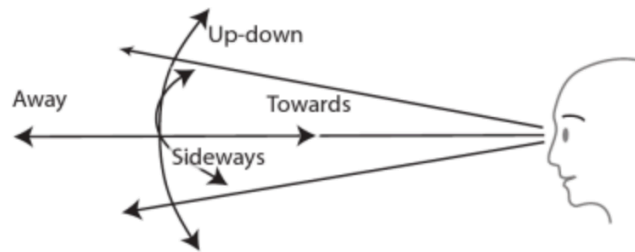


Structuring Two-Dimensional Space

The Pattern Processing Machinery
and Pattern for Design

2.5D Space

- We live in a 3D world, but can we see 3D effectively?
 - Up-down, sideways, and away dimensions



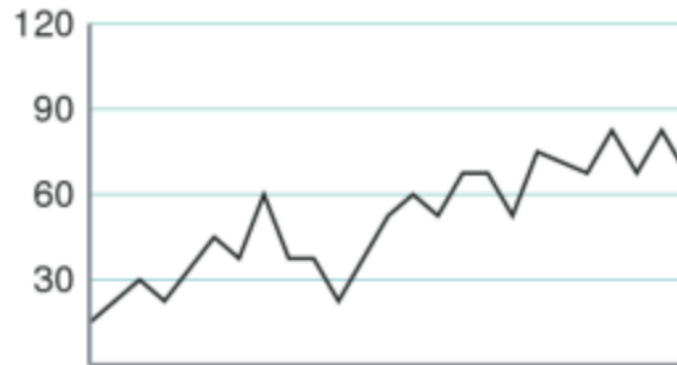
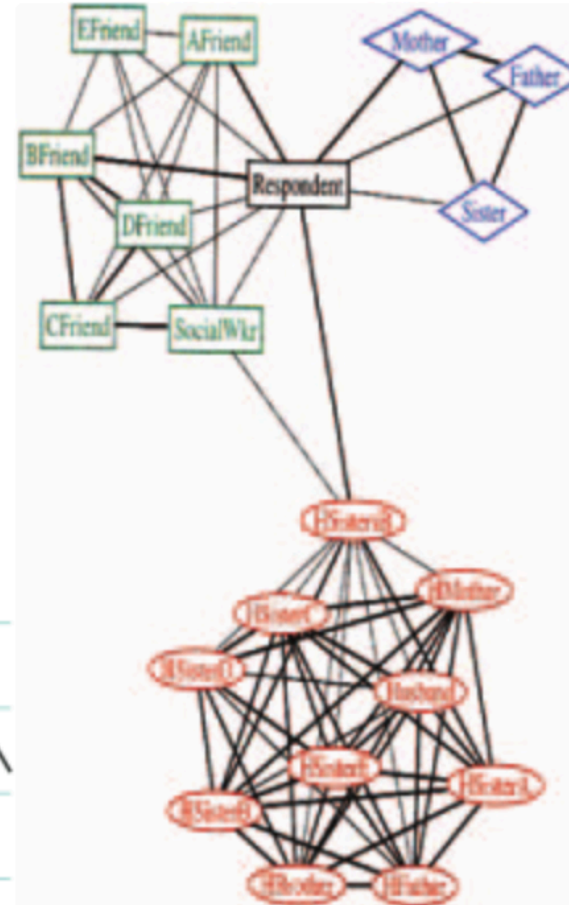
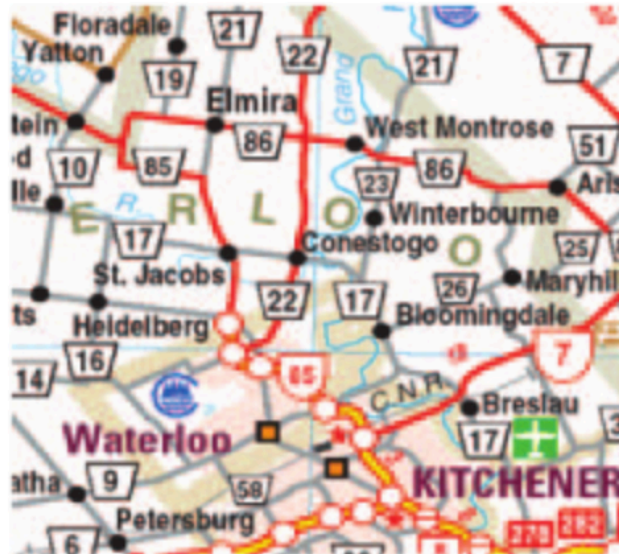
- Information at only one point along each away direction is available, and has to be indirectly inferred
 - So we actually only see 2.5D, or 2.05D according to Ware

2.5D Space

- We can sample up-down and sideways dimensions very rapidly (1/10 second), but to get new information in depth, we have to move our head
 - Image space sampling is 100 times faster than depth sampling
- The pattern-processing resources in the brain are mostly devoted to information in image plan, not depth
- Patterns:
 - The precursors of objects
 - Reveal relationships between objects

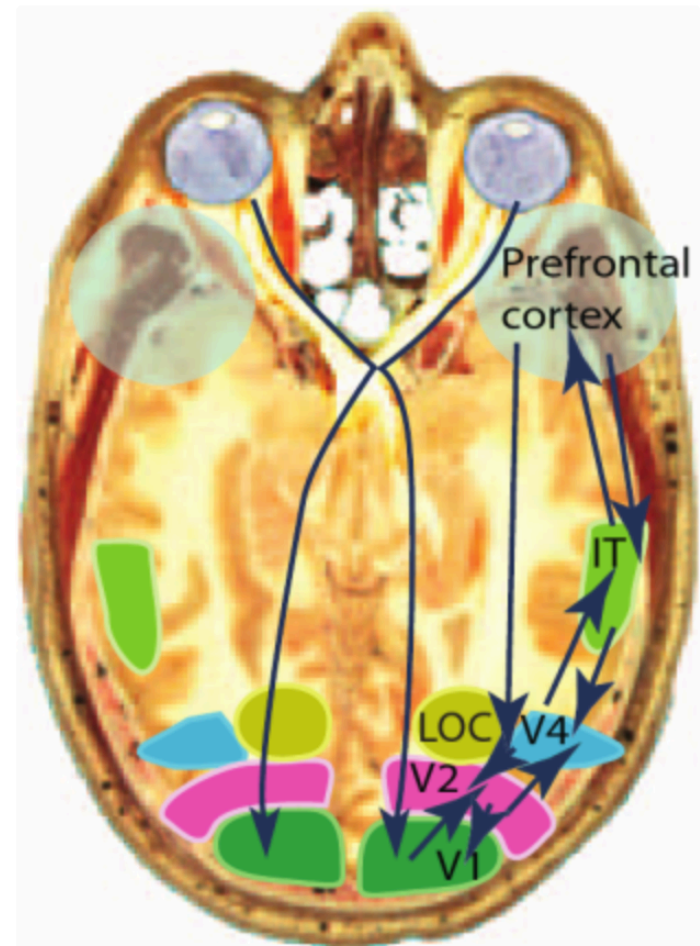


Patterns



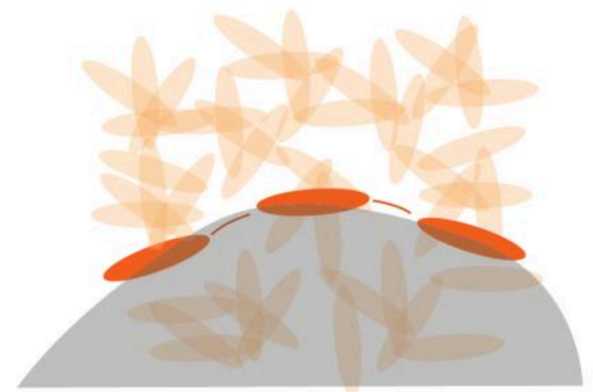
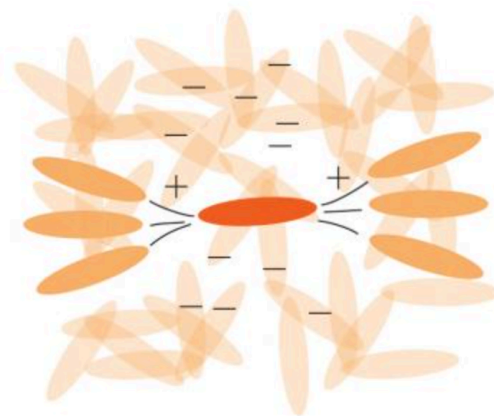
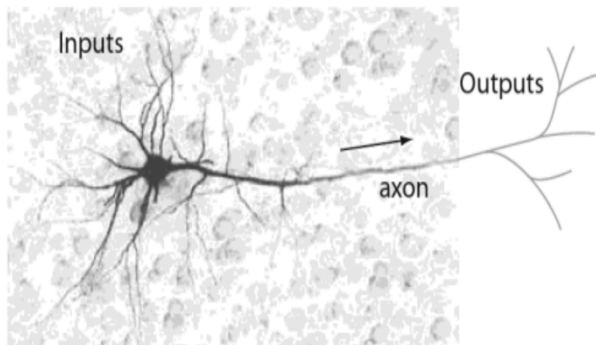
The Pattern-Processing Machinery

- The *What* pathway:
 - V1 -> V2 -> V4 -> Infero-temporal cortex (IT) -> Lateral Occipital Cortex (LOC)
 - Task-driven signals are also sent back to help region finding



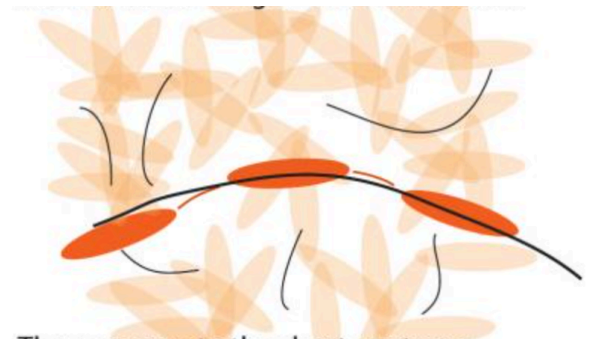
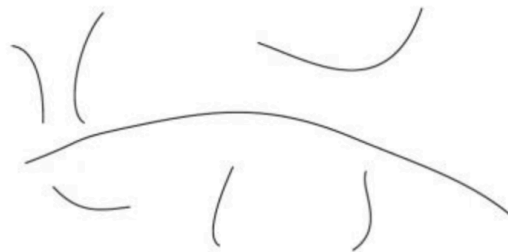
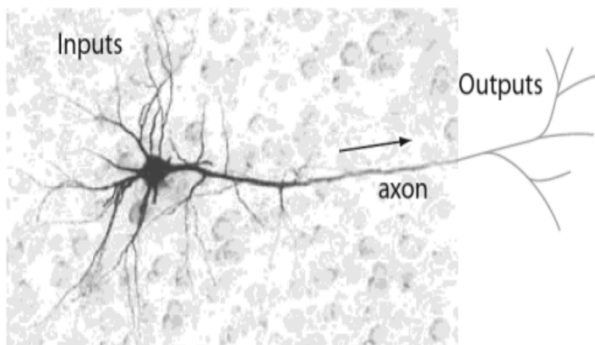
Features to Contours

- Millions of fragmented pieces of information in V1 need to be put together to form contours
 - Binding: combining different features that are parts of the same contour or region



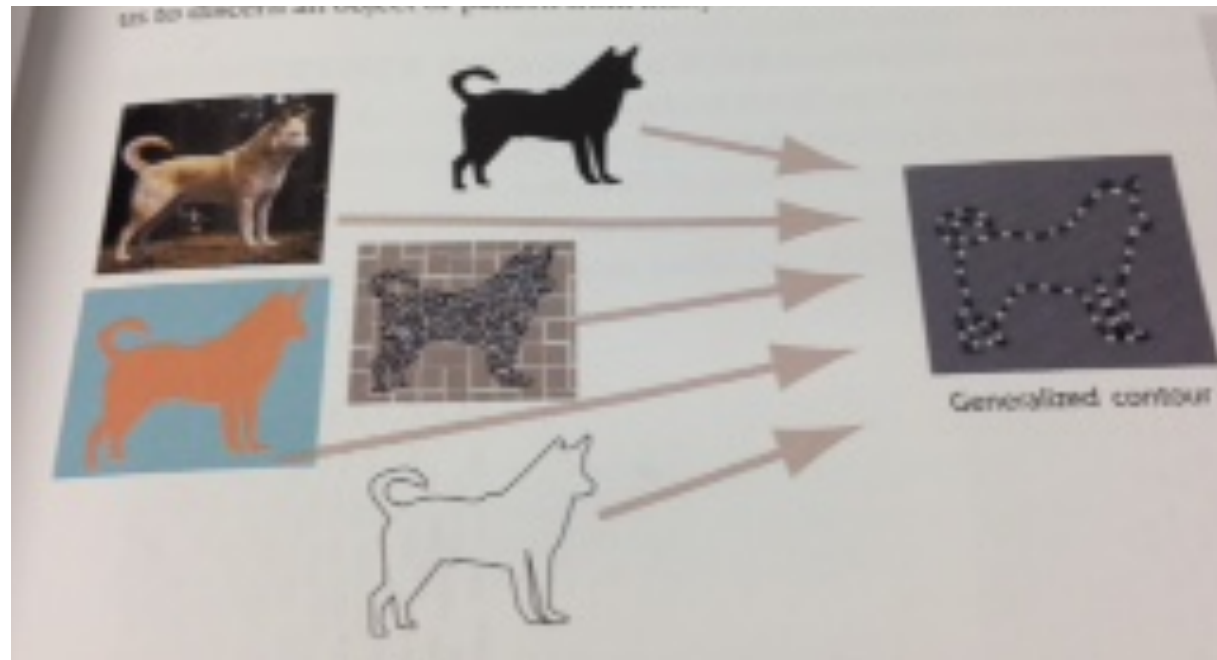
Features to Contours

- Millions of fragmented pieces of information in V1 need to be put together to form contours
 - Binding: combining different features that are parts of the same contour or region



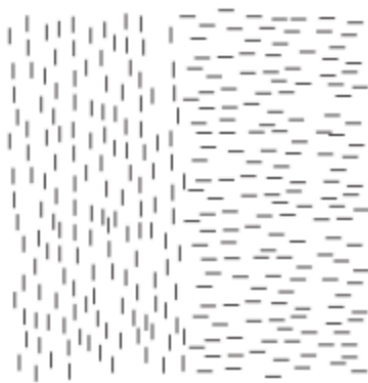
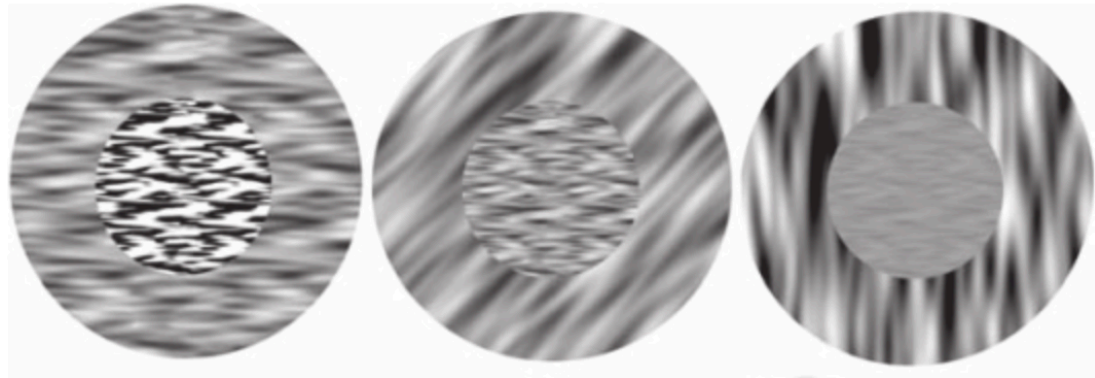
Generalized Contour

- Objects can be separated from its surrounding in many different ways
- A generalized contour extraction mechanism is needed (occurring in LOC with input from V2 V3)



Texture Regions

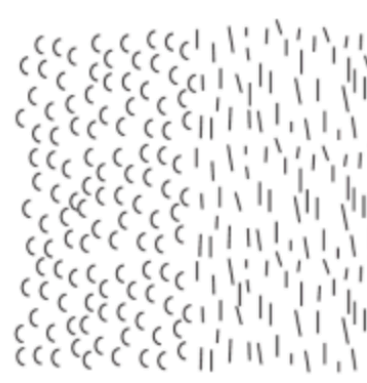
- The edges of objects can be defined by textures too



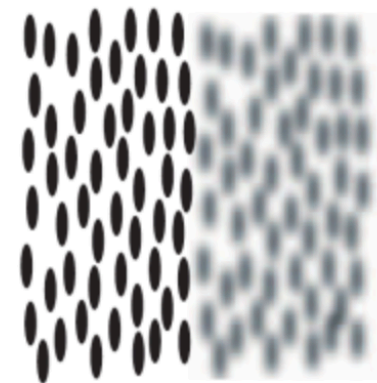
Orientation



Grain size



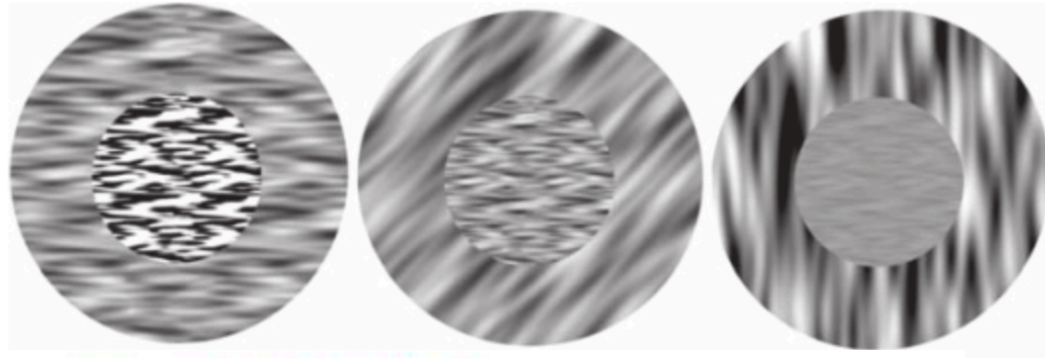
Curve versus Straight



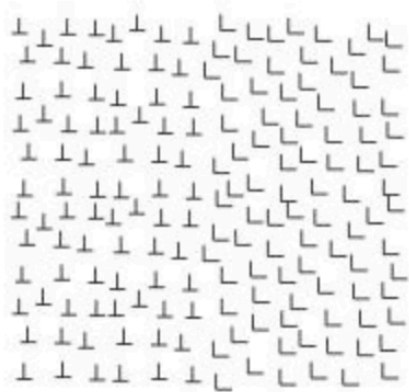
Blur

Texture Regions

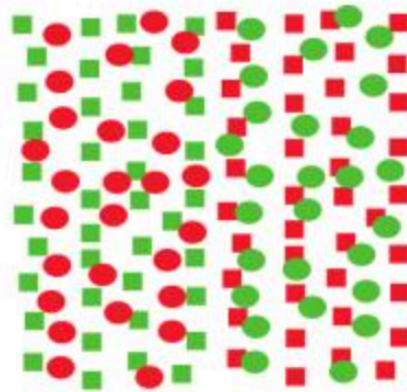
- The edges of objects can be defined by textures too



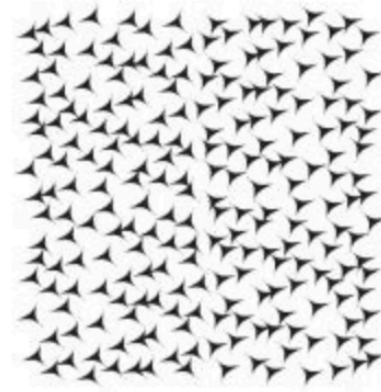
Harder to distinguish



Ts and Ls have the same line components.



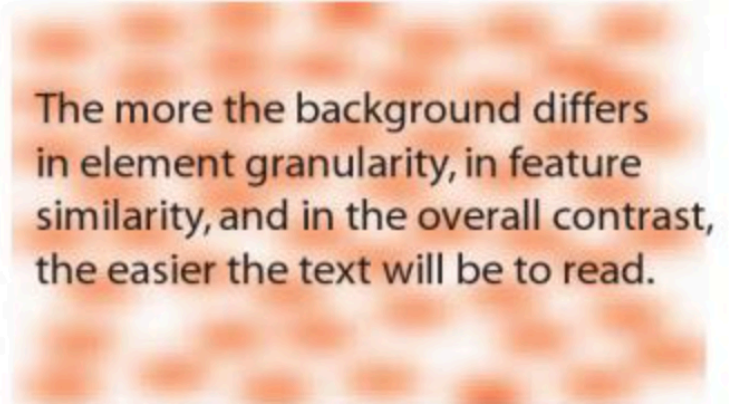
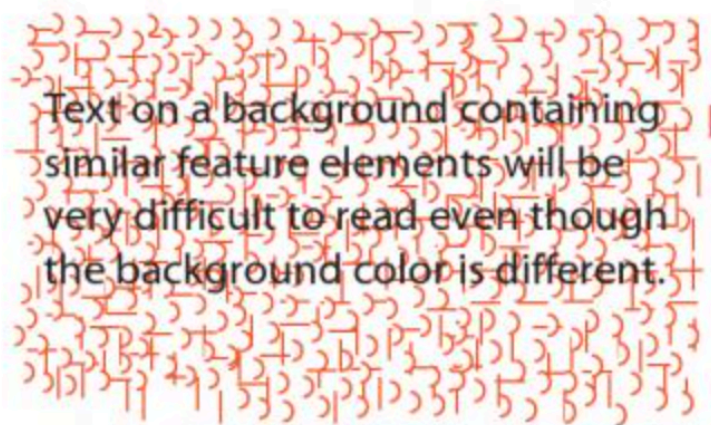
Red circles and green rectangles versus green circles and red rectangles.



The spikes are oriented differently; the field of orientations is the same.

Interference

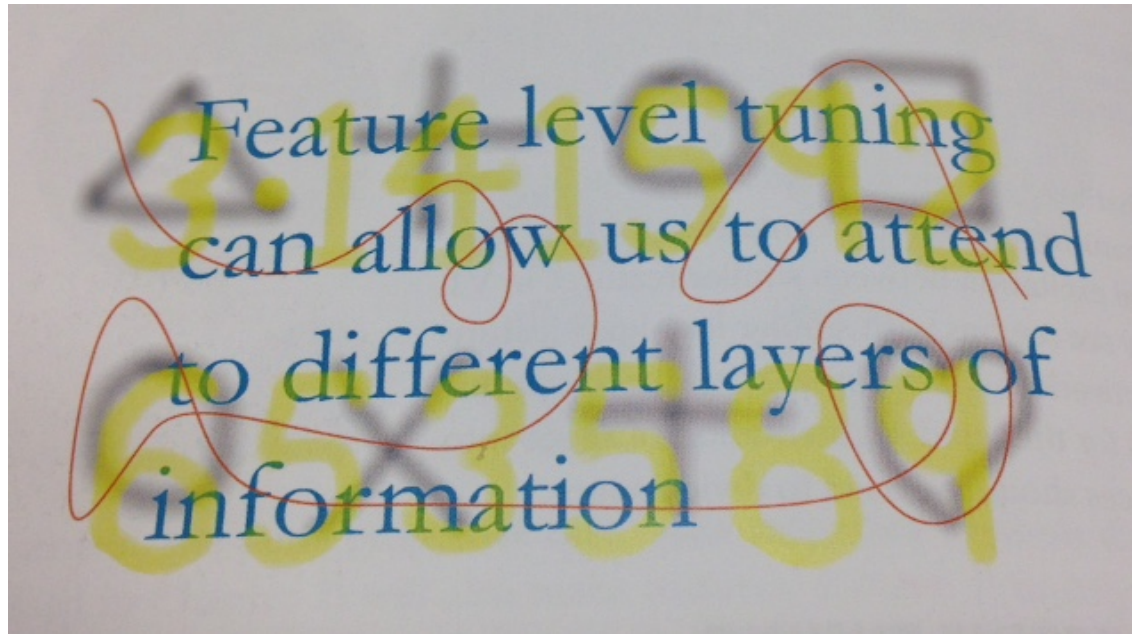
- One should maximize the feature-level difference



Subtle, low-contrast background texture with little feature similarity will interfere less.

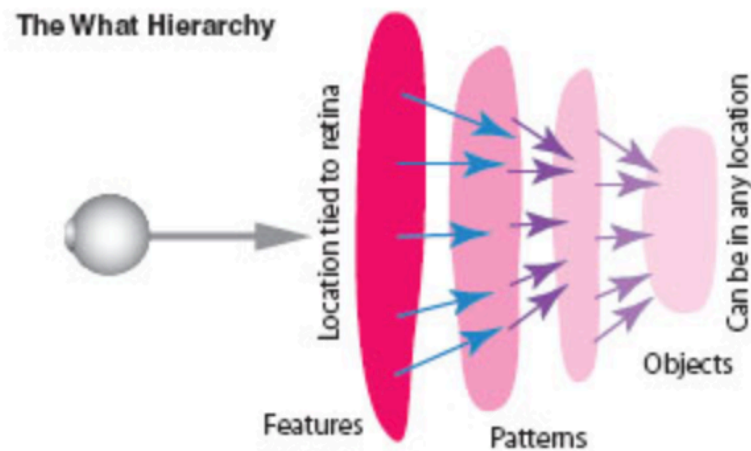
Attention and Patterns

- Only features (colors, orientation, size, motion, etc) can be pre-attentive
- Patterns with different features can also pop out



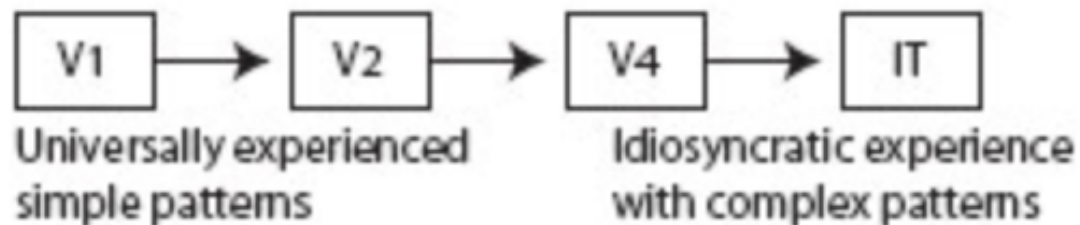
Pattern Finding Hierarchy

- Patterns are found in the what pathway, v1, v2, v3, v4, Tl, etc in an increasingly complex way
- It becomes harder to localize where in the brain the high level patterns are detected



Pattern Learning

- The ability to discern low level and simple features and patterns is pretty much universal
- More complex patterns can be learned by individuals, taking place in V4
- Pattern detection is mostly done sequentially, with very little pop out effect



Patterns formed by Groups of Objects

- Patterns can be formed based on proximity
- Pattern detection works on many different scales

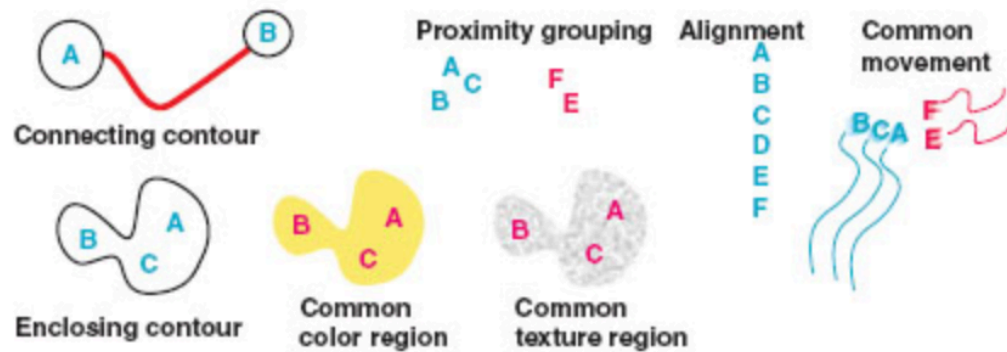


Multi-scale, Distortion, and Preference

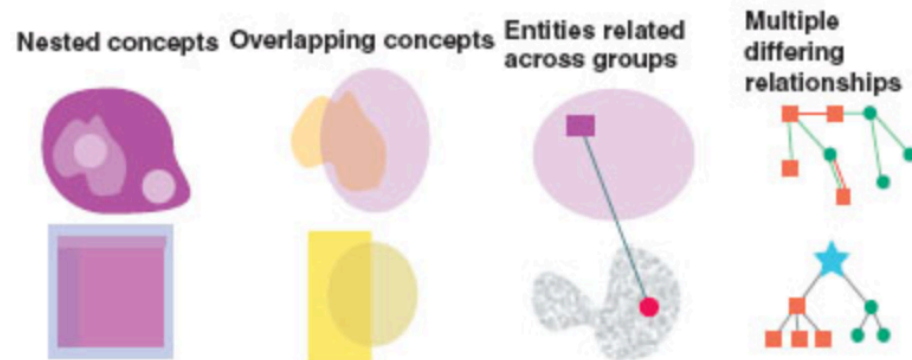


Pattern For Design

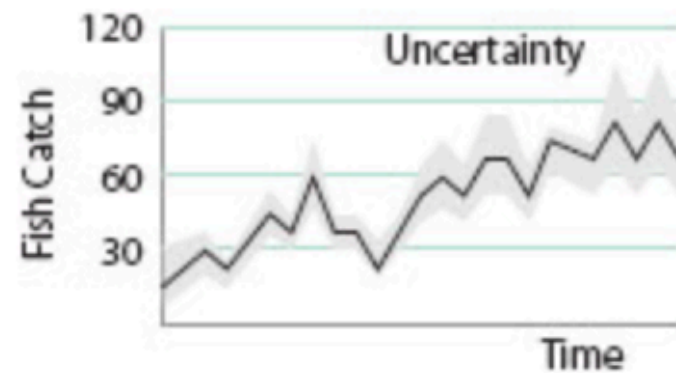
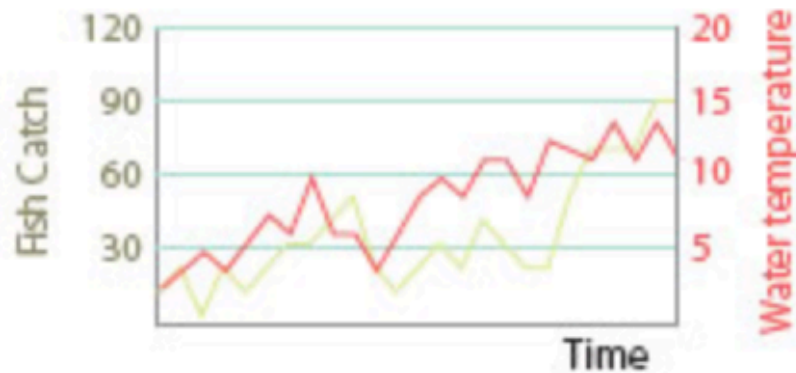
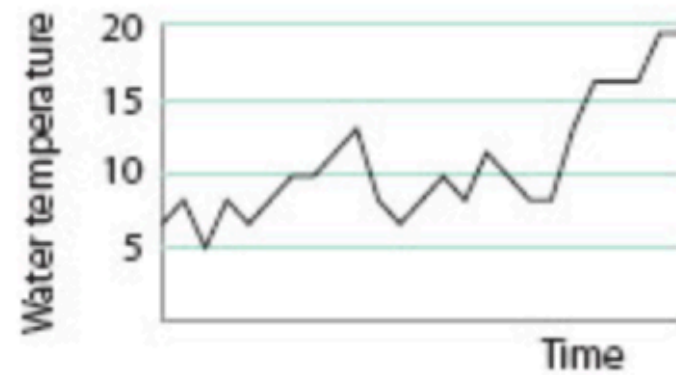
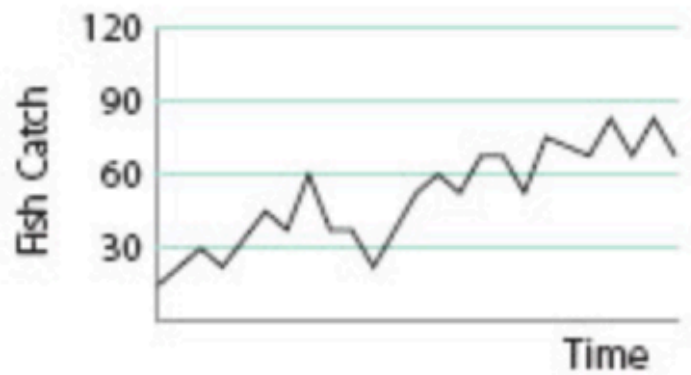
- Patterns can be used to establish relationships between components and make a design visually efficient



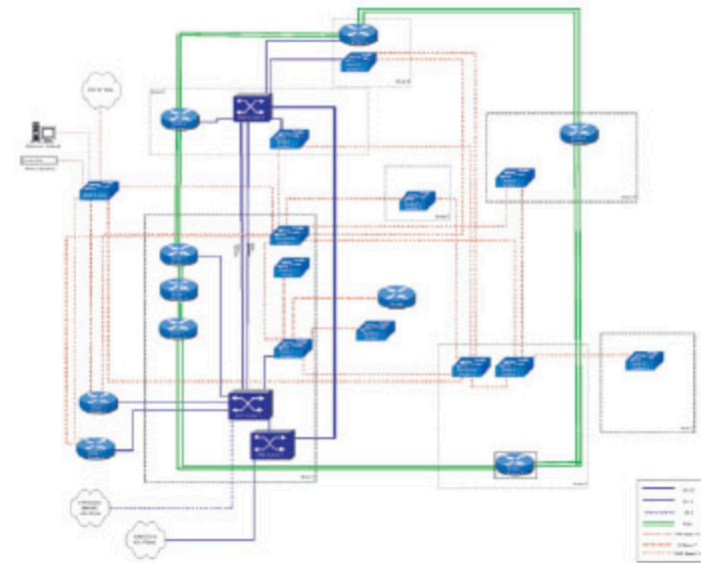
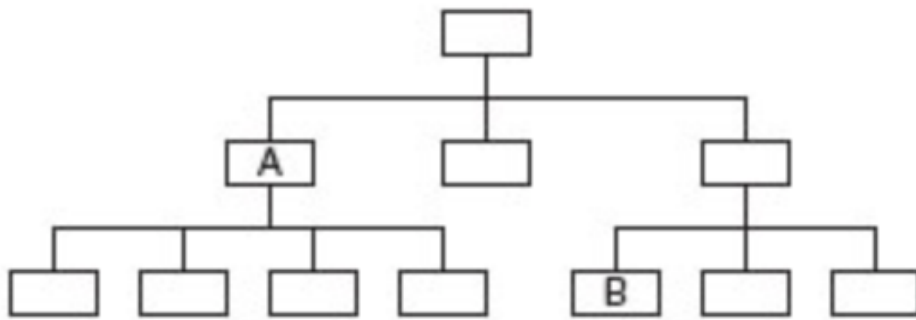
- Patterns can be used to express the structure of ideas



Example of Pattern Queries



Example of Pattern Queries



Semantic Pattern Mappings

Graphical Code	Semantics
Small shapes defined by closed contour, texture, color, shaded solid.	Object, idea, entity, node.
Spatially ordered graphical objects.	Related information or a sequence. In a sequence the left-to-right ordering convention borrows from the western convention for written language.
Graphical objects in proximity.	Similar concepts, related information.
Graphical objects having the same shape, color, or texture.	Similar concepts, related information.
Size of graphical object Height of graphical object.	Magnitude, quantity, importance.

Semantic Pattern Mappings

Graphical Code	Semantics
Shapes connected by contour.	Related entities, path between entities.
Thickness of connecting contour.	Strength of relationship.
Color and texture of connecting contour.	Type of relationship.
Shapes enclosed by a contour, or a common texture, or a common color.	Contained entities, Related entities.
Nested regions, partitioned regions.	Hierarchical concepts.
Attached shapes.	Parts of a conceptual structure.

Reference

- Visual Thinking for Design by Colin Ware

