What We Can Easily See

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Motivation

- How am I going to attract people's attention to my
  - Web page
  - Product brochure
  - Marketing pamphlet
- Design is the key
- The key to a good design is to understand how people think visually

Motivation

- Purpose of this lecture
  - What makes a graphic symbol to be found rapidly
  - How something can be highlighted
- We want to ensure all visual queries can be effectively and rapidly served
  - Make sure meaningful graphic objects in a design have the right amount of salience
  - Visual queries should be supported with the most visually distinct objects

How do we see the world?

- Do you feel you can see the world vividly, in complete detail?
- We comprehend the world by constantly moving our eyes
- Something is easier to find than others
    - Blinking light
    - Bright red sweater in a crowd of people wearing black

Ehklhfdiyaioryweklblkhockxlyhirhupwerlkhlkuyxoiasysifdh lksajdhflkihqdaklljerlajesljselusdslfjsalsuslcjlsdsjaf;ljulafjluj oufojrtopjhklghqlkshlkfjlkdshflymcvciwoazlsifhrmckreieuid

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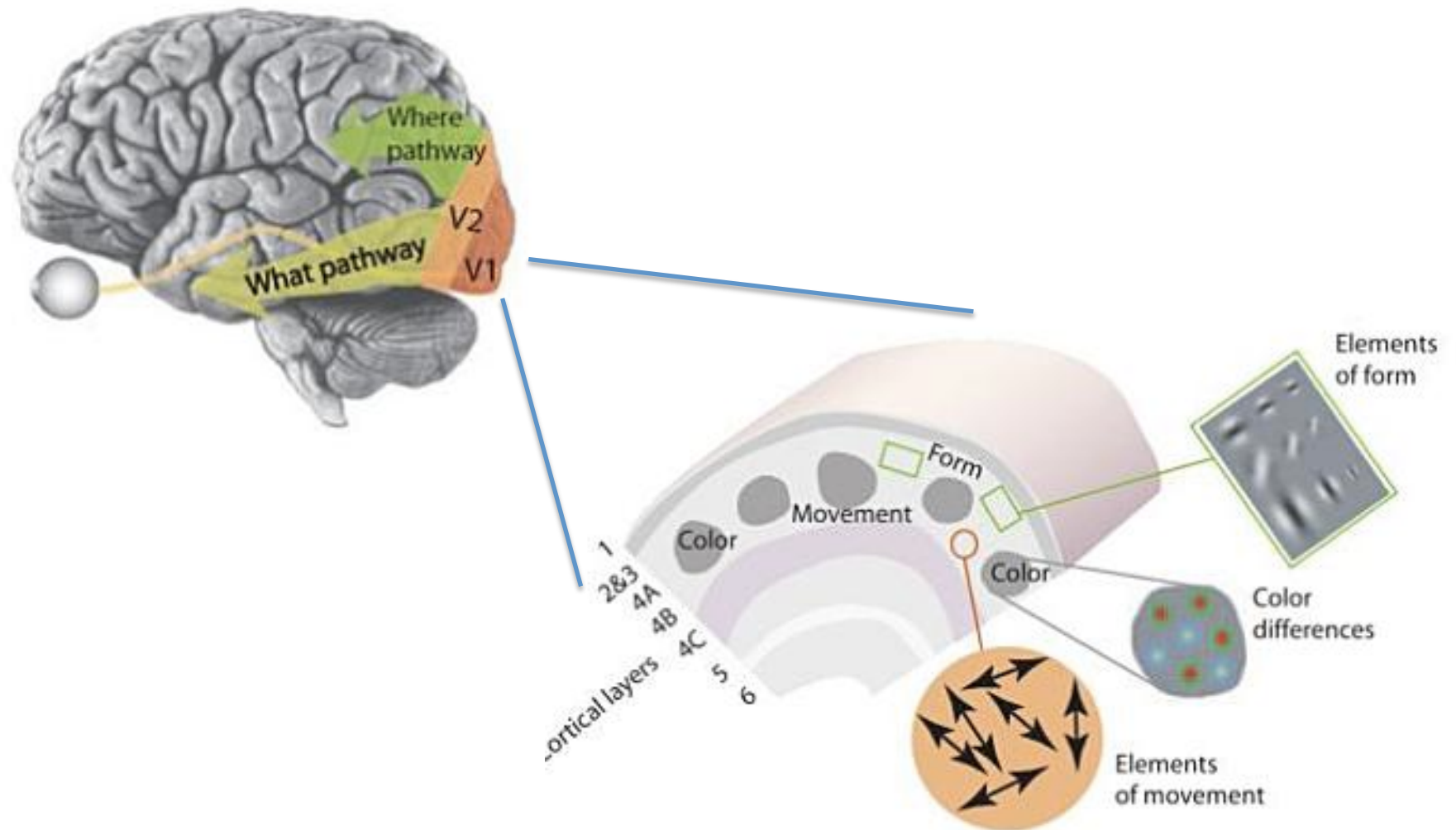 - Bright red sweater in a crowd of people wearing black

What about finding 'q' and why it is difficult?

Ehklhfdiyaiorywekblkhockxlyhirhupwerlkhlkuyxoiasysifdh lksajdhflkihqdaklljerlajesljselusdslfjsalsuslcjlsdsjaf;ljulafjluj oufojrtopjhklghqlkshlkfjlkdshflymcvciwoazlsifhrmckreieuid

Low Level Machinery

Elements of form

Form

Movement

Color

Color

Color differences

Cortical layers 1 2&3 4A 4B 4C 5 6

Elements of movement

Low Level Machinery

- Primary visual cortex (V1) has cells that would fire (emitting a series of spikes of electrical current) when certain kind of patterns are put in front of eyes
- Different areas are processing different type of information
  - Color, shape, texture, motion, stereoscopic depth
- This information is passed to visual area 2 (V2)
  - Millions of fibers from the eye send info to billions of neurons in V1 and then V2

What and Where

- *What* and *Where* pathways
  - *What* pathway: processing information about the identity of an object
  - *Where* pathway: processing information about where the objects in the world are located
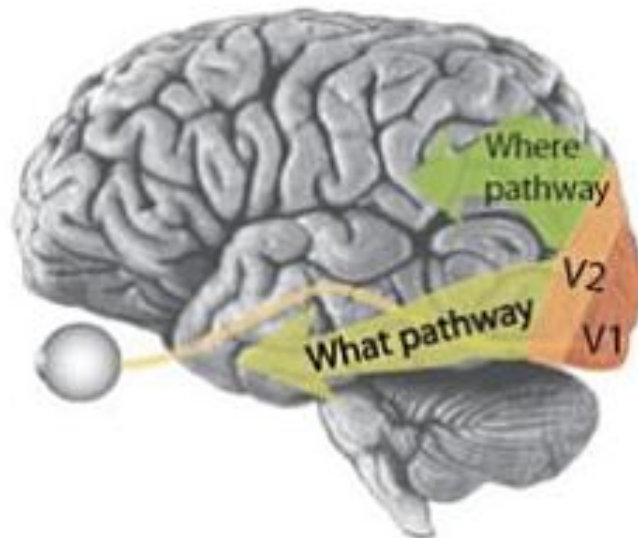
Eye Movement Planning

- How do the eyes get directed to the right location when we are looking for something?
- Bias competition
  - Neurons which process the type of info that we are looking for can shout louder
    - Color, orientation, size, motion, etc
  - Other cells keep quiet
- The biased responses are sent up the what pathway, and up the where pathway to make eye movements.

What Stands Out?

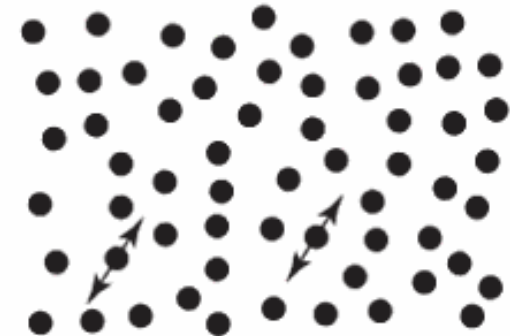- Something you cannot miss even if you try
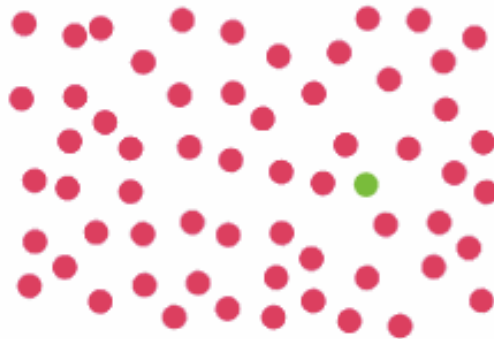
The green dot pops out
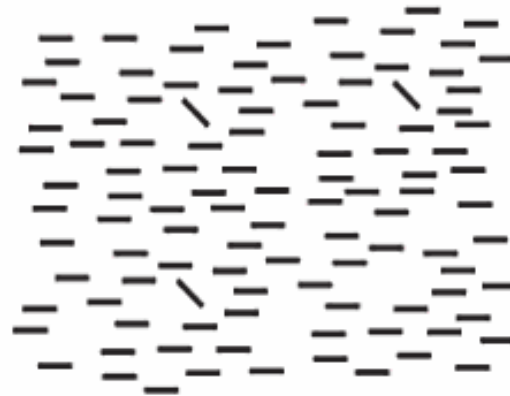
The oblique lines pop out

The large circle pops out

If two dots were to oscillate as shown they would pop out

Pre-attentive

- The time to respond did not depend on the number of distracters
  - This suggests a parallel automatic process
- The effects measured by this method were pre-attentive
  - Automatic mechanisms operating prior to the action of attention
- Pop-out effects are stronger when a single target differs from all other objects where all other objects are identical
- It is the degree of feature-level contrast between an object and its surroundings that makes it distinct.
- Common features are color, orientation, size, motion, stereoscopic depth – a striking correspondence to the early processing mechanisms.

What patterns do not show pop-out?

- Visual conjunctive search is hard
  - Finding green squares
- Features easy to see are done by neurons in the bottom of the visual processing. Hard to see features are done by neurons far ther up the what pathway
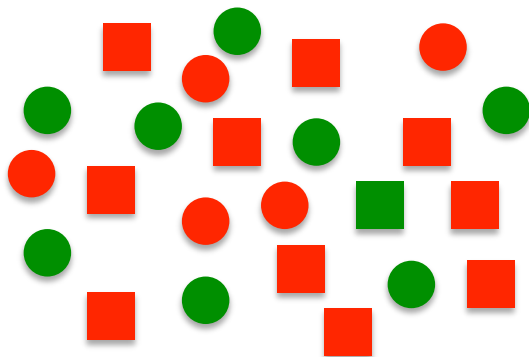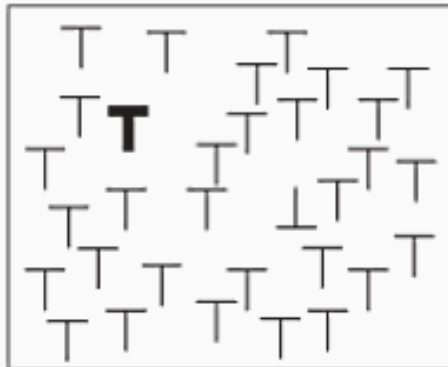
Sufficient Differences

- For things to pop out, the low level feature differences need to be sufficiently large
  - 30 degree difference or more
- The extend of variation in the background is also important
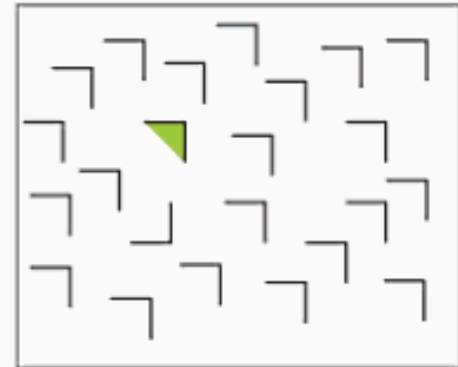 - Extremely homogeneous vs. busy background

Examples

The inverted T has the same feature set as the right-side-up T and is difficult to see. But the bold T does support pop-out and is easy to find.
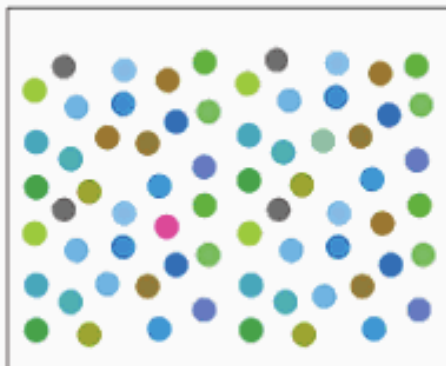
Similarly the backwards L has the same feature set as the other items, making it difficult to find. But the green triangle addition does pop out.

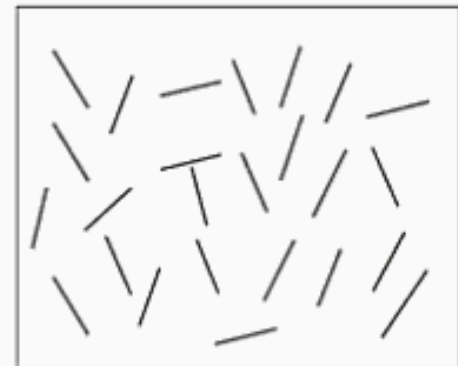A color that is close to many other similarly colored dots cannot be tuned for and is difficult to find.

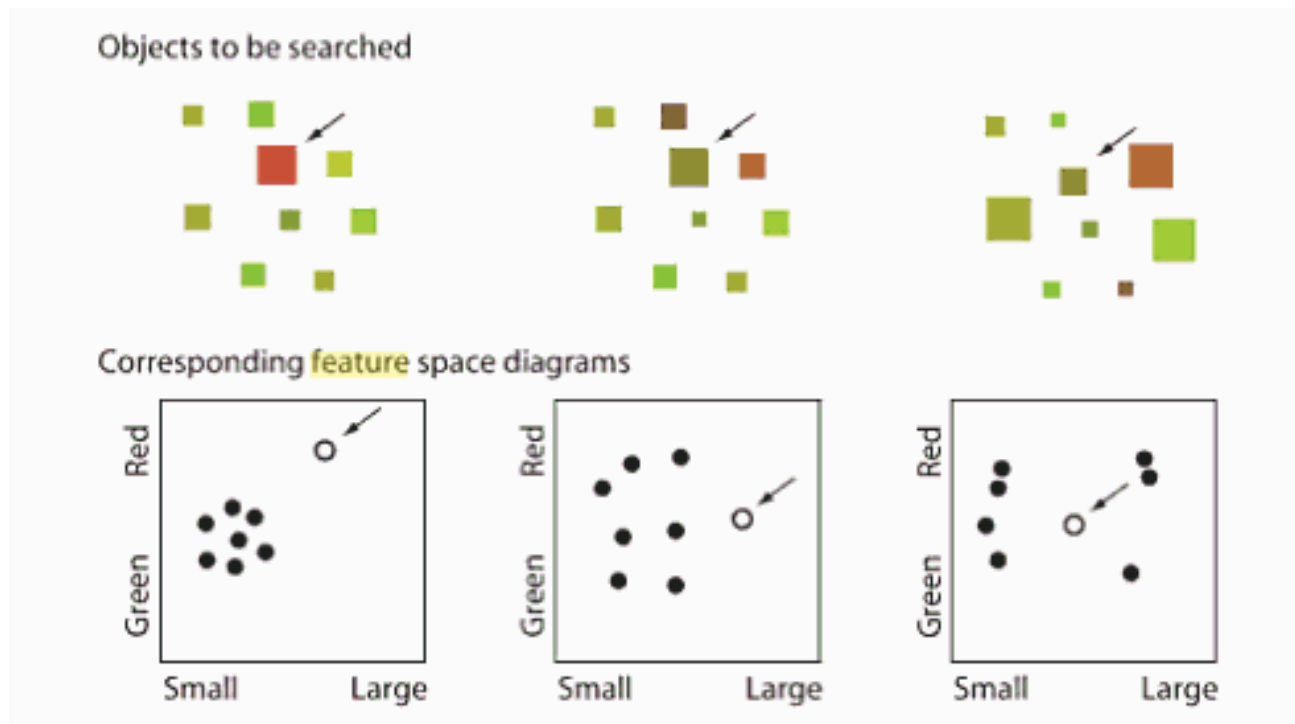Similarly, if a line is surrounded by other lines of various similar orientations it will not stand out.

Examples

# Feature Channels

- Channels are defined by the different ways the visual image is processed in V1

- Learning does not help

Objects to be searched

Corresponding feature space diagrams

Lesson for Design

- If you want to make something easy to find, make it different from its surroundings according to some primary visual channel
  - Color, size, shape, blinking, and so on
- How to make several things easy to search at the same time?
  - Use different channels
  - GDP example
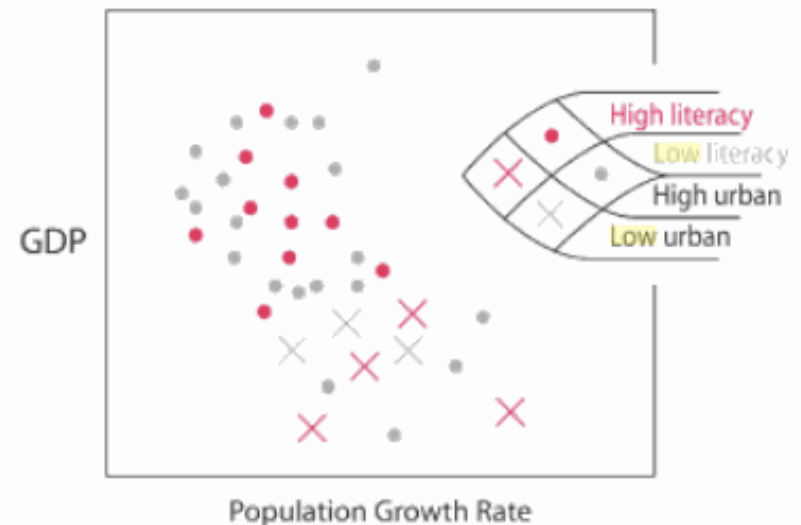
Lesson for Design

- Use multiple channels will make a symbol even easier to find
  - Differ in both size and color will make it easier
- Creating a display containing more than 8 to 10 independently searchable symbols is impossible – not enough channels
- We have only about three different steps in each channel
  - 3 sizes, 3 orientations, etc
- Visibility enhancements are not symmetric
  - Increase the size is more distinctive than decrease in size

Motion

- Motion is extremely powerful
- Things that emerge into the visual field is more powerful than things that simply move
- Think of example of email alert
- Rapid motion vs. slower and smoother motion
  - Urgent or gentle reminder
- Don't overuse because it can be irritating
  - Because people cannot suppress it

The Visual Search Process

- Move and scan loop
- Eye movement control loop
- Pattern testing loop

Multi-scale structure
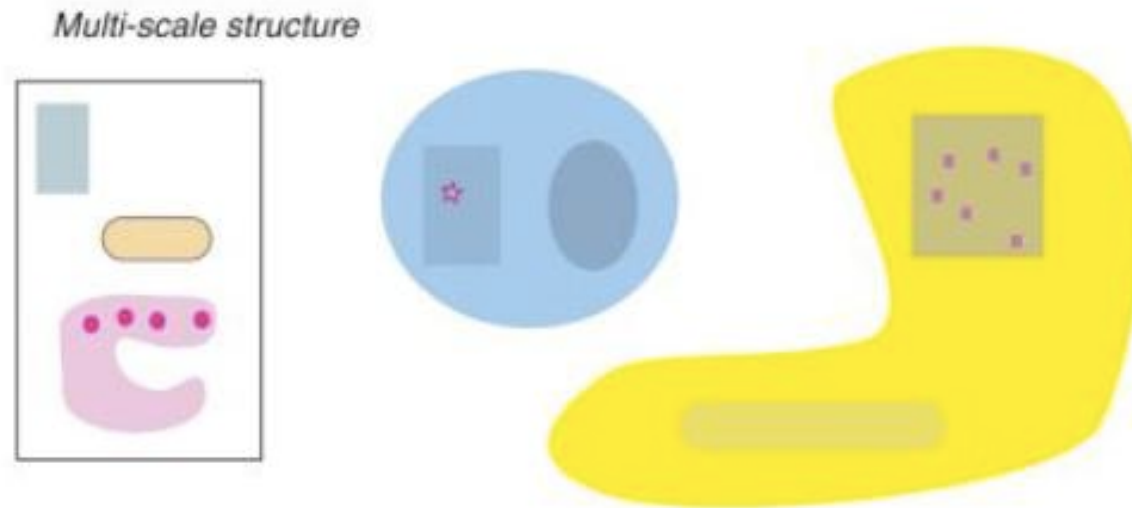
Multi-scale structure for design

- To support efficient visual search, a design should be given large-scale as well as small-scale structure

- This allows our eyes to move to the likely neighborhood of a target, then the local pattern information provides a few candidates for individual detail eye fixation

Conclusion

- Visual search is something that is fundamental to almost all seeing

- There is a world of difference between something that can be located in a single eye movement and one that takes five or ten

- Use pop-out properties well can go a long way

Reference

- Visual Thinking for Design by Colin Ware