Affect in Virtual Agents (and Robots)

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CHANGE THE WORLD FROM HERE

Software / Virtual Agents and Robots

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Affective Agents

Computer emotions are of primary interest in the area of affective or intelligent agents.

How can agents be made to be personalized, intelligent, believable, and engaging?

The dream of the artificial companion

Many artificial intelligence researchers have long wished to build robots, and their cousins called “agents,” that seem to think, feel, and live. These are creatures with whom you’d want to share some of your life

The dream of the artificial companion

In his 1985 American Association of Artificial Intelligence (AI) presidential address, Woody Bledsoe told of his continuing dream to build a computer friend. He spoke of the “excitement of seeing a machine act like a human being, at least in many ways,” of building a machine that could “understand, act autonomously, think, learn, enjoy, hate”.

Bledsoe, W. I had a dream: AAAI presidential address. *AI Mag.* 7, 1 (1986), 57-61.

Where did the dream go?

As AI researchers tried to find these essential qualities of humanity, they gravitated toward **reasoning, problem solving, learning via concept formation**.

But what do you end up with?...

Where did the dream go?

The equivalent of ‘feeling bad’.

The assistant that cannot read your emotional expression, reason about what your emotions might be, and learn what is important to you – when not to interrupt, for example, will act unintelligently.

If the agent cannot have a mechanism for the equivalent of ‘feeling bad’ for causing you distress then it is likely to repeat this behavior. *The lack of such a mechanism* is believed to be at the root of the problem. An ability to ‘feel good or bad’ does not merely effect the agent’s ability to learn, but helps it **prioritize and choose among all its actions** : learning, planning, decision-making, and more.

Emotion Synthesis using the Ortony Clore Collins (OCC) Model

Andrew Ortony, Gerald L. Clore, and Allan Collins. *The cognitive structure of emotions*. Cambridge university press, 1990.

The Ortony Clore Collins (OCC) Model is a framework of cognitive appraisal for emotions.

The OCC model addresses the problem of representing emotions not by using sets of basic emotions or a dimensioned space, but by grouping emotions according to *cognitive eliciting conditions.*

It assumes that emotions arise from valenced (positive or negative) reactions to situations consisting of events, agents, and objects.

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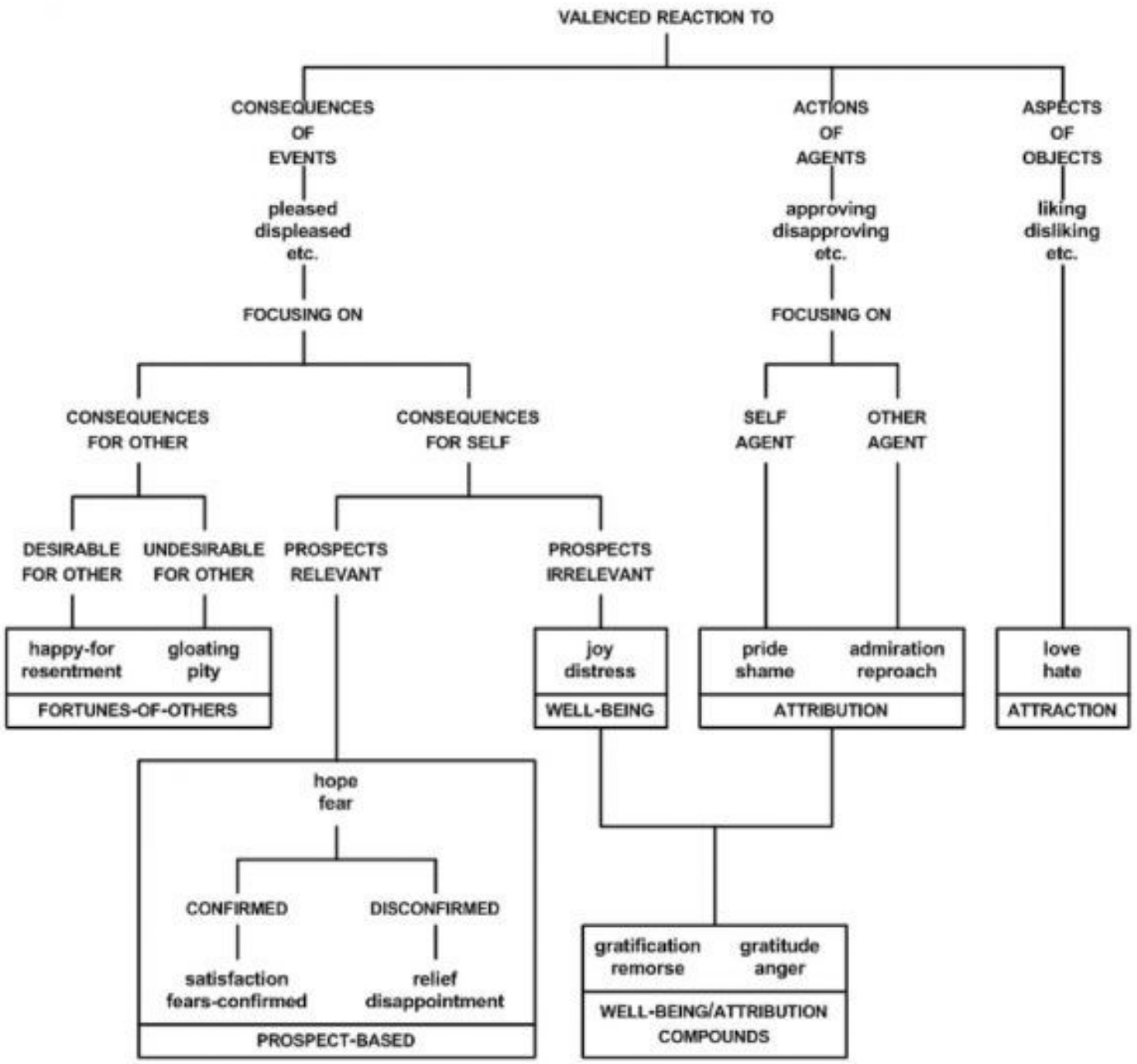

Andrew Ortony, Gerald L. Clore, and Allan Collins. *The cognitive structure of emotions*. Cambridge university press, 1990.

Rule-based system for generation of emotions.

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Synthesizing Emotion in Computers

Although the original intention of the OCC model was never intended for emotion synthesis it has become the *default model for synthesizing emotions in computers.*

Synthesizing Emotion in Computers – an example using Joy

Synthesis of Joy:

Let *D(p,e,t)* be the desirability of event *e* that person *p* assigns at time *t*.

This function returns a positive value if the event is expected to have beneficial consequences, and returns a negative value if the event is expected to have harmful consequences.

Let $I_g(p,e,t)$ represent a combination of global intensity variables (e.g., expectedness, reality, proximity).

Let $P_j(p,e,t)$ be the potential for generating a state of joy.

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Synthesis of Joy

IF $D(p,e,t) > 0$

THEN set $P_j(p,e,t) = f_j(D(p,e,t), I_g(p,e,t))$

Where $f_j(\ )$ is a function specific to joy (form is undefined).

Let $D(p,e,t)$ be the desirability of event e that person p assigns at time t.

Let $I_g(p,e,t)$ represent a combination of global intensity variables (e.g., expectedness, reality, proximity).

Let $P_j(p,e,t)$ be the potential for generating a state of joy.

This rule does not cause a state of joy but is used to trigger another rule that sets up an intensity of joy, I_j

Synthesis of Joy

Given a threshold value, T_j, then:

IF $P_j(p,e,t) > T_j(p,t)$

THEN set $I_j(p,e,t) = P_j(p,e,t) - T_j(p,t)$

ELSE set $I_j(p,e,t) = 0$

This rule activates the joy emotion, giving it an Intensity when the joy threshold is exceeded.

Let $D(p,e,t)$ be the desirability of event e that person p assigns at time t.

Let $I_g(p,e,t)$ represent a combination of global intensity variables (e.g., expectedness, reality, proximity).

Let $P_j(p,e,t)$ be the potential for generating a state of joy.

Let I_j be the intensity of joy.

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Synthesis of Emotion using OCC Model

The example of joy is the simplest case. More complicated rules exist for other emotional types in the OCC model.

Low-level details of implementation are omitted such as what values to use for thresholds and what form to use for functions such as $f_{j.}$

Example of Emotion Synthesis in Virtual Agents Using the OCC Model

Poker-Playing Virtual Agents with Affective/Emotional Facial Expressions

Ten emotional expressions were used for a modified subset of the OCC model (to include surprise) for *self-consequences only*:

Neutral	Anxious (Fear)
Pleased	Satisfied
Displeased	Disappointed
Excited (Hope)	Surprised
Very excited (Hope)	Relieved

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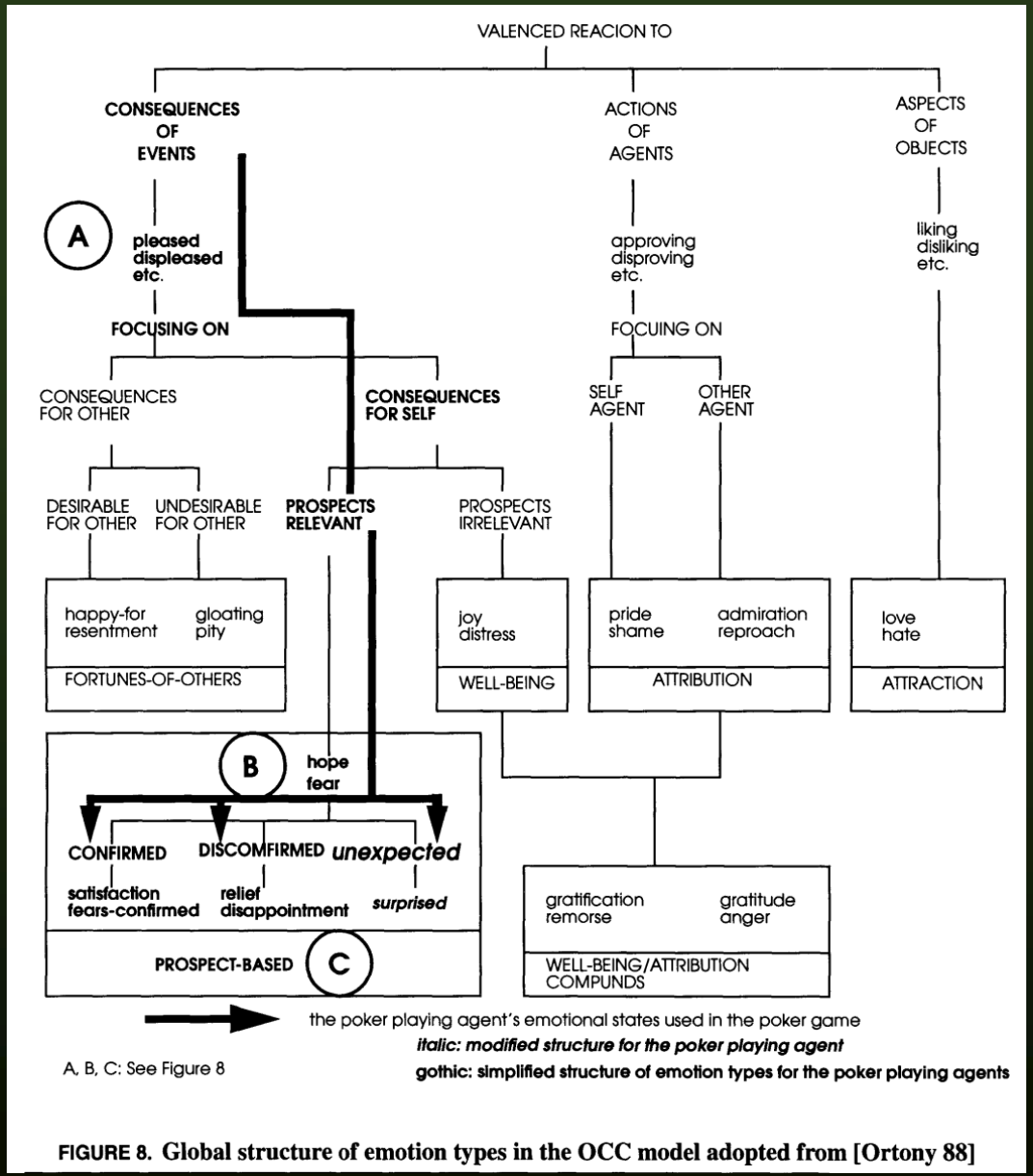

FIGURE 8. Global structure of emotion types in the OCC model adopted from [Ortony 88]

Structure used to synthesize emotional states in poker-playing agents – **surprise** is added to an unexpected event.

Koda, Tomoko, and Pattie Maes. "Agents with faces: The effect of personification." In *Robot and Human Communication, 1996., 5th IEEE International Workshop on*, pp. 189-194. IEEE, 1996.

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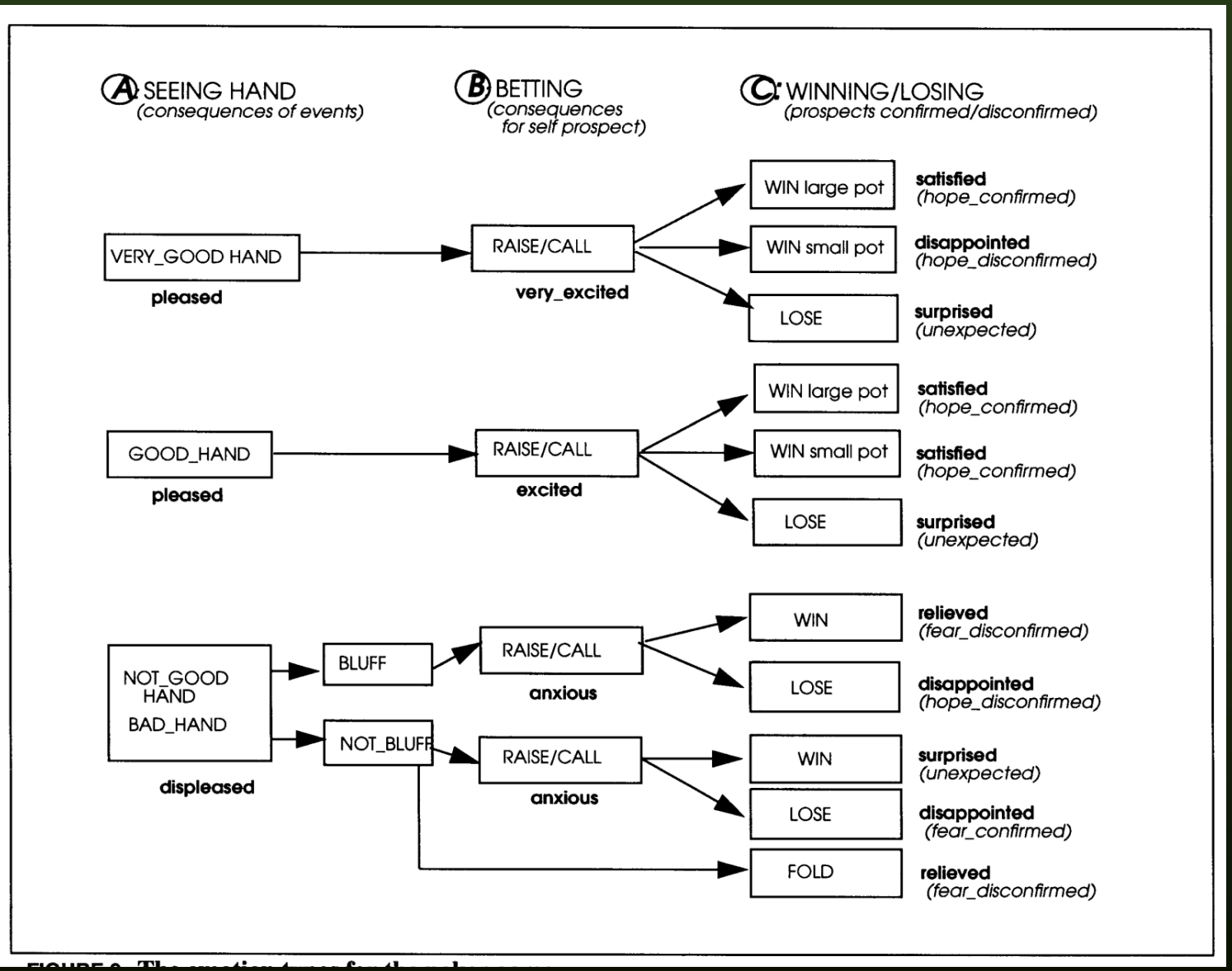

Agents' emotions generated according to poker events. The poker situations give rise to each emotion.

Koda, Tomoko, and Pattie Maes. "Agents with faces: The effect of personification." In *Robot and Human Communication, 1996., 5th IEEE International Workshop on*, pp. 189-194. IEEE, 1996.

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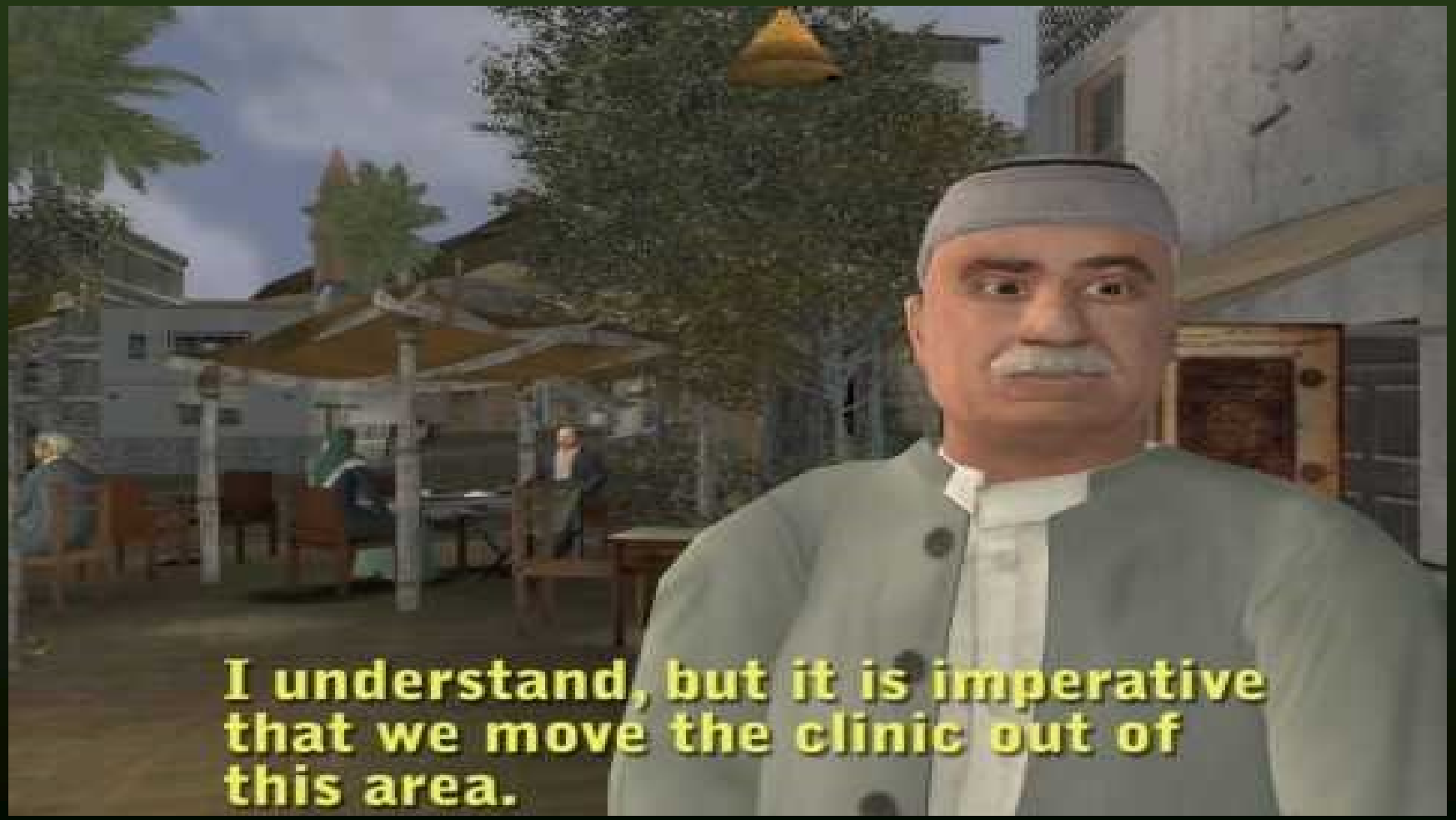
Example of Goals and Emotions in Virtual Agents Using Appraisal Theory



Appraisal theory is the theory in psychology that emotions are extracted from our evaluations (appraisals or estimates) of events that cause specific reactions in different people.

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SimSensei Kiosk

SimSensei Kiosk is an implemented virtual human interviewer designed to create an engaging face-to-face interaction where the user feels comfortable talking and sharing information.

SimSensei Kiosk is also designed to create interactional situations favorable to the automatic assessment of distress indicators, defined as verbal and nonverbal behaviors correlated with depression, anxiety or post-traumatic stress disorder (PTSD).

DeVault, David, Ron Artstein, Grace Benn, Teresa Dey, Ed Fast, Alesia Gainer, Kallirroi Georgila et al. "SimSensei Kiosk: A virtual human interviewer for healthcare decision support." In *Proceedings of the 2014 international conference on Autonomous agents and multi-agent systems*, pp. 1061-1068. International Foundation for Autonomous Agents and Multiagent Systems, 2014.

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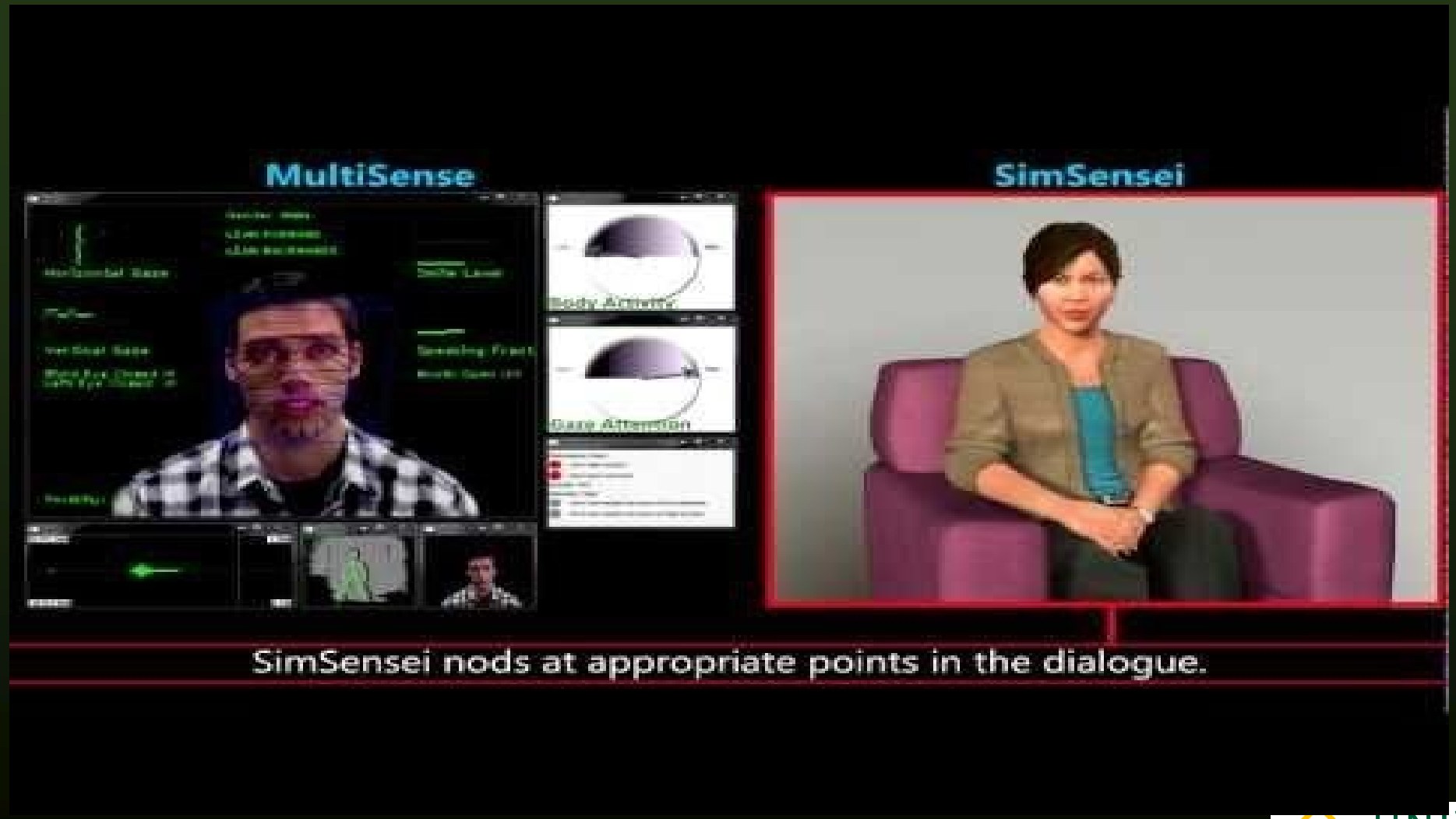
SimSensei – Virtual Human Interviewer for Healthcare Decision Support



DeVault, David, Ron Artstein, Grace Benn, Teresa Dey, Ed Fast, Alesia Gainer, Kallirroi Georgila et al. "SimSensei Kiosk: A virtual human interviewer for healthcare decision support." In *Proceedings of the 2014 international conference on Autonomous agents and multi-agent systems*, pp. 1061-1068. International Foundation for Autonomous Agents and Multiagent Systems, 2014.

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Perception of nonverbal behavior

SimSensei needs to:

1. Communicates the necessary nonverbal behavior signals to other components of the system so that the agent is sensitive to the user's nonverbal behavior.

2. Recognize automatically and quantify the nonverbal behaviors that help indicate the psychological conditions being studied (e.g. depression and PTSD).

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Dialogue Processing

1. Natural Language Understanding:

Automatic speech recognition and NLU classifiers to assign positive or negative or neutral valence to utterances.

2. Dialogue Management

About 100 fixed utterances in total.

Empathy responses.

Speaker	Utterance
Ellie	*How have you been feeling lately ?* (top level question)
Participant	*Not good at all*
Ellie	*Can you tell me about that ?* (continuation prompt)
Participant	*Um... yeah i mean... i recently got released from prison not too long ago... uh i'm older now... and a lot more responsibilities and i feel like my life is not where it's supposed to be... i feel like i could've made a lot more better decisions in my life... you know ... sometimes feeling sorry for myself ... and just things that i've been through and the whole nine yards so yeah*
Ellie	*I'm sorry* (empathy response)

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Generation of Nonverbal Behavior

1. Nonverbal behavior accompanying dialogue using Behavior Markup Language (BML).

2. Character animation takes in BML input and supports character movement and gestures.

3. Listening feedback designed to make participant feel safe, comfortable, and listened to.

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Evaluating SimSensei

Conditions

Face-to-Face	Wizard-of-Oz	AI interactions
Human Interviewer	Virtual Human ‘Puppet’	Automated SimSensei

A Wizard of Oz experiment is a research experiment in which subjects interact with a computer system that subjects believe to be autonomous, but is actually being operated by an unseen human.

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Evaluating SimSensei

Wizard-of-Oz	AI interactions
Higher Rapport	Lower Rapport
Higher Usability	Lower Usability
Better Listener	Weaker Listener

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Virtual Humans – USC ICT

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Build your own Virtual Agents

Customize your character in Fuse and rig it in Mixamo. Can import fbx file into Unity.

Mixamo Fuse:

https://www.mixamo.com/#/

See some example characters:

https://www.mixamo.com/#/?page=1&type=Character

You can also use Blender to work on facial expressions (see extra credit for Lab 2):

https://www.blender.org/

Python package cozmo 1.3.1
https://pypi.python.org/pypi/cozmo

Github:
https://github.com/anki/cozmo-python-sdk

Cozmo Robot

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