



Are computer-generated emotions and moods plausible to humans?

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Outline

- A computational Model of Affect
 - affect classification and representation
 - appraisal language
- Evaluation
 - methodology
 - material and participants
 - results





ALMA – A Layered Model of Affect

- Implemented computational model of affect¹
- Designed for interactive virtual characters
- Psychological models of personality, emotion, mood, and appraisal
- Provides an appraisal language
 - events, actions, and objects
 - dialog acts
- **Projects:**
 - VirtualHuman (<http://www.virtual-human.org>)
 - NECA (<http://www.ofai.at/research/nlu/NECA/>)
 - CrossTalk (<http://www.dfki.de/crosstalk>)

¹ Gebhard , ALMA – A Layered Model of Affect, Proceedings of AMAAS05, 29-36, 2005





Affect Classification

- *General term for feelings, emotions, or moods – the conscious subjective aspect of feeling*
- Can be distinguished by¹
 - **time** (short-term vs. long-term)
 - **influence** (unnoticed vs. dominant)
 - **cause** (specific vs. diffuse)
- Affect classified by time
 - short-term: **emotions** (dominant, specific)
 - medium-term: **moods** (unnoticed, diffuse)
 - **and** long-term: **personality** (dominant)

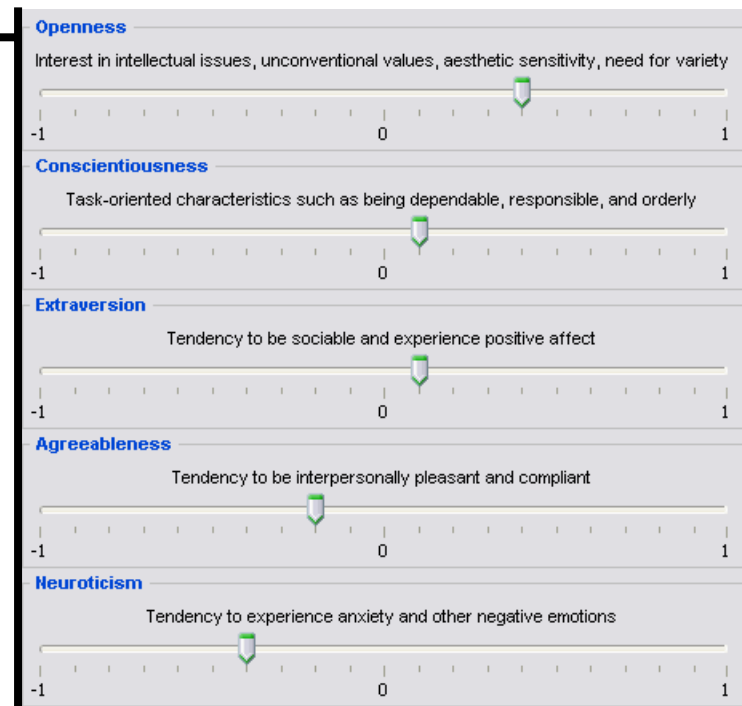
¹ Krause , Affekt, Emotion, Gefühl, In: Merten W., Wandvogel B. Handbuch psychoanalytischer Grundbegriffe, Kohlhammer, 2000, 73-80





Personality

- BigFive personality traits
 - emotion intensity and decay¹
 - default mood



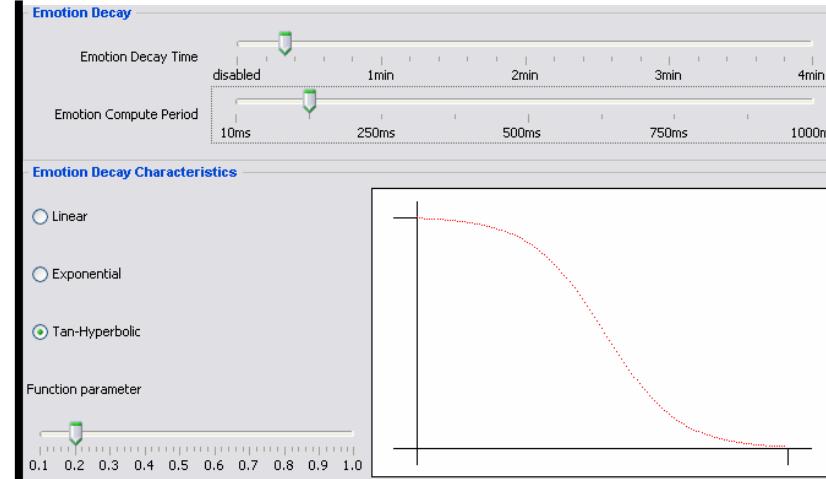
¹ Becker P. Structural and Relational Analyses of Emotion and Personality Traits.
In: Zeitschrift für Differentielle und Diagnostische Psychologie, 22,3, 2001, 155-172





Emotions

- OCC-Model of emotions¹
- Reactions to situational appraisal
- 24 types of emotion
- Real-time computation and decay²



1 Orthony A., Clore G.L., and Collins A. The Cognitive Structure of Emotions. Cambridge University Press, Cambridge, MA, 1988
2 Gebhard et al. Adding the Emotional Dimension to Scripting Character Dialogues, Proc. of IVA03 , 2003, 48-56
Gebhard et al. Coloring Multi-Character Conversations through the expression of emotion, Proc. of ADS04, 2004, 128-141

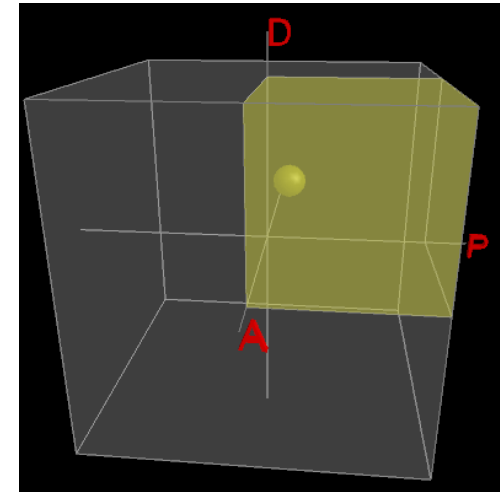




Moods

- **PAD** space for describing mood¹
 - mood is a value of the dimensions **Pleasure, Arousal, and Dominance**
 - 8 discrete mood types:

+P+A+D	Exuberant	-P-A-D	Bored
+P+A-D	Dependent	-P-A+D	Disdainful
+P-A+D	Relaxed	-P+A-D	Anxious
+P-A-D	Docile	-P+A+D	Hostile
 - mood strength = distance to origin
 - initial mood through BigFive personality traits²
 - provides relation of emotions to moods³
(e.g. pride – exuberant)



1 Mehrabian A. Pleasure-arousal-dominance: A general framework for describing and measuring individual differences in temperament
Current Psychology, 14 1996, 261-292

2 Analysis of the Big-Five Personality Factors in Terms of the PAD Temperament Model. Australian Journal of Psychology, 48-2, 1996, 86-92

3 Framework for a Comprehensive Description and Measurement of Emotional states. Genetic, Social, and General Psychology, 22, 1995, 334-361





Mood Changes

- **Concept**
mood change due to emotional experiences¹
- Mood change function
 - *pull phase*:
emotions change mood
 - *push phase*:
emotions intensify mood

¹ Morris, W.N. The frame of mind, New York, Springer, 1889





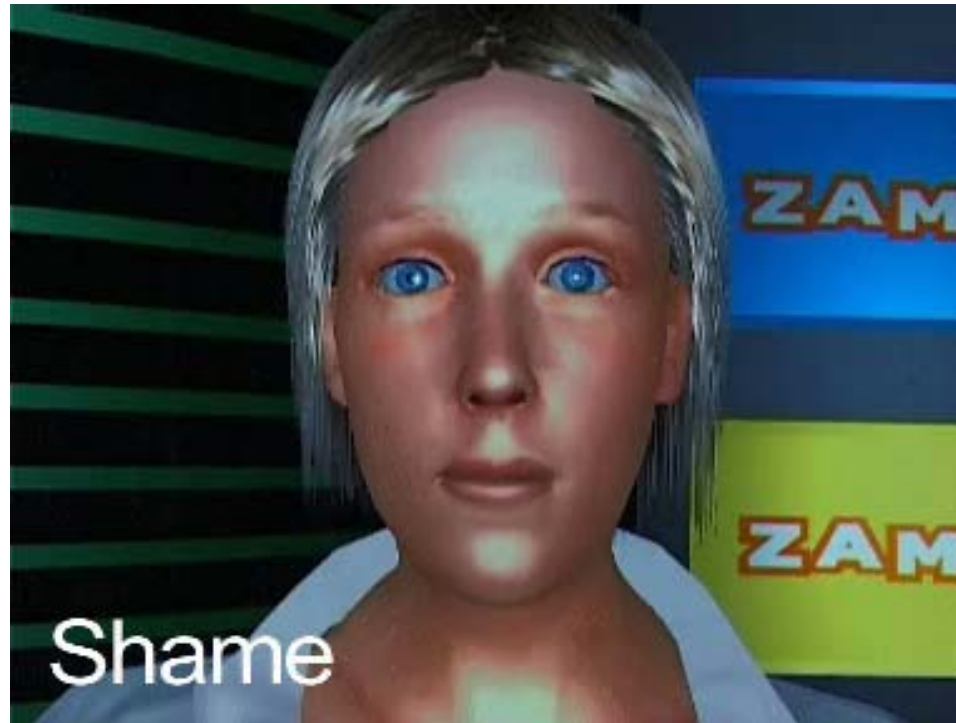
Exploitation for Virtual Characters

- Enhance non-verbal behavior
 - speech parameters
 - wording in utterances
 - facial expressions and complexions
 - conversational gestures
- Tailoring dialog and interaction strategies in script and plan based systems
- **What for?**
 - enhance believability
 - create the illusion of “human-like” behavior





Exploitation – Emotion Example



facial expression and complexions reflect emotions





Exploitation – Mood Example



posture reflects mood





Appraisal Language

- **Concept**
Affect is reaction to situational appraisal
- Situational appraisal using **appraisal tags**
 - shortcuts to variables of OCC-Model¹
- Appraisal tags are input for affect computation
- Simplifies affect generation in script- and plan- based applications

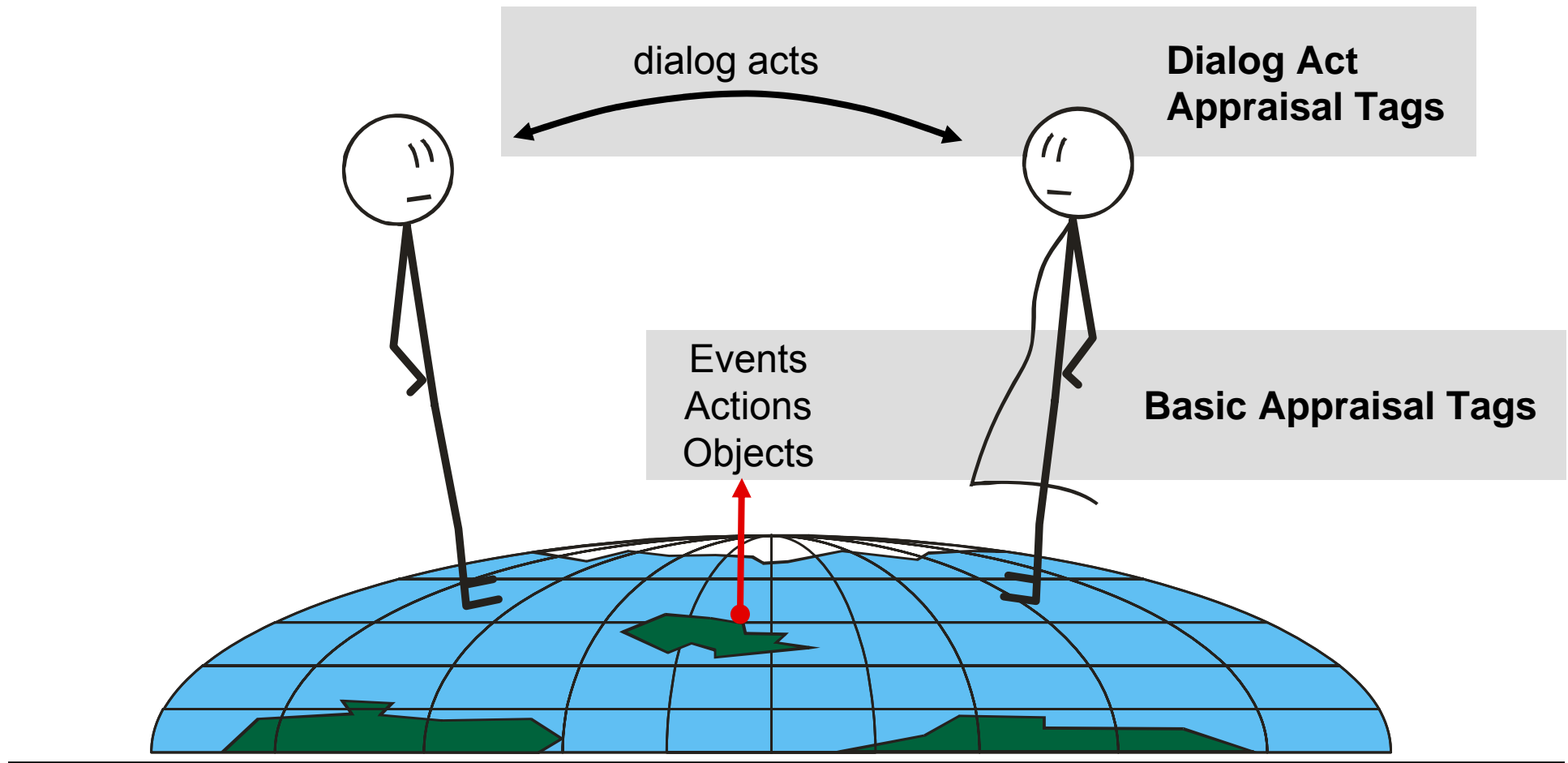
¹ Gebhard et al. Adding the Emotional Dimension to Scripting Character Dialogues, Proc. of IVA03, 2003, 48-56

Gebhard et al. Coloring Multi-Character Conversations through the expression of emotion, Proc. of ADS04, 2004, 128-141





Appraising Situations





Appraisal Tags



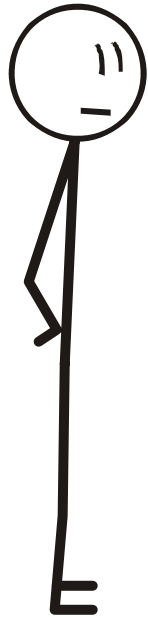
- Situation appraisal from a character's point of view





Basic Event Appraisal Tags

- 12 tags for appraising events



GoodEvent
BadEvent
GoodEventForBadOther
GoodEventForGoodOther
BadEventForGoodOther
BadEventForBadOther
GoodLikelyFutureEvent
GoodUnlikelyFutureEvent
BadLikelyFutureEvent
BadUnlikelyFutureEvent
EventConfirmed
EventDisconfirmed





Basic Event Appraisal Tags – Example

GoodEvent



Bob





Basic Event Appraisal Tags – Example

GoodEvent

↓ tag mapping

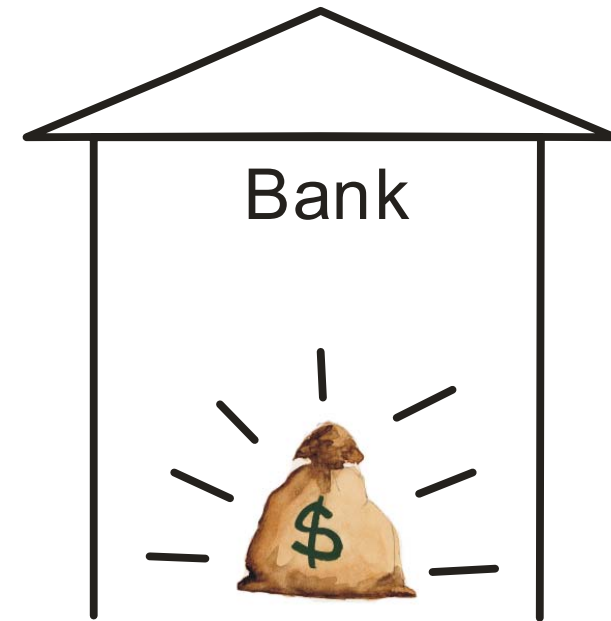
pos. desirability [occ variable]

↓ emotion generation

Joy



Bob





Basic Action Appraisal Tags

- 4 tags for appraising actions



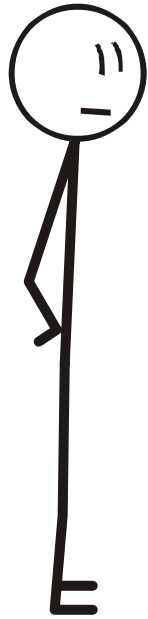
GoodActSelf
BadActSelf
GoodActOther
BadActOther



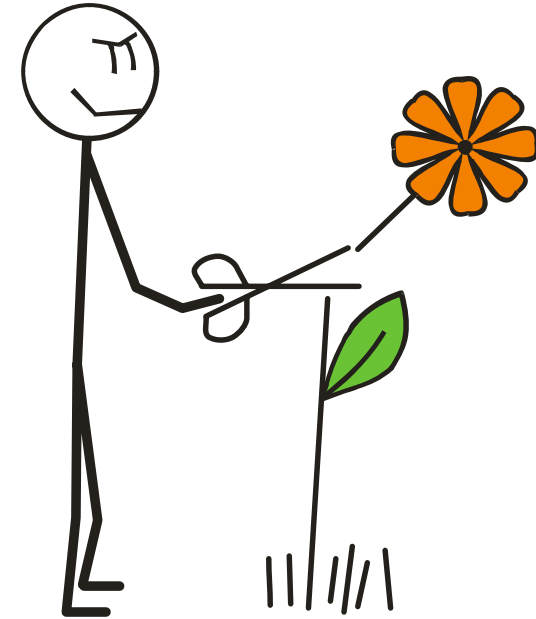


Basic Appraisal Tags - Example

BadActOther



Bob





Basic Appraisal Tags - Example

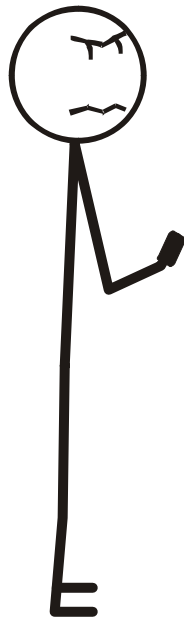
BadActOther

↓ tag mapping

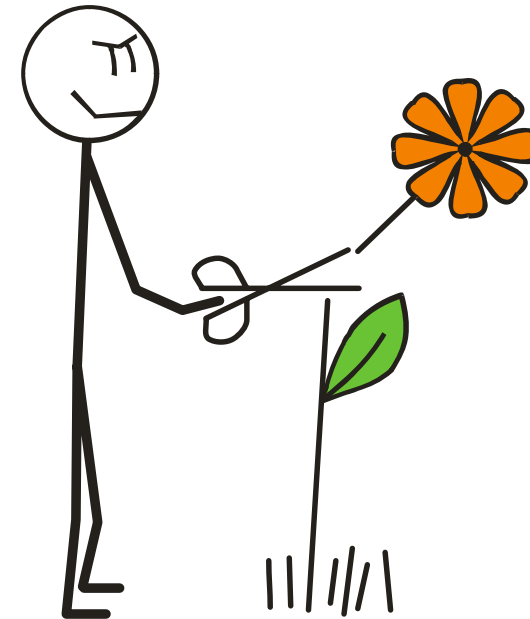
blameworthiness [occ variable]

↓ emotion generation

Reproach



Bob





Basic Object Appraisal Tags

- 2 object appraisal tags



NiceThing
NastyThing





Basic Appraisal Tags – Combination

GoodEvent + GoodActSelf





Basic Appraisal Tags – Combination

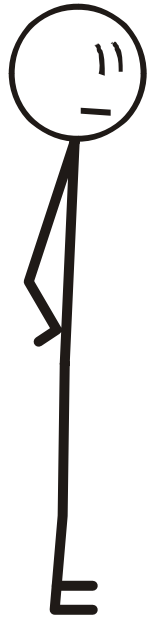
GoodEvent + GoodActSelf

↓ tag mapping

pos. desirability [occ variables]
praiseworthiness

↓ emotion generation

Joy + Pride





Basic Appraisal Tags – Combination

GoodEvent + GoodActSelf

↓ tag mapping

pos. desirability [occ variables]
praiseworthiness

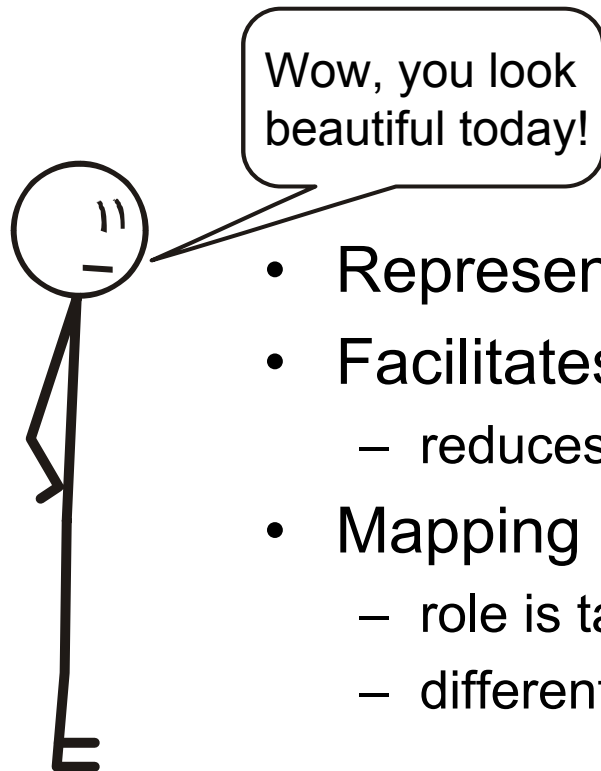
↓ emotion generation

Gratification





Dialog Act Appraisal Tags



Wow, you look beautiful today! **[PayCompliment <Adressee> <Hearer>]**

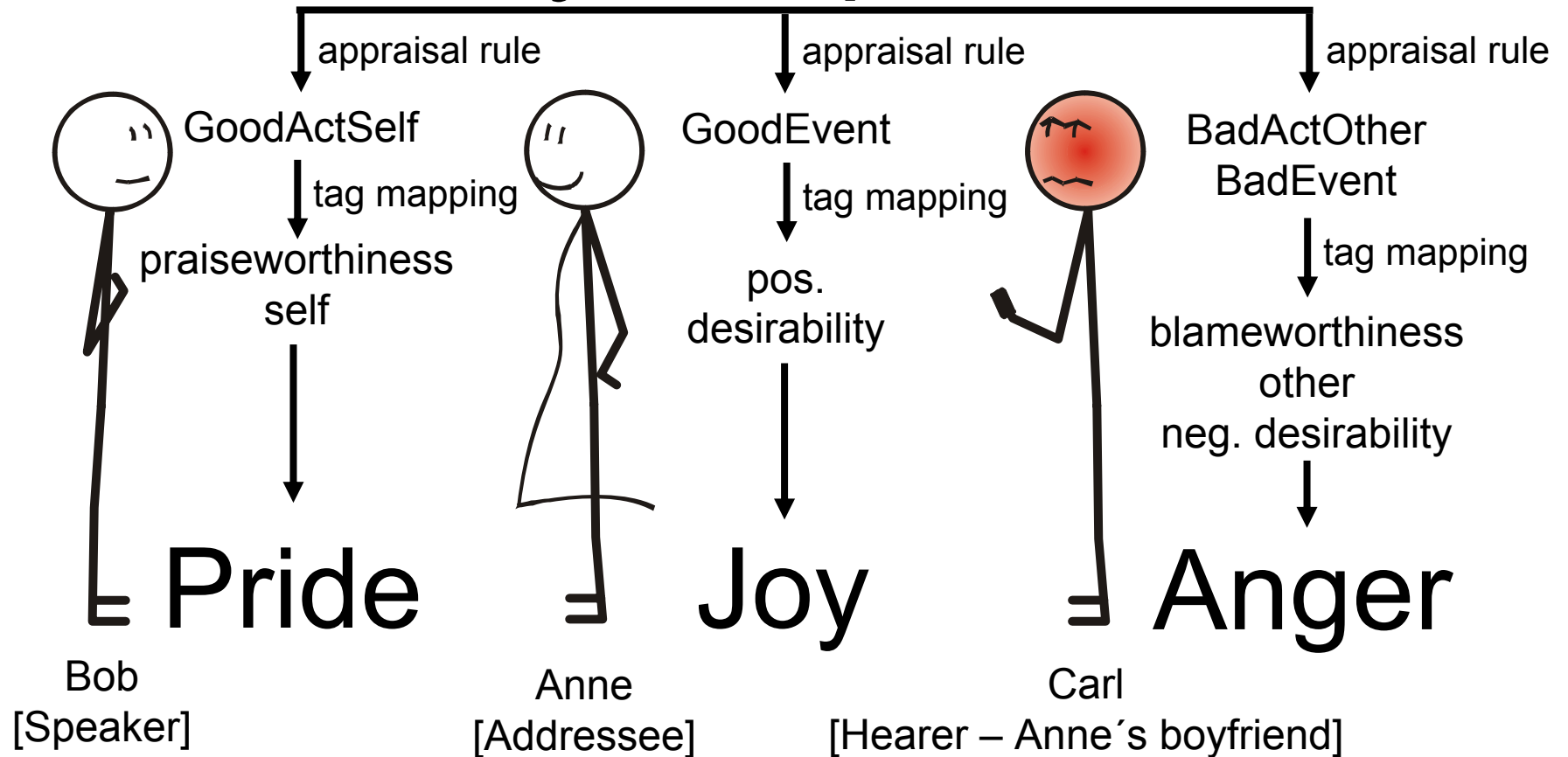
- Represents communicative intent
- Facilitates scripting affect
 - reduces amount of basic appraisal tags
- Mapping on Basic Appraisal Tags required!
 - role is taken into account
 - different appraisal of each involved character





Dialog Act Appraisal Tag – Example

PayCompliment





Dialog Act Appraisal Tag – Example

- Affect scripting reduction:

Bob: Wow, you look beautiful today!
[PayCompliment Anne, Carl]

instead of

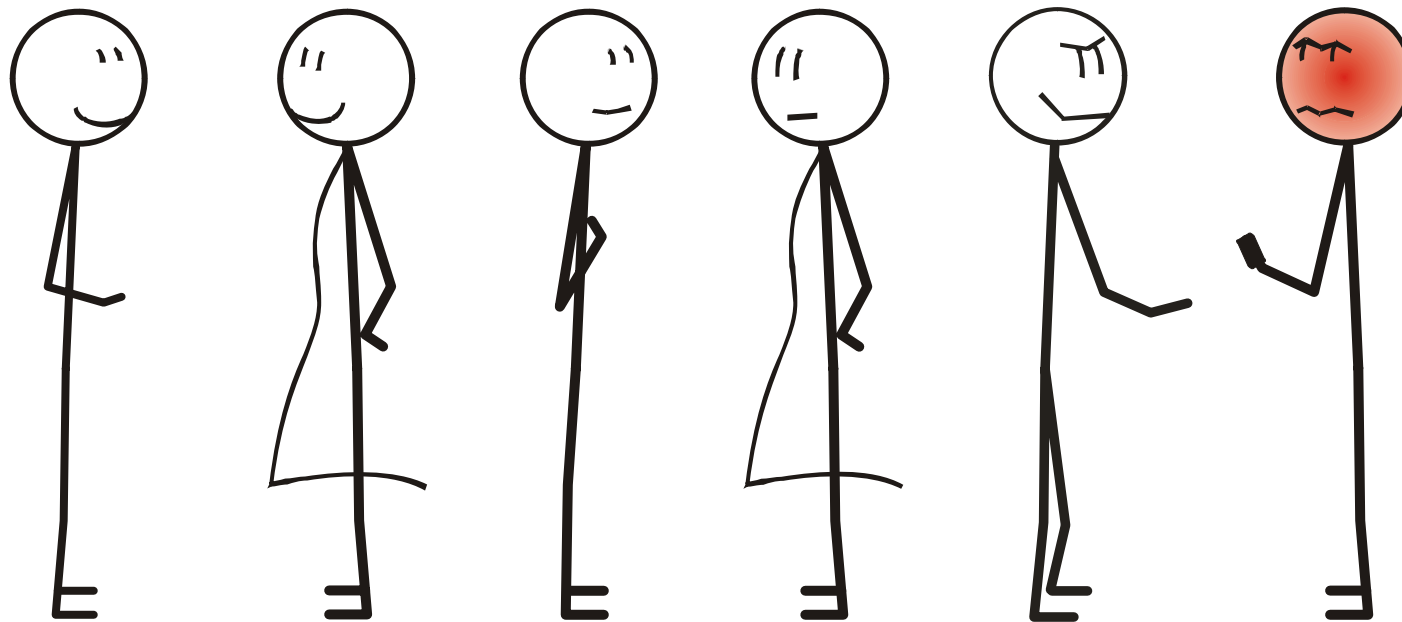
Bob: Wow, you look beautiful today!
[Bob: GoodActSelf, Anne: GoodEvent, Carl:BadEvent,BadActOther]





How to evaluate computer-generated affect?

- **Approach:** Plausibility check of affect through virtual character behavior



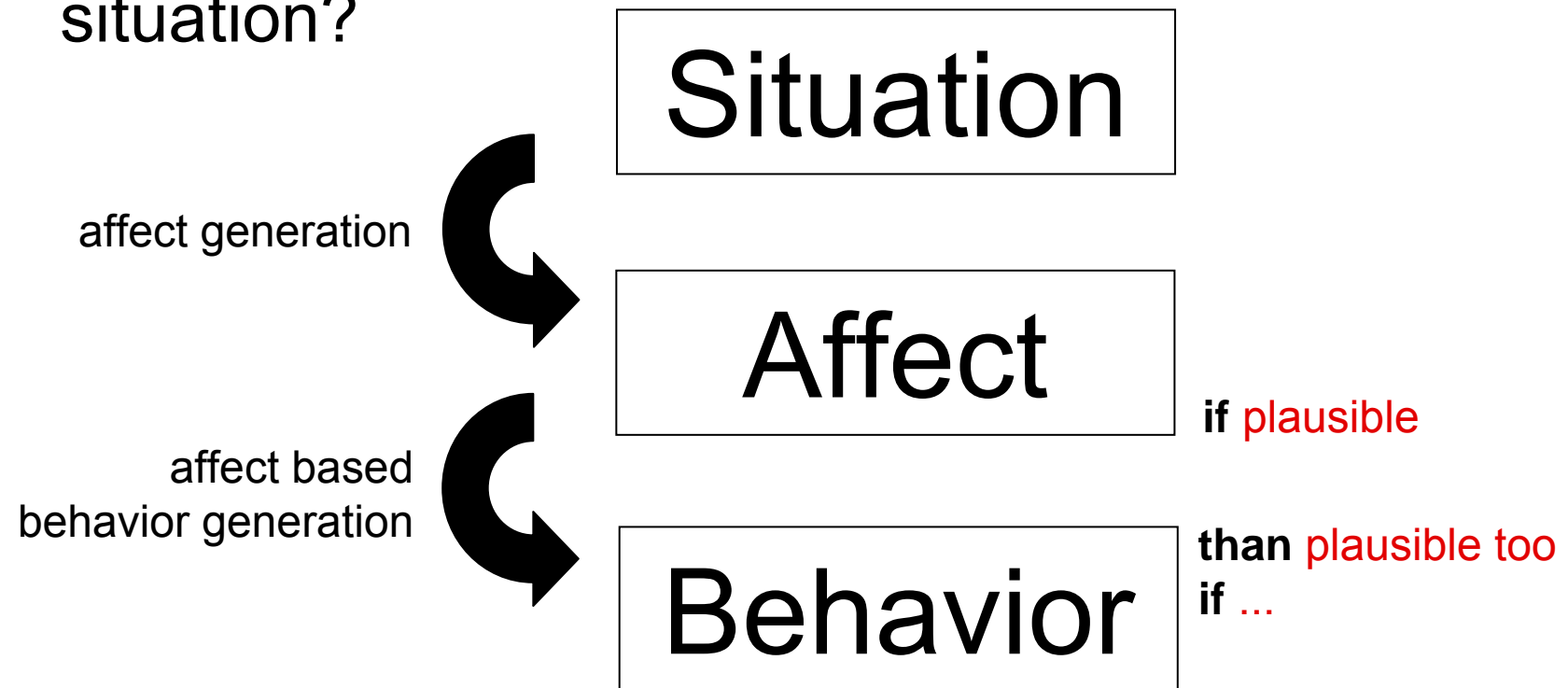
But: Behavior might not reflect generated affect efficiently - worst case: not at all!





Evaluation Question

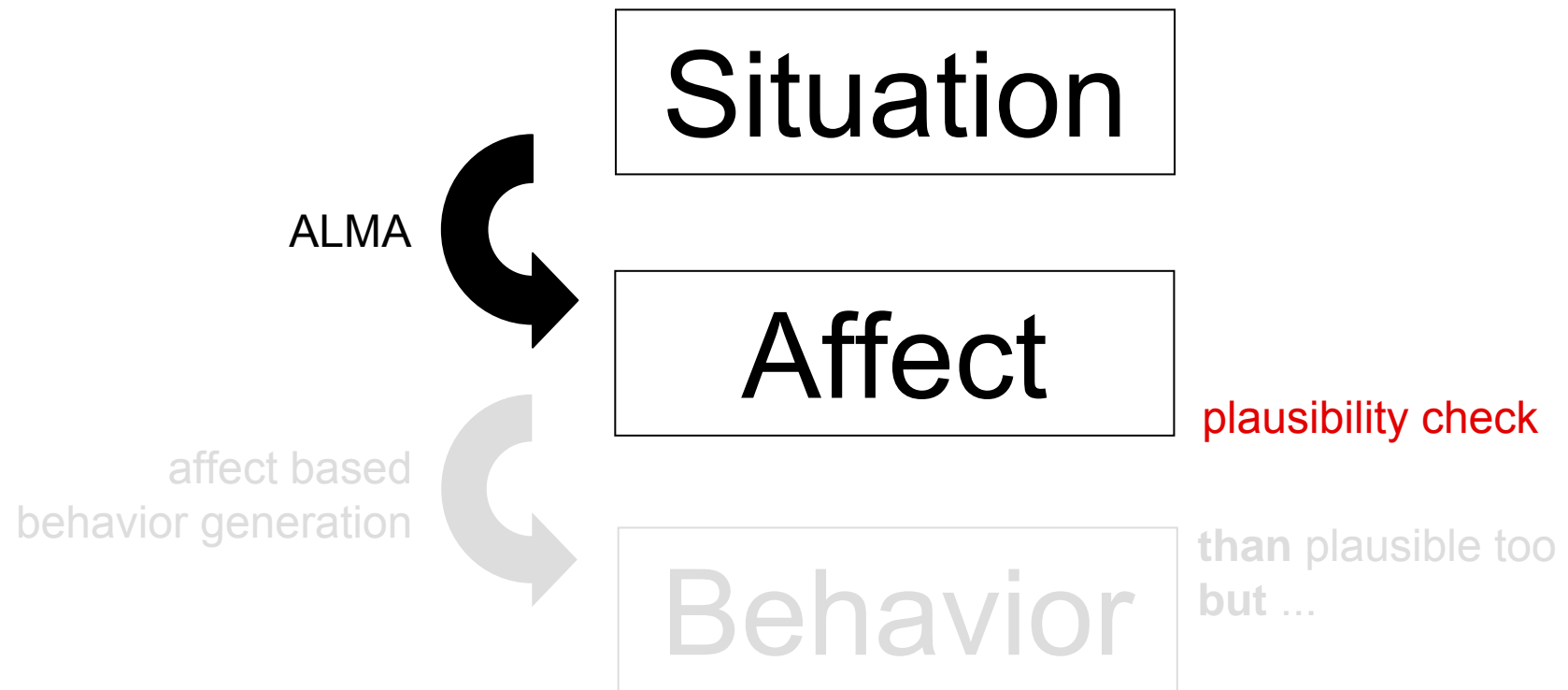
- Is affective behavior plausible in the current situation?





Evaluation Plan

- Is affect plausible in the current situation?





Material

- 30 min. textual questionnaire
 - plausibility check for 24 emotions, and 8 moods
 - only moods described verbally, e.g.
bored: sad, socially withdrawn, physically inactive ...
- 24 dialog contributions for emotions and
24 dialog scenes for moods (3 per mood)
 - both annotated with appraisal tags (hidden!)
 - emotions and moods computed by ALMA
- 33 Participants (17: (age 18-19), 16:(age 25-38))





Material - Emotions

- 24 dialog contributions, like:

Bruno: Anne, it's cool that you're helping grand-mother in cleaning up the garden!

Anne's emotion: pride

plausible not plausible

Bruno's emotion: admiration

plausible not plausible





Material - Mood

- 24 dialog scenes, like:

Situation: Mark is reorganizing his computer hard drive by letting Microsoft Windows removing unneeded files. Tanja just shows up.

Mark: Crap, Windows has killed all pictures of our last summer holiday at Mallorca.

Tanja: Don't panic, you'll find them surely in the waste bin.

Mark: Are you sure? But what if not, what I'm doing then – they will be lost forever!

Tanja: Well, I've no clue, I'm not the computer expert.

(Mark tries to recover the files by restoring the files of the waste bin)

Mark: No, damn it! All the pictures gone – and there's no way to get them back!

Tanja: Oh no, all our pictures are lost! You are a clean up maniac. I always told you that this will led some days to something bad. Well, and that's just happened. Wonderful!

Mark: Get of my back!

Marks mood after: hostile

plausible **not plausible**





Material - Appraisal Tags

- **Dialog contribution:**

Bruno: Anne, it's cool that you're helping grand-mother in cleaning up the garden! **[Praise Anne]**

Anne's emotion: ...

Bruno's emotion: ...

- **Dialog scene:**

Situation: Mark is reorganizing his computer hard drive by letting Microsoft Windows removing unneeded files. Tanja just shows up.

Mark: Crap, Windows has killed all pictures of our last summer holiday at Mallorca. **[BadEvent]**

Tanja: Don't panic, you'll find them surely in the waste bin. **[Calm Bruno]**

Mark: Are you sure? But what if not, what I'm doing then - they will be lost forever!

[AnnounceConcern Tanja]

Tanja: Well, I've no clue, I'm not the computer expert.

(Mark tries to recover the files by restoring the files of the waste bin)

Mark: No, damn it! All the pictures gone - and there's no way to get them back! **[BadEvent]**

Tanja: Oh no, All our pictures are lost! You are a clean up maniac. I always told you that this will led some days to something bad. Well, and that's just happened. Wonderful! **[Accuse Mark]**

Mark: Get of my back! **[Condemn Tanja]**

Marks mood after: ...





Affect Computation

- Dialog contributions and scenes → AffectScripts

```
<AffectScript>
<Context>Mark is reorganizing his computer hard drive by letting Microsoft Windows removing unneeded files. Tanja just shows up.
</Context>
<Item time="1000">
  <AffectInput>
    <Character name="Mark"/>
    <Event type="BadEvent" intensity="0.80" elicitor="lost vacation photos"/>
  </AffectInput>
  <Context>Mark: Crap, Windows has killed all pictures of our last summer holiday at Mallorca. [signal]</Context>
</Item>
<Item time="2000">
  <AffectInput>
    <Character name="Tanja"/>
    <Act addressee="Mark" listener="" type="Calm" intensity="0.40" elicitor="may be not lost"/>
  </AffectInput>
  <Context>Tanja: Don't panic, you'll find them surely in the waste bin. [signal]</Context>
</Item>
<Item time="3000">
  <AffectInput>
    <Character name="Mark"/>
    <Act addressee="Tanja" listener="" type="AnnounceConcern" intensity="0.80" elicitor="lost or not that's the question"/>
  </AffectInput>
  <Context>Mark: Are you sure? But what if not, what I'm doing then – they will be lost forever! [signal]</Context>
</Item>
...
```





Material - Emotions and Moods

- **Dialog contribution:**

Bruno: Anne, it's cool that you're helping grand-mother in cleaning up the garden!

Anne's emotion: **pride**

Bruno's emotion: **admiration**

- **Dialog scene:**

Situation: Mark is reorganizing his computer hard drive by letting Microsoft Windows removing unneeded files. Tanja just shows up.

Mark: Crap, Windows has killed all pictures of our last summer holiday at Mallorca.

Tanja: Don't panic, you'll find them surely in the waste bin.

Mark: Are you sure? But what if not, what I'm doing then – they will be lost forever!

Tanja: Well, I've no clue, I'm not the computer expert.

(Mark tries to recover the files by restoring the files of the waste bin)

Mark: No, damn it! All the pictures gone – and there's no way to get them back!

Tanja: Oh no, All our pictures are lost! You are a clean up maniac. I always told you that this will led some days to something bad. Well, and that's just happened. Wonderful!

Mark: Get of my back!

Marks mood after: **hostile**





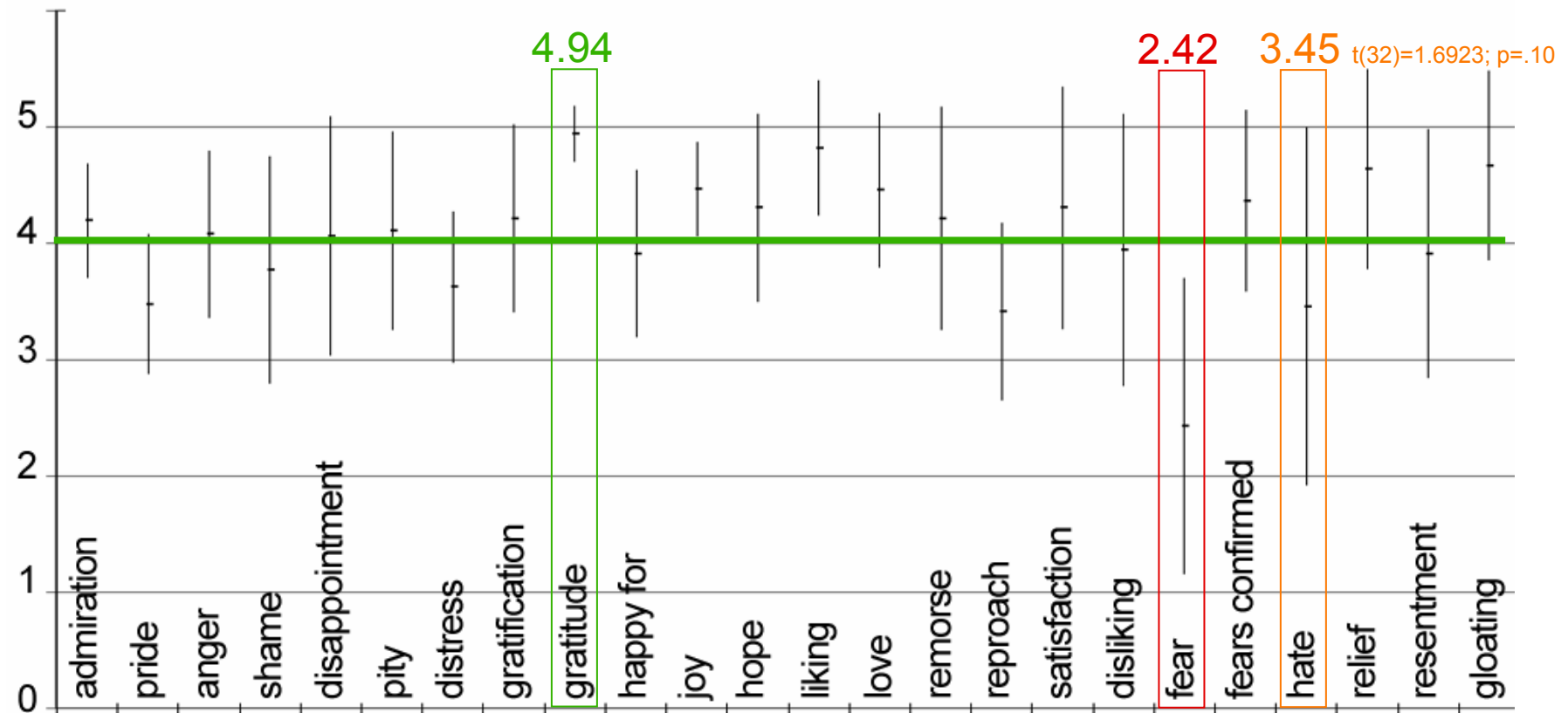
Data Analysis and Results

- Discrete plausibility ranking
(0: lowest plausibility, 5: highest plausibility, 3: mean plausibility)
- t-test for testing significance:
emotion/mood is plausible if mean score is significantly greater than 3
- Analysis of variance tests:
Are plausibility results connected to age and gender?
▶ *no!*





Results - Emotions

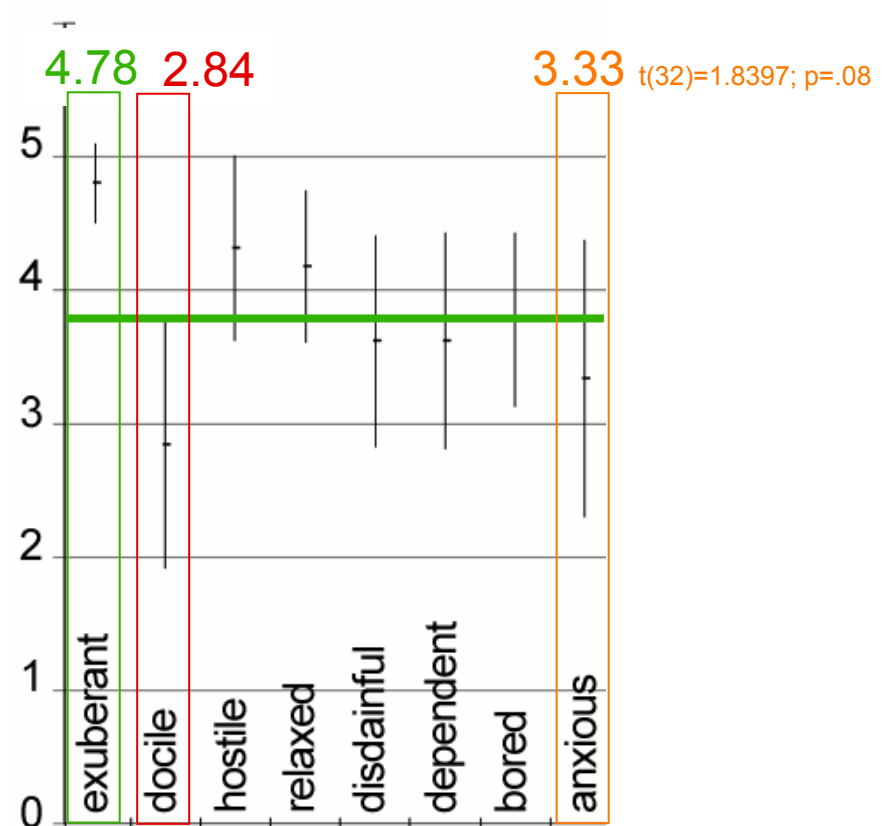


Mean of all emotions: 4.07 - significantly higher than 3 - ($t(32)=18.6312, p<.001$)





Results - Moods



Mean of all moods: 3.81 - significantly higher than 3 - t(32)=11.3195, p<.001)





Summary

- Fully operational model of appraisal and affect based on psychological theories
- Appraisal language allows easy appliance in virtual character dialog scenarios
 - Future: AppraisalEngine
- Real-time simulation of 24 emotions and 8 moods
- Evaluation shows positive plausibility of 22 out of 24 emotions and of 7 out of 8 moods.





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<http://www.dfki.de/~gebhard/alma.html>