PERCEPTION: VISION II

John Gabrieli 9.00

Image courtesy of orangeacid on Flickr. CC-BY.
Vision 2: Object Recognition

• Objects & Agnosia

• Faces

• Words
Vision 2: Object Recognition

• Objects & Agnosia
  Apperceptive Agnosia
    from parts to percept
  Associative Agnosia
    from percept to meaning
  Category-Specific Knowledge
    relation to perception & action
AGNOSIA

Modality-specific inability to recognize a stimulus that is not explained by sensory, attentional, linguistic, or other defects
AGNOSIA

Apperceptive agnosia
• failure to construct
  conscious percept from
  sense data
• right hemisphere

Associative agnosia
• conscious percept (match,
  copy) stripped of meaning
• left hemisphere

Lissauer, 1890
Figure 2
The copying ability of apperceptive agnostic patients. On the left is a simple geometric shape and patient E. S.’s copy. On the right are two columns of letters, numbers, and shapes, with the patient Mr. S’s copies.
Figure 3.
The shape matching ability of apperceptive agnosic patients. On the left is a set of rectangles matched for overall area, which were presented pairwise to Mr. S. to be judged same or different in shape. He was unable to discriminate all but the most distinctive, and made errors even with these. On the right are a set of rows containing a target shape (left) and a set of four choices to be matched with the target shape. Mr. S.’s answers are marked.
Figure 4
Patient X, studied by Landis et al. (1982), consistently read this stimulus as 7415.
Drawings of an elephant by patients with agnosia, from "The Working Brain: An Introduction to Neuropsychology." Aleksandr R. Luria, have been removed due to copyright restrictions. Please see figure 29, on page 119, on Google Books.
AGNOSIA

Apperceptive agnosia
• failure to construct conscious percept from sense data
  • right hemisphere

Associative agnosia
• conscious percept (match, copy) stripped of meaning
  • left hemisphere

Lissauer, 1890
Drawings done by anosia patients, from Alan B. Rubens, MD; D. Frank Benson, MD. "Associative Visual Agnosia." Arch Neurol 24 no. 4 (1971): 305-516, have been removed due to copyright restrictions.
Photo courtesy of hdrwfgg on Flickr. CC-BY.
Category-Specificity in Loss of Knowledge

Patients who can define and word-picture match manufactured objects, but not foods and animals

Patients who can define and word-picture match foods and animals, but not objects
Category-Specificity in Loss of Knowledge

Patients who can define and word-picture match manufactured objects, but not foods and animals

*Ok on body parts, bad on musical instruments*

Patients who can define and word-picture match foods and animals, but not objects

*Better on large outdoor objects than small manipulable objects*
Visual Similarities Among Musical Instruments

Photo courtesy of mitko_denev on Flickr. CC-BY-NC.

Photo courtesy of krabchick on Flickr. CC-BY.
Category-Specificity in Loss of Knowledge

How do we know and experience objects in the world?

• Visual experience (fine visual distinctions)
• Functional/motor experience
Name Line Drawings or Words

Animals > Tools

Visual cortex

Tools > Animals

Visual motion
Hand action
FACES

This is public domain.

Photo courtesy of Pete Souza, The Obama-Biden Transition Project. [CC-BY].
FACES

- Identity
- Expression (feelings)
PROSPAGNOSIA

Selective deficit in recognizing faces posterior cortical lesion also developmental prognosia
fMRI Data Analysis: Region of Interest (ROI)

Anatomical ROI

Functional ROI

© Unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see [http://ocw.mit.edu/fairuse](http://ocw.mit.edu/fairuse).
Selective FFA Response to Faces

3a. Faces > Objects

3b. Intact Faces > Scrambled Faces

3c. Faces > Houses

4a. Faces > Objects

4b. 3/4 Faces > Hands

4c. 3/4 F > H (1-back)

Courtesy of Kanwisher Lab. Used with permission.
Vision 2: Object Recognition

- Faces
  - infant preference for faces top-heavy bias
  - development of species-specific face processing
  - configural processing of faces
  - genetic preparation for face processing
Figure 1 from Cassia, Viola Macchi, Chiara Turati, and Francesca Simion. "Can A Nonspecific Bias Towards Top-Heavy Patterns Explain Newborns' Face Preference?" *Psychological Science* 15 (2004): 379-83. Removed due to copyright restrictions.
<table>
<thead>
<tr>
<th>Experiment 1</th>
<th>Experiment 2</th>
<th>Experiment 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upright Face</td>
<td>Upright Face</td>
<td>Upright Face</td>
</tr>
<tr>
<td>Upside-Down Face</td>
<td>Top-Heavy Configuration</td>
<td>Top-Heavy Configuration</td>
</tr>
<tr>
<td>Bottom-Heavy Configuration</td>
<td>Bottom-Heavy Configuration</td>
<td>Bottom-Heavy Configuration</td>
</tr>
</tbody>
</table>

- **Experiment 1**:
  - Upright Face: 160s
  - Upside-Down Face: 120s
  - Top-Heavy Configuration: 160s
  - Bottom-Heavy Configuration: 120s
  - Significance: $p < .001$, $p = .39$

- **Experiment 2**:
  - Upright Face: 80s
  - Top-Heavy Configuration: 80s
  - Bottom-Heavy Configuration: 80s
  - Significance: $p < .001$, $p = .39$

- **Experiment 3**:
  - Upright Face: 40s
  - Top-Heavy Configuration: 40s
  - Bottom-Heavy Configuration: 40s
  - Significance: $p = .39$

Image by MIT OpenCourseWare.
FACES

Faces - configural - whole rather than the parts (eyes, nose, mouth)
This is Obama

Photo courtesy of Pete Souza, The Obama-Biden Transition Project. CC-BY.

This is Obama’s house

Photo courtesy of Tom Lohdan on Flickr. CC-BY.
Test phase

Is this Obama’s nose?

Part condition

Is this Obama’s window?

Part condition

Whole condition

Whole condition

Photo courtesy of Tom Lohdan on Flickr. CC-BY.

Photo courtesy of Pete Souza, The Obama-Biden Transition Project. CC-BY.
• no early exposure to faces 6-24 months
• before seeing a real face, preferred human & monkey faces in photographs equally, discriminated human & monkey faces
• gained expertise for 1 month in exposed species of faces (human or monkey) only
• Preferred only the exposed species vs. objects
• Preferrence lasted for at least a year despite exposure to humans & monkeys

Genetic preparation & Sensitive period

Fig. 1. An infant monkey and her living circumstance

Courtesy of National Academy of Sciences, U.S.A. Used with permission.
Cuneiform – 3200 BC

Photo courtesy of litlnemo on Flickr.
Adult Reading

• we read fast – can read one word that we know, from among 50,000 – 100,000 words that we know in 50 thousandths of a second!
• typical adult reading speed is 200-250 words per minute
• we read about 12 letters at a time, then move eyes
Moving Window Experiment

• track eye movements (McConkie & Raynor, 1975)
• with each movement, replace all others letters with x’s
• people did not notice the x’s

Xx xxx people of txx xxxxxxx xxxxxxxx, xx xxxxx xx
Xx xxx xxxxxx xx xhe United xxxxxxx, xx xxxxx xx
Xx xxx xxxxxx xx xxx Xxxxed States, ix xxxxx xx
Xx xxx xxxxxx xx xxx Xxxxxx Xxxxxx, in order to
Figure 1.1 from "Reading in the Brain: The Science and Evolution of a Human Invention," Stanislas Dehaene, has been removed due to copyright restriction. See: Google Books.
Word Blindness/Alexia
Mr C – 1887 – could not read
Could see
Could hear words, speak words
Could see numbers
Write down words to dictation
Figure 2.7 from "Reading in the Brain: The Science and Evolution of a Human Invention," Stanislas Dehaene, has been removed due to copyright restriction.
Figure 2.7 from "Reading in the Brain: The Science and Evolution of a Human Invention," Stanislas Dehaene, has been removed due to copyright restriction.
Vision 2: Object Recognition

• Faces
  - face processing as a slowly learned and highly specific skill
  - inversion effects
  - fusiform specialization for faces
  - overlap in brain between seeing and imagining a face
  - same-race memory superiority for faces
FACES

Faces - slowly learned expertise
face inversion
development - age 16
dog-show judges - 8 years
to develop face-inversion
for dog faces
Overlap of Perception & Imagination in the Brain

Courtesy of Journal of Cognitive Neuroscience. Used with permission.
Superior Memory for Same-Race Faces

Subsequent memory

Discriminability ($d'$)

AA Subjects  |  EA Subjects

AA Faces  |  EA Faces
GREATER FFA ACTIVATION FOR OWN THAN OTHER RACE

FFA activation (defined $p < 0.0001$)

FFA activation (defined $t=2$)

![Graph showing mean percent signal change for Same Race and Other Race for FFA activation. The graph on the left shows a higher mean percent signal change for Same Race compared to Other Race, defined as $p < 0.0001$. The graph on the right shows a higher mean percent signal change for Same Race compared to Other Race, defined as $t=2$.](image)
FACES

Development of Same-Race Bias

- not present at birth (and no species preference)
- present by 3 months
- Korean children 3-9 years old adopted by European Caucasian families - better memory for Caucasian faces, same as French children, opposite of Korean children
FACES

• Identity
• Expression (feelings)
  - six universal facial expressions
  - amygdala & fear
  - amygdala and recognition of fearful facial expressions
Fear & The Amygdala

Fear

Photo courtesy of artindeepkoma on Flickr.

Image by MIT OpenCourseWare.
Selective amygdala lesions: Rodents

• Direct implication of amygdala in emotional behaviors

Cute & Cuddly or fearsome predator?

Human amygdala: Impaired recognition of fear

- Intact face recognition
- Impairment selective for fear