Quality and Usability Lab, TU Berlin

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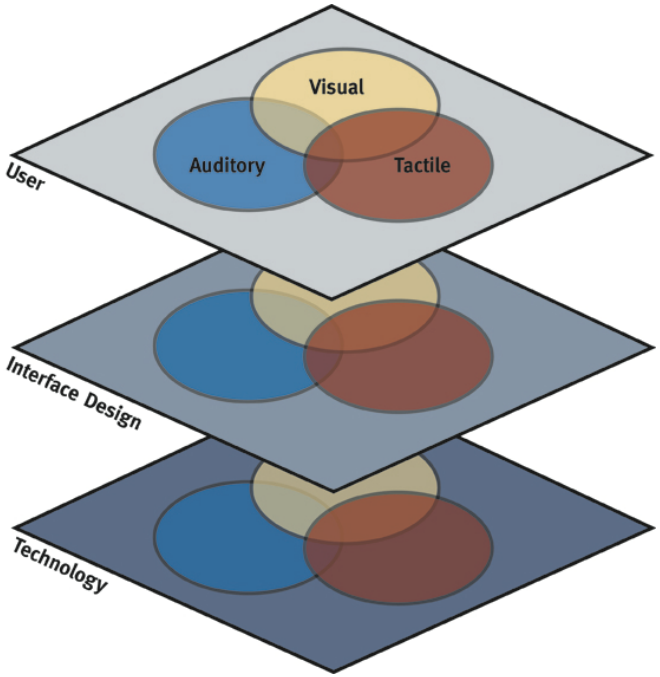
QUALITY AND USABILITY LAB
@ TU BERLIN

Goal: Explore future technology and human perception to design quality interactions.

Approach: Comprehensive usability design requires taking viewpoints on three layers.



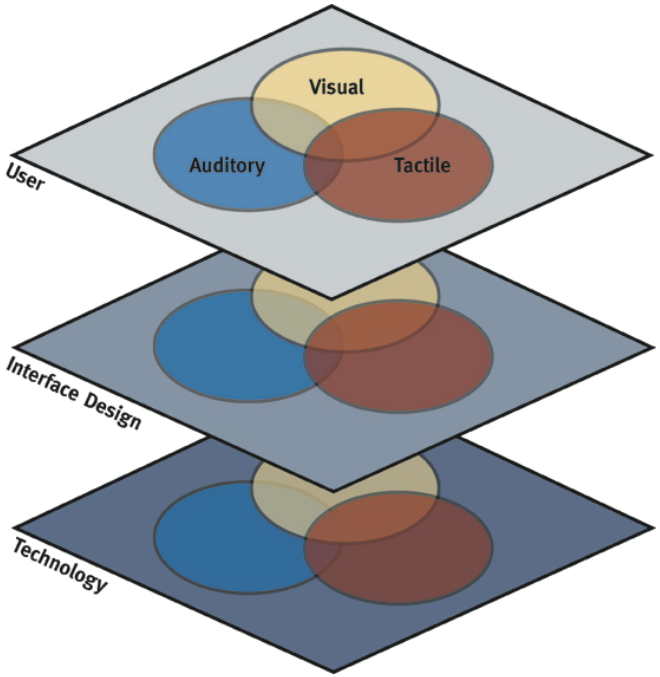
- **User:** Measuring and modelling usability and perceptual quality
- **Interface design:** Designing the communication interface between user and system
- **Technology:** Multimedia analysis, synthesis and compression

QUALITY AND USABILITY LAB
TOPICS

Quality: Perception, judgment and prediction of auditory, visual and tactile signals

Audio and Augmented Reality: Audio, acoustics, and auditory and visual augmented reality

Speech : Speech processing, voice perception, and spoken human-computer interaction



User Experience: Measuring and optimizing the usability of human interfaces

Next Generation Crowdsourcing: Mobile, real-time, secure and confidential crowdsourcing on our Crowdee platform

Usable Security & Privacy: Determining and modelling user factors in security and privacy

QUALITY AND USABILITY LAB
TEAM

Quality:

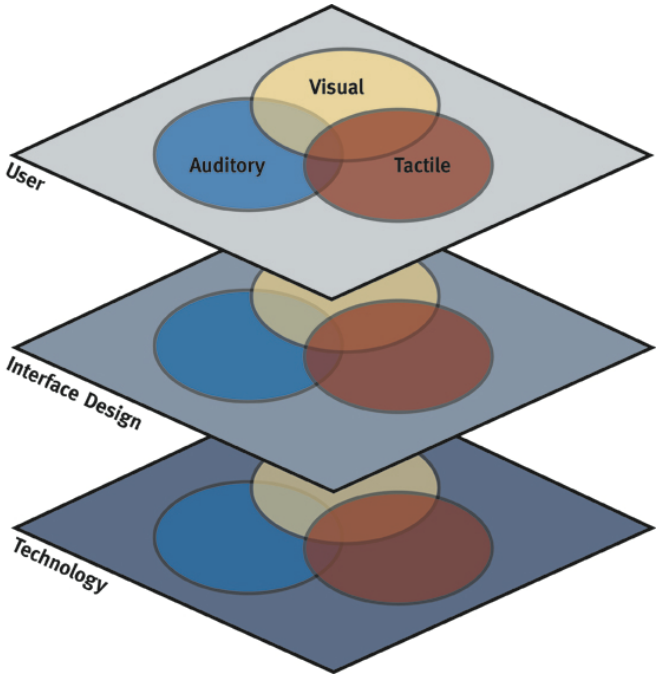
- **Jan-Niklas Antons**
- Gabriel Mittag
- Falk Schiffner
- Steven Schmidt
- Stefan Uhrig
- Saman Zadtootaghaj

Audio and Augmented Reality:

- Tanja Kojic

Speech :

- **Laura Fernandez Gallardo**
- **Prof. Michael Wagner**
- **Benjamin Weiss**



User Experience:

- Patrick Ehrenbrink
- **Stefan Hillmann**
- Thilo Michael
- Carola Trahms

Next Generation Crowdsourcing:

- Neslihan Büyükdemircioglu
- **Babak Naderi**
- **Tim Polzehl**
- Rikhu Prasad Surya
- Rafael Zequira

Usable Security & Privacy:

- Maija Poikela

QUALITY AND USABILITY LAB
MAJOR PROJECTS

Quality:

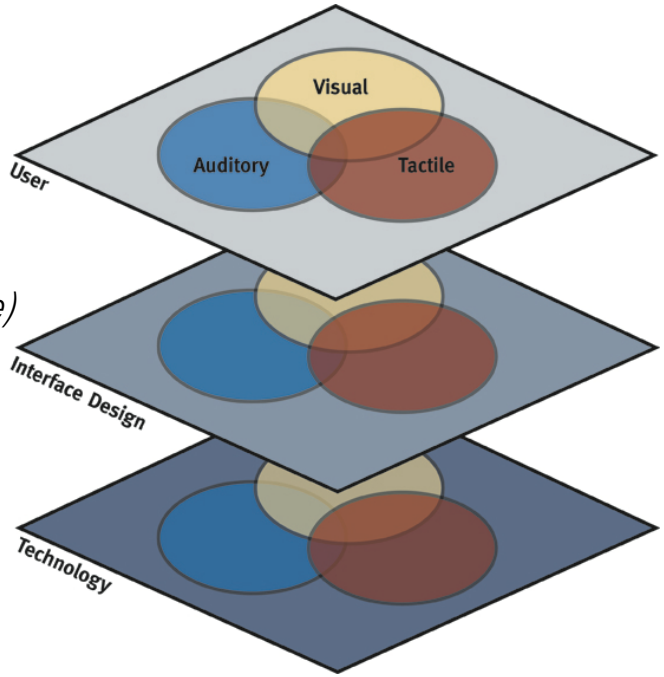
- **Gaming QoE (DFG)**
- **Dimension-based Speech Quality (DFG)**
- **Simulation of Conversation Behavior (DFG)**
- *QoE-Net (H2020 Marie-Curie)*

Audio and Augmented Reality:

- 360 Degree (Exist)

Speech :

- **Speaker Personality and Likability (DFG)**



User Experience:

- Social Psychological Aspects of Smart Homes (SoftwareCampus)
- PflegeTab (GKV)
- *Mieles (Erasmus+)*
- Fix-IT (BMBF)

Next Generation Crowdsourcing:

- OurPuppet (BMBF)
- ICU (BMBF)
- *ALMeS (EIT)*
- *ERICS (EIT)*
- Crowdee (Exist)

Usable Security & Privacy:

- –

PROJECT EXAMPLE: QUALITY
QOE-NET AND GAMING QUALITY

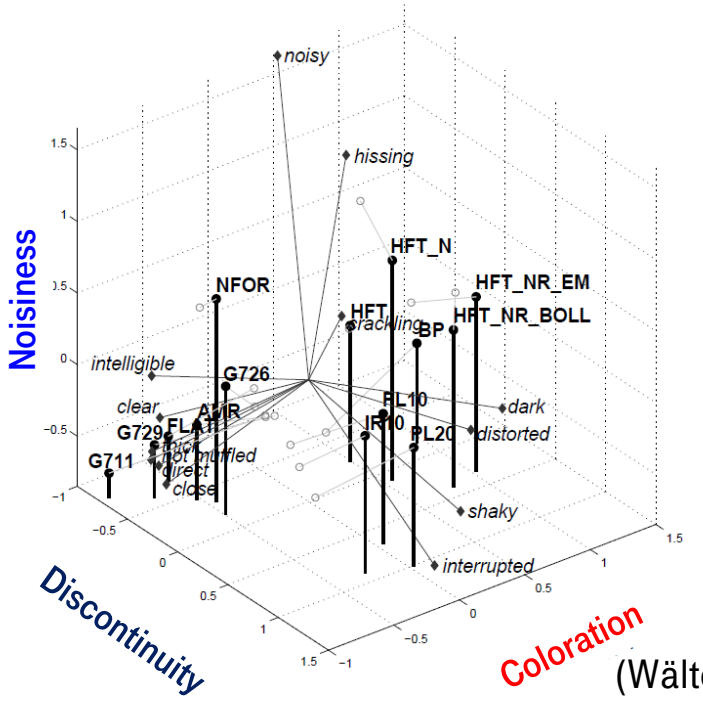
Quality of Gaming Experience (Gaming QoE):

- Identification of influence factors
- Impact of technical characteristics on QoE
- Measurement of Player Experience (ITU Rec.)
- Development of prediction models
- Gamification

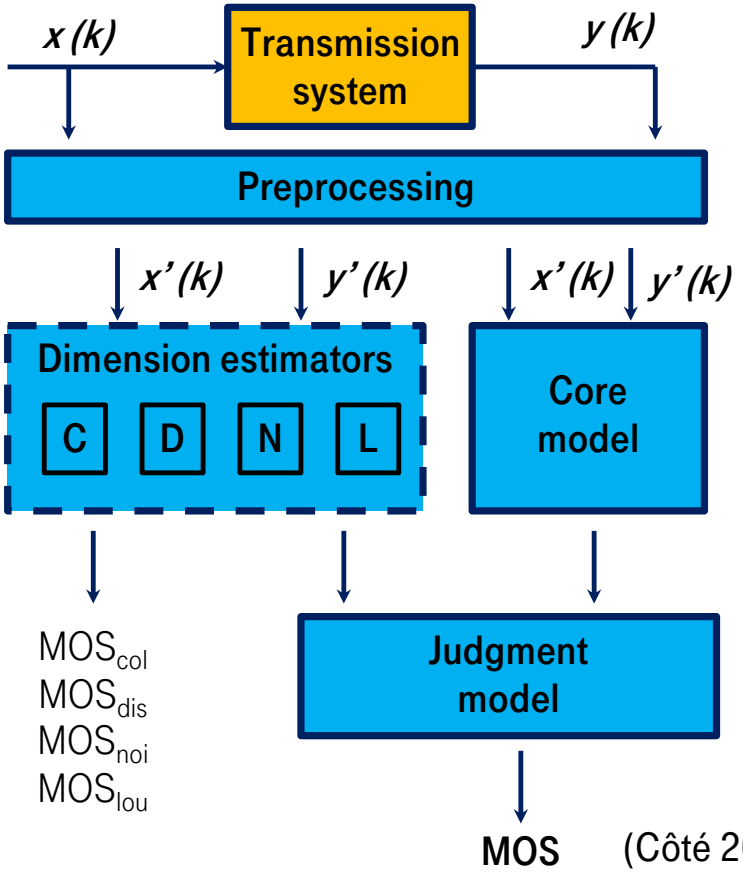
PROJECT EXAMPLE: QUALITY
DIMENSION-BASED SPEECH QUALITY

QoE prediction: perceptual dimensions

- DIAL model, candidate for future P.AMD standard



(Wältermann, 2012)



(Côté 2011)

PROJECT EXAMPLE: QUALITY
PREDICTING TTS QUALITY

QoE prediction: application to TTS quality

Dimensions	Relevant Scales	Kraft1995	Mayo2005	Vis2005	Seget2007	Mayo2011	SD/FA	ST/MDS
Naturalness of Voice	*naturalness voice pleasantness*	Prosody		Naturalness	Naturalness and Prosody		Naturalness	Naturalness of Voice
Prosodic Quality	*stress rhythm prosody intonation*		Prosodic Cues	Intelligibility		Unit Appropriatness and Prosody		Temporal Distortions
Fluency and Intelligibility	*fluency intelligibility bumpiness polyphony*	Segmental	Segmental or Unit Level Cues		Intelligibility	Overall Join Quality/Quantity Join Distribution	Temporal Distortions	
Absence of Disturbances	*hissing noise rasping disturbances*							
Calmness	*speed tension*							

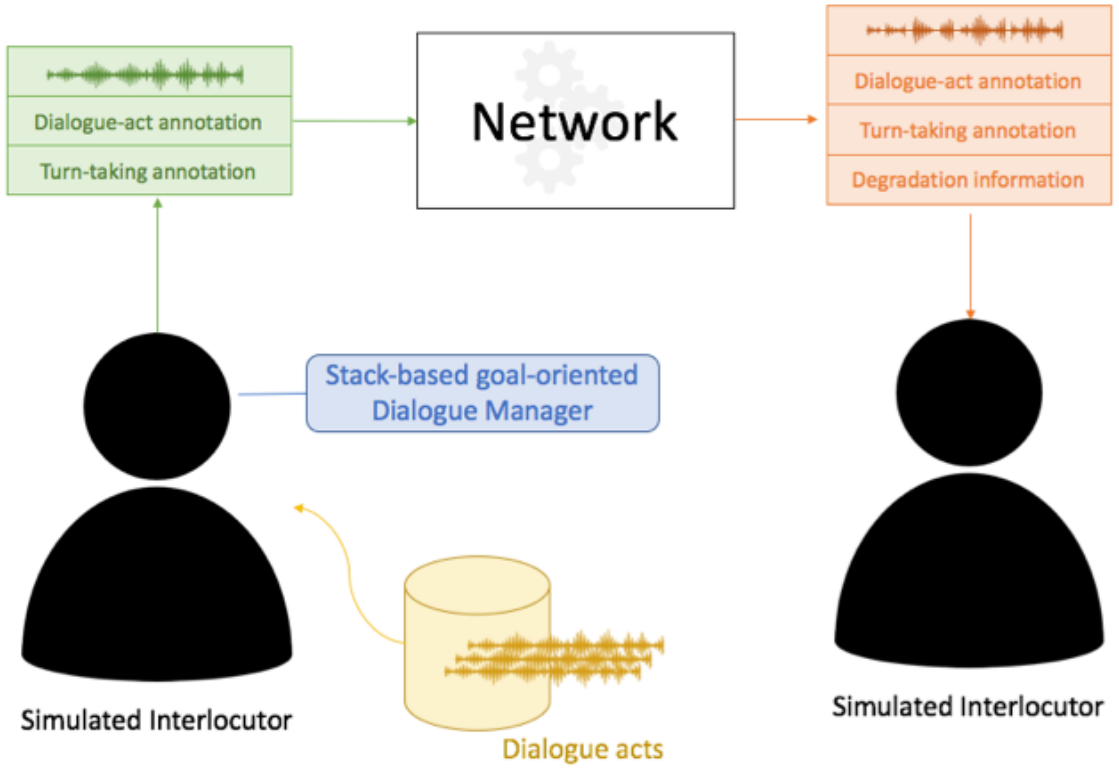
(Hinterleitner, 2017)

Database	Gender	Model	NOV $\overline{R}$	NOV RMSE	PQ $\overline{R}$	PQ RMSE	FAI $\overline{R}$	FAI RMSE
SD/FA, ST/MDS, Seget2007	Female	SVR	.43	0.90	.58	0.76	.14	0.63
		RPM	.85	0.49	.85	0.54	.77	0.39
	Male	SVR	.62	0.73	.56	0.73	.31	0.77
		RPM	.90	0.44	.82	0.43	.79	0.34

PROJECT EXAMPLE: QUALITY
CONVERSATIONAL SPEECH QUALITY

Simulation of human conversation behavior:

- Uses a stack-based goal-oriented dialogue manager
- Agents “talk” based on dialogue acts and turn-taking signals
- Networks adds degradations to the messages (delay, packet loss, ...)
- Agents react to increased double-talk and mutual silence due to delay
- Agents try to correct misunderstandings due to packet loss and other degradations



The system will give us an estimation of the perceived quality based on the simulation

PROJECT EXAMPLE: SPEECH
SPEAKER CHARACTERISTICS

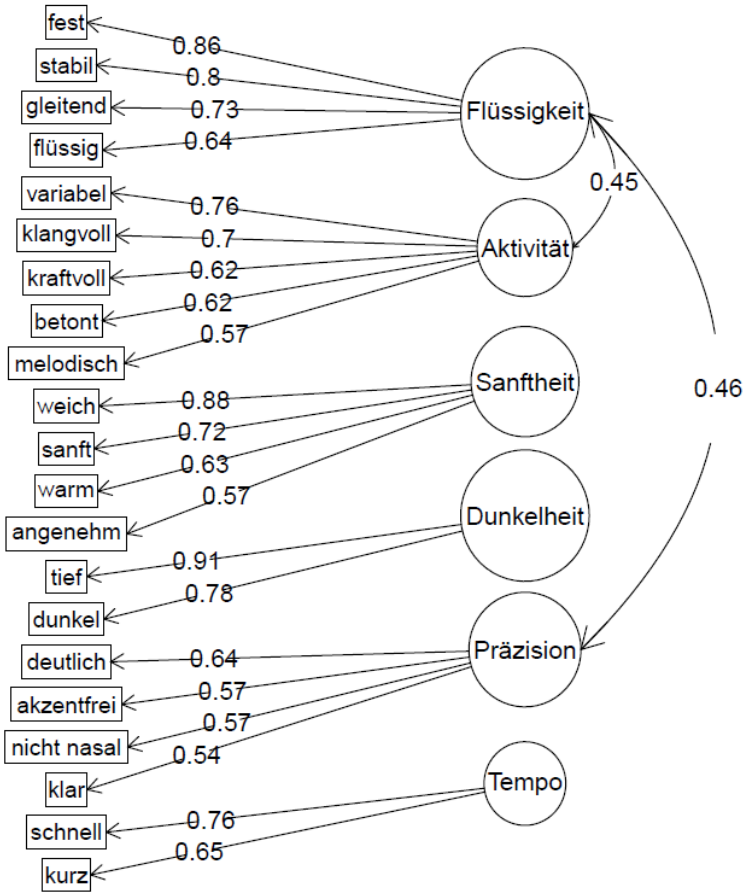
Dimension analysis:

- 6 dimensions for voice descriptions
- 5 dimensions for interpersonal descriptions
  - Attractiveness, confidence, apathy, serenity, incompetence

	attract.	confid.	apathy	seren.	incomp.
Extrav.	-0.02	0.37	-0.42	-0.21	0.05
Agreea.	0.53*	-0.55*	-0.29	-0.26	-0.35
Consci.	0.52*	0.18	-0.87***	-0.29	-0.74**
Neurot.	-0.32	-0.70**	-0.03	-0.62*	0.31
Open.	0.53*	-0.13	-0.94***	-0.53*	-0.60*

$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Correlation between interpersonal descriptions and Big 5 (Fernandez Gallardo and Weiss, 2017).



Perceptual dimensions for German items (Weiss and Hinterleitner, 2015).

PROJECT EXAMPLE: SPEECH
SPEAKER CHARACTERISTICS

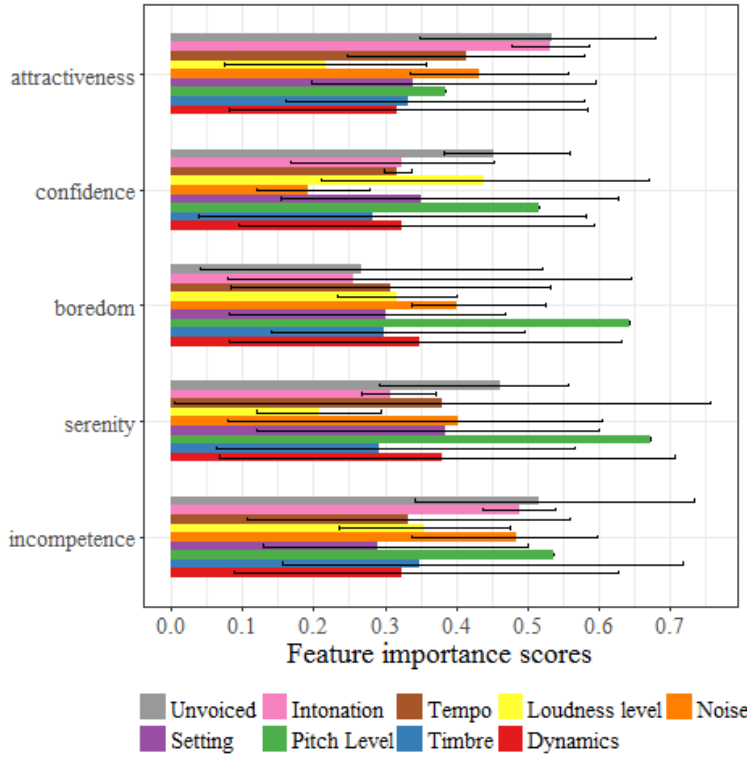
Prediction of voice description dimensions:

- Good acoustic models for
  - Darkness, Activity, Softness, Tempo
- Other dimensions are more difficult:
  - Precision, Fluency (Weiss, 2016)

Prediction of interpersonal description dimensions:

- Intonation features for attractiveness and incompetence
- Pitch level for confidence, apathy and serenity
- Ongoing work modelling these dimensions

Acoustic modelling of interpersonal characteristics (Fernandez Gallardo and Weiss, 2017).



PROJECT EXAMPLE: SPEECH
SPEAKER IDENTITY

Effect of transmission channels

- Human speaker recognition: WB greatly improves over NB
  - yet SWB offers no additional benefit
- Automatic speaker recognition: significant improvement in WB and in SWB with respect to NB

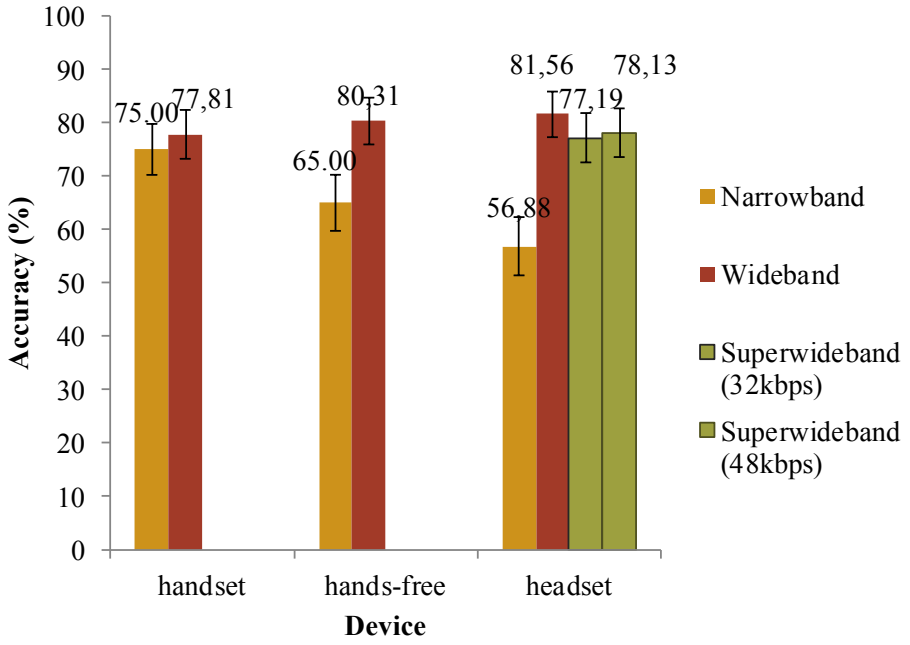
	EER (%)	
Distortion	Males	Females
Clean 4 kHz	2.36	4.21
G.711at 64	2.95	4.68
AMR-NB at 12.2	3.82	6.63
GSM-EFR at 12.2	4.23	6.11
Speex NB at 24.6	3.17	6.42
Clean 8 kHz	1.36	1.55
G.722at 64	1.23	1.64
AMR-WB at 12.65	1.82	2.35
Speex WB at 42.2	1.23	1.92
Clean 16 kHz	1.17	1.05
G.722.1C at 48	1.14	1.10

EER based on GMM-UBM experiments (Fernandez Gallardo, 2015).

Relative EER reduction NB to WB:
42.4% males
63.2% females

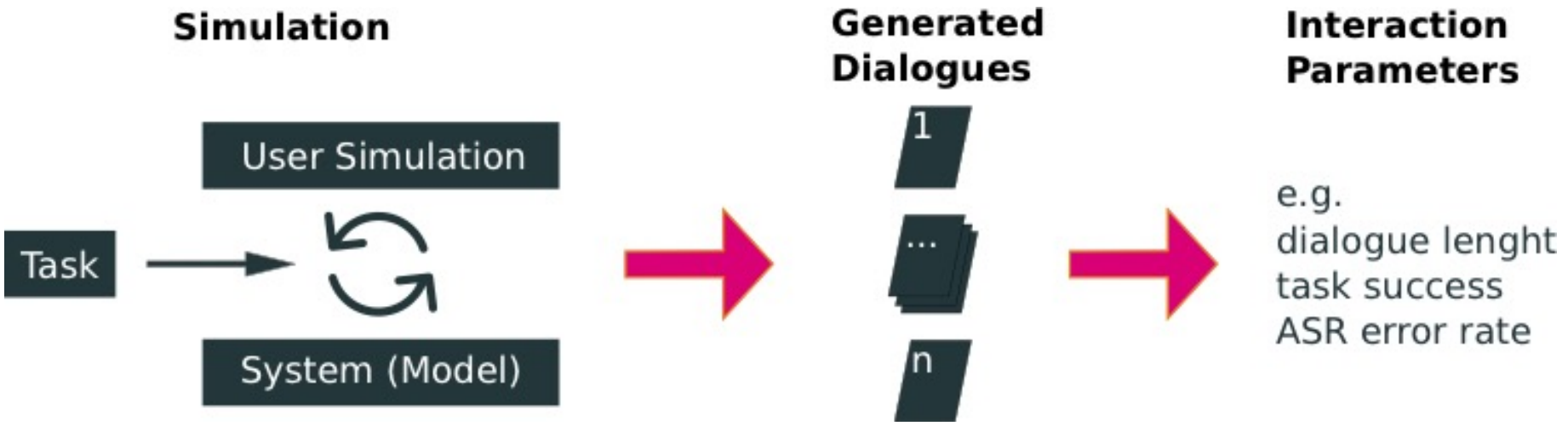
Relative EER reduction WB to SWB:
14.0% males
32.3% females

Human speaker recognition performance with user interfaces in receiving direction (Fernandez Gallardo et al., 2013).



PROJECT EXAMPLE: USER EXPERIENCE
INTERACTIVE SPEECH SERVICES

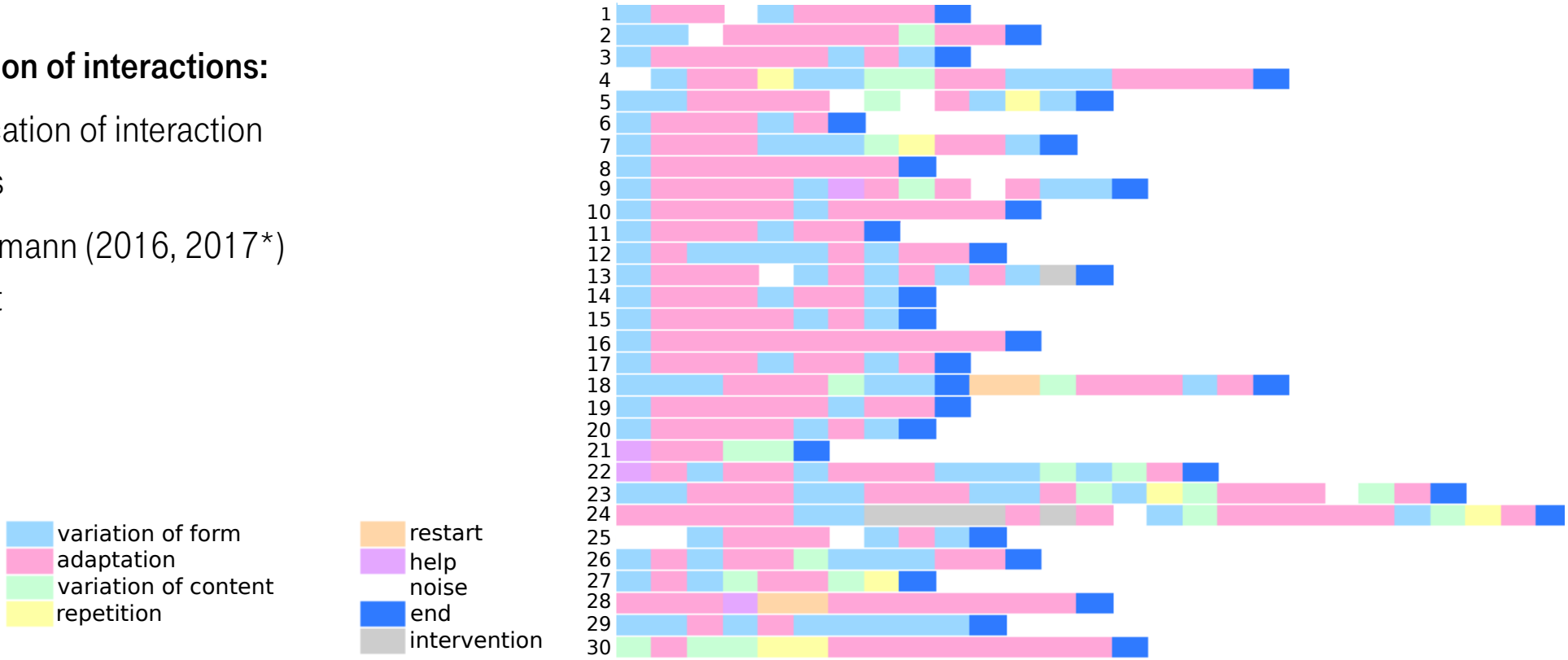
User behavior simulation: Principle



PROJECT EXAMPLE: USER EXPERIENCE
INTERACTIVE SPEECH SERVICES

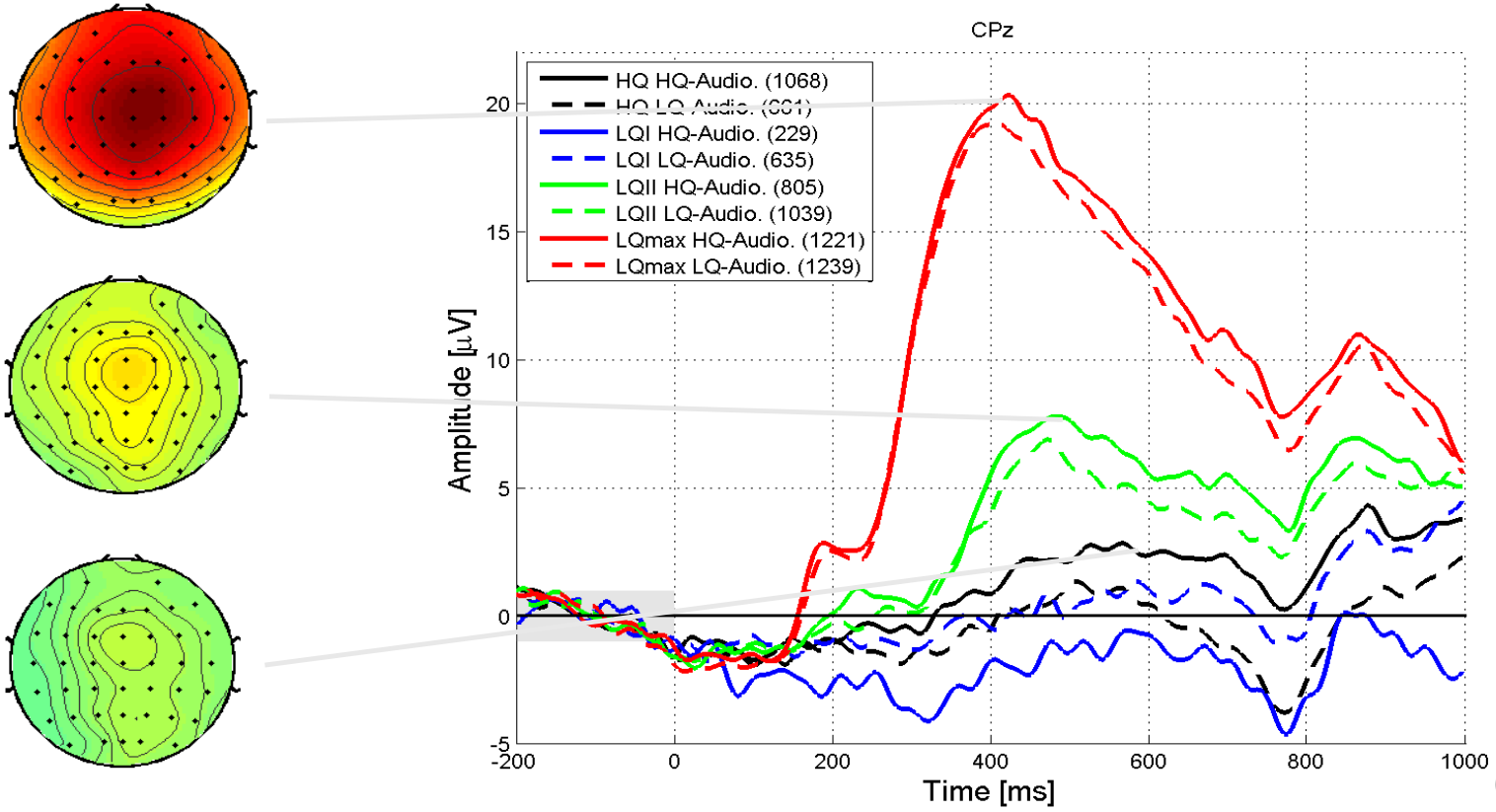
Formalization of interactions:

- Identification of interaction patterns
- See Hillmann (2016, 2017*)
  *in print



PROJECT EXAMPLE: USER EXPERIENCE

PHYSIOLOGY-BASED EXPERIENCE MEASUREMENT



- Correlation of EEG-ERP amplitude and MOS: r = -0.7

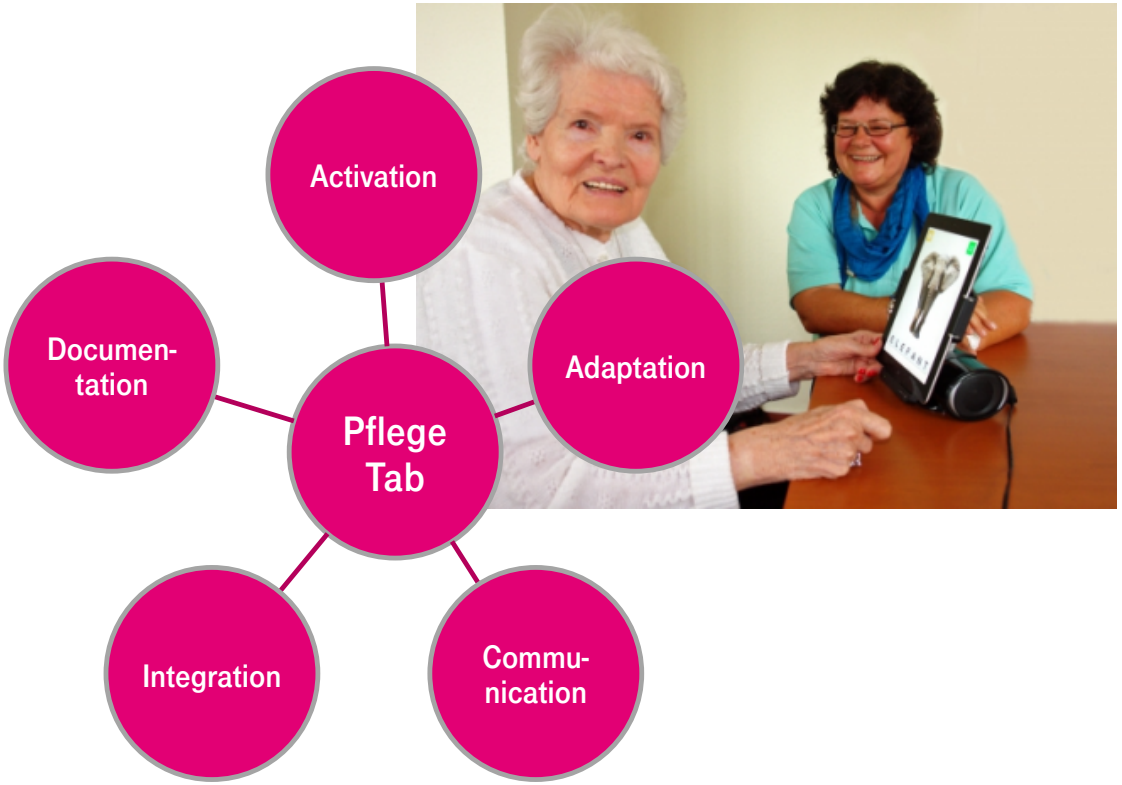
(Arndt et al., 2012 and 2014)

PROJECT EXAMPLE: USER EXPERIENCE
EXPERIENCE STIMULATION

PflegeTab: Adaptive Software for Cognitive Training

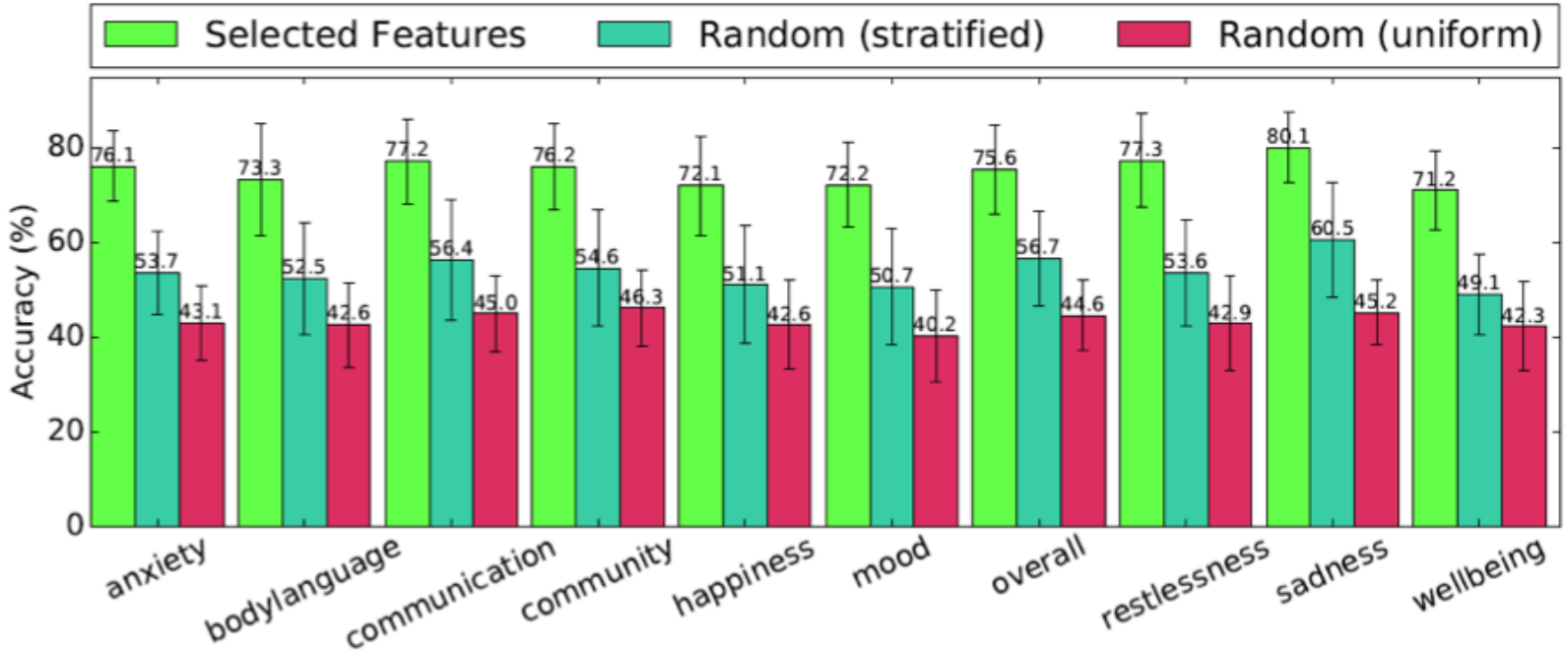
- **Activation** of care recipients with age related diseases (dementia) using games
- **Adaptation** based on individual data, matching capabilities (physical and mental state) to demand
- **Communication** ensuring trust of all involved parties (care takers and recipients, families)
- **Integration** in family life (shared photos, video telephony)

PflegeTab



PROJECT EXAMPLE: USER EXPERIENCE
EXPERIENCE STIMULATION

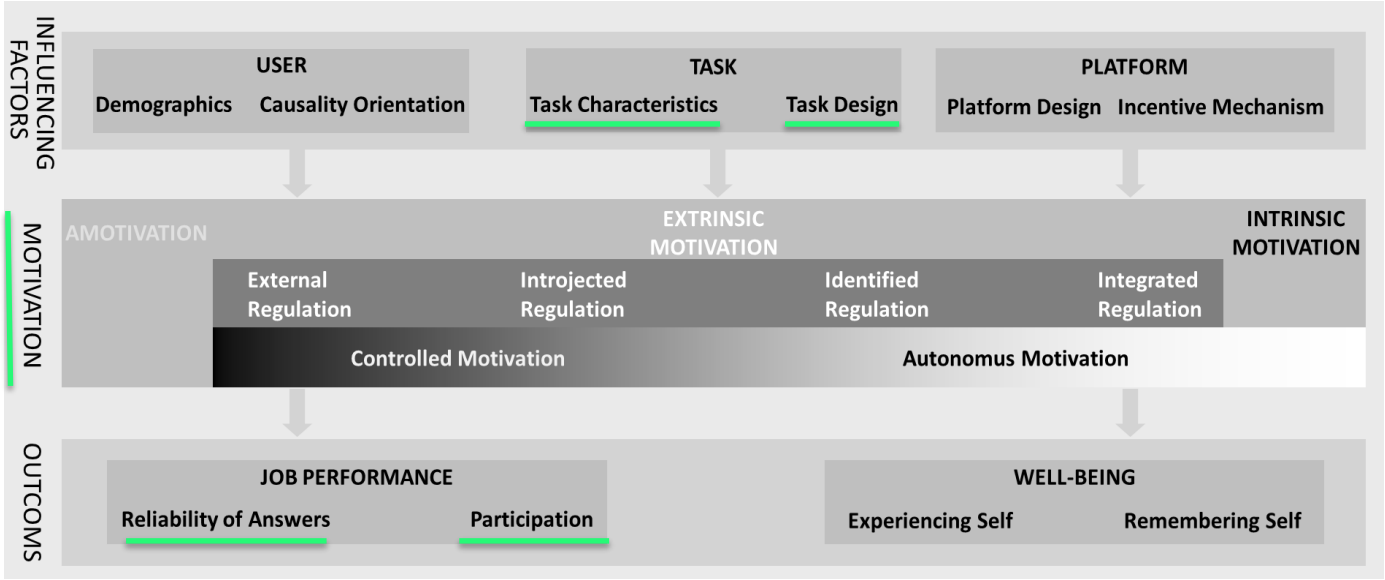
PflegeTab: Prediction of user states



PflegeTab

PROJECT EXAMPLE: CROWDSOURCING
MOTIVATION

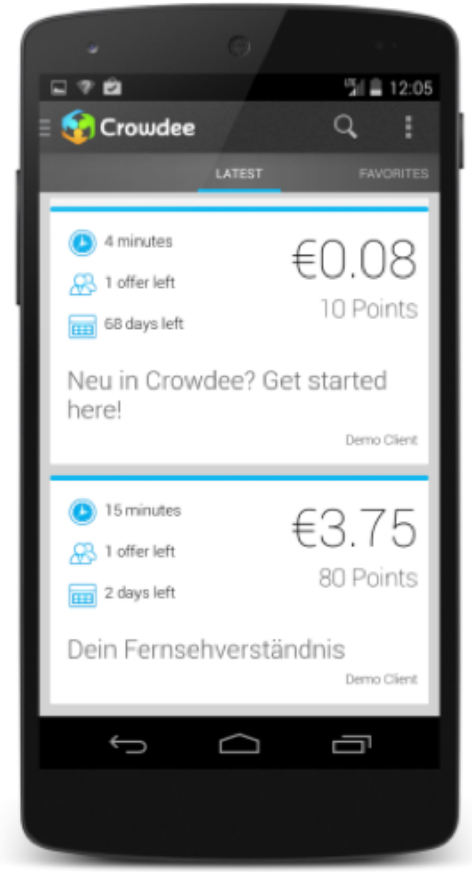
- **Crowdsourcing Work Motivation Scale (CWMS)**: Based on **self-determination theory,** measuring both **type and amount of motivation**
- Task **Acceptance** can be predicted by its characteristics with 88.36% accuracy:
  - **Interestingness**,
  - **Frequency**,
  - Ratio of **reward to workload**
- **Workload** can be predicted from **Task Design** (adjusted-R^2 = 0.61)



PROJECT EXAMPLE: CROWDSOURCING PLATFORM

Crowdee: (incl. Crowdee GmbH spin-off from TU Berlin)

- **Microjob platform working on mobile and fixed computers**
- **Mobile workforce-on-demand**: Dynamics, Opportunities and Threats by Humans-as-a-Service including Privacy and Security for Corporate/Personal data
- **Research tool for investigating**
  - motivation for crowd workers
  - crowdsourcing platform optimization
  - future communication and online labor markets
  - data quality analysis
  - quality assessment via crowdsourcing

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