Visual Thinking for Design
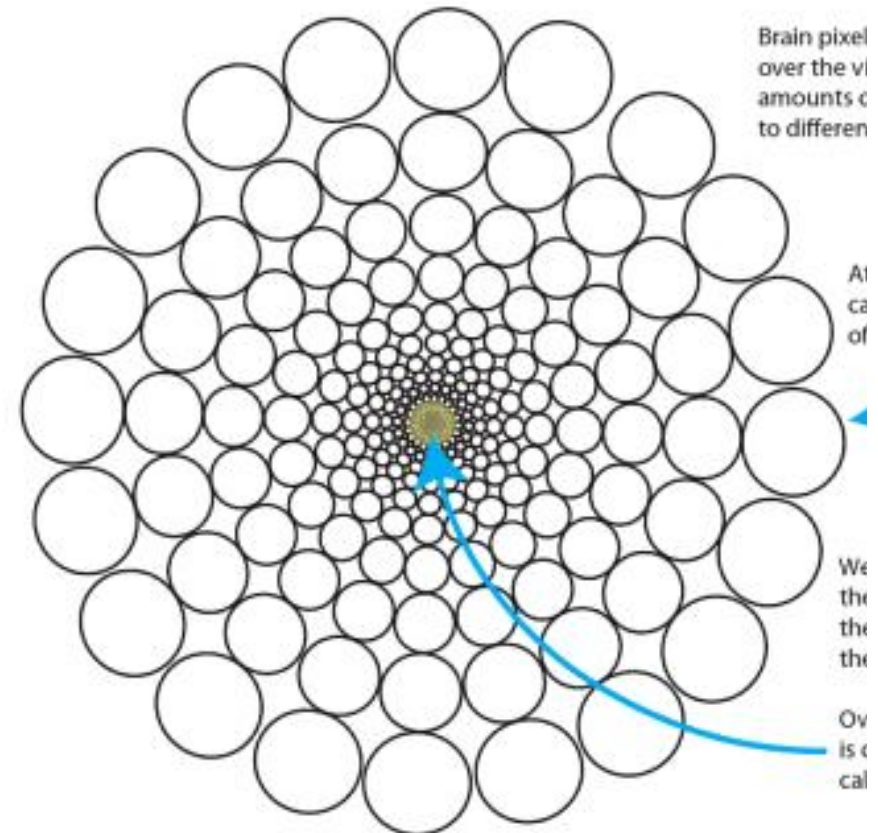Colin Ware

How much do we see?

- We do not have the entire visual world in conscious awareness
- We apprehend only a tiny fraction of information in our surrounding
  - Just the right amount of information
- But we can sample the world around us very rapidly with swift eye movement (1/10 second)
- Although we have very little attention capacity
- A good use of our cognition ability is very important to keep our brain small

Visual Thinking and Queries

- Visual thinking – the process of allocating attention

- We are conscious of the field of information that we have rapid access rather than the entire world
  - Allows us to do a better graphics design

- Visual thinking consists of a series of acts of attention, driving eye movements and turning our pattern finding circuits

- The act of attention is called visual query – search for pattern

The Apparatus

- Eye – digital camera
- Light sensitive cones – three colors
- Brain pixels are concentrated in a central region called fovea to process visual detail (100 pts on the top of a pin)
- Half of our visual brain is to process about 5 % of the visual world
- Eyeball muscle moves about 900 degree/second (saccade)

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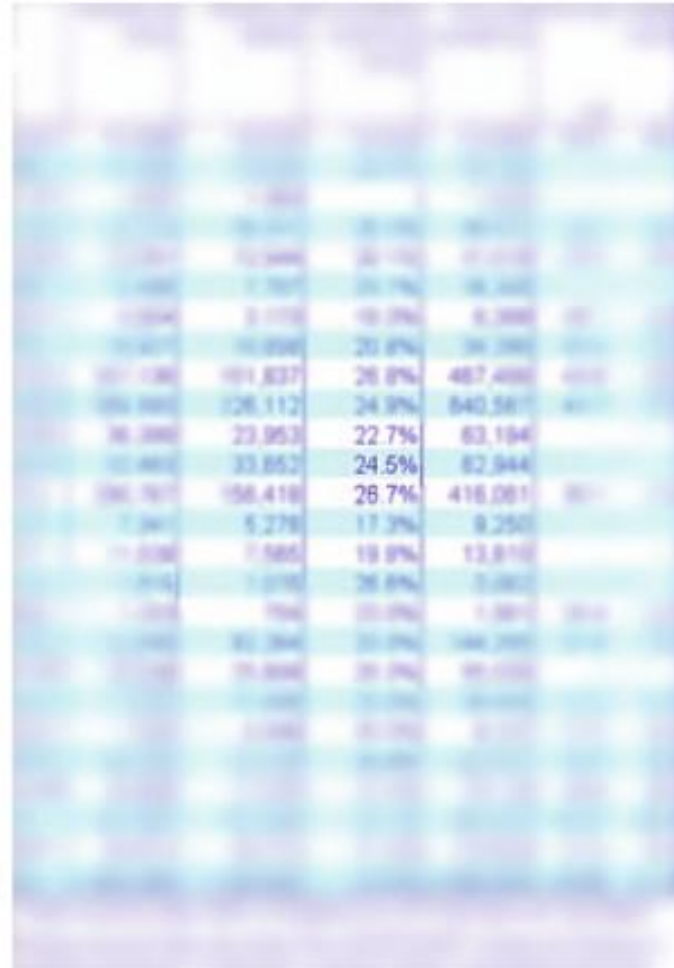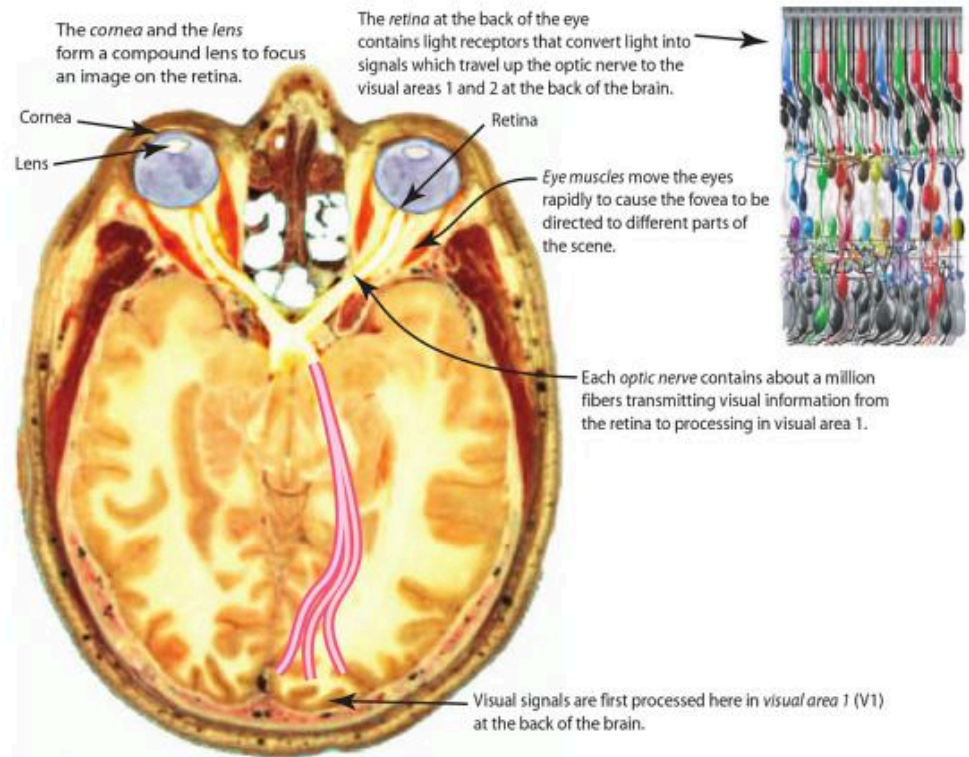of

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The *cornea* and the *lens* form a compound lens to focus an image on the retina.

Cornea

Lens

The *retina* at the back of the eye contains light receptors that convert light into signals which travel up the optic nerve to the visual areas 1 and 2 at the back of the brain.

Retina

Eye muscles move the eyes rapidly to cause the fovea to be directed to different parts of the scene.

Each *optic nerve* contains about a million fibers transmitting visual information from the retina to processing in visual area 1.

Visual signals are first processed here in *visual area 1* (V1) at the back of the brain.
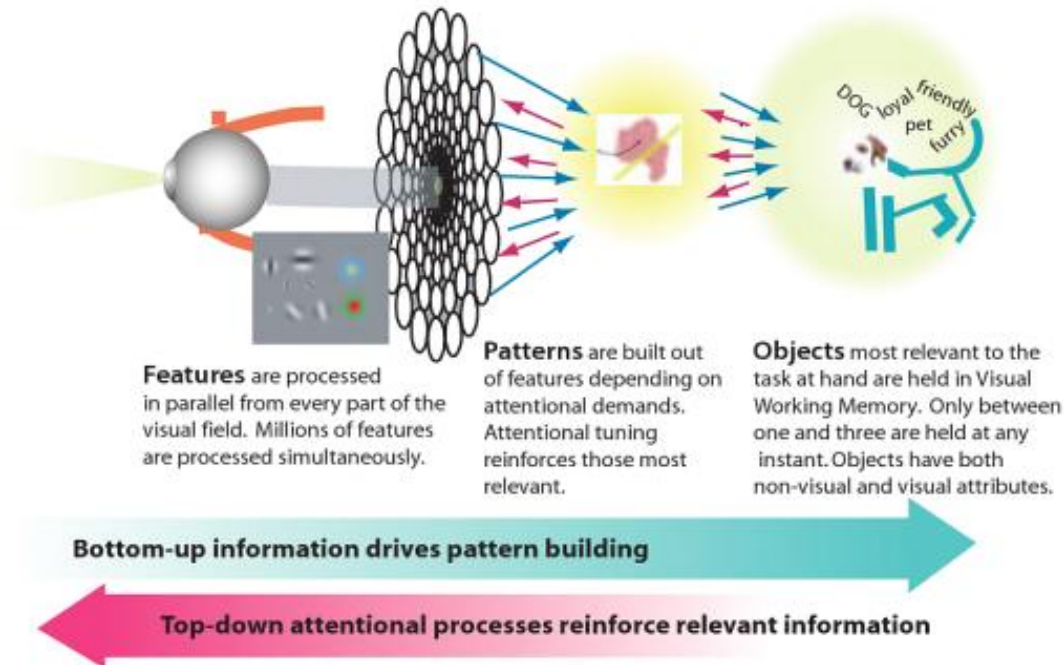
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The Act of Perception

- Two waves of neural activity
  - Information driven wave
  - Attention driven wave
- Bottom up and top down perception

Features are processed in parallel from every part of the visual field. Millions of features are processed simultaneously.

Patterns are built out of features depending on attentional demands. Attentional tuning reinforces those most relevant.

Objects most relevant to the task at hand are held in Visual Working Memory. Only between one and three are held at any instant. Objects have both non-visual and visual attributes.

Bottom-up information drives pattern building

Top-down attentional processes reinforce relevant information

Bottom Up Perception

- Low level features –> pattern –> object
  - Optical nerve – V1 cortex : feature detection edges and contours; color; motion;
  - Features are put together to form patterns – textures, long contours, (Gelstat psychology)
  - Visual objects (three in visual working memory at a time)
  - Not all visual processing in done in visual working memory
    - They are done in parallel by many parts instead
  - The real power lies in pattern finding
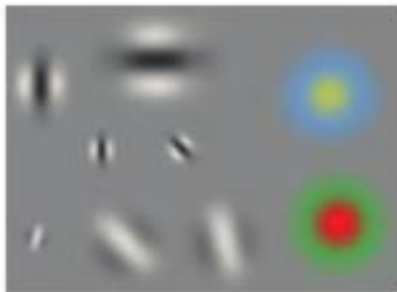
The Act of Perception

- Top-down (attention)
  - Driven by the need to accomplish some goals
  - Search for a color then the color feature will be enhanced
  - Eye movement: fast at first, fixation was brief,
  - How does our brain where to look?
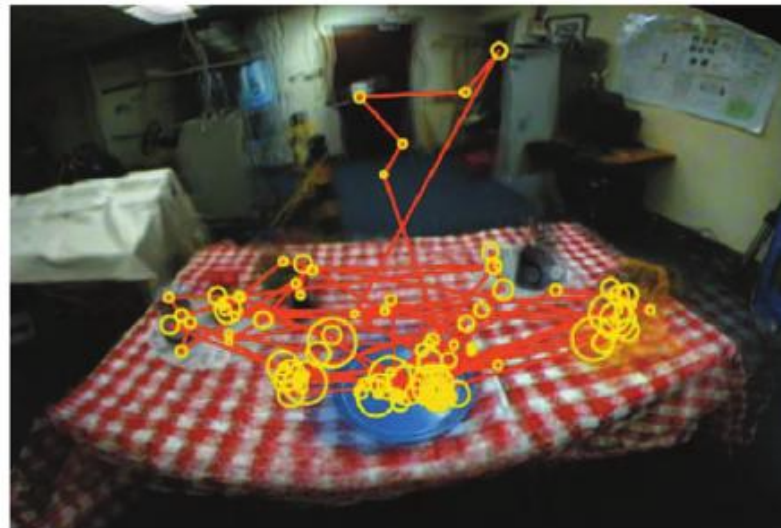
Design Implication

- The design should allow visual queries to be processed *rapidly* and *correctly* for the cognitive tasks that the display is intended to support
  - Understand the intended cognitive tasks and visual queries

What are the cognitive tasks?

How We Solve Problems?

- Nested Loops
  - Outer loop deals with generality (construct a set of steps to solve the problem)
  - Inner loops deal with details (visual search, eye movement, find patterns, etc.)

Outer **problem solving** loop includes finding candidates for visual problem solving

Middle loop consists of a visual pattern search using **eye movements**

Pattern testing