Human-Robot Interaction

Module 5: Emotion

Lecture 2: Emotions for robots

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Topics

- Emotion interaction strategies
- Artificial perception of emotions
- Expressing emotions with robots
- Emotion models
- Challenges in affective HRI

Emotions for Robots

- A social robot expresses emotion ...

  people ascribe a level of social agency to it

- A social robot doesn't express emotion ...

  people may still infer the robot's behavior is motivated by emotion

- Social robots need to be able to understand and express emotional states

Emotion Interaction Strategies

Mimicry ... the most straightforward way of programming emotional responsiveness

1. Recognize an emotion in the human
2. Reflect back the emotion in the response

Exception: anger

Humans many even expect this as a response

Emotion Interaction Strategies

Caveat

When users see that a robot is emotionally responsive,
they may infer it has other capabilities,
e.g., being able to comply with other social norms

Consequence

A robot's emotional responsiveness should match its ability to fulfill other expectations

Artificial Perception of Emotions

- Using computer vision
  - From facial cues
  - From gait (walking pattern)
- Using computer audition
  - From speech, e.g., from prosody: the patterns of stress and intonation
    - Low pitch and slow speech: sad
    - High pitch: happy
- Using other cues
  - Human skin conductance changes with affective state

Expressing Emotions with Robots

- Facial expressions (remember Kismet?)
  - Mimic the way humans display emotions
  - Ekman's Facial Action Coding System (FACS)
    - Human facial muscles are grouped as actions units
    - Emotions are described by combinations of action units
    - Some robots can express emotions described by FACS
- Body movements
- Prosody

Expressing Emotions with Robots

Nonanthropomorphic robots

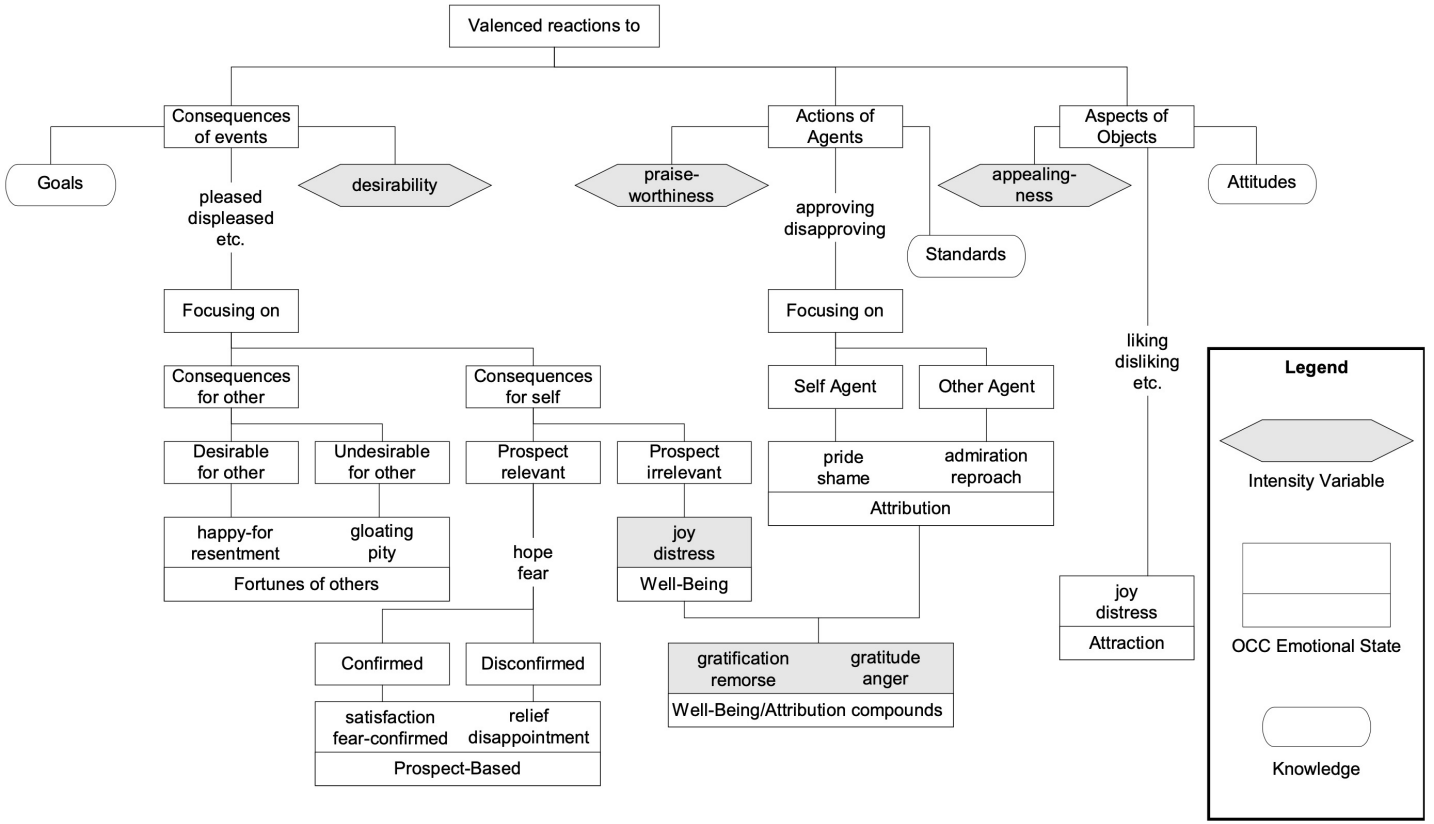
- Speed of motion
- Body posture
- Sound
- Color
- Orientation to the interaction partner

Emotion Models

OCC Model

- 22 emotion categories
- Based on
  - Valenced reactions to events and agent actions
  - Reactions to attractive or unattractive objects

(Ortnony et al., 1988)



Emotion Models

OCC Model

- Many robots do not have to ability to express all 22 emotions
- Eckman's six basic facial emotional expressions

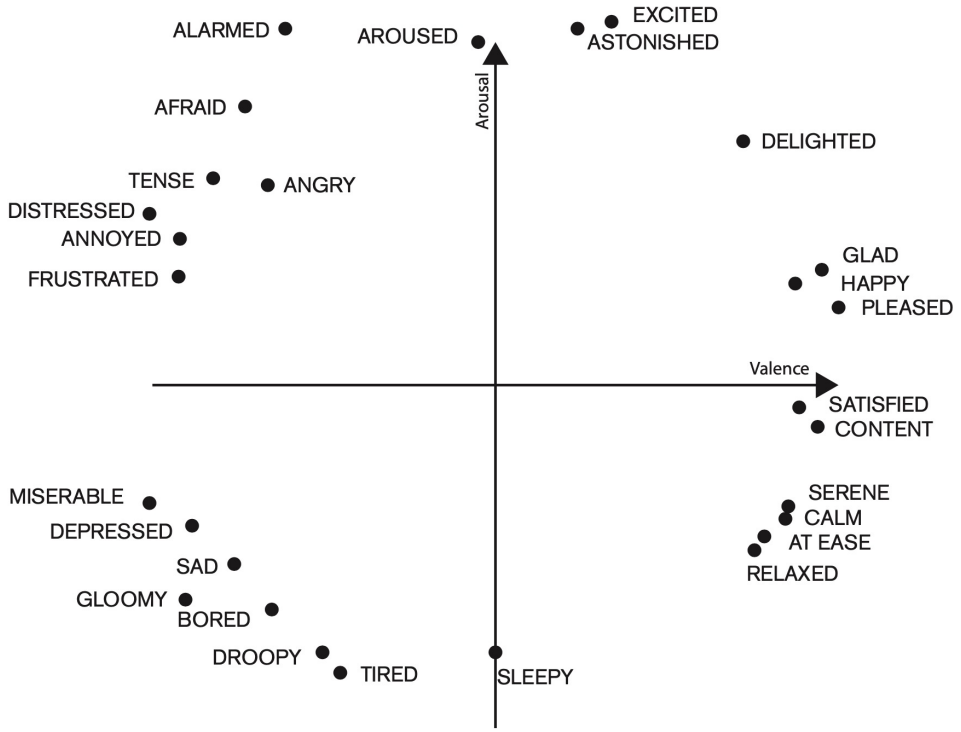
  Anger, surprise, disgust, enjoyment, fear, and sadness

  Reliably recognized across cultures
- A robot with just these six emotions would make for a rather limited interaction experience

Emotion Models

Russell's circumplex model is one of the simplest emotion models that has sufficient expressive power for HRI

However, it positions angry and afraid close together but these are completely different emotions



Russell's circumplex model of affect (Russell 1980)

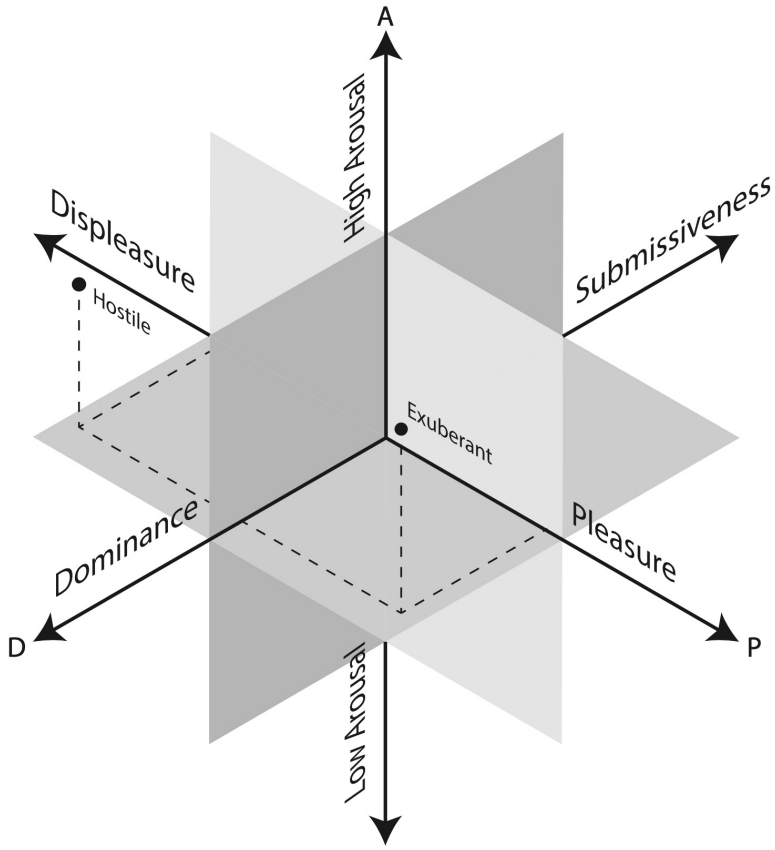
Emotion Models

3D PAD model

1. Pleasure (P)
2. Arousal (A)
3. Dominance (D)

(Mehrabian and Russell, 1974; Russell 1980)

Used on many social robots, including Kismet



Challenges in Affective HRI

"It is virtually impossible to correctly read emotions from facial information alone"

Did this tennis player win or lose the point?

Challenges in Affective HRI

Body language, context, animation make the difference

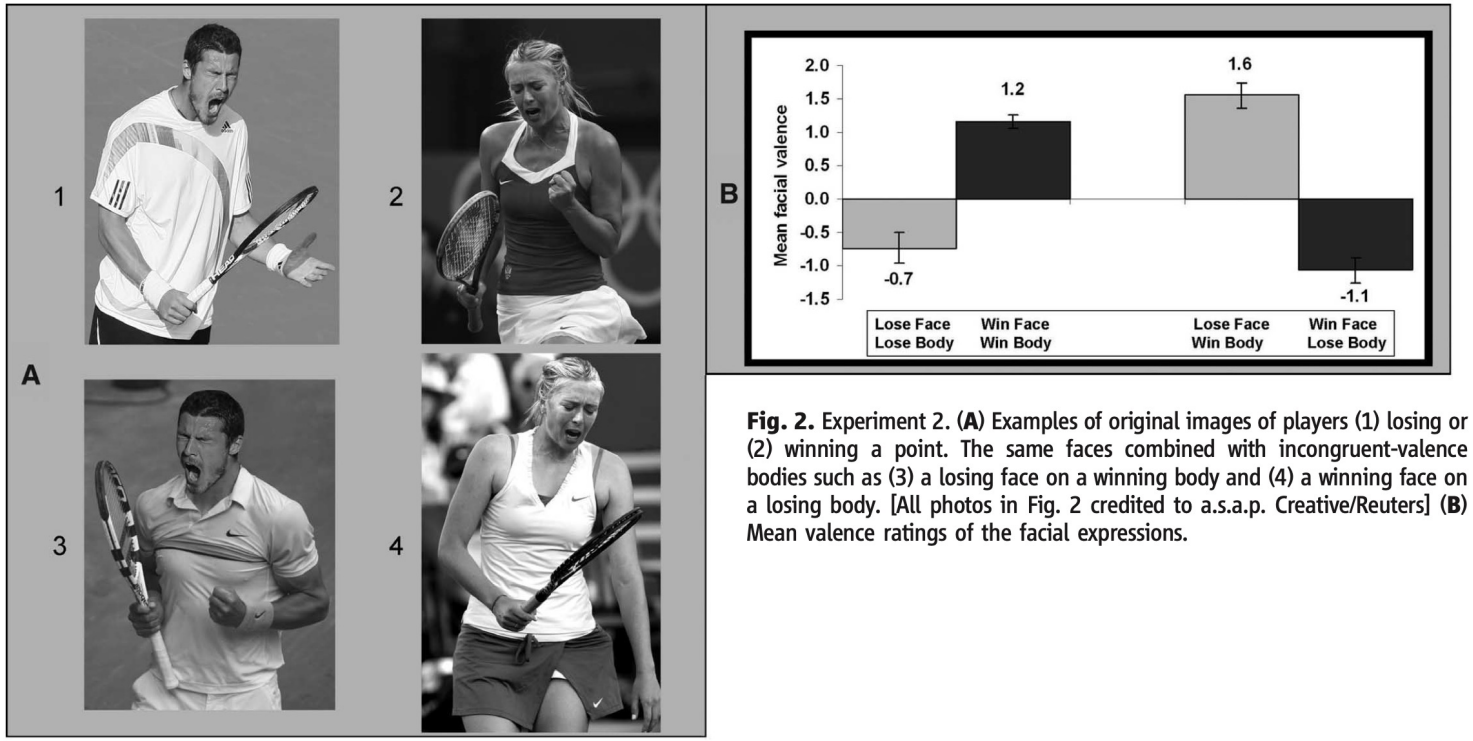


Fig. 2. Experiment 2. (**A**) Examples of original images of players (1) losing or (2) winning a point. The same faces combined with incongruent-valence bodies such as (3) a losing face on a winning body and (4) a winning face on a losing body. [All photos in Fig. 2 credited to a.s.a.p. Creative/Reuters] (**B**) Mean valence ratings of the facial expressions.

Hi. Aviezer,Y. Trope, A. Todorov, "Body Cues, Not Facial Expressions, Discriminate Between Intense Positive and Negative Emotions", Science, 338, 2012.

Challenges in Affective HRI

- Algorithms are trained on emotion data from actors
  - Emotions are exaggerated
  - Recognition software only identifies exaggerated emotional intensity
  - Recognition rate of subtle emotion expression is poor
- Most emotion-recognition software only returns probabilities for
  - The six Ekman emotions or
  - A point in the 2D or 3D emotion space

Challenges in Affective HRI

- Problems dealing with a variety of people
  - Intensity of emotion expression varies
- Currently restricted to snapshots
  - Rather than long term-models and
  - Time-extended data

Challenges in Affective HRI

- A robot's emotional responsiveness can fool users:

  The robot might be able to experience emotion

- Affective cognition still remains an elusive goal

Reading

Bartneck, C., Belpaeme, T., Eyssel, F., Kanda, T., Keijsers, M., Sabanovic, S. (2020). Human-Robot Interaction - An Introduction, Cambridge University Press.

Chapter 8 – Emotion, pp. 118-125.