THE EMOTIONAL APPROACH

OVERVIEW

1. Definition of emotion
2. Theories of emotion
3. Emotions and evolution: Basic emotions and their disorders
4. Emotions and neuroscience
5. Emotions and cognition
6. Emotions and artificial intelligence
7. Evaluation

DEFINITION OF “EMOTION”

WHAT IS AN EMOTION?

- Davidson, Scherer and Goldsmith (2003):

- Emotion: A relatively brief episode of coordinated brain, autonomic and behavioral changes that facilitate a response to an external or internal event of significance for the organism.

- Feeling: The subjective experience of emotion

- Mood: A diffuse affective state of lower intensity but longer duration than emotions.

WHAT IS AN EMOTION?

- Dolan (2002): Three characteristics distinguish emotions from cognitive processes:

1) Embodied
2) Global
3) Hard to control

THEORIES OF EMOTION

- JAMES-LANGE
- CANNON-BARD
- COGNITIVE APPRAISAL
- EMERGENCE SYNTHESIS

THE JAMES LANGE THEORY

In an nutshell: An emotion is a result of a causal chain, that has three stages:

(1) Significant event

External: A mad dog

Internal: A sudden thought of your paper, due today

(2) Physiological changes

Adrenaline and cortisol pumping through your bloodstream

Heartbeat rate increases

(3) Interpretation

What you make of the physiological response you are experiencing

"I'm scared!"

_____

Emotion

THE CANNON-BARD THEORY

Cannon and Bard noticed some important shortcomings of the James-Lange theory:

a) Physiological changes can occur, without causing an emotion

b) Same physiological state can be interpreted in more than one way, so there is no direct causal connection between arousal and interpretation

They then propose a simpler model, on which emotions and physiological changes are simultaneously caused by a significant event:

(1) Significant event

_____

Physiological changes and emotion

THE COGNITIVE APPRAISAL THEORY

Schachter & Singer, 1962

Emotions arise in a context

Interpretation of the physiological changes is dependent on the context

THE EMERGENCE SYNTHESIS APPROACH

LeDoux 1996; Russell 2003

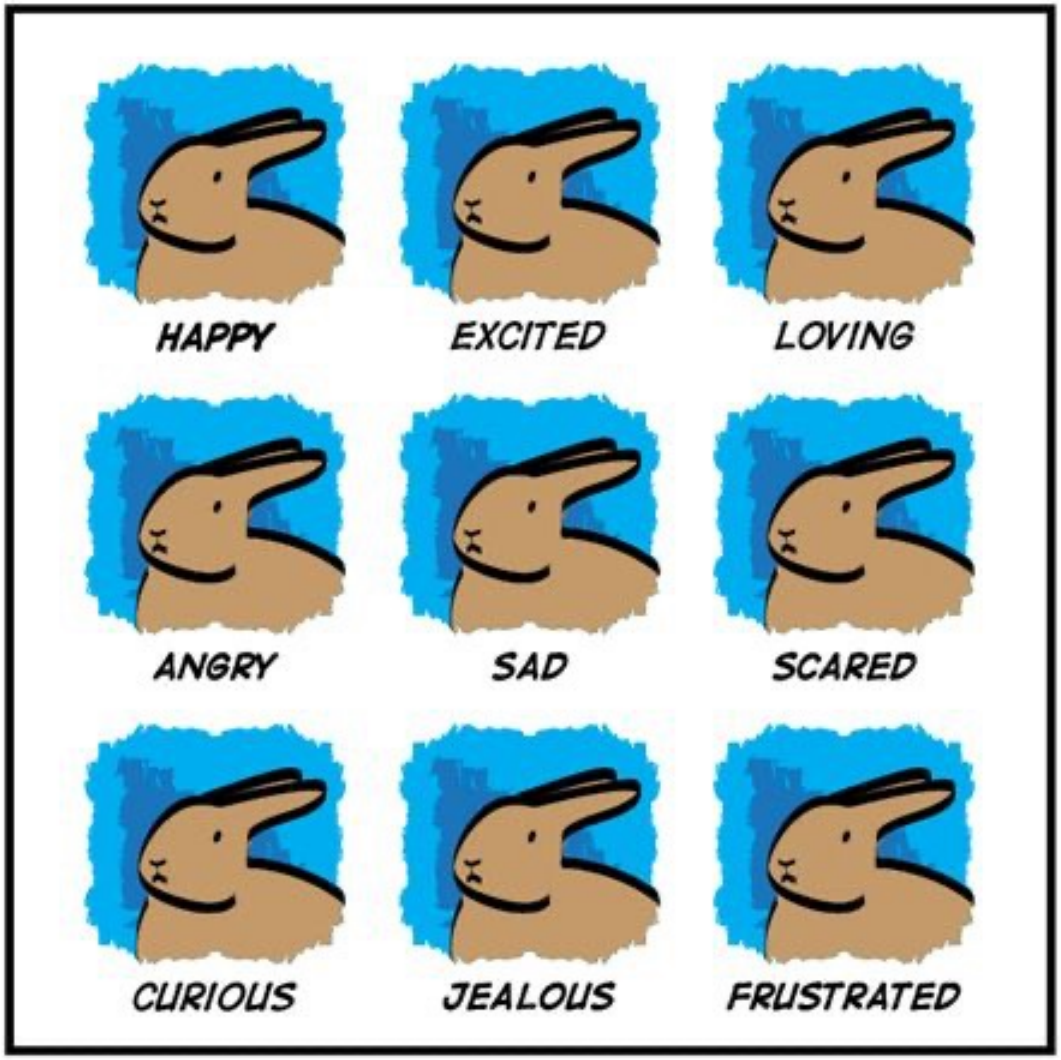
A mixed approach

Some emotions are triggered by the stimulus only

Some emotions require interpretation

EMOTIONS AND EVOLUTION: BASIC EMOTIONS AND THEIR DISORDERS

REGARDING THE SECRET LIFE OF RABBITS: EMOTIONS



BASIC EMOTIONS

- Mostly innate
- Universal (potentially in some animals as well)
- Associated facial expressions

(1) Happiness

(2) Sadness

(3) Fear

(4) Anger

(5) Surprise

(6) Disgust

EVOLUTIONARY ROOTS OF BASIC EMOTIONS

- Emotions serve three primary functions (Rolls 1999):

(1) Survival: Avoiding potential threats

(2) Communicative and social needs: Conveying our feelings to others

(3) Cognitive needs: Asisting in thinking and problem solving

➢ Examples?

BASIC EMOTIONS AND PSYCHOLOGICAL DISORDERS

	Evolutionary function	Associated disorders
Disgust	To avoid sources of infection	Obsessive-compulsive disorder
Fear	To avoid danger	Phobias Panic attacks Post-traumatic stress disorder
Anger	To mobilize and sustain vigourous motor activity	Borderline personality disorder Antisocial personality
Sadness	To disengage from unattainable goals (Nesse, 2000) To focus and analyze complex problems (Andrews, Thomson and Anderson, 2009)*	Major depressive disorder
Happiness	To reinforce adaptive responses To broaden the scope of attention To foster altruism	Bipolar disorder (manic state)
➢ Surprise		

EMOTIONS AND NEUROSCIENCE

EMOTIONS AND THE AMYGDALA

- Emotions are associated with the limbic system and in particular with the amygdala

- The amygdala is involved in **associating** a particular stimulus with a fear response (Barinaga 1992).
- It is part of two neural circuits (LeDoux 1996):
  a) The low road: Directly from the thalamus to the amygdala
  b) The high road: From the thalamus to the amygdala and the cortex

- **Perceptual and attentional** processing of dangerous stimuli: An emotional "early warning" system

- **Memory consolidation** is improved for physiologically arousing stimuli

CHEMICAL AND ELECTRICAL BASIS OF EMOTION

- “Thought is electrical, emotion is chemical”
- **Neurotransmitters**: Chemical substances that are released at synapses in the brain
- **Hormones**: Chemical substances released in the bloodstream

Neurotransmitters	Hormones
Glutamate	Cortisol
GABA	Testosterone
Norepinephrine	Estrogen
Serotonin	Oxytocin
Dopamine	

EMOTIONS AND COGNITION

PERCEPTUAL AND ATTENTIONAL EFFECTS

- Attention:
- **Filters out** irrelevant perceptual information, and
- **Enhances processing** of relevant items

- Emotional processes help in allocating attention toward stimuli with survival value (Vuilleumier, 2005)

a) The threat superiority effect

b) An emotional Stroop effect

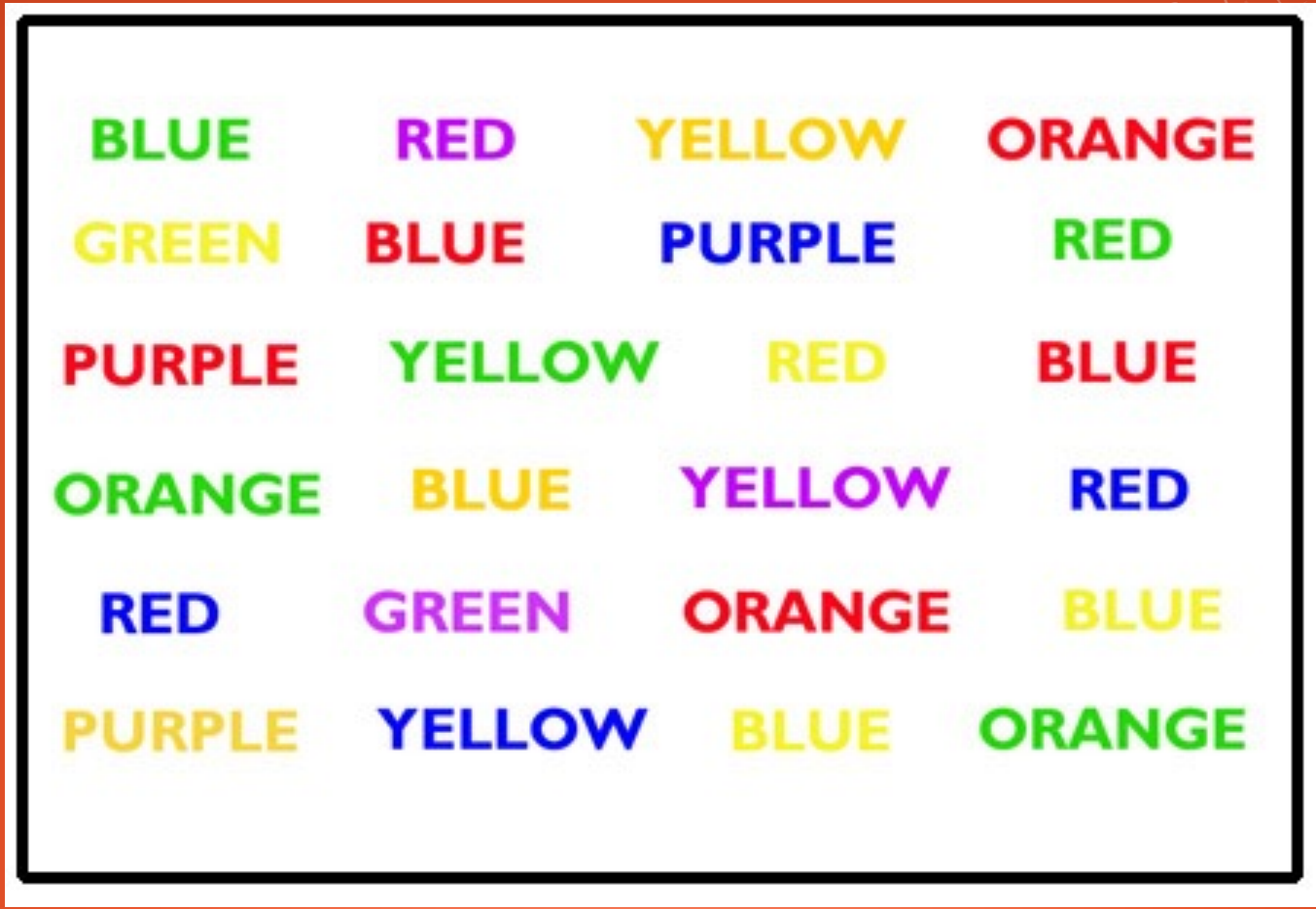
THE THREAT-SUPERIORITY EFFECT

THE THREAT-SUPERIORITY EFFECT

- The effect: Dangerous stimuli are more perceptually salient.

- This is measured by reaction times: Angry faces in a crowd (the dangerous stimuli) are located faster than neutral or happy faces.
- An explanation of this is that angry faces pop-out, or are more perceptually salient.

THE STROOP EFFECT



EMOTIONAL STROOP EFFECT

EMOTIONAL STROOP EFFECT

- The effect: Stimuli that carry negative emotional information capture attention more than neutral or positive stimuli do.

- This is measured again by reaction times: When presented with negative words, subjects take longer to report colors.
- An explanation of this is that attention is strongly captured by negative stimuli, so that subjects have to make more effort to re-direct attention to the colors.

EFFECTS OF EMOTION IN MEMORY

- **Flashbulb memory**
- A sub-type of episodic memory, namely, autobiographical memory
- (Reported) better recall of personal events during emergency situations

- Also: Better recall for emotional stimuli (Ochsner, 2000)
- Negative stimuli are remembered better than positive or neutral ones
- Emotionally arousing words are remember better than neutral words

EFFECTS OF MOOD IN MEMORY

- Mood-congruent memory: Stimuli are remembered better if they match the mood during learning
- Deep thought and associations are enhanced to mood-congruent material

- Mood-dependent memory: Recall is better when the mood at recall matches the mood at learning
- Mood acts as a retrieval cue

- Good mood favors assimilation to the expense of accommodation
- Good mood makes us less critical

HOW RELIABLE IS MEMORY IN GENERAL?

- TED talk by Elizabeth Loftus:

https://www.youtube.com/watch?v=PB2OegI6wvI

EMOTIONS AND ARTIFICIAL INTELLIGENCE

ARTIFICIAL INTELLIGENCE: AN OVERVIEW

- AI (artificial intelligence) is defined as an imitation of the complex thought processes that are found in humans.

- Intelligence: A complex capacity that includes capacities for:

✓ Rationality

✓ Autonomy

✓ Observing and acting on an environment

✓ Goal-directed activity

✓ Learning

AFFECTIVE COMPUTING

- Affective computing is the processing of information that relates to, arises from, or deliberately influences emotions.

- The goal: Enabling artificial systems with this kind of computing, to facilitate their interaction with humans.

- Three important strands of reseach are pursued:

1) Recognition of emotions
2) Production and expression of emotions
3) Internal design of emotional processing

EMOTION RECOGNITION

- Emotion recognition in speech (Petrushin, 2000)

- Energy, speaking rate and fundamental frequency are cues that indicate the speaker's emotional state.

- Four emotions: Happiness, fear, anger and sadness, plus a neutral state
- Accuracy: 70% (human level performance)

- Implemented in: Automated telephone reservation systems

- Read more here:
- http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.198.8834&rep=rep1&type=pdf

EMOTION RECOGNITION

- FaceSense (MIT)

- Visual/Multimodal recognition

- Bottom-up cues (Facial expressions, head gestures)
- Top-down predictions (Context)

EMOTION PRODUCTION AND EXPRESSION

- The Kismet project (Breazeal, 2002)
- Able to recognize and express basic emotions, via voice cues and facial expressions
- Cognitive sub-systems: Perception, attention, drive and behavior

- A three-dimensional affect space is used to model emotions in Kismet:

1) Valence: Good or bad?
2) Arousal: High or low?
3) Stance: Advance or withdraw?

- Example:
  - Positive valence, moderate arousal => Joyous expression (Joy)

EMOTION PRODUCTION AND EXPRESSION

- Kismet's emotional responses are a guided by at least two factors:

a) Detection of affective information (for instance, from "caregiver")

b) Drive satisfaction

- Drives: Thirst, hunger, fatigue, social interaction, stimulation

- Example:
  - Social drive is high, stimulation is low => Sorrowful expression
  - Stimulation is high, drive gets low => Fearful expression

EMOTION PRODUCTION AND EXPRESSION

- A philosophical question: Can emotions be artificially replicated?
- What does it take to artificially replicate an emotion?

- A simpler (actually existent) IA: Furby:

https://www.youtube.com/watch?v=38dItC7lQpc

- A more complex (possible?) IA: David:

https://www.youtube.com/watch?v=ZMbAmqD_tn0

INTERNAL DESIGN: COGAFF ARCHITECTURE

- The **CogAff architecture** is a generic scheme for how cognitive-emotional processing may take place (Sloman, Chrisley and Scheutz, 2005).
- In human beings and in artificial systems

- CogAff follows a three-stage model of processing:

  (1) Perception => (2) Central processing => (3) Action

- This model, in turn, takes place at three different levels:

  I) Reactive: Fast, automatic reactions; reflexes

  II) Deliberative: Predictions, decision making, alternate plans of action

  III) Reflective: Metacognition; monitoring and controlling mental states

EVALUATION

WHERE DOES THE EMOTIONAL APPROACH STAND?

Strengths

- Recognition of the impact of affective processes in cognition
- Initial identification of brain and neuronal structures underlying emotions and other affective states

Further research directions

- What is the influence of cognition on affective processes?
- How do basic emotions relate to more complex emotions? Are there laws regarding the formation of complex emotions?