Department of Electrical & Computer Engineering

What's in the face?

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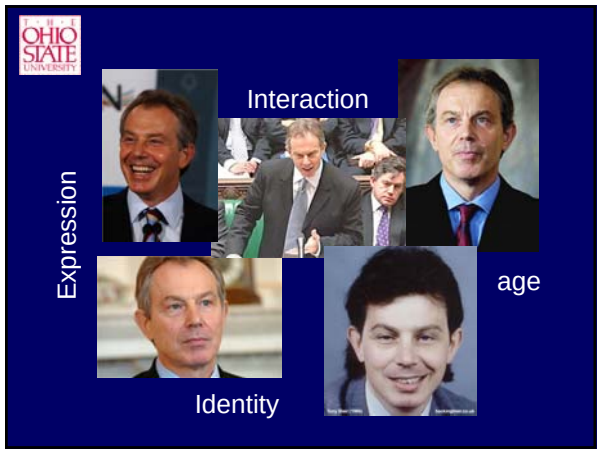
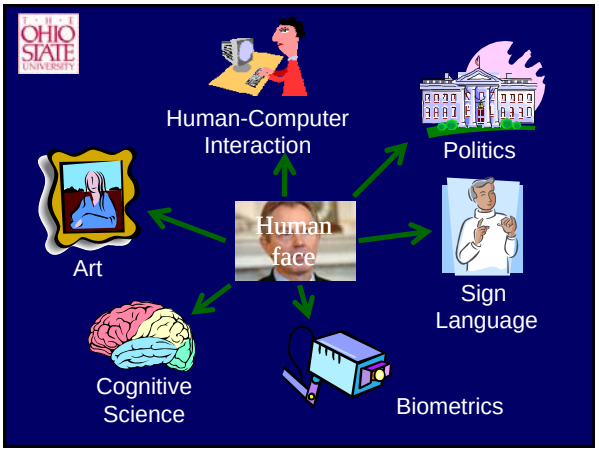




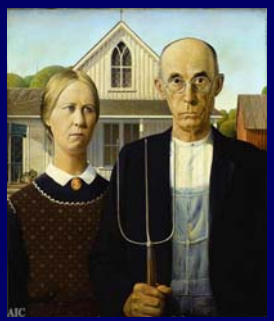
Human-Computer Interaction

Don't blame me…..
I do not see your face.

Computers are prosopagnosic.

Facial expressions are essential for understanding behavior.

Art



Am I sad or what?

Sign Language

Nonmanuals are part of the **grammar**.

American Sign Language

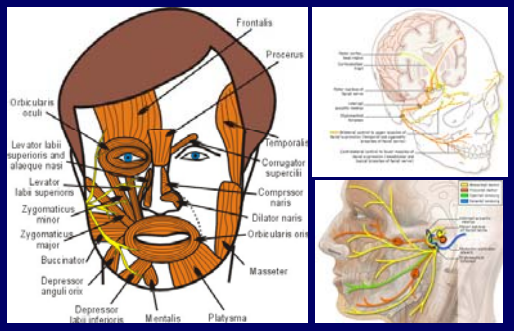
WH questions

Yes/no questions

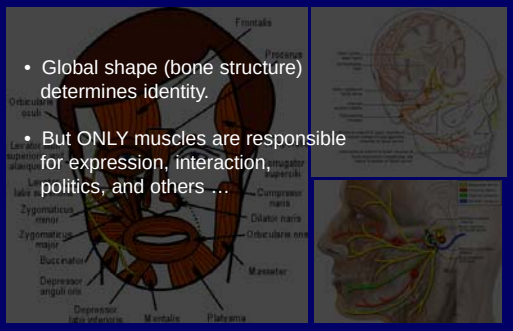
How do We Analyze and Recognize Faces ?

- We do NOT really know.
- In general, we do not even know how faces shape our daily lives.
- If we are to build technology that can help us in any way, we must first understand how face recognition works.
- What's in the face, then?
- Muscles, which can articulate and thus be recruited for a variety of purposes: **FACS**.

Muscle Movements Are the Key



Muscle Movements Are the Key

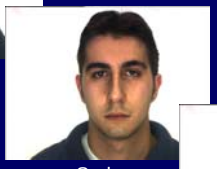


- Global shape (bone structure) determines identity.
- But ONLY muscles are responsible for expression, interaction, politics, and others …

Configural Processing

Emotion perception in neutral expressions

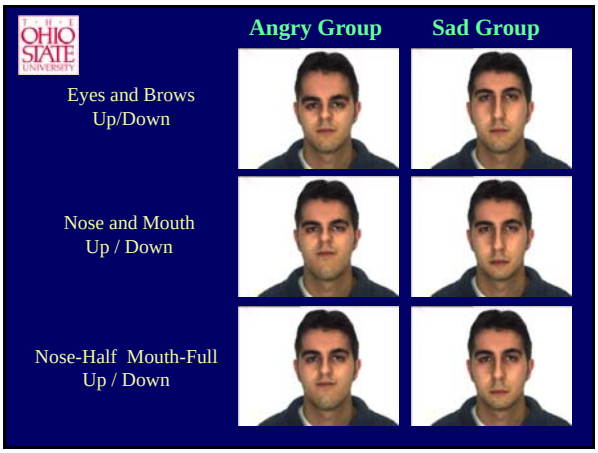
Neutral

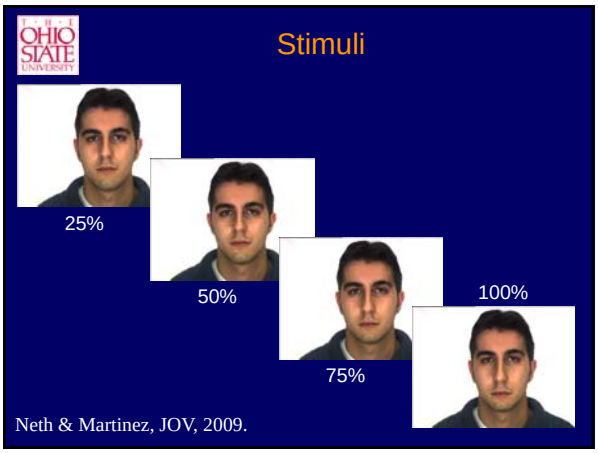


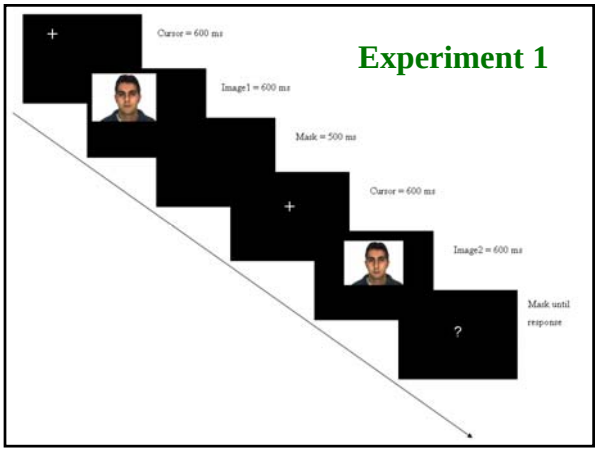
Sad

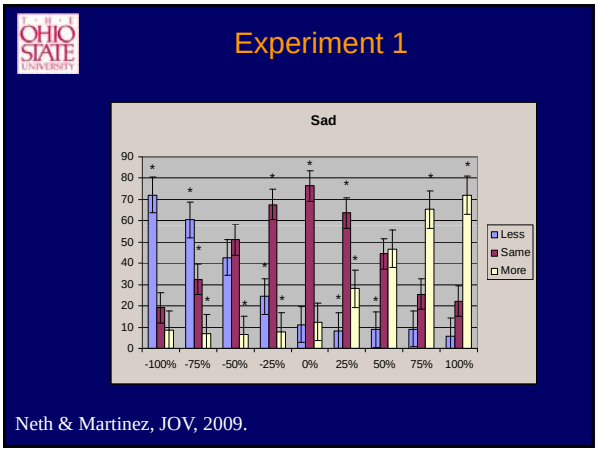
Angry

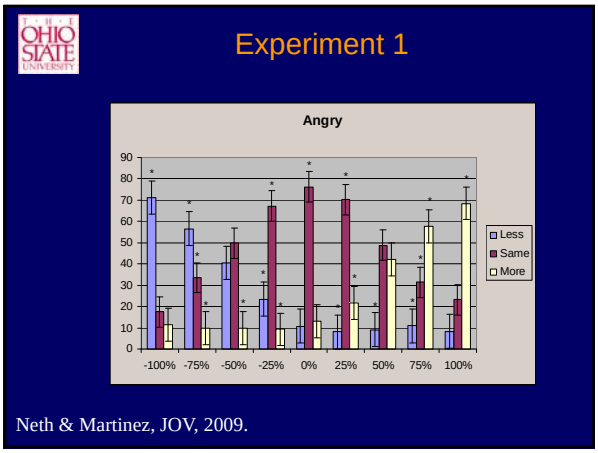
Neth & Martinez, JOV, 2009.

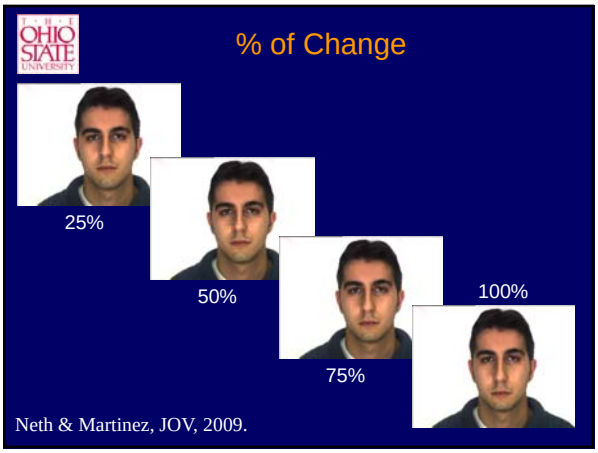

Angry Group
Sad Group
Eyes and Brows
Up/Down
Nose and Mouth
Up / Down
Nose-Half Mouth-Full
Up / Down


Stimuli
25%
50%
75%
100%
Neth & Martinez, JOV, 2009.

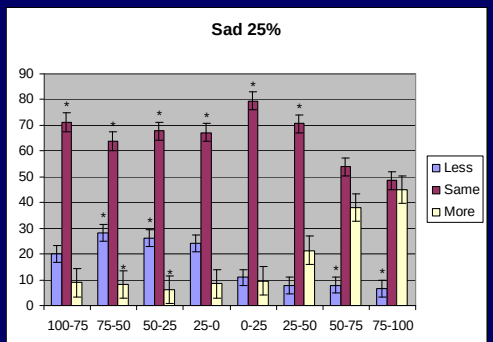

Experiment 1
Cursor = 600 ms
Image1 = 600 ms
Mask = 500 ms
Cursor = 600 ms
Image2 = 600 ms
Mask until response


Experiment 1
Sad
Less
Same
More
-100% -75% -50% -25% 0% 25% 50% 75% 100%
Neth & Martinez, JOV, 2009.

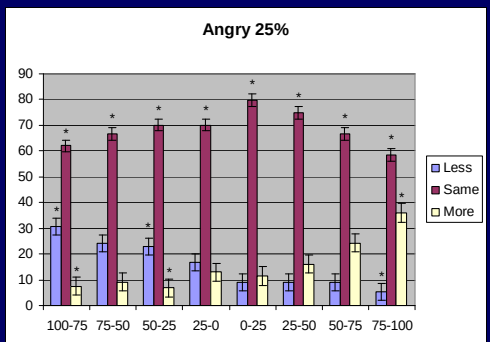

Experiment 1
Angry
Less
Same
More
-100% -75% -50% -25% 0% 25% 50% 75% 100%
Neth & Martinez, JOV, 2009.

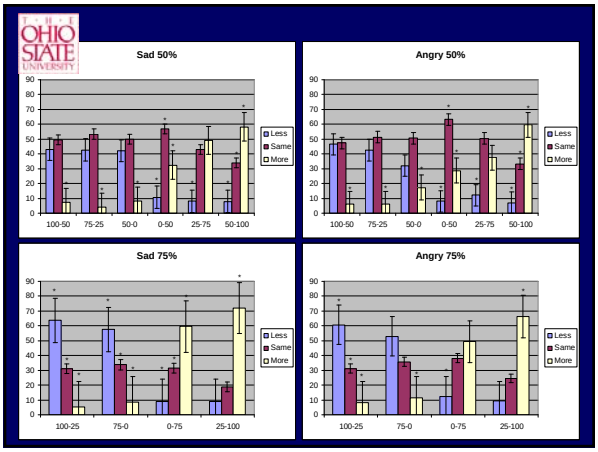

% of Change
25%
50%
75%
100%
Neth & Martinez, JOV, 2009.

Responses at 25%

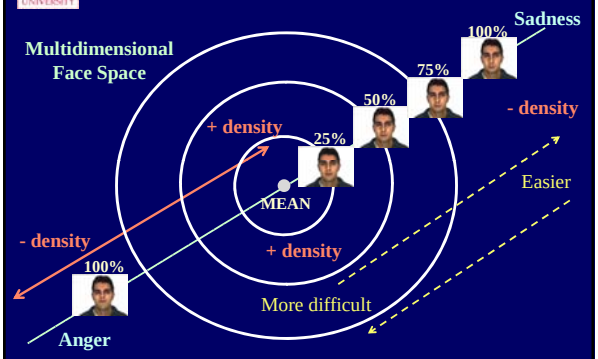


Responses at 25%





Norm-based Space



Neth & Martinez, JOV, 2009.

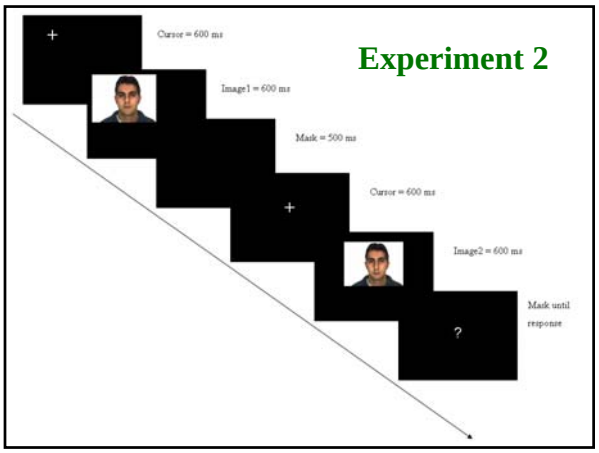
Discussion

- These results suggest a norm-based representation.
- They identify a single dimension within the multidimensional face space.
- Suggest the coding in this dimension is configural, i.e., second-order components.

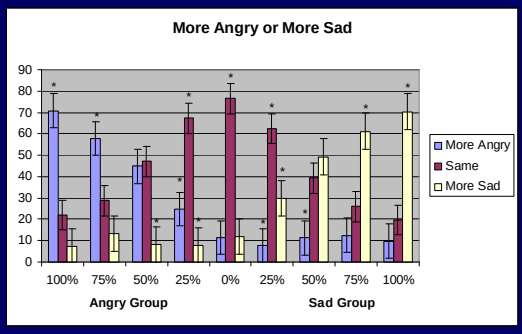
Experiment 2

- **Are emotions really norm-based?**
- It has been argued that as a face deviates from the norm face, negative affect toward it increases.
- When subjects notice a deviation from the mean face, they may tend to respond toward the negative category.
- If this alternate hypothesis were true, subjects would not be able to distinguish between the sad and angry stimuli.

Neth & Martinez, Vision Research, 2010.



Responses

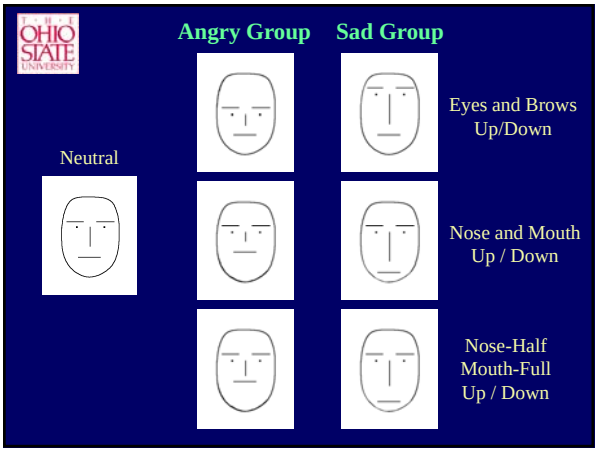


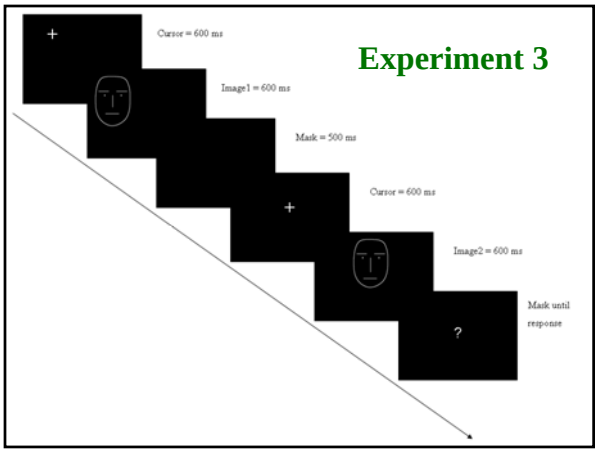
Neth & Martinez, Vision Research, 2010.

Experiment 3

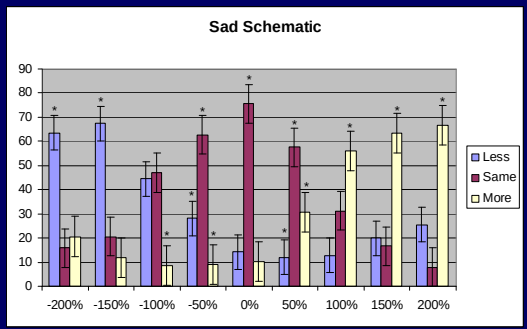
- **Is it really configural?**
- Skeptics will wonder whether there is some textural cues or change in the images that reinforces the perception of the emotion – there is none.
- Yet, if this effect is really due to configural cues, the perception of anger and sadness should also be observed when **all** the textural information is removed.

Neth & Martinez, Vision Research, 2010.



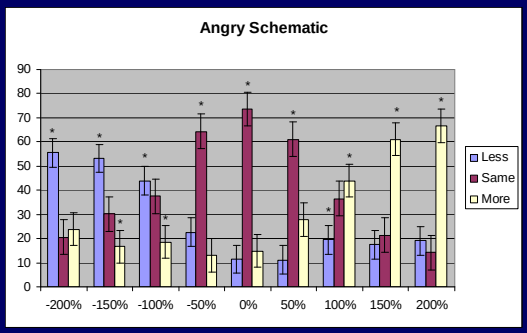


Responses



Neth & Martinez, Vision Research, 2010.

Responses

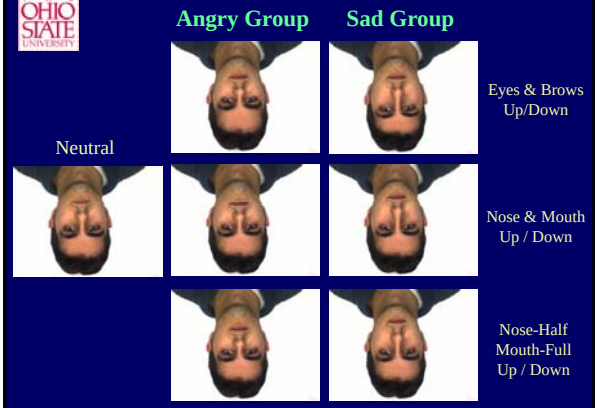


Neth & Martinez, Vision Research, 2010.

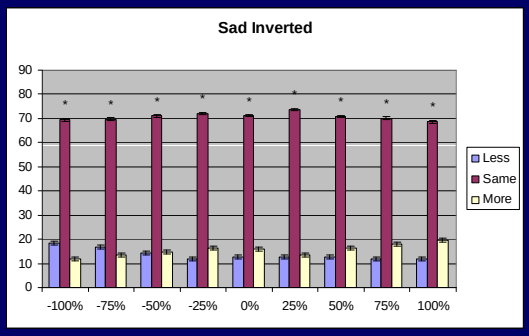
Experiment 4

- Configural cues may be learned.
- They are very sensitive to the orientation of the stimuli.
- They break with inversion – the so called inversion effect.

Neth & Martinez, Vision Research, 2010.

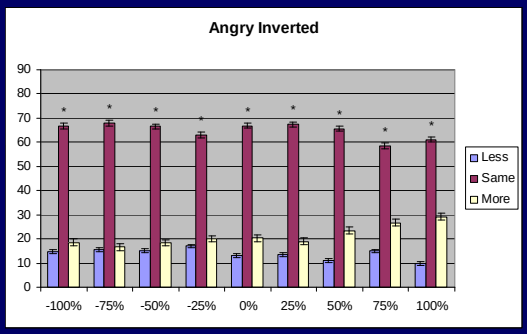


Responses



Neth & Martinez, Vision Research, 2010.

Responses



Neth & Martinez, Vision Research, 2010.

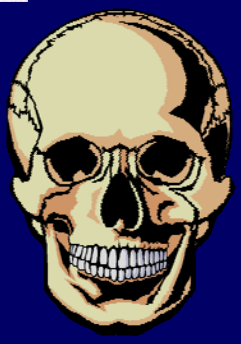
Discussion

- These results combined strongly suggest a norm-based coding of facial expression of emotions.
- The perception of each emotion does not move to the other side of the mean face.
- At least one dimension of this face space describes configural (second order) cues.
- The space is warped.

Configural Processing

Configural Processing

Configural Processing



Facial expressions are determined (at least in part) by the shape of our skull and jaw.

This influences:

- Emotion perception.
- Social interaction.
- Attractiveness.
- Election outcomes.
- Tenure cases.
- Design of technology.

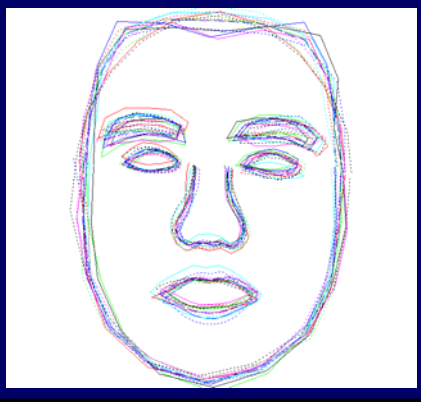
Shape Model

Feature Contours

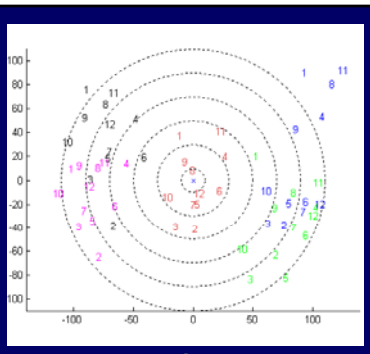
Feature Points

Ding & Martinez, PAMI, 2010.

Scaling and Alignment



PC_2 vs PC_1

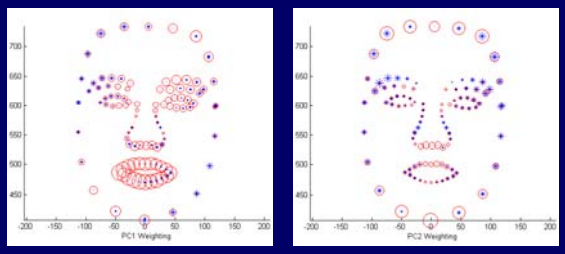


PC_2

PC_1

Neutral; Eyes Up; Eyes Down; Mouth Down; Mouth Up

Relevant Shape Changes



1st Principal Component 2nd Principal Component

Neth & Martinez, Vision Research, 2010.

Still much work ahead…