Visual Apprehension

How we process visual information
and what we can most easily see

Facilitating visual queries

- Visual attention works like a spotlight
- In a graphic or interface, you want to ensure that all **visual queries** can be rapidly and effectively served
- How do we design graphical symbols that can be rapidly located?
- The most important and frequent queries should be supported by the most **visually distinct objects**

What makes a small thing easy to spot?

Visual query illustration #1

- In the following text, find the two p's

ahklhsdfasdgdramzxmxzcbkdkhjsdnnpksdfjzxnc
xnfhagspdjgruioqweuyruywutsdbsmawqw

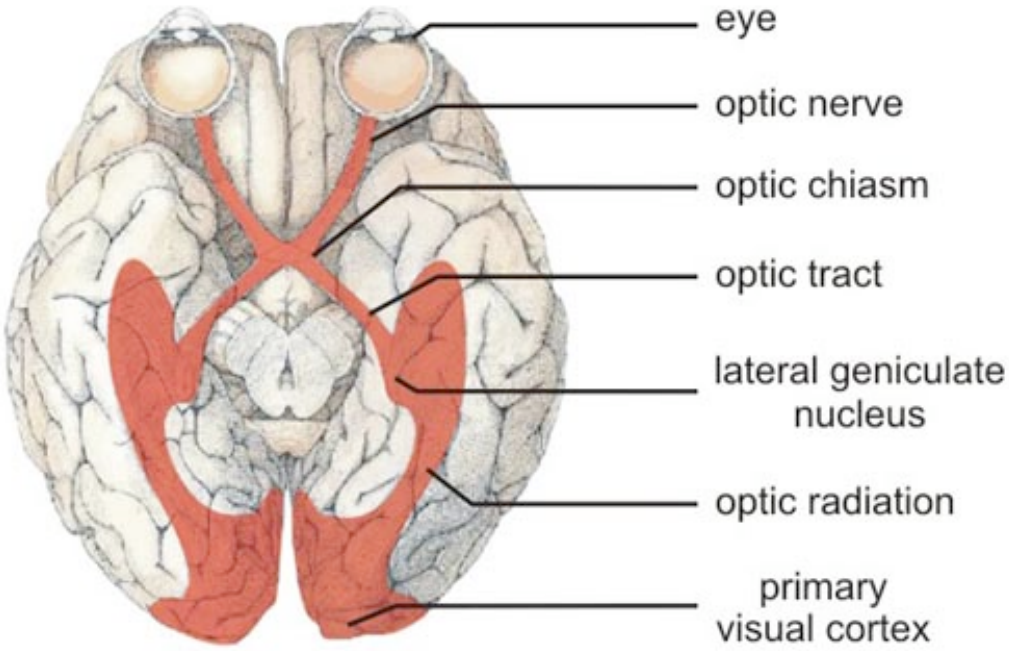
- Now, find the two q's

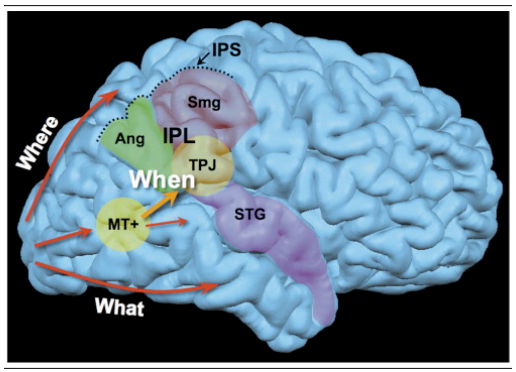
Visual query illustration #1

- Finding the p's is very easy
- Finding the q's takes much longer and imposes a much greater cognitive burden
- Why do the q's take longer to find?

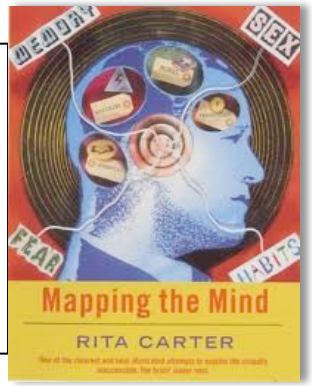
How humans do low-level feature analysis

- Early stages of visual processing occur in the primary visual cortex:
  - V1 : general scanning
  - V2 : stereo vision
  - V3 : depth and distance
  - V4 : colour
  - V5 : motion
  - V6 : objective position of object
- **"Where?"** path: location of objects
  - V1-V2-V3-V5-V6
- **"What?"** path: identification of objects
  - V1-V2-V4





very nice book on the brain ->



How to find what you are looking for:
biased competition

- If you are looking for a particular colour/ orientation/size of an object, the visual system highlights these
  - e.g. if looking for strawberries, all red sensitive cells will “shout louder”

- some things pop out

much more easily than others

What makes objects **pop out**?

- Some kinds of shapes have properties to which our eye-movement programming system is sensitive – they **pop out**
  - can be seen in a single eye movement: at-a-glance
  - processing takes less than a tenth of a second
    - compare with between 1-5 seconds for a search
- easiest when single object differs in one feature from all the objects around it
  - to do with degree of contrast to the environment of the object

What makes objects pop out?

- Simplest features that lead to pop out are:

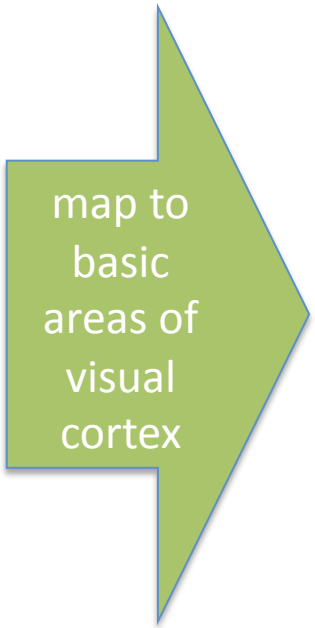
  colour,

  orientation

  size

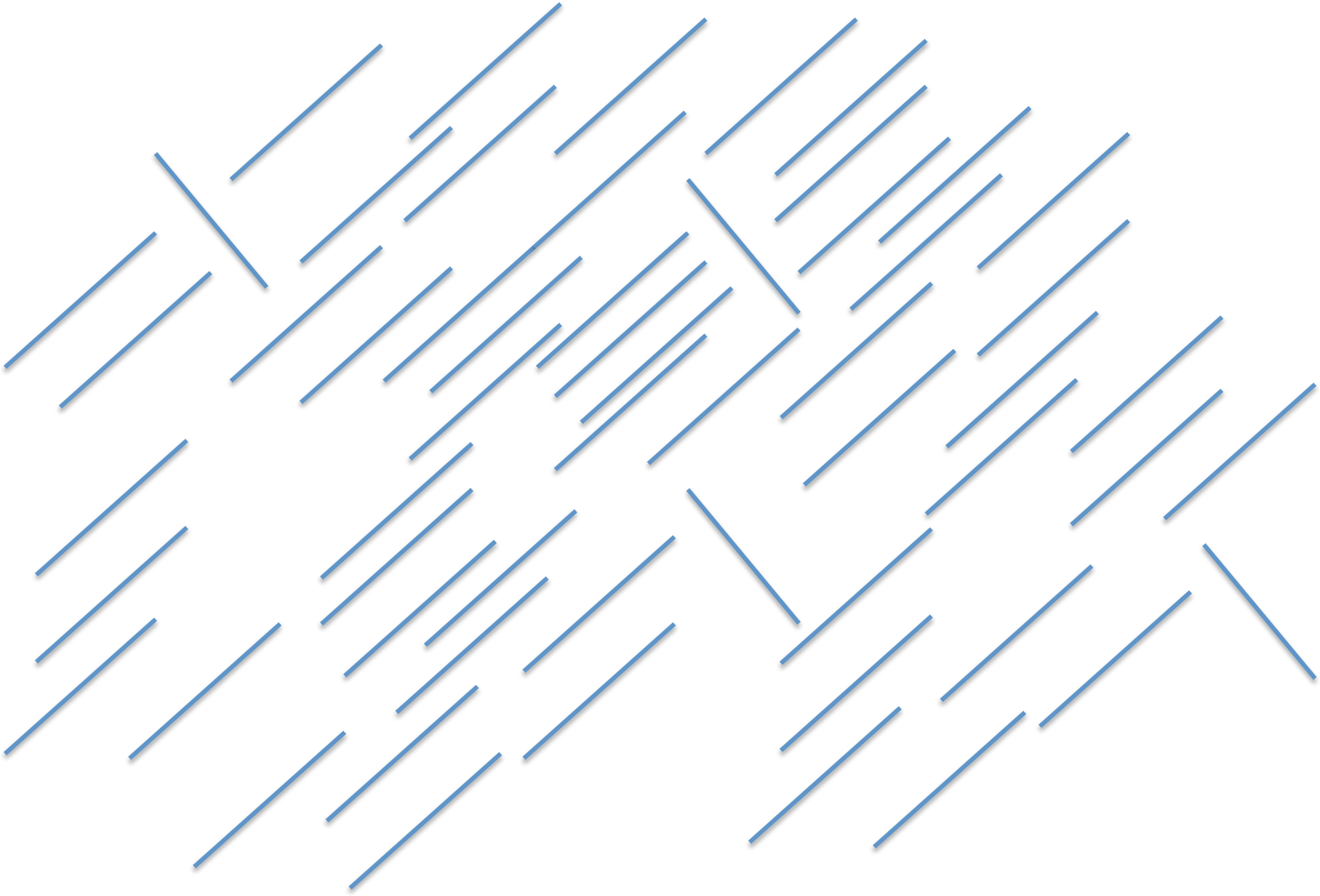
  motion

  stereoscopic depth

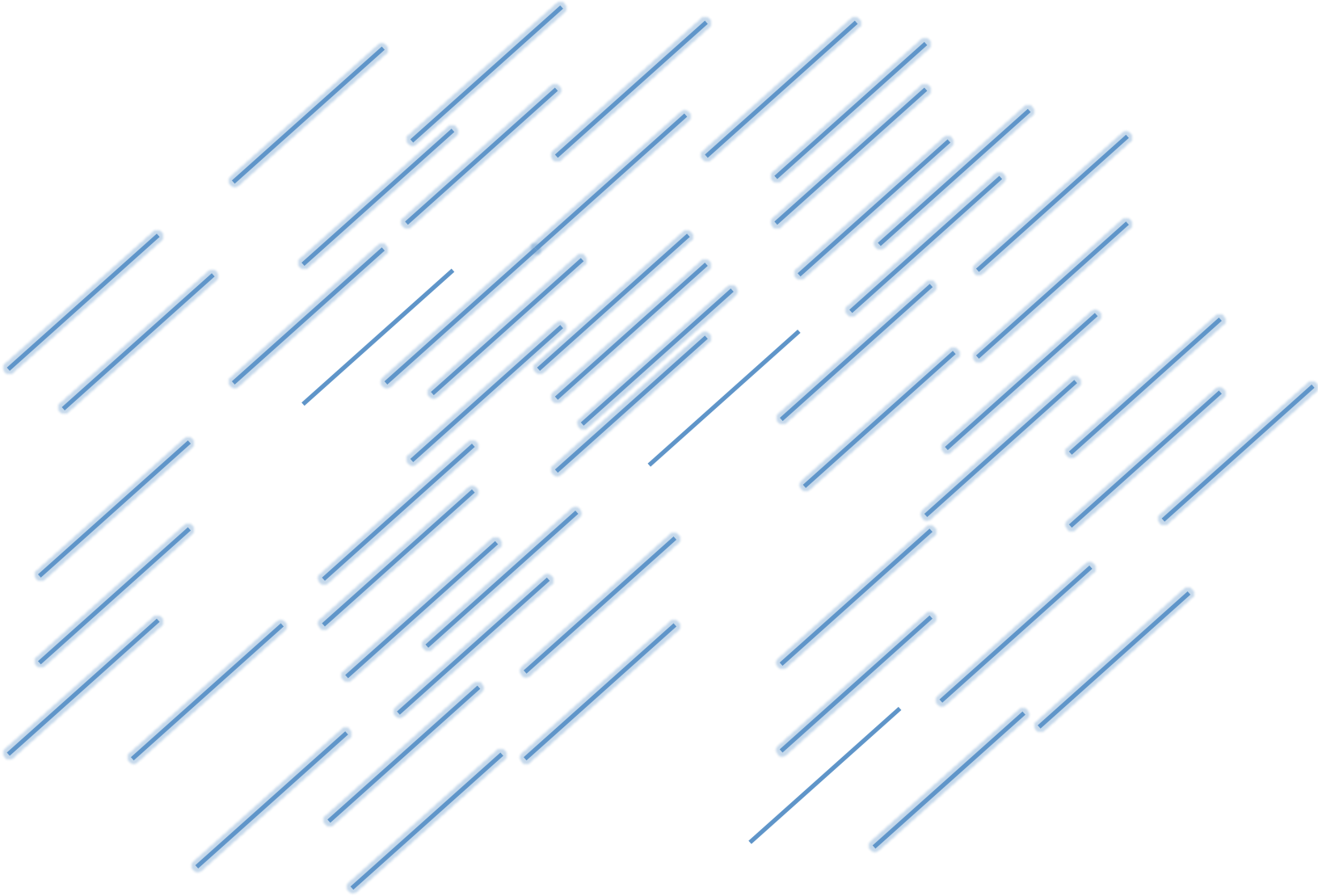


- V1 : general scanning
- V2 : stereo vision
- V3 : depth and distance
- V4 : colour
- V5 : motion
- V6 : objective position of objects

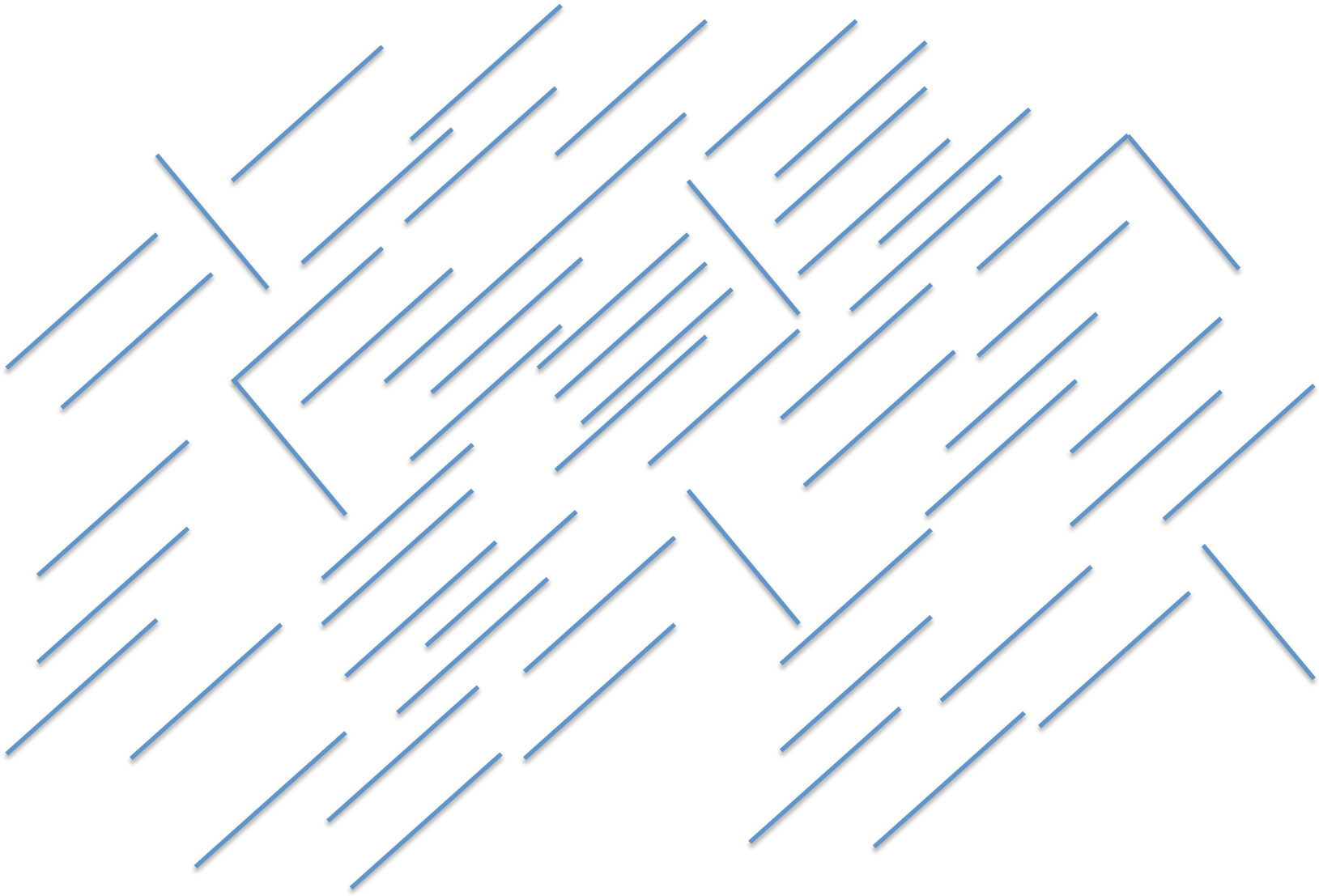
What stands out: orientation



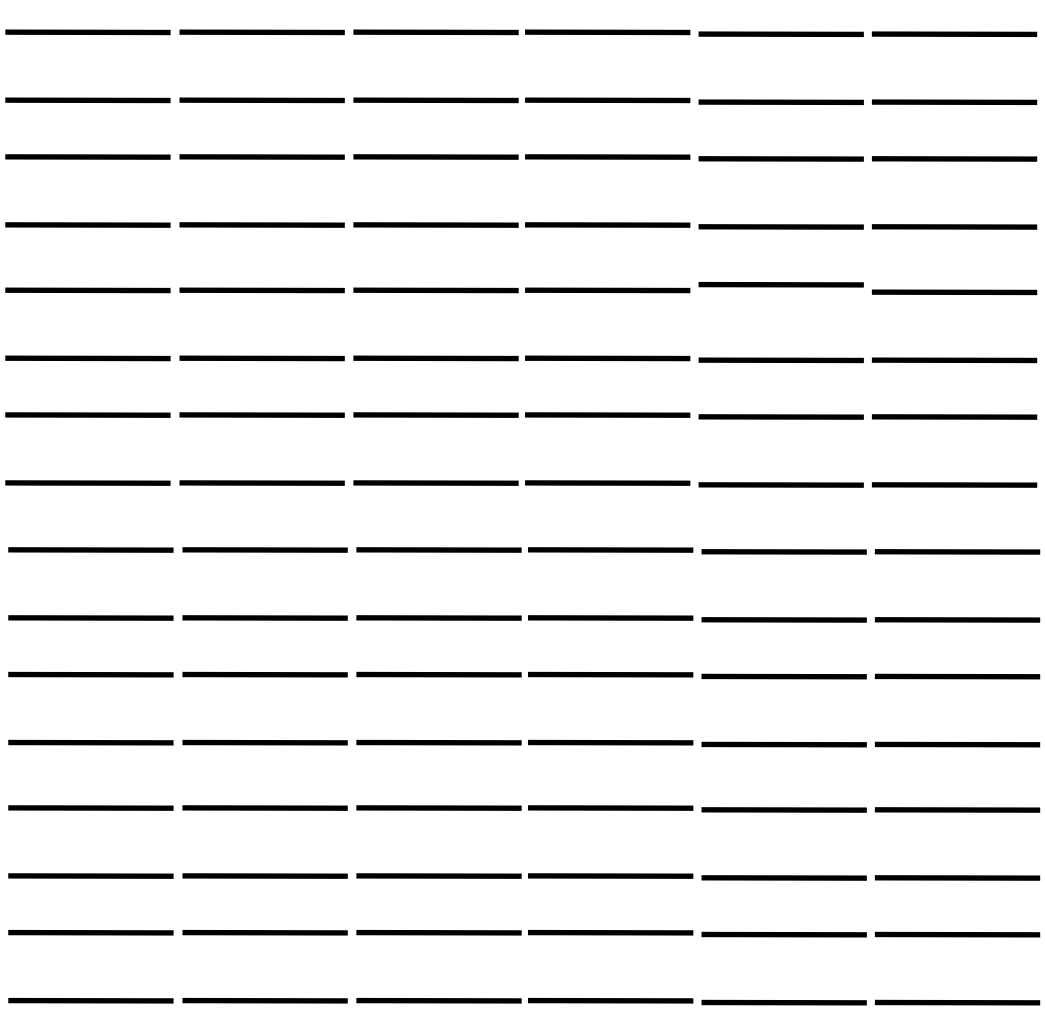
What stands out: sharpness



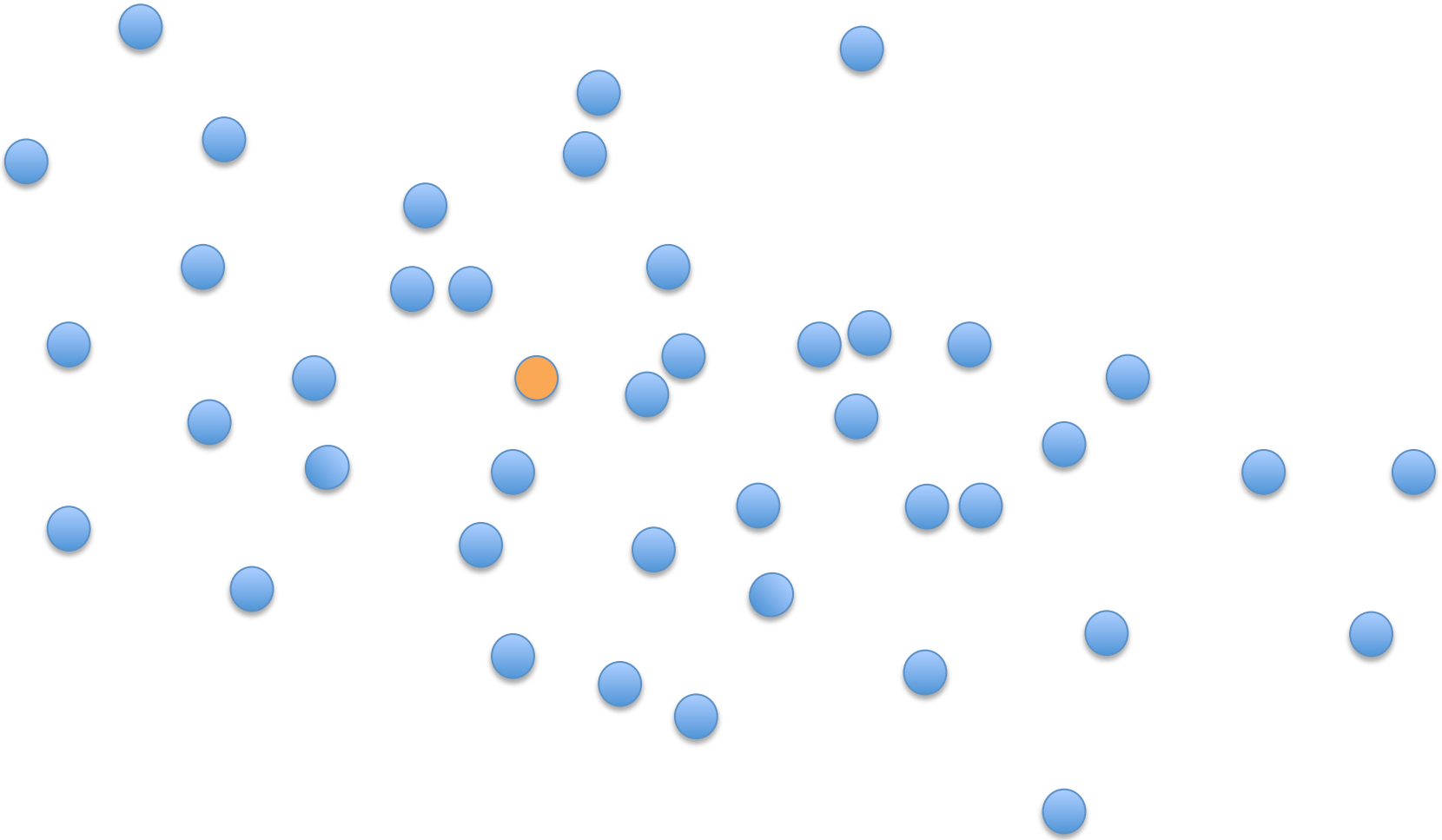
What stands out: joined lines



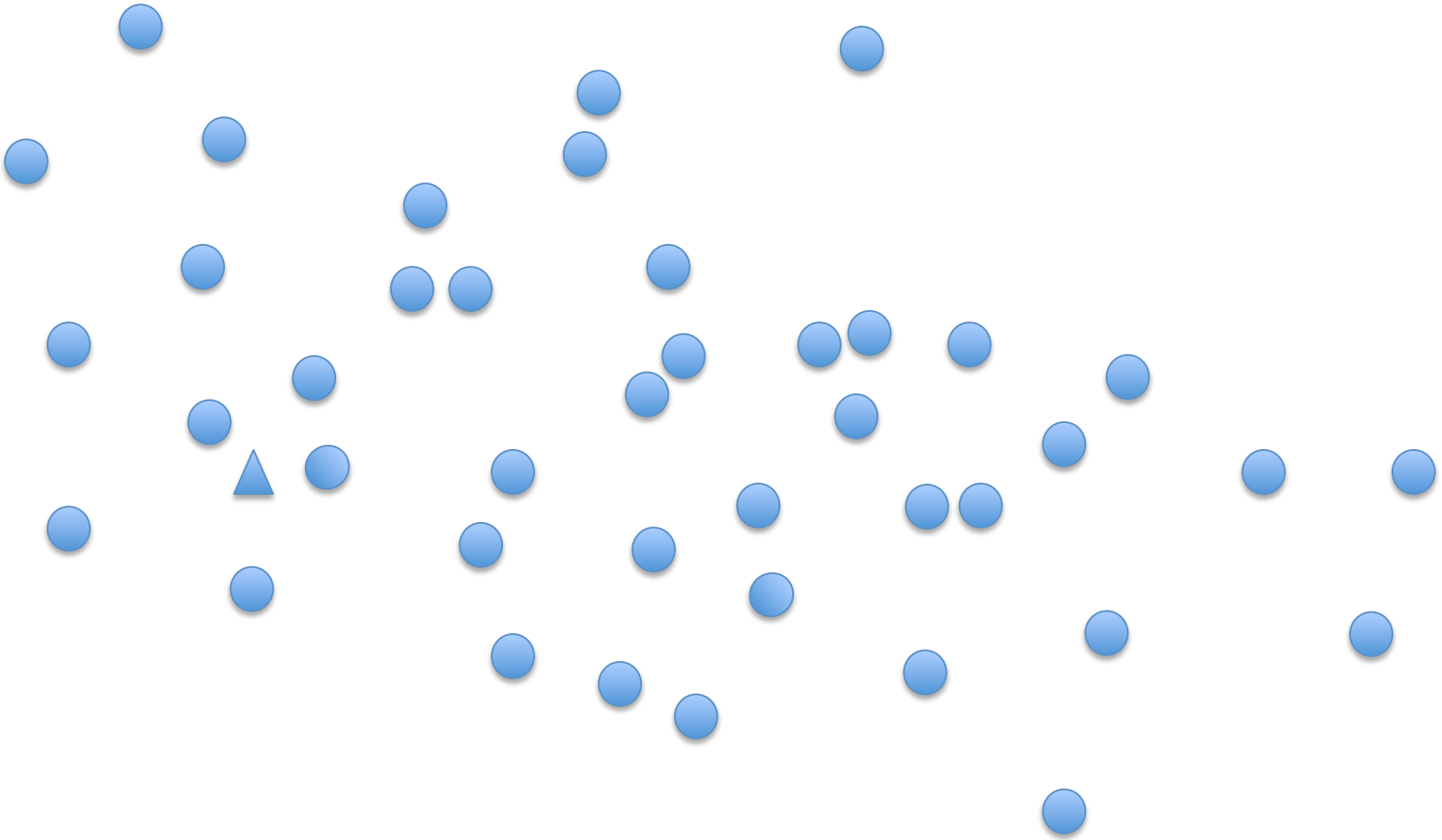
What stands out: misalignment



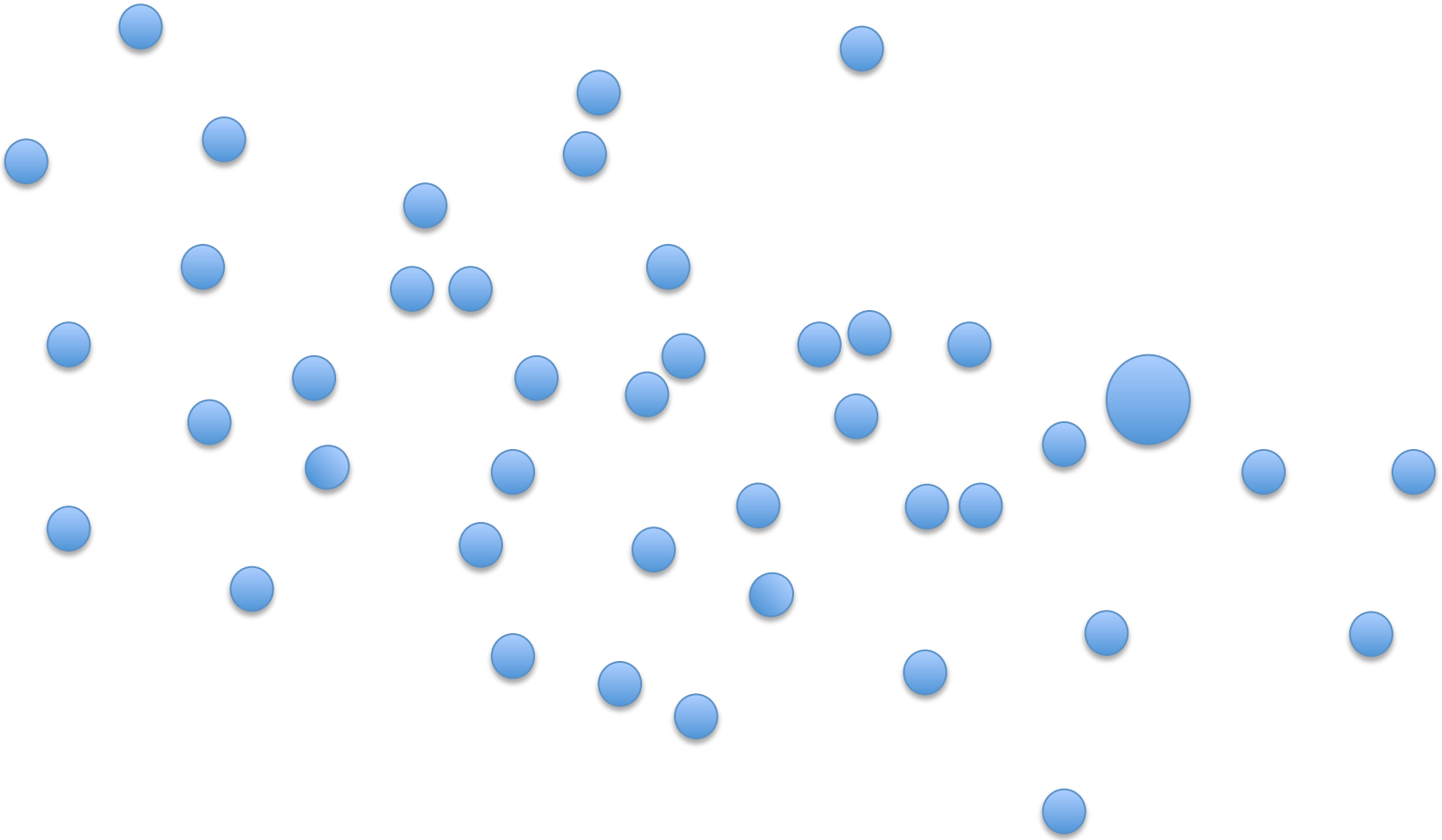
What stands out: colour



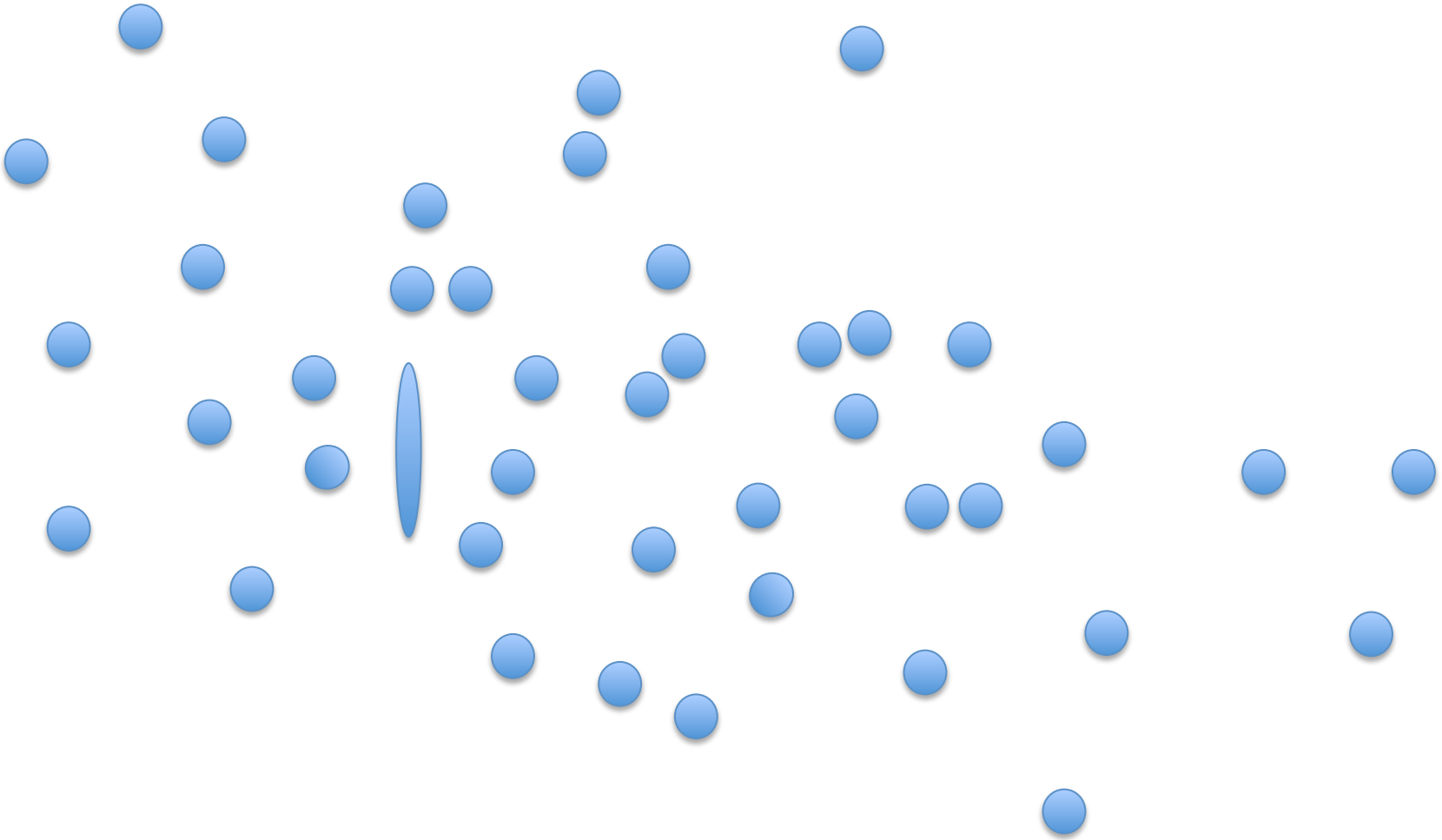
What stands out: shape



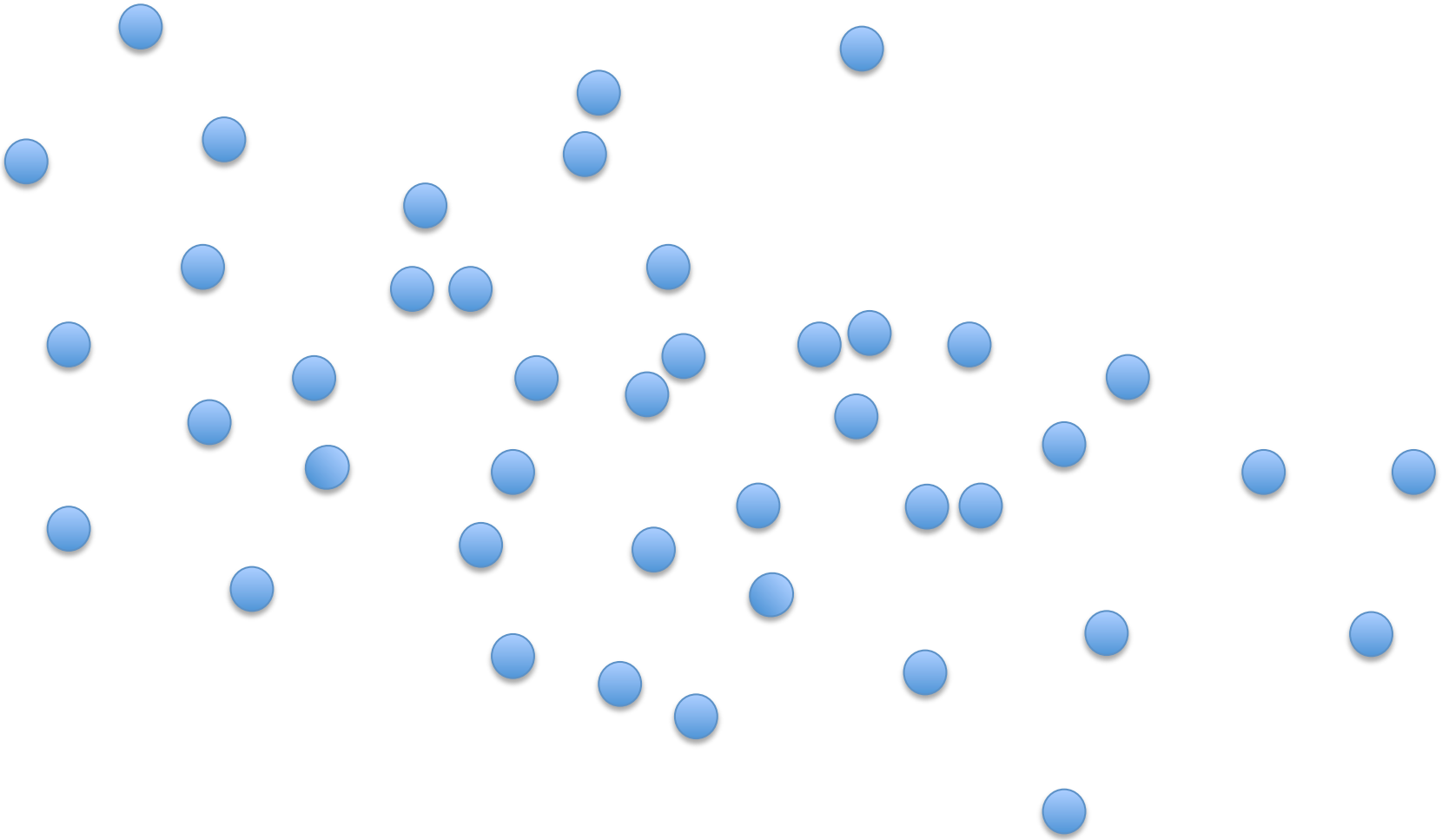
What stands out: size



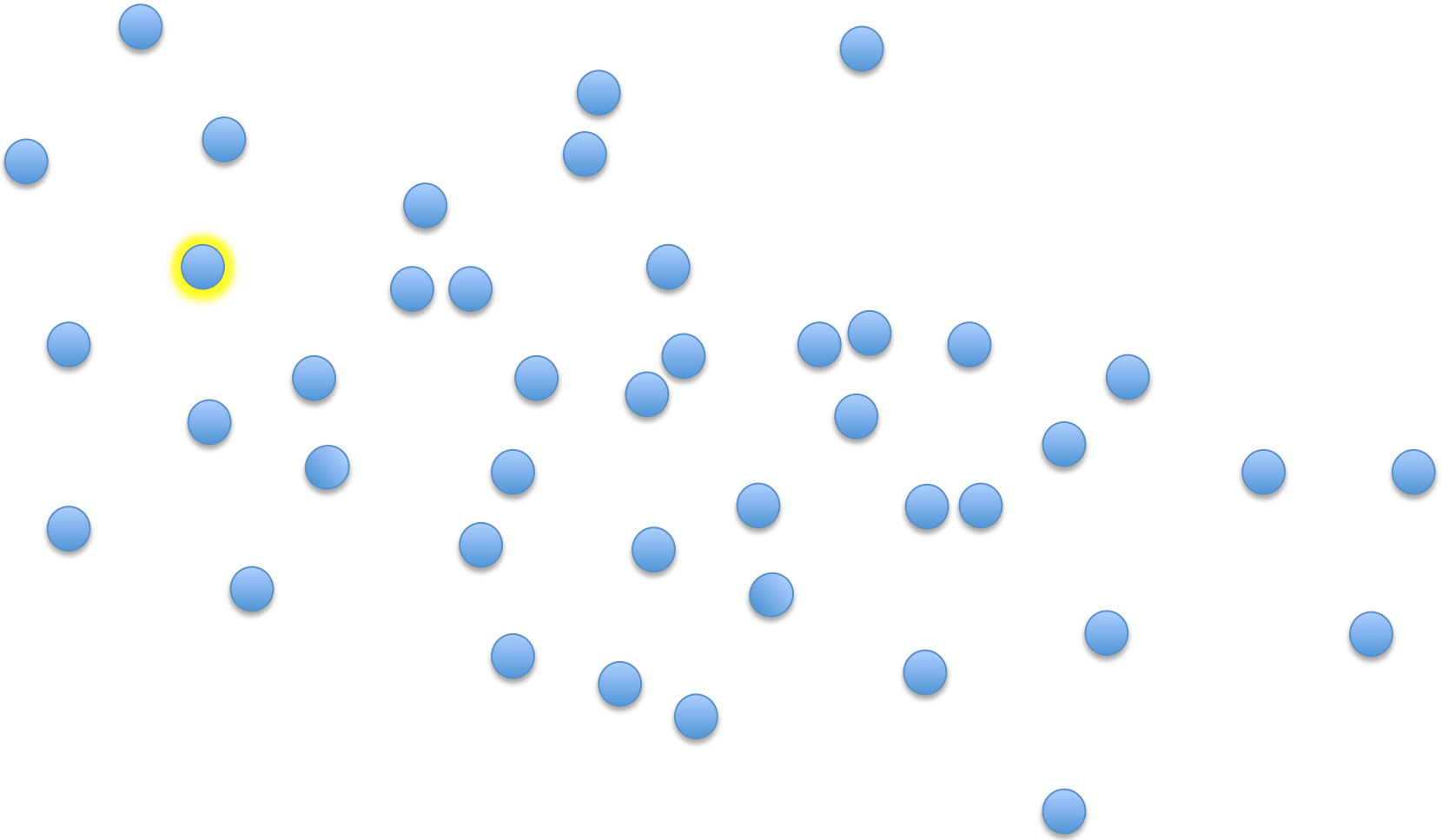
What stands out: elongation



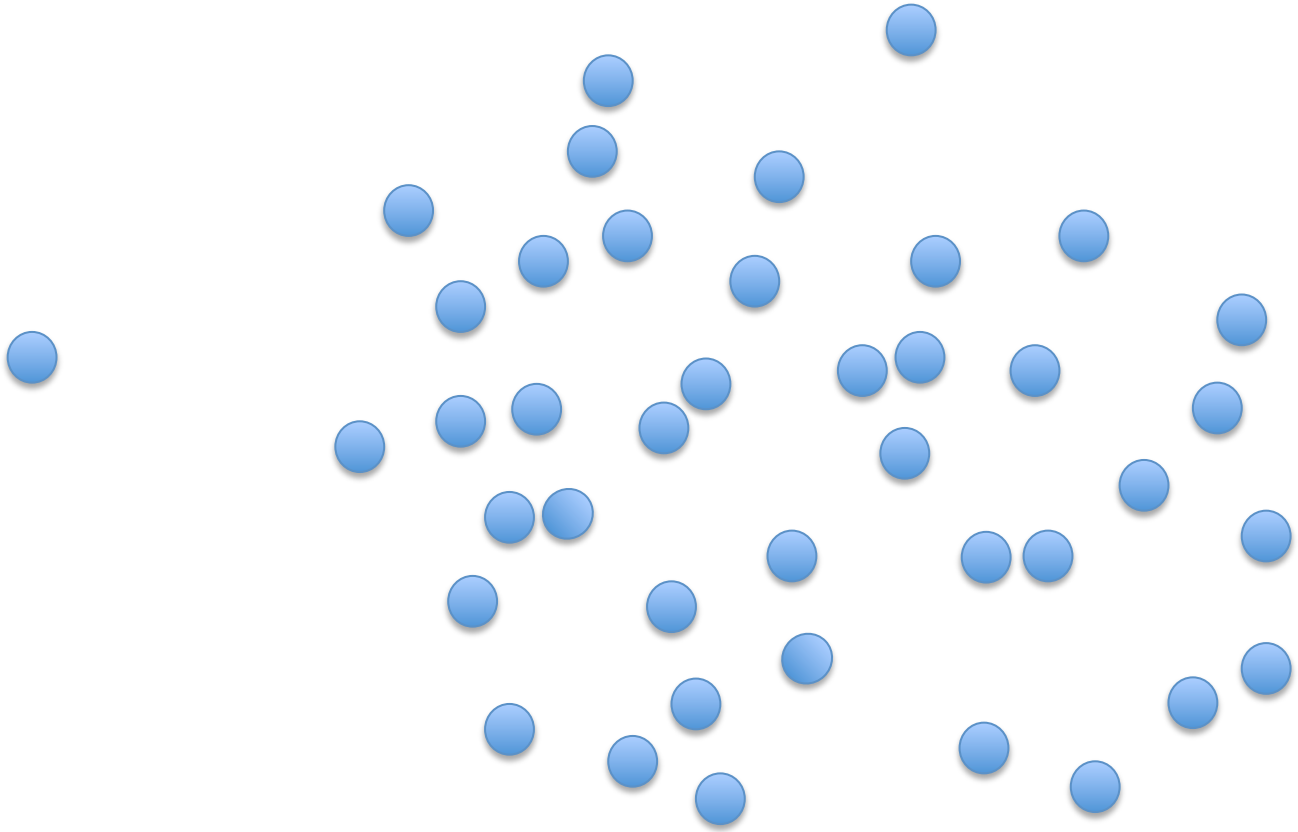
What stands out: motion



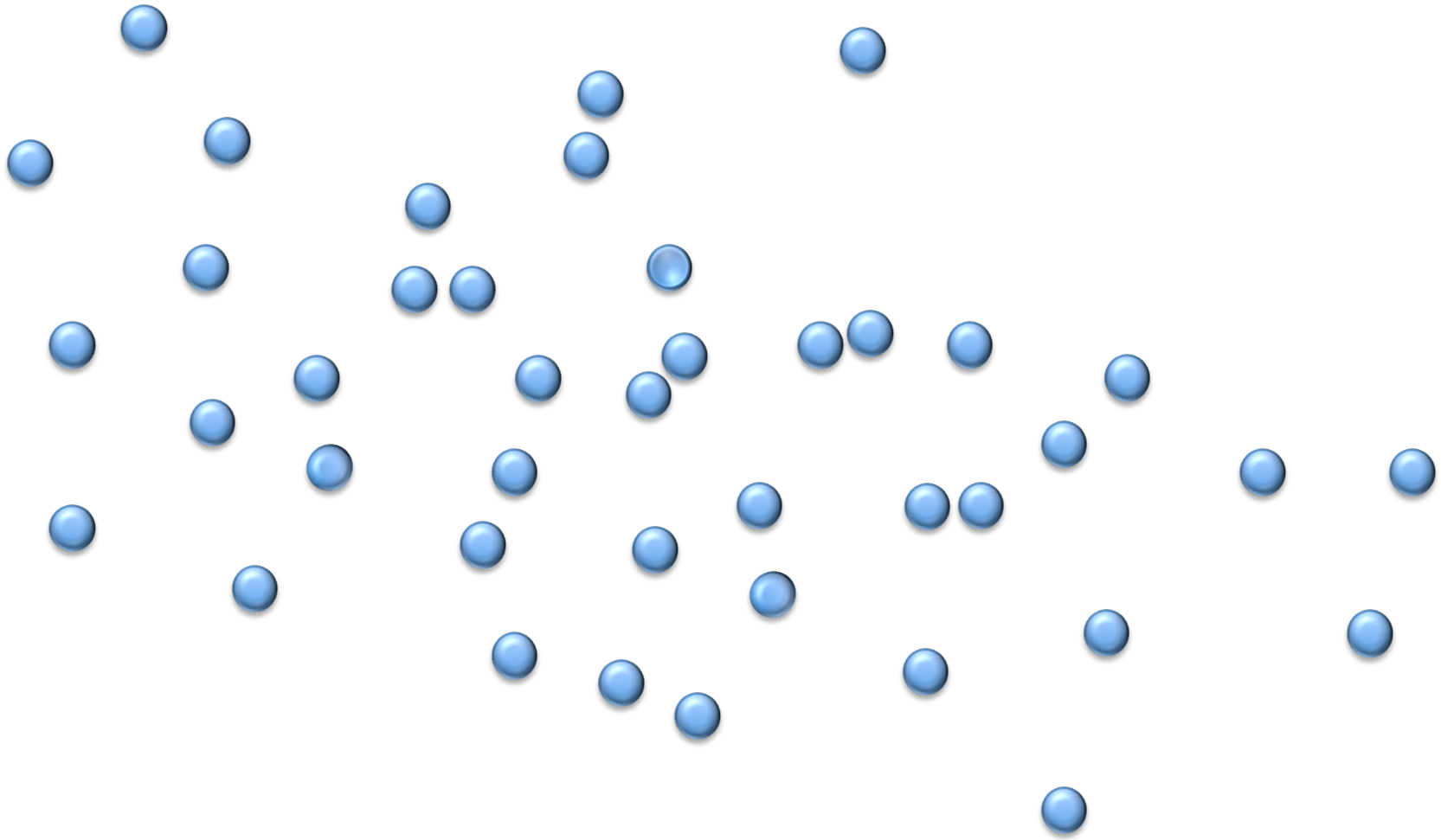
What stands out: surround colour



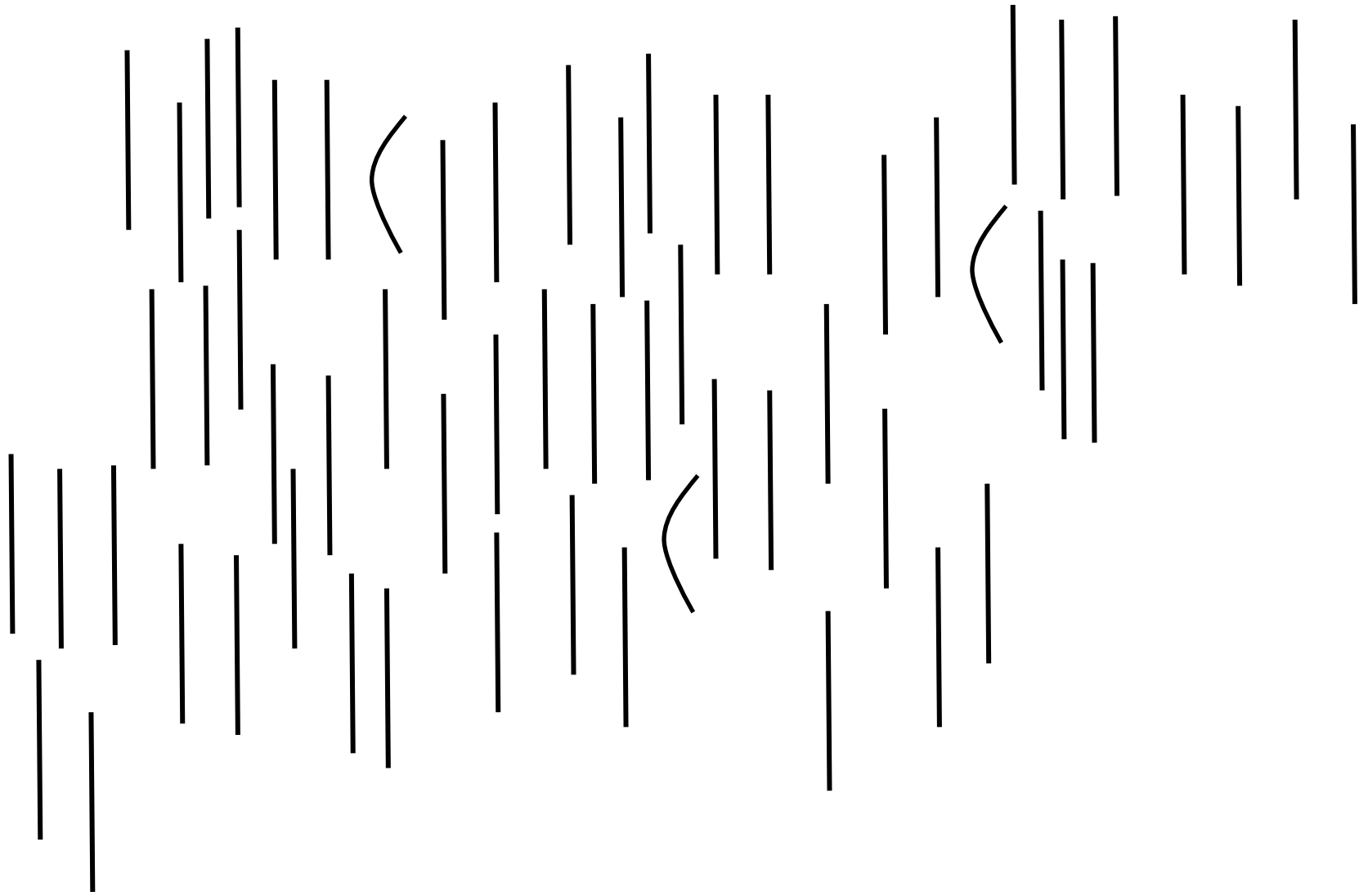
What stands out: spacial grouping



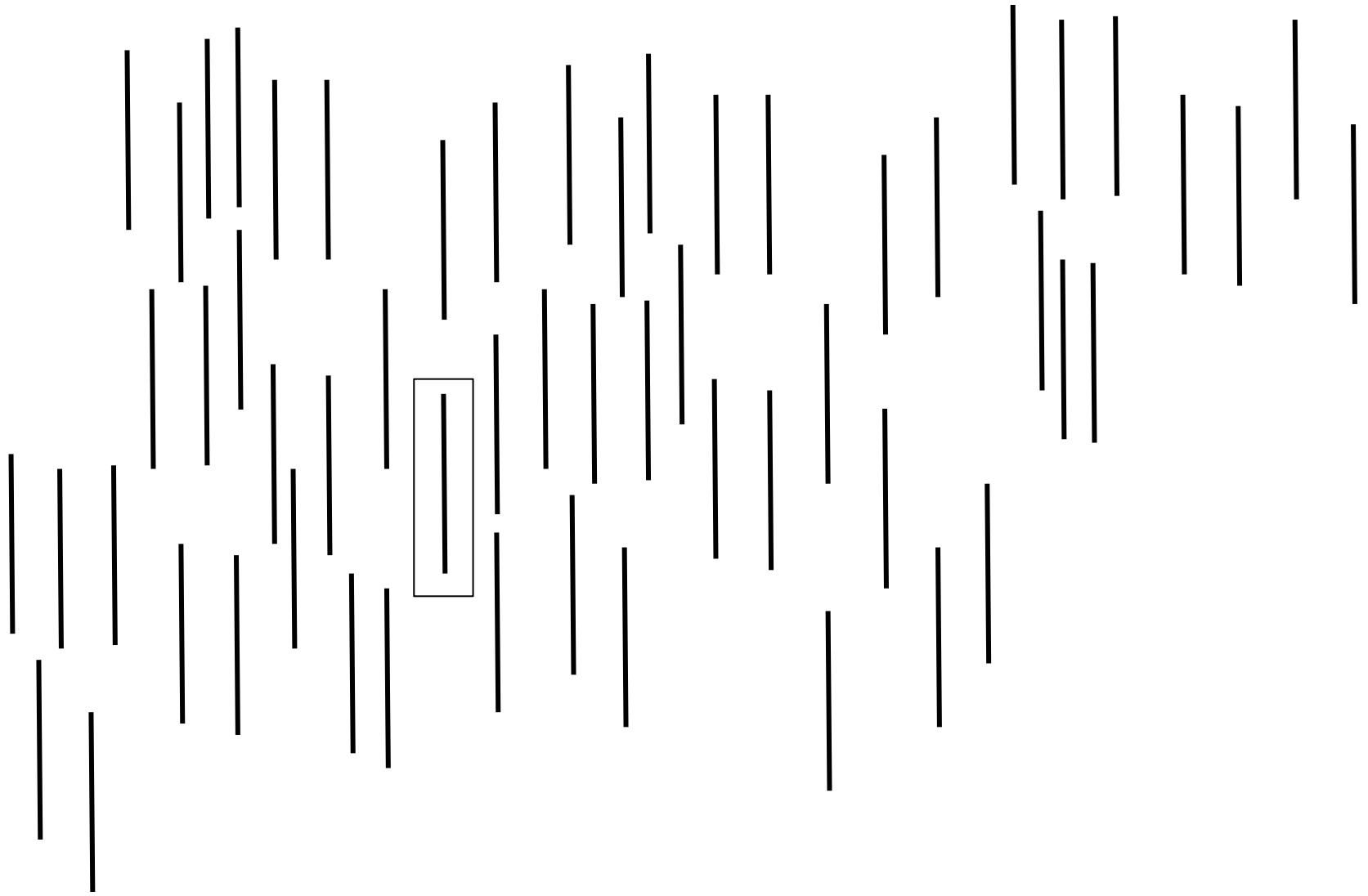
What stands out: convex and concave



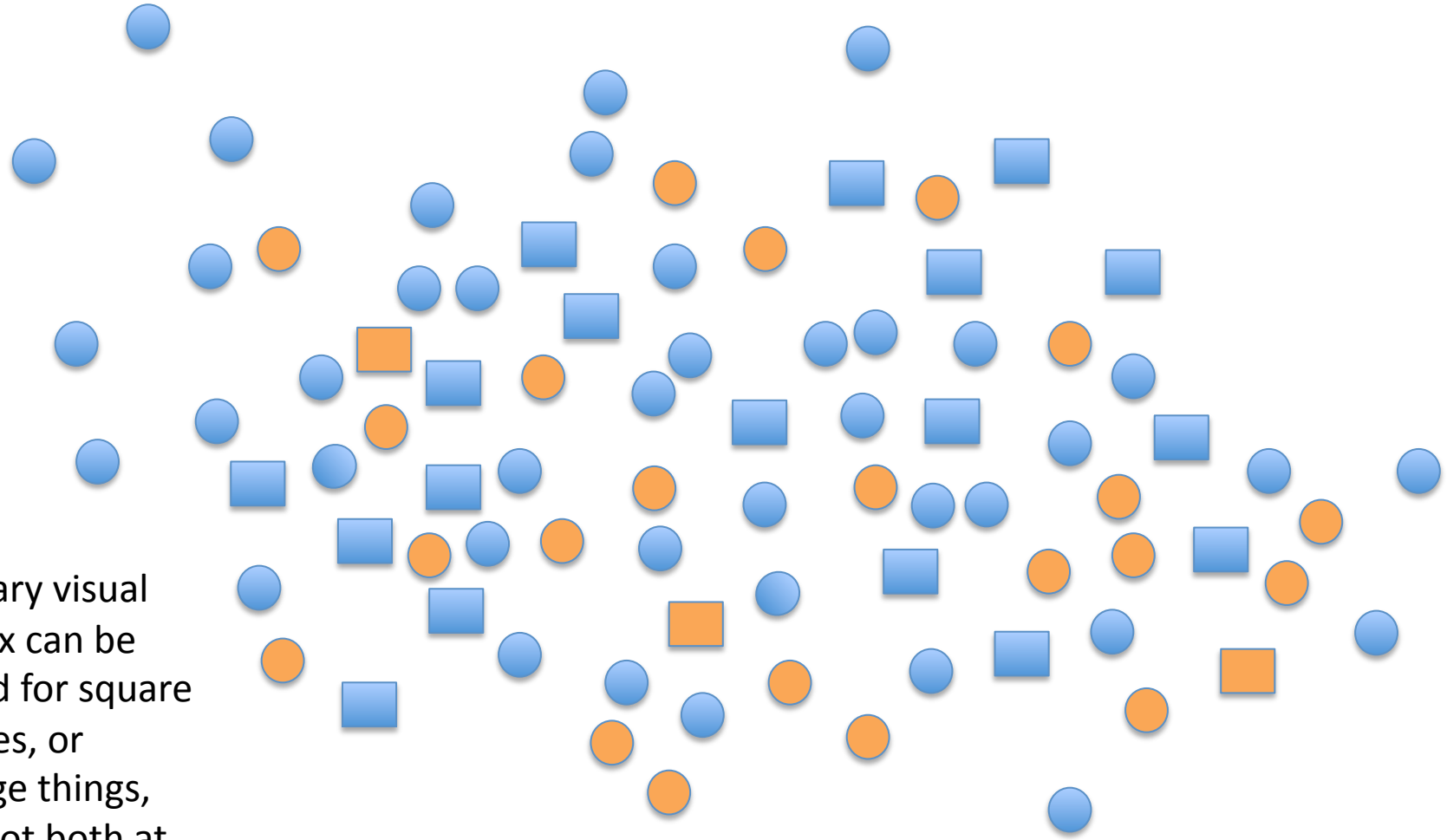
What stands out: curvature



What stands out: surround box



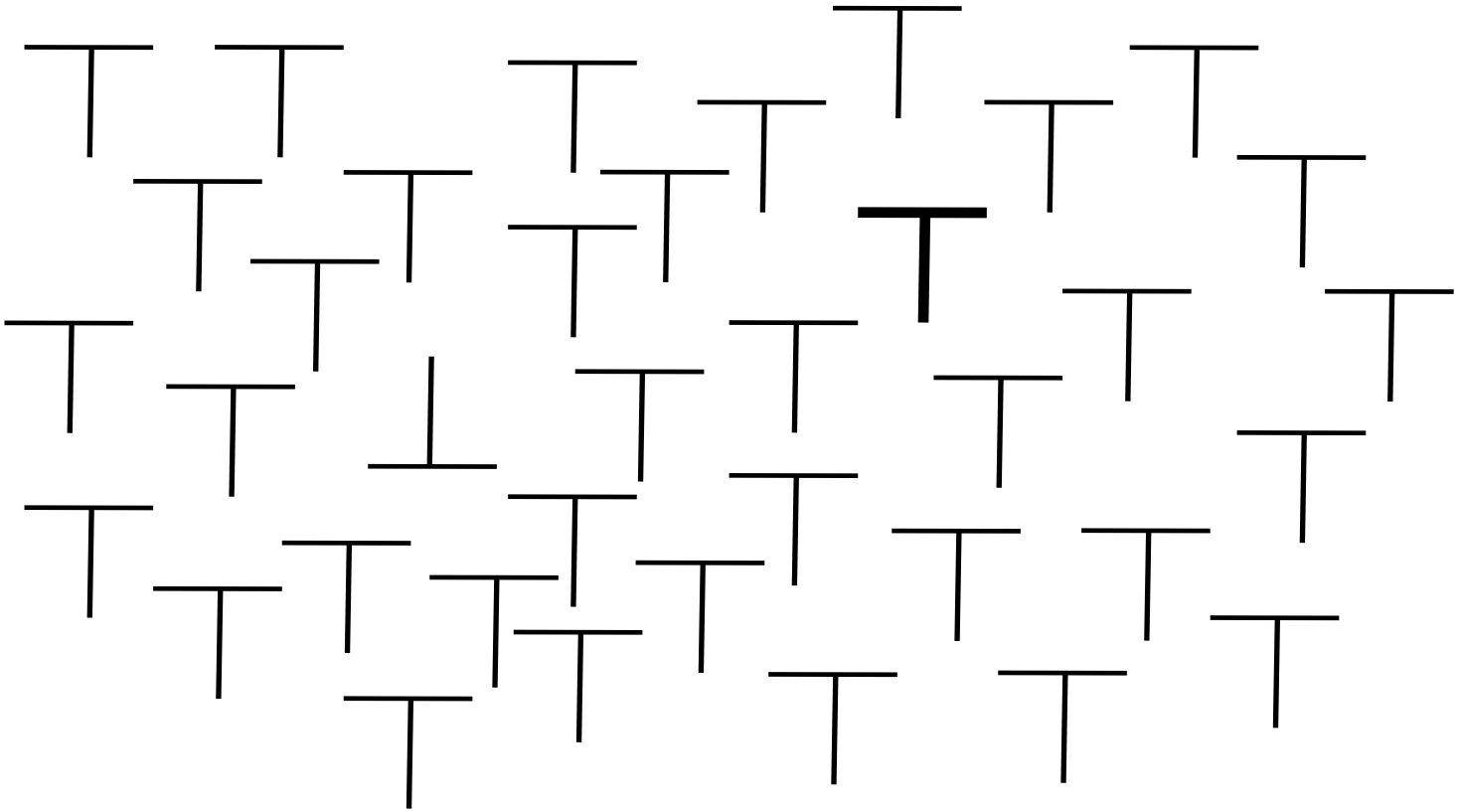
What does not stand out: find the three orange squares

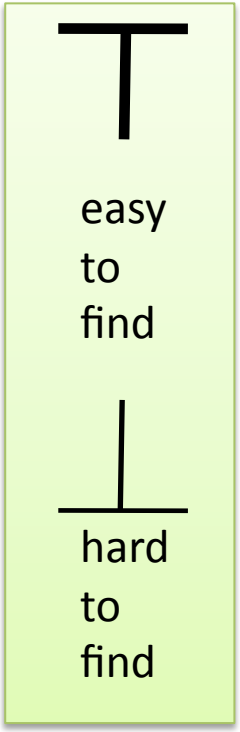


primary visual cortex can be tuned for square shapes, or orange things, but not both at the same time

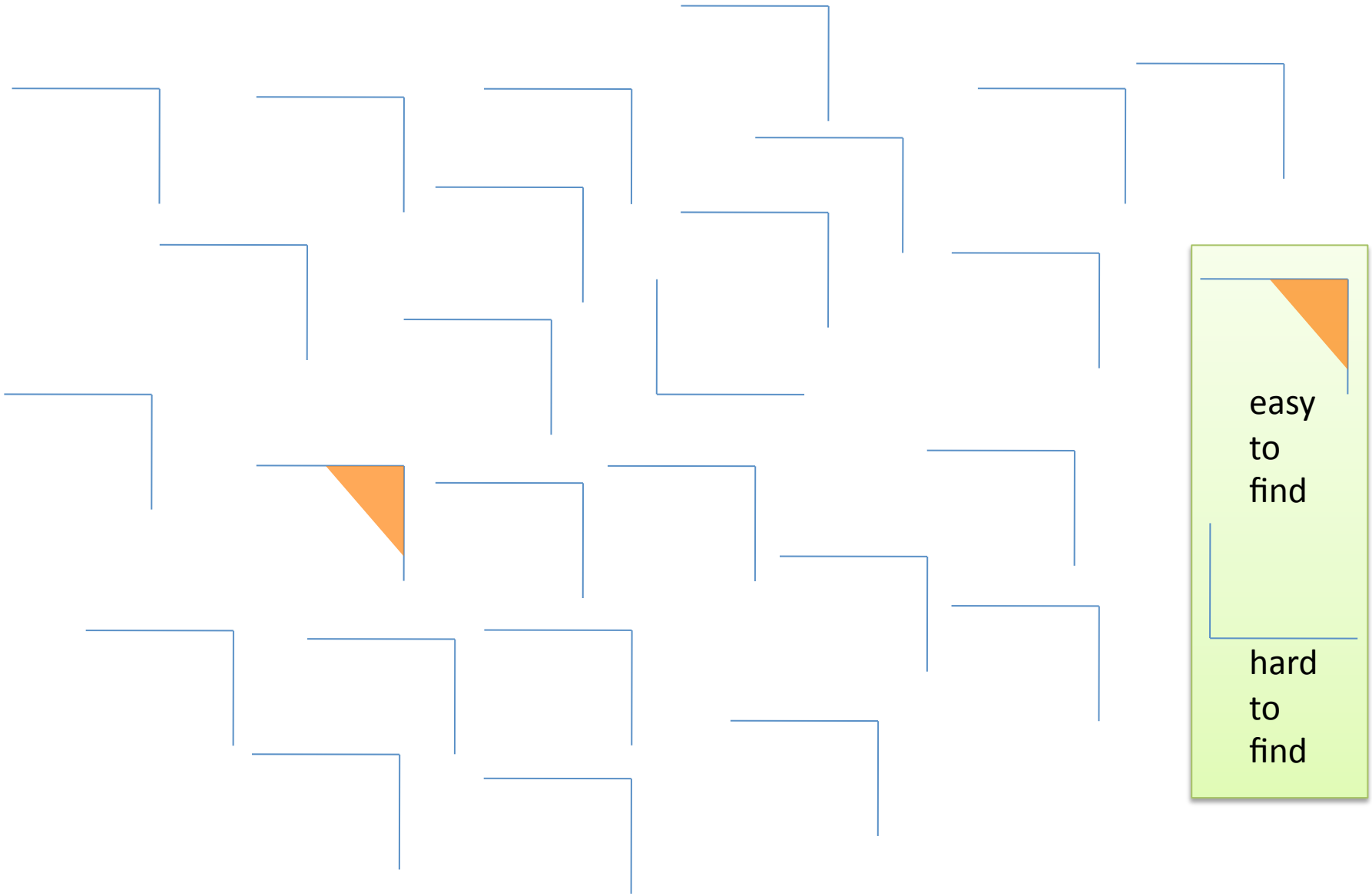
Visual conjunctive search

- Trying to find a target based on two features
  - most visual conjunctions are hard to see





Visual conjunctive search



Feature channels

- The more the background varies in a particular feature channel

  -- color, texture, orientation etc ---

the larger the difference in that channel required to make the feature distinct

Visual learning

- Finding things quickly is not a matter of practice
  - this can help with patterns, which are higher up the visual pathway

Visual learning

- e.g. find the 6 and the •

54789342507

10239874•14

32345023931

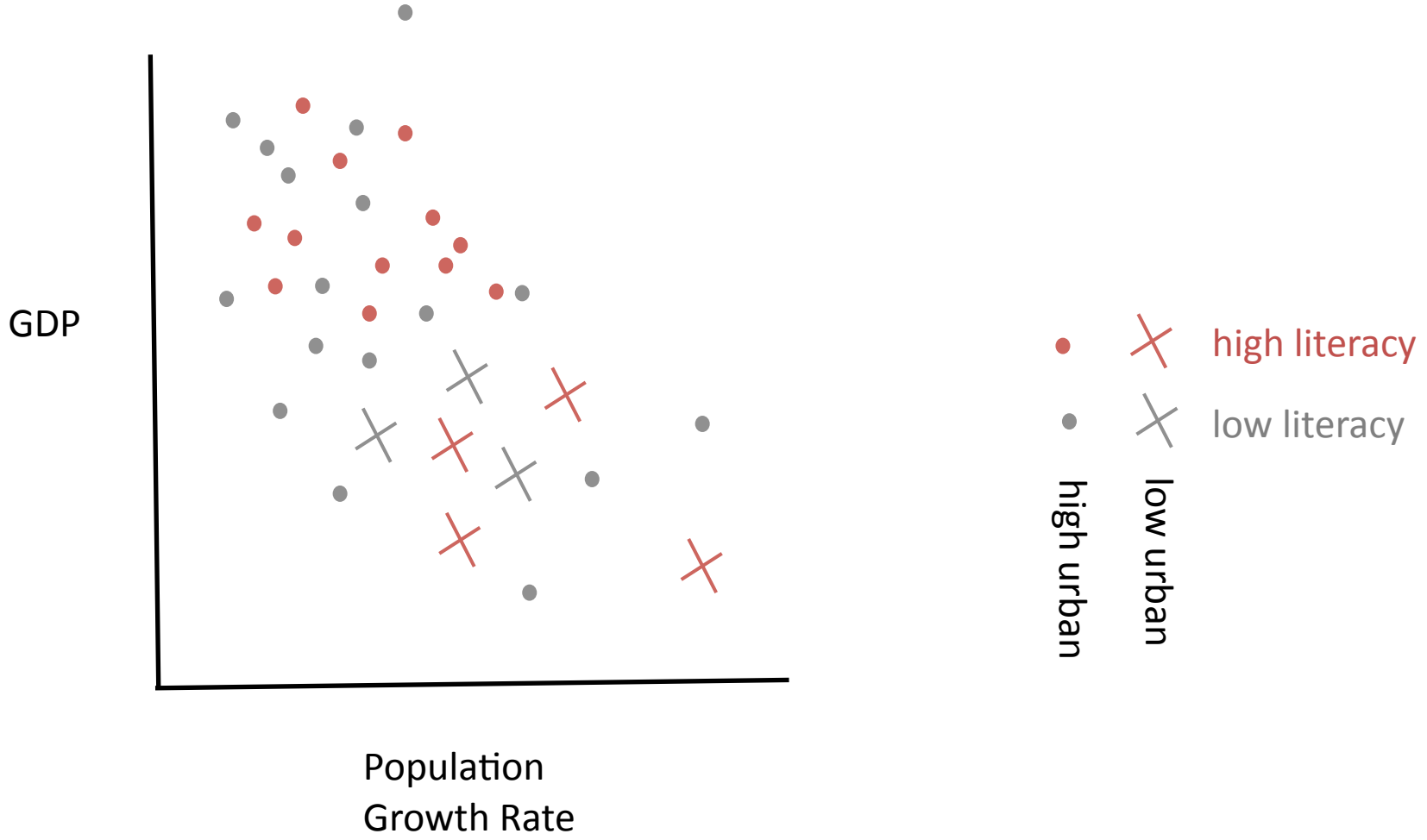
45677908122

12953709809

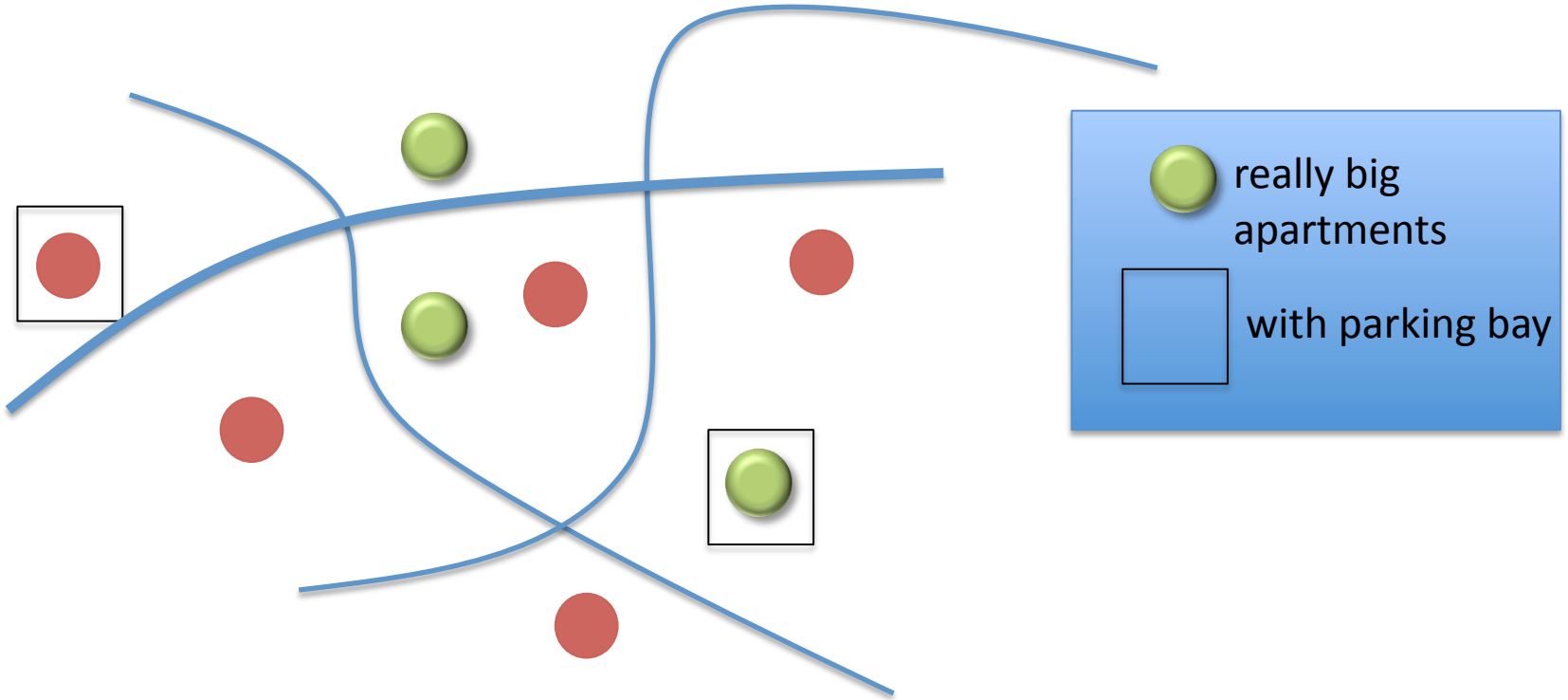
Lessons for design

- If you want to make something easy to find, make it different from its surroundings according to some primary visual channel – size colour etc.
- A design to support two different kinds of visual query will be most effective if each query uses a different channel

Design example 1#

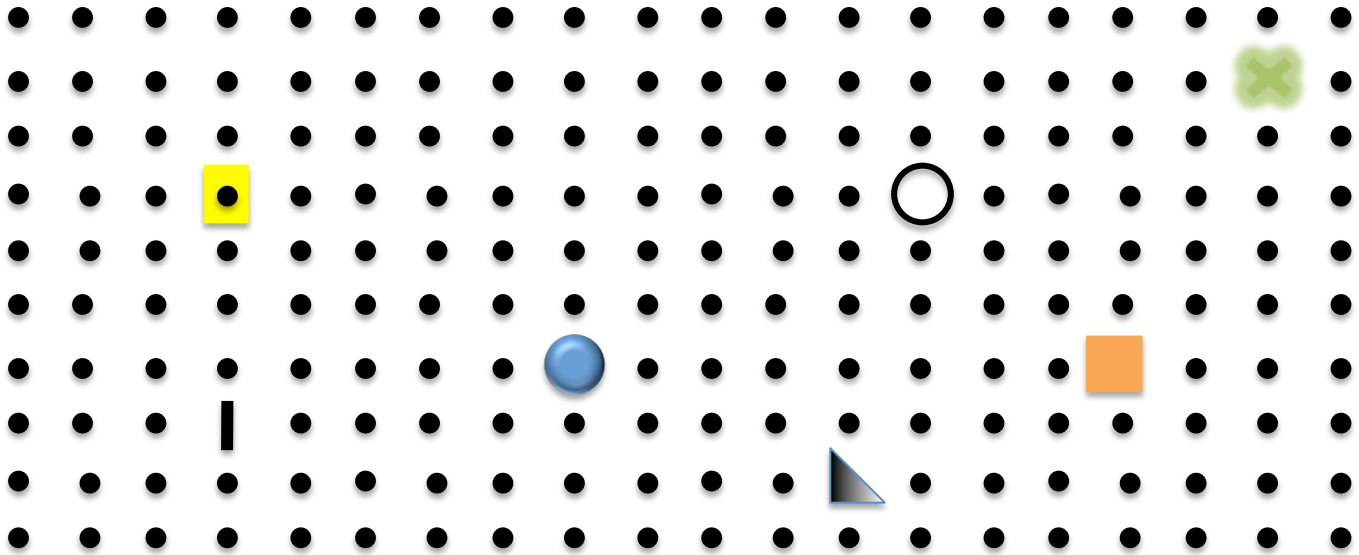


Divergence on one channel is good, but two channels can make a symbol more distinct



A set of symbol designed so **all** are independently searchable

- Each differs from the others on more than one channel



attempt to produce seven symbols as distinct as possible

Limitations

- When we aim for pop-out, we only have about three difference steps available on each channel: 3 sizes, colours etc.
- Many kinds of visibility enhancements are not symmetric:
  - doubling size of a symbol has more an effect than halving size

Motion

- Motion in a special class by itself

– because humans are prey….

… we are much more sensitive to

motion in our peripheral vision

- motion triggers an **orientation response**

- strong with high frequency motion

which can be irritating –

especially strong with things that emerge into the visual field

too much motion the worst form of visual pollution

Large scale structure

- Can help with visual search, but only if searcher already know where in the large structure a feature exists