

## Affective Computing

### Lecture 2: a short introduction

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## Can computers/robots use emotion in a constructive sense?

- To communicate with humans?
  - Animal emotions evolved for communication purposes
- To be more adaptive?
  - Animal emotions evolved for adaptive purposes as well
- As modeling tool to simulate and understand human emotions better?
  - The computer is a medium to simulate a theoretical model.
- This field of research is called *Affective Computing* (see also the book by Rosalind Picard)

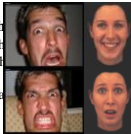


## Overview

- **What** is emotion?
- What **theoretical angles** can we take to study emotion?
- What is **affective computing**?
- A couple of **examples**.
- Why is affective computing **useful**?
- Summary

## Emotion (what)?

- Common emotions: fear, anger, happiness, sadness, surprise, disgust
- **Short episode of synchronicity triggered by event:**
  - subjective feelings (they refer to),
  - tendency to do something,
  - facial expressions,
  - evaluation of the situation (on, thinking),
  - physiological arousal
- **Affect (affectie)**= related to emotion and mood:
  - **emotion** : short term, high intensity, object directed,
  - **mood** : unfocused, long term, low intensity,
  - **attitude** : affect associated with an object/person
  - **affect** : sometimes seen as abstraction of emotion/mood in terms of,
    - **positiveness/negativeness** and **activation/deactivation** (Russell).



## Emotion (why)?

- **Situational evaluation and communication.**
- Heuristic relating events to personal goals, needs and beliefs:
  - evaluates **personal relevance** of event (Scherer) and helps decision-making (*Damasio*),
  - **fast reactions** and **action preparation** (*Frijda*),
  - influence **information processing** and **decision making** (*Damasio*):
    - e.g. adaptation, attention, mental search.
- Communication medium:
  - **communicate** internal state (*Darwin, Ekman*),
  - **alert** others,
  - show **empathy** (understanding of situation of others).

## What angles can we take to study emotion?

- Biological/Neurological (*Damasio, Panksepp, LeDoux, Rolls*):
  - aim: find the necessary / sufficient **brain areas and circuits** involved in emotions /feelings / self-regulation / adaptation.
- Biological/Evolutionary (*Darwin, Ekman*):
  - aim: **why** emotions exist in the first place, what's the **utility** of **emotion**.
- Cognitive/Psychological (*Scherer, Frijda*):
  - aim: understand **relation cognition/emotion**, why does event  $e$  results in emotion  $x$  while:
    - the **same event**  $e$  may result in a **different emotion**, and
    - **other events** may result in the **same emotion**  $x$ .
- Social (*Ekman, and others*):
  - aim: understand the role of **emotion in communication**.

## What is affective computing?

- *Computing that relates to, arises from, or deliberately influences emotions (Picard).*
- Different *types of affective abilities*:
  - **recognize** emotions (perception, *in*),
  - **interpret** (user modeling, interpretation of emotion in context, *processing*)
  - **elicit** emotions (synthetic emotion from simulation, *processing*),
  - **emotional influence** on behavior (adaptation, attention, behaviors),
  - **express** emotions (face, gesture, *out*), and
  - *Affective systems typically use mixtures of these...*
- An **affective computing system** is
  - *a system of computational processes that perceives, expresses, interprets, or uses emotions,*
  - e.g. a **robot**, a **virtual character**, a **tutor agent**, a **fridge**, etc...

## Affective computing, why? (1)

- Advance emotion theory
  - simulated agents that elicit emotions to **study** possible **psychological structure of emotions** (*Scherer*),
    - Causes, structure of experience, effects on thought and behavior
  - emotion as **artificial motivator**
    - e.g. a bored robot that explores (*Canamero*).
- Understand intelligence and adaptation
  - Rational **laws and rules** are **not sufficient** for understanding or predicting human behavior and intelligence
    - e.g. how to sift thru many possible choices (*Damasio, Picard*)
  - simulated **learning agents influenced by emotions**
    - e.g., emotion as reward (*Breazeal, Broekens*),
  - Artificial Intelligence, Artificial Life?

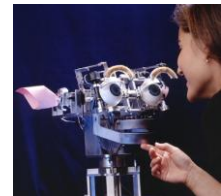
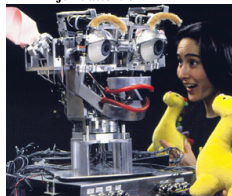
## Affective computing, why? (2)

- Facilitate Human-Computer (Robot) interaction
  - use **emotions** in simulated-agent **plans** (e.g., *reason more human-like*) (*Gratch & Marsella*),
  - **communication and joint attention** (*Breazeal*)
  - robot acceptance (*Heerink*)
  - Persuasive design (VR training, tutor agents (*Gratch & Marsella, Nijholt*))
- Entertainment
  - Computer **games** such as the Sims (*EA*), Aibo Robot (*Sony*).

## Some examples...

## Kismet (*Breazeal*)

- *Social*: Kismet, A framework, using a humanoid head expressing emotions, to study:
  - effect of emotions on **human-machine interaction**.
  - learning of **social robot behaviors** during human-robot play.
  - **joint attention**.



## EARL (at mediatech and liacs)

- *Adaptation*: study the influence of emotion on adaptive behavior:
  - emotion as **reinforcement** (*reward/punishment*),
  - emotion as **influence** on **learning process**,
  - emotion as **information**,
  - artificial emotion **resulting** from **learning process**



## Companion Robots

- Aibo (Sony, Japan)  
Entertainment robot
- I-Cat (Philips, NL)  
Robot assistant for elderly people
- Paro (Wada et al, Japan)  
Robot companion for elderly
- Huggable (MIT, USA)  
Robot companion for elderly



## SIMS 2 (*Electronic Arts*)

- *Entertainment*: emotions are used to provide **entertainment value**.



## STEVE (Rickel/Johnson) and Cosmo (Lester)

- *Training*: Pedagogical agent to train procedural tasks in a virtual environment



## Mission Rehearsal Exercise (*Gratch & Marsella*)

- *Cognitive*: study the influence of artificial emotions on
  - **planning** mechanism of virtual characters,
  - **training effect** on **trainees** (emotion might enhance effect)



## Virtual Patients for Clinical Therapist Skills Training (*Kenny et al*)

- Therapist training using virtual characters



## Virtual Therapy (at Delft)

- Social phobia training: therapist (avatar) & patient. Voice, speech recognition, dialog system.



## Other examples

- Enable a game to adapt to kids with autism spectrum disorder (de Silva et al., 2007)
- Enable a simulate robot to learn better (Broekens, 2007)
- Enable games to adapt to user satisfaction (Yannakakis)
- Enable recommender engines to better predict user preferences (Pommeranz et al., 2008)
- Mood and programmers' performance (Khan et al, 2007)
- Webpage and document analysis for affective aspects.
- Etc...

## To summarize...

- Affect.
  - **emotion** : short term, high intensity, object directed,
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    - **positiveness/negativeness and activation/deactivation.**
- Affective computing
  - *"a system of computational processes that perceives, expresses, interprets, or uses emotions"*
- Why?
  - advance emotion theory,
  - facilitate Human-Computer (Robot) interaction,
  - understand intelligence,
  - Entertainment.