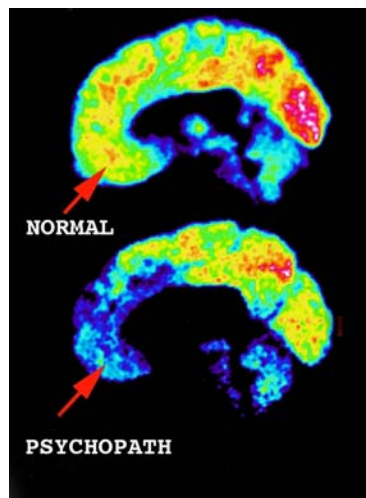


Can't Clear Chemicals From Brain

## An Interesting Case....



James Fallon, neuroscientist



## He Also Has The Monoamine Gene Mutation



James Fallon, neuroscientist

Brain scan and genetics of a psychopath.

But he never hurt or killed anyone..

Looks back on his life....

What's the difference??

## Is This Gene Fixed or Can It's Activity Go Up or Down?

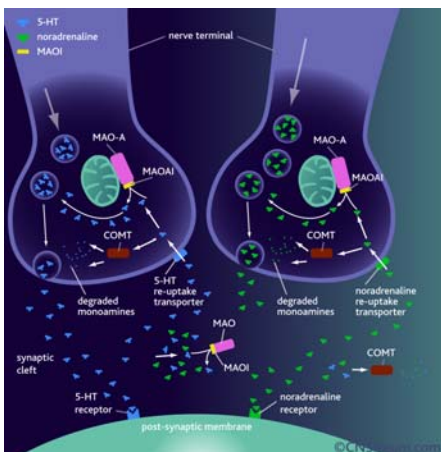
### MAOA Gene Activity In A Positive Direction

- Exercise
- Diet
- Stress Management
  
- Are genes our destiny?

[\(Morishima et al., 2006\)](#), [\(Jahng et al., 1998\)](#), [\(Marquez et al., 2013\)](#),

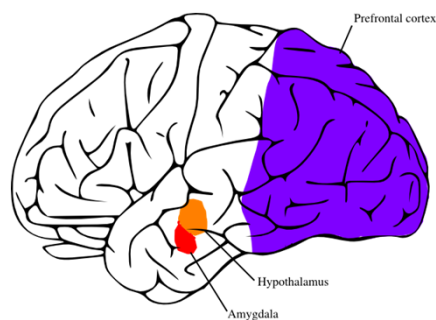


## What If Mutation Is Paired With Childhood Trauma?



## Presence Of Mutation With Childhood Trauma

- Affect is greater.
- In many cases we can't really separate Nature vs. Nurture.

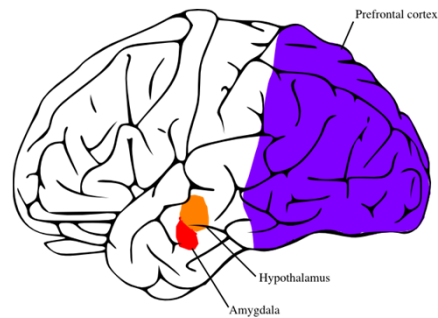


## This Suggests With Aggression It's Not Just Genes Or Just Environment

- Genes load the gun. Environment pulls the trigger.
- Francis Collins PhD
  
- And in most cases we are not slaves to our genes.....

## Anger Management Strategies In Terms Of Neuroscience

- Anger is normal.
- The problem is when it's chronic and gets out of control.
- No one size fits all for treatment.



## Brain Changes?

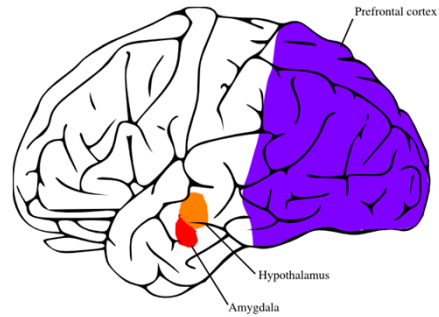


*UCLA psychiatry professor Dr. Jeffrey Schwartz*

## How We Learn.....



## We LEARN To Deal With and Control Anger Just Like We Learn Everything Else



## Our Brains Develop Patterns On How We Deal With and Respond To Anger

- 1. Angry withdrawal (bottling up)

or

- 2. Venting

## Burying Vs Venting Strategy If Practiced Can Become Automatic

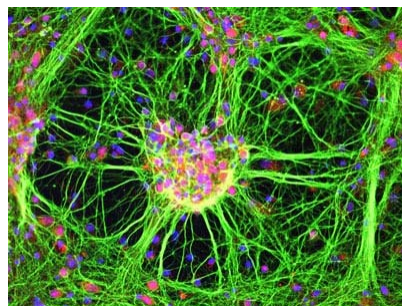
- Automatic response to threat in adulthood based on we learned in childhood.



An individuals anger response becomes a reflex

## PRACTICING BEING ANGRY MAKES YOU PERFECT AT BEING ANGRY

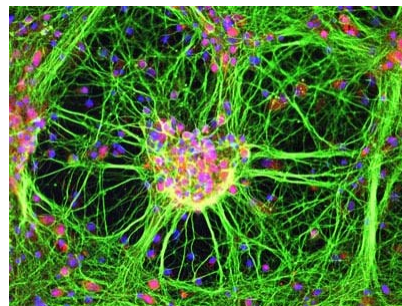
- In terms of **neuroplasticity.....**
- One solidifies neuronal connections based on repeating strategy.



## How To Break A Pattern of Behavior?

### Breaking Automatic Responses To Anger: (Neuroplasticity)

1. Consciousness  
(awareness of emotion)
2. A decision to express it differently.
3. Repetition to reprogram the response pattern.



**Practice, practice, practice** causes reprogramming of brain wiring.

- Identify triggers and change habits.
- Get rusty at the old anger response

**In Terms Of Neuroscience and  
Physiology....  
Bury Or VENT???!!!!**



## Burying and Suppressing?



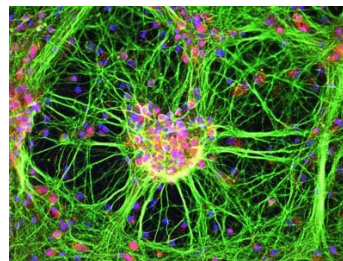
## Venting In A Heated Manner??

- Chronically venting anger in a heated manner is linked to higher risk of heart disease, stroke and heart attack.



- Anger wears out the body.

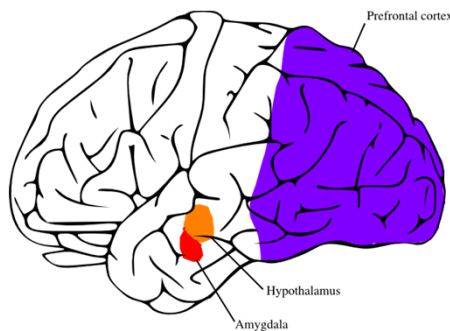
- **And what does chronically venting due to neuroplasticity?**





## Third Strategy

### Be Aware and Get Yourself Out Of Situation



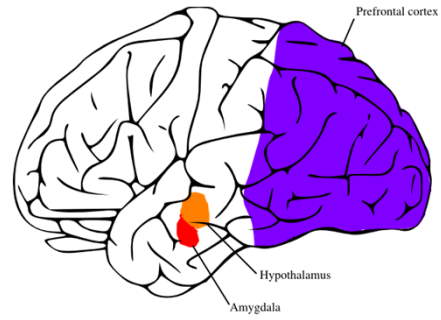
Wait for prefrontal cortex to suppress the amygdala hijack

Make new habits.

## IN TERMS OF CHRONIC ANGER... The Power Of Practicing Distraction

**Break the cycle and negative health consequences.**

- Play a board game
- Work on a puzzle
- Paint, draw or sculpt
- Play with your pet
- Call/text/chat with a friend
- Play a computer game
- Read a book
- Watch a movie
- Cook
- Meditate



**It's actually difficult for the brain to be angry when you are doing something you enjoy**

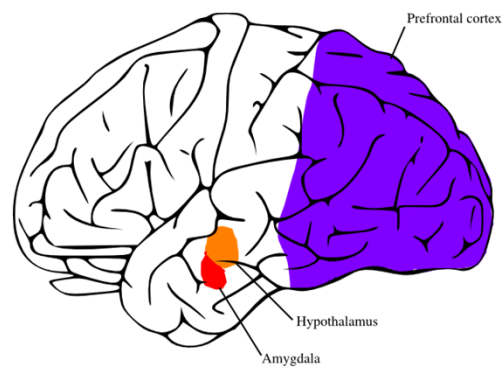
## What About Exercise?

## What About Exercise??



A new study ties heavy exertion while stressed or mad to a **tripled risk** of having a heart attack within an hour.

## Is There Something We Can Do That Strengthens Prefrontal Cortex and Quiets Amygdala?



## Mindfulness



Is this the only way?

## What About Our Faces?



## What Is A Mirror Neuron?



## Why We Get Emotionally Involved At The Movies...



## We Want Our Brains To Be Synced Up To Others

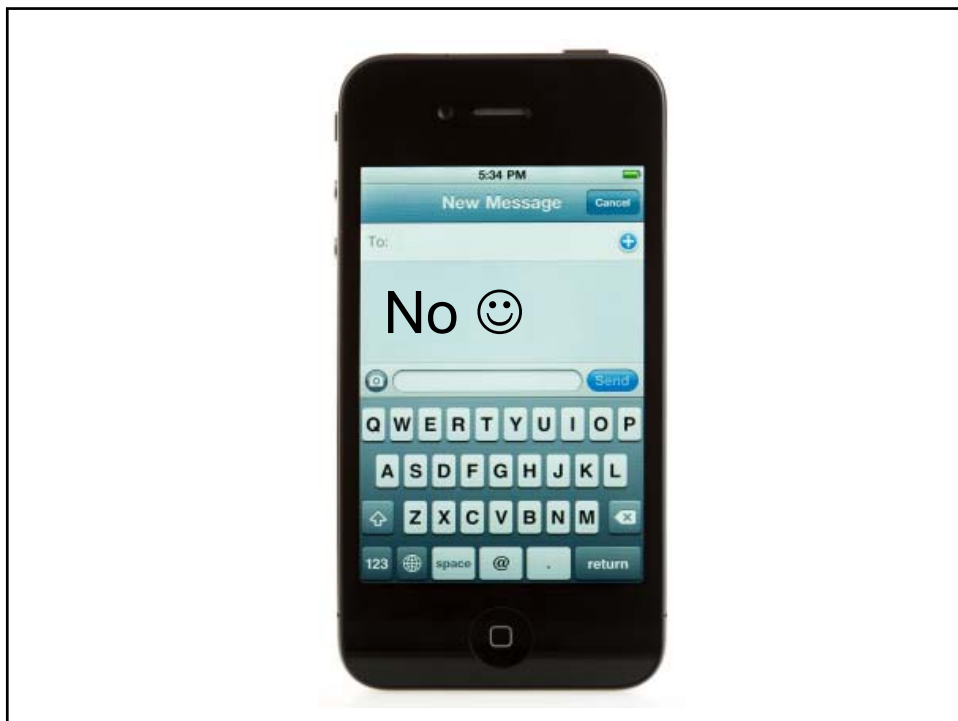
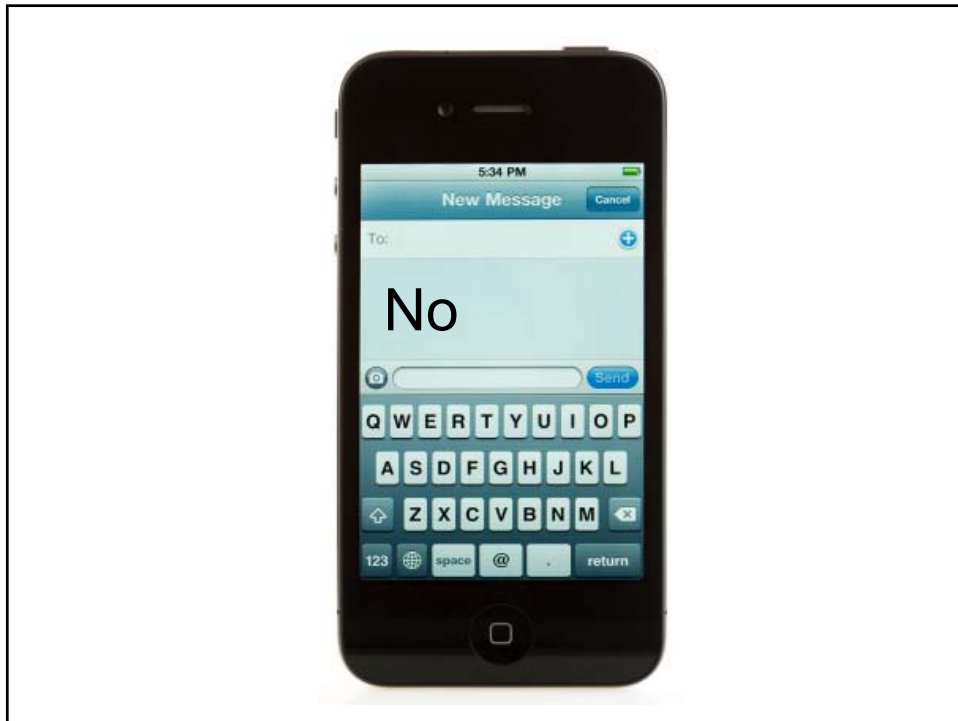


**You Get Me!**  
**This builds trust....**

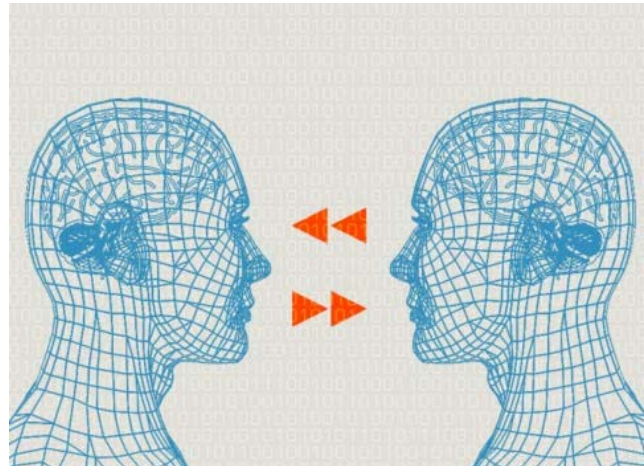
## What Happens When You Smile At Someone And They Don't Smile Back?



Or a text message.....



## So What Happens When We Look At An Angry Face?



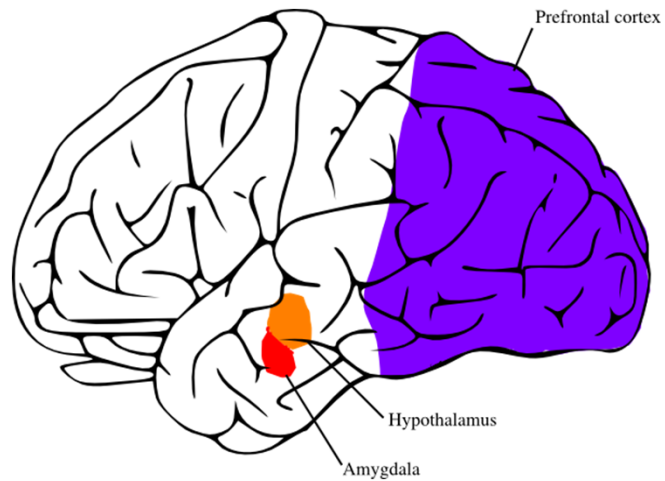
### 1. Look At This Face.....



Blechert , Stanford



## What's Happening In Your Brain?



### Experiment: Two Groups Of People

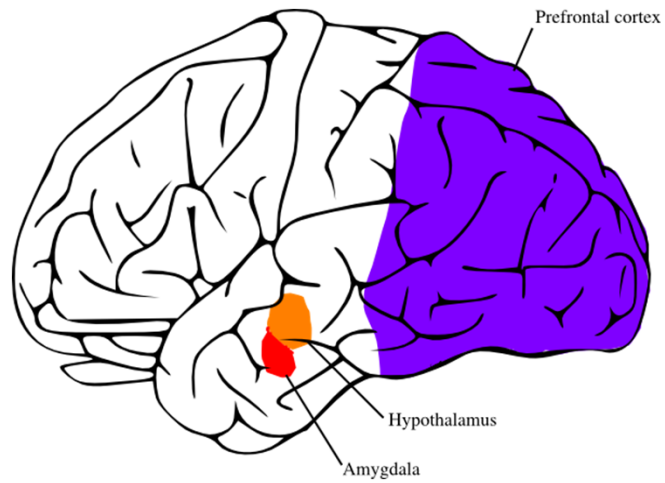
Group 1:

Look at photo twice.

What happens in the  
brain?



## What's Happening In The Brain?



## Group 2

Look at the photo  
once. Then tell group  
2....



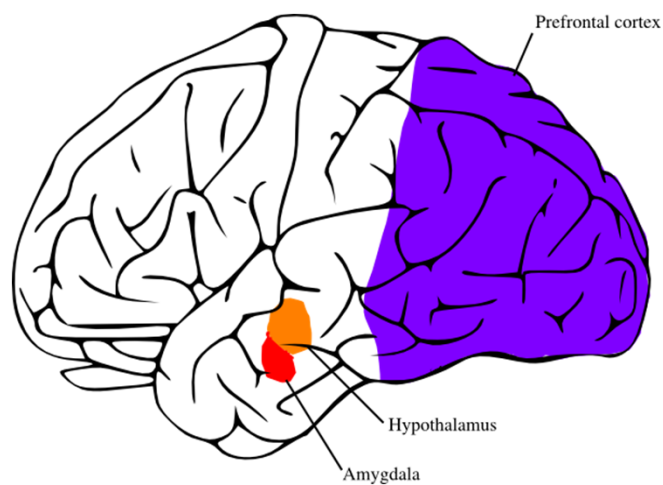
## Group 2. Try Reappraising - Consider This Person Had A Bad Day And It Had Nothing To Do With You



What happens the to the brain the second time you look at the photo?

Blechert and his colleagues

## Now What's Happening In Your Brain?



## The Power of Reframing

**Wait A Second!**



## A Gift For Your Mirror Neurons



Thanks!

[www.drmarcmilstein.com](http://www.drmarcmilstein.com)

[www.theangrybrain.com](http://www.theangrybrain.com)