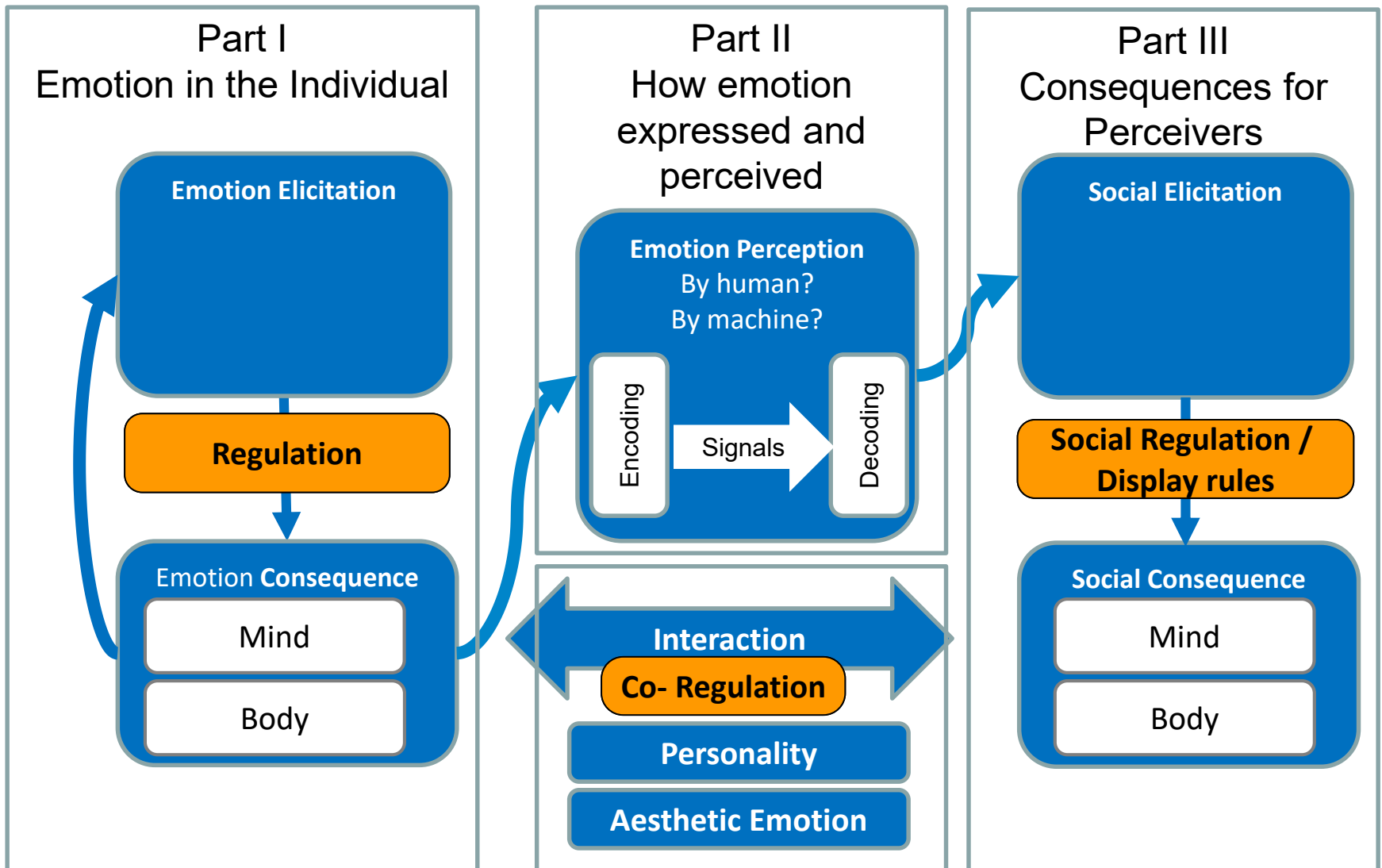


Lecture 11: Emotion Regulation

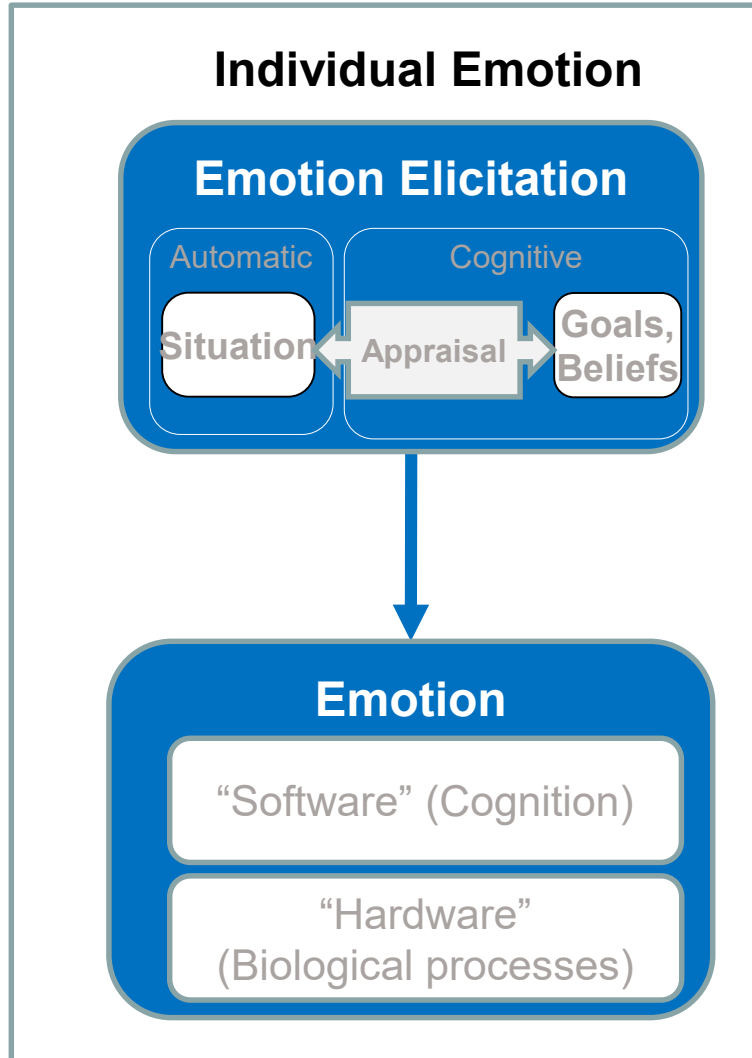
Overview

- **Brief Review Individual Emotion**
- **Why regulate emotion?**
- **Gross regulation framework**
- **Affective computing approaches**
- **Case study : Emotion Regulation in cars**

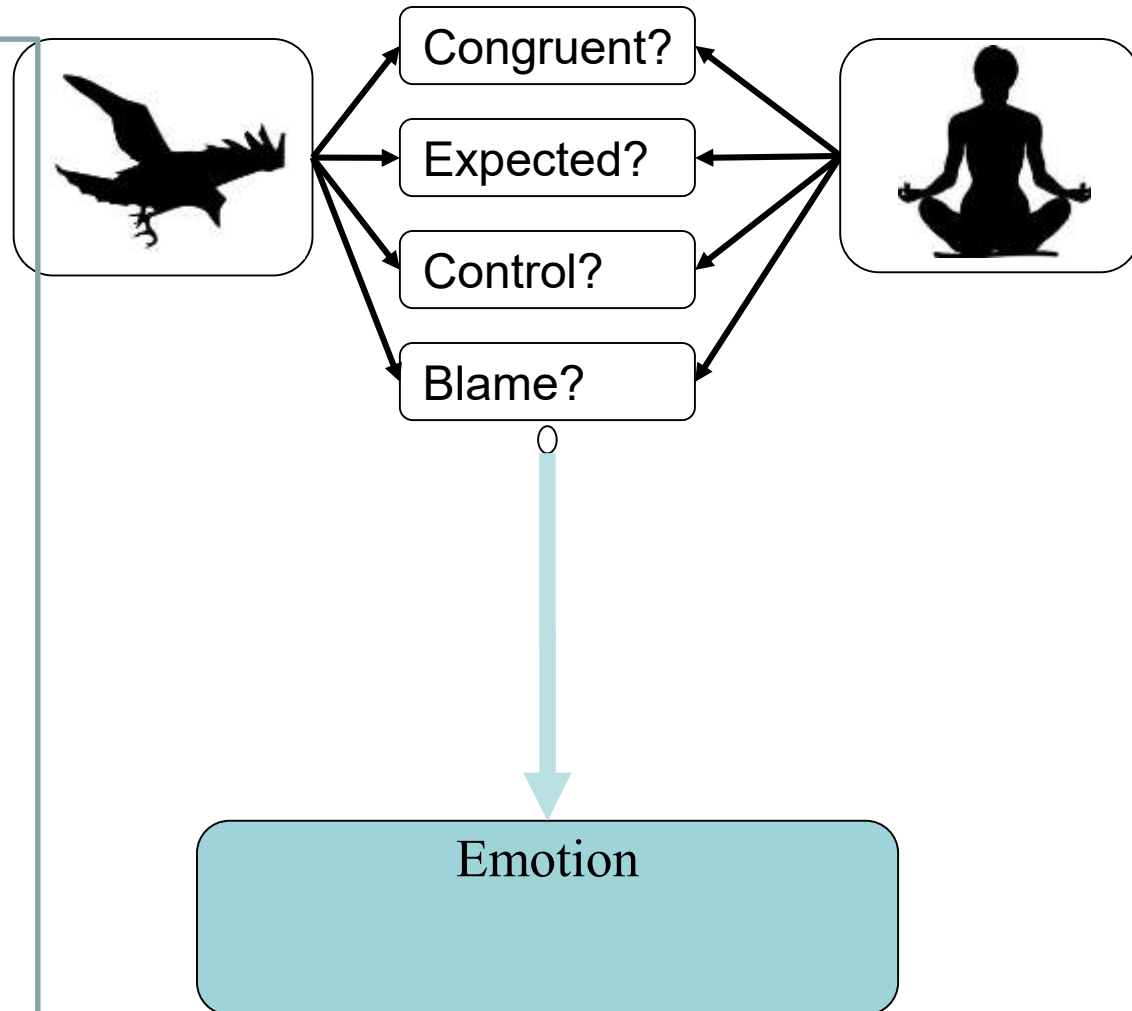
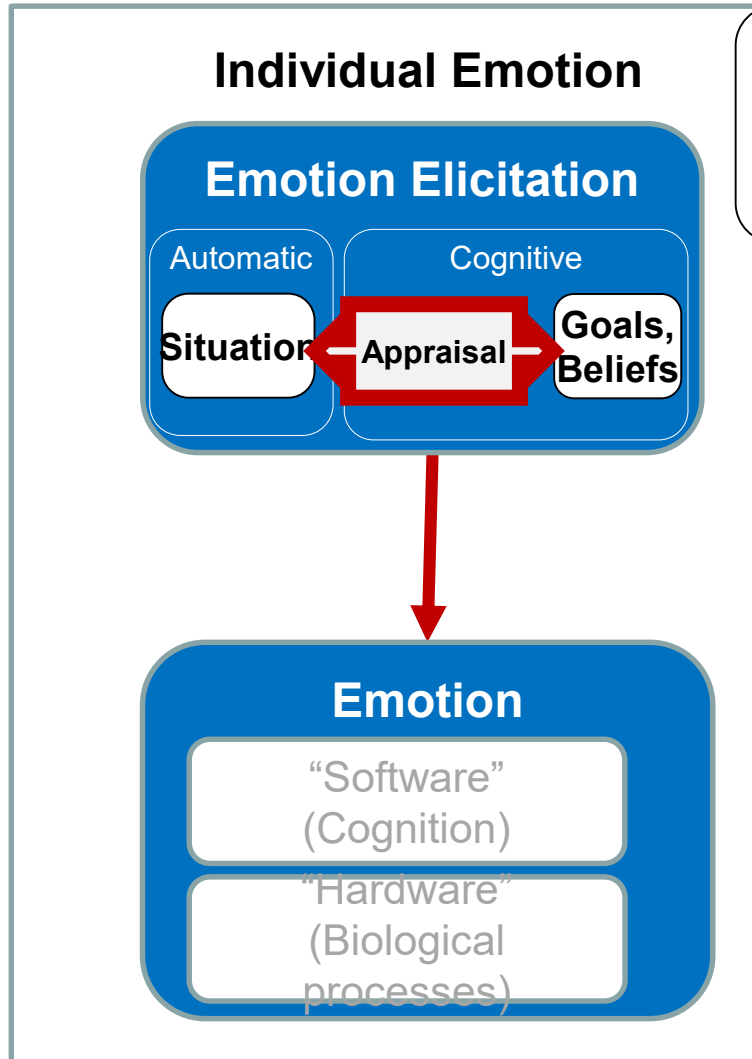
Review



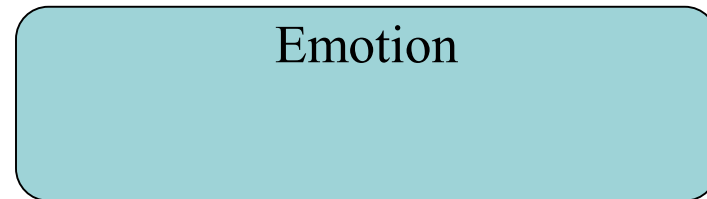
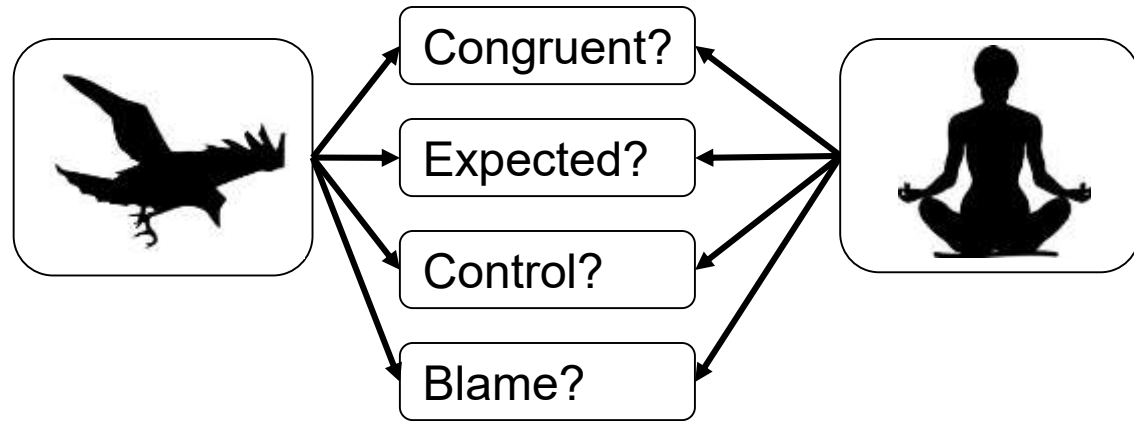
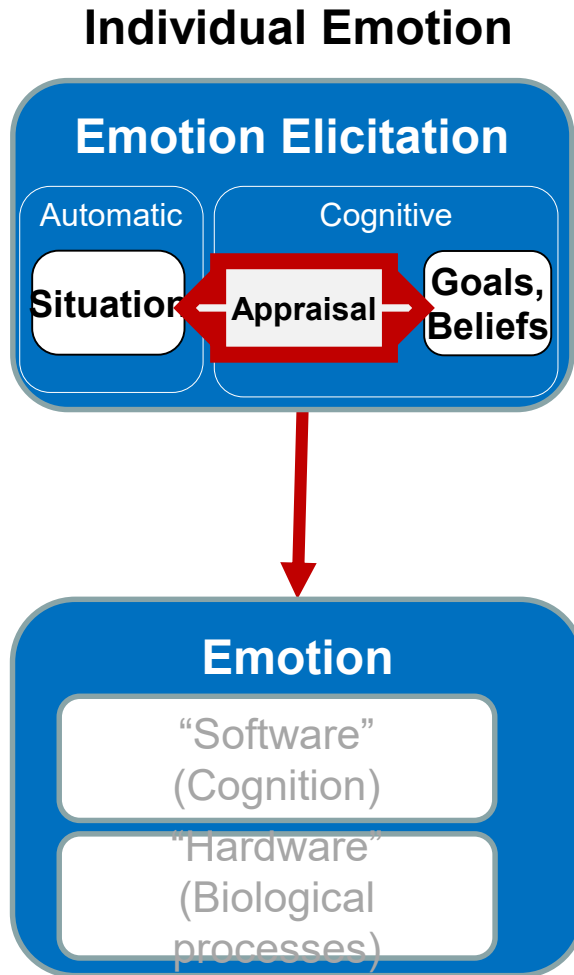
Where do emotions come from?



Top Down Theories (Appraisal theories)



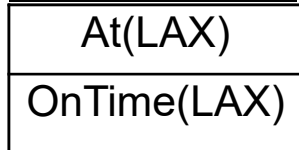
Top Down Theories (Appraisal theories)



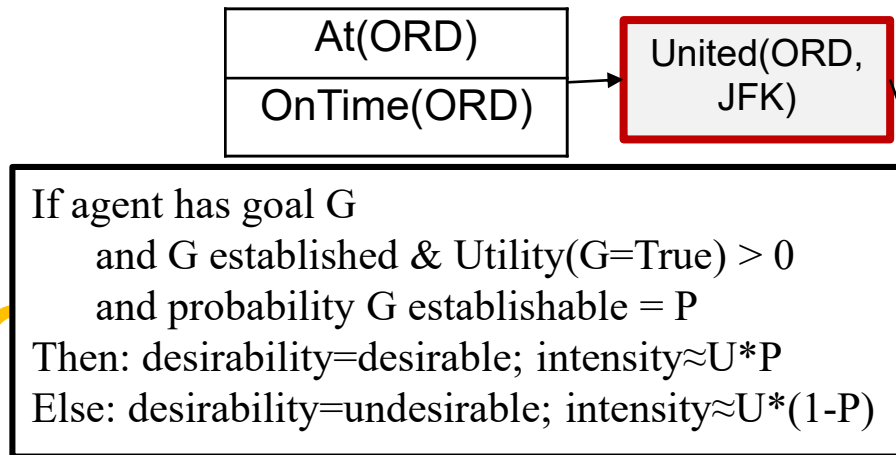
Emile, EMA built on Decision Theoretic Planning



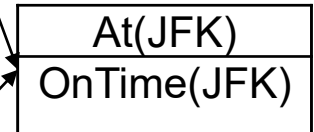
LAX



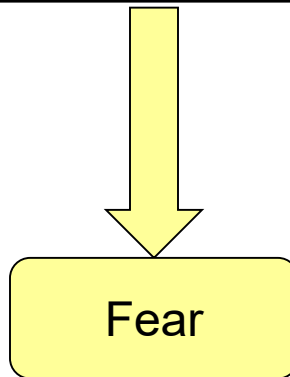
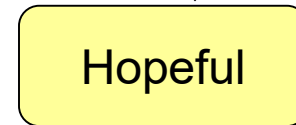
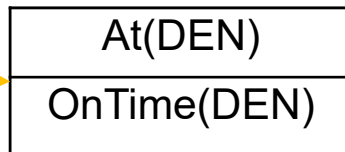
Situation



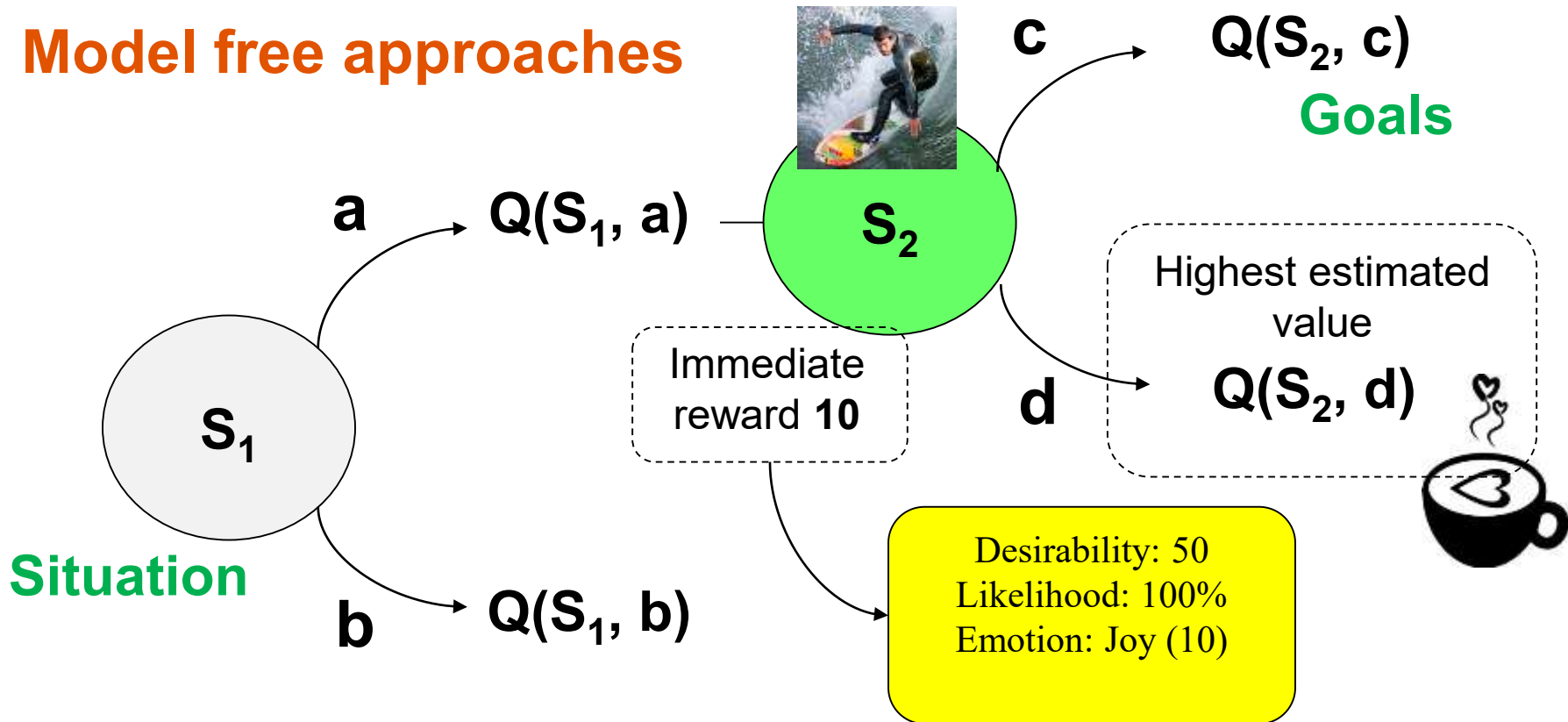
Reward \$1000



Goals



Model free approaches



- **How might you derive Joy/Distress?**
 - Immediate reward can be seen as desirability of a state
 - Positive (negative) immediate reward maps to Joy/Distress

Evaluating Models

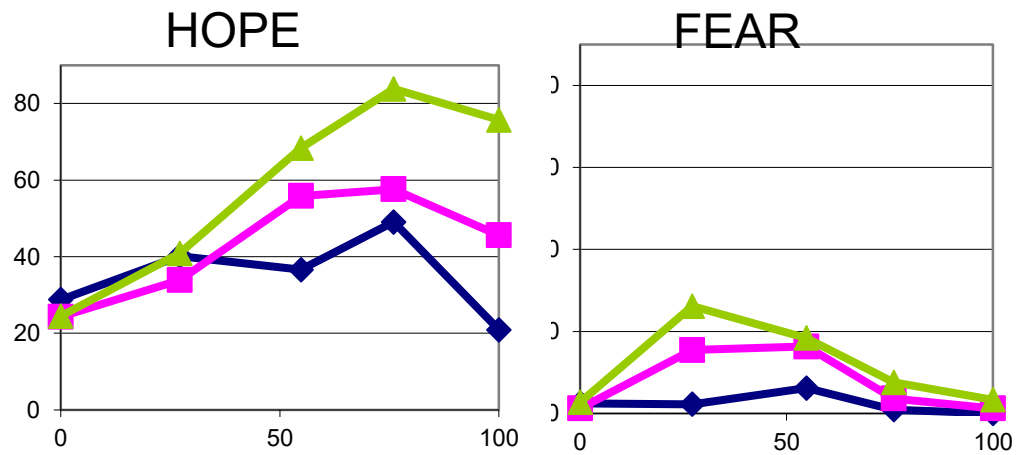
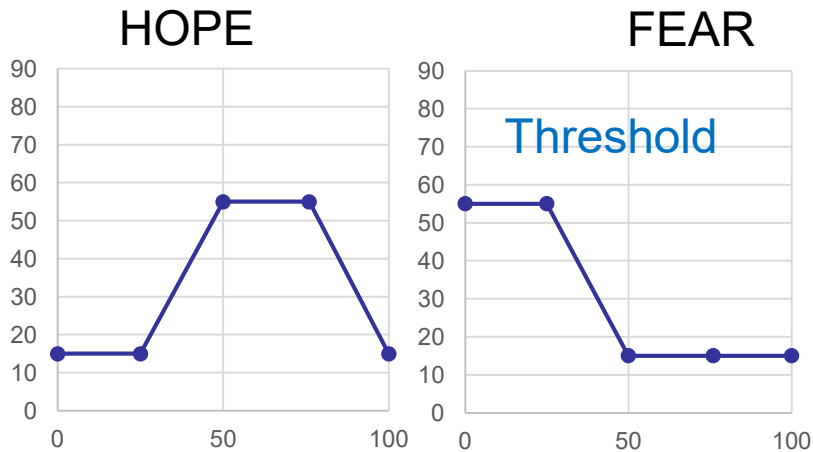
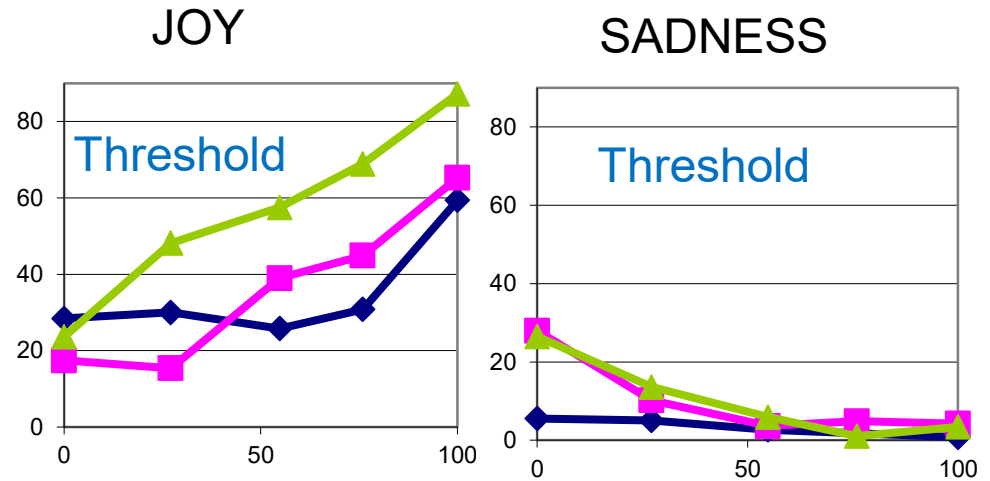
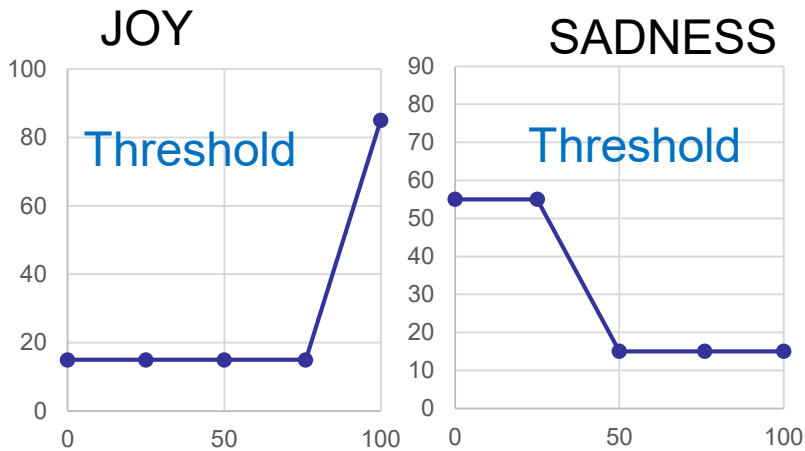
START: Imagine you are playing a simple game with someone from class. You are the green player. The other classmate is the red player. You take turns flipping a coin. The first person to get four heads wins \$100. Imagine the game is just about to start and it is your turn. Answer the following questions on a scale from 1 to 100 where 1 means not at all and 100 means a lot:

WINNING: Now imagine that you have obtained four heads and your opponent has only achieved four tails. Answer the following questions on a scale from 1 to 100 where 1 means not at all and 100 means a lot:

LOSING: Imagine instead that you have obtained zero heads and your opponent has four heads. Answer the following questions on a scale from 1 to 100 where 1 means not at all and 100 means a lot:



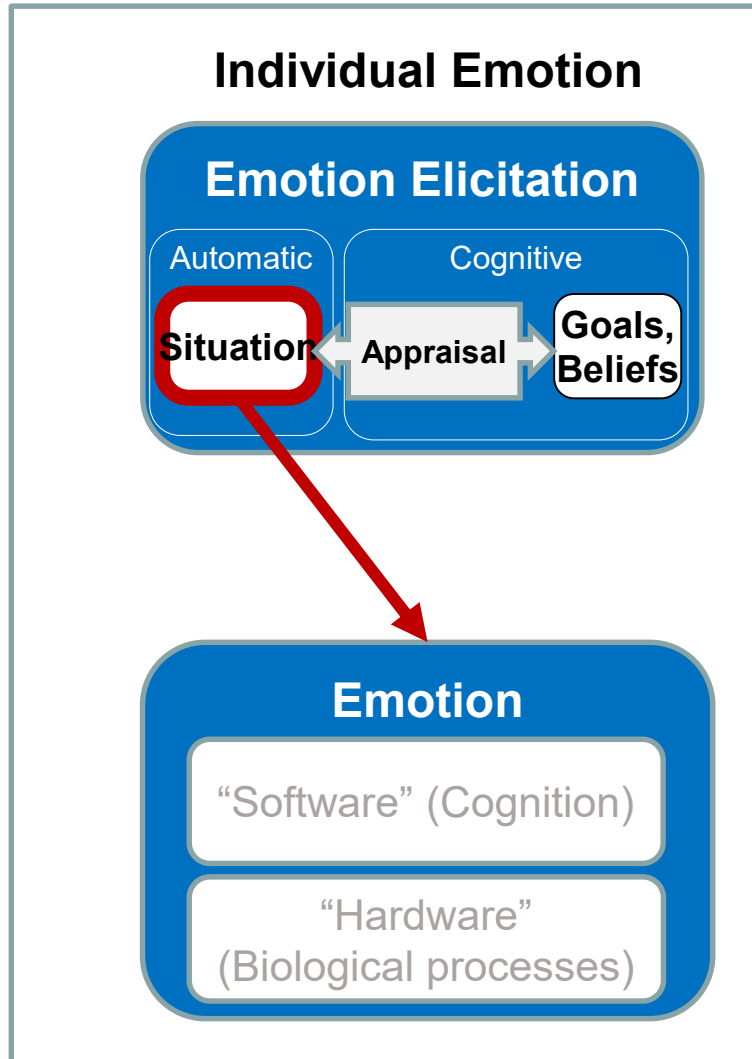
Results



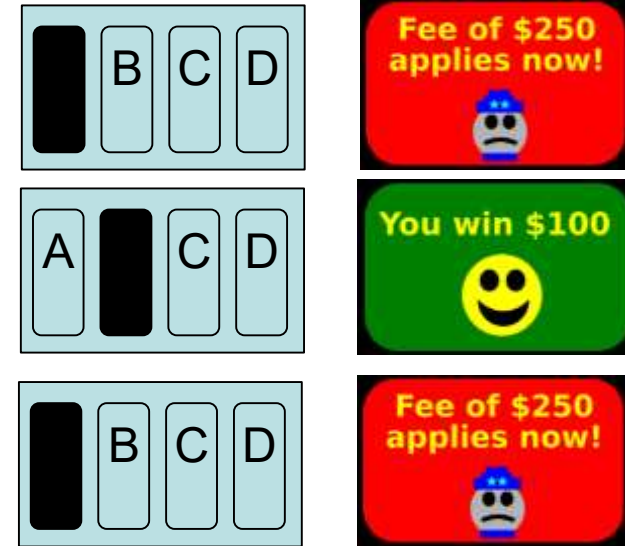
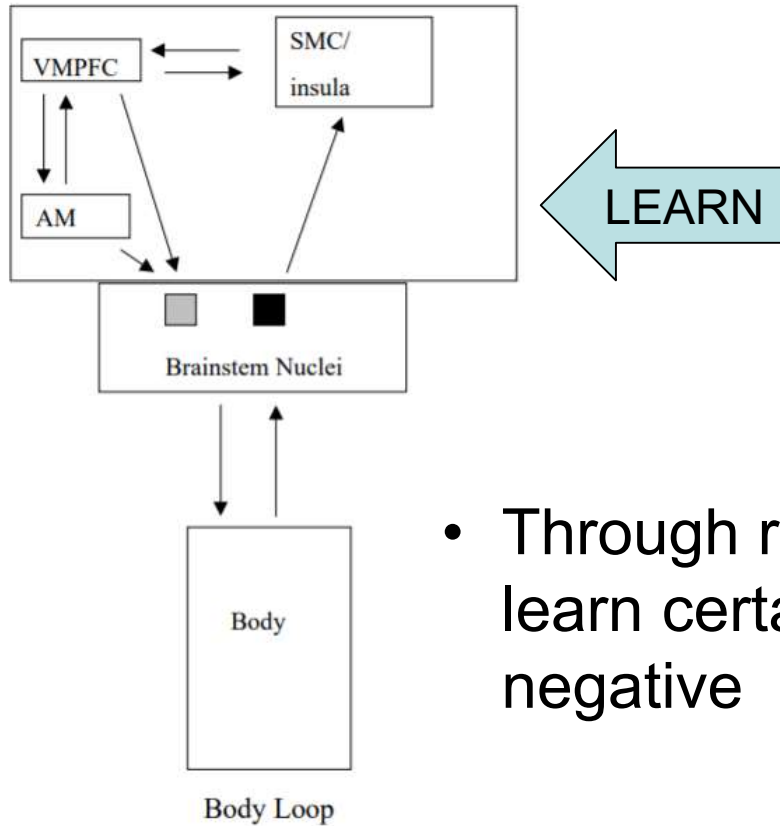
ChatGPT

Human

Bottom up

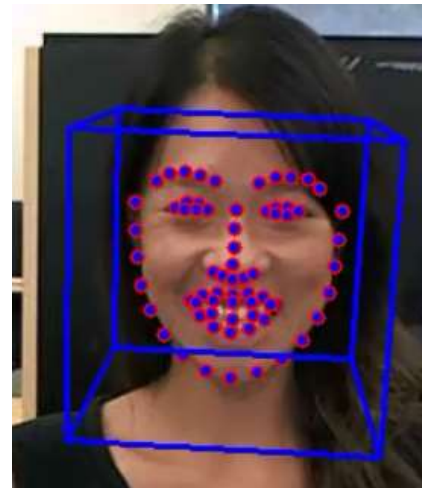
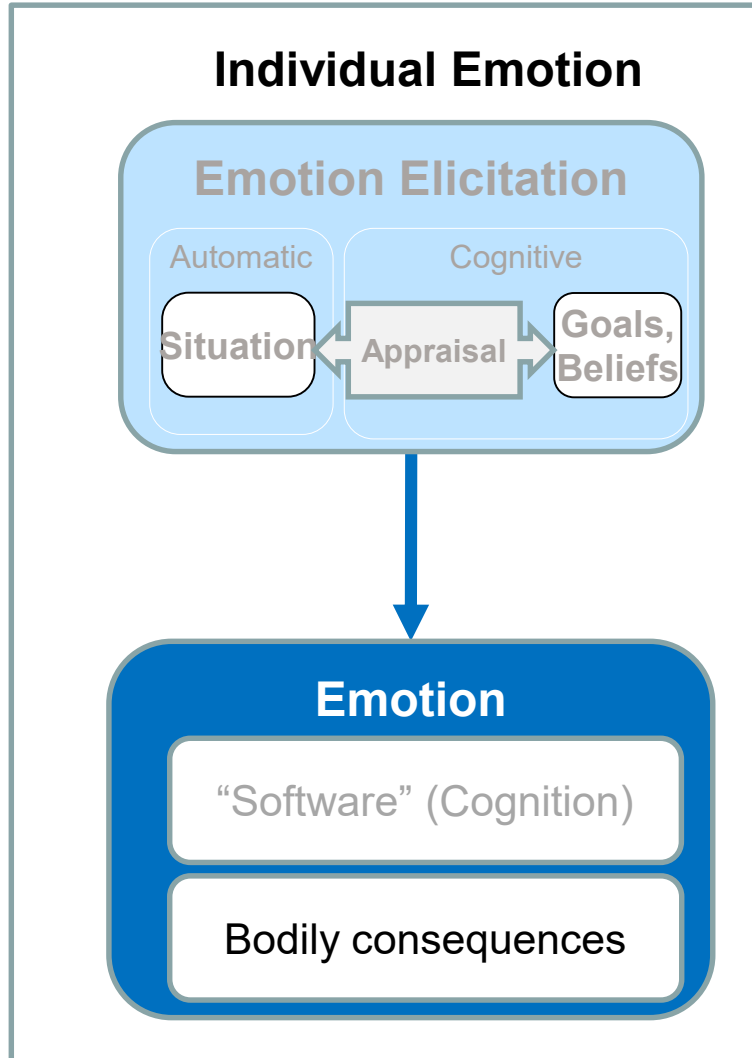


Somatic Marker Hypothesis

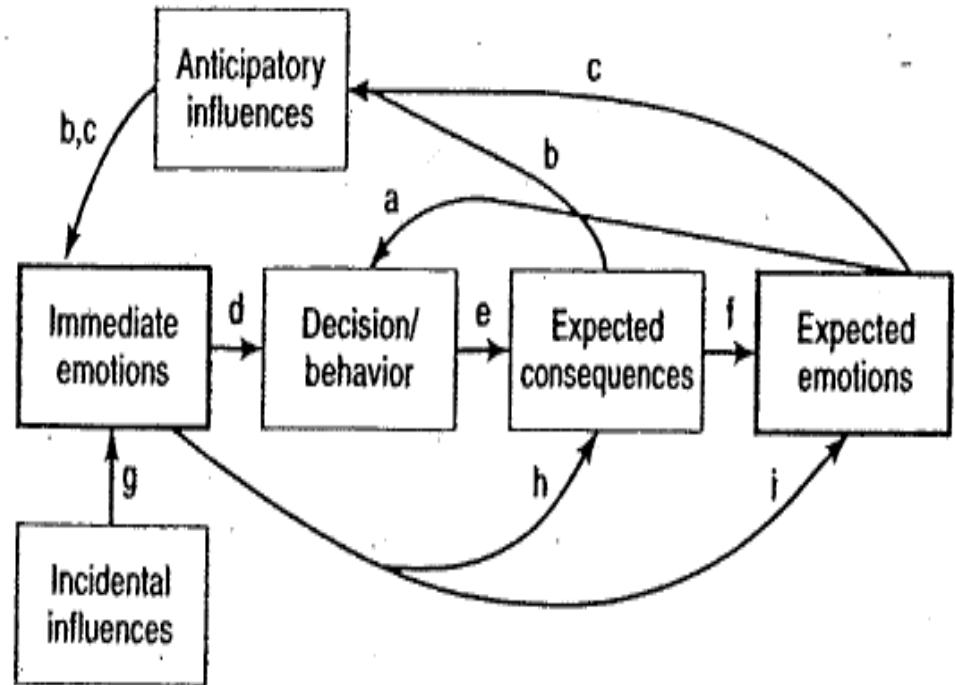
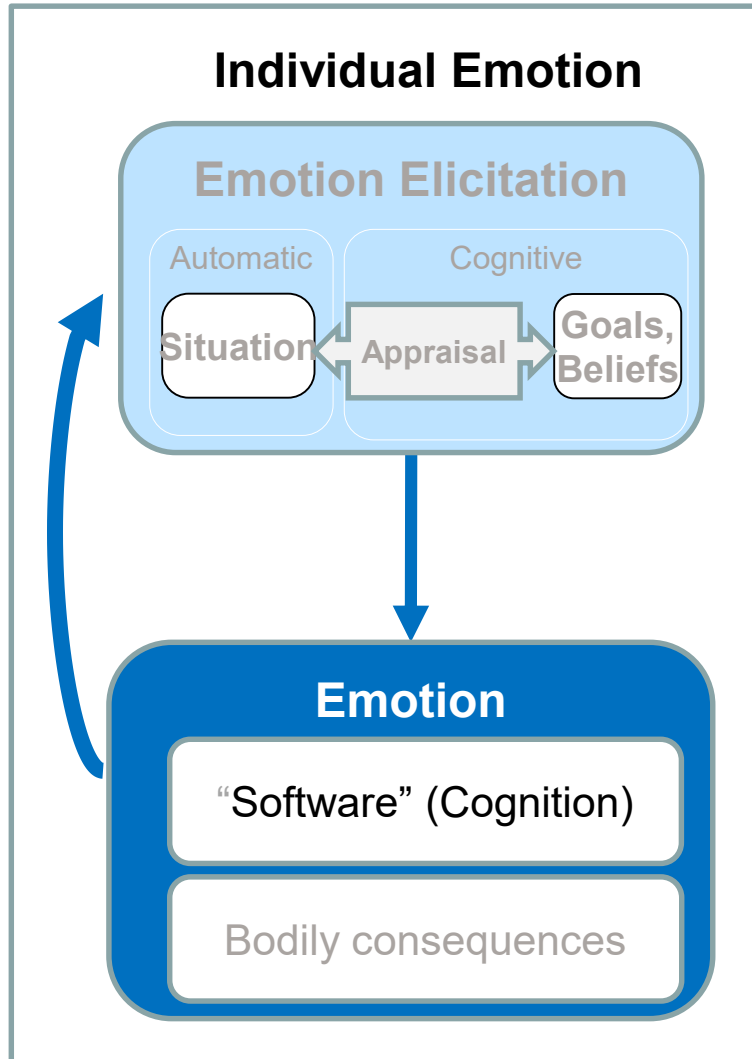


- Through reinforcement learning we learn certain stimuli are positive or negative

Emotion shapes brain and cardiovascular system



Emotion shapes decision-making



$$E_{A(C)} \propto U_A + d(U_A - U_B)(1 - p_A) + r(U_A - U_C)(1 - p_A p_C)$$

⏟ ⏟ ⏟ ⏟
reward disappointment surprise regret

Today: Emotion regulation

- **Why do we regulate emotion?**
- **Gross' process model of regulation**
- **Affective computing approaches**
- **Case study : ER in cars**

Why regulate emotions?

▪ ChatGPT?

- Main reason is to maintain social relationships and avoid negative consequences that might come from expressing emotions in inappropriate ways
- Help individuals feel more in control of themselves
- Help individuals manage their stress
- Excessive regulation of emotion can have negative effects such as leading to lack of authenticity in relationships

Taxonomy of motives in emotion regulation (Tamir 2016)

- **What are consequences of having emotion?**

Outcomes

Hedonic ← Hedonic happiness = pleasure & enjoyment
Instrumental
Behavioral

Epistemic ← Some emotions convey what is real about world or self

Social

Eudaimonic ← Eudaimonic happiness = meaning or purpose

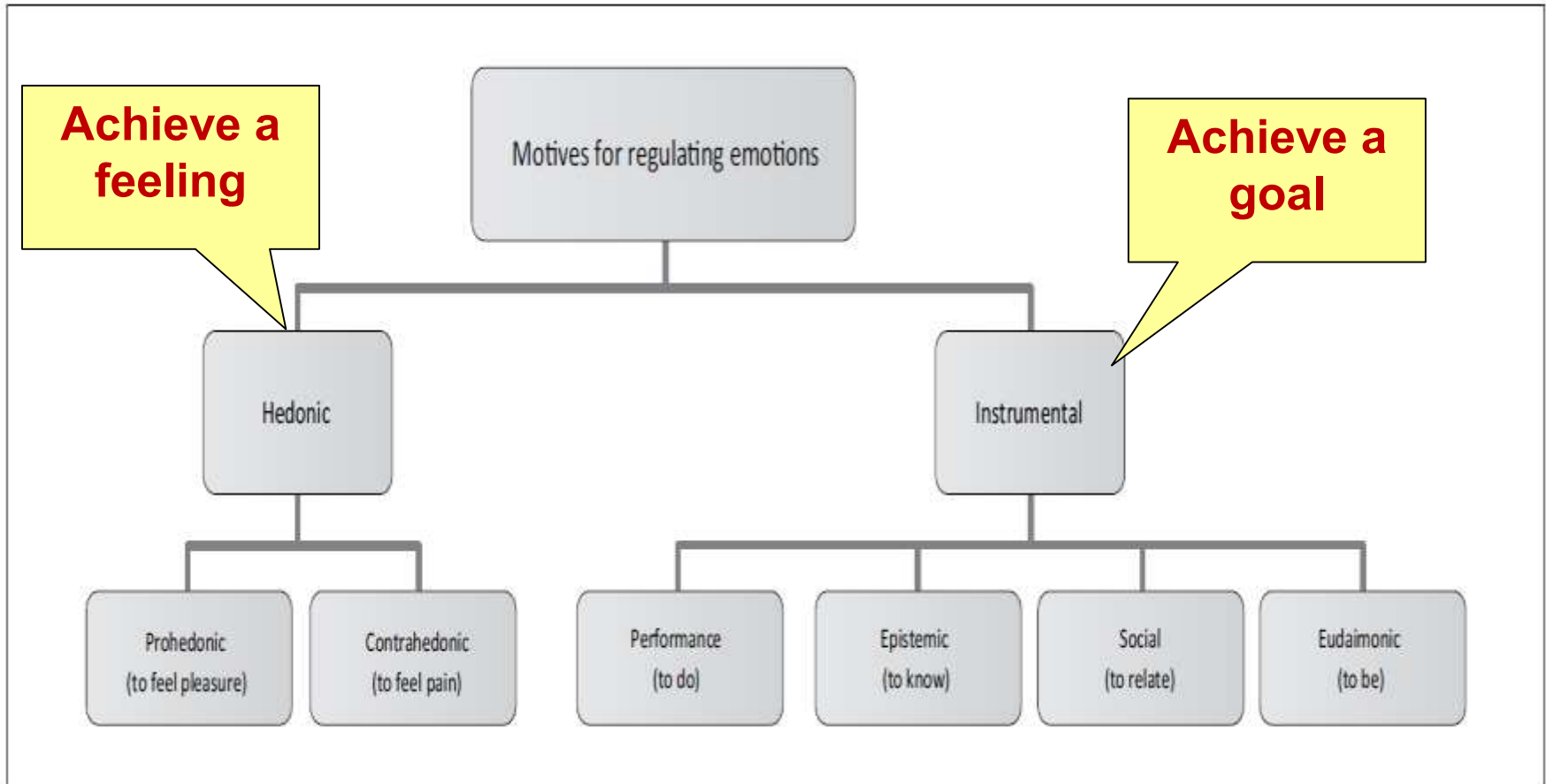
Taxonomy of motives in emotion regulation (Tamir 2016)

What are consequences of having emotion?

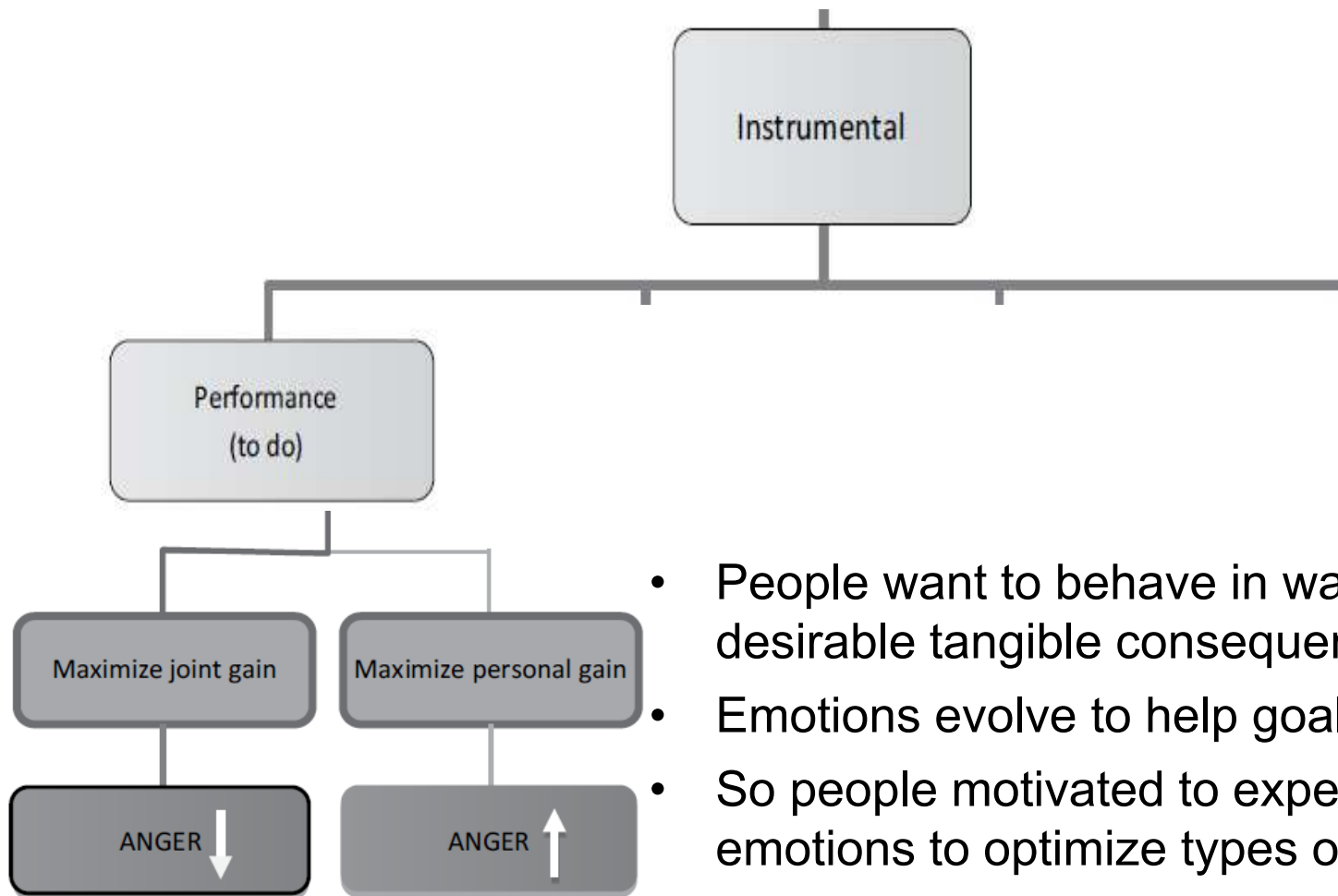
Outcomes	Happiness	Anger	Fear	Sadness
Hedonic	Pleasant ^a	Unpleasant ^a	Unpleasant ^a	Unpleasant ^a
Instrumental				
Behavioral	<ul style="list-style-type: none"> Promotes collaboration^b Promotes creativity^c 	<ul style="list-style-type: none"> Promotes competition^b Promotes confrontation^d Promotes risk-taking^e 	<ul style="list-style-type: none"> Promotes avoidance^f Promotes risk aversion^e 	<ul style="list-style-type: none"> Promotes analytic processing and attention to detail^g
Epistemic	<ul style="list-style-type: none"> Signals safety^h Self-enhancesⁱ 	<ul style="list-style-type: none"> Signals injustice^h 	<ul style="list-style-type: none"> Signals danger^h 	<ul style="list-style-type: none"> Signals loss^h Self-verifiesⁱ
Social	<ul style="list-style-type: none"> Renders self-attractive^j Promotes trust^k Promotes helping others^l 	<ul style="list-style-type: none"> Increases dominance^m Promotes blaming or negative judgment of othersⁿ 	<ul style="list-style-type: none"> Signals danger to others^o Recruits help from others^p Promotes ethnocentrism^q 	<ul style="list-style-type: none"> Recruits help from others^r
Eudaimonic	<ul style="list-style-type: none"> Promotes meaning in life^s 			<ul style="list-style-type: none"> Promotes meaning in life^t

Taxonomy of motives in emotion regulation (Tamir 2016)

Taxonomy of motives in emotion regulation (Tamir 2016)

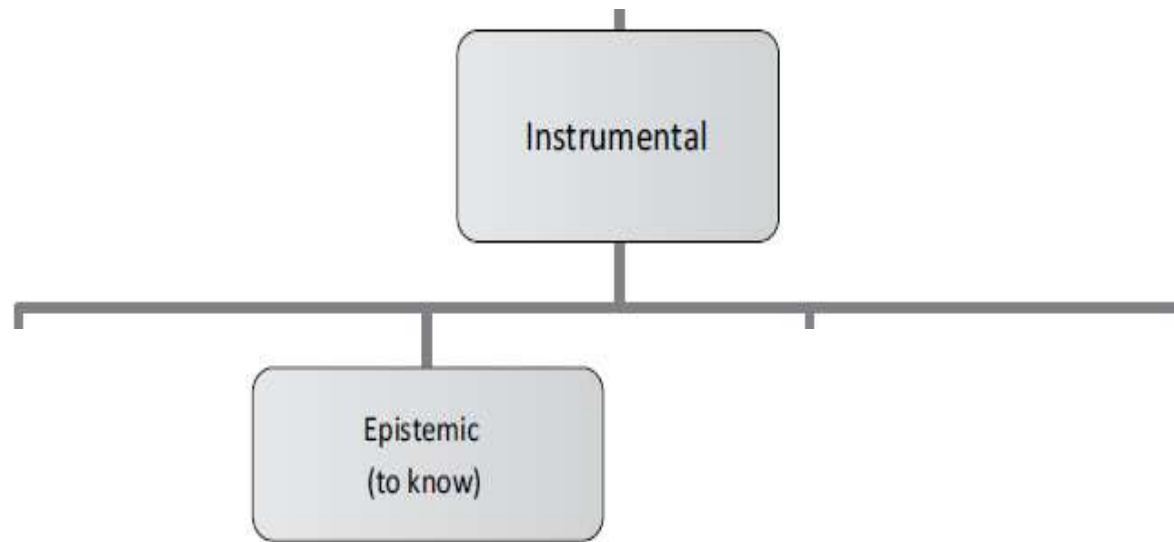


Taxonomy of motives in emotion regulation (Tamir 2016)



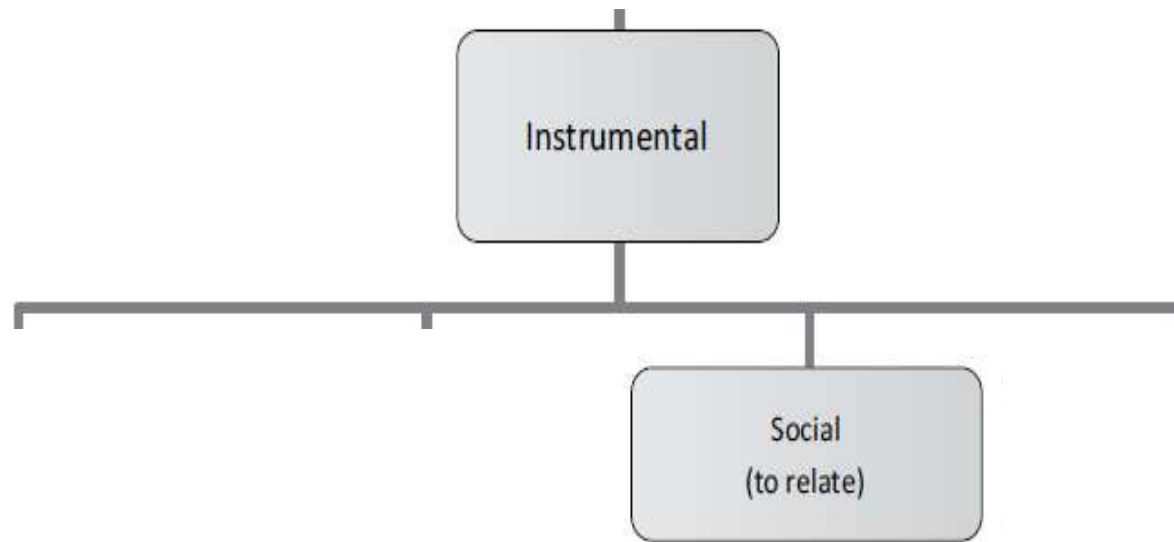
- People want to behave in way that leads to desirable tangible consequences
- Emotions evolve to help goal pursuit
- So people motivated to experience emotions to optimize types of performance

Taxonomy of motives in emotion regulation (Tamir 2016)



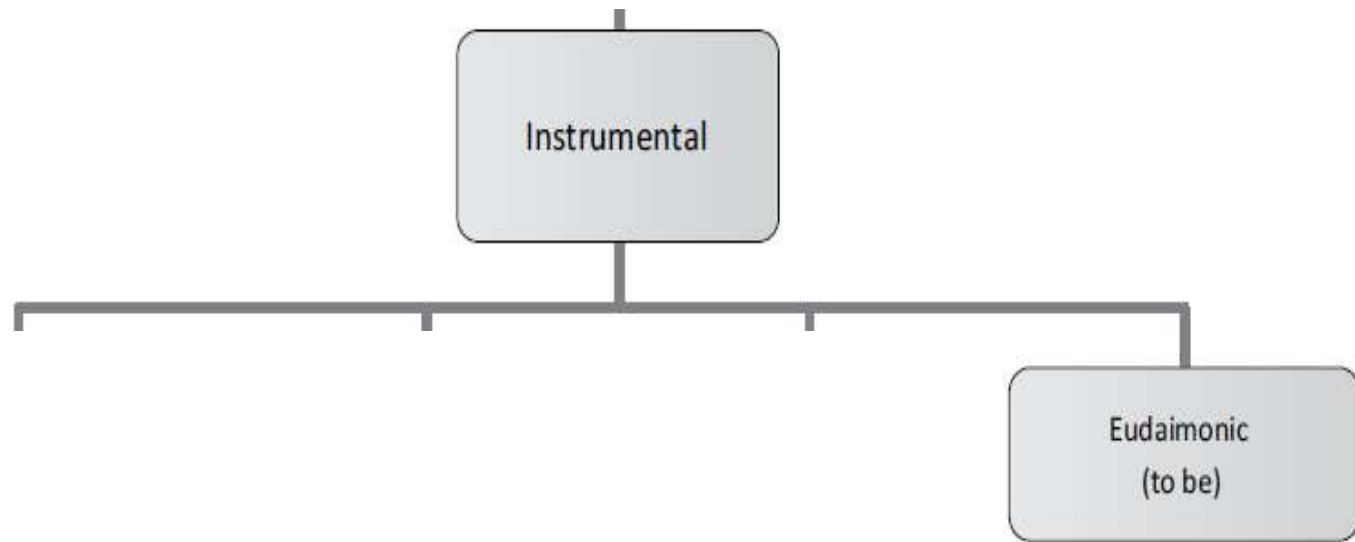
- People want to know what is real about world or self
 - Motivated to feel anger in face of injustice to prove to self they are moral person
 - “I normally feel this way so this emotion makes me feel like myself”
 - (people w/ low self-esteem less motivated to regulate unpleasant emotions because these feel familiar)

Taxonomy of motives in emotion regulation (Tamir 2016)



- Motivation to promote social relationships
 - To influence how others see them (identity)
 - To not cause harm to others
 - To achieve social outcomes (show anger to win at negotiation)

Taxonomy of motives in emotion regulation (Tamir 2016)



- Certain emotions reinforce sense of meaning
- Tamir maps this to promoting sense of competence and autonomy (self-determination theory)
 - Want to feel pleasure from curiosity
 - Go to scary movies to improve mastery over fear-inducing situations

How to regulation emotions



Professor

James Gross

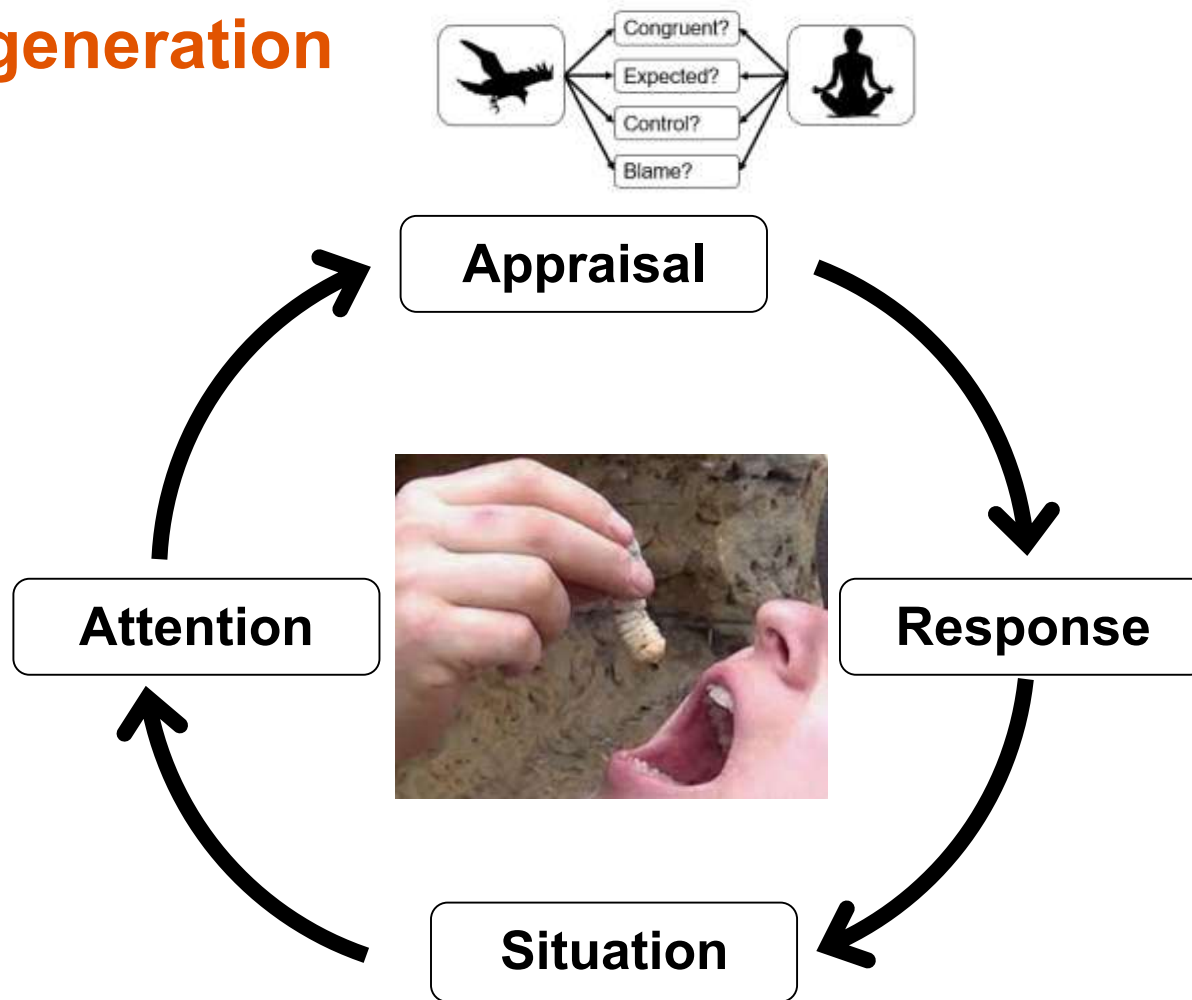
Professor of Psychology and, by courtesy, Professor of
Philosophy

Director, Stanford Psychophysiology Laboratory

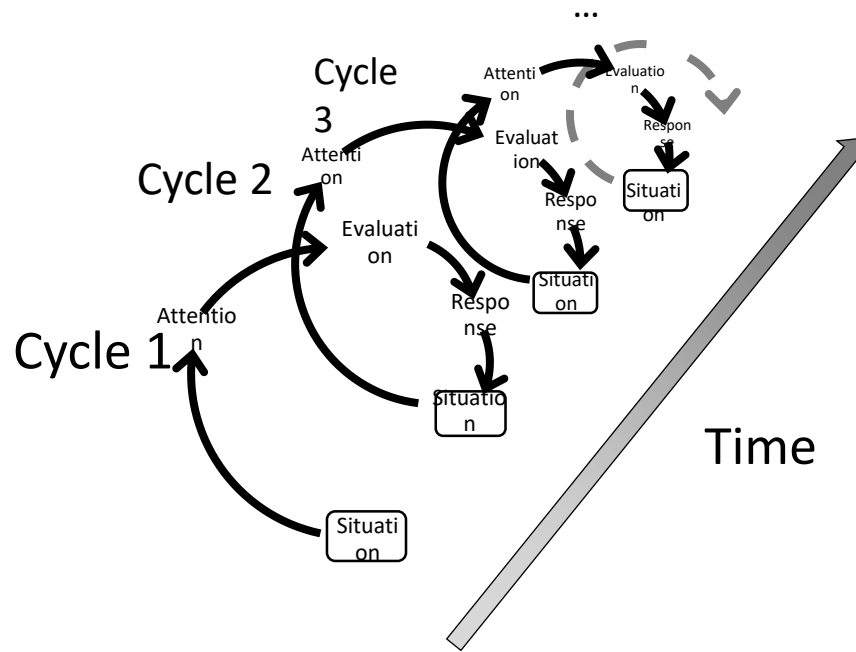
What is emotion regulation?

- **Processes that influence which emotions one has, when one has them, and how one experiences and expresses these emotions**
- **Defined by the activation of a goal to modify the emotion-generative process**
- **May involve regulating one's own emotions or another's emotions**
- **May be used to increase or decrease either negative or positive emotions**

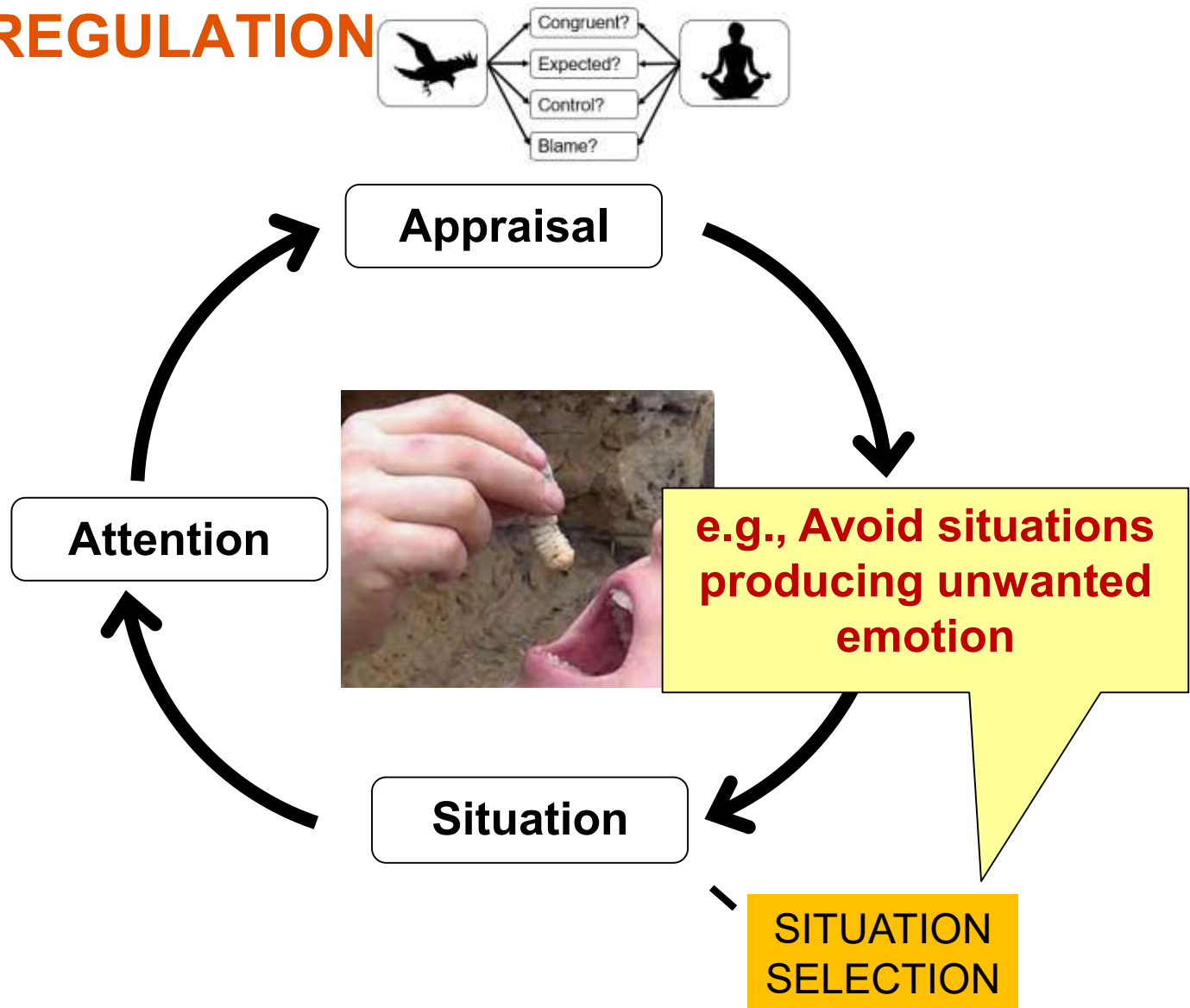
Emotion generation



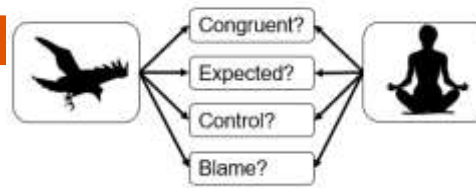
Emotion generation



Emotion REGULATION



Emotion REGULATION



Appraisal

Response

Situation

Change external features of situation to change its emotional impact

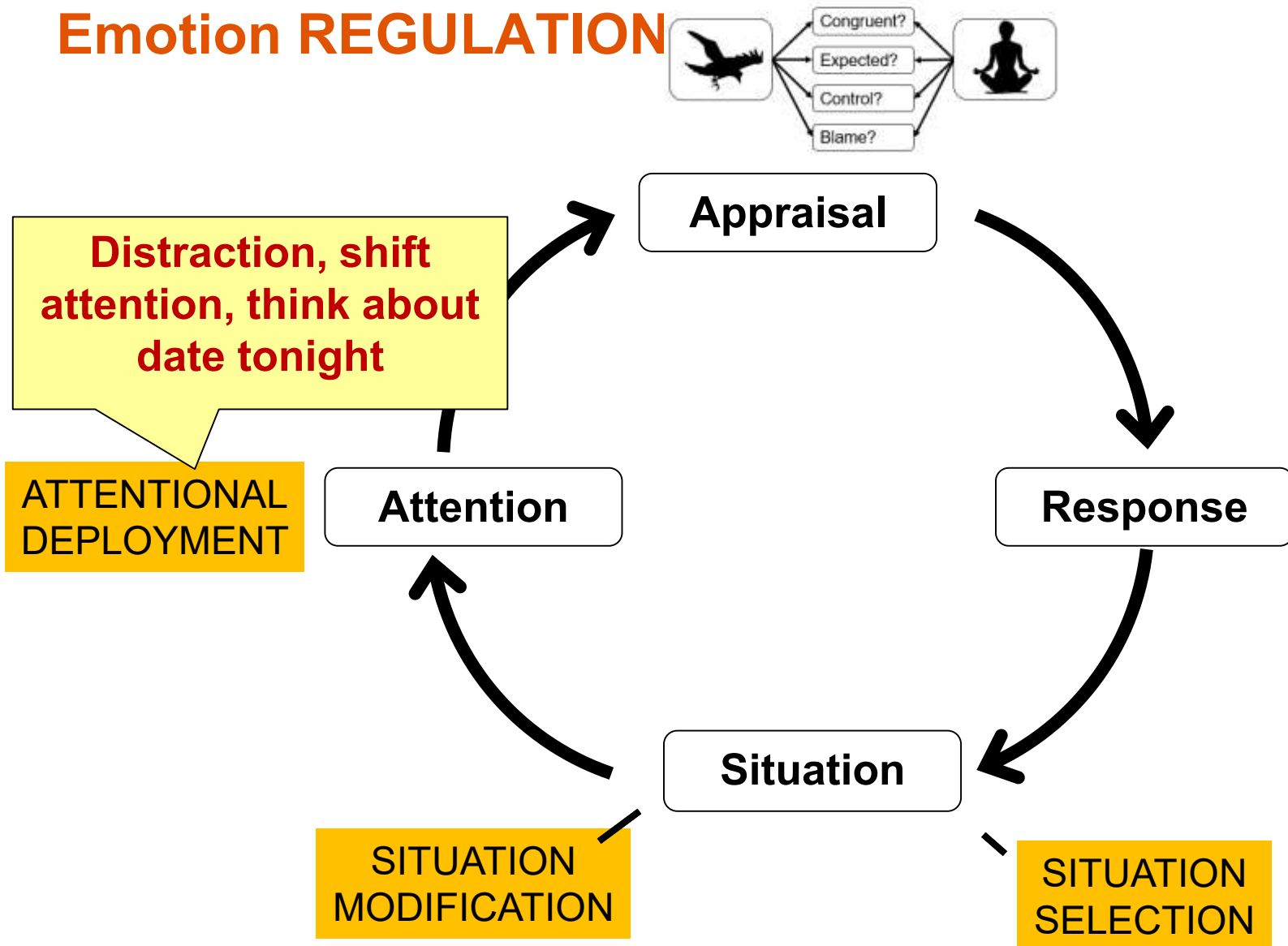
Attention

SITUATION MODIFICATION

SITUATION SELECTION

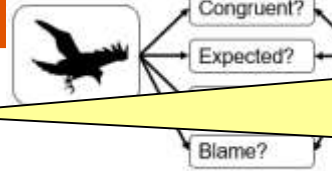


Emotion REGULATION



Emotion REGULATION

REAPPRAISAL



Modify appraisal of situation (cognitive behavioral therapy)

Appraisal



Attention

Response

Situation

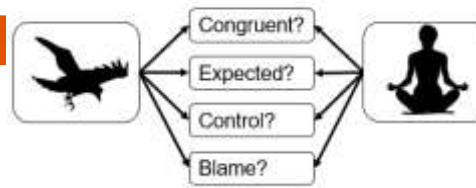
SITUATION MODIFICATION

SITUATION SELECTION

ATTENTIONAL DEPLOYMENT

Emotion REGULATION

REAPPRAISAL



Appraisal

RESPONSE MODULATION

Suppression, Amplification



Attention

Situation

SITUATION MODIFICATION

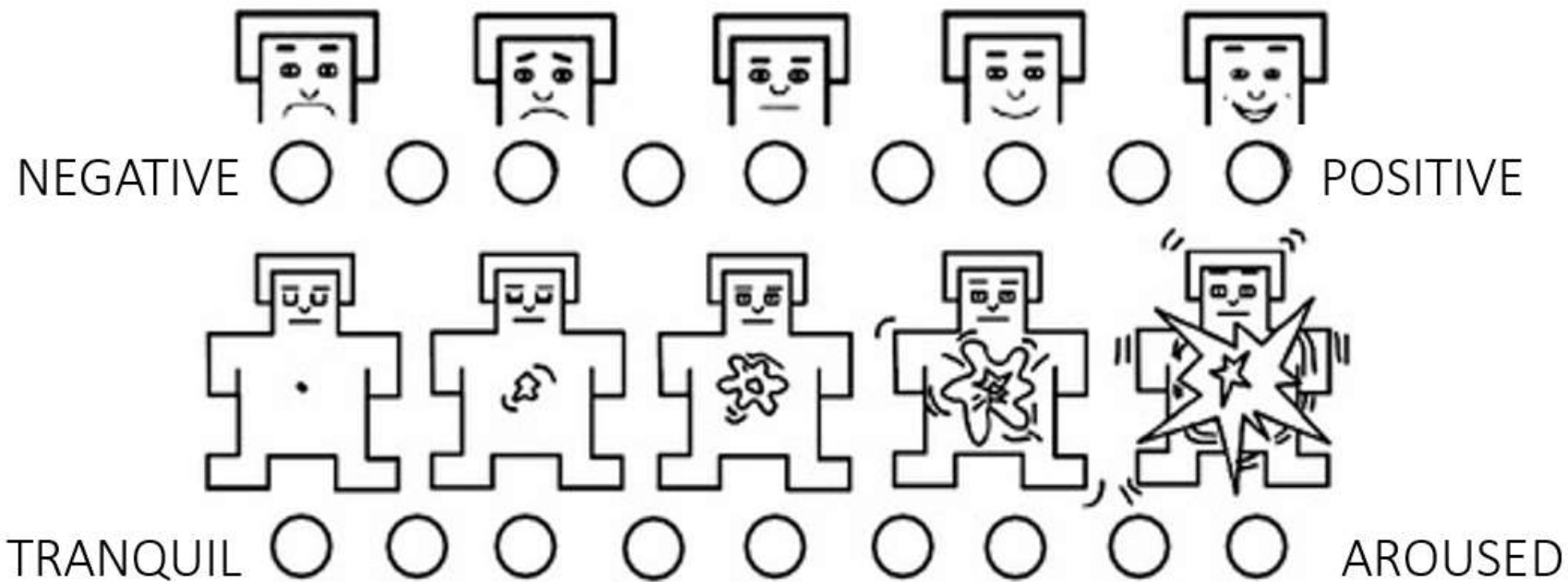
SITUATION SELECTION

ATTENTIONAL DEPLOYMENT

Class Exercise

- **Need 3 volunteers**
- **You will watch an emotion-evoking movie**
- **Won't be filmed (this time)**
- **1pt HW credit if you have Apple watch**



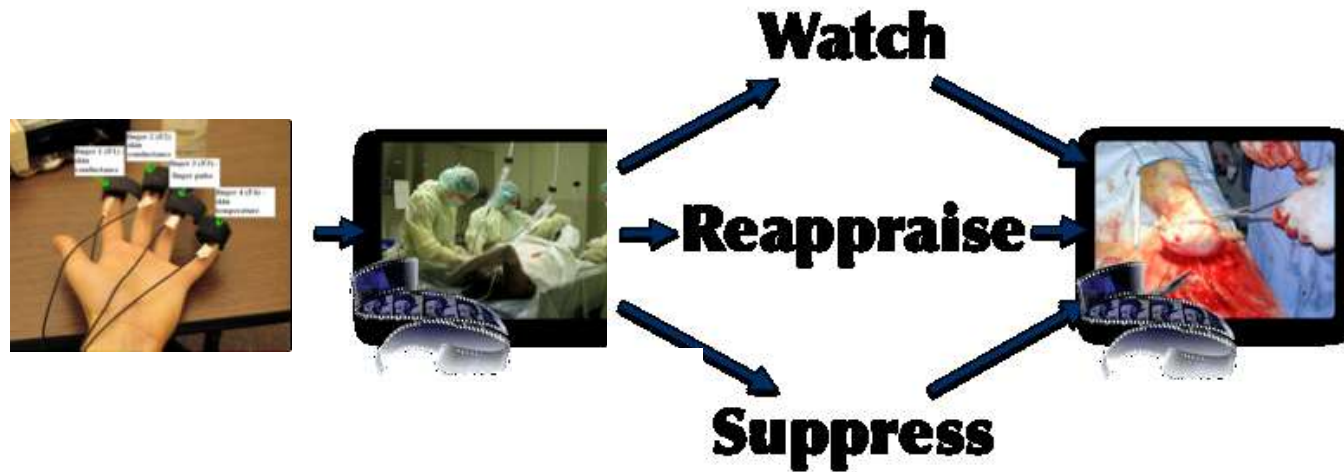


	A	B	C
Valence			
Arousal			

Who more expressive?

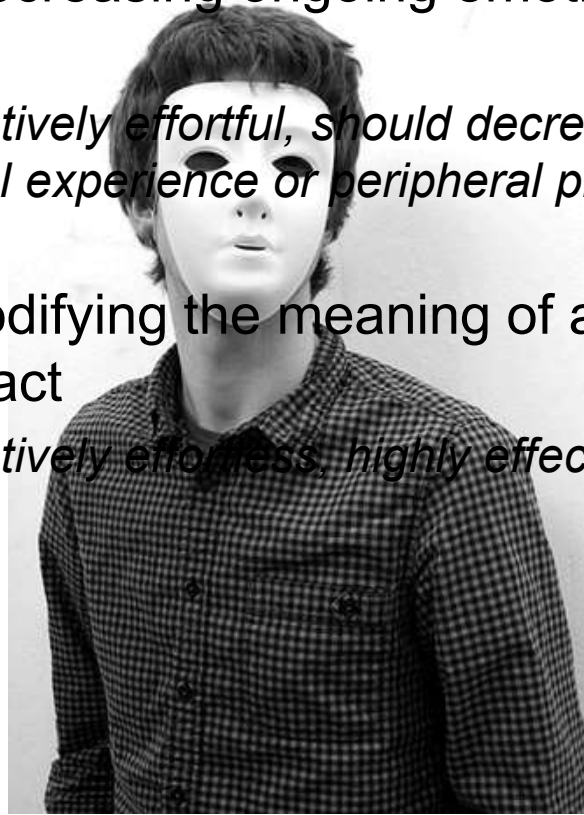
- **A?**
- **B?**
- **C?**

Emotional Suppression Experiment (Gross 1998)



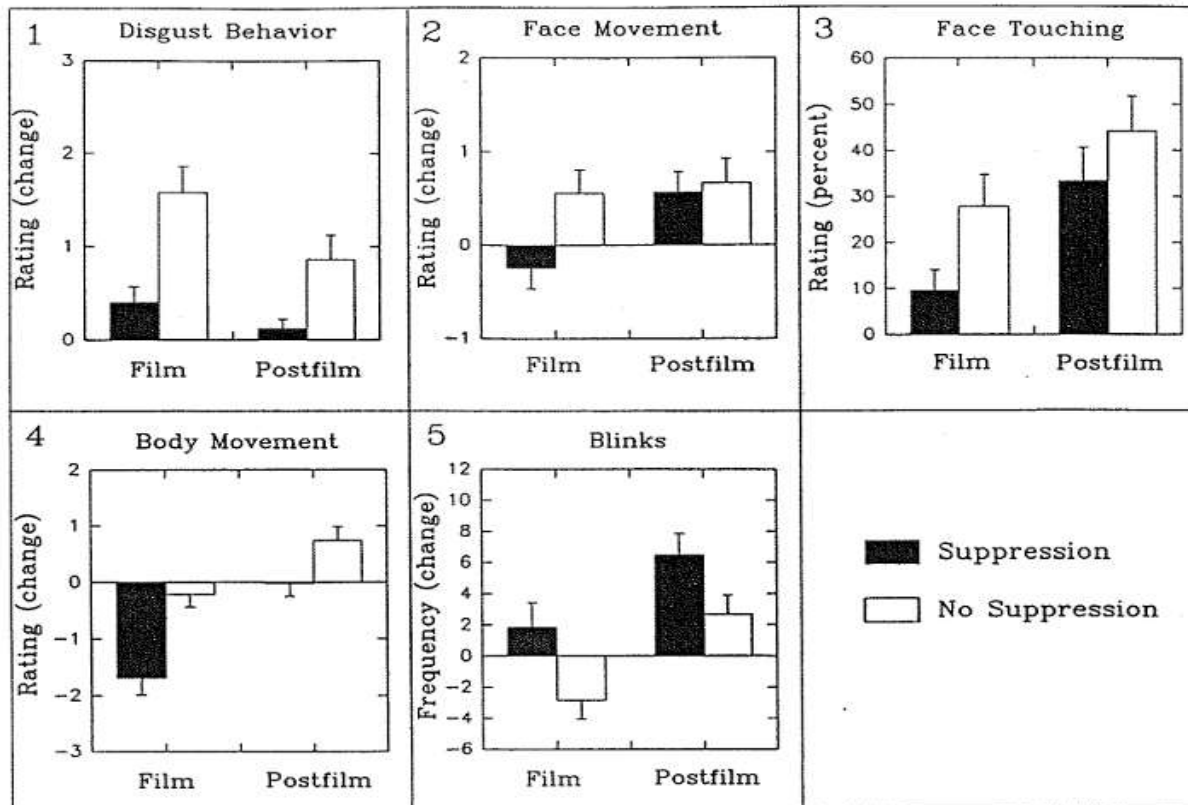
Considered two emotion regulation strategies

- **Suppression**: decreasing ongoing emotion-expressive behavior
 - *Expectation: relatively effortful, should decrease emotional behavior, but not emotional experience or peripheral physiological responses*
- **Reappraisal**: modifying the meaning of a situation so as to decrease its impact
 - *Expectation: relatively effortless, highly effective at shutting down emotion*



Consequences of suppression

- **Expression**
 - Decreased negative emotion-expressive behavior



Consequences of suppression

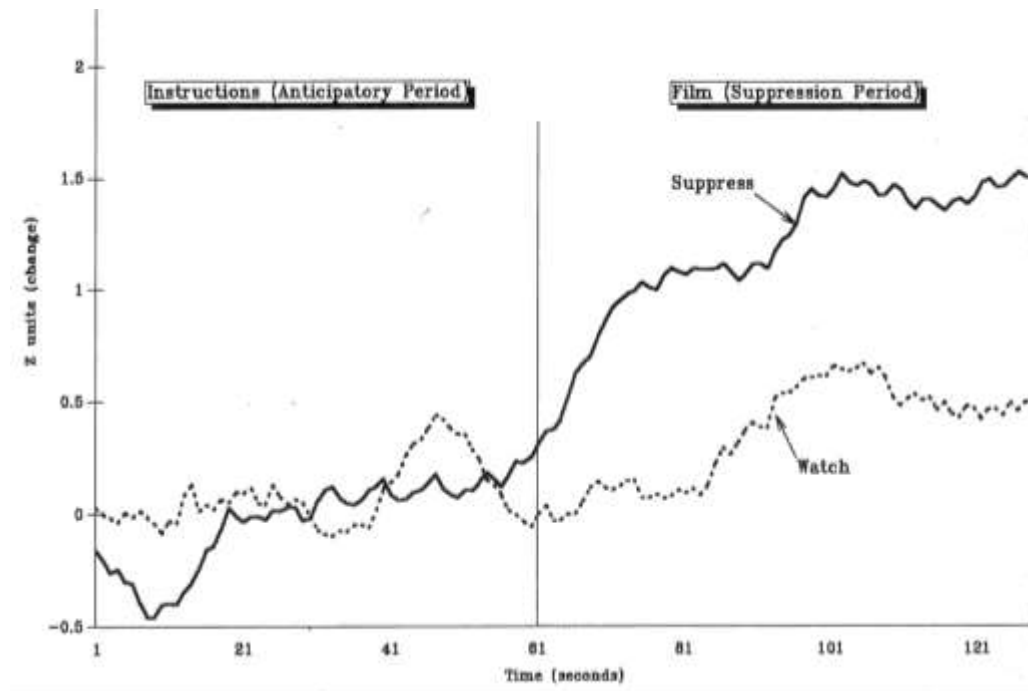
- **Expression**
 - Decreased negative emotion-expressive behavior
- **Experience**
 - No impact on self-reported emotion (still feel intense emotion)
- **Brain**
 - No impact on insula and amygdala
 - Recall these brain regions associated with emotion so suggests still feel intense emotion

Consequences of suppression

- **Expression**
 - Decreased negative emotion-expressive behavior
- **Experience**
 - No impact on self-reported emotion (still feel intense emotion)
- **Brain**
 - No impact on insula and amygdala
- **Physiology**
 - Increase in skin conductance

Consequences of suppression

- **Increase in skin conductance with suppression**
 - Suggests suppression is effortful

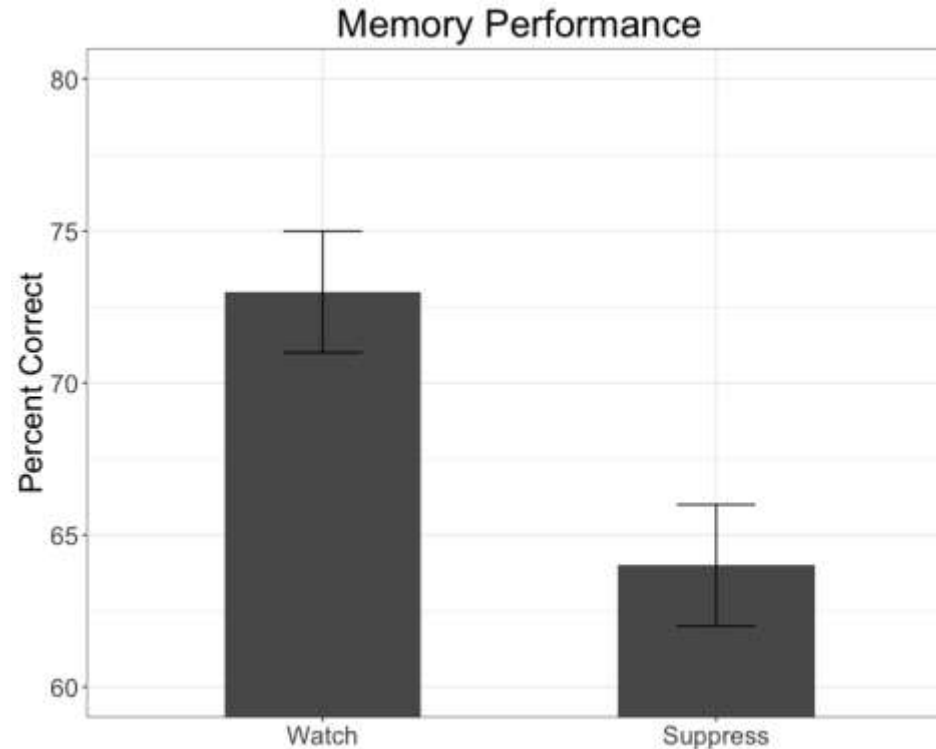


Gross (1993)

Consequences of suppression

- **Expression**
 - Decreased negative emotion-expressive behavior
- **Experience**
 - No impact on self-reported emotion (still feel intense emotion)
- **Brain**
 - No impact on insula and amygdala
- **Physiology**
 - Increase in skin conductance
- **Cognitive costs,**
 - Less memory for material presented during regulation period

Consequences of suppression



Richards & Gross (2000)

Consequences of suppression

- **Expression**
 - Decreased negative emotion-expressive behavior
- **Experience**
 - No impact on self-reported emotion (still feel intense emotion)
- **Brain**
 - No impact on insula and amygdala
- **Physiology**
 - Increase in skin conductance
- **Cognitive costs,**
 - Less memory for material presented during regulation period
- **Social costs**
 - partner blood pressure and partner report of lesser rapport

Correlates of suppression use

- **Affectively, individuals who frequently use suppression have worse mood and more negative emotions than those who use suppression less frequently**
- **Socially, suppression use is associated with less close social relationships**
- **In terms of physical health, suppression use is associated with higher blood pressure**

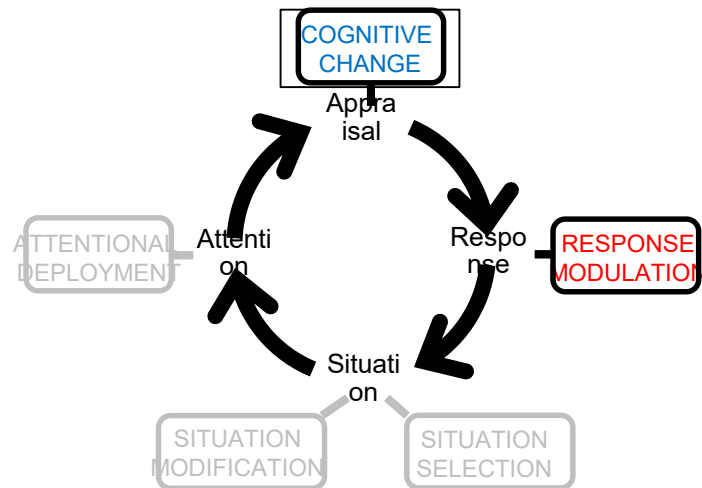


Suppression frequently used individuals experience less positive emotion, more negative emotion, and lower levels of well-being than those who use suppression less frequently

Suppression use is associated with less close social relationships

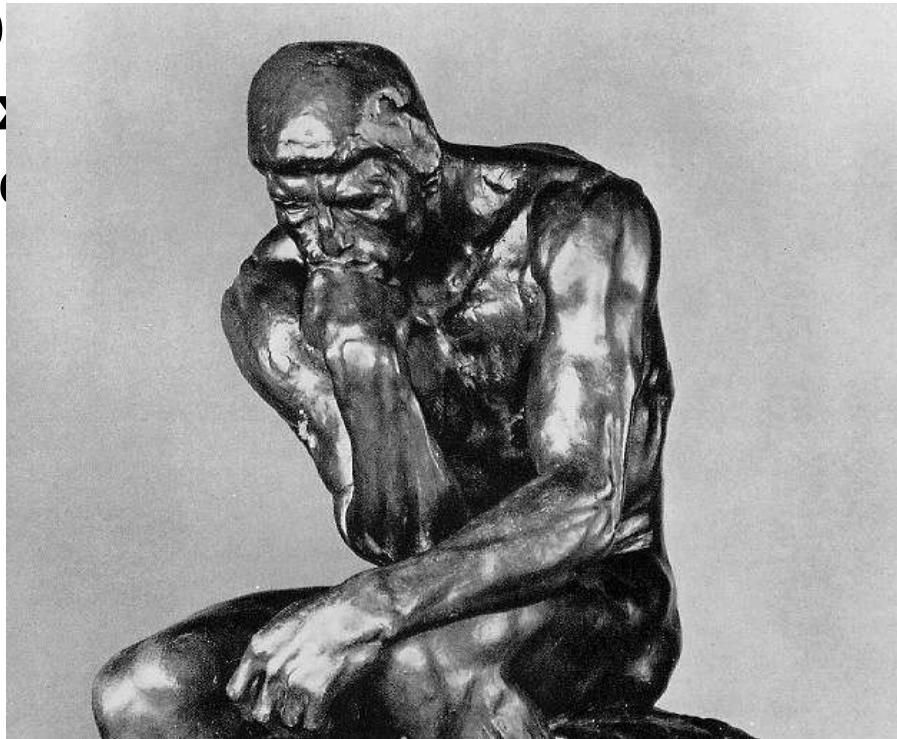
Suppression use is associated with higher blood pressure and cardiovascular disease

Two emotion regulation strategies



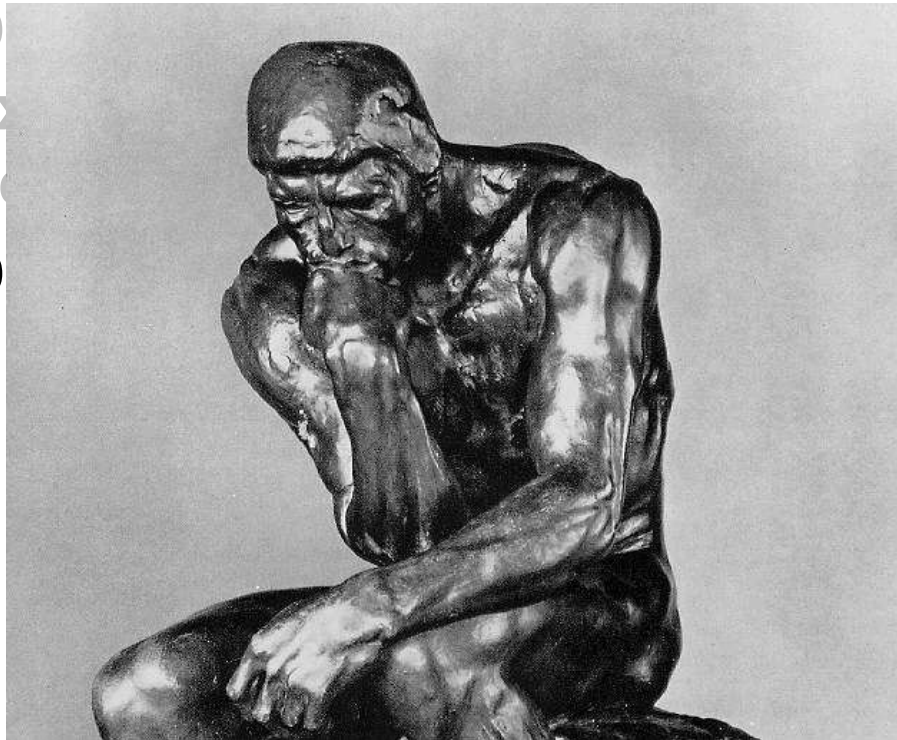
Consequences of reappraisal

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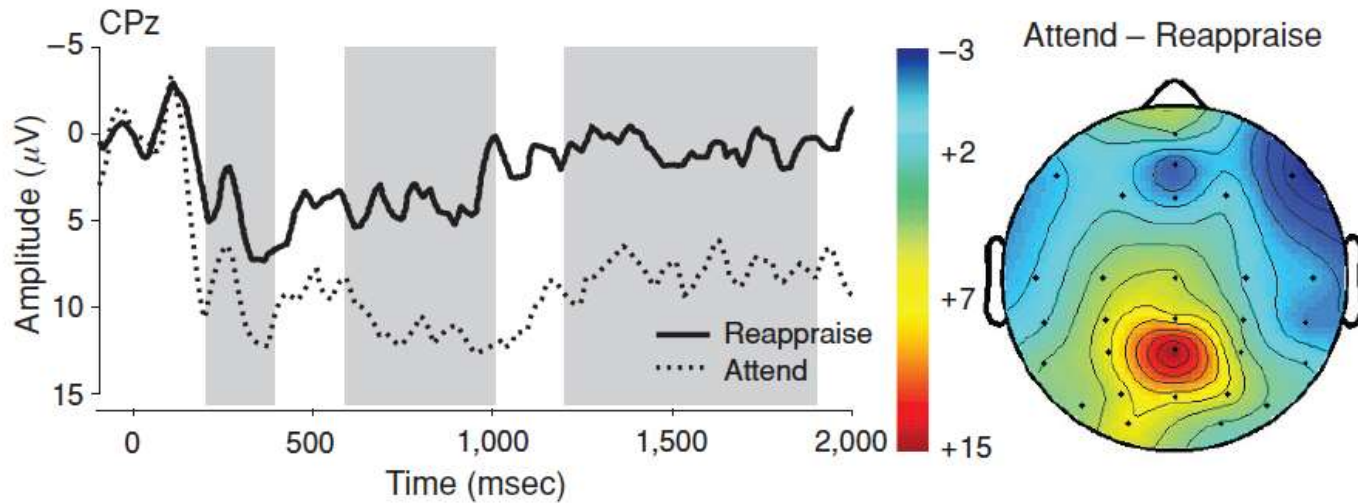
Consequences of reappraisal

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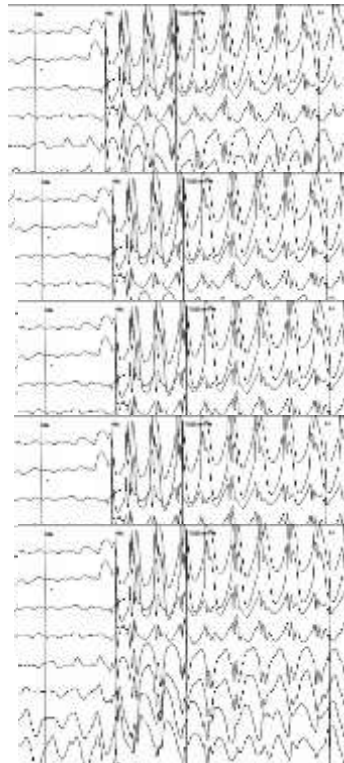
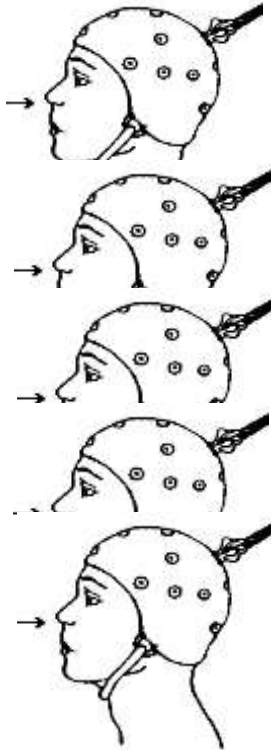
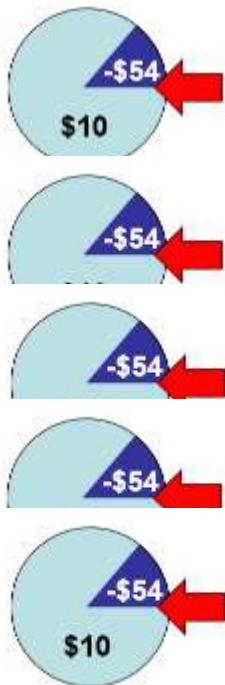
Consequences of reappraisal



LPP is highly sensitive to the emotional intensity of stimuli and is larger for both pleasant and unpleasant than for neutral stimuli

Hajcak & Nieuwenhuis (2006)

Alternative: Event related potentials

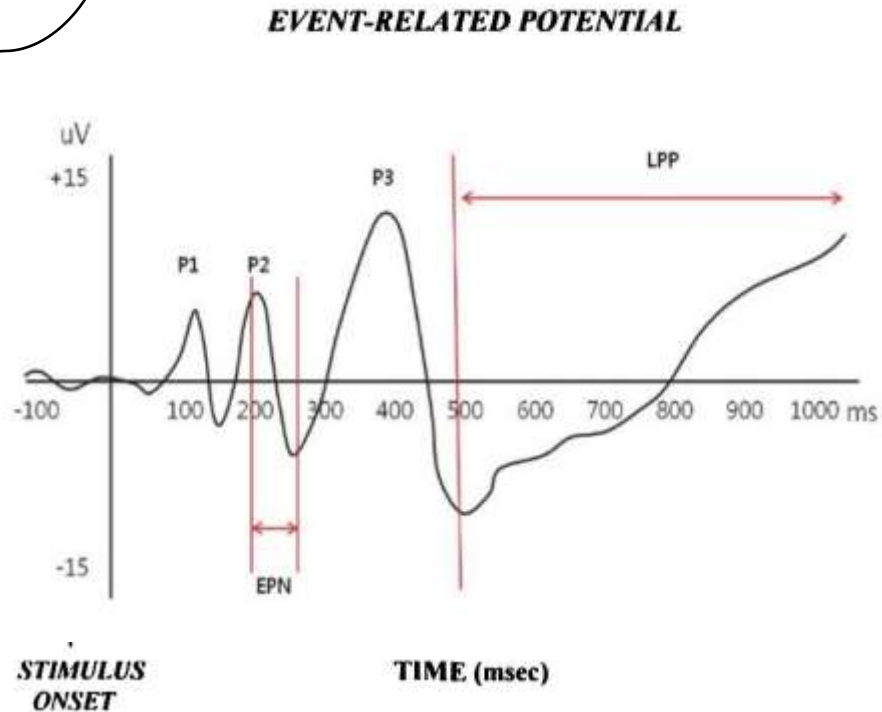
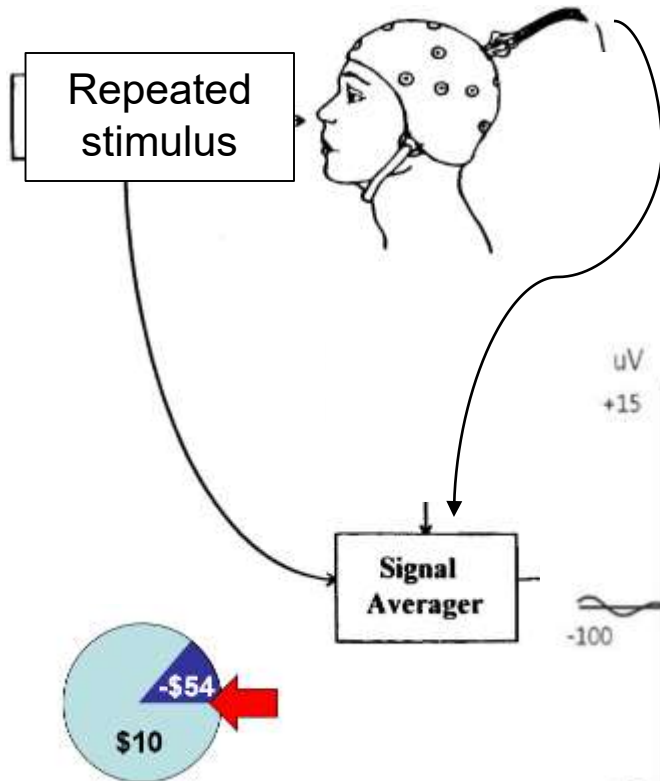


Problem: Lots of stuff going on in our heads

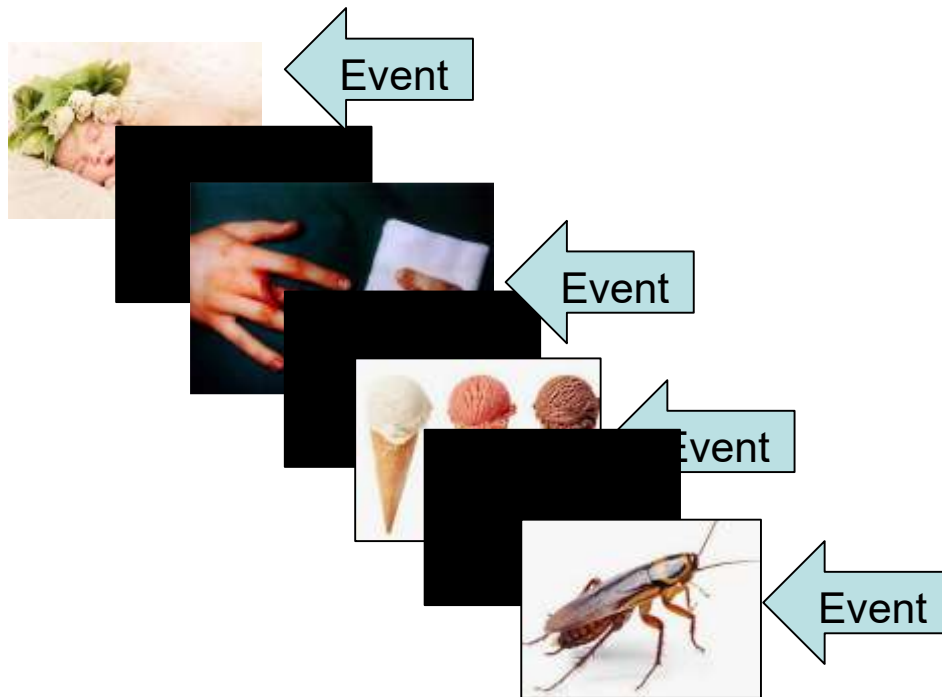
- I want to make good decision
- When is this experiment ending?
- I'm hungry?
- This experimenter is cute!
- Did I turn in my homework?

Alternative: Event related potentials

late positive potential (LPP) is LPP is highly sensitive to the emotional intensity of stimuli and is larger for both pleasant and unpleasant than for neutral stimuli

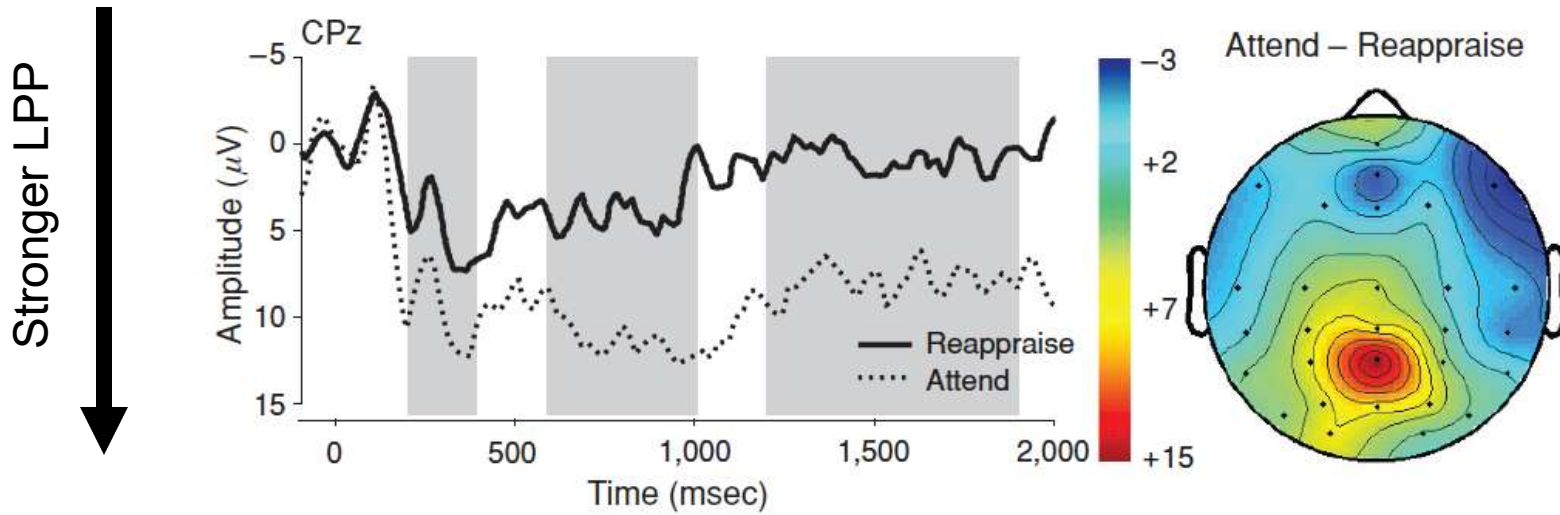


Idea: Transform HR using event-related potentials



- **Told to just attend**
- **Told to reappraise**
 - Reinterpret image so does not evoke emotion
 - e.g., a bloody crime scene could be seen as the place where a murder investigation was finally solved

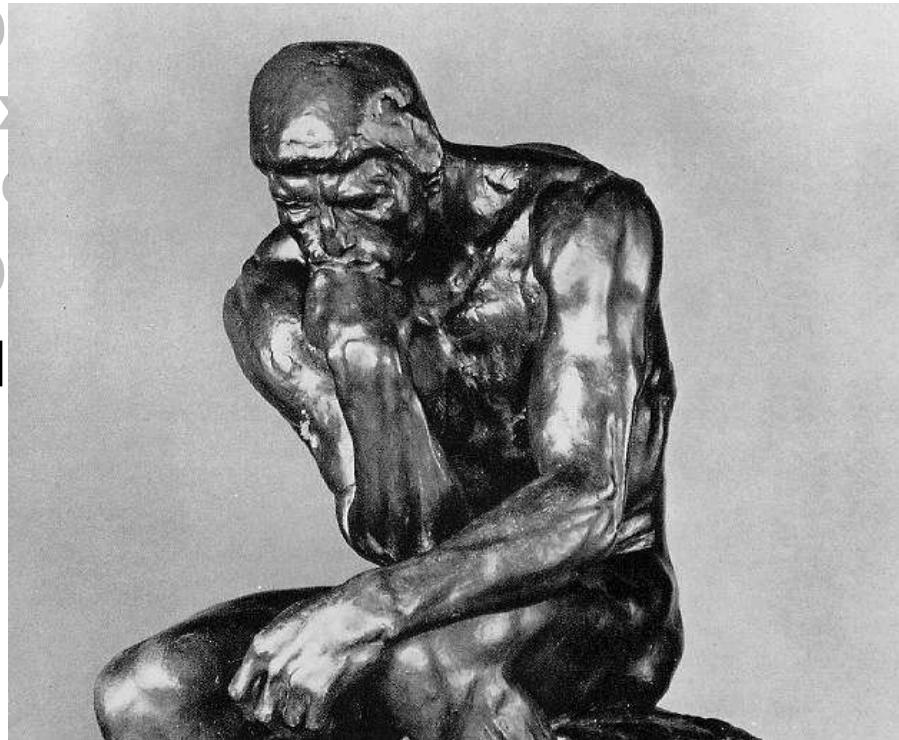
Consequences of reappraisal



Hajcak & Nieuwenhuis (2006)

Consequences of reappraisal

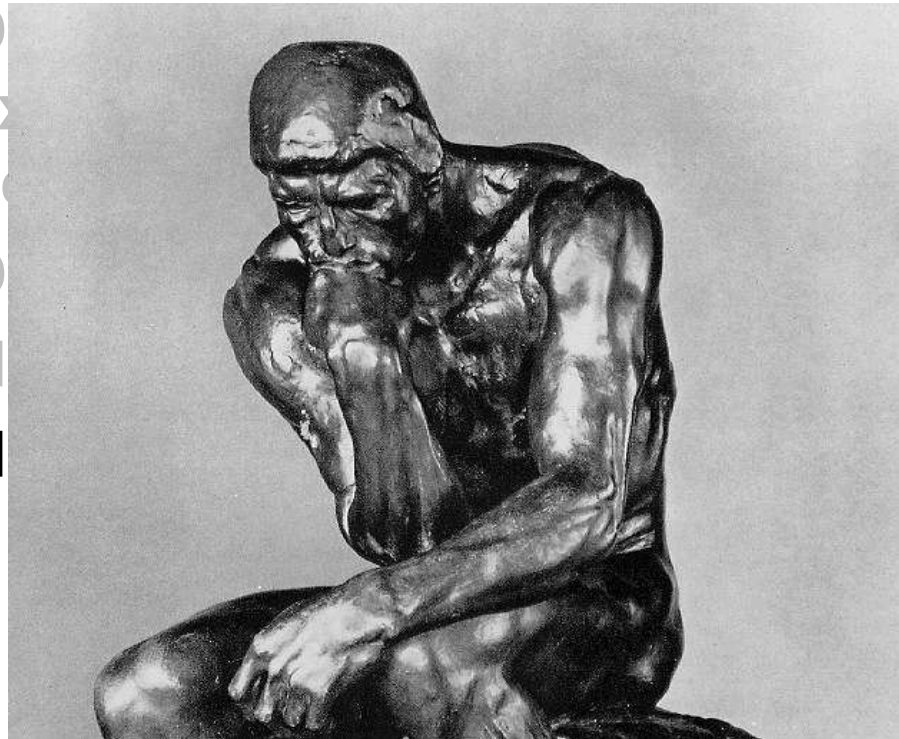
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Consequences of reappraisal

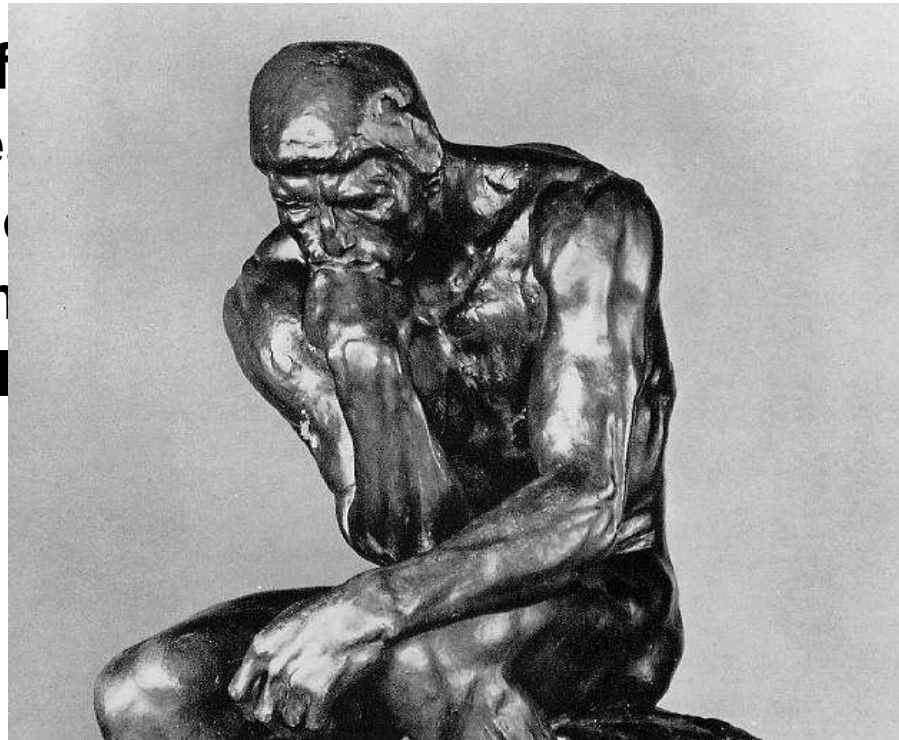
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Correlates of reappraisal

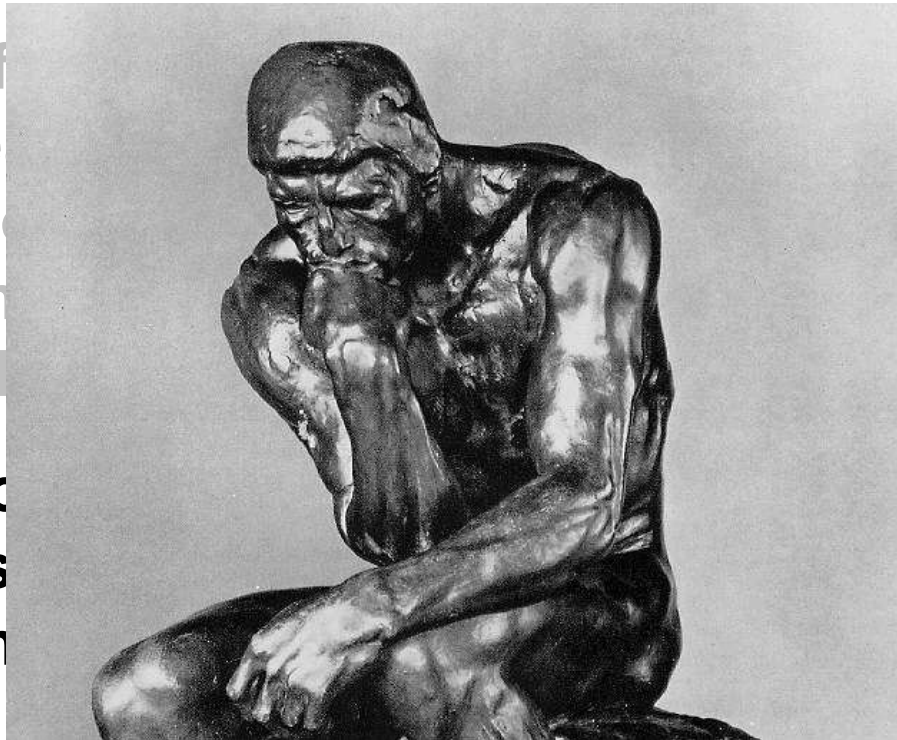
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Correlates of reappraisal

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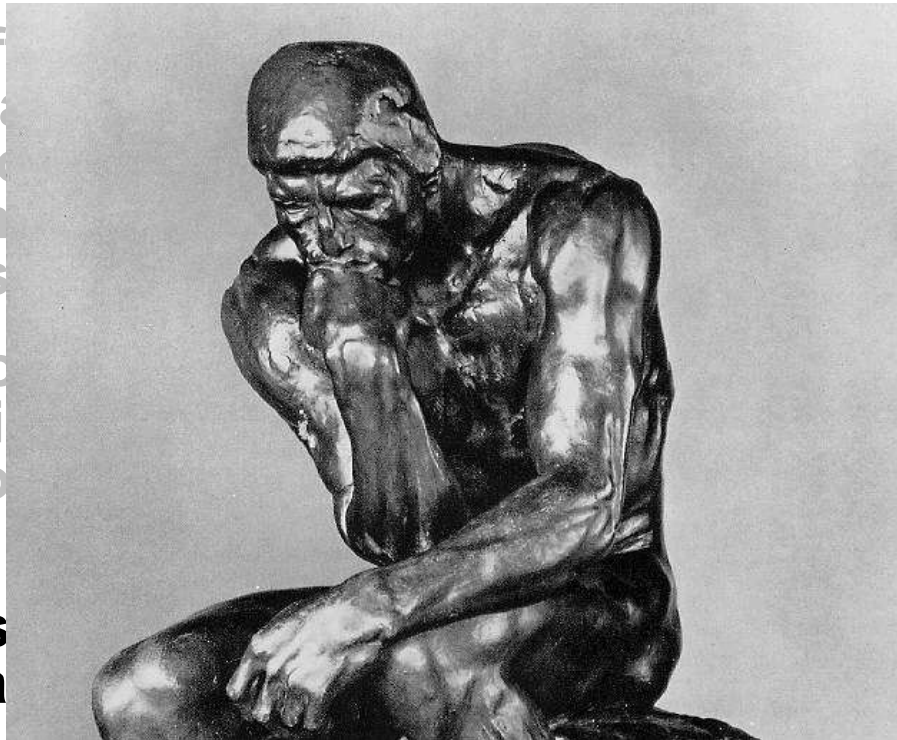


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Correlates of reappraisal

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Examples of Reappraisal in digital age

Strategy Family

Example Strategies

Situation Selection

(seeking / avoiding a situation that one expects will give rise to desired / undesired emotions)

Non-digital examples (from Gross 1998, 2015) [21, 22]

Go to a movie. Avoid a mean co-worker.

Digital examples (reported by participants)

Get immersed in a comforting audio book from childhood.

Block out household and enjoy “me time” by watching Netflix on an iPad with earphones.

Joining Friday-night drinks in Zoom (during lockdown).

Situation Modification

(changing aspects of a situation in order to change its emotional impact)

Non-digital example [21, 22]

Convince a neighbour to tone down a loud party.

Digital examples (reported by participants)

Make a dreary shopping task fun by using Siri to help.

Resolve frustration at not going to the gym by watching an exercise video.

Attentional Deployment

(focusing on or away from emotion-eliciting aspects of a situation in order to gain desired emotion)

Non-digital example [21, 22]

Distract from a depressing work meeting by thinking about vacation plans.

Digital examples (reported by participants)

Check email to disengage from an unpleasant work situation.

Reduce anger by playing a quick phone game.

Smith et al CHI22

Examples of Reappraisal in digital age

Cognitive Change

(reappraising a situation in order to alter its emotional impact)

Non-digital example [21, 22]

Compare one's situation with that of a less fortunate person.

Digital examples (reported by participants)

Search for news about Covid-19 impacts on the economy.

Deep-dive Google searches to combat uncertainty around a particular event.

Response Modulation

(altering an ongoing emotional response or expression towards a more desired one)

Non-digital examples [21, 22]

Use of alcohol, deep-breathing, exercise or social sharing to change how one feels.

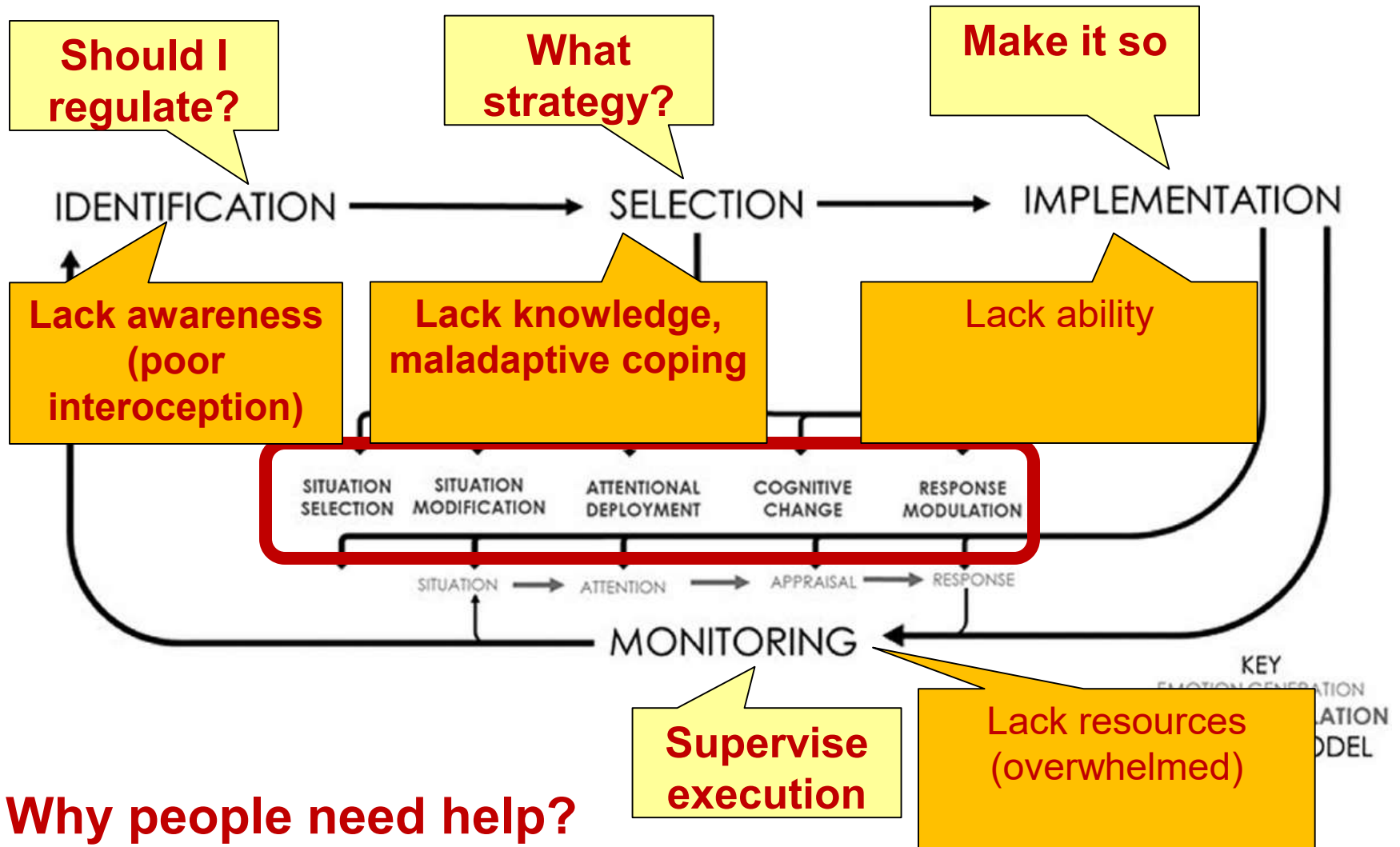
Digital examples (reported by participants)

Listen to music to soothe worries that cooking will not work out.

Prolonging a positive feeling about good news by messaging it to others.

Smith et al CHI22

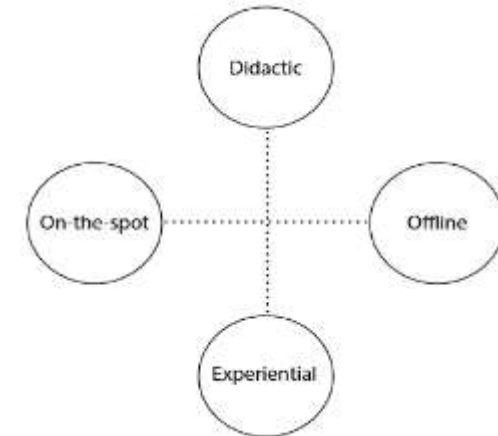
Can Affective Computing Help?



How, when and where should system provide support?

How?

- **Didactic: Give knowledge**
 - Reminders, recommendations
 - Explanations to build cognitive understanding of how, why, where, when specific strategies can be used
- **Experiential: Guide an experience**
 - Real-time Biofeedback
 - Game where get exposed to emotional experiences to practice skills
 - Subtle feedback to shift emotional state

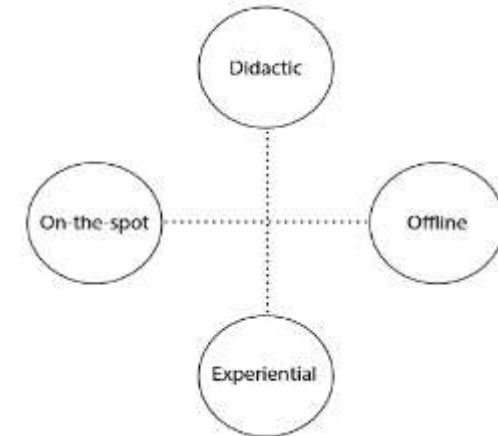


Slovak et al. 22 –recommended reading

How, when and where should system provide support?

When/Where?

- **Offline:**
 - Emotion regulation training
 - Reflection on tracked emotional data
 - Hope this transfers to real world
- **On the spot**
 - train emotion regulation strategies during naturally occurring emotional situations (e.g. stressful events in daily life)
- **Experiential learning sits in between**



Slovak et al. 22 –recommended reading

Virtual interactive interventions for reducing risky sex (Miller et al., 2012)

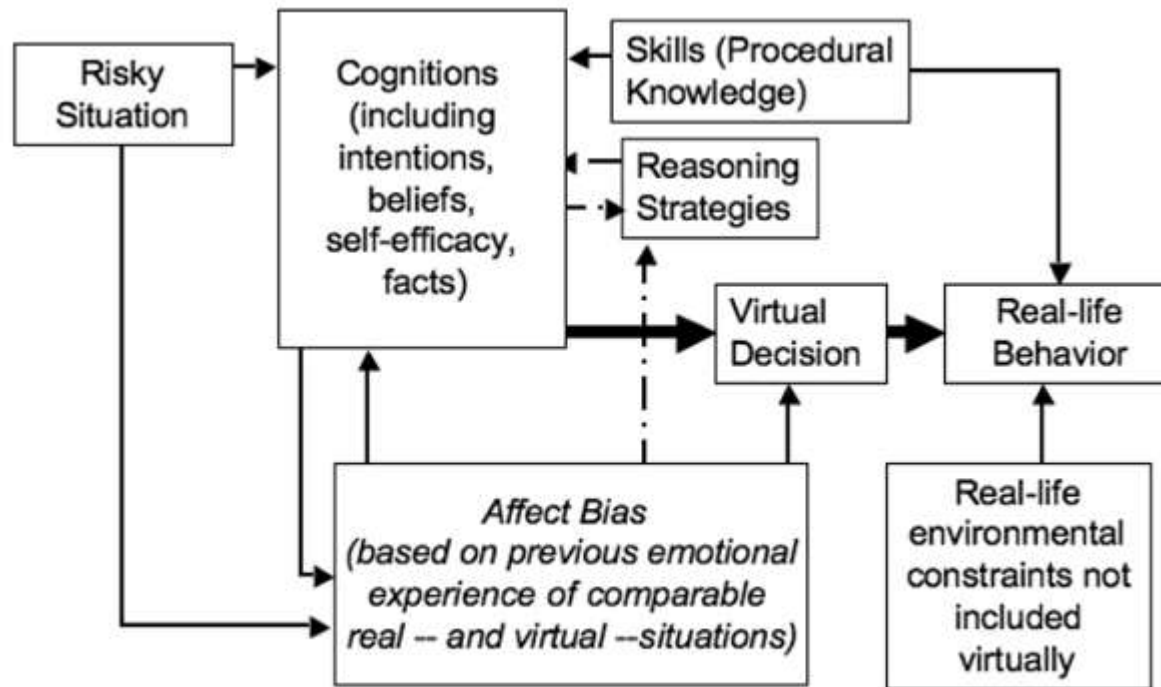
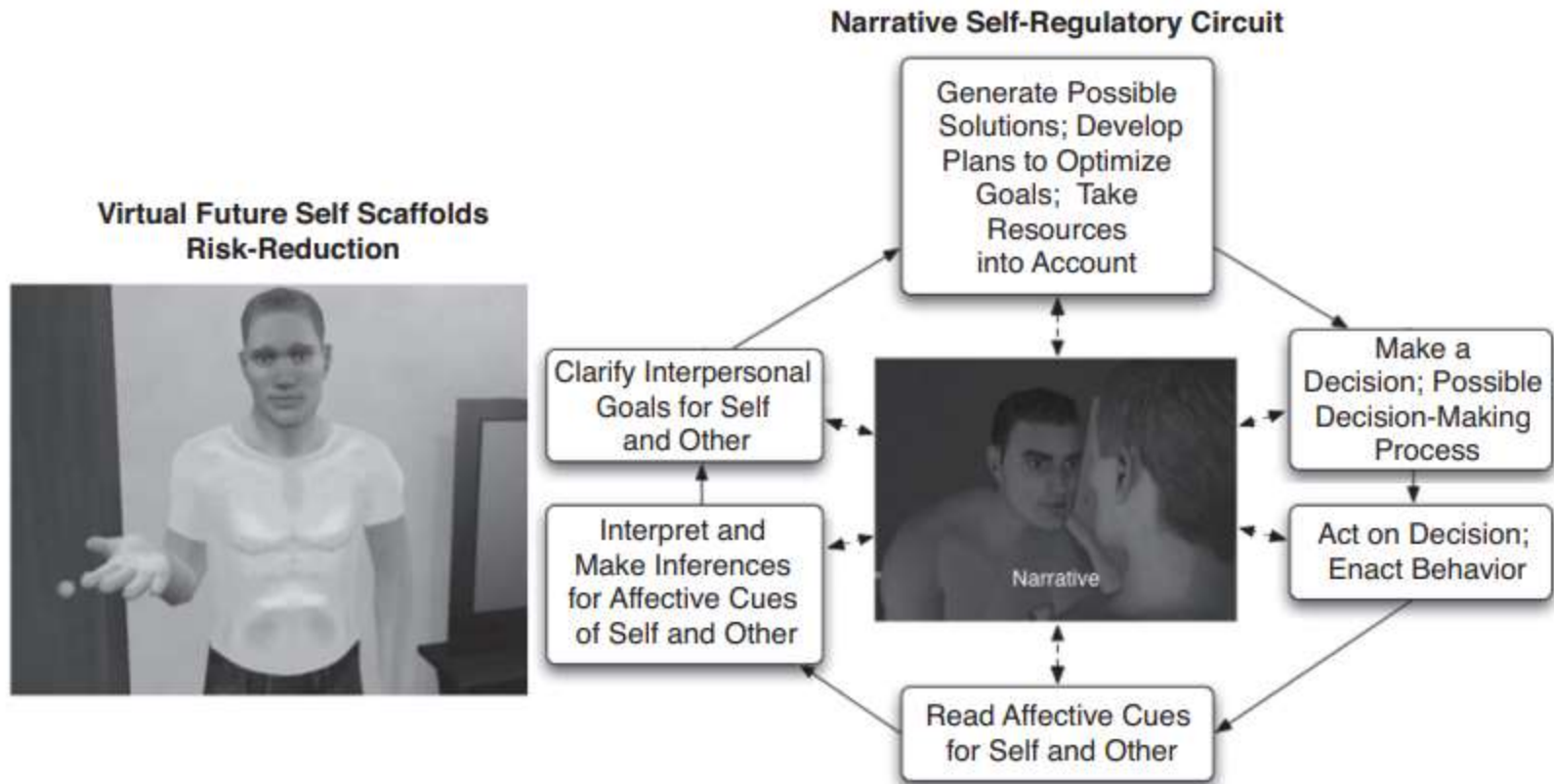


Figure 5.1 SOLVE Conceptual Model for reducing sexual risk taking

Virtual interactive interventions for reducing risky sex (Miller et al., 2012)

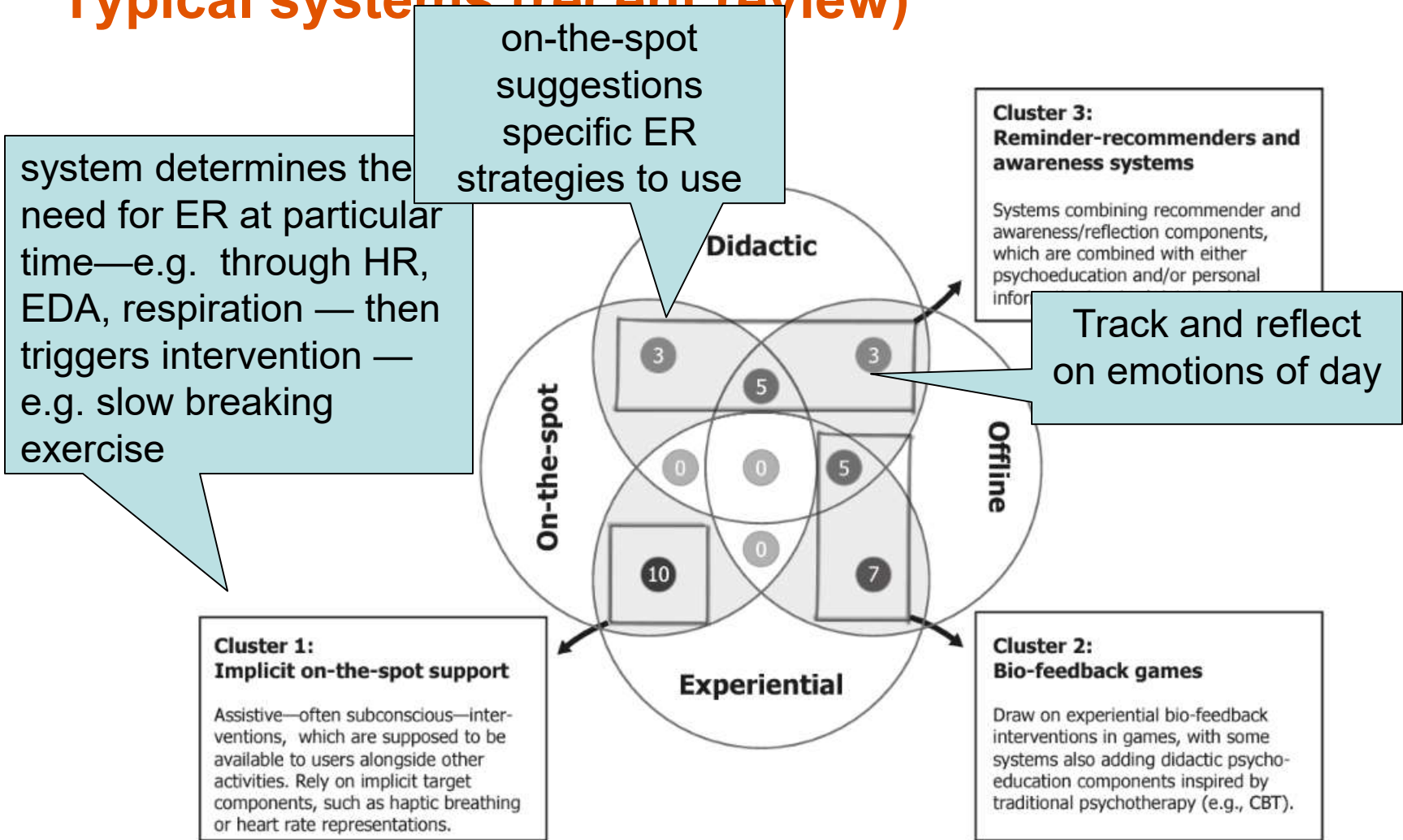


Virtual interactive interventions for reducing risky sex (Miller et al., 2012)



Participant's avatar, aged few years, helps user make decisions "because your behavior effects me"

Typical systems (recent review)



Slovak et al. 22 –recommended reading

Case study



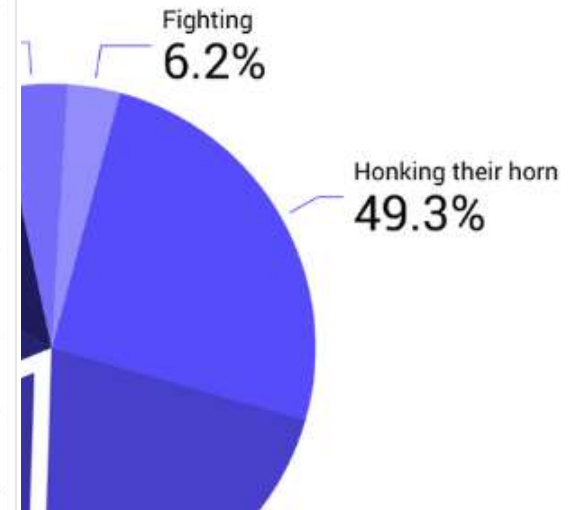
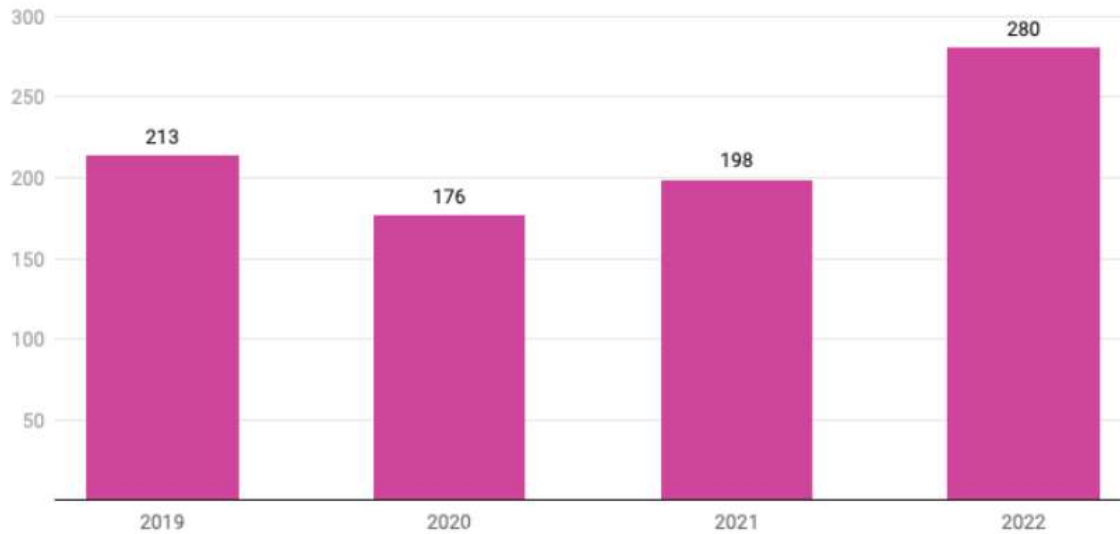
Tesla driver smashes cars with pipe on California freeway

[Visit](#)

Case study

In the past year, have you witnessed in any of the following activities while driving:

Road rage reports in Los Angeles, Jan. 1-April 30



Extreme Road Rage Epidemic: Los Angeles is the No. 1 City in America for Vehicle Violence.

Case study

- **Cars have advantages for emotion recognition**
 - Have power and space to carry hardware
 - Person seated and (mostly) looking in same direction



Hernandez et al 2014

Case study

- **Cars have advantages for emotion recognition**
 - Have power and space to carry hardware
 - Person seated and (mostly) looking in same direction
- **Emotion impacts variety of behavior**
 - Aggressive driving: Anger +
 - Driving performance: mixed
 - Road element localization: Anger → slower to detect hazards
 - Reaction time: Anger +, Happy+
 - Risk perception: mixed
 - Risk taking: Anger+
 - Subjective Safety: mixed

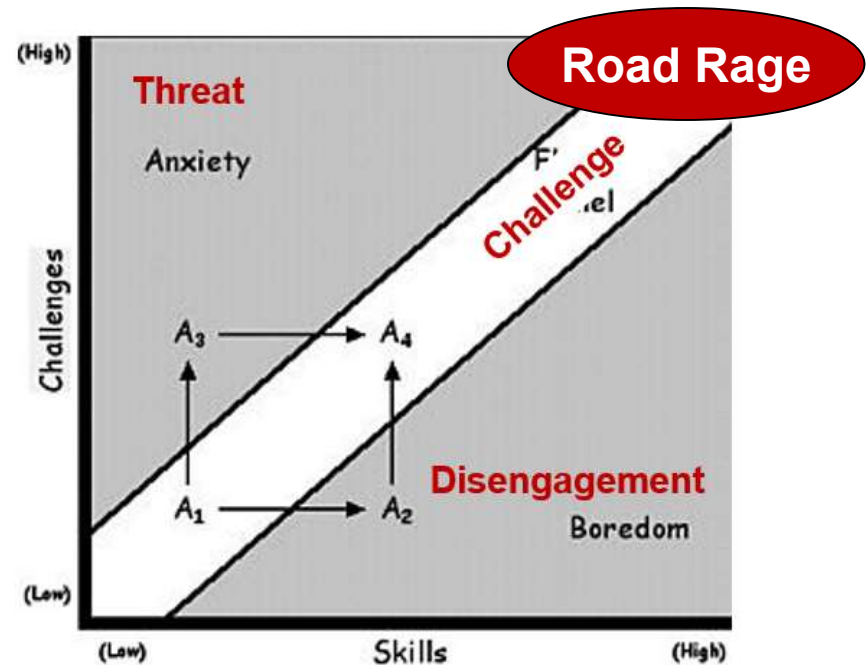
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Emotional Models of driving performance



Dimensional models

Suggests moderate arousal may be best



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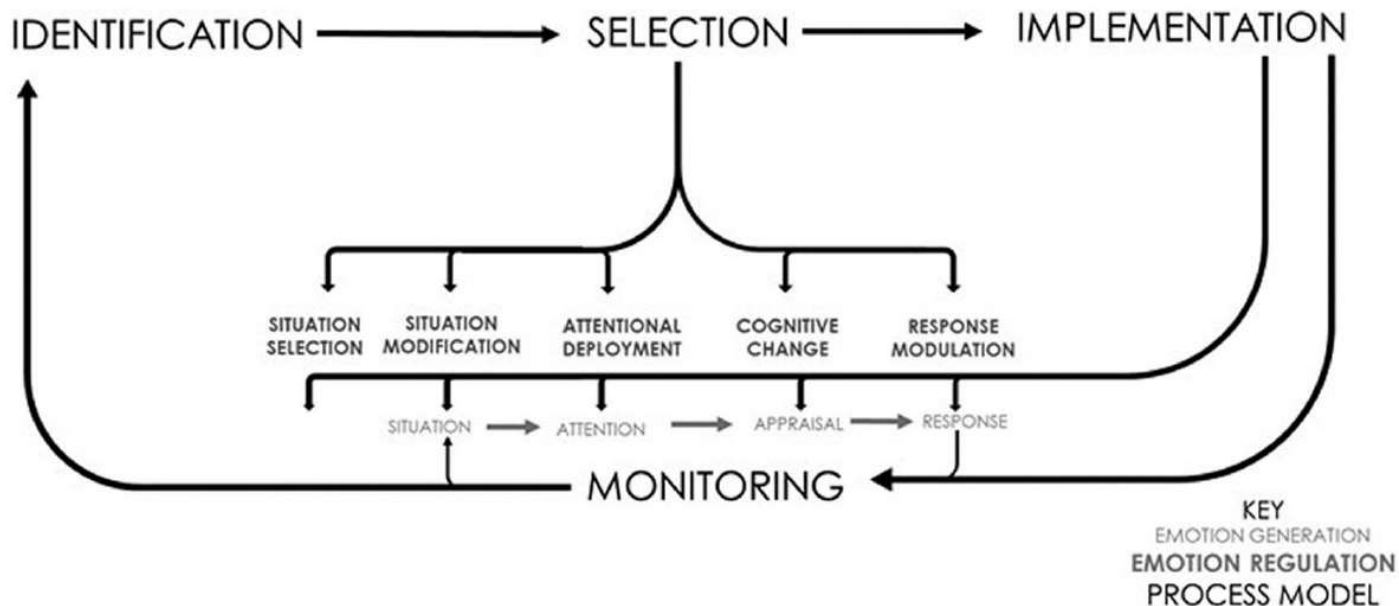
Triggers of emotion in cars

	Negative Emotions	Positive Emotions
Driving Behavior, Traffic	Braun et al. 2018a; Burns & Katovich 2003; Jeon & Walker 2011; Mesken et al. 2007; Zepf et al. 2019	
Environment	Braun et al. 2018a; Burns & Katovich 2003 Mesken et al. 2007; Wurhofer et al. 2015	Braun et al. 2018a; Zepf et al. 2019
Interface	Zepf et al. 2019	
Near Accident	Braun et al. 2018a; Jeon & Walker 2011; Underwood et al. 1999	
Own Performance	Braun et al. 2018a; Zepf et al. 2019	Braun et al. 2018a
Personal Interaction	Jeon & Walker 2011	Braun et al. 2018a; Jeon & Walker 2011
Time Constraints	Burns & Katovich 2003; Jeon & Walker 2011	
Vehicle Performance	Braun et al. 2018a	Braun et al. 2018a; Zepf et al. 2019

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Regulation approaches

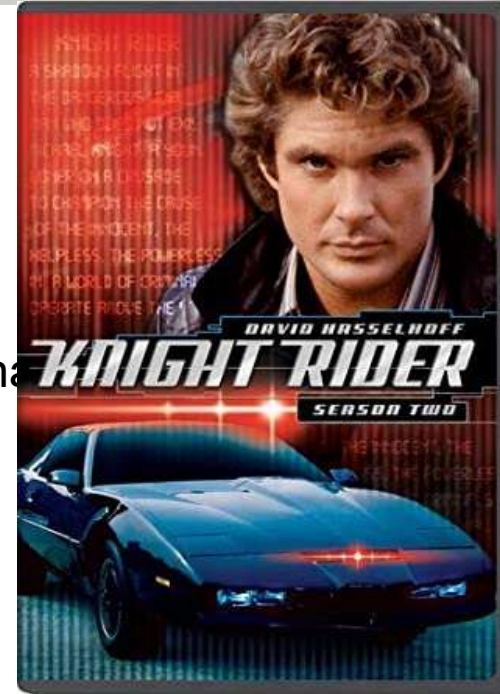
- **Adaptive Music**
 - Play calming music → + driving behavior, but some habituation
- **Where does this fit?**



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Regulation approaches

- **Adaptive Music**
 - Play calming music → + driving behavior, but some have
- **Ambient light**
 - Blue light lowers anger and blood pressure
- **Empathetic Speech**
 - Matching voice arousal w/ driver can improve performance (Nass et al 2005)



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Regulation approaches

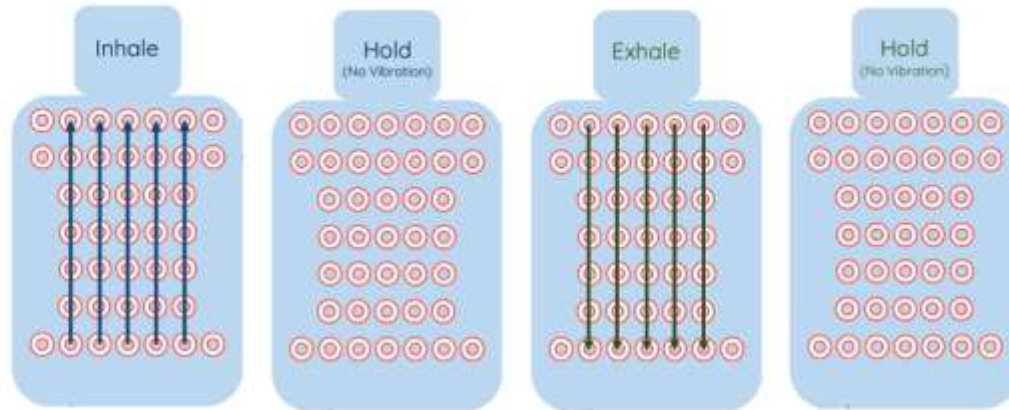
- **Warnings**
 - “Calm down...”
- **Relaxation techniques**
- **Biofeedback**
- **Temperature control**

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Regulation approaches

- **Biofeedback for deep breathing (Pareds et al 2018)**
 - Vibration patterns help people perform coordinated movements

Haptic System



Voice System



Fig. 2. Intervention design. Top row: Haptic system—car seat back-rest with 41 vibrotactile motors. Guidance patterns: Inhale (swipe up) + Hold (no-vibration) + Exhale (swipe down) + Hold (no-vibration). Bottom row: Voice system—speaker. Guidance pattern: "Breathe in" + Hold (Silence) + "Breathe out" + Hold (Silence).

Change the car

- **Corrective headlights to help with emotion-induced loss of peripheral vision**
- **Communicative paint: Changing color of car to warn other drivers to keep distance**
- **Emotion-aware GPS**
 - Choose route to reduce stress (Pfeging et al 2014)
 - Pick challenging backcountry route for driver in “adventurous” state

Summary

- **Why do people regulate emotion?**
 - Hedonic
 - Instrumental
- **How do people regulate emotion?**
 - Gross Process model of emotion regulation
- **How can affective computing help?**

Next time

- **Enjoy long weekend**
- **Wednesday, guest lecture, Gale Lucas**