

German Research Center for Artificial Intelligence
Cognitive Assistants Department
Research Fellow



TOWARDS EMPATHIC AI

The Future of Affective Computing

Patrick Gebhard

Saarbrücken, November 25th, 2020

A photograph of a modern, multi-story building with a glass facade and a sign that reads "DFK Deutsches Forschungszentrum für Künstliche Intelligenz GmbH". The building is set against a clear sky and is surrounded by greenery. The text "Thank you!" is overlaid in the center of the image.

Thank you!

CYBERELLA



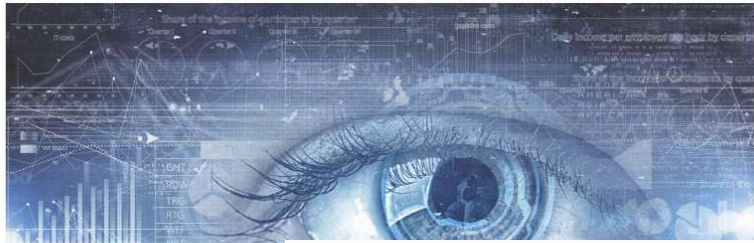
[André et al., Integrating models of personality and emotions into lifelike characters, 99]
[Rist et al., CrossTalk: An interactive installation with animated presentation agents, 02]
[Gebhard et al., Adding the emotional dimension to scripting character dialogues, 03]

What is Affective Computing?



Affective Computing: Wie Künstliche Intelligenz menschliche Emotionen versteht

13. März 2018 / Michaela Tiedemann / Artikel



Inhaltsübersicht

1. Wie Maschinen lernen, Menschen zu verstehen
2. Anwendungsbereiche von Affective Computing
3. Die Schnittstelle von Mensch und Maschine
4. Künstliche emotionale Intelligenz als Werkzeug

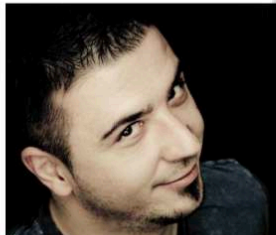
Was wäre, wenn in Zukunft die AI eines Aut...
Consumer Electronics Messe CES in LA wur...
biometrische Daten, erkennt und öffnet a...
Stimmung der Interessen an Menschen sind...

WELT+ EMOTIONALE INTELLIGENZ

Bald kennt der Computer Sie besser als Ihre Familie

Veröffentlicht am 18.01.2018 | Lesedauer: 7 Minuten

Von **Thomas Heuzeroth**, Los Angeles



TELEPOLIS

POLITIK WIRTSCHAFT WISSENSCHAFT ENERGIE & KLIMA KULTUR

TELEPOLIS > WISSENSCHAFT > DIGITALISIERUNG DER GEFÜHLE?

Digitalisierung der Gefühle?

02. April 2018 - Roland Benedikter



Computer lernen, menschliche Emotionen natürlich zu interpretieren

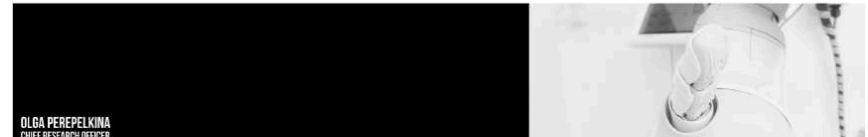
26.07.18 | Redakteur: Sebastian Gerstl

Forscher des MIT Media Lab haben ein maschinelles Lernmodell entwickelt, das Computern näherbringt,

I Know How You Feel

Imagine a robot that can get your ironic joke and smile back — this is the future that the developers of AI-based emotion recognition technology are approaching every day. Among them is Neurodata Lab, which recently set the machine the task of deciphering the mysterious smile of Mona Lisa. How did the algorithm work and did the machines learn to distinguish fake emotions? Read the interview with Neurodata Lab Chief Research Officer Olga Perepelkina.

Neurodata Lab Feb 25, 2019 - 6 min read



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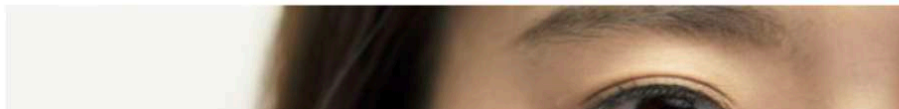
News Opinion Sport Culture Lifestyle

Coronavirus World UK Environment Science Global development Football Tech

Facial recognition

Don't look now: why you should be worried about machines reading your emotions

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



GOETHE INSTITUT JAPAN

START DEUTSCHE SPRACHE KULTUR ÜBER UNS STANDORTE

Q MEIN GOETHE.DE - ANMELDEN DE JA

SEX (los) SEX-ROBOTER: DAS ENDE MENSCHLICHER NÄHE?

KULTUR

Magazin

Projekte

- gelda@goethe
- Terézia Mora: Liebe unter Allens
- Symposium: Mehrsprachigkeit
- Kultur in Atemnot
- Fermentation Station
- #Studio202X - Staffel 2
- Danachgedanken
- Social Translating
- Kakohashi-Literaturpreis
- Residenzprogramm Villa Kamogawa
- Service



LSR 2017: THIRD INTERNATIONAL CONGRESS ON LOVE AND SEX WITH ROBOTS | © LSR2017

Was steckt hinter dem Wunsch nach künstlich belebten menschlichen Abbildern? Ist es nur eine Folge des technischen und digitalen Fortschritts oder ein Symptom der gesellschaftlich-kulturellen Lage?

Copyright: Goethe-Institut e. V., Goethe-Institut Japan August 2017

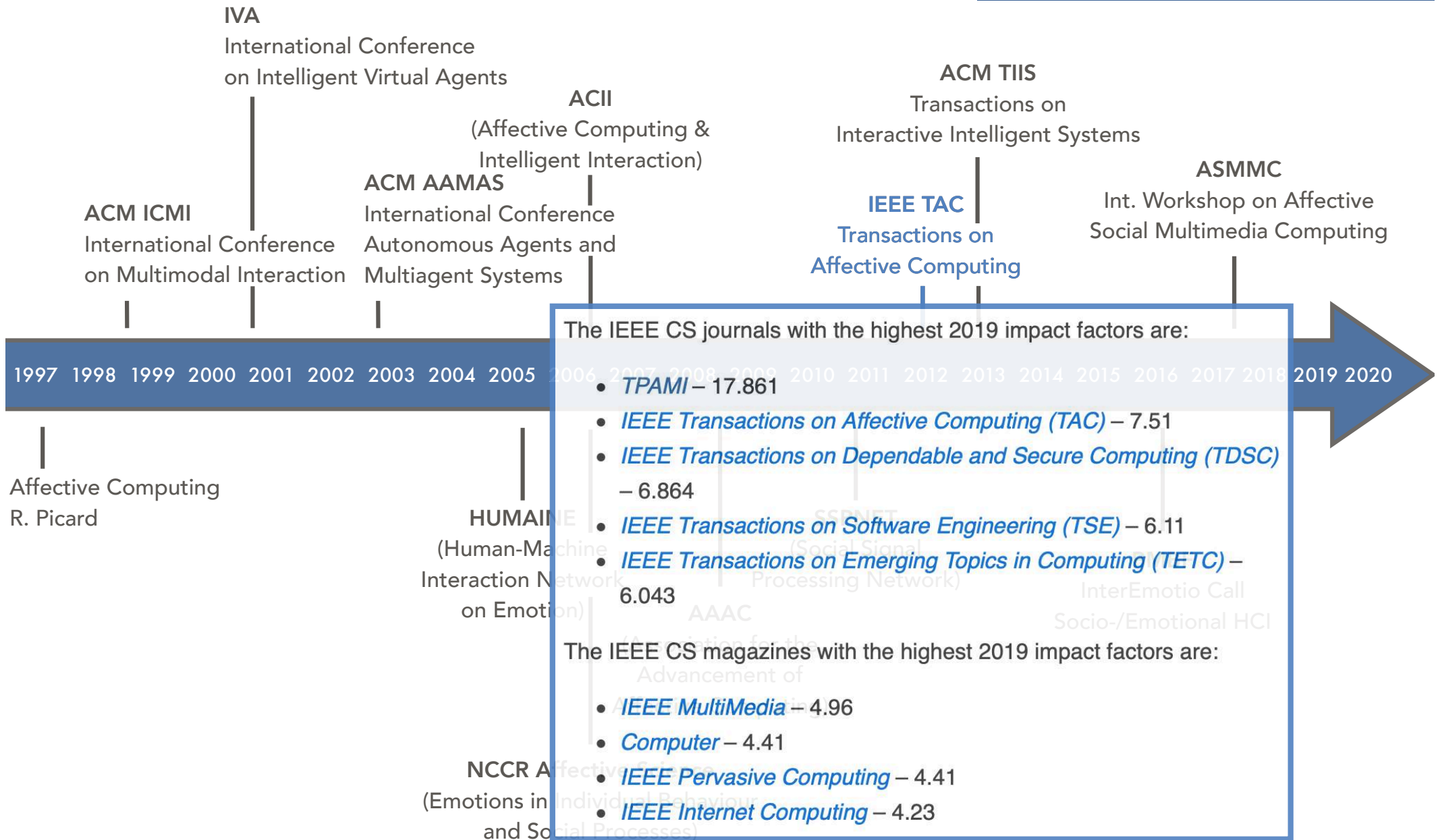
Fortschritte in den Gebieten der Hard- und der Software erlauben Maschinen eine immer glaubhaftere Nachahmung von beobachtbarem menschlichen Verhalten für verschiedenartige Anwendungen. Erste technische Systeme - gerade aus dem „Uncanny Valley“ entstieg - sind akzeptierte Bestandteile unseres täglichen Lebens. Die Fähigkeiten solcher Systeme werden stets verbessert, was deren Akzeptanz zuträglich ist. Konkret übernehmen Haushalts-, Pflege-, Sexroboter und Digitale Bediener Aufgaben in

Haben Sie noch Fragen zu diesem Artikel? Schreiben Sie uns!

teilen

Research

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



Commercial

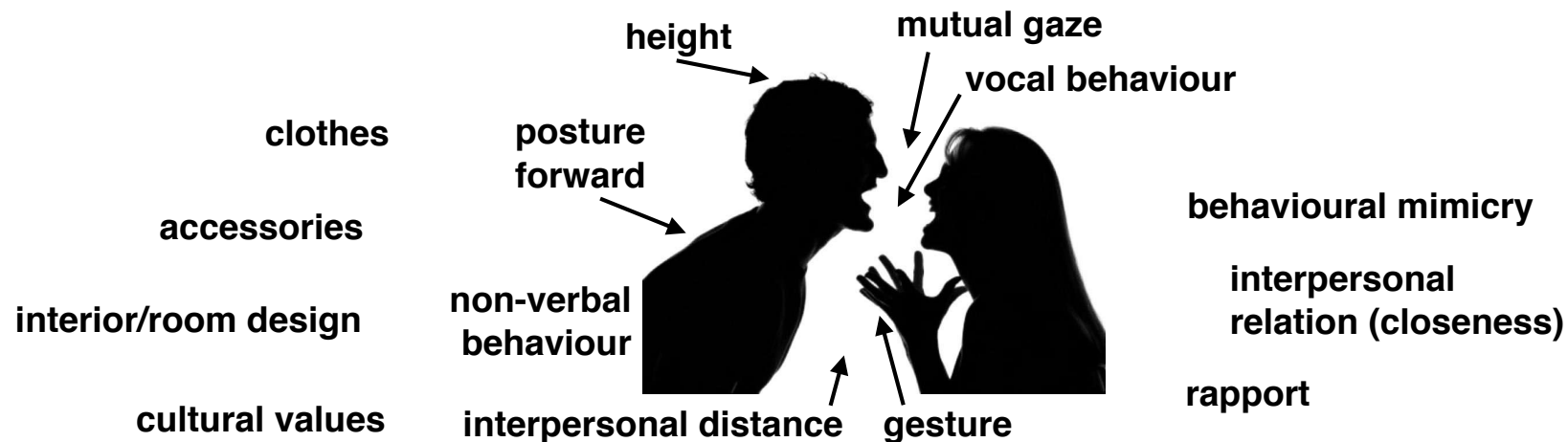
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020



:) Affectiva
R. Picard



is kind of ... User Modeling



A photograph showing a group of people running away from a bear in a field. The bear is on the left, and the people are running towards the right. One person in the center is holding a camera on a tripod. The scene is set in a grassy field with trees in the background.

... what are emotions?

Emotion is information that describes the subjective embodied experience of a situation.

Let's do a test ...



from <http://skinnyartist.com/beating-the-green-eyed-bastard/>

Ah!



from <http://skinnyartist.com/beating-the-green-eyed-bastard/>

Emotion-detecting tech should be restricted by law - AI Now

[<https://www.bbc.com/news/technology-50761116>]

By Leo Kelion
Technology desk editor

12 December 2019



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

[<https://www.theneweconomy.com/technology/the-problem-with-emotion-detection-technology/>]

By Charlotte Gifford | Monday, June 15th, 2020

„... 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]

Affect-recognition systems

A leading research centre emotion-detecting tech.

The AI Now Institute says

Despite this, systems are c for signs of deception, and

It wants such software to t affect people's lives and/o

The US-based body has fo company developing its ov cautioned that any restrict hamper all work being dor



Our bodies go through a chain of physiological chang deeper breathing and an intensified heart rate. These analysed with artificial intelligence

Emotion detection is a hot ask in marketing, but the tech just isn't ready yet

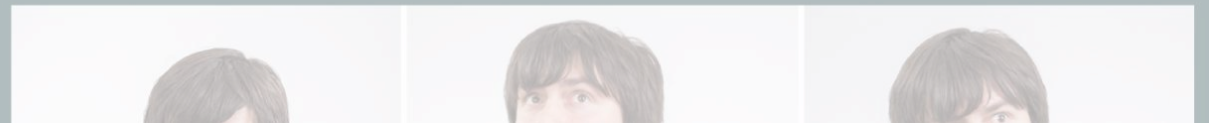
[<https://venturebeat.com/2020/05/02/emotion-detection-is-a-hot-ask-in-marketing-but-the-tech-just-isnt-ready-yet/>]

Paul Barba, Lexalytics

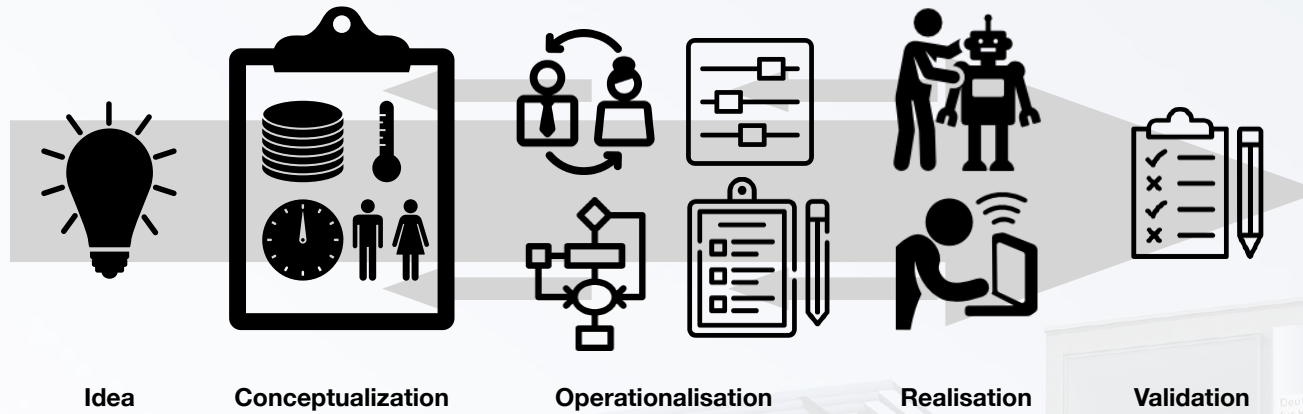
@PaulBarba_

May 2, 2020 12:12 PM

AI



Computer Science Focus



Idea

Conceptualization

Operationalisation

Realisation

Validation

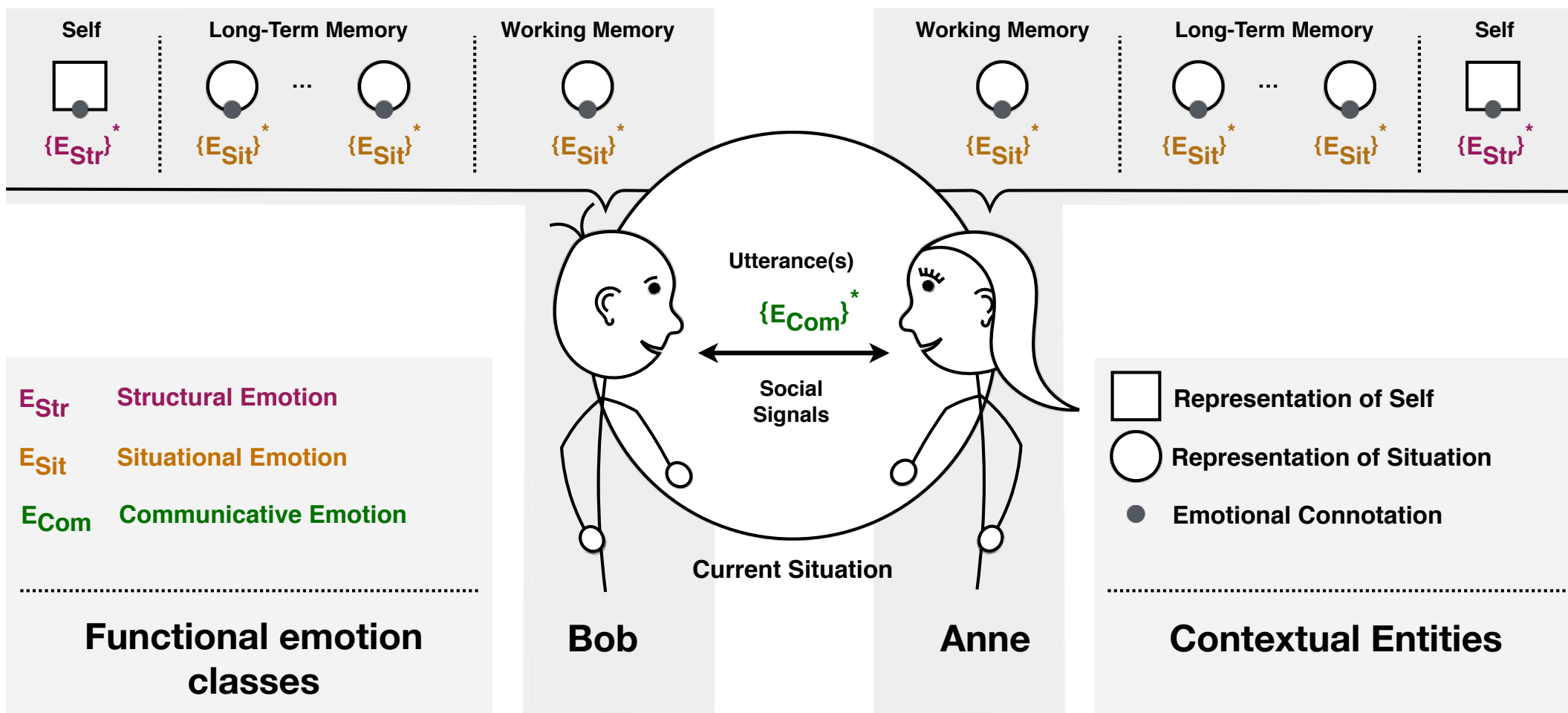
DFK
Deutsches Forschungszentrum
für Künstliche Intelligenz GmbH

Social Science Focus

An extended approach ...



Interaction, Emotions, Memory, and Self



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

[Gebhard et al. 18]

Communicative

Situational

Structural

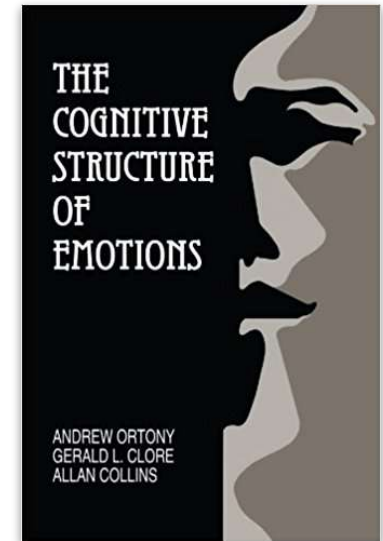
Intrapsychic Regulation

Intrapsychic Regulation

Upper Face Action Units					
AU 1	AU 2	AU 4	AU 5	AU 6	AU 7
*AU 41	*AU 42	*AU 43	AU 44	AU 45	AU 46
Lower Face Action Units					
AU 9	AU 10	AU 11	AU 12	AU 13	AU 14
AU 15	AU 16	AU 17	AU 18	AU 20	AU 22
AU 23	AU 24	*AU 25	*AU 26	*AU 27	AU 28

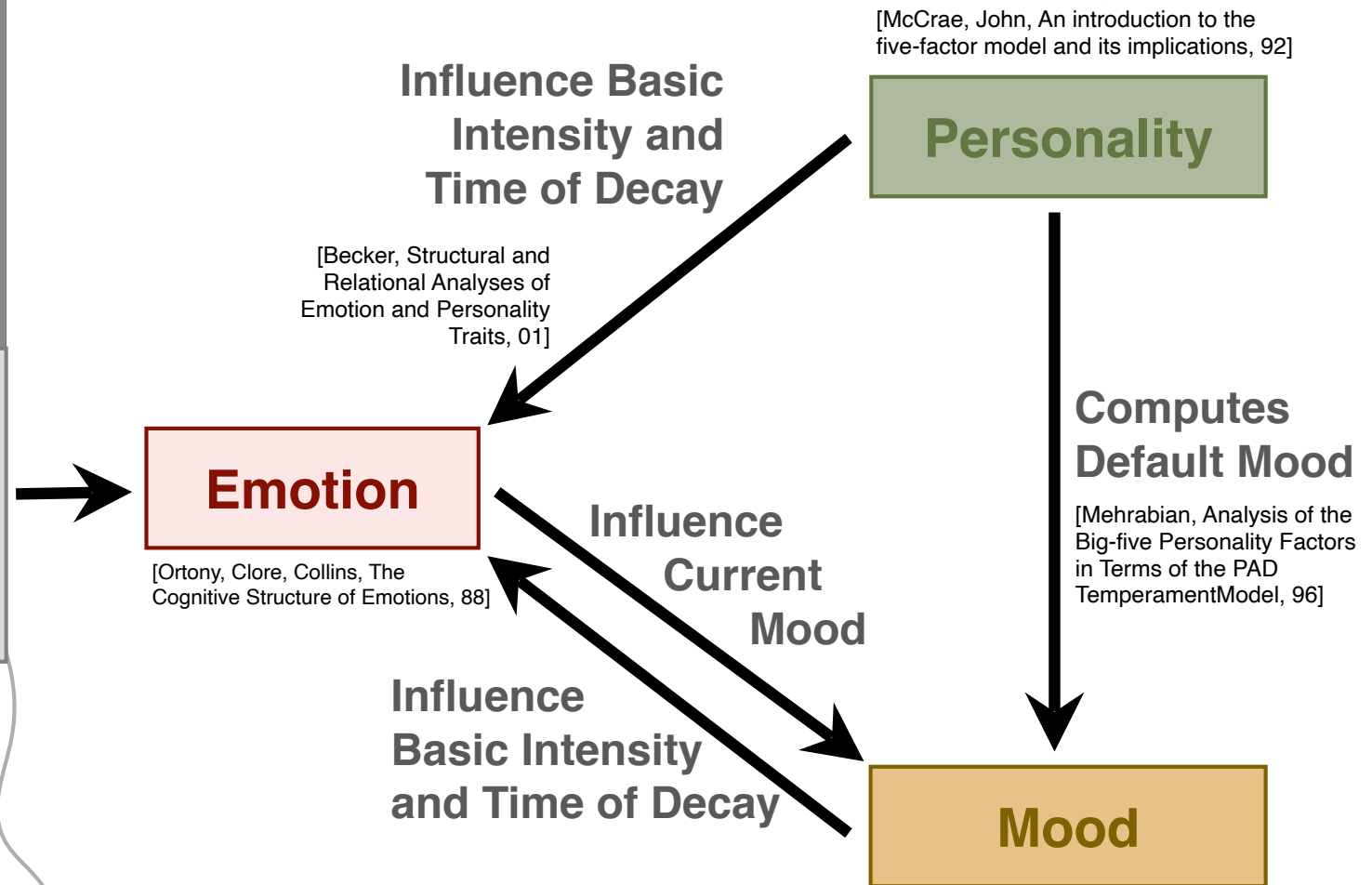
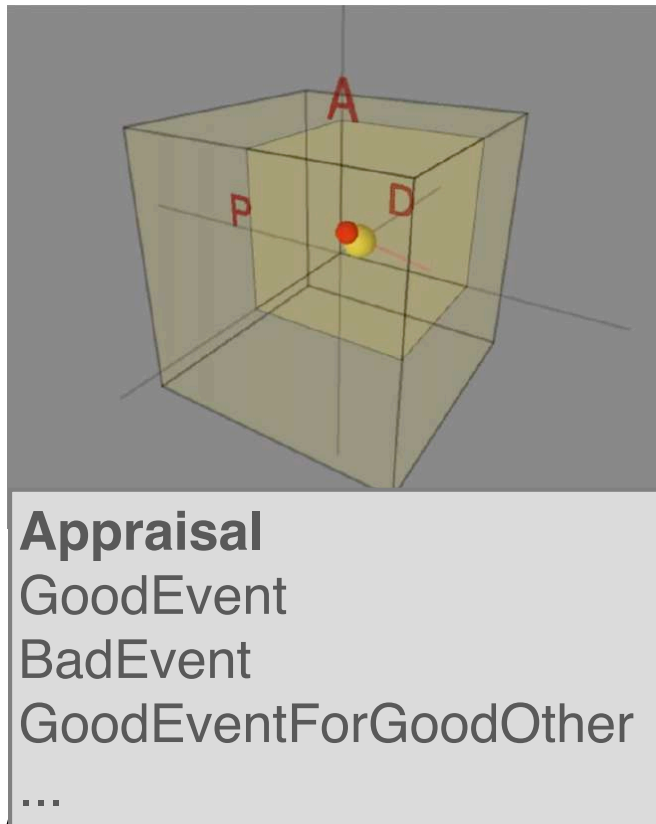
[Ekman et. al. 76/78]

- BadEventForSelf
- GoodEventForSelf
- BadEventForBadOther
- BadEventForGoodOther
- GoodEventForBadOther
- GoodEventForGoodOther
- BadLikelyEvent
- BadUnlikelyEvent
- GoodLikelyEvent
- GoodUnlikelyEvent
- EventConfirmed
- EventDisonfirmed
- BadActSelf
- GoodActSelf
- BadActOther
- GoodActOther
- NastyThing
- NiceThing



[A. Ortony, G. L. Clore, and A. Collins 88]

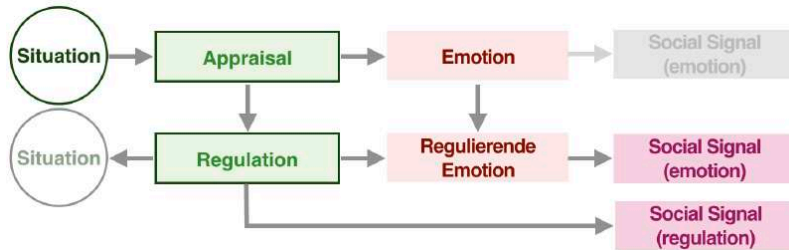
ALMA - A Computational Model of Affect for building believable behaviour



alma.dfki.de

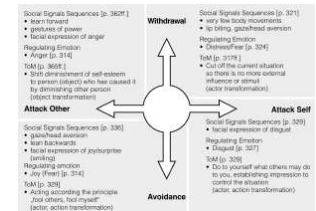
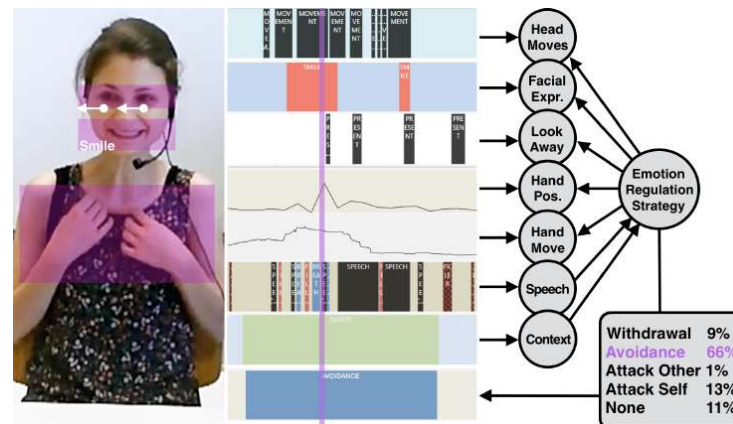
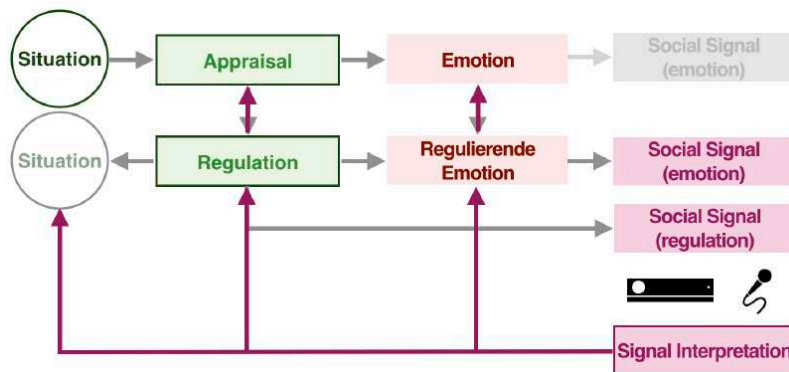
ALMA extension MARSSI: Model of Appraisal, Regulation, and Social Signal Interpretation

1. Preparation: Hypotheses 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

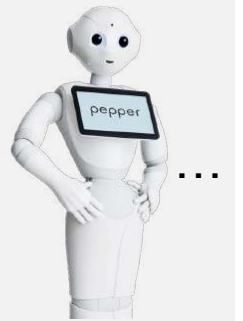
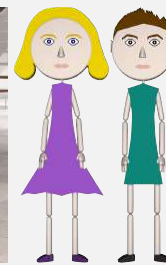
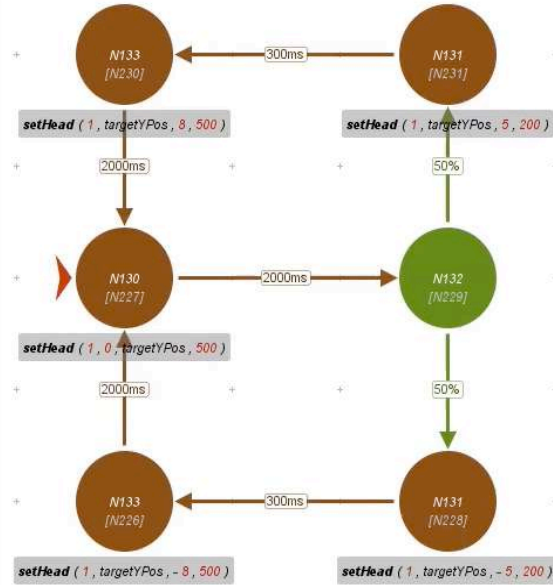
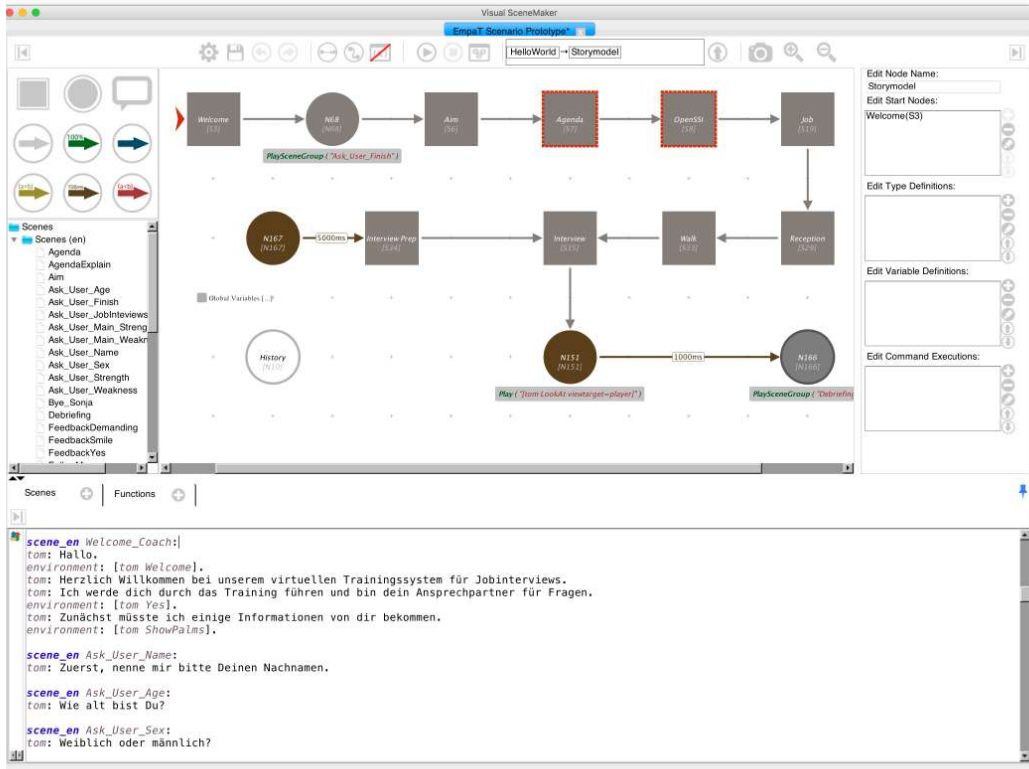
2. Approximation: Social Signal Interpretation



Annotated Dyadic Interaction

Advanced classifiers for the recognition of regulatory processes

Authoring and Managing SIA Behaviour



decad.sb.dfki.de


scenemaker.dfki.de



VisualSceneMaker Research and Industry Projects



EMPAT
DFKI, 2015-2018



Emma
emotional mobile assistant
DFKI, 2018-2021

Bundesministerium für Bildung und Forschung



IRIS
External, 2009-2012



IDEAS4Games  
DFKI, 2007-2008

TARDIS  
Training young Adult's Regulation of emotions and Development of social Interaction Skills
DFKI, 2011-2014

X Roads
External, 2015-2020

Julius-Maximilians-
UNIVERSITÄT WÜRZBURG

ecute  
Education in Cultural Understanding, Technology enhanced
External, 2010-2013

virtual human
www.virtual-human.org
DFKI, 2003-2007

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yello
DFKI 2009

(Visual)SceneMaker

SEM PROM  
DFKI, 2008-2011

Bundesministerium für Bildung und Forschung

DynaLearn  
External, 2008-2011

Pegasus Spiele

SmartSenior  
DFKI, 2009-2012

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KRISTINA
External, 2015-2018

KomParse  
DFKI, 2008-2011



AUTOSTADT VirtualConstructor
DFKI, 2007-2014

2008
DFKI, 2008-2011

DFG
DFKI, 2018-2021

MindBot  
DFKI, 2020-2023

INTAKT  
DFKI, 2010-2013

Bundesministerium für Bildung und Forschung

2013

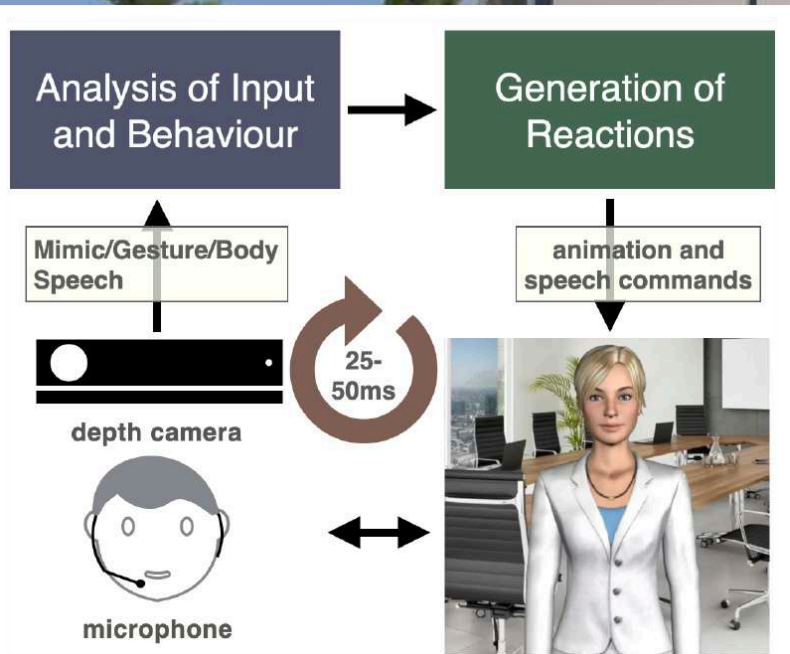
2018

Social Training and Learning

Experiencing difficult situations in an emotional way



Empathic Training



[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]



Charamel

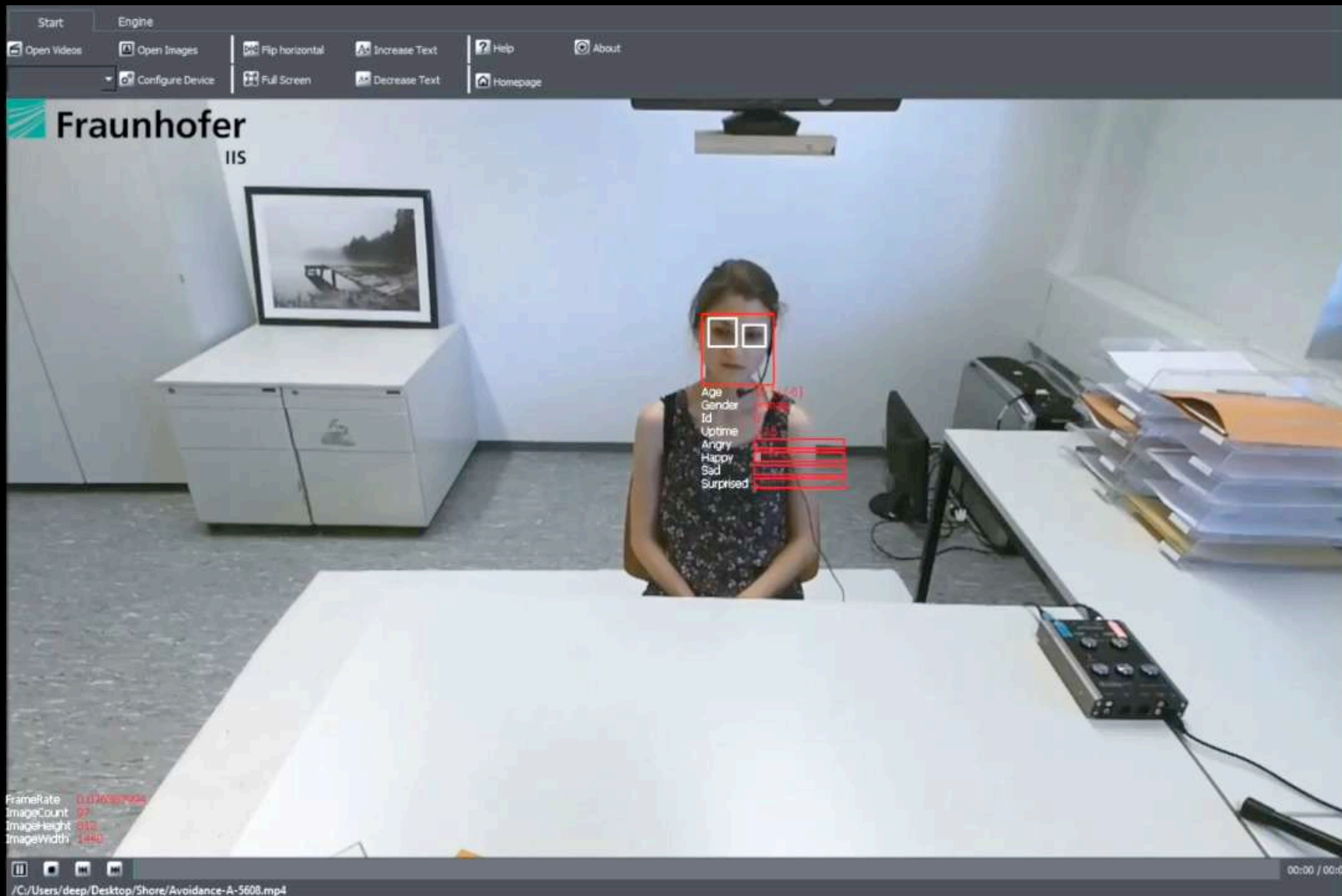


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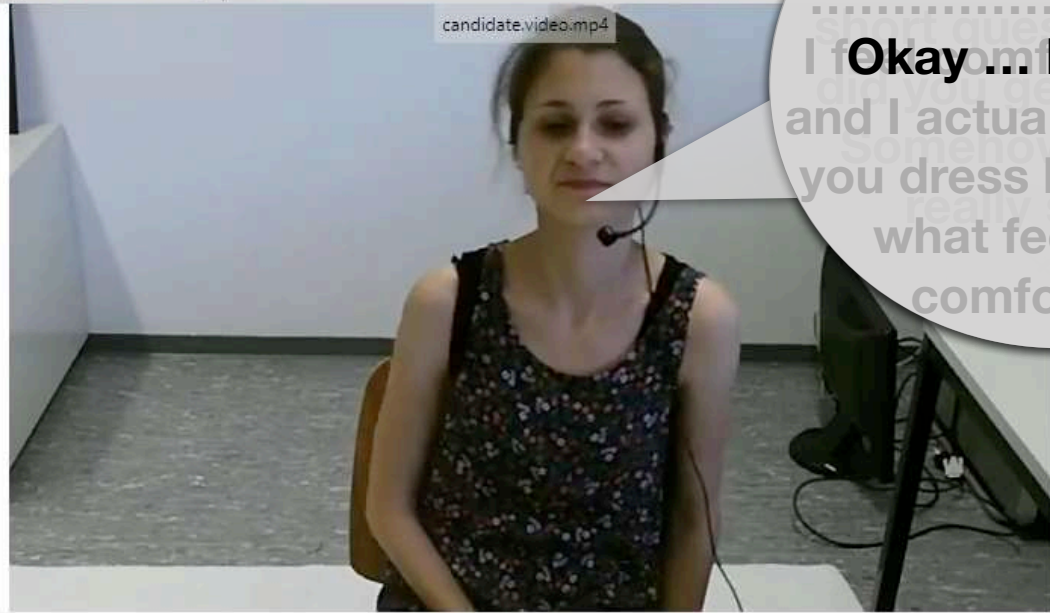
2015-2018



Typical Classification



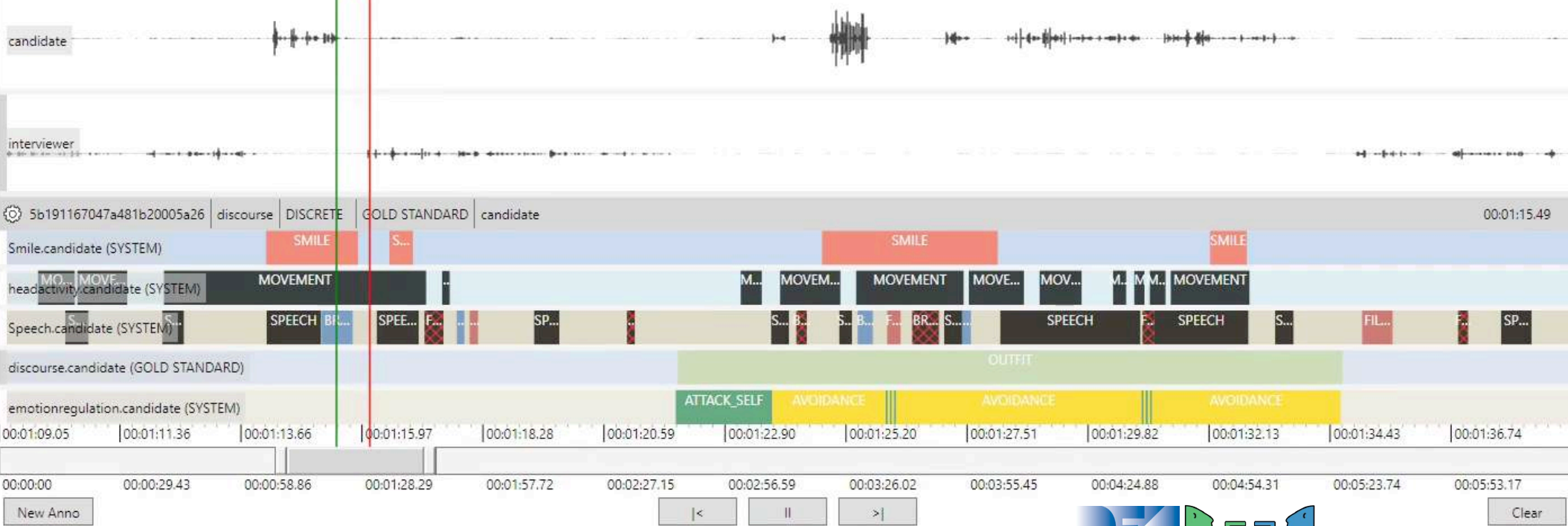
[SHORE®, www.iis.fraunhofer.de/shore]



.....
well,
 I **Okay.m Let's begin**
 and I actually think that
 you dress best in that,
 what feels most
 comfortable.

interviewer.video.mp4 | 0 | 1 | 48000 Hz | 4 bytes | FLOAT | Stats | min -0.5803223 | max 0.9174805 | -0.01092529

Volume | 00:01:16.12/00:06:22.61



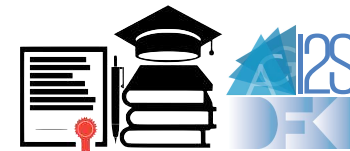
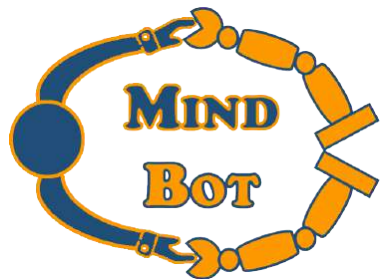
Automatic Generation of Social Sign Language

- 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

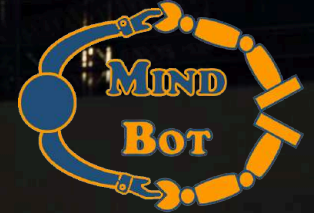
Technology that is socially supportive



Working with Social Cobots



Horizon 2020
European Union funding
for Research & Innovation



2020-2023

ASSOCIAZIONE
la Nostra Famiglia

STIIMA

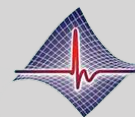
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per il Manifatturiero Avanzato
Consiglio Nazionale delle Ricerche

UNIA Universität
Augsburg
University

ffri University of Rijeka
Faculties of Humanities
and Social Sciences



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DEGLI STUDI
DI MILANO



BioRICS

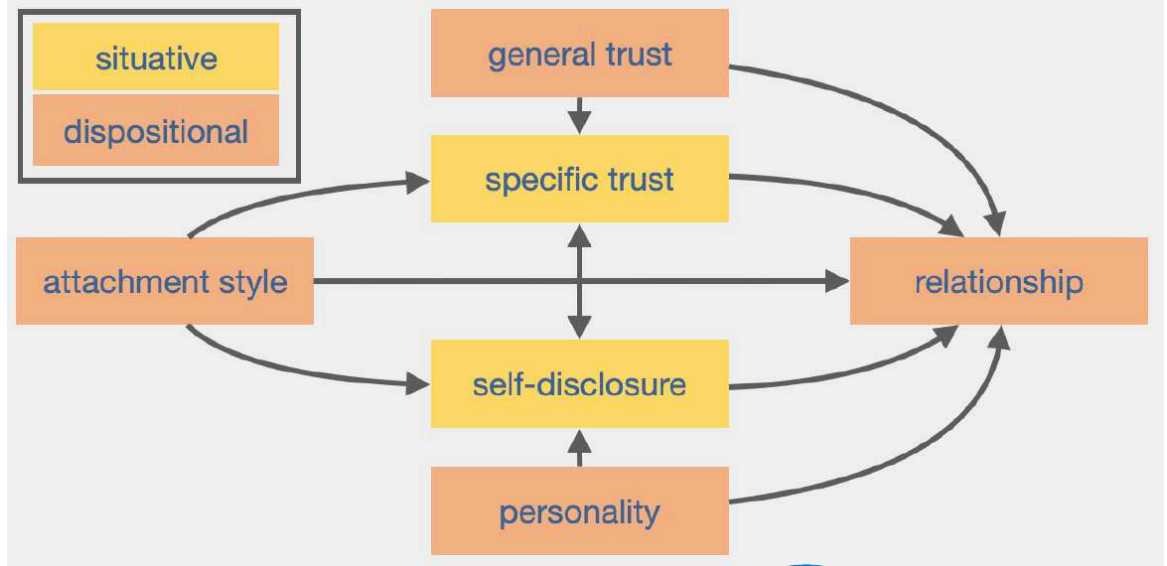
KUKA



MINISTARSTVO RADA I
MIROVINSKOGA SUSTAVA

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

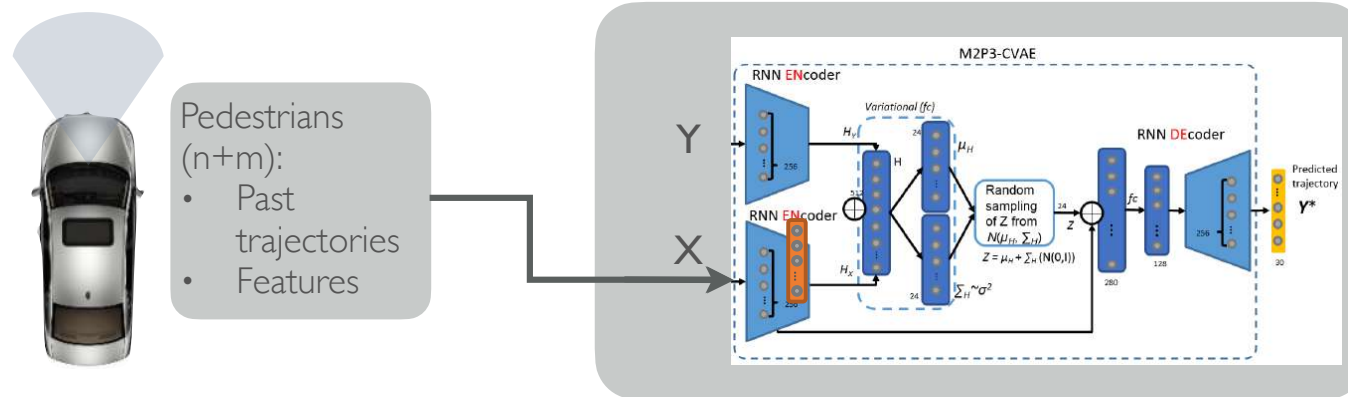
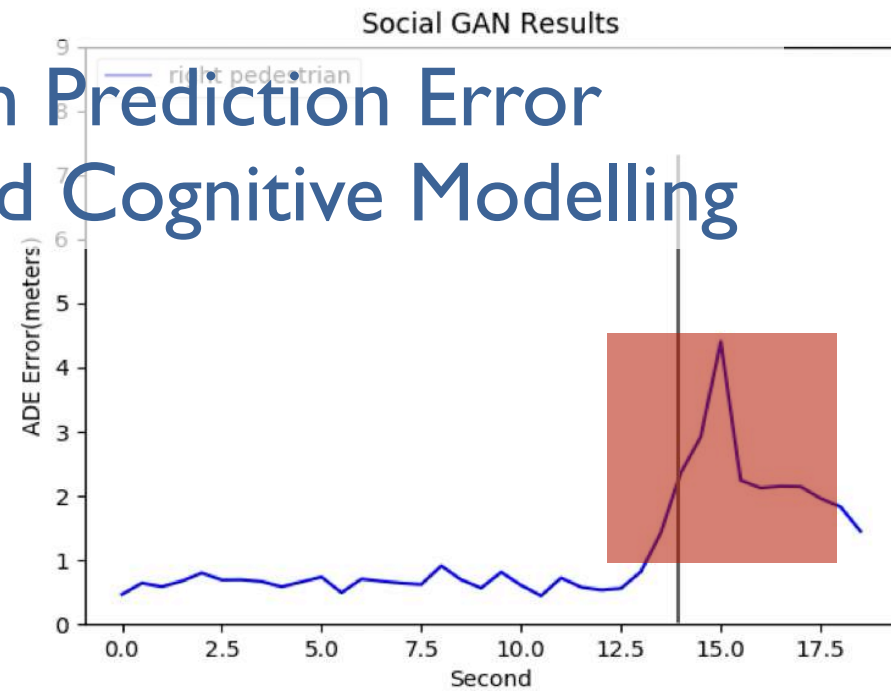


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und Technologie

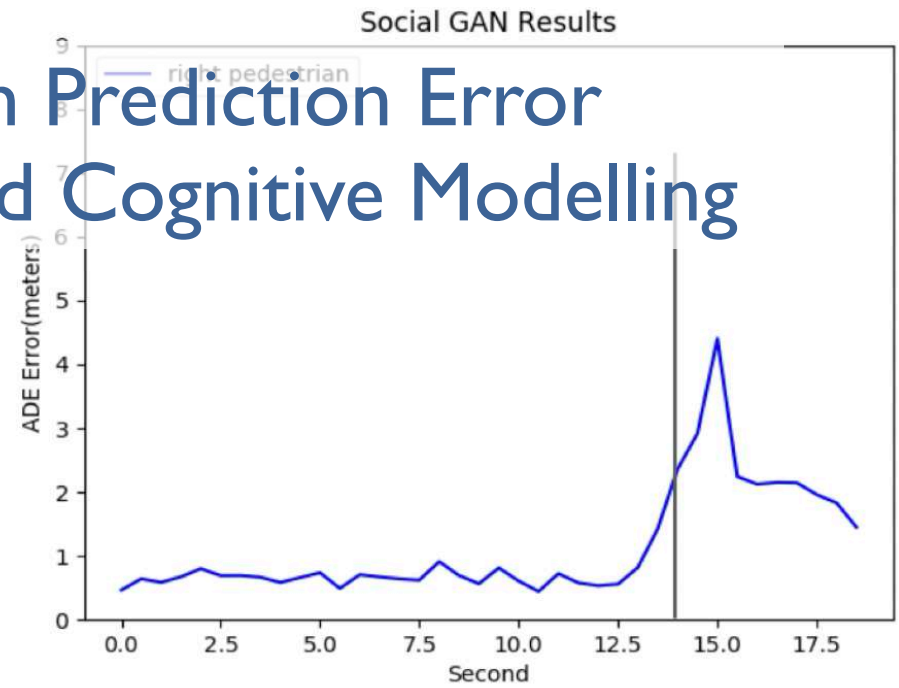


2020-2023

Reducing Pedestrian Path Prediction Error with Social Signal Analysis and Cognitive Modelling



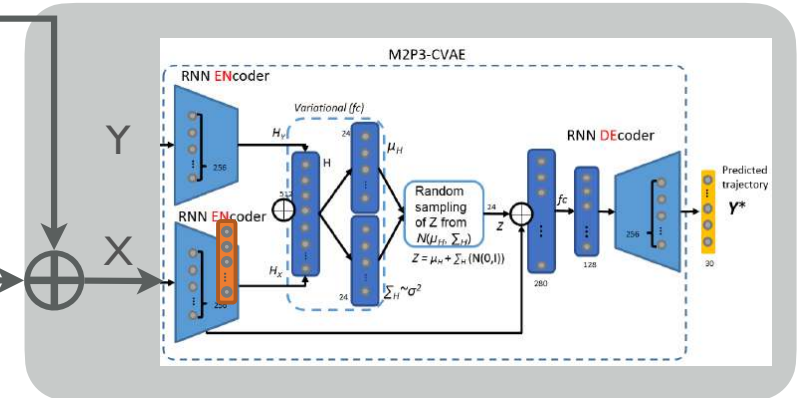
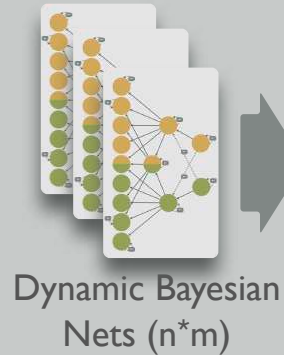
Reducing Pedestrian Path Prediction Error with Social Signal Analysis and Cognitive Modelling



Pedestrians (n+m):

- Past trajectories
- Features

DBN features



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

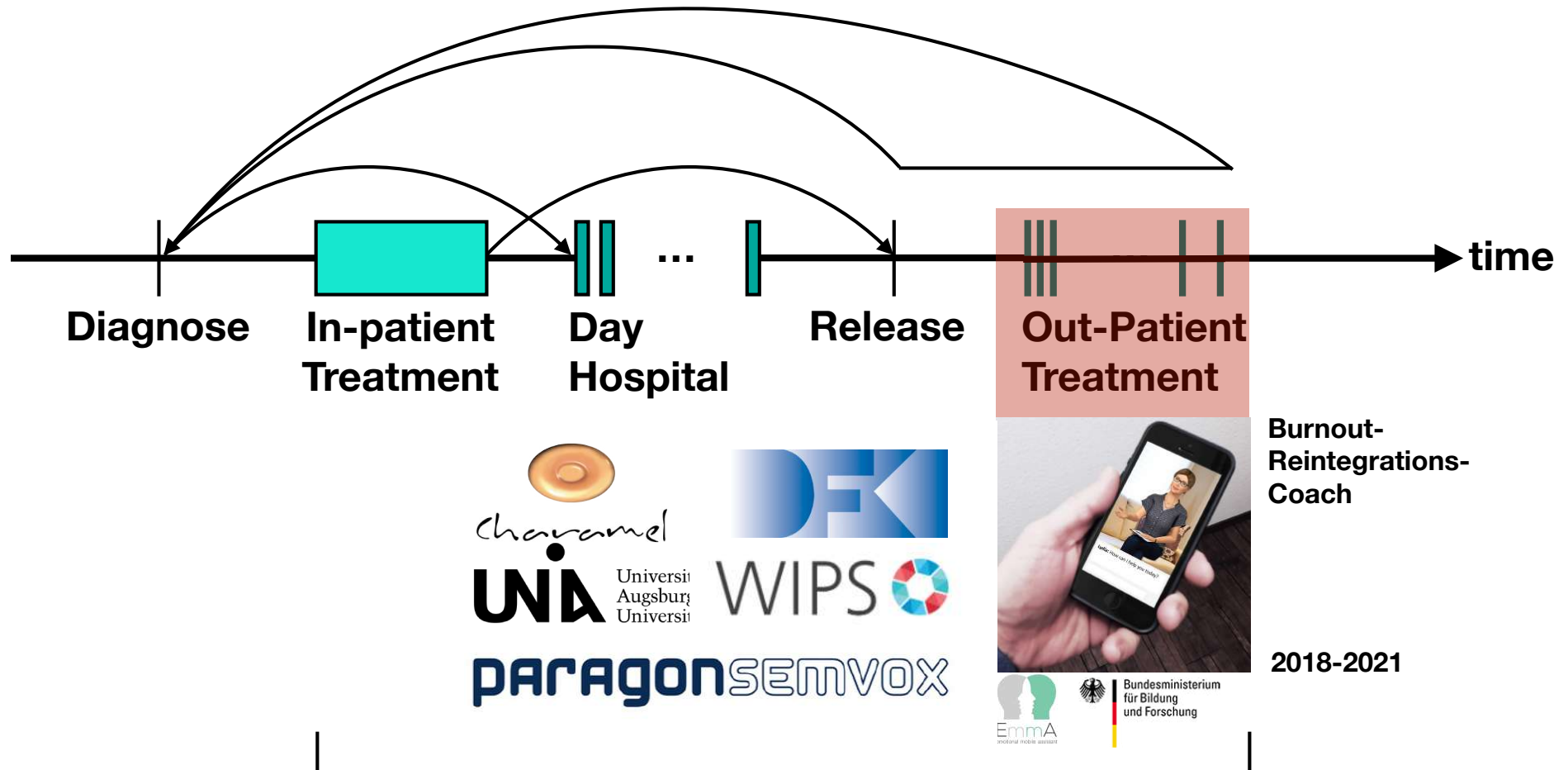
Empathic Assistance for Health and Wellbeing

Empathic SIAs for therapy support



Therapy Assistance in your Pocket

Relapse (> 50-65%)



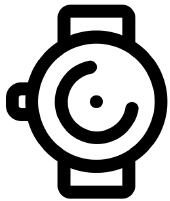
Treatment Gap 56,3% (median, worldwide) for major depression

[Statistics of German Health Insurances, 19]

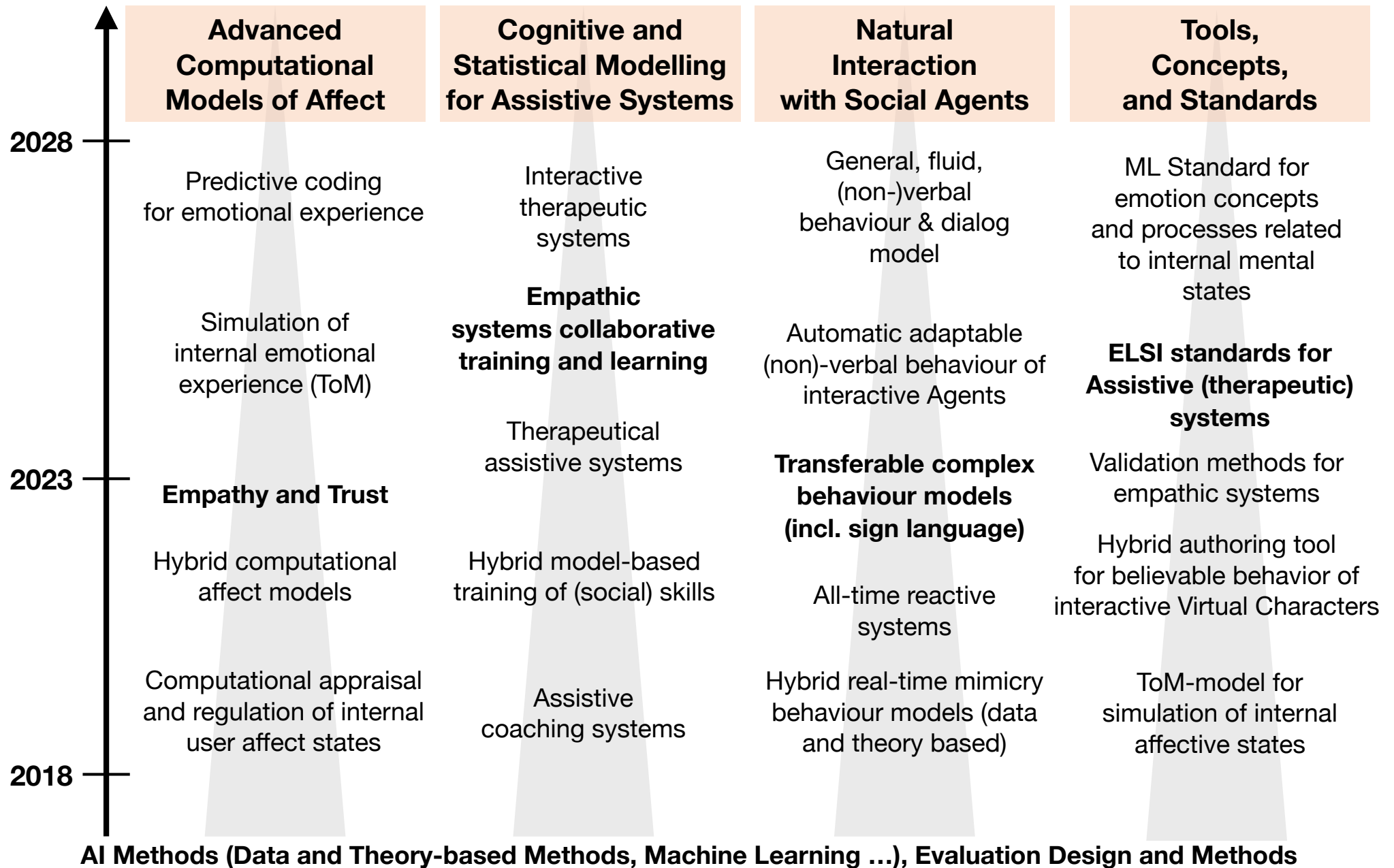
[Beshai et al. Relapse and recurrence prevention in depression: Current research and future prospects, 11]

[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

ACG Research Roadmap



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



German Research Center for Artificial Intelligence
Research Fellow



THANK YOU!

TOWARDS EMPATHIC AI

The Future of Affective Computing

Patrick Gebhard

Saarbrücken, November 25th, 2020