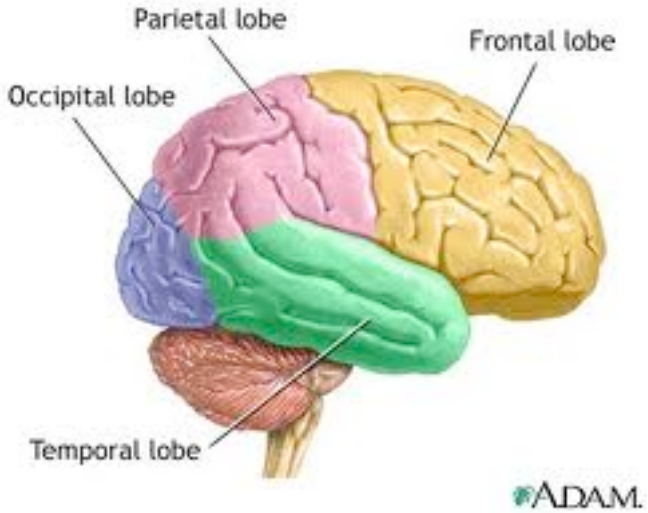
Visual Thinking

Visual Queries

active vision



- Almost **half** our brain is devoted to vision

- We should think of graphic designs as **cognitive tools**
  - diagrams, maps, technical illustrations all help us to understand and solve problems
    - **visual thinking**
  - enhances and amplifies our mental abilities

How do we design effective visual images?

- Which colours and **shapes** will stand out clearly?
- How do we organise space?
- When should we use images instead of words?
  - and vice-versa?

Perception and visual attention

At any given instant, we apprehend only a tiny fraction of the information stored in our surroundings

- "The world is its own memory."

We are not immediately conscious of the world:

- conscious of the "field of information" to which we have "rapid access"

Change blindness 1/3

- We cannot even remember new faces!

Simons, D.J., & Levin, D.T. (1998). Failure to detect changes to people during a real-world interaction. Psychonomic Bulletin and Review , 5 , 644-649

http://scienceblogs.com/mixingmemory/2006/12/coolest_experiment_ever.php

Simons and Levin had experimenters approach a passer by with a map in hand (on the Cornell U. campus), and ask for directions to a campus building. After the passer by had been giving directions for about 15 seconds, a second and third experimenter, both carrying a door, passed between the first experimenter and the passer by. As the door went by, the first experimenter -- the one who'd asked for directions -- **switched places** with the experimenter carrying the back end of the door, who took the direction-taker's place in front of the passer by.

Change blindness 2/3

- We cannot even remember new faces!

Simons, D.J., & Levin, D.T. (1998). Failure to detect changes to people during a real-world interaction. Psychonomic Bulletin and Review , 5 , 644-649

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After the direction-giver finished giving directions, the experimenter asked:

We're doing a study as part of the psychology department [experimenter points to the psychology building next door] of the sorts of things people pay attention to in the real world. Did you notice anything unusual at all when that door passed by a minute ago?

If the direction-giver didn't say that the person to whom he was talking changed when the door passed, the experimenter then asked:

Did you notice that I'm not the same person who approached you to ask for directions?

Eight out of fifteen direction-givers failed to notice that the person they were talking to changed in mid conversation!

Change blindness 3/3

- We cannot even remember new faces!

Simons, D.J., & Levin, D.T. (1998). Failure to detect changes to people during a real-world interaction. Psychonomic Bulletin and Review , 5 , 644-649

All seven people who did notice the change were students, like the experimenters, 20-30 years old. Older participants didn't notice the change.
In a second experiment, the two experimenters who acted as direction-takers were dressed as construction workers.
This time, only 4 of 12 young participants (college age) noticed the switch, supporting the hypothesis that people only notice the change when the appearance of the individuals is relevant to them.

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Perception and visual attention

- Why did this happen?
  - people were concentrating on the map
  - we have limited capacity for attention and unnecessary information is discarded
    - working memory is limited
    - tradeoff of space vs time!
  - We see very little at any given instant, but can sample the world so rapidly* by eye, that we have the illusion of having it all in our brains at once

* 0.1 s per eye movement

Perception and visual attention

- The knowledge that we only visually sample the world on a need-to-know basis only emerged over the last decade
  - led to profoundly different model of perception
    - we are conscious of the "field of information" to which we have "rapid access"

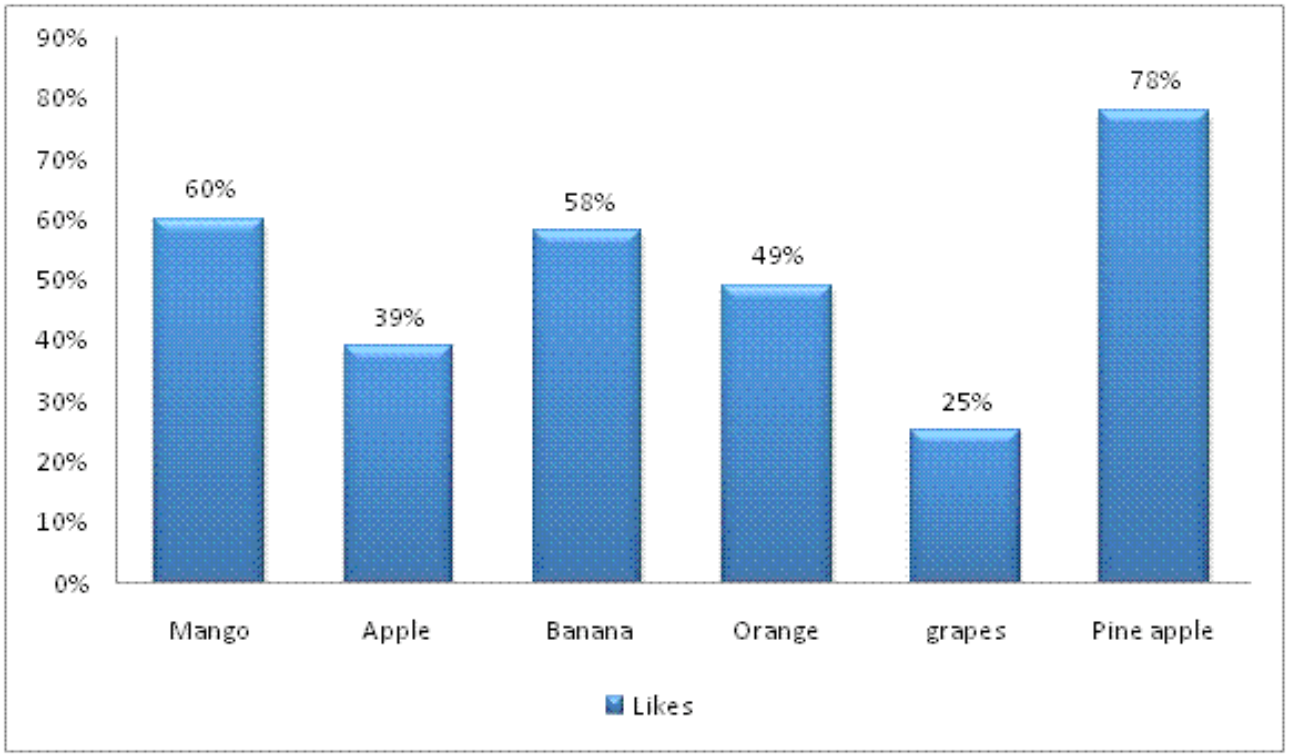
Visual thinking

Visual thinking consists of a series of “acts of attention” -

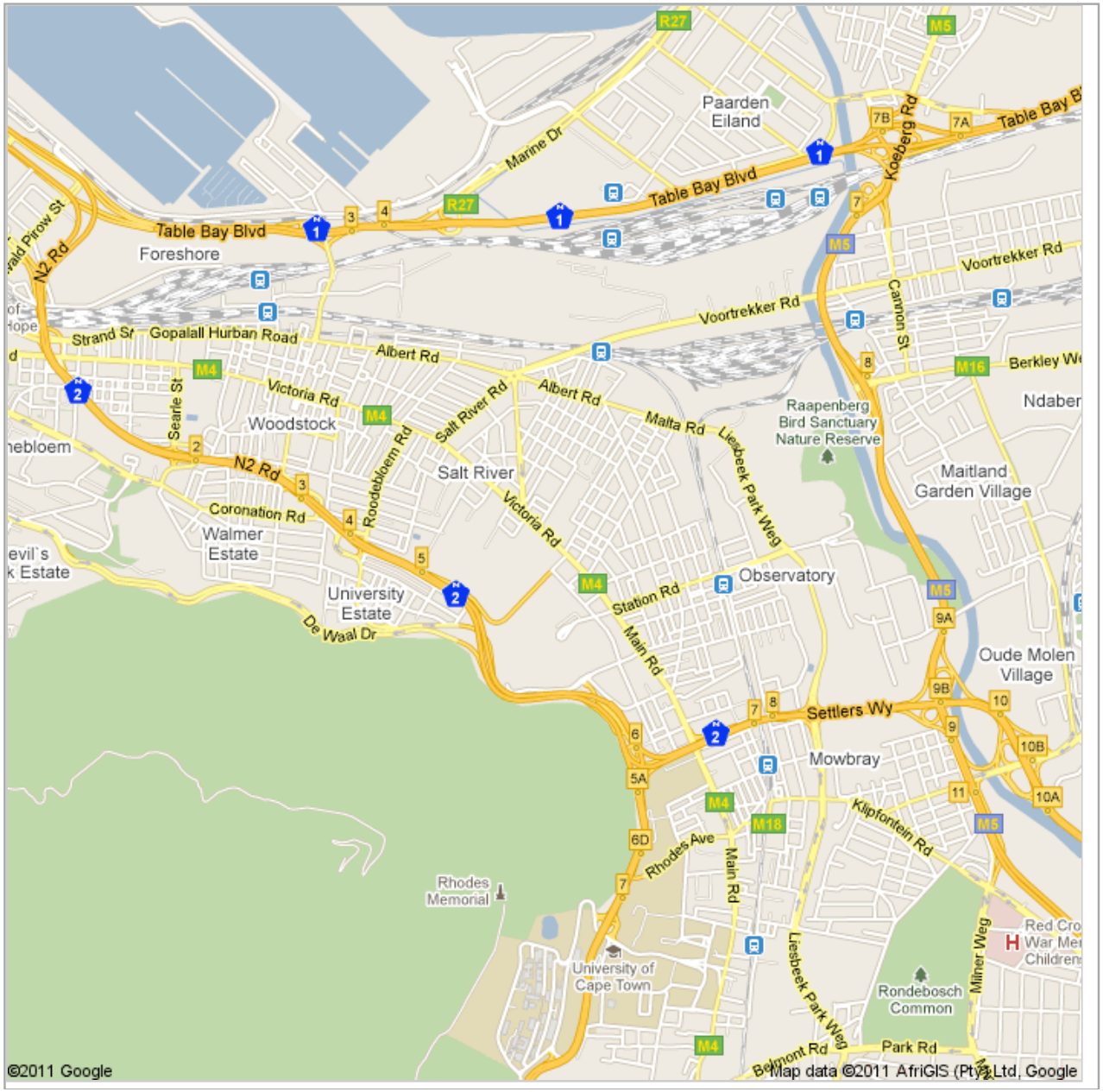
visual queries

- which drive eye movements and tune our pattern-finding circuits.

Visual queries



- Which fruit is the most popular?



Visual queries

- Find a FAST route from UCT to Paarden Island

Visual thinking

We are mostly unaware of how structured and directed our seeing processes are

e.g. scanning people's faces when talking to them, facial expressions, directions of gaze etc.

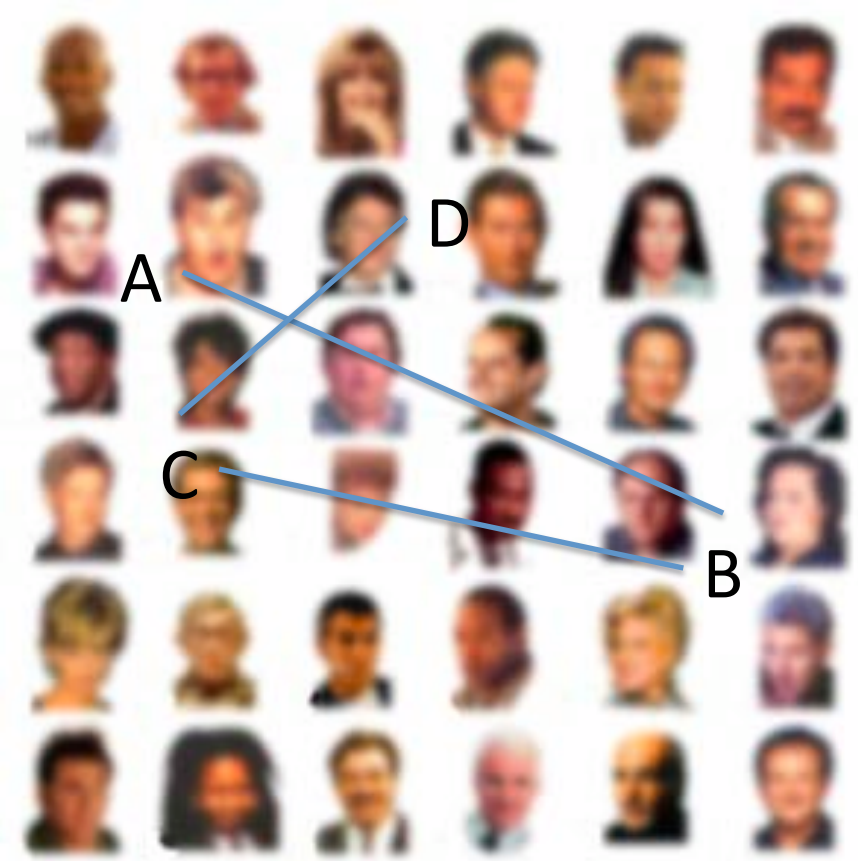
Understanding how visual queries work can make us better designers:

we should base graphic design on a scientific understanding of visual attention and pattern perception.

The process of seeing

- eyes are like digital cameras with a range of light-seeing elements: rods and cones
- brain pixels vary enormously in size over the visual field:
  - tiny ones at the centre (fovea)
  - large ones at the periphery
    - at the end of the visual field, vision is terrible
      - can resolve objects about the size of a human head
- Non-uniformity means that half our brain power is devoted to viewing less than 5% of our visual world
- we also have a visual blind spot

Blurred Picture example



The act of perception

- perception is driven by 2 processes:
  - **bottom-up**:
  - driven by external stimulus

  retinal image -> features -> patterns -> objects

  We detect motion, edges of shapes, colours, contours, contrasts through bottom-up processes without conscious awareness

The act of perception

- **top-down** or attention
  - driven by need to accomplish some goal, prior knowledge, expectations
    - biased in favour of signals we are looking for
  - only get information we need when we need it
    - sequence of rapid eye movements to locate important objects
- Brain functions as a kind of distributed processor
  - even outside the brain??

The working memory bottleneck

- very limited capacity
  - on average, a person can manipulate around three to five chunks of awareness in memory at one time
- short duration

- cognitive load:
  - when high, cannot process information
  - good designs should limit cognitive load

Implications for design

- Goal is to design displays so that visual queries are **processed** both **rapidly** and **correctly** for every important cognitive task
  - Therefore, we must understand the cognitive tasks and visual queries a graphic is intended to support
    - usually done intuitively, but can be made explicit
- the goal is not to make you neuropsychologists, but to give you a **theoretical understanding** of how we perceive, in order to inform the design process.
- Understanding how people process information will help you to produce graphics that users understand

Implications for design

Effective design should start with a visual task analysis,

determine set of visual queries to be supported by a design

then use colour, form and space to efficiently serve those queries

There is never a single optimal solution to a design problem, but rather a huge variety of alternative clear and effective designs.