TOWARDS EMPATHIC AI
The Future of Affective Computing

Patrick Gebhard

Saarbrücken, November 25th, 2020
Thank you!
[André et al., Integrating models of personality and emotions into lifelike characters, 99]
[Rist et al., CrossTalk: An interactive installation with animated presentation agents, 02]
[Gebhard et al., Adding the emotional dimension to scripting character dialogues, 03]
What is Affective Computing?
Don’t look now: why you should be worried about machines reading your emotions

Facial recognition

Machines can now allegedly identify anger, fear, disgust and sadness. ‘Emotion detection’ has grown from a research project to a $20bn industry.
Research


ACM ICMI
International Conference on Multimodal Interaction

ACM AAMAS
International Conference on Autonomous Agents and Multiagent Systems

IVA
International Conference on Intelligent Virtual Agents

AAAC
(Association for the Advancement of Affective Computing)

SSPNET
(Social Signal Processing Network)

NCCR Affective Science
(Emotions in Individual Behaviour and Social Processes)

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The IEEE CS journals with the highest 2019 impact factors are:

- **TPAMI** – 17.861
- **IEEE Transactions on Affective Computing (TAC)** – 7.51
- **IEEE Transactions on Dependable and Secure Computing (TDSC)** – 6.864
- **IEEE Transactions on Software Engineering (TSE)** – 6.11
- **IEEE Transactions on Emerging Topics in Computing (TETC)** – 6.043

The IEEE CS magazines with the highest 2019 impact factors are:

- **IEEE MultiMedia** – 4.96
- **Computer** – 4.41
- **IEEE Pervasive Computing** – 4.41
- **IEEE Internet Computing** – 4.23

all important HCI conferences have a track for/contributions to affective computation/social signal processing
Commercial

is kind of ...

User Modeling

clothes
accessories
interior/room design
cultural values

height
posture forward
non-verbal behaviour
interpersonal distance
gesture

mutual gaze
vocal behaviour

behavioural mimicry
interpersonal relation (closeness)
rapport
... what are emotions?

Emotion is information that describes the subjective embodied experience of a situation.
Let’s do a test …

Angry

Distressed

Skeptical

from http://skinnyartist.com/beating-the-green-eyed-bastard/
Ah!

from http://skinnyartist.com/beating-the-green-eyed-bastard/
The problem with emotion-detection technology

Technology that detects human emotion is being used by firms to improve customer service, decide which candidates to interview and optimise the emotional impact of advertising. But experts in the field have warned that some software relies on outdated psychological theories and cannot always be trusted

“... the scientific path forward begins with the explicit acknowledgment that we know much less about emotional expressions and emotion perception than we thought we did …”

[Barrett et al., Emotional Expressions Reconsidered: Challenges to Inferring Emotion From Human Facial Movements, 19]
An extended approach ...
Interaction, Emotions, Memory, and Self

Current Situation

Interaction, Emotions, Memory, and Self

Functional emotion classes

Structural Emotion

Situational Emotion

Communicative Emotion

based on [Moser, von Zeppelin, Die Entwicklung des Affektsystems, 96]
Emotions - Inside and Outside

**None**
- null

**Avoidance**
- Avert Gaze, Gaze Wandering
- Joy → facial expression: smile

**Attack_Self**
- Searching Gaze (Avert Gaze)
- Disgust → facial expression: disgust

**Attack_Other**
- Directed Gaze, spacious gestures/postures
- Reproach → facial expression: anger

**Withdrawal**
- Head adaptors, lip biting,
  little body movements, avert gaze
- Fear/Anger → facial expression: distress, anger

[Ekman et. al. 76/78]

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**Upper Face Action Units**

<table>
<thead>
<tr>
<th>AU 1</th>
<th>AU 2</th>
<th>AU 4</th>
<th>AU 5</th>
<th>AU 6</th>
<th>AU 7</th>
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<tbody>
<tr>
<td>Inner Brow Raiser</td>
<td>Outer Brow Raiser</td>
<td>Brow Lowerer</td>
<td>Upper Lid Raiser</td>
<td>Cheek Raiser</td>
<td>Lid Tightener</td>
</tr>
<tr>
<td><em>AU 41</em></td>
<td><em>AU 42</em></td>
<td><em>AU 43</em></td>
<td>AU 44</td>
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<tbody>
<tr>
<td>Nose Wrinkler</td>
<td>Upper Lip Raiser</td>
<td>Nasolabial Depressor</td>
<td>Lip Corner Puller</td>
<td>Cheek Puller</td>
<td>Dimpler</td>
</tr>
<tr>
<td>AU 15</td>
<td>AU 16</td>
<td>AU 17</td>
<td>AU 18</td>
<td>AU 20</td>
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<th><em>AU 26</em></th>
<th><em>AU 27</em></th>
<th>AU 28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lip Corner Depressor</td>
<td>Lower Lip Depressor</td>
<td>Chin Raiser</td>
<td>Lip Pucker</td>
<td>Lip Stretcher</td>
<td>Lip Funneler</td>
</tr>
<tr>
<td>AU 19</td>
<td>AU 21</td>
<td>AU 19</td>
<td>AU 20</td>
<td>AU 21</td>
<td>AU 22</td>
</tr>
</tbody>
</table>

**Lower Face Action Units**

- Head adaptors, lip biting,
  little body movements, avert gaze
- Fear/Anger → facial expression: distress, anger

[Ekman et. al. 76/78]

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**THE COGNITIVE STRUCTURE OF EMOTIONS**

Andrew Ortony, G. L. Clore, and A. Collins 88

[Ortony, Collins 88]

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[None null]

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[Ortony, Collins 88]
ALMA - A Computational Model of Affect for building believable behaviour

Appraisal
GoodEvent
BadEvent
GoodEventForGoodOther

Emotion

Influence Basic Intensity and Time of Decay

Influence Current Mood

Influence Basic Intensity and Time of Decay

Personality

Computes Default Mood

Mood

alma.dfki.de

[McCrae, John, An introduction to the five-factor model and its implications, 92]

[Becker, Structural and Relational Analyses of Emotion and Personality Traits, 01]


[Mehrabian, Analysis of the Big-five Personality Factors in Terms of the PAD TemperamentModel, 96]

[Mehrabian, Pleasure-arousal-dominance: A general framework for describing and measuring individual differences in temperament, 96]

[Gebhard, A Layered Model of Affect, 05]
ALMA extension MARSSI: Model of Appraisal, Regulation, and Social Signal Interpretation

1. **Preparation: Hypotheses Generation**

   ![Diagram showing the process of hypothesis generation]

   - **BadActSelf** → **Shame** → **Blush, Head down, ...**
   - **Avoidance** → **Avert Gaze, Gaze Wandering** → **Joy** → **facial expression: smile**
   - **Attack_Self** → **Searching Gaze (Avert Gaze)** → **Disgust** → **facial expression: disgust**
   - **Attack_Other** → **Directed Gaze, spacious gestures/postures** → **Reproach** → **facial expression: anger**
   - **Withdrawal** → **Head adaptors, lip biting, little body movements, avert gaze** → **Fear/Anger** → **facial expression: distress, anger**

2. **Approximation: Social Signal Interpretation**

   ![Diagram showing the process of social signal interpretation]

   Advanced classifiers for the recognition of regulatory processes

   [Gebhard et al. 18]
Authoring and Managing SIA Behaviour

decad.sb.dfki.de

scenemaker.dfki.de
Social Training and Learning

Experiencing difficult situations in an emotional way

Research Fellow Talk, Patrick Gebhard, November 25th 2020
Empathic Training

Analysis of Input and Behaviour

- Mimic/Gesture/Body Speech
- depth camera
- microphone

Generation of Reactions

- animation and speech commands

Gebhard et al., Serious Games for Training Social Skills in Job Interviews 18
Schneeberger et al., Can Social Agents elicit Shame as Humans do? 19
Typical Classification

[SHORE®, www.iis.fraunhofer.de/shore]
Before we start, a little question: Where did you get the outfit? Somehow it doesn't really suit you.

I...

Well, I feel comfortable in it and I actually think that you dress best in that, what feels most comfortable.

Okay... Let's begin...
Automatic Generation of Social Sign Language

- How do deaf people live?
- How do they communicate?
- What is important to them?
- Other social values
- Other communication of emotions
- Other individual experiences
- Integration of these aspects in automatic generation
Collaboratively Working with Technology

Technology that is socially supportive
Working with Social Cobots
Empathic Self-Driving Cars

- Automation of driving has high market potential
- Relies on technology acceptance
- Employing a socially interactive agent
- Managing user trust through interaction
- Transparency and user participation
Reducing Pedestrian Path Prediction Error with Social Signal Analysis and Cognitive Modelling

Pedestrians (n+m):
- Past trajectories
- Features
Reducing Pedestrian Path Prediction Error with Social Signal Analysis and Cognitive Modelling

Pedestrians (n+m):
- Past trajectories
- Features

Dynamic Bayesian Nets (n*m)

Pedestrian Interaction Graph

[Muscholl et al. SIMP3: Social Interaction-Based Multi-Pedestrian Path Prediction By Self-Driving Cars, 20 (in press)]
Empathic Assistance for Health and Wellbeing

Empathic SIAs for therapy support
Therapy Assistance in your Pocket

Relapse (> 50-65%)

Diagnose | In-patient Treatment | Day Hospital | Release | Out-Patient Treatment

Burnout- Reintegrations- Coach

2018-2021

Treatment Gap 56.3% (median, worldwide) for major depression

[Statistics of German Health Insurances, 19]
[Beshai et al. Relapse and recurrence prevention in depression: Current research and future prospects, 11]
[Kohn et al. The treatment gap in mental health care, 04]
• Interactive diary

• Lydia shows empathic behavior

• ... listens and asks for

• Automatic annotation for later doctor's consultations (requires user consent!)

• Exercises for own emotion regulation (biofeedback)

• Ongoing "Stress reduction" studies

[Gebhard et al., Designing a Mobile Social and Vocational Reintegration Assistant for Burn-out Outpatient Treatment 19]

[Schneeberger et al., Developing a Social Biofeedback Training System for Stress Management Training 19]
Conclusion and Future Work

- Interdisciplinary research concept
- Deep emotion simulation
- Always on, socially interactive agents (SIA)
- Comparative Studies - Human-Human vs. Human-SIA
- More empathy in algorithms
THANK YOU!

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