

Alternative Theoretical Perspectives on Emotion Representation & Modeling

Eva Hudlicka

Psychometrix Associates
Blacksburg, VA
hudlicka@ieee.org
psychometrixassociates.com

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Outline

- Definition
- Three Theoretical Perspectives
- Similarities & Differences
- Implications for Affective Modeling
- Summary & Conclusions

Emotions

- **Evaluative** judgments of the:
 - World
 - Others
 - Self
- ... in light of agent's **goals** & beliefs
- ...**motivating** & **coordinating** adaptive behavior

Emotions Are Multimodal

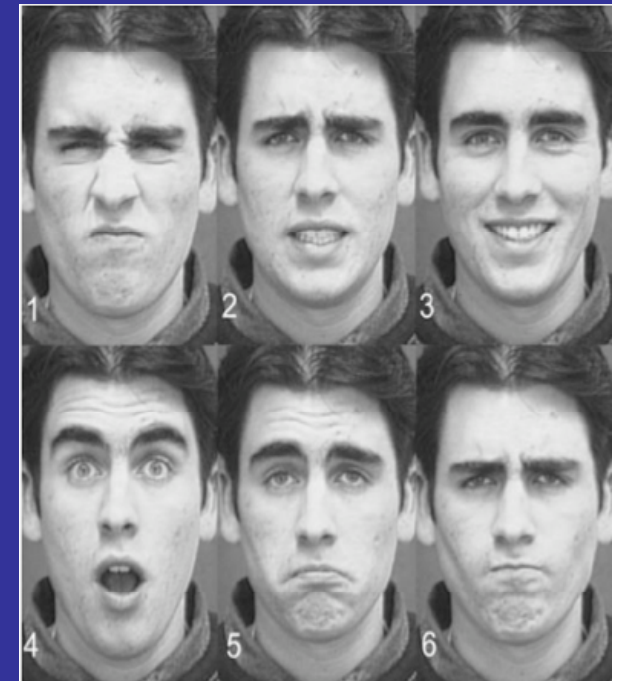
- Manifested across multiple, *interacting* modalities:
 - Physiological / Somatic (neuroendocrine - e.g., heart rate, GSR)
 - **Cognitive / Interpretive** (“Nothing is good or bad but thinking makes it so...”; appraisal, biasing effects)
 - **Motor / Behavioral** (expressive, action oriented)
 - Experiential / Subjective (conscious experience)

Dominant Theoretical Perspectives

- Discrete / Categorical
(Tomkins, Izard, Ekman, Panskepp...)
- Dimensional
(Wundt, Osgood, Lang, Russell, Thayer, Watson, Tellegen, Mehrabian...)
- Componential (focus on cognitive appraisal)
(Scherer, Roseman, Reisenzein, Smith, Ellsworth, Frijda, Ortony...)

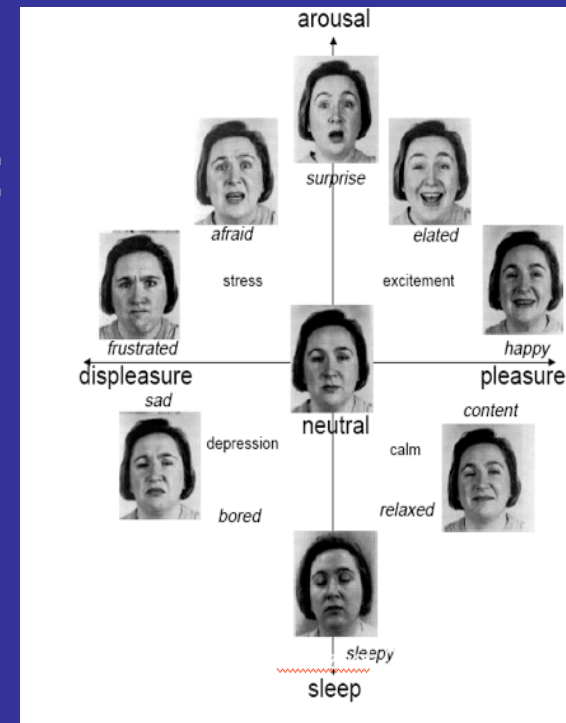
Discrete / Categorical

- A small number of 'hardwired' basic emotions
 - Joy, fear, anger, sadness, disgust, surprise..
- Characterized by distinct patterns of:
 - Triggering stimuli
 - Cognitive processing
 - Behavioral tendencies
 - Expression



Dimensional

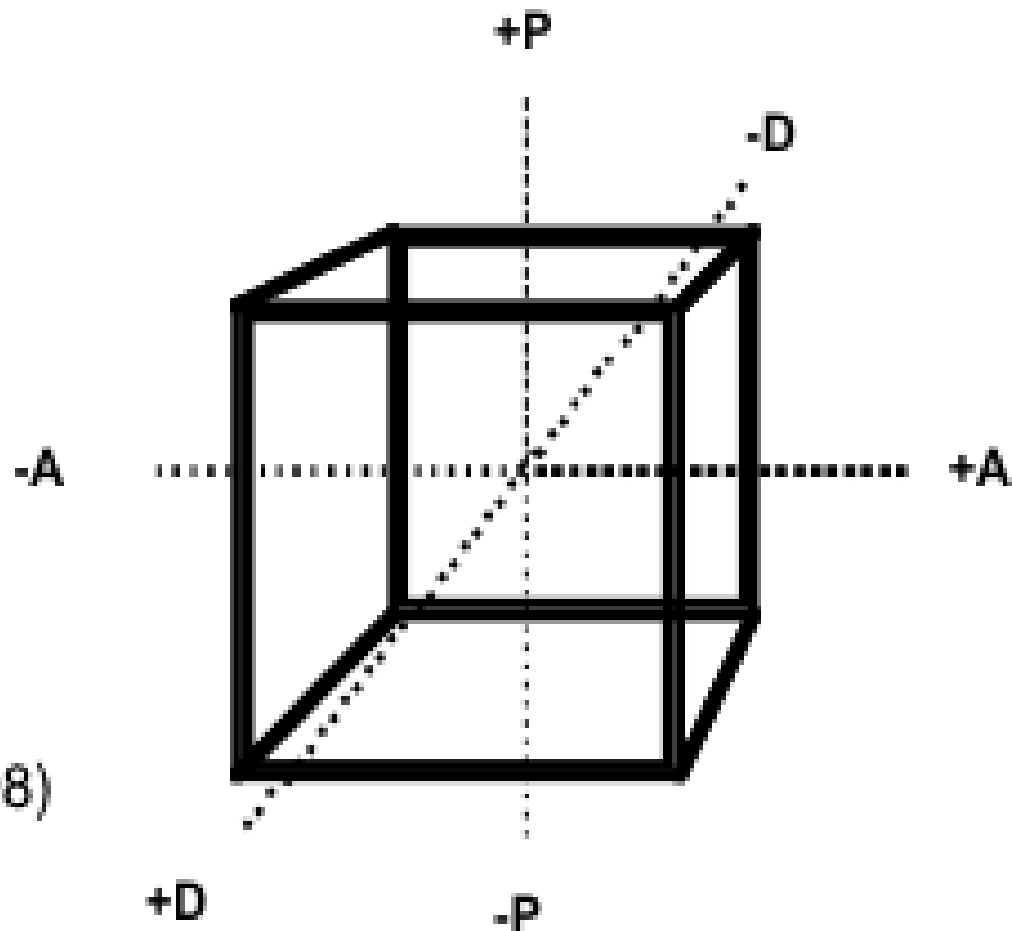
- Emotions defined in terms of 2 or 3 dimensions
 - 2D: Pleasure & Arousal
 - 3D: Pleasure & Arousal & Dominance
- 4th dimension recently proposed:
 - **Unpredictability**
(Fontaine, Scherer et al., 2007)



(Breazeal, 2003 adapted from Russell, 1997)

Dimensional

angry (-.51, .59, .25)
bored (-.65, -.62, -.33)
curious (.22, .62, -.01)
dignified (.55, .22, .61)
elated (.50, .42, .23)
hungry (-.44, .14, -.21)
inhibited (-.54, -.04, -.41),
loved (.87, .54, -.18)
puzzled (-.41, .48, -.33)
sleepy (.20, -.70, -.44)
unconcerned (-.13, -.41, .08)
violent (-.50, .62, .38).



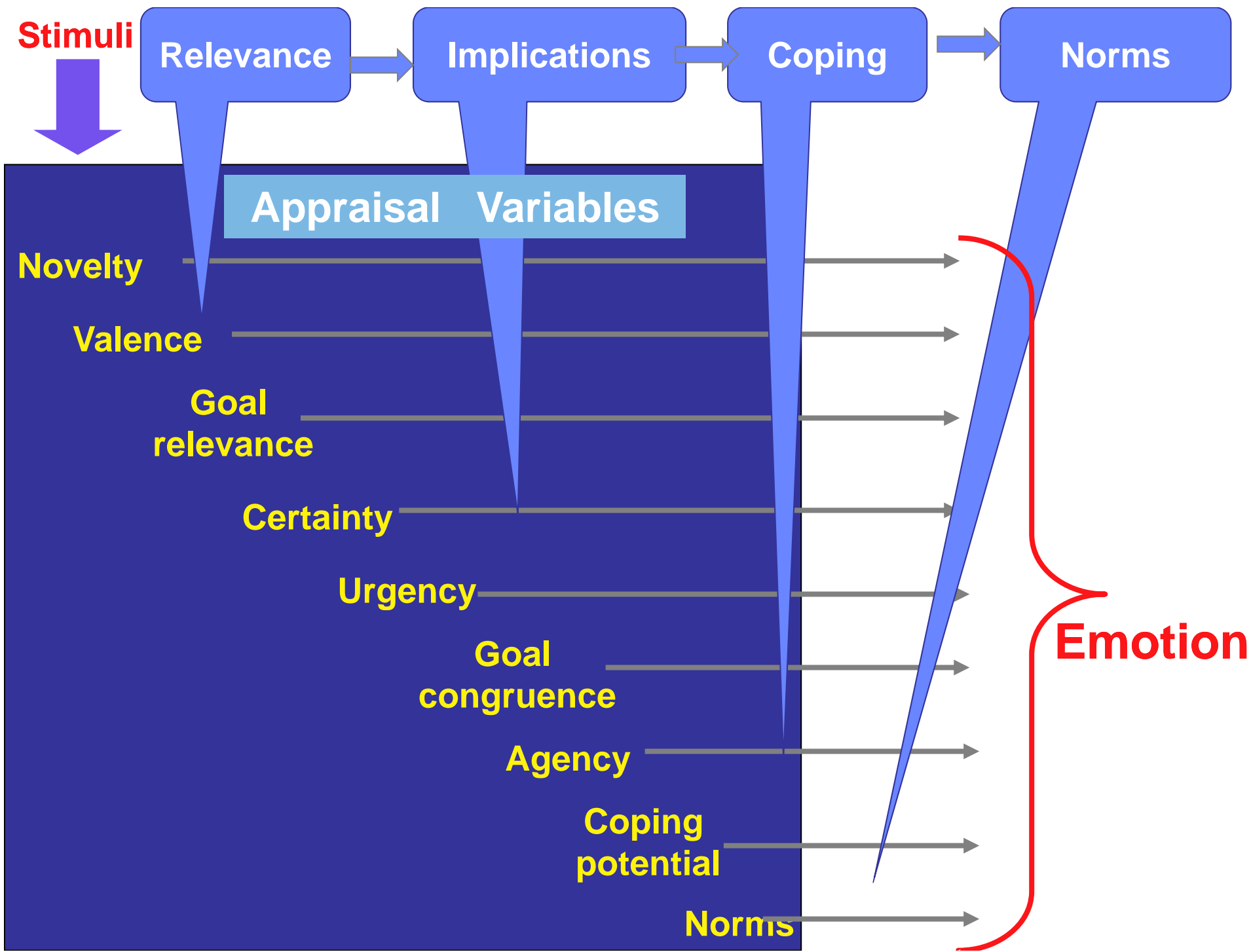
from de Groot & Broekens, 2003 – adapted from Mehrabian, 1995

2 or 3 Dimensions?

- 2D - cannot distinguish between emotions sharing same P & A values
 - Negative valence, positive arousal
 - Anger? Fear?
- Need 3rd dim. to distinguish --> dominance
 - Anger: - val., + arousal, + dominance
 - Fear: - val., + arousal, - dominance

Componential

- Emotions characterized by synchronized activity across multiple modalities
 - Cognitive, Physiological, Expressive, Behavioral, Subjective
- Cognitive modality & appraisal characterized by appraisal variables (dimensions)



STIMULI



FEAR

Novelty

Valence

Goal
relevance

Agency

Outcome
probability

Goal
congruence

Urgency

Coping
potential

high

low

high

other

high

low

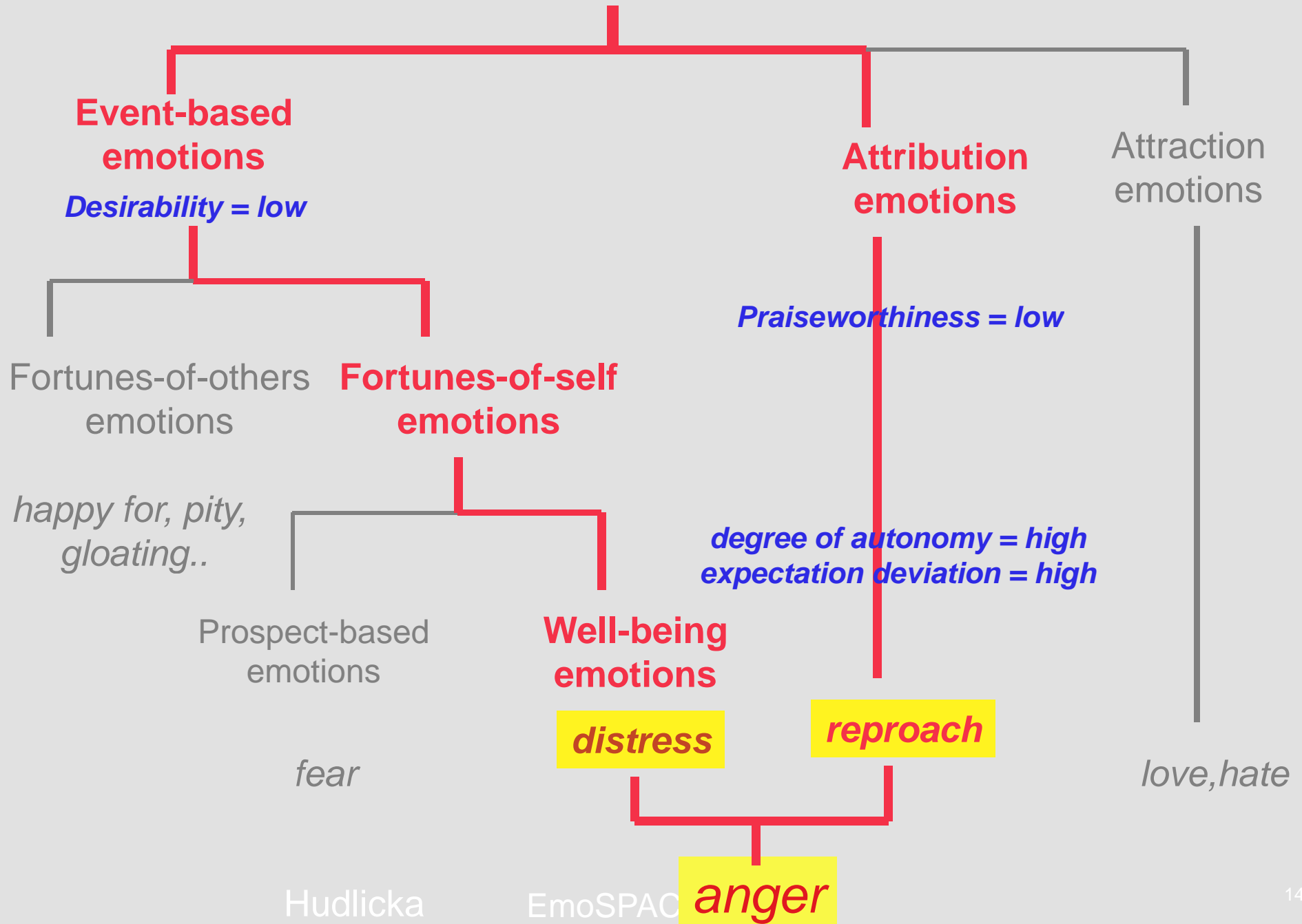
v. high

low

OCC Theory

- Ortony, Clore, Collins (OCC):
Cognitive Structure of Emotions (1988)
- Emotions characterized by abstract evaluative criteria applied to:
 - Events (desirable / not...)
 - Acts by other agents (praiseworthy / not...)
 - Objects (attractive / not...)
- ~22 emotions defined (including complex/social)

Valenced Reactions



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Semantic Primitives: Atomic Structure of Emotions

**Discrete /
Categorical**

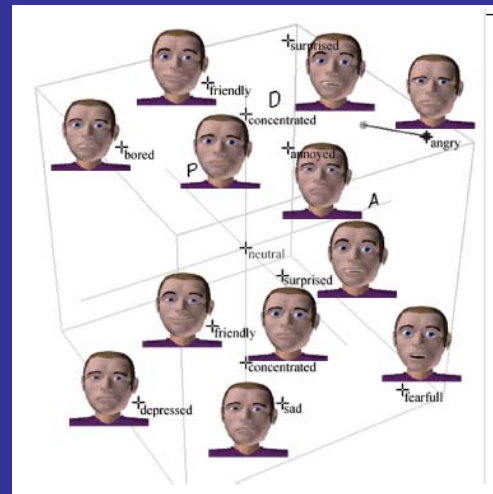
~6 Basic
emotions



Etc.

Dimensional

PA or PAD dims.



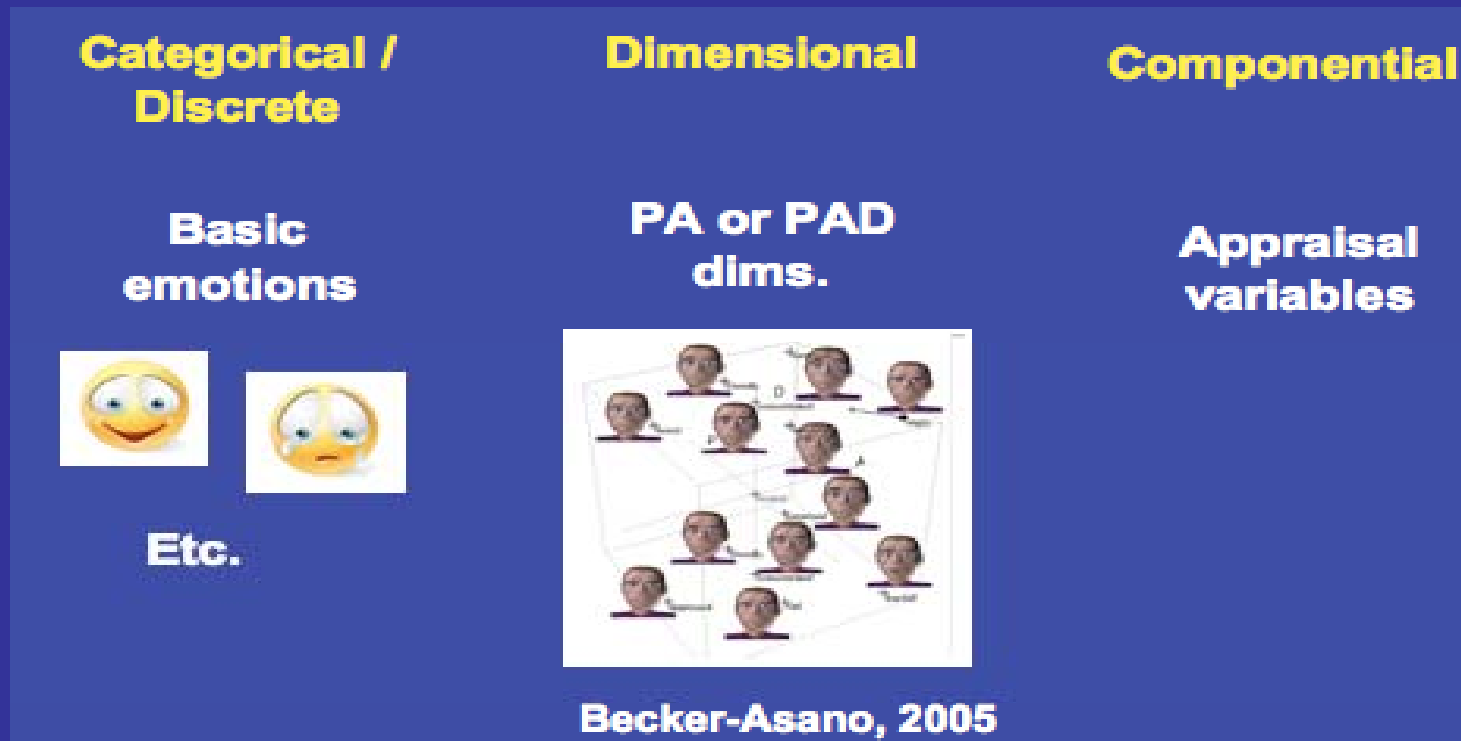
Becker-Asano, 2005

Componential

Appraisal
variables (13)

OCC evaluation
criteria (11)

(Size of) Affective Spaces



small

of affective states accommodated

large

Hudlicka

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Which Emotions Can be Defined by the Semantic Primitives?

- Discrete / Categorical
 - Basic emotions (joy, sadness, fear, anger, disgust, surprise)
 - Complex & social emotions? - Theoretical basis lacking
- Dimensional
 - Larger set than basic - but not all emotions uniquely defined
 - Lacks cognitive differentiation
- Componential (cognitive appraisal variables)
 - Very large space, accommodates many types of affective states & varying intensities

What Do the Different Semantic Primitives Characterize?



**World &
Relationship of
Self w/ World**

**Subjective Felt
Experience**

Componential

Dimensional

**Appraisal variables
/ OCC criteria**

PA or PAD dims

Emotion Modalities Emphasized

- Discrete / Categorical
 - Multimodal patterns (cognitive, motivational, behavioral, subjective) characterizing distinct basic emotions
- Dimensional
 - Subjective felt experience - physiology & subjective experience >> cognition
 - Characterize 'core affect' (Russell)
- Componential (appraisal)
 - Interpretation of stimuli & the stimuli-agent relationship - cognitive & interpretive structure >> physiology
 - Characterize emotions proper

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(Some) Implications for Affective Modeling

- Modeling core affective processes
 - Modeling emotion generation
 - Modeling emotion effects

Domain
Stimuli

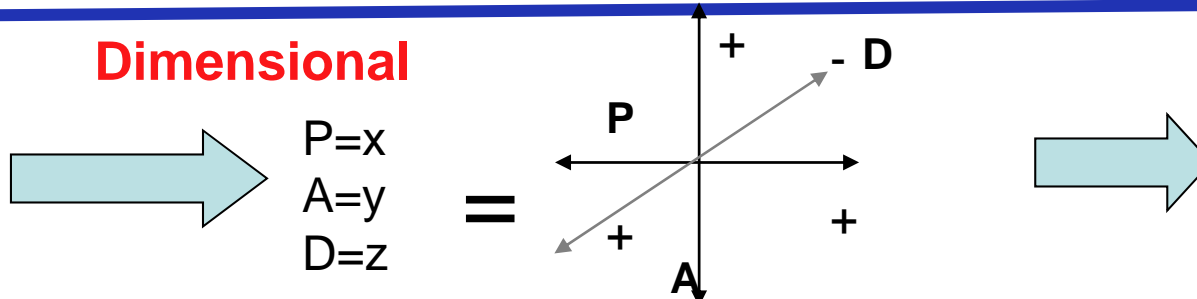
EMOTION GENERATION MODELS

Emotions

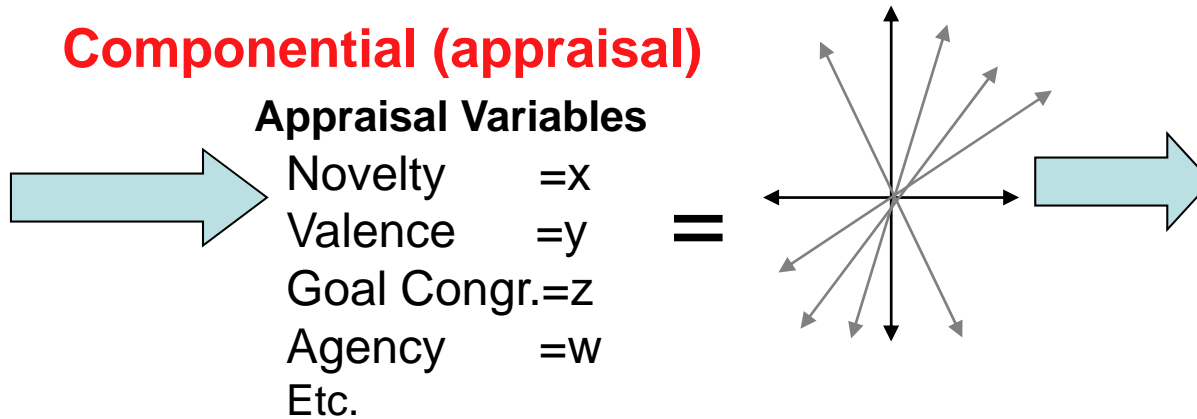
Discrete / Categorical



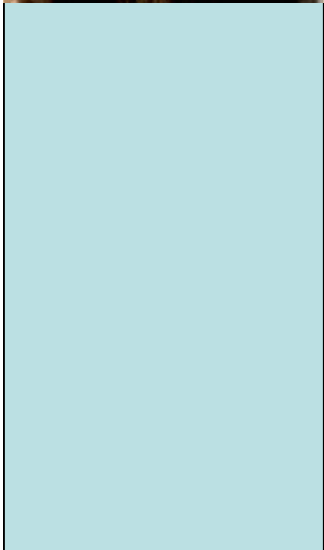
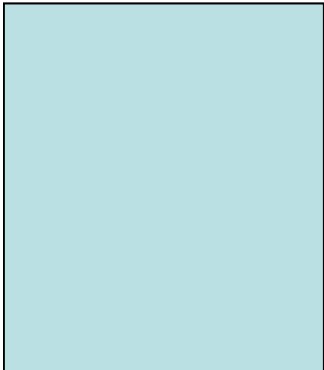
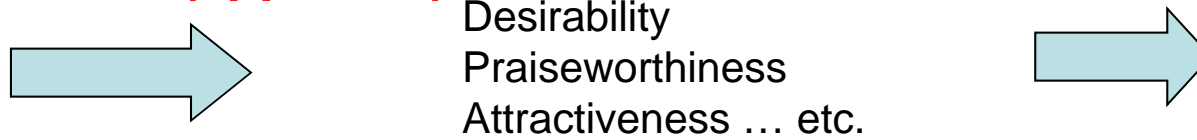
Dimensional



Componential (appraisal)



OCC (appraisal) Evaluative criteria



Modeling Emotion Generation

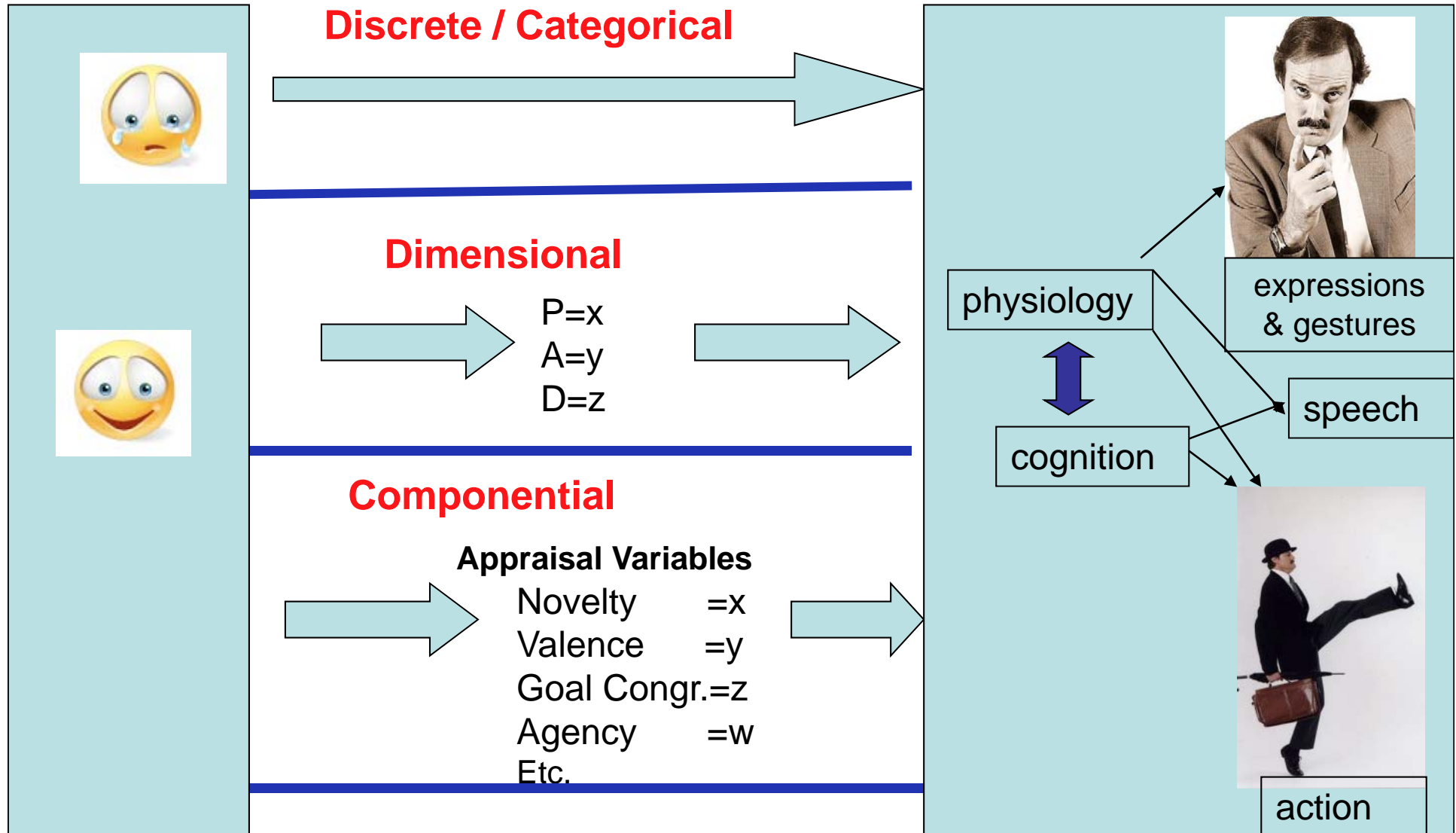
- Emphasis on cognitive modality - cognitive appraisal (other modalities ignored / minimized)
- Appraisal theories (componential perspective) provide best theoretical support
- Emotions defined in terms of abstract (domain-independent) features:
 - Vectors of appraisal variables
 - Vectors of OCC evaluation criteria
- Identifying values of these features may be non trivial

EMOTION EFFECTS MODELS

Emotions



Multimodal Manifestations of Emotions



Modeling Emotion Effects

- More challenging > emotion generation:
 - Cannot easily ignore multiple modalities
 - Effects on behavior, expression, (less) cognition
- Theoretical support << emotion generation
- PAD representation facilitates modeling of expressive manifestations
- Supporting data for mapping PAD & appraisal variables onto effects not always available
 - More data available at discrete / categorical level

Benefits of Dimensional Representations

- Model large # of emotions
- Facilitate integration of multiple emotions
 - ... but theory still lacking
- Continuous representations facilitate smooth transitions among emotions & different intensities
 - ...more realistic affective expression
- Enable parsimonious representation of shared qualities of different emotions
 - ...high arousal --> rapid movement, high speech pitch

Which Perspective & Space Should You Choose?

-it depends
- Which emotions will you need?
- Which affective processes will you model?
 - Appraisal variables good for emotion generation modeling (via cognitive appraisal)
 - PAD dimensions good for dynamics of emotion expression
 - ...
- Are the data available?
 - For each dimension / variable?
 - For each modality of interest?

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Summary of Continuous Characterizations of Emotions

- Different spaces defined by different underlying dimensions (semantic primitives)
 - PAD vs. appraisal variables (& OCC evaluative criteria)
- Emphasizing different aspects & modalities of emotions
 - Felt experience vs. stimulus <--> agent relationship
 - Physiology vs. cognition
- Different pros/cons for particular affective computing tasks
- “the search for the optimal low-dimensional representation of the emotion domain remains open”
(Fontaine, Scherer, Roesch, Ellsworth, 2007)

Conclusions

- Different perspectives / spaces should be viewed as complementary
 - Decision re: perspective choice guided by specific research & applied objectives
 - Multiple perspectives may be used in a single architecture ...supporting different tasks
- It's too early for a “unified theory” of emotions
 - Unified theory of emotions may not exist
 - “Emotion is too broad a class of events to be a single scientific category, and no one structure suffices.” (Russell & Feldman Barrett, 1999)



Thank you

Questions?