Perception

• **Bottom-up perception**
  – Driven by stimulus

• **Top-down perception**
  – Driven by expectations

• **Interactive**
  – Driven by both at the same time
Knowing where an object is can make an otherwise invisible object appear
Units of Perception

• What are the basic features of perception?

• Evidence for chunks
  – Context effects (dependencies between parts)
    • ABC/12 13 14
    • Fruit faces (Palmer, 1982)
    • Part in whole versus part judgments (Tanak & Farah, 1993)
  – Lack of complexity effects (Goldstone, 2000; Shiffrin & Lightfoot, 1997)
  – Interference between parts
    • Garner interference: can’t ignore irrelevant dimensions (Garner, 1974)
  – Inversion cost (Gauthier & Tarr, 1997)
    • Upright recognition much easier than inverted for familiar configurations
  – Blindness to parts within chunks (Tao, Healy, & Bourne, 1997)
    • proofreading example

• Chunks as modules
  – Large within-chunk dependencies, small between-chunk dependencies
TAE CAT

A, B, C, D, E, F, I0, II, I2, I3, I4
Archimbaldo
Proofreading

Count the number of “F”s:

Finished files are the result of years of scientific study combined with the experience of many years.

Tend to miss letters when the word they occur in is highly frequent. Automatic “gluing” of letter to its word
Brightness and Size are SEPARABLE Dimensions

<table>
<thead>
<tr>
<th>Brightness</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
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<tr>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
</tbody>
</table>

Size

1  2  3  4
Brightness and Saturation are INTEGRAL Dimensions
Subjects are more likely to choose the correct letter when it is in the context of a word than when it is isolated.

Context improves people’s sensitivity, not just bias.
Word Superiority Effect

D or T?

D or T?
Aspects of the Word Superiority Effect (WSE)

- Letters better identified in words than in non-words or by themselves
- Words as perceptual units
- Sensitivity, not bias, effect
  - Bias to give respond with letter than would form a real word cannot explain WSE because both letter choices form a real word
- Pseudo-word superiority effect too
  - E in MAVE is better identified than E in VMAE
- Pattern mask is important for WSE
Interactive Activation Model
McClelland & Rumelhart (1981)
Interactive Activation Model (IAT)

• Cascading activation
  – Feature-level processing not complete before higher-levels start
  – Top-down and bottom-up is not viciously circular
  – Contrast to standard information processing

• Architecture
  – Feature, Letter, and Word level units
  – Activation between levels, inhibition within levels
  – Lateral inhibition
    • Good for creating discrete edges, category, decisions
    • Digitalization

• Processing: flow of activation/inhibition along links
Phenomena Explained by IAT

- Word superiority effect (WSE)
- WSE strongest with pattern mask
- Pseudo-word effect
- Rich-get-richer effect
- Gang effect
word activations

letter activations
letter level activations

output values

e in READ

E alone

activation

probability

time

0 10 20 30
\[ n_i(t) = \sum_{j} a_{ij} e_j(t) \sum_{k} a_{ik} i_k(t) \]

n= net input, \( a \) = weight of excitatory input, e = activation of incoming excitatory node. 
\( g \) = weight of inhibitory input, i = activation of incoming inhibitory node. 

Net input to node is based on consistent and inconsistent inputs.
\[ E_i(t) = n_i(t)(M \square a_i(t)) \text{if } n_i(t) > 0 \]

\[ E_i(t) = n_i(t)(a_i(t) \square m) \text{if } n_i(t) < 0 \]

\( E_i = \text{effect on node } i, \) \( M = \text{maximum activation possible, } a_i : \text{activation of node } i. \)

Effect on node is based on input, but has a ceiling at \( M. \) The closer the current activity of the node is to \( M, \) the less the effect of positive input will be.

\( m = \text{minimum activation possible.} \)

If input is negative, then the floor is at \( m. \) If current activity is already at floor, then input has no effect.
\[ a_i(t + □t) = a_i(t) □ □_i(a_i(t) □ r_i) + E_i(t) \]

□ = rate of decay, \( r = \) resting level of unit

New activity is based on old activity, and decay to a resting level, and the effect of the input to the node.

\[ \overline{a}_i(t) = \boxed{a_i(x)} e^{□(t □ x)r} dx \]

\( \overline{a} \) = running average of activation, decay of old information.

A cumulative average across time of a unit's activity will be its strength. More recent activity levels matter more than older activity levels, and the decay rate of old information is based on \( r \).
\[ S_i(t) = e^{\alpha_i(t)} \]

Si = response strength of unit i, \( \alpha \) = steepness of function relating activation to response.

Exponential functions serve to emphasize differences between larger quantities, which is important because activations are capped at 1. The difference between .8 and .9 should be greater than between .7 and .8.
\[ p(R_i, t) = \frac{s_i(t)}{\prod_{j \in L} s_j(t)} \]

\( P(R_i, t) = \) probability of responding with unit i's response
\( L = \) set of nodes at same level as i.

Luce choice rule: if you have N alternatives that are mutually exclusive (can only do one of them), then this rule assures that the probabilities will add up to one, and the probability of making a response is based on its relative strength.
the "rich get richer" effect

Figure 11. The rich-get-richer effect. (Activation functions for the nodes for have, gave, and save under presentation of MAVE.)
Figure 12. The gang effect. (Activation functions for move, male, and save under presentation of MAVE.)