

Kesako?

- Affective Computing
 - Book by R. Picard (1997)
 - **Detect, Interpret, Process and Simulate human emotions**

 - How is it connected to HMI?
 - (Hess et al., 1999)
Emotions play a crucial role in social interactions
 - (Krämer et al., 2003)
People, when interacting with an ECA, tend to be more polite, more nervous and behave socially
- **Affective ECA / Affective Robot!**

The story so far...

H-M Dialogue

Eliza

Trains

Agents

MAS

AAMAS

1970

1990

2010

Virtual Agents

Video Games

CHI

IVA

Serious Games
Simulation

Online ECAs
everywhere

Emotions

R. Picard

Humaine

ACII

Links from the community

- IVA (Intelligent Virtual Agents)
<http://iva2012.soe.ucsc.edu/>
- ACII (Affective Computing & Intelligent Interaction)
<http://www.acii2011.org/>
- AAAC (ex Humaine)
 - FP6 Project
(1/12004 – 31/12/2007)
 - Association: <https://aaac.cs.nott.ac.uk/>



Association for the Advancement of Affective Computing

University of Cambridge, Department of Computer Science & Technology, William Gates Building, 15 JJ Thomson Ave, Cambridge CB3 0FD, United Kingdom

The AAAC is a professional, world-wide association for researchers in Affective Computing, Emotions and Human-Machine Interaction. A PDF version of its Association Constitution can be downloaded here.

The Association for the Advancement of Affective Computing (AAAC) manages the bids and the organisation of the International Conference on Affective Computing and Intelligent Interaction (ACII).

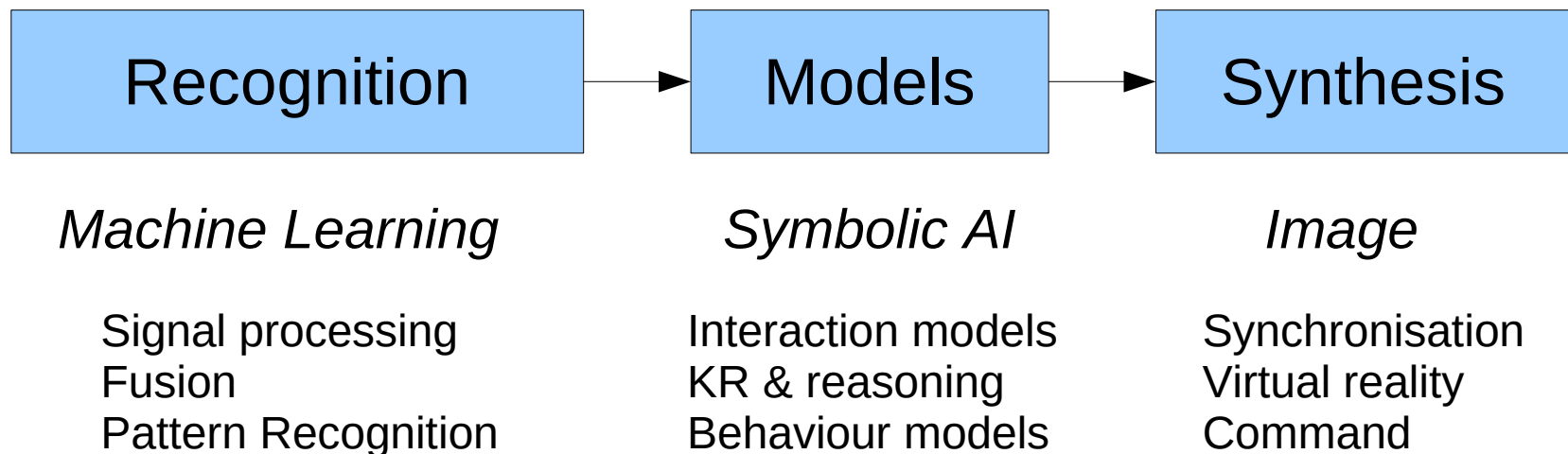
The Conference series on Affective Computing and Intelligent Interaction is the premier international forum interdisciplinary research on the design of systems that can recognize, interpret, and simulate human emotions and related affective phenomena.

The IEEE Transactions on Affective Computing is a cross-disciplinary and international archive journal aimed at disseminating results of research on the design of systems that can recognize, interpret, and simulate human emotions and related affective phenomena. The journal publishes original research on the principles and theories explaining why and how affective factors condition interaction between humans and technology, on how affective sensing and simulation techniques can inform our understanding of human affective processes, and on the design, implementation and evaluation of systems that carefully consider affect among the factors that influence their usability.

Research questions

Detect, interpret, process and simulate human emotions → **affects**

- Computer Sciences ↔ Cognitive Sciences
 - AI and Psychology (for emotions)
 - AI and Sociology (for social relations)
- 3 computational scientific domains:



Examples

- Recognition

- Affectiva Q sensor:

https://www.youtube.com/watch?feature=player_profilepage&v=mFrSFMnsl4

- Synthesis

- Virtual agent:

<http://www.youtube.com/watch?v=CiuoBiJjGG4>

- Robot (Hanson):

<http://www.youtube.com/watch?v=pkpWCu1k0ZI>

- Models

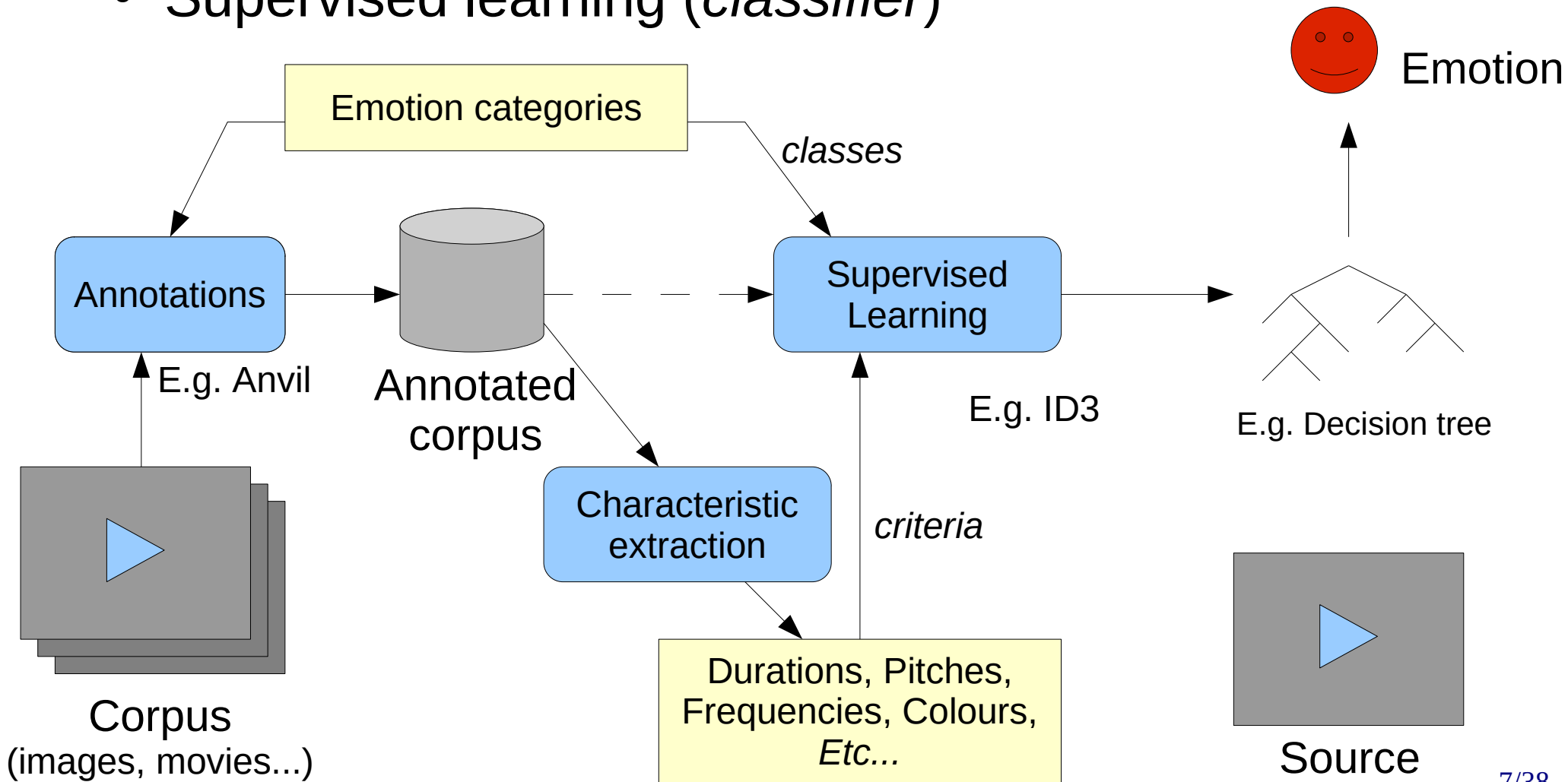
- Fatima (LIREC):

<http://www.youtube.com/watch?v=ZiPIE80Xiv4>

Emotion Recognition

Emotion recognition

- General principle: data-oriented
 - Corpus tagging
 - Supervised learning (*classifier*)



Multi-modal behavior annotation: ANVIL

The screenshot displays the ANVIL tool interface for multi-modal behavior annotation. The main window is titled "Annotation: sarkis-mm-ext-03-v6.anvil" and shows a video player window titled "Video: ext-03.avi" in the center. The video shows a woman in a green shirt sitting on a street, with her face obscured by a red box. The video player has a timeline from 00:19 to 00:28. Below the video player is a large, multi-modal behavior annotation timeline. The timeline is organized into several categories, each with sub-categories and corresponding colored bars indicating the duration of specific behaviors. The categories and their sub-categories are:

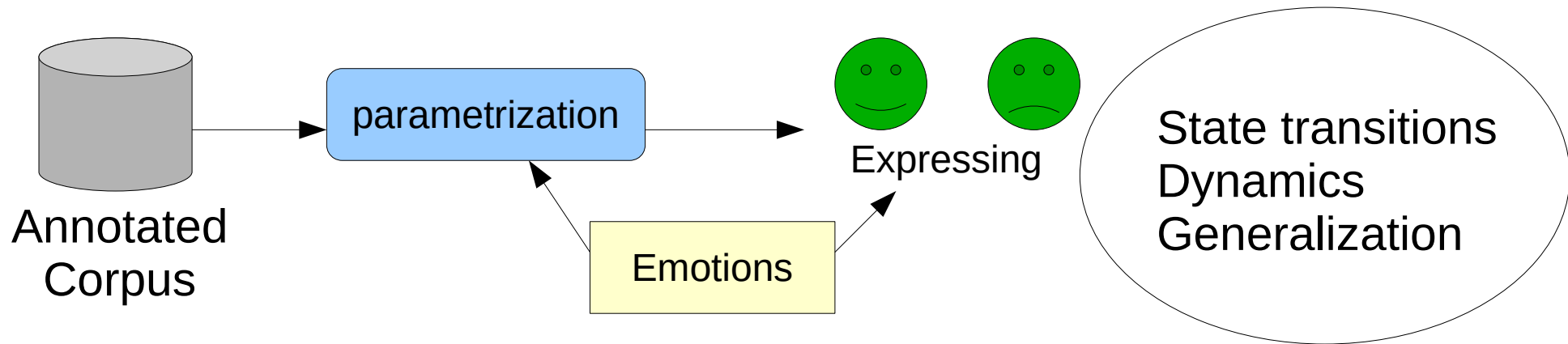
- transliteration (english)
- torso
 - pose
 - movement
- head
 - pose
 - primary movement
 - secondary movement
- shoulders
 - pose
 - movement
- facial expressions
 - eyes
 - brows
 - mouth
 - other
- arms
 - pose
- gesture
 - gesture left hand
 - right hand
 - phase
 - phrase
 - movement

The timeline shows various behaviors such as "full twist.", "half t.", "back (180), fr.", "high", "no repeti.", "right", "le..", "downward..", "downward", "fast, head downw.", "norma..", "fast, head turn ri..", "eyes", "eyes turn righ..", "eye", "eye", "brow lowe.", "lip..", "stroke", "ref.", "prepa..", "sequenceOfStroke", "retra..", "pre..", "stroke", "stroke", "retract", "stro", "hold", "beat", "deictic, other", "manipulator, eyeb..", "jerky, hard,", "smooth, normal, fast, contracted, cigarette, chest, linear, downward, independent", "jerky, hard, fast, contracted, ci..", "smooth, soft, fast, ..".

Emotion Synthesis

Emotion synthesis

- From Emotion to Parameters



- Evaluation

- Human recognition of expressed emotions

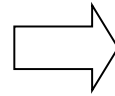
not reliable, even in H-H interaction (with spontaneous emotions)

- Some examples:

- Virtual agents: Greta/Semaine/MARC
- Robots: Kismet, iCat, Nao

Example : from videos to animations

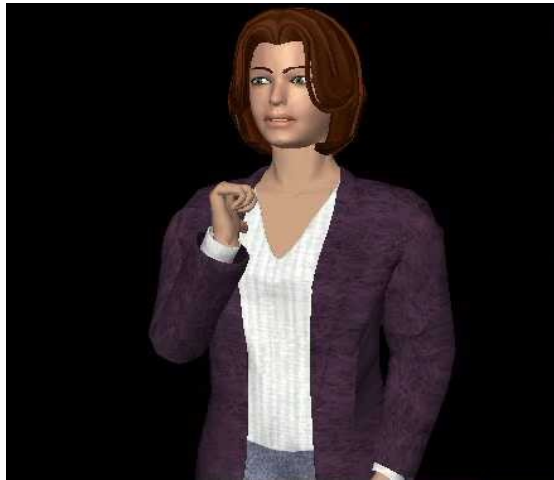
Original
video



GRETA



Anger



Desperation



C. Pélachaud LTCI and J-C Martin LIMSIS

Emotion Modelling

A bit of Human Sciences

« The question is not whether intelligent machines can have any emotion, but whether machines can be intelligent without any emotions. »

Marvin Minsky, 1986

- Darwin, 1872 (Ed. 2001)

The expression of emotions in man and animals

→ Adaptation mechanism

- (Ekman, 1972 & 1990): role in communication

- 2 schools

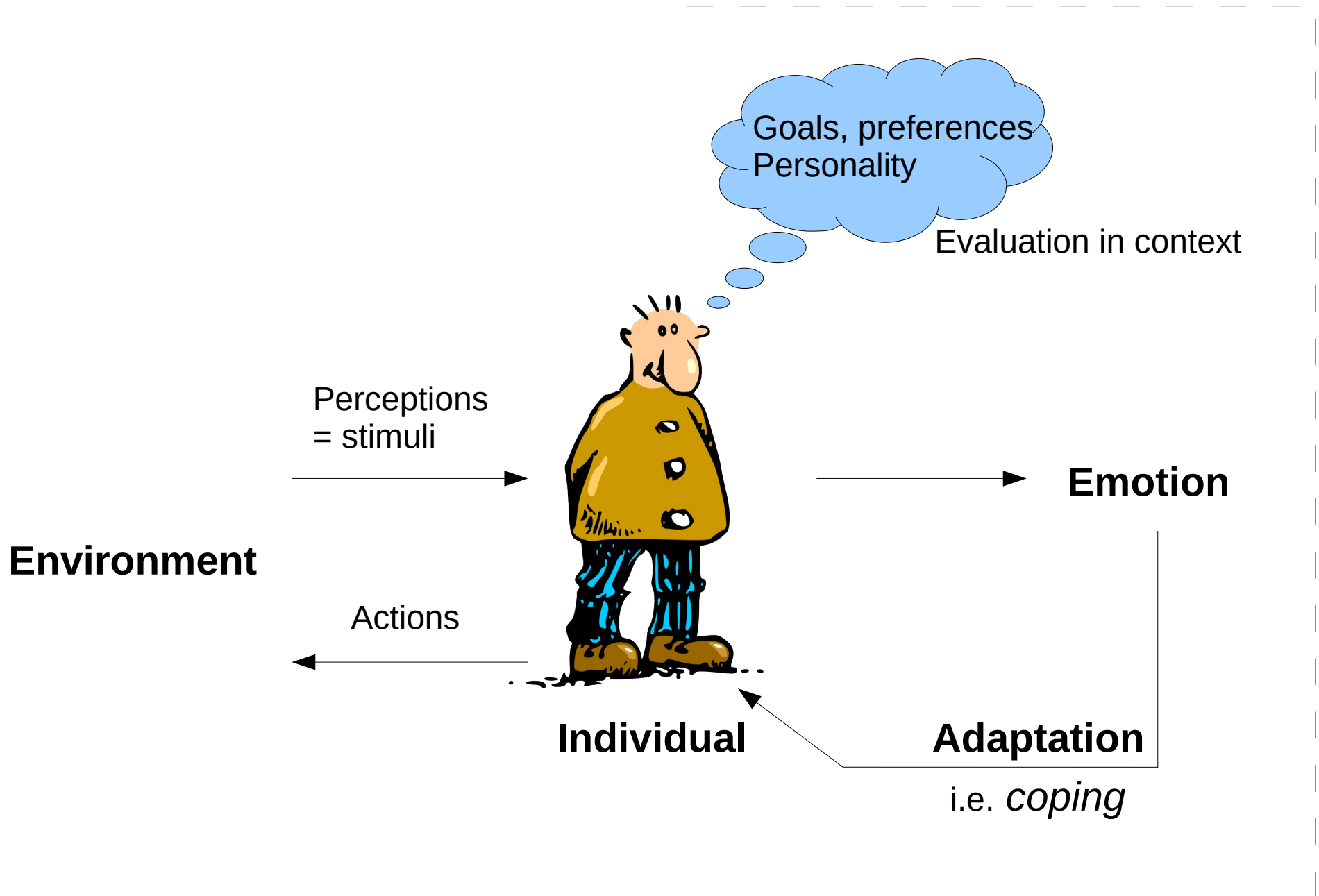
- William James, 1887

Organism changes → emotion

- Lazarus, 1984 ; Scherer, 1984

Appraisal theory

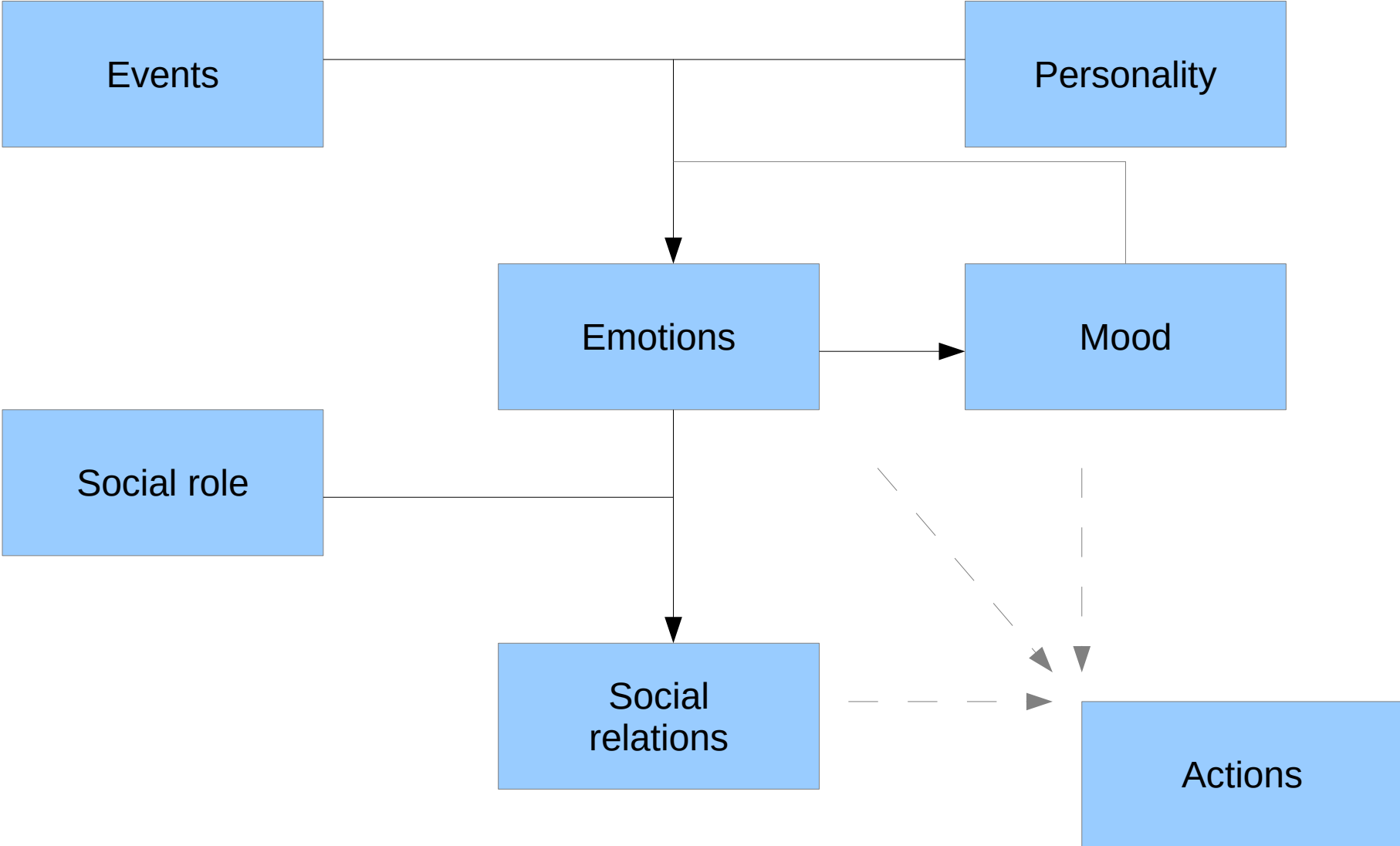
Appraisal theory (1)



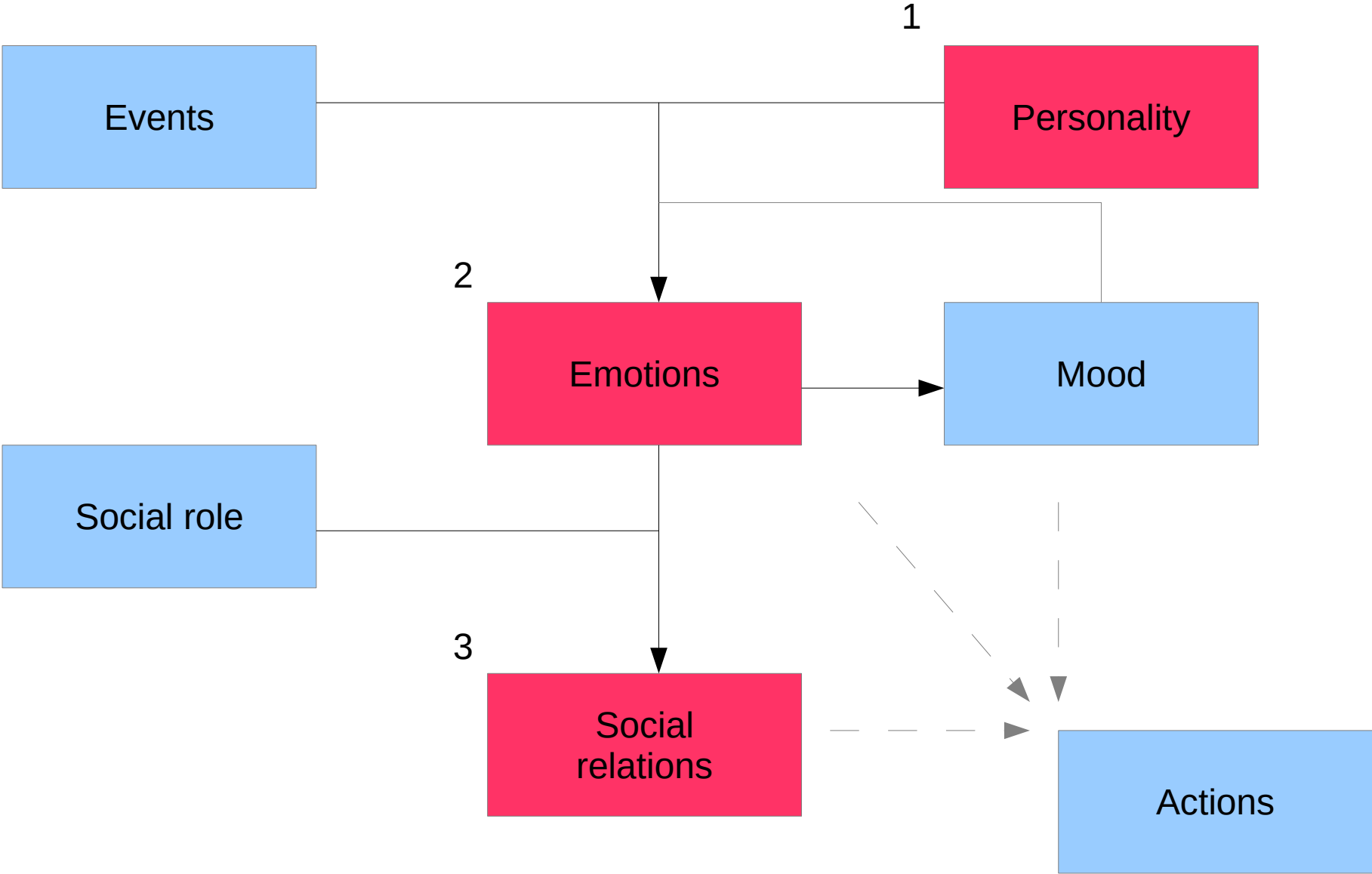
Appraisal theory (2)

- Coping (adaptation strategy)
 - = the process that one puts between himself/herself and the "stressing" event
 - Active coping (*i.e.* problem focused)
 - act upon the environment
 - Passive coping (*i.e.* emotion focused)
 - act upon one's emotion
- Rousseau & Hayes-Roth, 1997
 - Personality → emotions (Watson & Clark, 1992)
 - Emotions → social relations (Walker, 1997)

Architecture



Architecture



Personality models

Definition and problem

- Personality = stable component in an individual's behaviour, attitude, reactions...
- Designing computational models
 - Define variables
 - Define their value domains
 - Define the characteristic values

Models of personality (1)

- Eysenck, 1967 (1982)
 - Extraversion → Higher sensitivity to positive emotions (and more expressive)
 - Neuroticism → Higher sensitivity to negative emotions (and more frequent changes)
 - Psychoticism → impulsive nonconformity or tough-mindedness

Models of personality (2)

- McRae, 1987 (i.e. O.C.E.A.N. or "Big Five Model")
 - Openness → curiosity, imagination
 - Conscientiousness → organization, self-discipline
 - Extraversion → exteriorization
 - Agreeableness → compassionate, cooperative
 - Neuroticism → emotional instability
- Myer-Briggs Type Indicator (MBTI) *based on Jung*
 - Energy → introverted or extroverted
 - Information collection → sensitive or intuitive
 - Decision → thinking or feeling
 - Action → judgement or perception

An example: ALMA

(Gebhard, 2005)

The screenshot displays the ALMA CharacterBuilder software interface, which is used for creating and monitoring characters. It is divided into several main sections:

- Personality Configuration:** This section allows for the adjustment of personality traits based on the O.C.E.A.N. model. The traits shown are:
 - Openness:** Interest in intellectual issues, unconventional values, aesthetic sensitivity, need for variety.
 - Conscientiousness:** Task-oriented characteristics such as being dependable, responsible, and orderly.
 - Extraversion:** Tendency to be sociable and experience positive affect.
 - Agreeableness:** Tendency to be interpersonally pleasant and compliant.
 - Neuroticism:** Tendency to experience anxiety and other negative emotions.
 - Personality Influence:** A slider ranging from 0.0 to 0.5.
- Character Description:** A text field containing the name "Bruno".
- Bruno's Affect Monitor:** A 3D mood cube visualizing the character's current emotional state. The axes represent different dimensions of affect. A red arrow points to the "Emotions" label, and another red arrow points to the "Mood" label. The status bar below the cube indicates:
 - Dominant emotion: Fear
 - Current mood: slightly Relaxed (P: 0.04, A: -0.06, D: 0.33)
 - Mood tendency: fully Hostile
 - Default mood: slightly Relaxed
- Interaction Recorder:** A window showing a script of interactions between characters. It includes a diagram of the interaction graph and a table of events.

Interaction Recorder Script Table:

Time (ms)	Performer	Signal	Intensity	Addressee	Liste...	Elicitor	Context
0	Anne	Reset Character					
0	Bruno	Reset Character					
1000	Bruno	BadEvent	0.80			lost vacation photos	Bruno: Crap, Windows has killed all pictures of our last summer holiday at M...
2000	Anne	Calm	0.40	Bruno		may be not lost	Anne: Don't panic, you'll find them surely in the waste bin. [signal]
3000	Bruno	AnnounceConcern	0.80	Anne		lost or not - that's the question	Bruno: Are you sure? But what if not, what I'm doing then ... they will be lo...
4000		Context					Anne: Well, I've no clue, I'm not the computer expert.
5000		Context					(Bruno tries to recover the files by restoring the files of the waste bin)
8000	Bruno	BadEvent	0.90			vacation photos are lost!	Bruno: No, damn it! All the pictures gone ... and there's no way to get the...
9500	Anne	Accuse	0.80	Bruno		lost photos	Anne: Oh no, all our pictures are lost! You are a clean up maniac. I always t...
11000	Bruno	Condemn	0.40	Anne		bad things happen	Bruno: Get off my back! [signal]

Context:
Bruno is reorganizing his computer hard drive by letting Microsoft Windows removing unneeded files. Anne just shows up.

This script demonstrates how Bruno's mood moves from slightly Relaxed to slightly Hostile, because of the actions/events he experiences.

Emotions

Mood

O.C.E.A.N.

Events

Emotion models

Models of emotions

- What is an emotion ?
 - James, Ekman, Scherer, ...
- Characterizing an emotion
 - Category-based approaches
 - There are N emotions (N being subject to discussion)
 - Dimension-based approaches
 - An emotion is a point in an N -space (dimensions must make a basis)

Categorical model: Ekman

- **Ekman & Friesen, 86**: joy, surprise, fear, anger, sadness, disgust (, contempt, neutral)
 - Intensity scale associated with emotional labels
 - Sub-categories associated with emotional families
- Complex emotions linked with other mental states (**Baron-Cohen, 07**)
- Detection: Google, Noldus FaceReader, Affectiva, ...

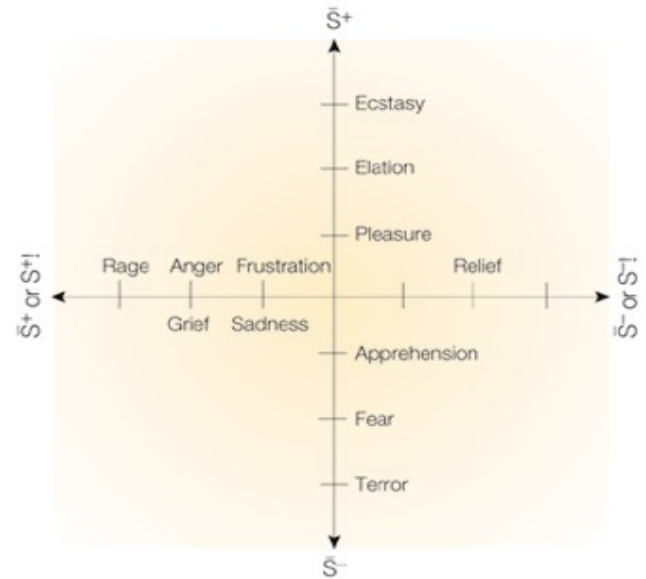
Dimensional model: PAD (1)

- Mehrabian, 1980
- Emotion = 3 dimensions
 - Pleasure (or « valence »)
 - Arousal (or « activation degree »)
 - Dominance
- Examples

The circumplex model — Russell (1980)

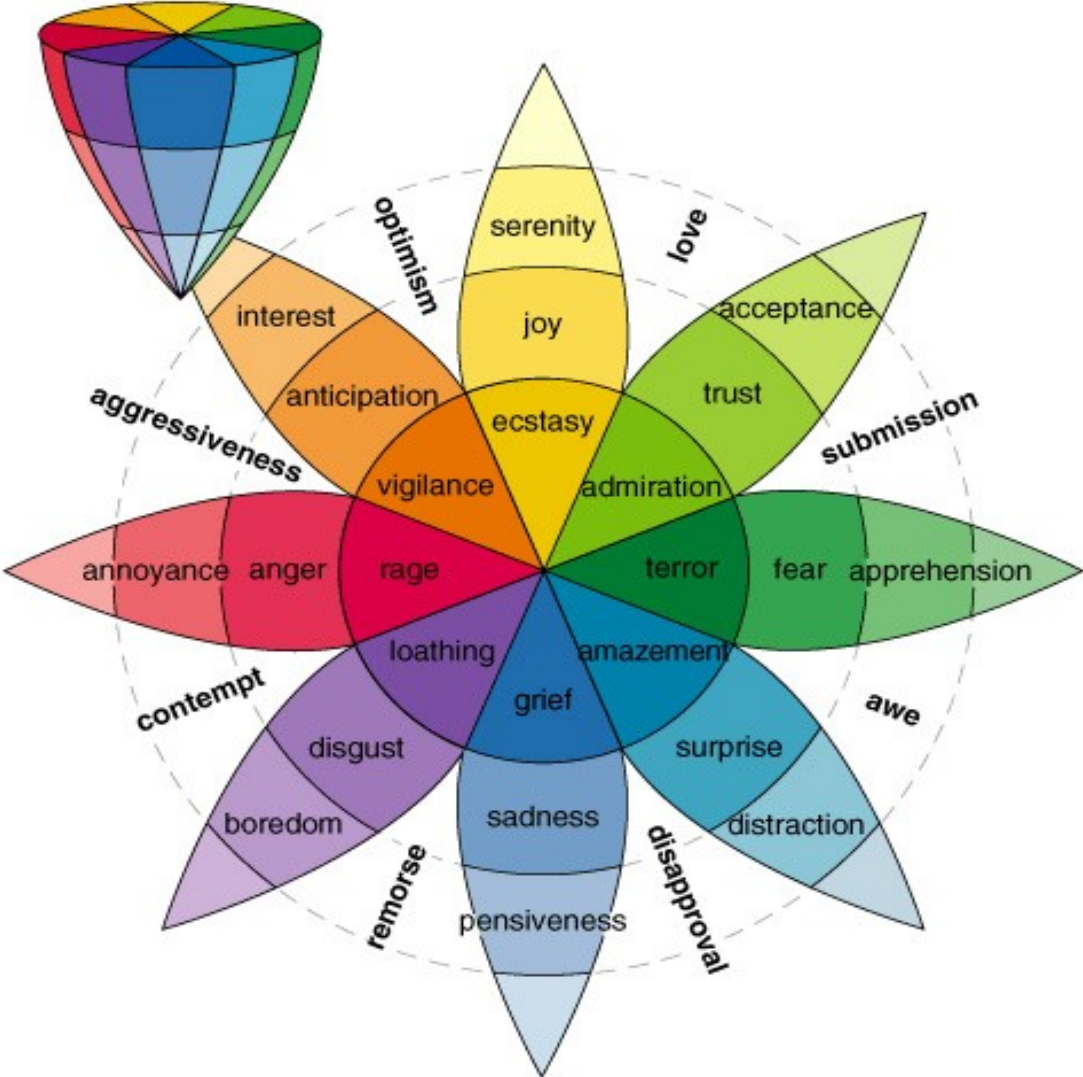


Theory of emotion — Rolls (1999)



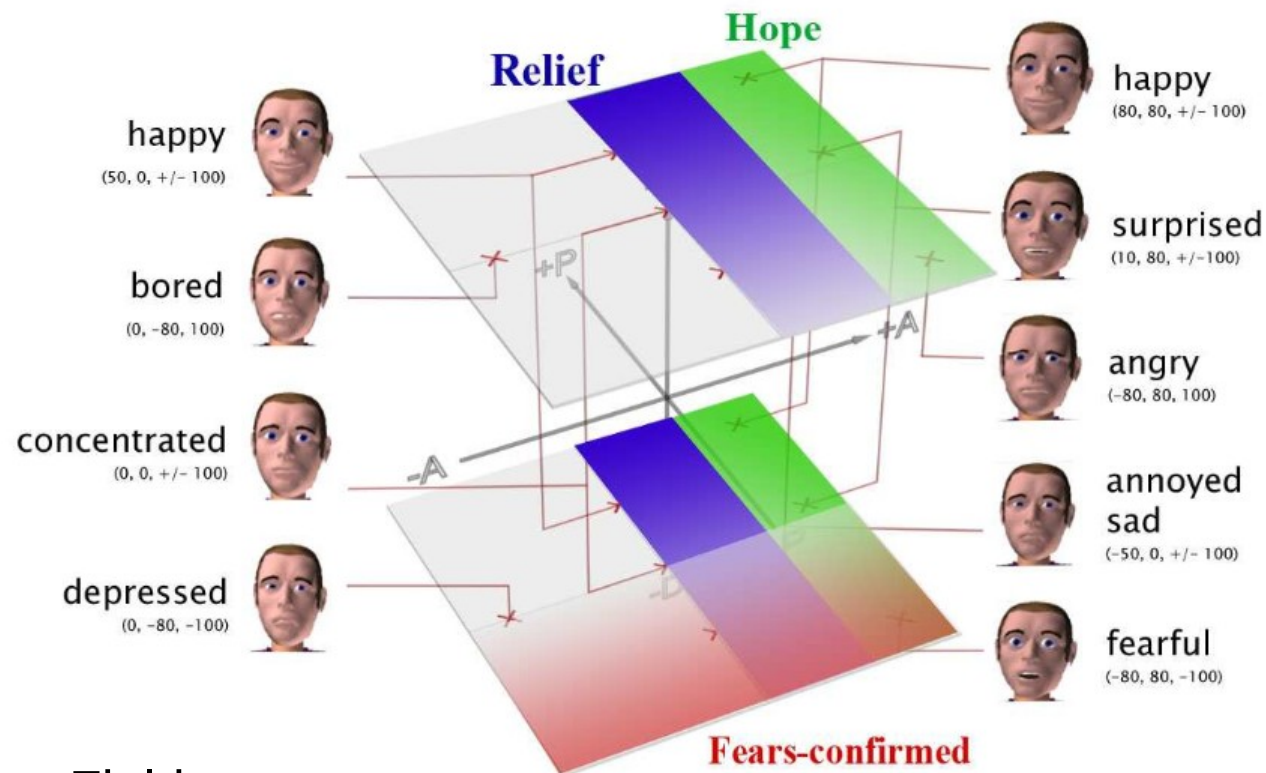
Dimensional model: PAD (2)

- Pluchnick's wheel



Dimensional model: PAD (3)

- **Wasabi**: Affect simulation for agents with believable interactivity
- Idea: emotions and mood influence each other over time



- Application Field
 - Robotics: MARCO at ICMI2014
<https://www.youtube.com/watch?v=qADz9Vq5e7Y&feature=youtu.be>
 - ECA acts as a teacher in paired associate task

Appraisal: the OCC model (1)

- Ortony, Clore, Collins, 1988
- 20 emotion categories
 - Joy – Distress
 - Fear – Hope
 - Relief – Disappointment, Fear-confirmed – satisfaction
 - Pride – Shame, Admiration – Reproach
 - Love – Hate
 - Happy-for – Resentment, Gloating – Pity
 - Remorse – Gratification, Gratitude – Anger

Appraisal: the OCC model (2)

- Appraisal model based on individuals' goals & preferences:

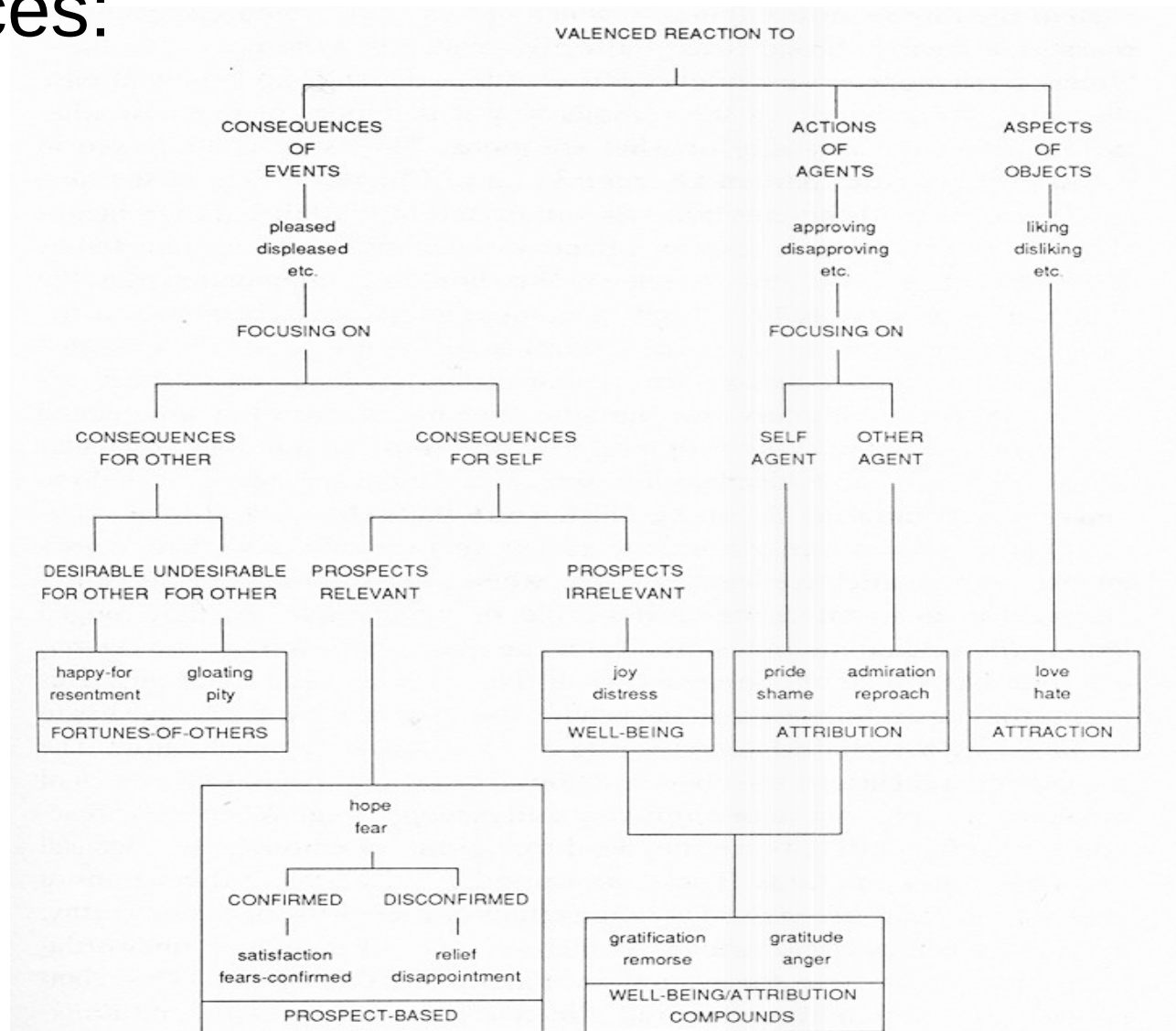
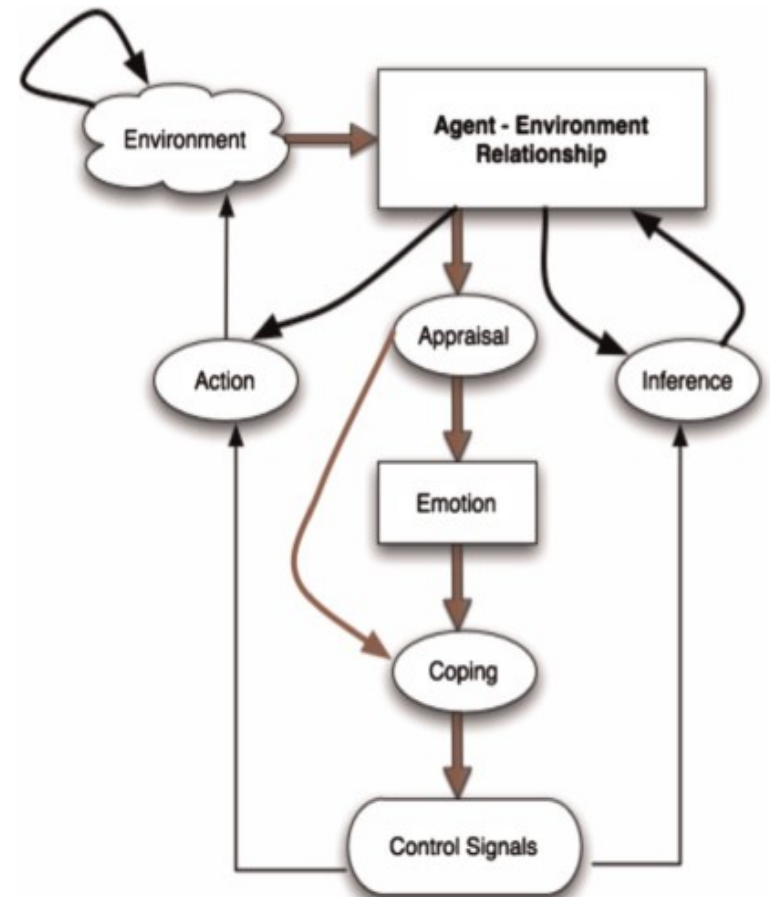


Figure 2.1. Global structure of emotion types.

Appraisal and coping: EMA (1)

(Gratch & Marsella, 2010)

- EMotions & Adaptation
 - OCC (appraisal)
 - Coping (action selection)
- Based on SOAR
- Evaluation criteria
 - Relevance
 - Point of view
 - Desirability (expected utility)
 - Probability & expectedness
 - Cause
 - Control (by me and others)



Appraisal and coping: EMA (2)

- Rule-based system

E.g. : $\text{Desirability}(\text{self}, \text{event}) > 0$
& $\text{Probability}(\text{self}, \text{event}) < 1.0 \rightarrow \text{hope}$

- Coping strategies

- Perceptions
- Belief revision (including about other agents' intentions and responsibilities)
- Changing goals

- Simulation model

- Application to serious games



Social relations

Social relations

- Social behaviour model

 - Static models: Walker, Rousseau et al., Gratch...

 - Dynamic model: Ochs et al.

- Several traits:

 - Liking

 - Dominance

 - Solidarity (or social distance)

 - ...

→ Social relations are unidirectional and not-always reciprocal!

Emotions and Social relations

- Influence $E \rightarrow RS$ (examples)
 - Ortony, 91 : caused + emotions $>0 \rightarrow$ liking \uparrow
 - Pride + Reproach \rightarrow dominance \uparrow
 - Admiration + Fear + Distress \rightarrow dominance \downarrow
- Influence of the social relation on actions and communication
- Action selection guided by target social relation
- Emotional contagion
 - \rightarrow neighbour computation based on social relations

An example: OSSE

Attitudes

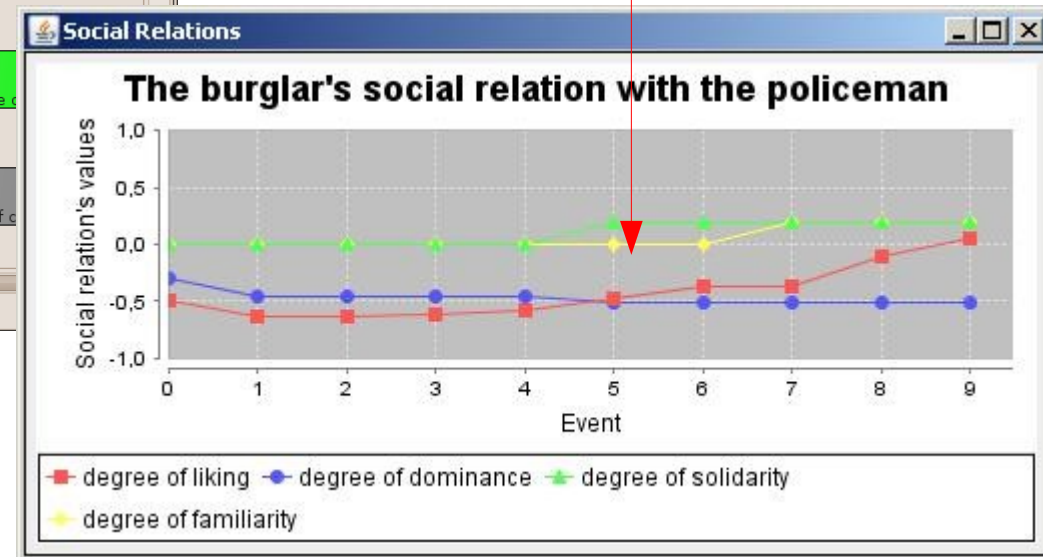
(Ochs et al., 2008)

The screenshot shows the 'PNJs Mind Simulator' interface. On the left, there are panels for 'Events', 'Characters', 'Concepts', and 'Social Roles'. The 'Events' panel has a 'Display events' button. The 'Characters' panel lists 'Bob' and 'Smith'. The 'Concepts' panel has an 'Add Concept' button and a list of concepts with values. The 'Social Roles' panel has a 'Define a new role' button and a list of roles including 'Cop' and 'Thief'. The main area shows a 'Graph' with a 'New event' button. A 'Modify Event' dialog box is open, showing fields for 'Date of the event', 'Type of event', 'Select the speaker', 'Select the receptors', 'Subject', 'The verb', 'The object', 'The degree of certainty', and 'Enter the degree of confidentiality'. The 'Type of event' is set to 'SUBJECT_VERB_OBJECT'. The 'Subject' is 'Smith', 'The verb' is 'to make', and 'The object' is 'coffee'. The 'degree of certainty' is 40 and 'Enter the degree of confidentiality' is 0. The 'Social Relations' window is also visible, showing a line graph titled 'The burglar's social relation with the policeman'.

Scenario
= set of events

Events
→ Emotions
→ Social relation dynamics

Social roles
→ initial relation



Learn more!

- Books
 - Rosalind Picard, *Affective Computing*, MIT Press
 - Scherer, Bänziger, & Roesch (Eds.) A blueprint for an affectively competent agent: Cross-fertilization between Emotion Psychology, Affective Neuroscience, and Affective Computing. Oxford University Press
- Next IVA conference
 - Humaine-news mailing list !
- Next ACHI conference
- Transaction on Affective Computing Journal

Advanced Human Machine Interaction

Affective Computing

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