PART II

People and Technologies

PART II

- Chapter 5. Understanding people 1: An introduction to cognitive psychology
- Chapter 7. Understanding people 2: Embodied, situated band distributed cognition

PART II

- Goal: To consider some of the theoretical and practical foundations of designing interactive systems.
- Can be used individually, or as a set of three parts I-III:
  - to extend the material of Part I, or
  - To complement the method-based material in Part III.

Chapter 5:

Understanding people 1:

An introduction to cognitive psychology

Chapter 5

5.6 Visual perception
5.7 The *Gestalt* laws of perception
5.8 Depth perception
5.9 Factors affecting perception
5.10 Colour
5.4 Memory
5.5 Attention

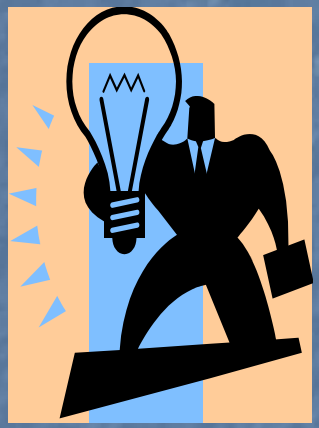
Chapter 5 (2)

- Introduces the role of psychology in the design of single-user interactive systems.
- $\Rightarrow$ Helps to understand:
  - The human information processing (HIP) view of human cognition
  - The role of cognitive psychology in interactive systems design
  - The importance of memory, intention, perception and mental models to the design of interactive systems
  - Criticism of the cognitive psychology approach

5.6 Visual perception

- Can be considered as the best understood of all the forms of perception.
- Is concerned with extracting meaning, and hence recognition and understanding, from the light falling on our eyes.

5.6 Visual perception (2)



Sighted people

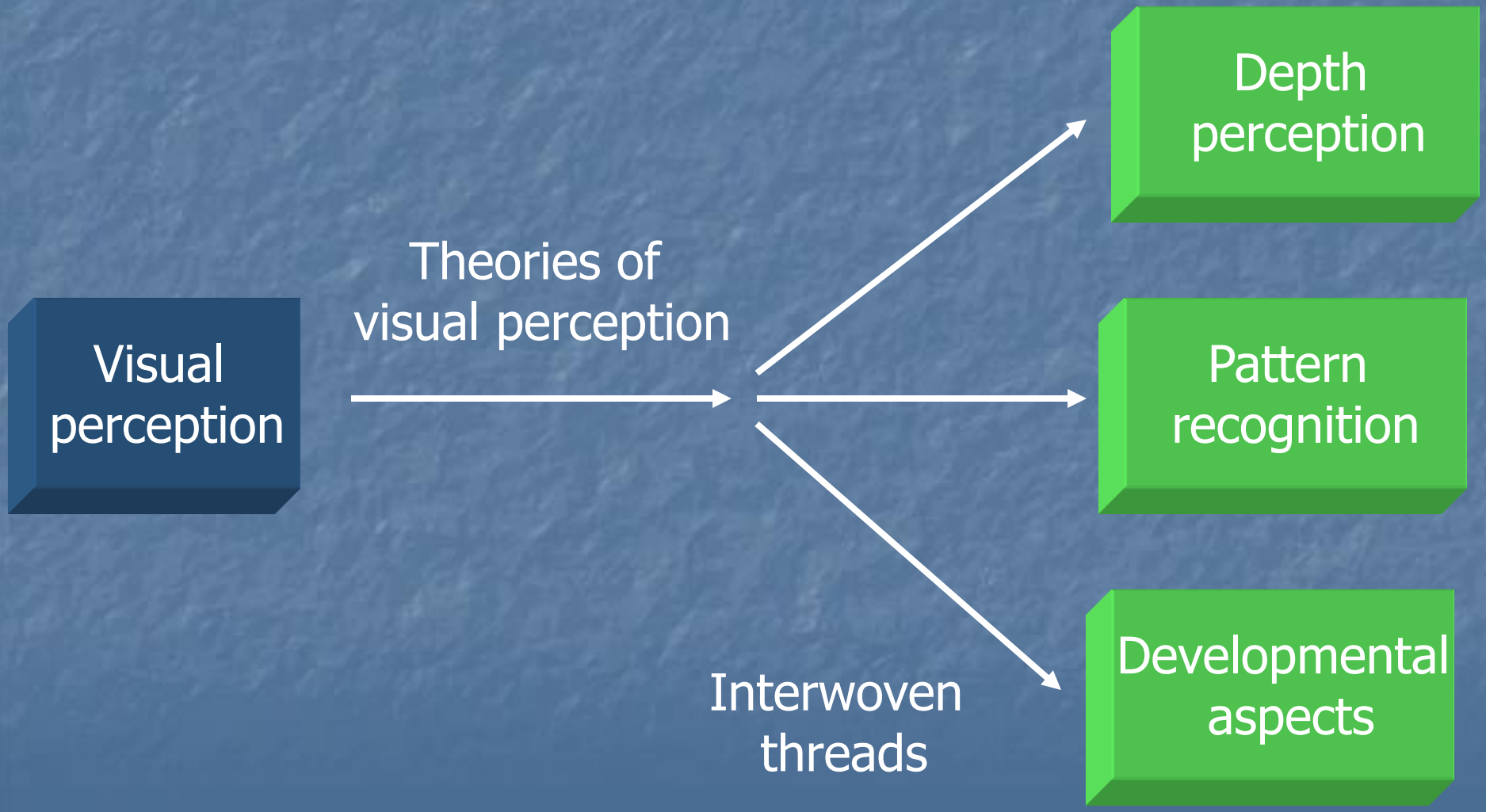
Perceiving a stable, 3-D, full colour world filled with objects

⇒ How we perceive the world

Brain extracting and making sense of the sensory data pickup by our eyes

⇒ How it can be explained

5.6 Visual perception (3)



5.6 Visual perception (4)

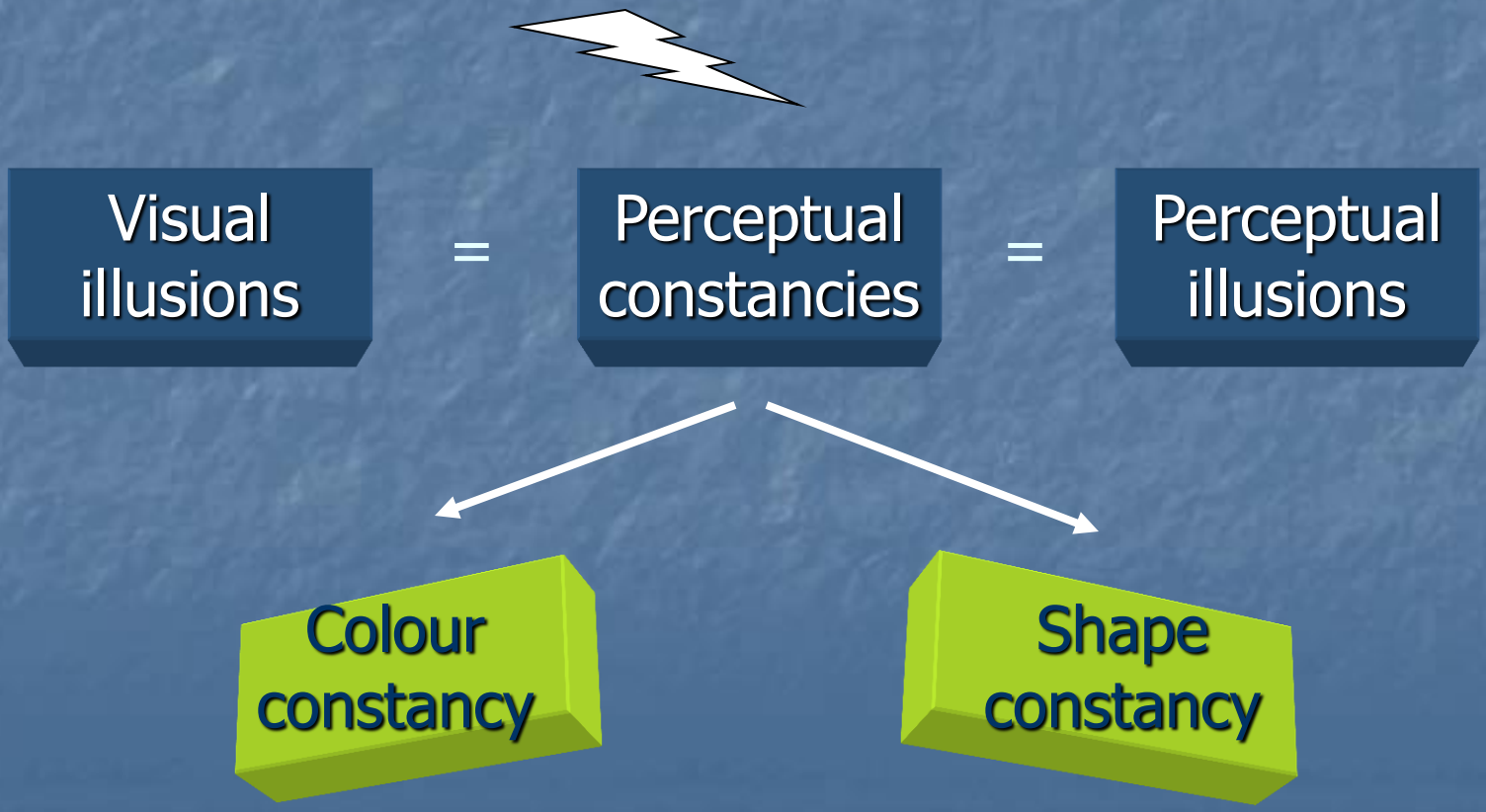
- Content about the visual perception in the chapter:
  - Theoritical positions:
    - Discussion of top-down visual perception
    - An account of *Gibson's* direct perception theory
  - Application:
    - *Gestalt* laws of visual perception
    - Their application to user interface design

5.6 Visual perception (5)

- Understanding visual perception:
  - 19th century thinking of Helmholtz: We percrive the world by means of a serie of unconscious inferences
  - ⇒ A constructivist account of visual perception of Richard Gregory: We *construct* our perception of the world from *some* of the sensory data falling on our senses.

5.6 Visual perception (6)

Ability to perceive an object or a scene in an unchanged fashion illumination, viewpoint and so forth affecting the information arriving at our senses

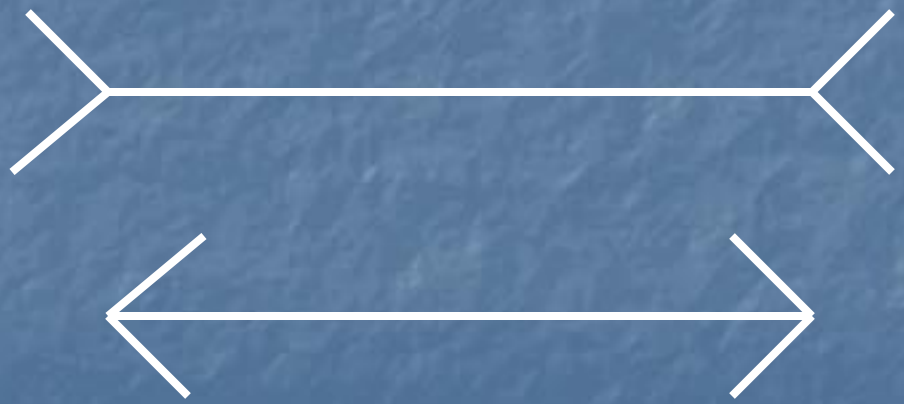


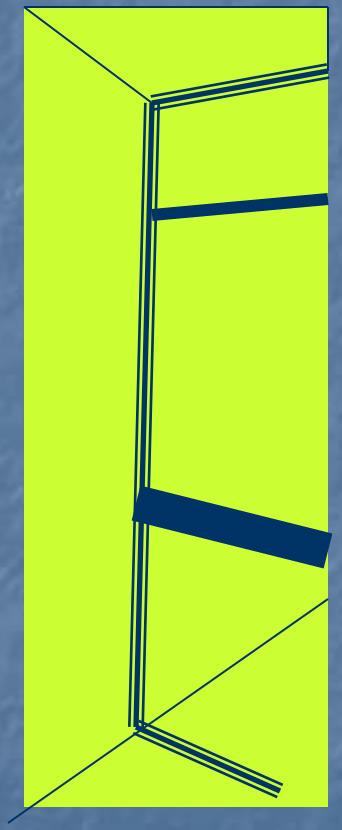
5.6 Visual perception (7)

- Visual perception is studied because they are thought to be very revealing of how perception works by understanding what happens when perception does not work.
- Because the perception is seamless.

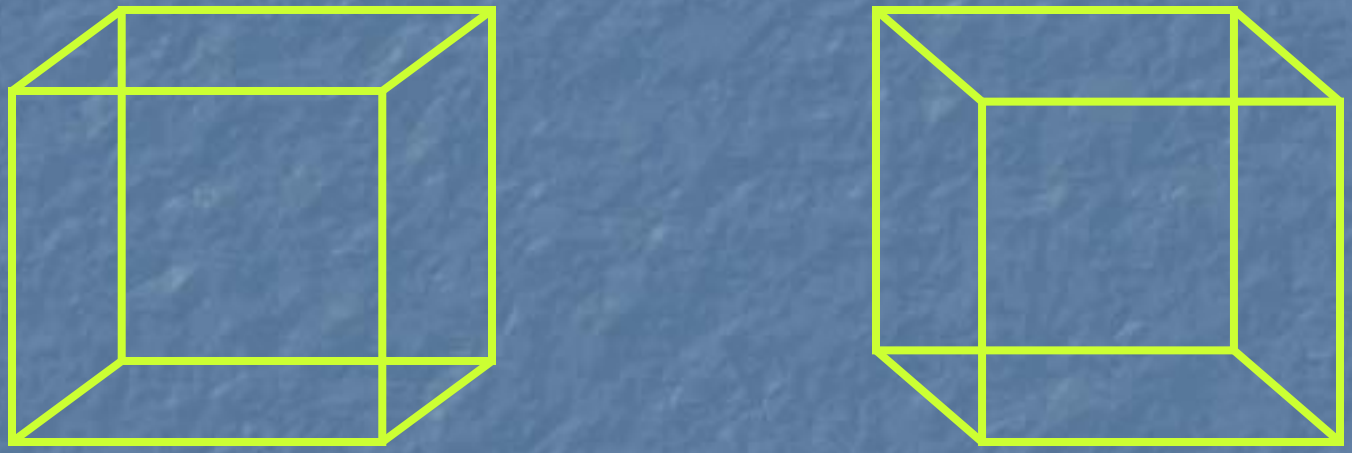
5.6 Visual perception (8)

- Examples drawn by Gregory:
  - Müller-Lyer illusion:





5.6 Visual perception (9)



Necker cubes

⇒We unconsciously form a hypothesis: the cube is facing to the right/ left

But if we gaze the cube, it appears to turn inside-out and back again

⇒ Hypothesis testing= a form of unconscious inference

5.6 Visual perception (10)

- Gregory has produced in interesting and engaging account of visual perception.
- But:
  - How do we get started ?
  - If visual perception relies on knowledge of the world, how do we bootstrap the process ?
  - Because we can only acquire (visual) knowledge of the world from visual perception which relies on knowledge of the world.

5.6 Visual perception (11)

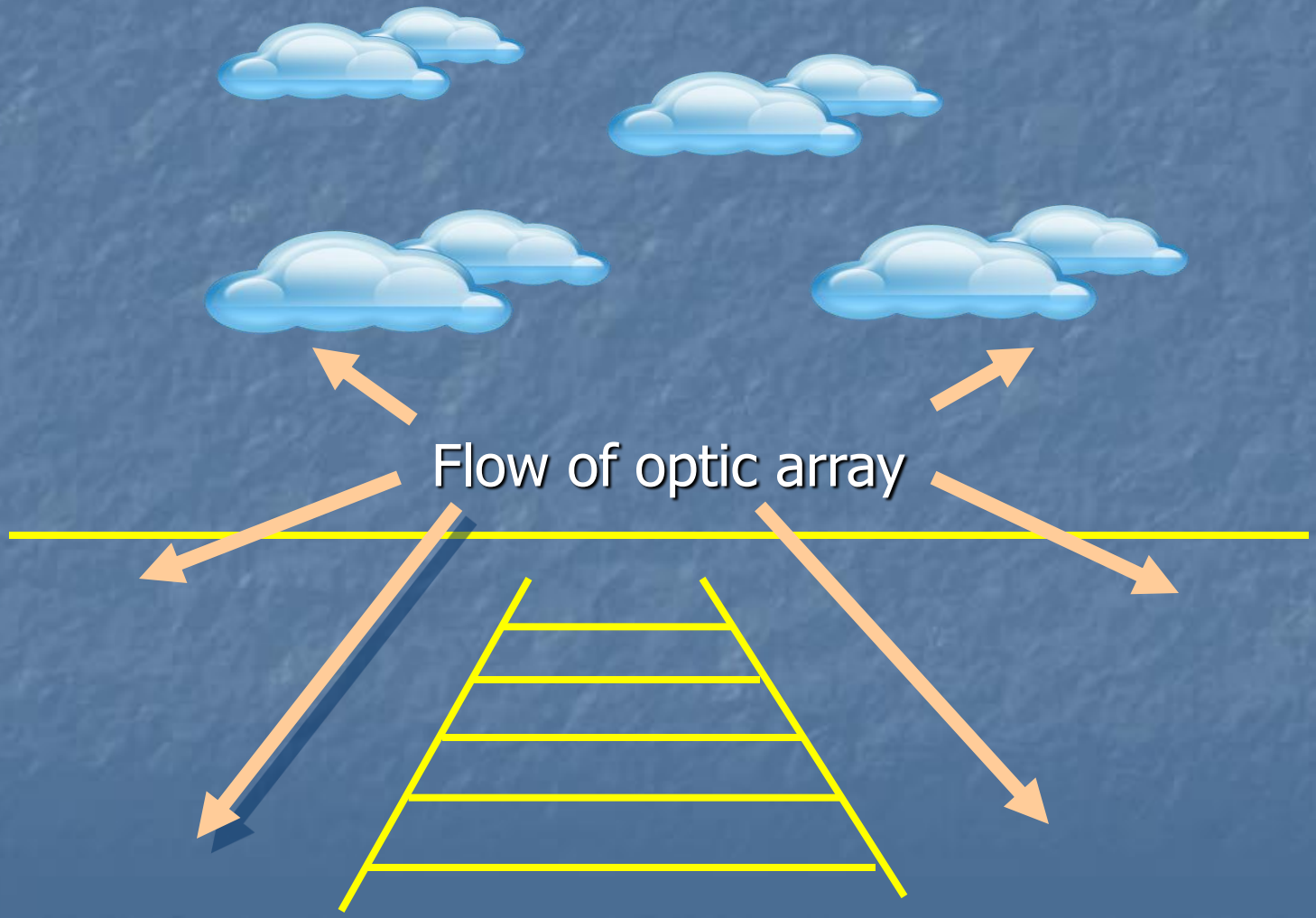
- Direct perception:
  - Gibson's work: contrast to Gregory's work.
  - Ex: The pilot sitting in the fixed point experiences the world apparently flowing past him.

  ⇒ Optic array= flow of information : supplies unambiguously all information relevant to the position, speed and altitude of the aircraft to the pilot.

  ⇒ No need for unconscious inferences or hypothesis testing.

  ⇒ The texture of the environment is expanding.

5.6 Visual perception (12)



5.6 Visual perception (13)

- Texture gradients provide important depth information.
- Ex:
  - pebbles on the beach,
  - trees in a wood
- Gibson: The environment provides all of information we required to experience it.

5.6 Visual perception (14)

- So, in practice, according to psychologists, both theories merit:
  - Gibson: offers an account for optimal viewing conditions.
  - Gregory: offers an account for restricted conditions.

5.7 The *Gestalt* laws of perception

- Gestaltists: a group of psychologists in the early of 20th century.
- Their law of perception, despite the age, map remarkably well onto a number of modern user interface design features.

5.7 The *Gestalt* laws of perception (2)

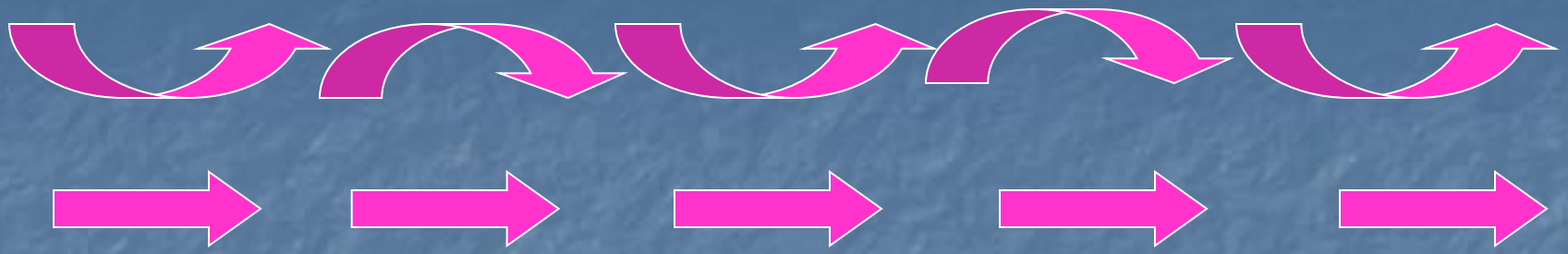
- The laws:
  - Proximity
  - Continuity
  - Part-whole relationship
  - Similarity
  - Closure

5.7 The Gestalt laws of perception (3)

- Proximity:
  - The objects appearing close together in space or time tend to be perceived together.
  - Applied to auditory perception: the proximity of auditory 'objects' is perceived as a song or a tune.

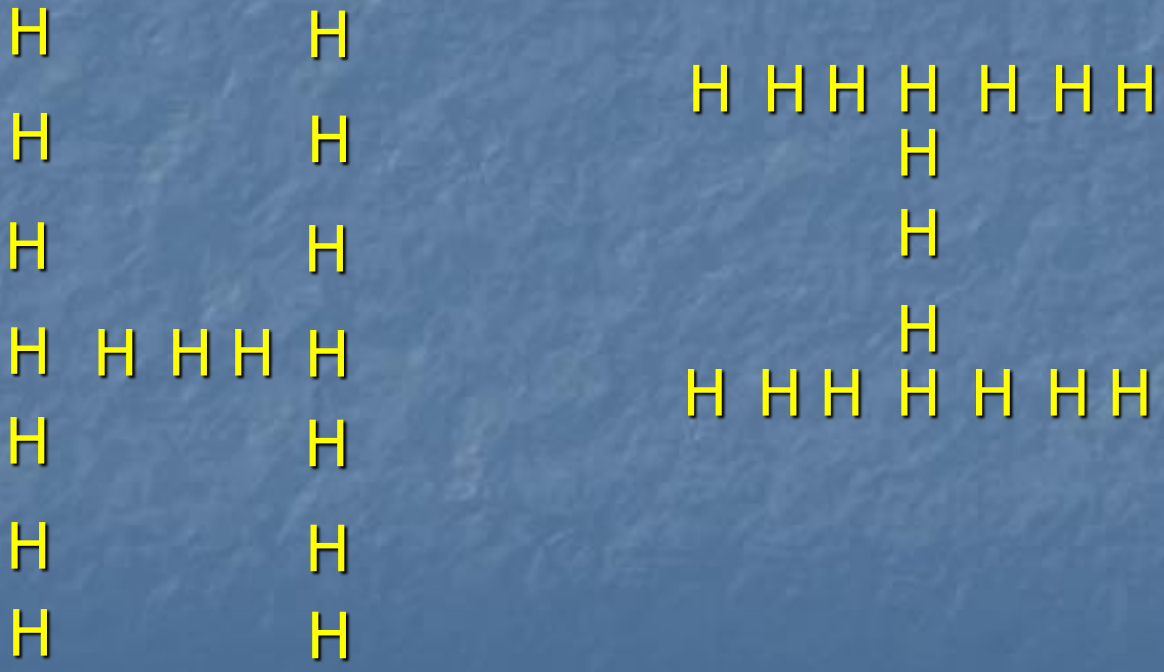
5.7 The Gestalt laws of perception (4)

- Continuity:
  - We tend to perceive the smooth, continuous patterns rather than disjoint, interrupted ones.



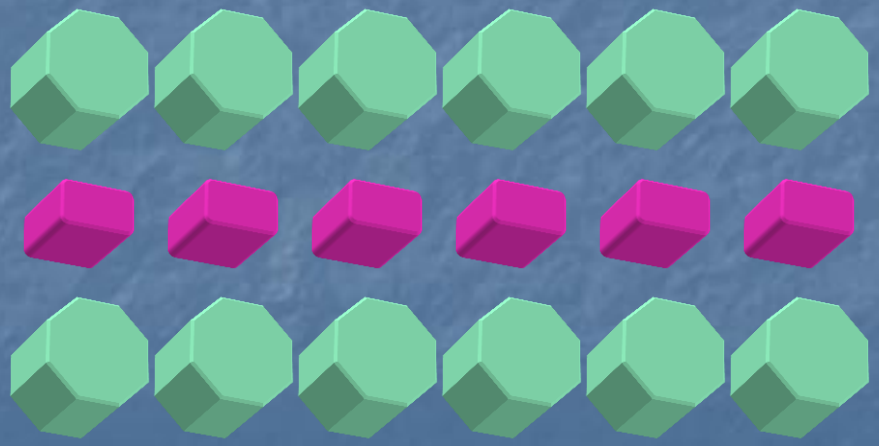
5.7 The Gestalt laws of perception (5)

- Part-whole relationship:
  - The whole is greater than the sum of its parts



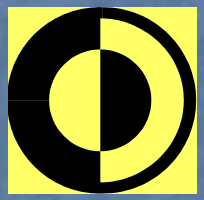
5.7 The Gestalt laws of perception (6)

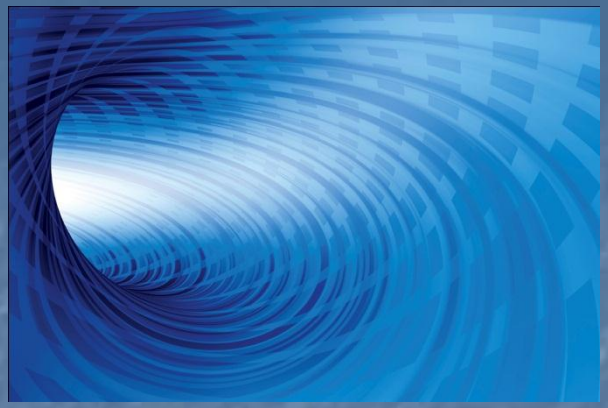
- Similarity:
  - Similar figures to be tend to be grouped together.

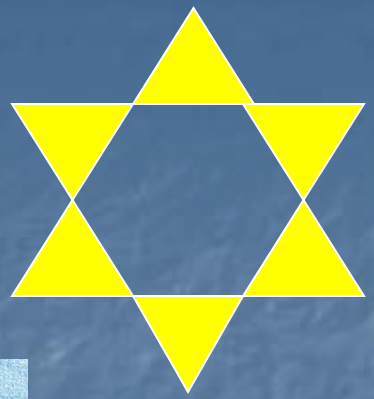


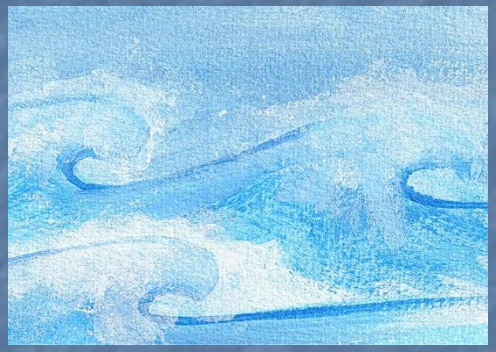
5.7 The Gestalt laws of perception (7)

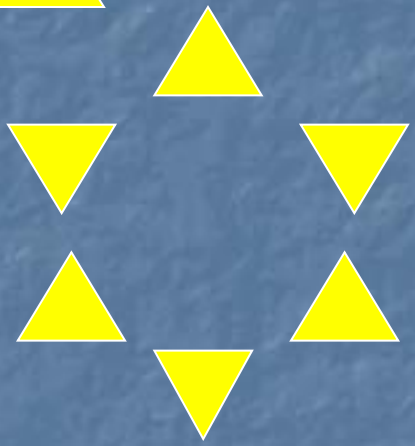
- Closure:
  - Closed figures are perceived more easily than incomplete or open figures.
  - That feature is so strong that we even supply mising information to make a fifure easier to perceive.

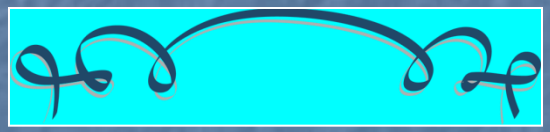


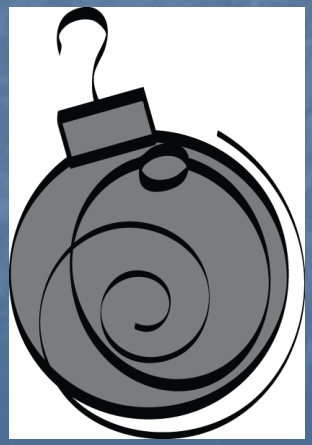


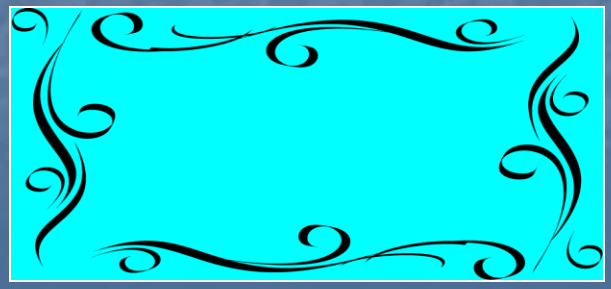












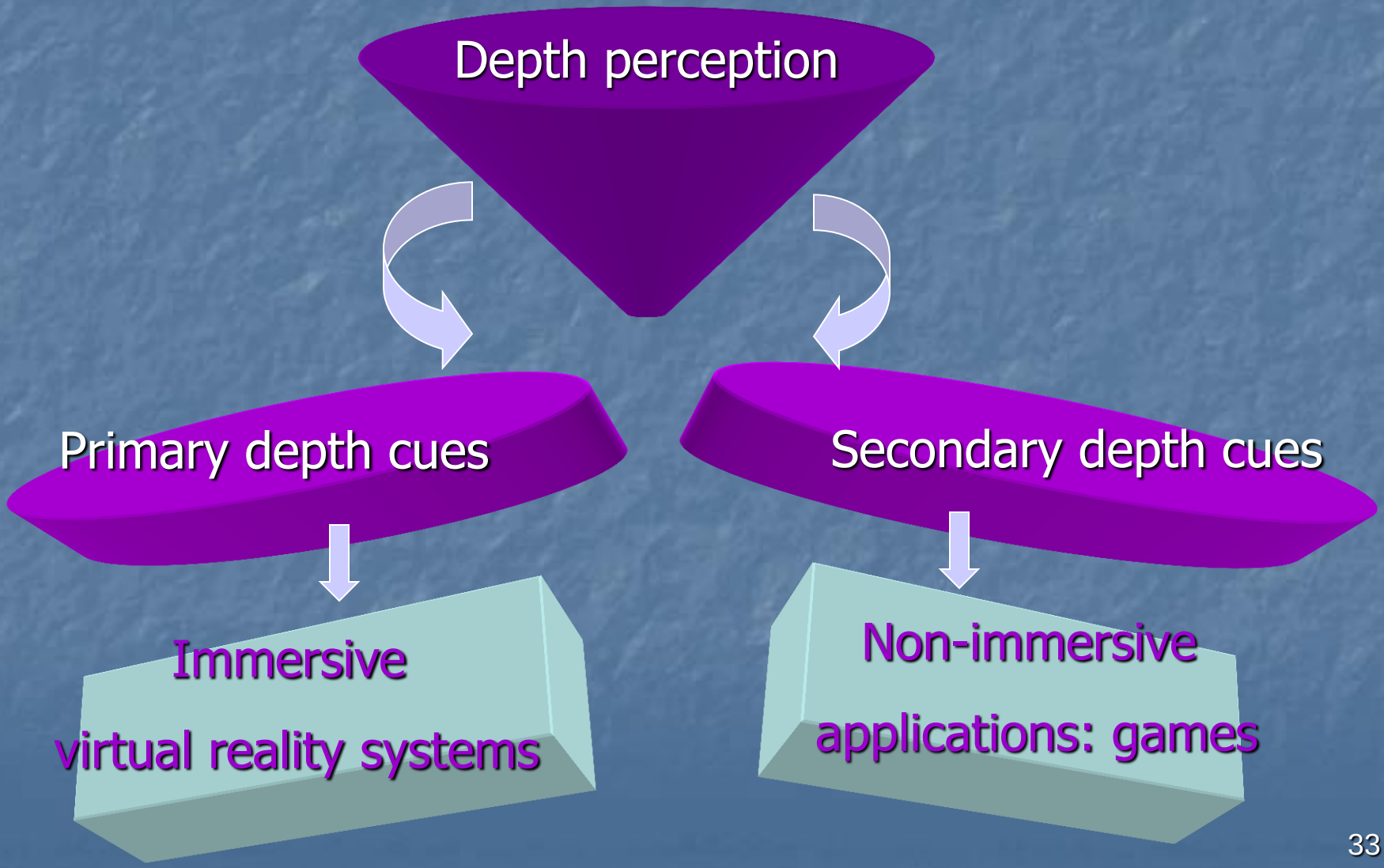
5.7 The Gestalt laws of perception (8)

- Application of the Gestalt laws of perception:
  - Using proximity to organize buttons
  - Using proximity to organize files
  - Using continuity to connect disconnected elements. Ex: scrollbars of MS Windows and Mac.
  - Using closure: We often unconsciously add missing info to close a figure
  - Illustrating part-whole relationships: the larger figure is completed by a figure more detailed.

5.8 Depth perception

- Is not particularly relevant to everyday office applications
- Is often essential to the effective design of ***games***, ***multimedia*** applications and ***virtual reality*** systems.
- When designing to give the impression of three-dimensionality (a sense of depth and height), we need to understand how we pick up information from the environment which we interpreted as depth and height.

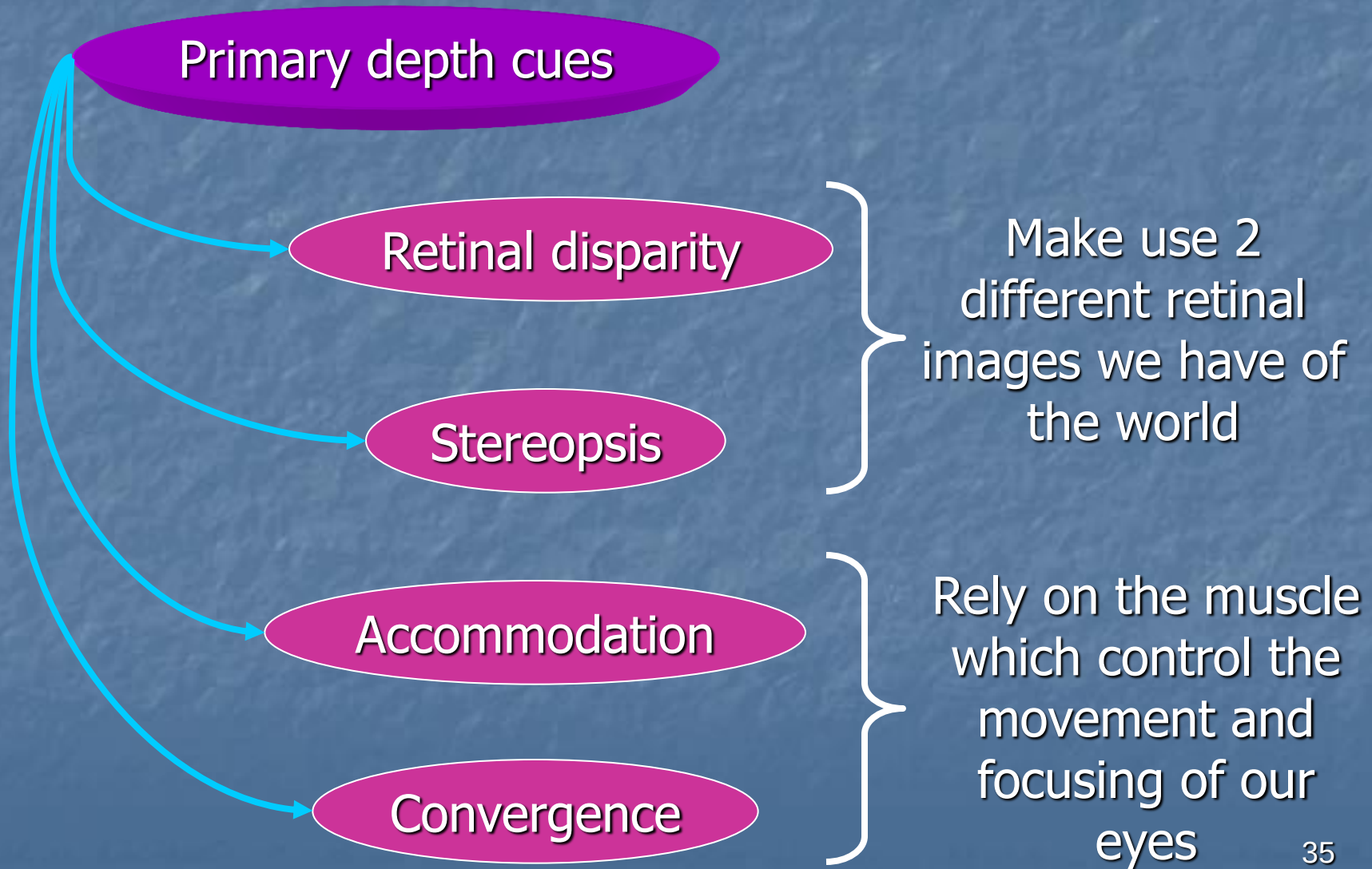
5.8 Depth perception (2)



5.8 Depth perception (3)

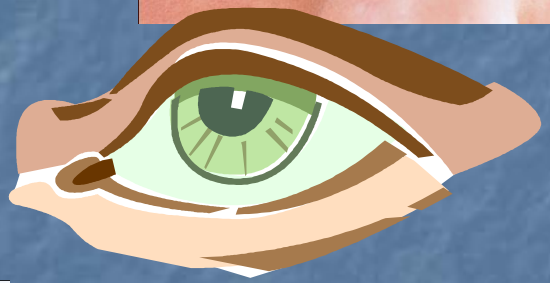
- Cue= a means or mechanism which allows us to pick up information about environment.
- 4 keys primary depth cues:
  - Retinal disparity
  - Stereopsis
  - Accommodation
  - Convergence

5.8 Depth perception (4)



5.8 Depth perception (5)

- Retinal disparity

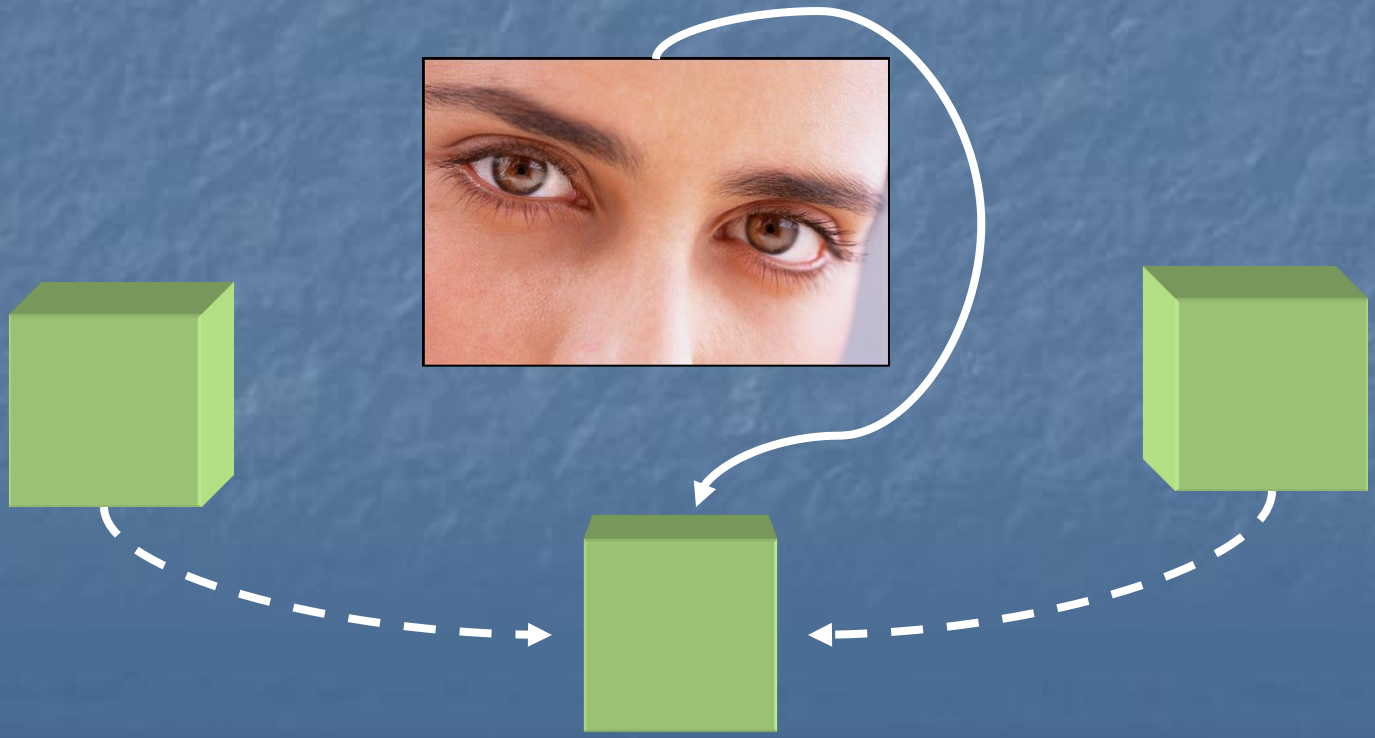


5.8 Depth perception (5)

- Retinal disparity: Each retina receives a slightly different image of the world when our eyes are approximately 7cm apart. This difference (Retinal disparity) is processed by the brain and interpreted as distance information

5.8 Depth perception (6)

- Stereopsis: The process by which the different images of the world received by each eye are combined to produce a single 3-D experience.



5.8 Depth perception (7)

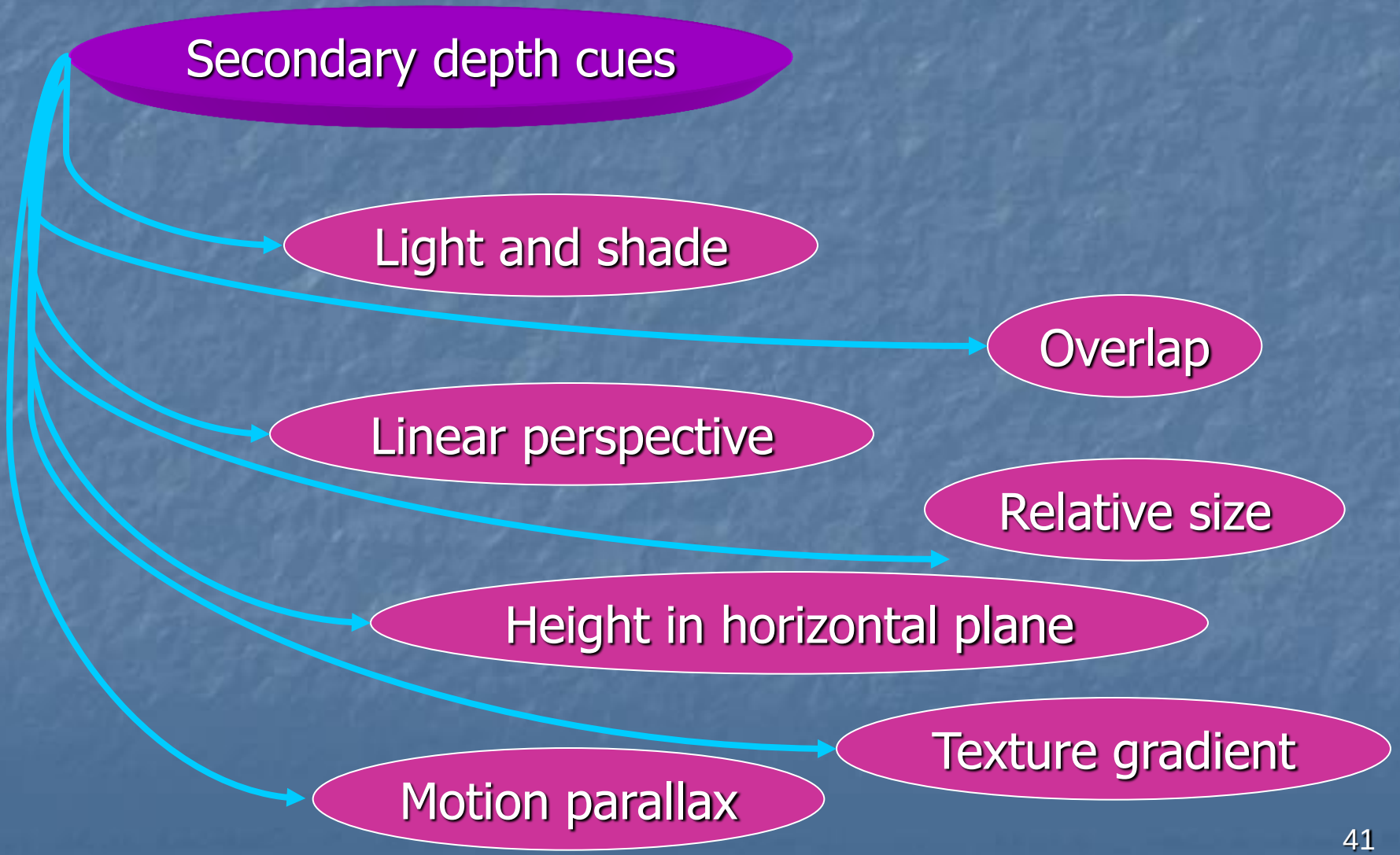
- Accommodation: A muscular process by which we change the shape of the men in our eyes in order create a sharply focused image. We unconciously use information from these muscles to provide depth information.

5.8 Depth perception (8)

- Convergence:
  - Over distances of 2-7 meters we move our eyes more and more inwards to focus on an object at these distances

  $\Rightarrow$ To help provide additional distance information.

5.8 Depth perception (9)

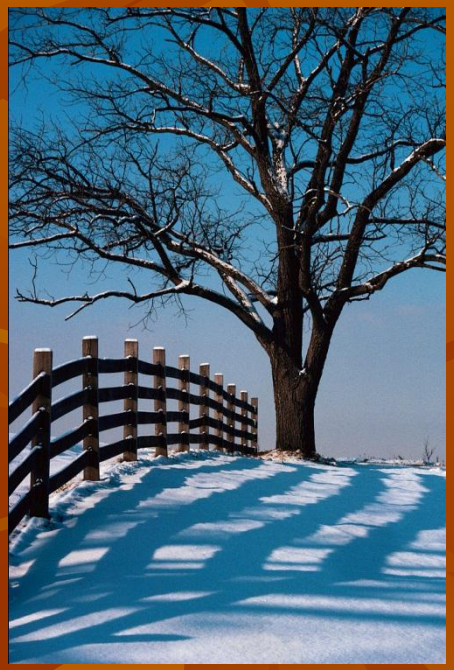


5.8 Depth perception (10)

- Secondary depth cues:
  - Also called monocular depth cues
  - ⇒ Rely only on one eye
  - ⇒ Are the basis for the perception of depth on flat visual displays.

5.8 Depth perception (11)

- Light and shade:
  - An object with its attendant shadow improves the sense of depth.



5.8 Depth perception (12)

- Linear perspective:Using

shadow:

wire-frame:

5.8 Depth perception (13)

- Height in horizontal plane:
  - Distant objects appear higher (above the horizon) than nearby objects.

5.8 Depth perception (14)

- Motion parallax (thị sai chuyển động):
  - Depends upon movement
  - Ex: when looking out through a window in a fast-moving train or car

  ⇒ nearby objects such as telegraph poles are seen to flash past very quickly

  ⇒ while a distant building moves musch more slowly.

5.8 Depth perception (14b)

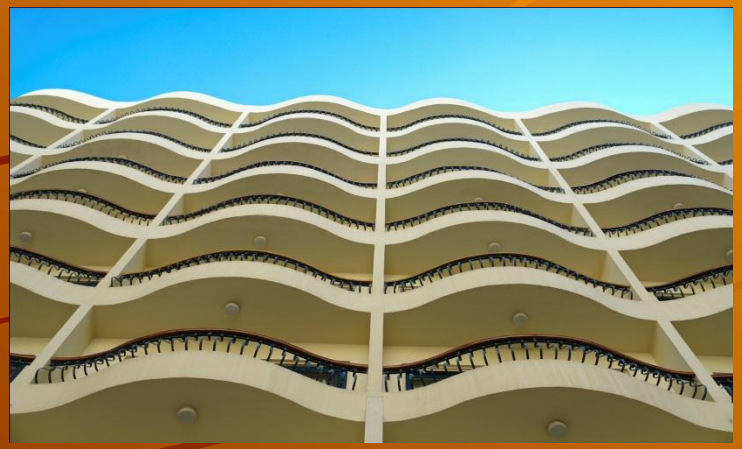
5.8 Depth perception (15)

- Overlap:
  - An object which obscures the sight of another is understood to be nearer.

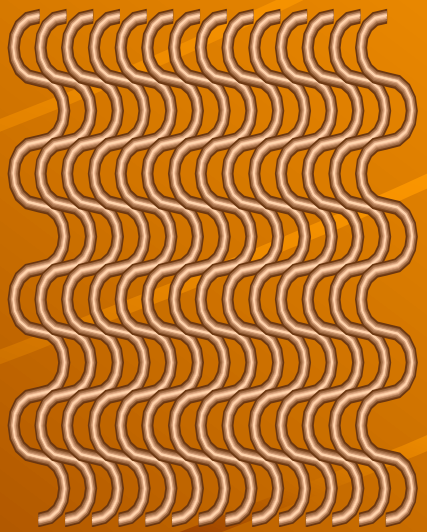
5.8 Depth perception (16)

- Relative size:
  - Smaller objects are usually seen as being further away, particularly if the objects in the scene are approximately the same size.

5.8 Depth perception (17)

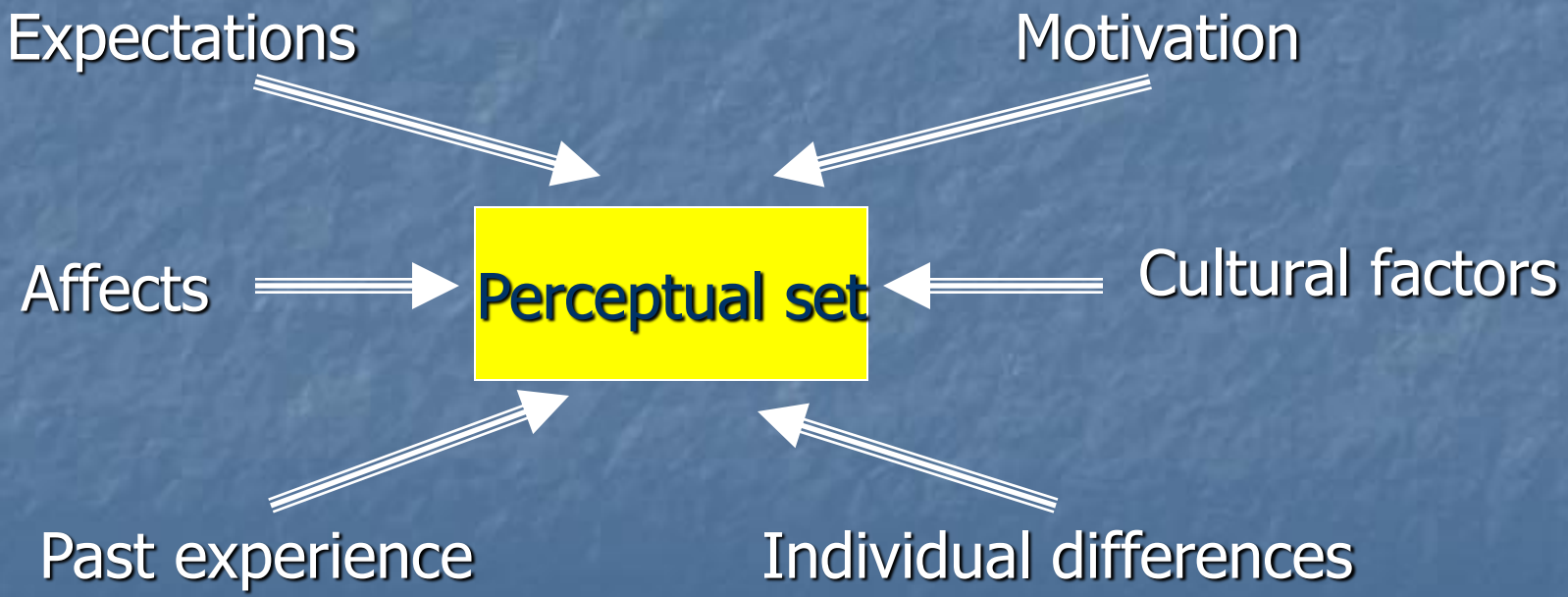


- Texture gradient:
  - Textured surfaces appear closer; irregularities tend to be smoothed out over distance.

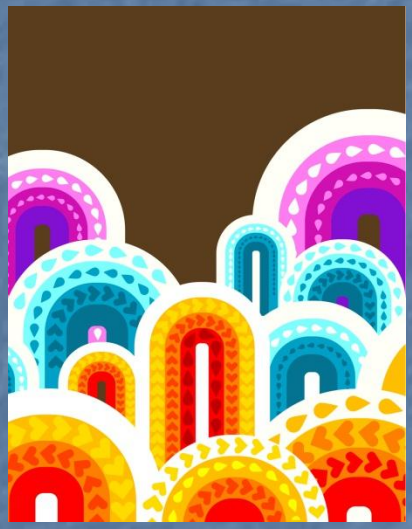


5.9 Factors affecting perception

- Perceptual set= the things affect on how we perceive others, objects and situations.

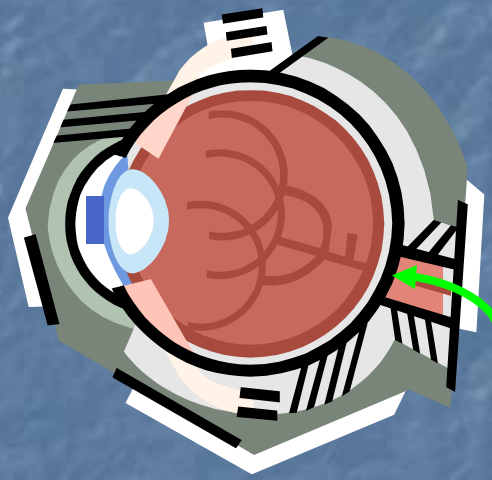


5.10 Colours



5.10 Colours (2)

- How colour vision work:



Fovea of retina ⊃ light-sensitive cells

- 120 millions rods
- 6-7 millions cones

5.10 Colours (2b)

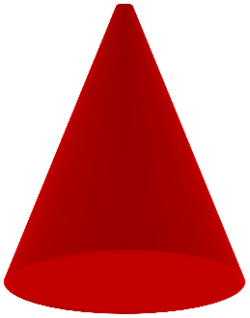
rods

Not sensitive to colour

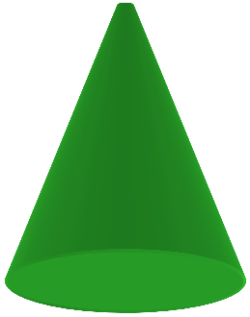
cones

Sensitive to colour

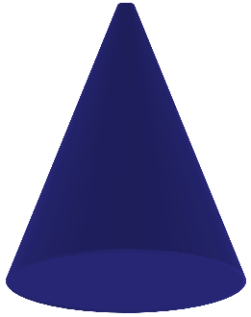
5.10 Colours (3)



Red cones (64 %)



Green cones (32 %)



Blue cones (2 %)

The colour of cones reflects their particular sensitivity

5.10 Colours (4)

- The cones are also responsible for all high-resolution vision (as used in such thing as reading), which is why the eyes moves continually to keep the light from the object of interest falling on the fovea.

5.10 Colours (5)

- Designing with colour:
  - Colour is very important to us.
  - Someone that is described colourless seems to be considered without character or interest.
  - Desinging colour into interactive systems is very difficult.

5.10 Colours (6)

- Rules by Aeron Marcus, 1992:
  1. Use a maximum of 5 ± 2 colours
  2. Use fovea (central) and peripheral colours appropriately
  3. Use a colour area that exhibits a minimum shift in colour and / or size if the colour area changes in size.
  4. Do not use simultaneous high-chroma, spectral colours
  5. Use familiar, consistent colour coding with appropriate references

5.10 Colours (7)

- Colour convention:
  - Guidelines which may not suit every situation but should at the very least provide a sound starting point:

Red	Danger, hot, fire
Yellow	Caution, slow, test
Green	Go, okay, clear, vegetation, safety
Blue	Cold, water, calm, sky
Warm colours	Action, response required, proximity
Cool colours	Status, background information, distance
Grey, white and blue	Neutrality

5.4 Memory

- Has 2 major components
- Should be thought as a set of processes (ex: recall, recognition, chunking, rehearsal) rather than as a database in your head.
- Appears to be multi-modal $\Rightarrow$ remembers colours, sounds, the feel, the smell
- Memories in the brain are not stored as colours, sounds, the feel, the smell, but appears so when we recall them

5.4 Memory (2)

5.4 Memory (3)

- Working memory: = Short-term memory
  - Holding material for up to 30 sec. (short-lived nature)
  - Very limited in size (limited capacity)
  - Holding only 3-4 "chunk" of information (not 7 ± 2 items)
- To maintain the contents of working memory $\Rightarrow$ to rehearse it $\Rightarrow$ to refresh mentally the contents

5.4 Memory (4)

- The *working memory* supports 2 different modalities:
  - Visuo-spatial sketchpad in which the working memory can store a small amount of visual information ⇒ Visuo-spatial sketchpad= the mind's eye ⇒ when we picture the face of someone
  - Articulatory loop in which the working memory can store a small amount of verbal information ⇒ Articulatory loop = your inner voice ⇒ when we are signing to ourself.

5.4 Memory (5)

- Long-term memory:
  - The inverse of working memory
  - Have unlimited capacity
  - Can last from a few minutes to a lifetime
  - Have multi-modal memories: To remember:
    - The smell
    - The taste
    - The voice
    - The feel
    - The sound
    - The words
    - …

5.4 Memory (6)

- Other long-term memory memories: long-lived, but difficult to articulate. Ex:
  - Signing your name
  - Recognizing your signature
  - Riding a bicycle
  - Making a sandwich
  - Typing
  - …

5.4 Memory (7)

- Recall and recognition:
  - **Recall**= the process whereby individuals actively search their memories to retrieve a particular piece of information.
  - **Recognition**:
    - Searching your memory
    - Deciding whether the piece of information matches what you have in your memory store.
  - Recognition is generally easier and quicker than recall.

5.4 Memory (8)

- Ex: menu "Font" in Microsoft Word
  - Use recognition rather than recall
  - Direct manipulation (clicking on an item) rather than having to memorize sthg (ex: the name of a font)
  - Extensive use of chunking
  - Use of meaningful natural mappings
  - Use icons
  - Rely on visual processing

5.5 Attention

- Usually defined in term of the focusing of mental resources at or on a particular task or object.
- Is a pivotally important human ability.
- Failures in attention are frequently cited reason for accidents of car, aircraft, control room, …
- ⇒ We clearly need to be able to understand:
  - The mechanism of attention
  - Its capabilities and limitations
  - How to design to make the most of these abilities while minimizing these limitations

5.5 Attention (2)

- Attention can be directed at a particular task and/ or divided between a number of different tasks ⇒ We can perform:
  - A small number of simple tasks more or less concurrently, or
  - One demanding task alone

⇒ Depending upon the characteristics of the task we are performing

- *Practice* reduces the amount of attention required by a particular task

  ⇒ freeing us to perform other tasks concurrently.
- Attention and *awareness* are closely linked.

5.5 Attention (3)

- How attention work:
  - Historically: 3 kinds of models developed by psychologists to account for attention ⇒ they do not agree with each another:

1. *Single-channel* theory of attention
2. *Allocation* model
3. Controlled and automatic *processing*

5.5 Attention (4)

1. Single-chanel theory of attention:
   - By oldest group, begin by Broadbent 1958, and then Triesman 1960, Deutsch and Deutsch 1963, Norman 1968
   - There is a kind of mental switch or filter which select material either to be ignored or to which we pay attention.
   - This switch or filter could be thought to be rather like the tuning dial of a radio.

$\Rightarrow$ Not widely accepted today

5.5 Attention (5)

2. *Allocation* model:

- Developed by Kahneman, 1973
- We have a limited amount of processing power at our disposal, and whether or not we are able to carry out a task depends on how much of this capacity is applied to the task.

⇒ More flexible and dynamic than the single-channel models

⇒ Unable to describe how attention is channeled or focused.

⇒ Unable to define exactly what is meant by "capacity".

5.5 Attention (6)

3. Controlled and automatic *processing:*

- By Schneider, 1977
- Distinguish between:
  - controlled *processing*
  - automatic attentional *processing*

5.5 Attention (7)

- *controlled processing*:
  - makes heavy demands on attentional resources
  - Slow
  - Limited in capacity
  - Involves consciously directing attention towards a task.
- *automatic processing*:
  - makes no demands on attentional resources
  - Fast
  - Unaffected by capacity limitations
  - Unavoidable and difficult to modify
  - Is not subject to conscious awareness

5.5 Attention (8)

- Until now:
  - There is no one agreed account of attention
  - Reasons:
    - Attention has been studied in many different ways
    - Difficult to define what actually constitute attention
  - ⇒ There are 2 broad types of accounts of attention which proposed a limited capacity information processing system:
    - May / may not have general purpose / specific elements
  - ⇒ There is support for automatic tasks which do not require attentional resources *per se.*

5.5 Attention (9)

- Vigilance:
  - Is an aspect of attention
  - Refers to detecting:
    - A rare event/ signal in a desert of inactivity
    - Noise
  - Ex:
    - Mariners watching for enemy submarines
    - Radar operators watching for attacking aircrafts
  - The study of vigilance became important
  - More usually people are required to be vigilant

  $\Rightarrow$ Important: to understand our interaction with large complex systems, particularly with respect to the monitoring of such systems.

5.5 Attention (10)

- Designing alerts and warnings:
  - 2 different *approaches*:
    1. Unobtrusive display which expect the user to notice the message but in their own time
    2. Unobtrusive display, in contrast:
       - May interrupt the user's work,
       - Requires interactions- unless it is important, urgent or life threatening
       - Allows the user to configure the application to turn off such alerts

5.5 Attention (11)

- *Attention- grabbing techniques*:
  - Must be used cautiously in some cases, according to more or less dramatic means.
  - Ex: reporting the fire ≠ alerting the crew to the movie tape being jammed

5.5 Attention (19)

- *Wording* and *presentation* of attention-getting alerts:
  - Require a little thought.
  - Ex:
    - phrases containing a negative expression
    - Phrases in the passive voice take longer to read and understand
    - In an emergency situation: simple, direct and positive command

Chapter 7:

Understanding people 2:

Embodied, situated band distributed cognition

Chapter 7

- 7.3 Embodied interaction 3: Affordance

7.3 Embodied interaction 3: Affordance

- (James Gibson, 1977)
  - Affordance= a resource of support that the environment offers an animal; the animal in turn must possess the capabilities to perceive it and to use it.
  - Ex:
    - surfaces that provide support
    - Objects that can be manipulated
    - Substances that can be eaten
    - Other animals that afford interactions of all kinds

7.3 Affordance (2)

- In HCI:
  - If we were able to design interactive systems which immediately presented their affordances to the user,
  - ⇒ Then many, if not all, usability issues would be banished at a stroke.
  - ⇒ ???

7.3 Affordance (3)

- Donald Norman (1988):
  - Introducing the concept of affordance to HCI:
  - Replacing the original biological-environmental formulation with the perceived affordances.
  - An user perceive the intended and perceived behaviors which are usually very simple: sliding, pressing, rotating.

7.3 Affordance (4)

- Perceived affordances tell the user:
  - What actions can be performed on an object, and
  - To some extent, how to do them
- Perceived affordances are often more about conventions than about reality. Ex: scrollbars.
- Real affordances are not nearly as important as perceived affordances.