

Facial Expressions

Computational Social Intelligence - Lecture 15

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This lecture is based on the following text
(available on Moodle):

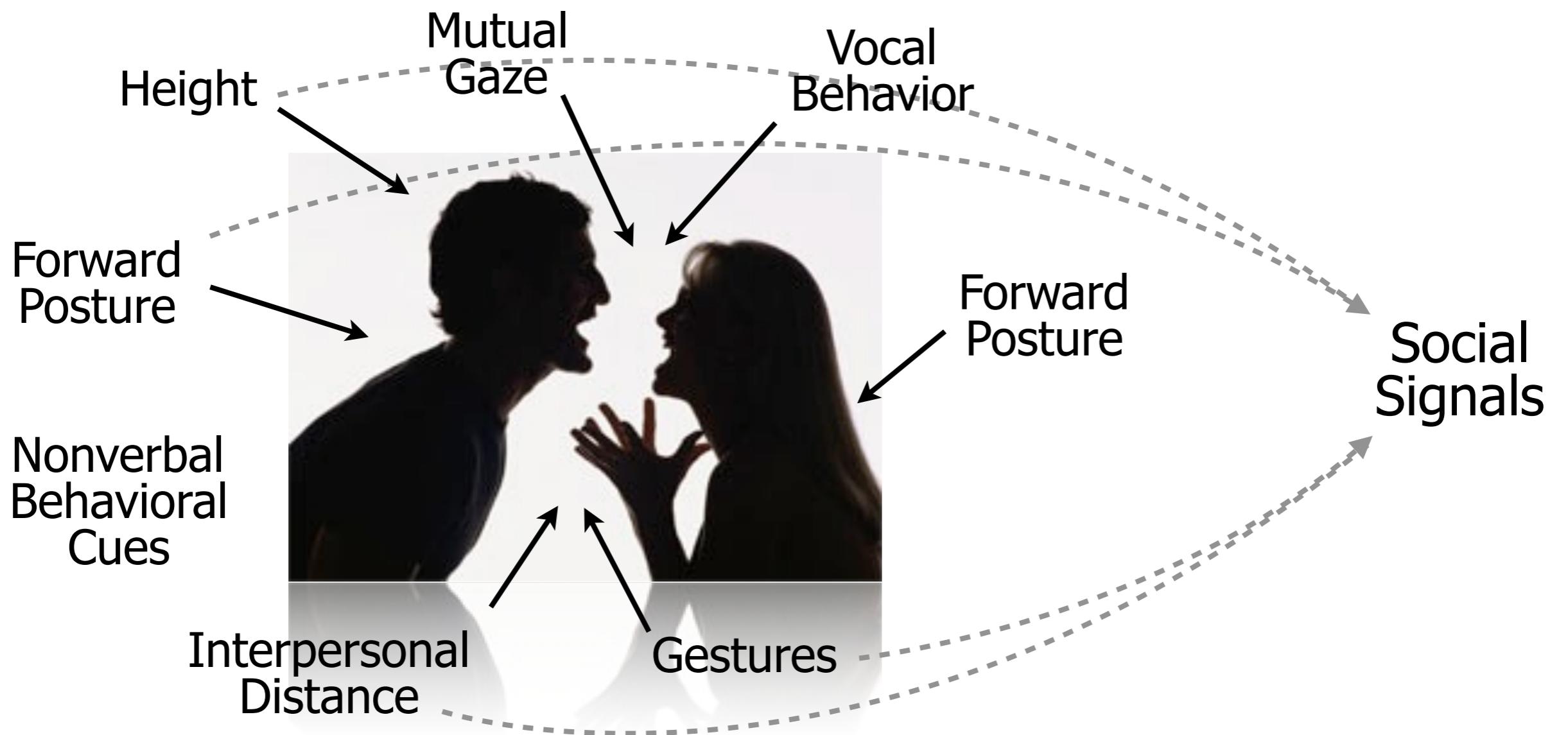
- Ekman and Friesen, “Measuring Facial Movements”, Environmental Psychology and Nonverbal Behavior, 1(1):56-75, 1976.
- Baltrušaitis, Robinson, and Morency, “Openface: an open source facial behavior analysis toolkit”, IEEE Winter Conference on Applications of Computer Vision, 2016.

Outline

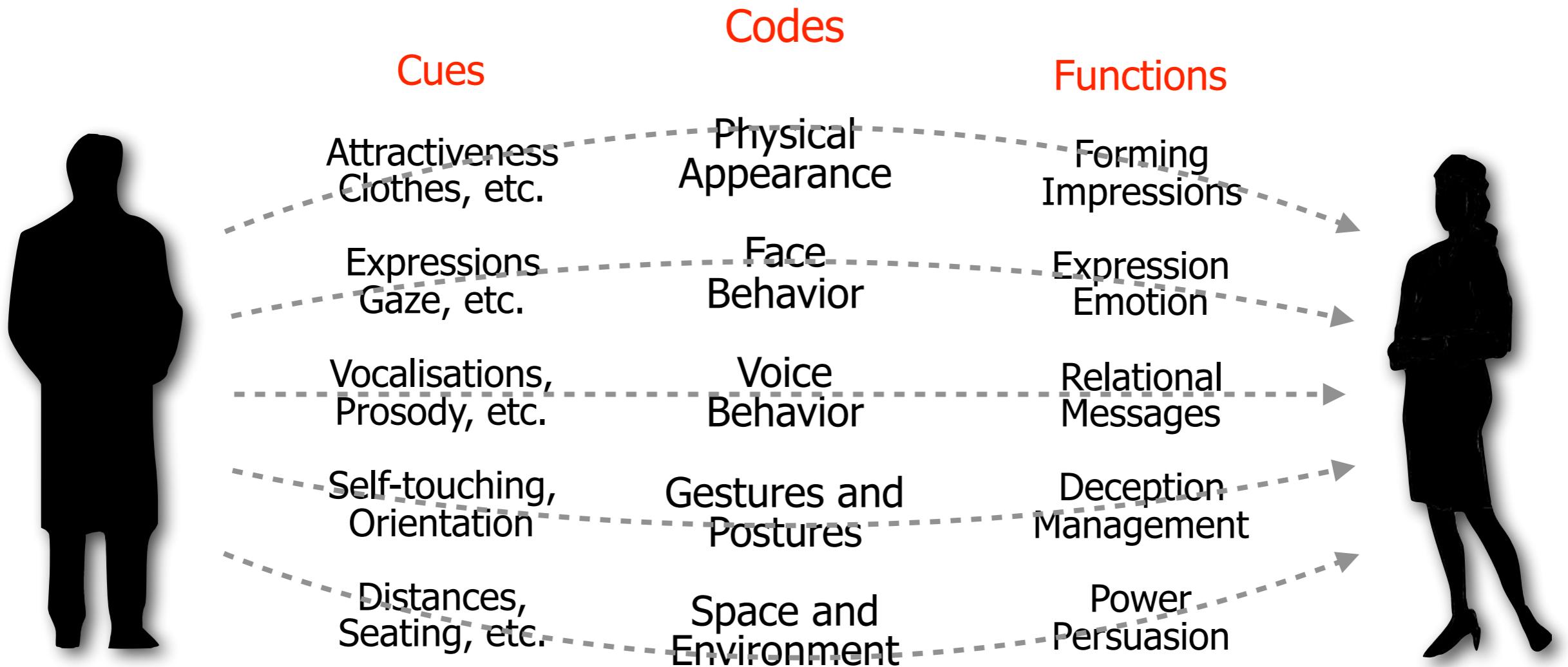
- Nonverbal Communication
- Facial Expressions
- Action Units
- Facial Expression Analysis
- Conclusions

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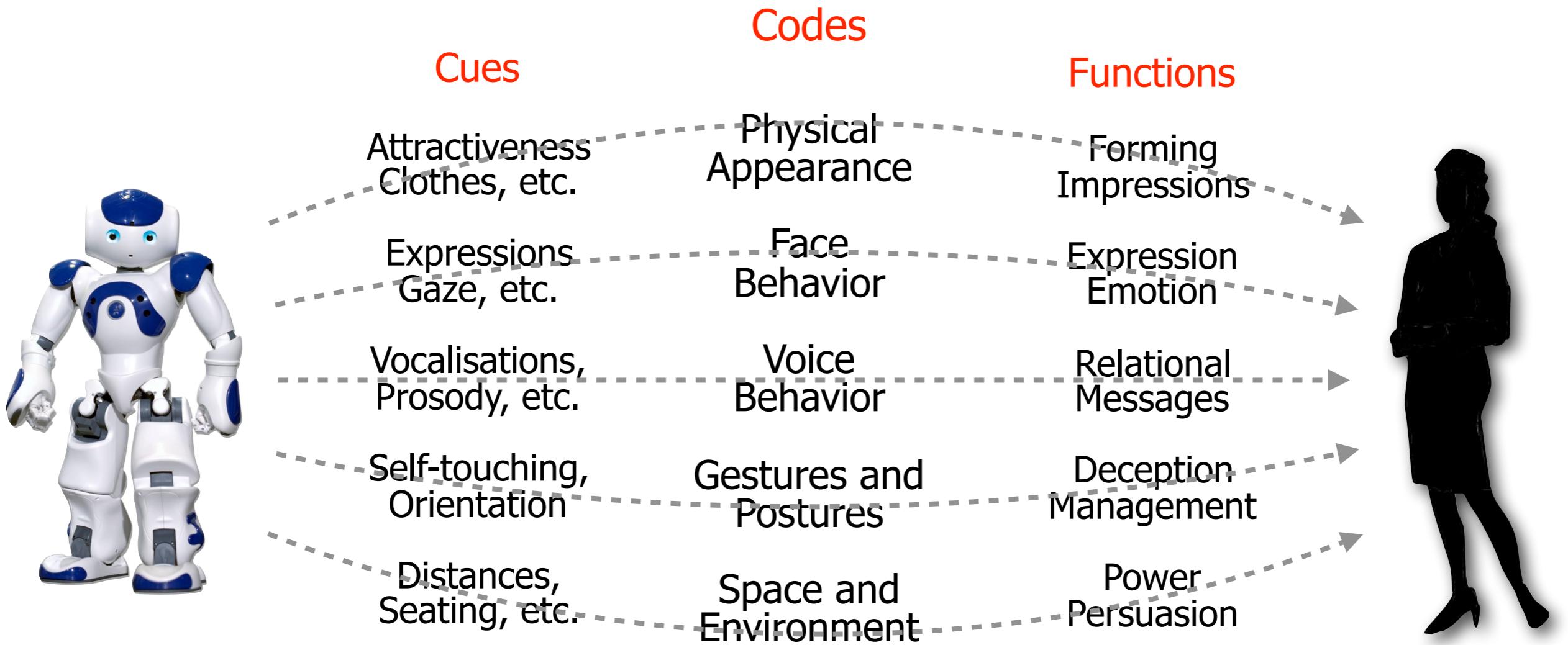
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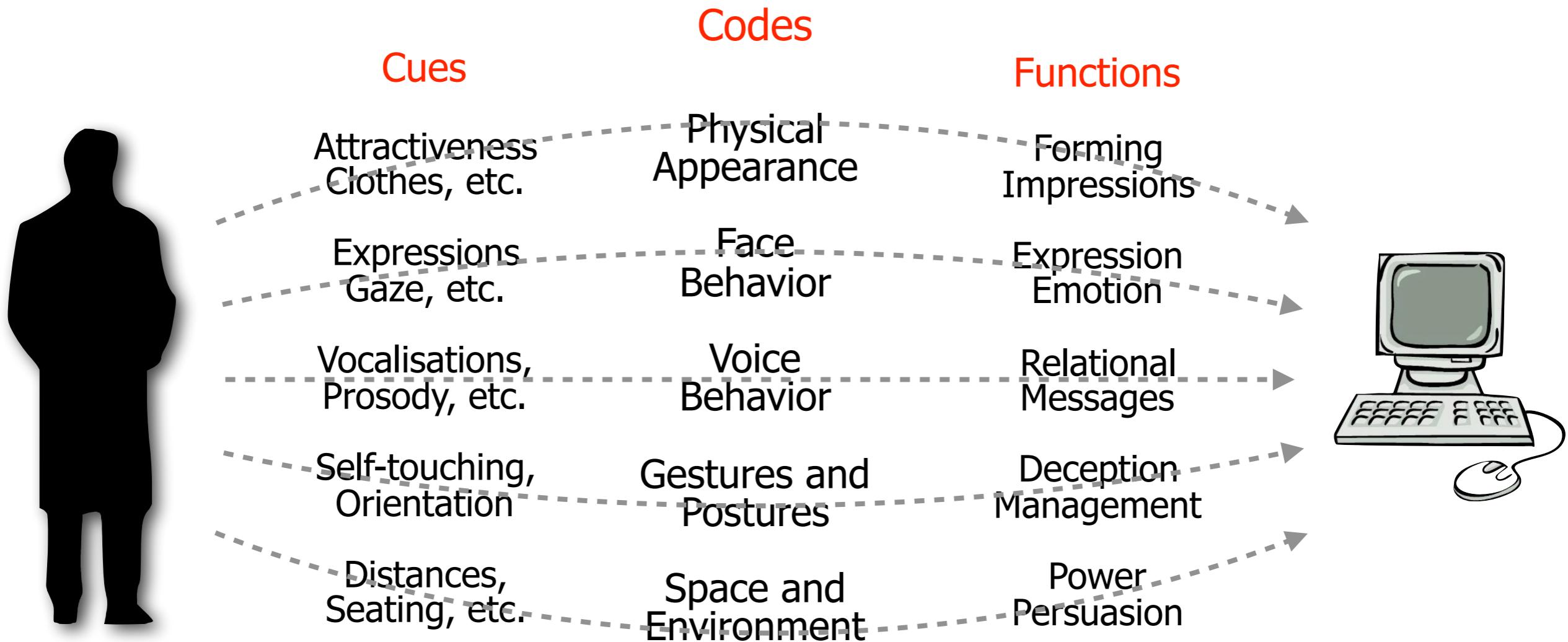
Vinciarelli, Pantic and Bourlard, "Social Signal Processing: Survey of an Emerging Domain", Journal of Image and Vision Computing, 27(12):1743-1759, 2009



Richmond and McCroskey, "Nonverbal Behaviors in Interpersonal Relations",
Allyn and Bacon, 1995



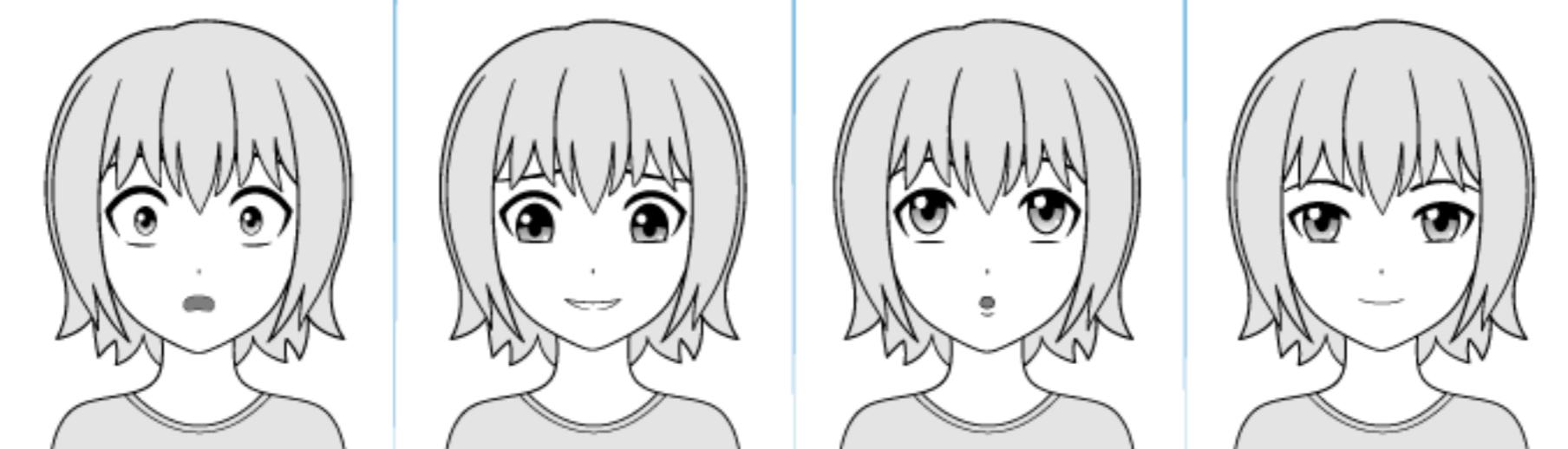
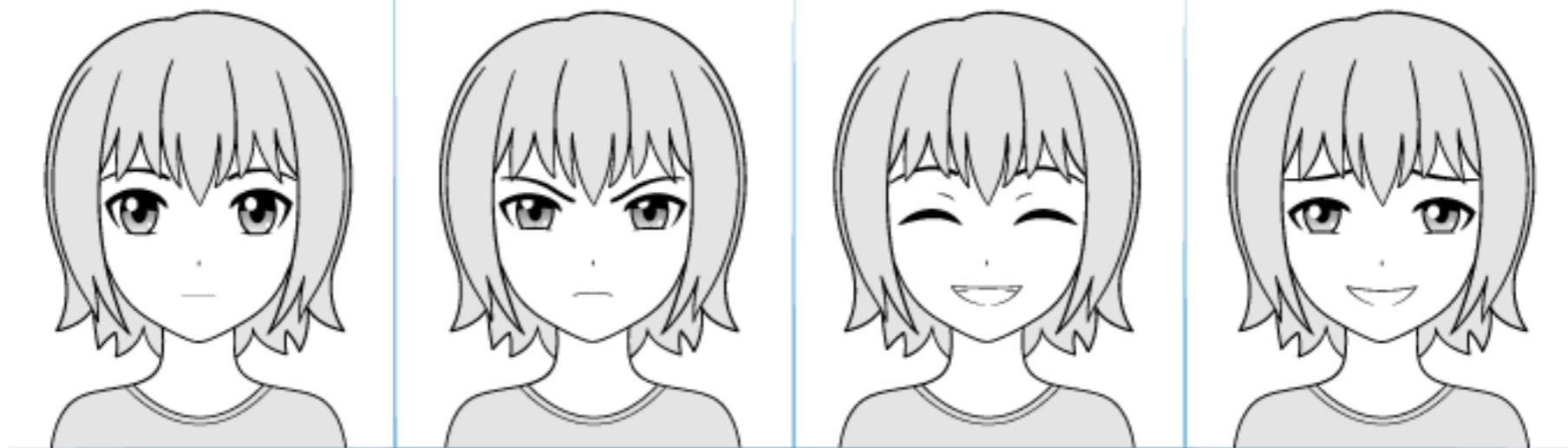
Richmond and McCroskey, "Nonverbal Behaviors in Interpersonal Relations",
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<https://www.pinterest.co.uk/pin/214906213452277482/>

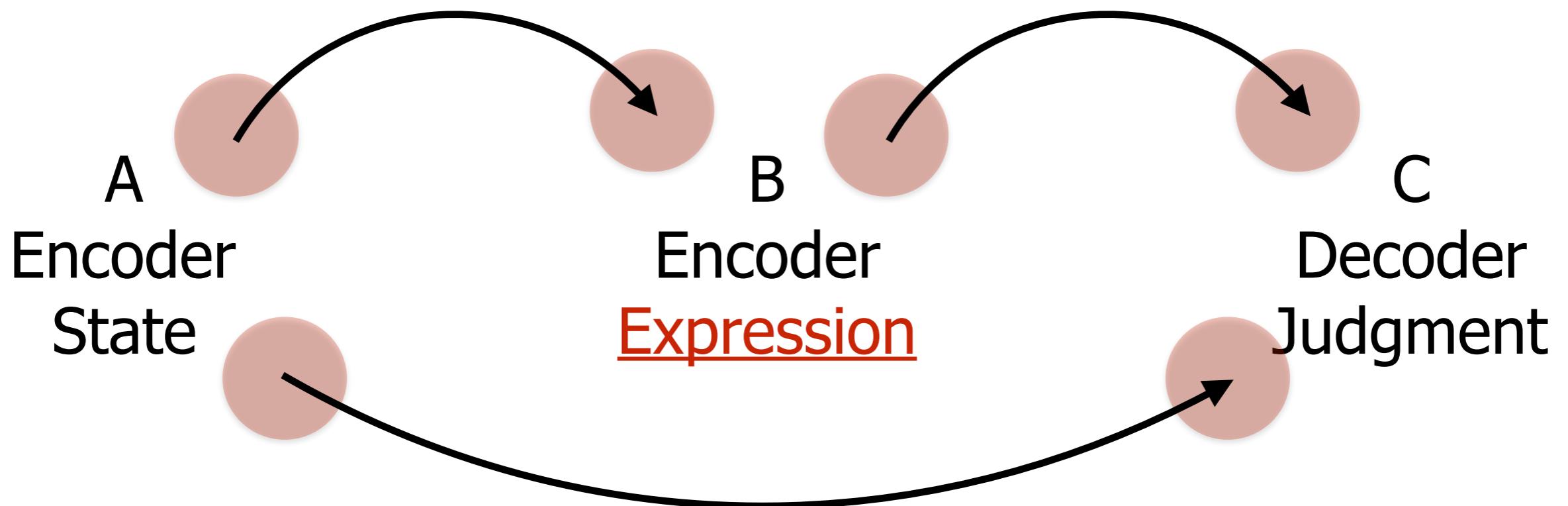
Facial Expressions

“Which movements signal emotion? [...] Do the same facial movements occur in the same social contexts in different cultures? Are certain facial actions inhibited in certain social settings? Which facial movements punctuate conversation, etc.?”

Ekman and Friesen, “Measuring Facial Movements”, Environmental Psychology and Nonverbal Behavior, 1(1):56-75, 1976

How does the encoder manifest her/his state through her/his expressions?

How do decoders interpret the expressions of the encoder



What is the state the decoder attributes to the encoder?

Facial Action Code (I)

"Our primary goal in developing the Facial Action Code (FAC) was to develop a comprehensive system which could distinguish all possible visually distinguishable facial movements."

Ekman and Friesen, "Measuring Facial Movements", Environmental Psychology and Nonverbal Behavior, 1(1):56-75, 1976

Facial Action Code (II)

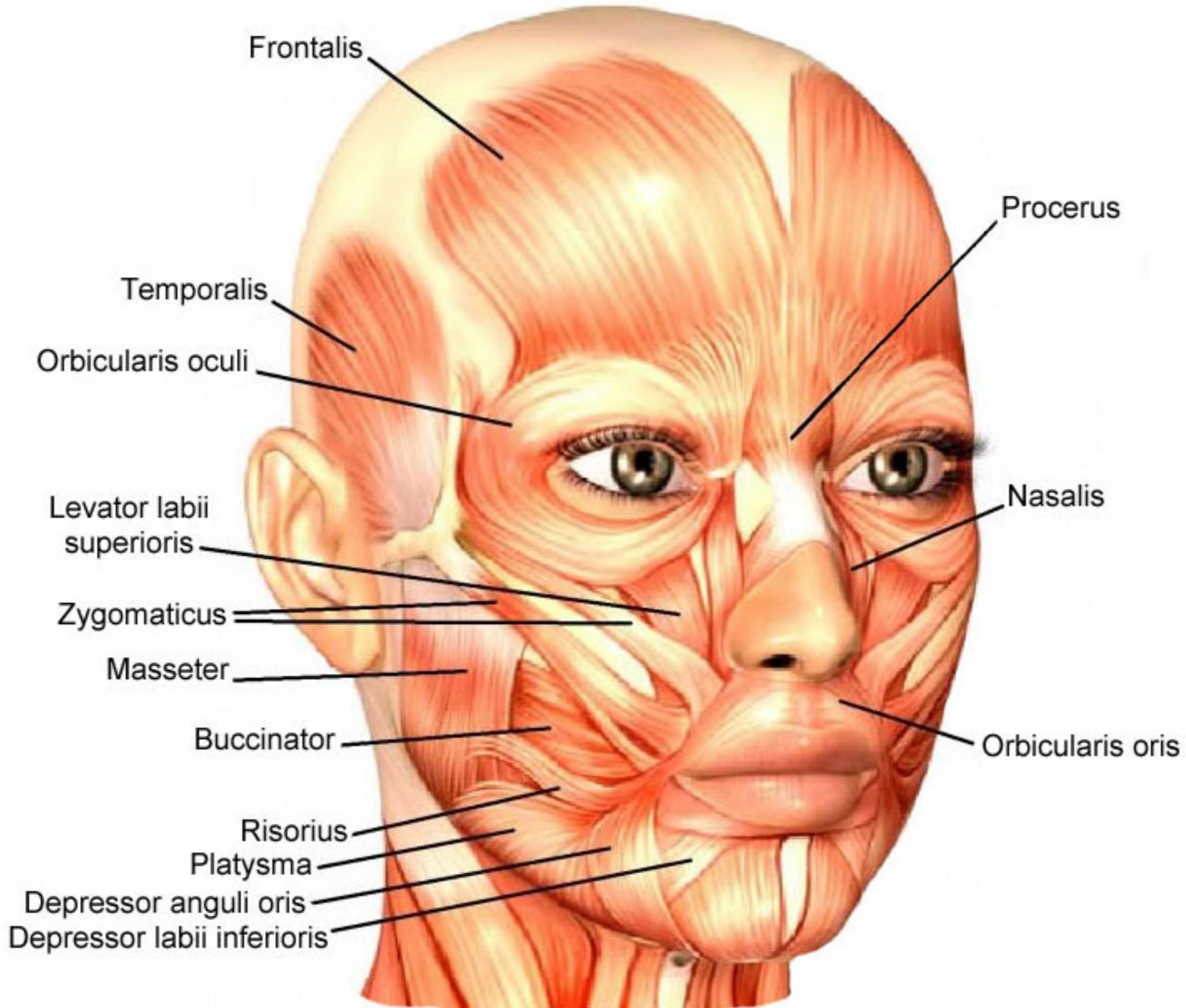
“[...] it deals with what is clearly visible in the face, ignoring invisible changes [...] based on our interest in what could have social consequences [...] could be applied to any record of behaviour [...]”

Ekman and Friesen, “Measuring Facial Movements”, Environmental Psychology and Nonverbal Behavior, 1(1):56-75, 1976

Facial Action Code (III)

“We chose to derive FAC from an analysis of the anatomical basis of facial movement. Since every facial movement is the result of muscular action, a comprehensive system could be obtained by discovering how each muscle of the face acts to change visible appearance.”

Ekman and Friesen, “Measuring Facial Movements”, Environmental Psychology and Nonverbal Behavior, 1(1):56-75, 1976

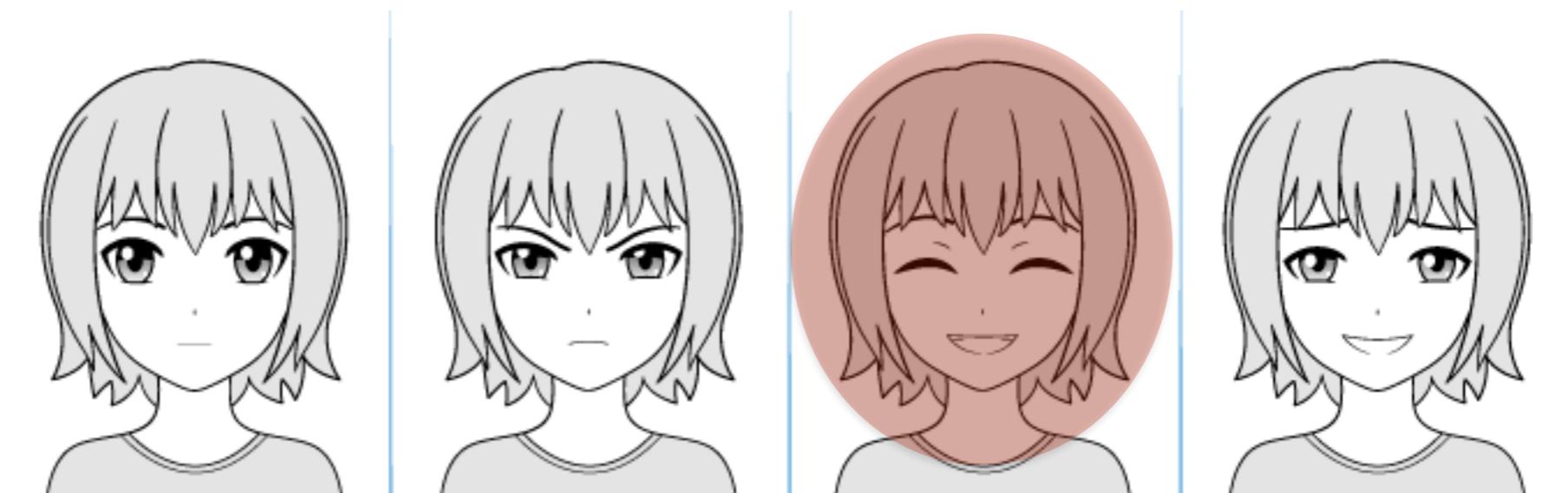


Facial Action Code (III)

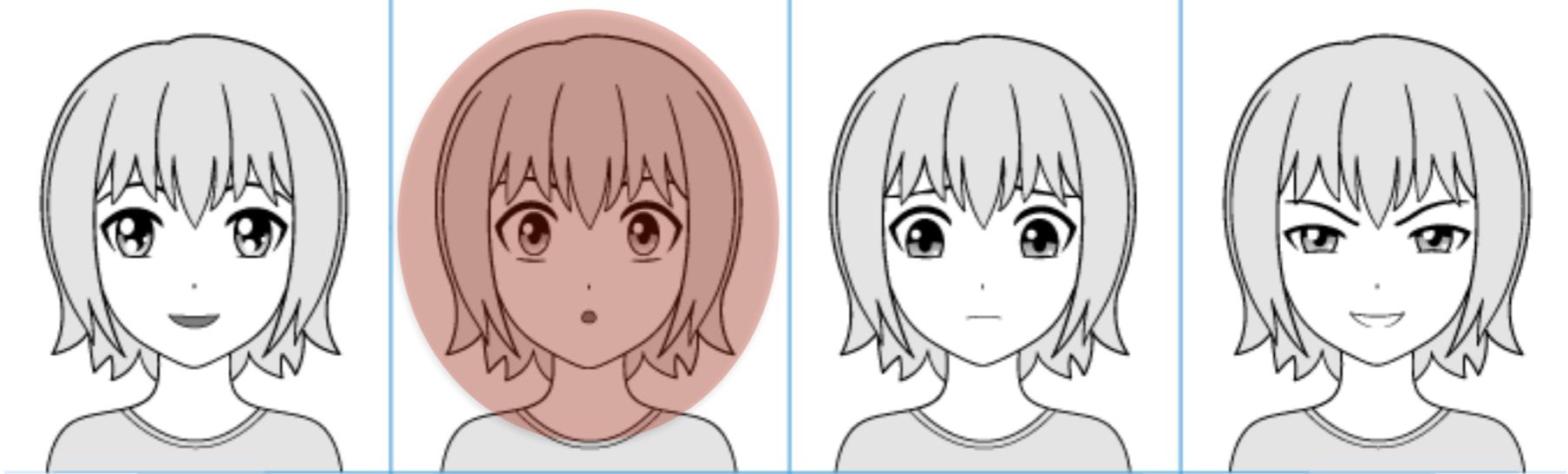
“[...] separate inference from description. We are interested in determining which facial behavior is playful, or puzzled, or sad, but such inferences about underlying state, antecedent, or consequent actions should rest upon evidence.”

Ekman and Friesen, “Measuring Facial Movements”, Environmental Psychology and Nonverbal Behavior, 1(1):56-75, 1976

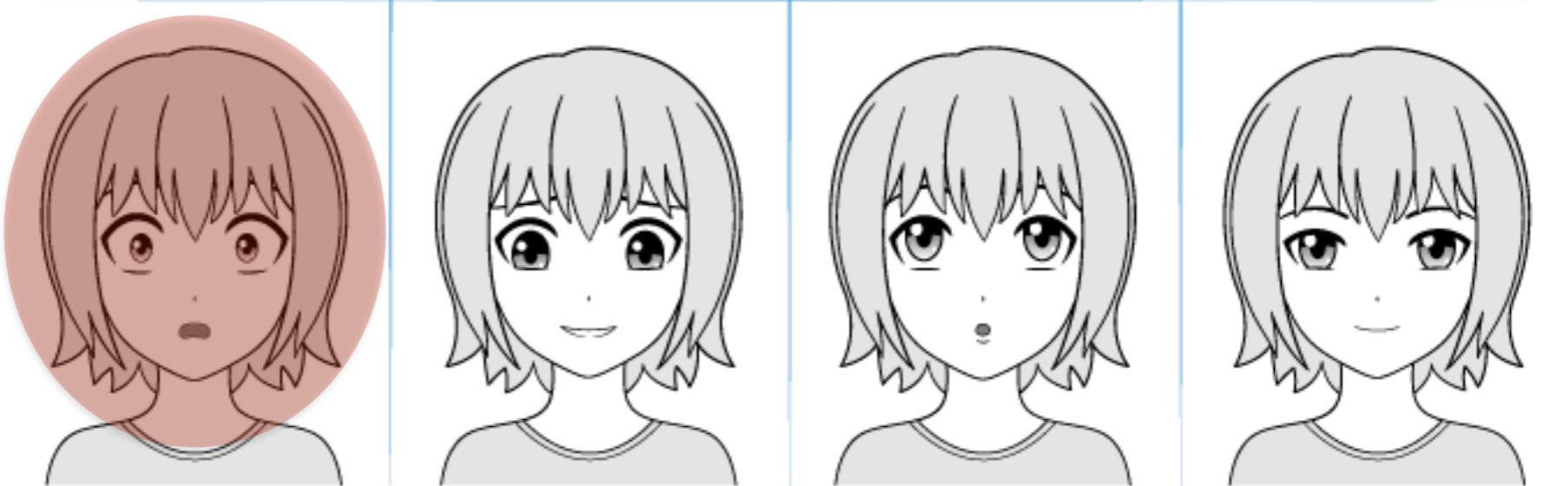
Happiness



Surprise



Fear



<https://www.pinterest.co.uk/pin/214906213452277482/>

Facial Action Code (III)

"[...] most of the appearance changes were additive. The characteristic appearance of each of the two AUs was clearly recognizable and virtually unchanged. There were a few AU combinations which were not additive."

Ekman and Friesen, "Measuring Facial Movements", Environmental Psychology and Nonverbal Behavior, 1(1):56-75, 1976

The Likelihood of a muscle activation pattern given a certain expression

Every component accounts for the activation of a muscle

$$p(\vec{x}|\mathcal{C}_k) = p(x_1, x_2, \dots, x_D | \mathcal{C}_k)$$

The diagram illustrates the decomposition of a vector \vec{x} into its components x_1, x_2, \dots, x_D . A large oval labeled $p(\vec{x}|\mathcal{C}_k)$ contains the equation. An arrow points from this oval down to the entire equation. Another arrow points from the oval to the first term $p(x_1|\mathcal{C}_k)$. From this term, two arrows point to x_1 and x_2 . From the term $p(x_D|\mathcal{C}_k)$, an arrow points to x_D .

The class can corresponds to a inner state (e.g., happy or sad)

The number of Action Units

The probability of a vector is the joint probability of its components

Likelihood of an individual component

$$p(x_1, x_2, \dots, x_D | C_k) = \prod_{i=1}^D p(x_i | C_k)$$

It is true if the components are statistically independent given the class

The Naive Bayes classifier

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Inner Brow Raiser (AU1)

Outer Brow Raiser (AU2)

Brow Lowerer (AU4)

Upper Lid Raiser (AU5)

Cheek Raiser (AU6)

Lid Tightener (AU7)

Nose Wrinkler (AU9)

Upper Lid Raiser (AU10)

Nasolabial Fold Deepener (AU11)

Lip Corner Puller (AU12)

Cheek Puffer (AU13)

Dimpler (AU14)

Lip Corner Depressor (AU15)

Lower Lip Depressor (AU16)

Chin Raiser (AU17)

Lip Puckerer (AU18)

Lip Stretcher (AU20)

Lip Funneler (AU22)

Lip Tightner (AU23)

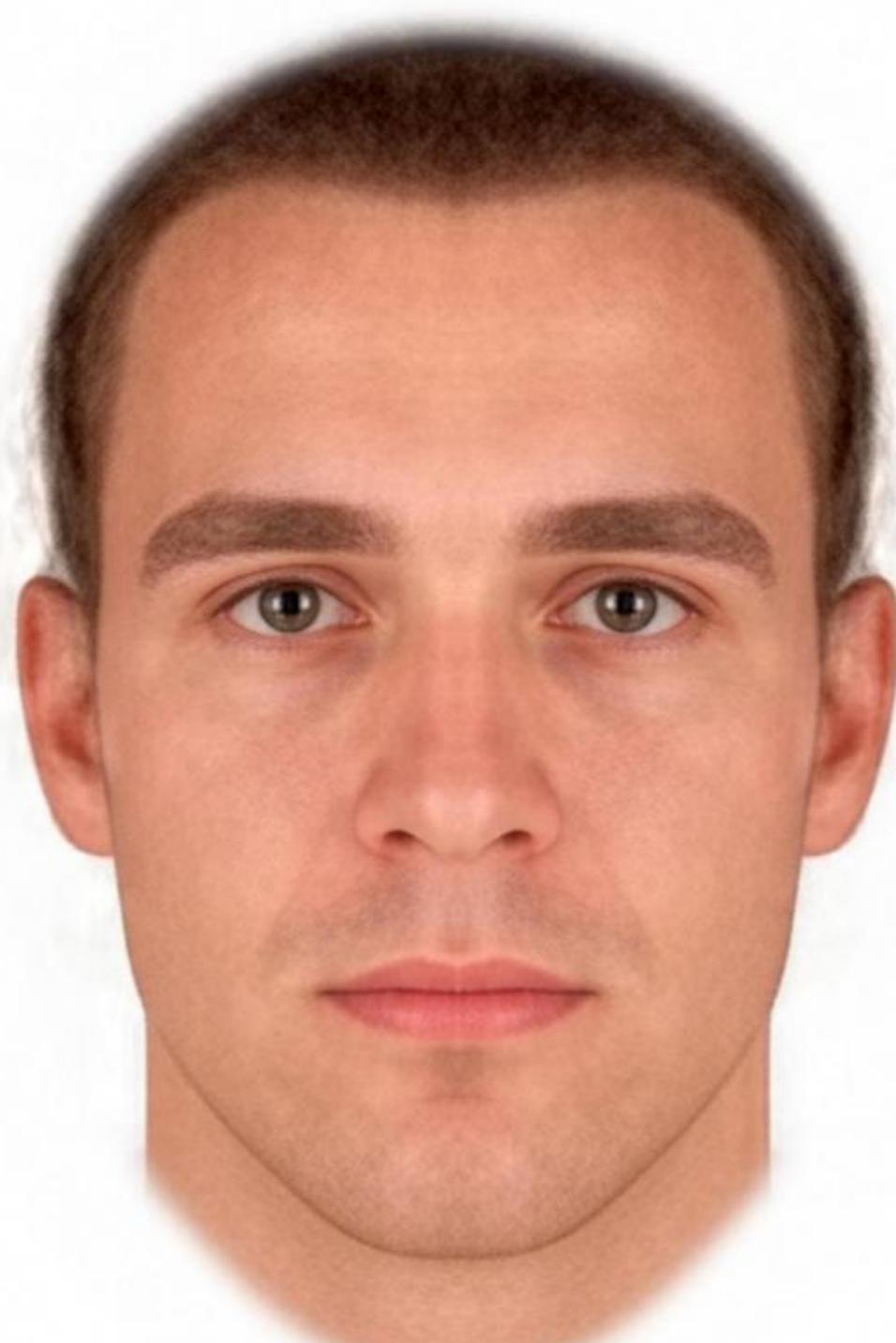
Lip Pressor (AU24)

Lips Part (AU25)

Jaw Drop (AU26)

Mouth Stretch (AU27)

Lip Suck (AU28)



Tongue Out (AU19)

Neck Tightener (AU21)

Jaw Thrust (AU29)

Jaw Sideways (AU30)

Jaw Clencher (AU31)

Lip Bite (AU32)

Cheek Blow (AU33)

Cheek Puff (AU34)

Cheek Suck (AU35)

Tongue Bulge (AU36)

Lip Wipe (AU37)

Nostril Dilator (AU38)

Nostril Compressor (AU39)

Lid Droop (AU41)

Slit (AU42)

Eyes Closed (AU43)

Squint (AU44)

Blink (AU45)

Wink (AU46)

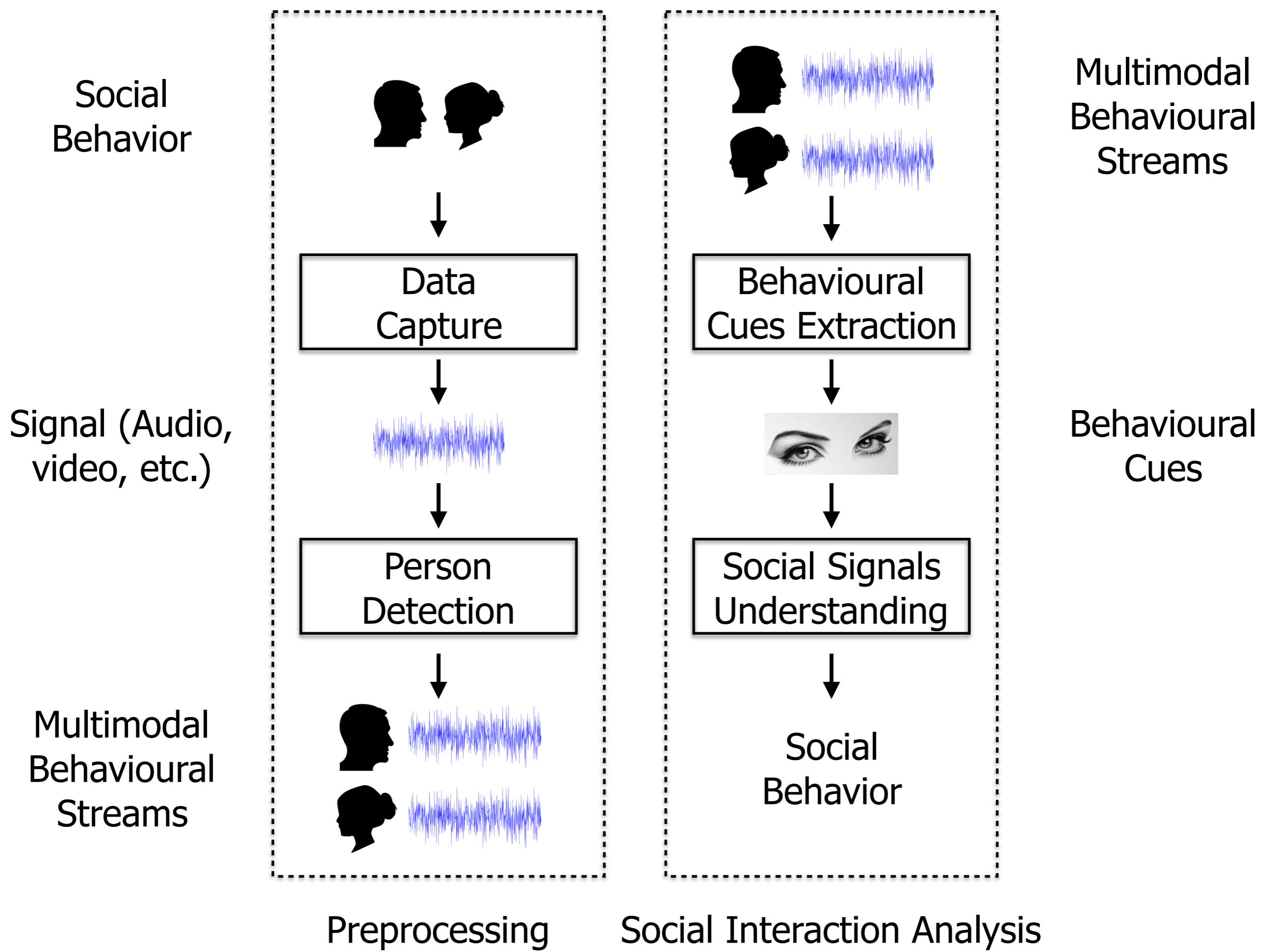
- <https://imotions.com/blog/facial-action-coding-system/>

Recap

- An Action Unit (AU) corresponds to the activation of one or more muscles (it is an “atom” of facial movement);
- A facial expression is a combination of some of the Action Units identified by Ekman and Friesen;
- Different facial expressions convey different social and psychological messages.

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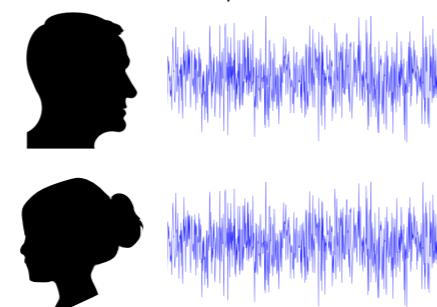
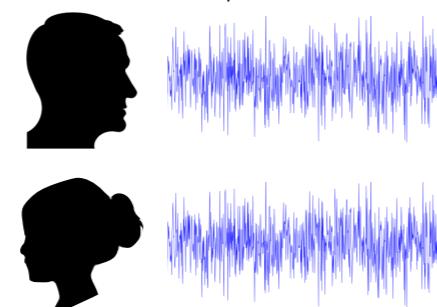
Facial Expressions

Video

Behavioural Streams

Video Recording

Face Detection



Landmarks and AUs Extraction



Facial Expression Understanding

Facial Expressions



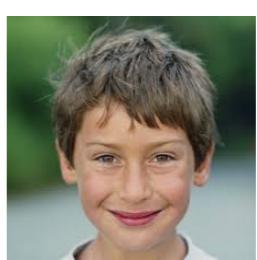
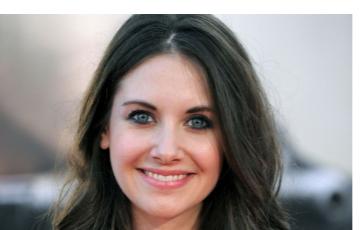
Video Behavioural Streams

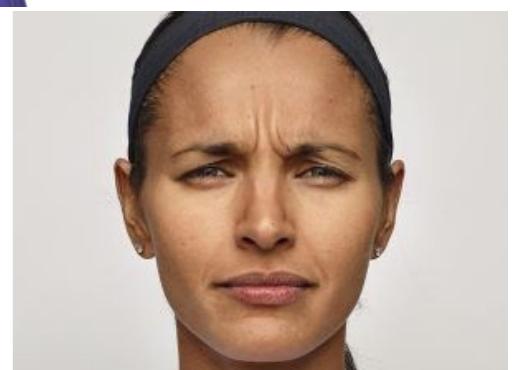
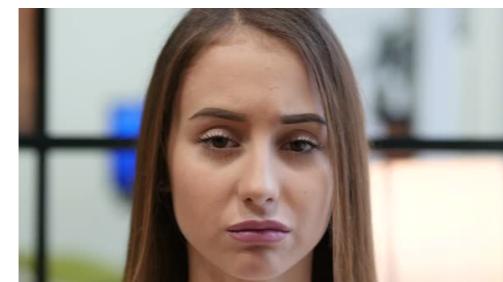
Behavioural Cues

Preprocessing

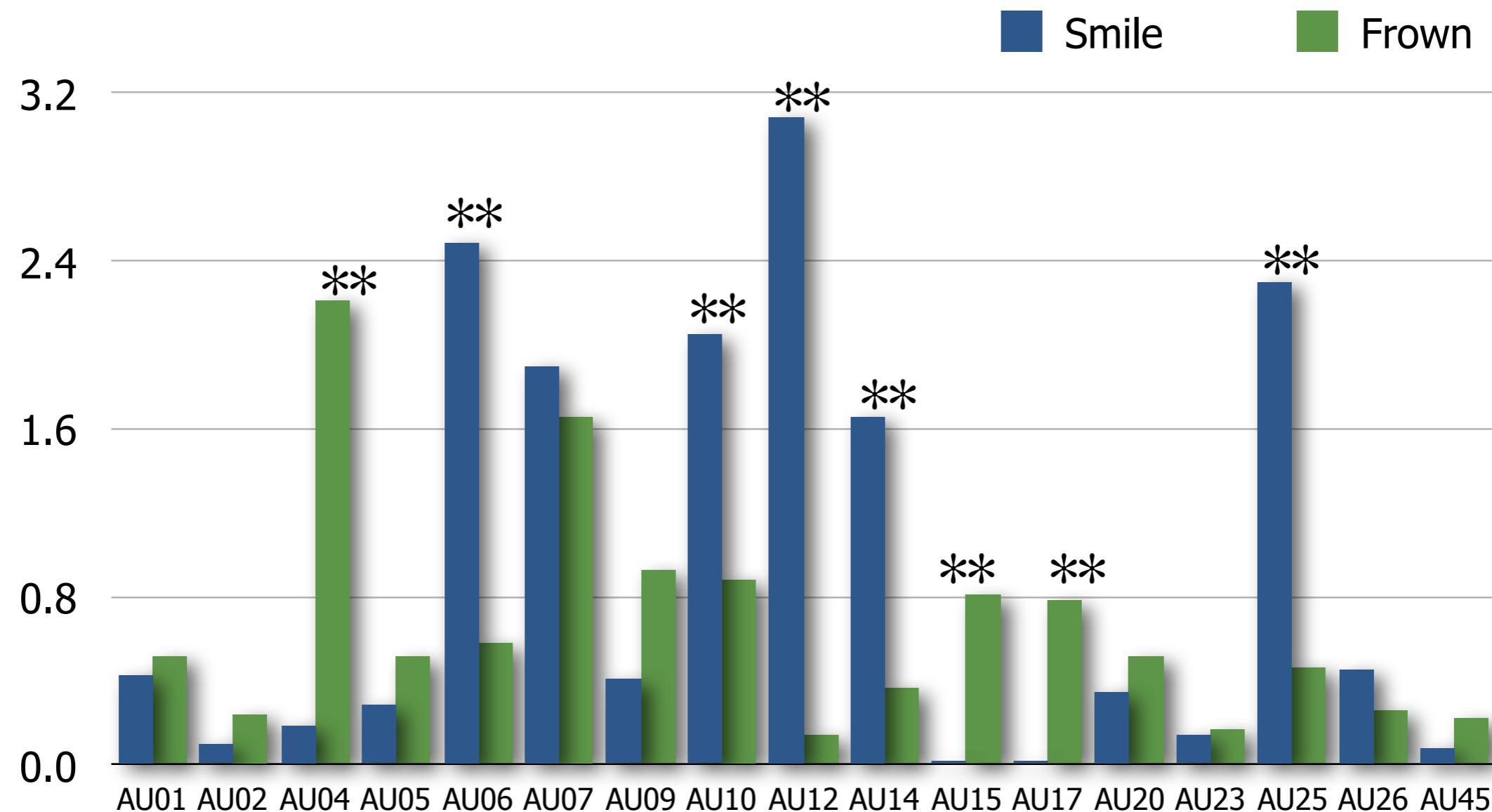
Social Interaction Analysis

<https://www.youtube.com/watch?v=QDQff5d1NJM>





9.Run Tests of your Hypotheses.



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Conclusions

- The analysis of facial expression is based on **Action Units**, movements associated with changes in facial appearance;
- There is a gap between the Action Units being displayed and the interpretation of an expression;
- Machines can automatically detect (and possibly interpret) Action Units.