- Results:
  - The data are consistent with subjects conducting a **serial exhaustive search** through memory rather than a serial self-terminating search.
  - Snodgrass argues that memory scanning is very fast: data suggest an **extremely rapid rate of search** (25 comparisons between the encoded version of the probe and a single item in memory can be made per second).
    - Therefore, the search is exhaustive because the comparison process itself is so fast that it is more efficient to complete the search through all items and then determine whether the probe item matches any items in memory, than to stop after each comparison and make a decision.

### » Investigating Unobservable Processes

*Why do we have to investigate cognitive processes so indirectly*?

- Introspective data do not provide valid insight into the determinants of cognition
- Some cognitive processes occur "automatically" without any conscious awareness or control and therefore are not available for introspection.
- Even our consciously controlled cognitive processes are subject to a variety of "cognitive biases" and reasoning errors that influence our interpretation of events without our awareness.

### » Cognitive Biases

- The **pseudocertainty effect** is observed in multi-stage decisions, in which evaluation of outcomes in previous decision stage is discarded when making an option in subsequent stages.
  - Shows importance of "**framing**" (e.g. wording of the problem) when asking questions.
- **Hindsight bias**: inclination to see events that have already occurred as being more predictable than they were before they took place ("I knew it all along")
- **Confirmation bias**: seek information that confirms our beliefs and ignore information that does not.
- Many of these "errors" in human reasoning and judgement make us **very efficient information processors**, but they mean that we are **not accurate reporters on our cognitive processes**.

## Attention

### » Attentional Limits

- We can only pay attention to a limited amount of the information available at any one time. These limitations on attention are a major constraint on human information processing.
  *Why is attention limited? What is limited?*
- ***The amount of information that can be registered***?
  - Not really. All information is briefly ***registered*** but the amount that can be ***reported*** is limited.
- ***The amount of information that can be selected for "high level" processing***?
  - Can information be meaningfully processed without attention being directed to it?
  - **Early vs. late selection**.
- ***The amount of resources ("energy") available for cognitive processing***?
  - There do appear to be **limitations** on how much **processing** can be carried out at one time, or at least on how much we can be **consciously aware of**.

#### # Inattentional Blindness

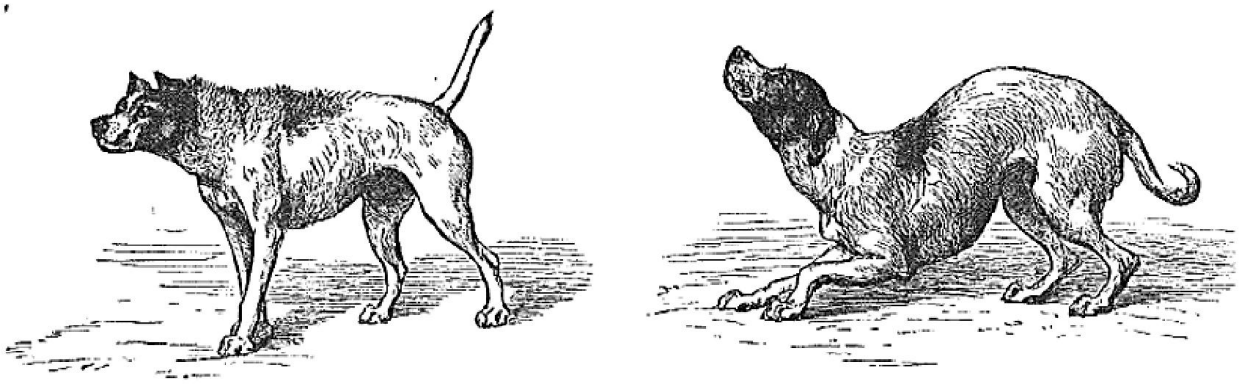
- **Inattentional/perceptual blindness**: We are not aware of unexpected stimuli if our attention is focused elsewhere.
  - "*Our eyes are open, yet we do not see*".
  - The **stimulus is usually unexpected but fully visible**, in plain sight.
- Typical cause is because we are **overloaded with inputs**.
- Evidence: "Invisible gorilla test".

# EMOTION

## Built for Emotion: Evolutionary and Biological Perspectives on Emotion

### » Darwin

- **Darwin** emphasised **continuities between human beings and non-human primates**.
  - We are not too different from animals in evolutionary terms (98.3% genetic information shared with chimpanzees).
- Basic emotional (including facial) expressions are **innate**: they are **produced and recognised automatically**.
  - Emotion is both expressive and communicative.
- Darwin was the first to carefully observe **facial expressions of emotion**, including those of human infants and blind children.
  - When infants cry, their **eyes are firmly closed** and their **mouth is wide open**.
- Darwin brought new technology to research emotions: heavily relied on **photographs** of different faces from different cultures.
  - **Electrical stimulation** was used to determine the **facial muscles** responsible for different **facial expressions**.
- Darwin:
  - Fundamentally changed the ways in which emotions would be conceptualised within Western scientific thinking.
  - Grounded emotion in our evolutionary history and drew strong parallels between different species regarding the functions and adaptive value of emotional expression.
- Darwin emphasised the intimate **connection between inner emotions and outward manifestations**: "*to be sad is to look sad*" (a conceptual relationship, not a causal relationship) – crying, slumping ← this is what sadness is.
  - Darwin also believed that emotions are **culturally determined**: one must know what happiness in a culture is like in order to be happy.
- Darwin proposed the principle of **antithesis**: e.g. high/low stance of dogs – standing high (aggressive) or poised low (defensive/submissive).



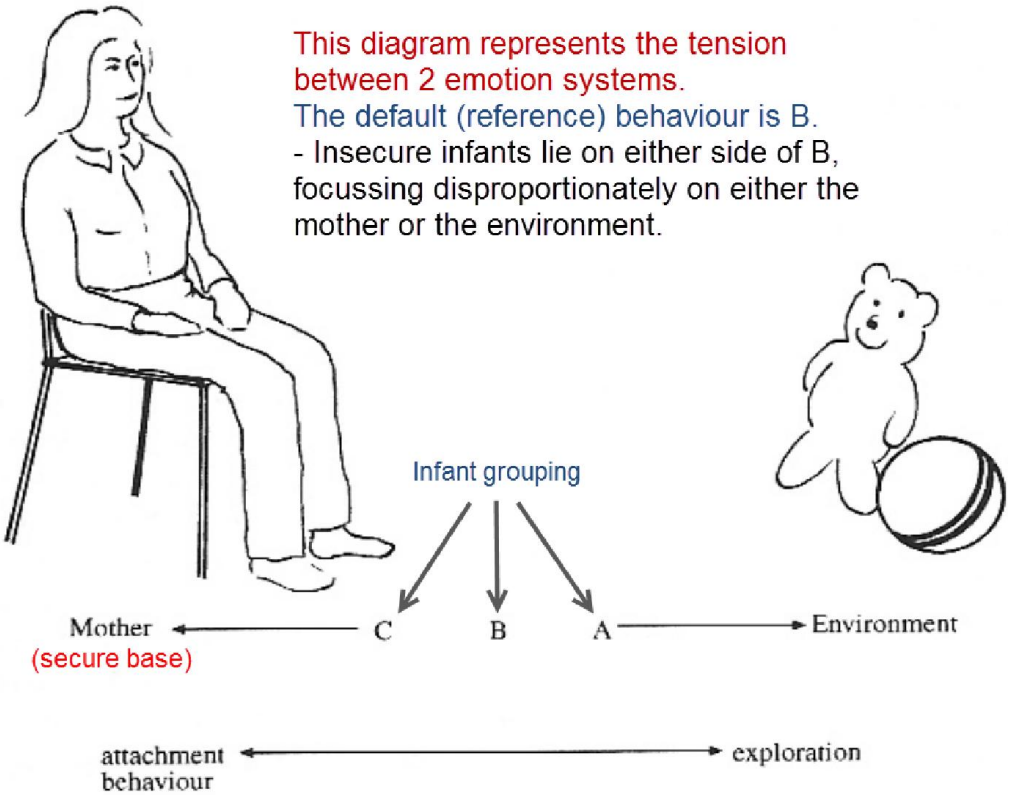
- Darwin provided a framework for **subsequent emotion research** that is still influential today.

### » Basic Emotions

- Proposed basic emotions: surprise, fear, disgust, anger, happiness, sadness.
- **Basic emotions** are **emotional states** that are linked to **survival** and fundamental life tasks.
- **Basic emotions** are a **condensation of adaptive behaviour in evolutionary times**.
  - There is an automatic set of responses ready to go in certain circumstances.

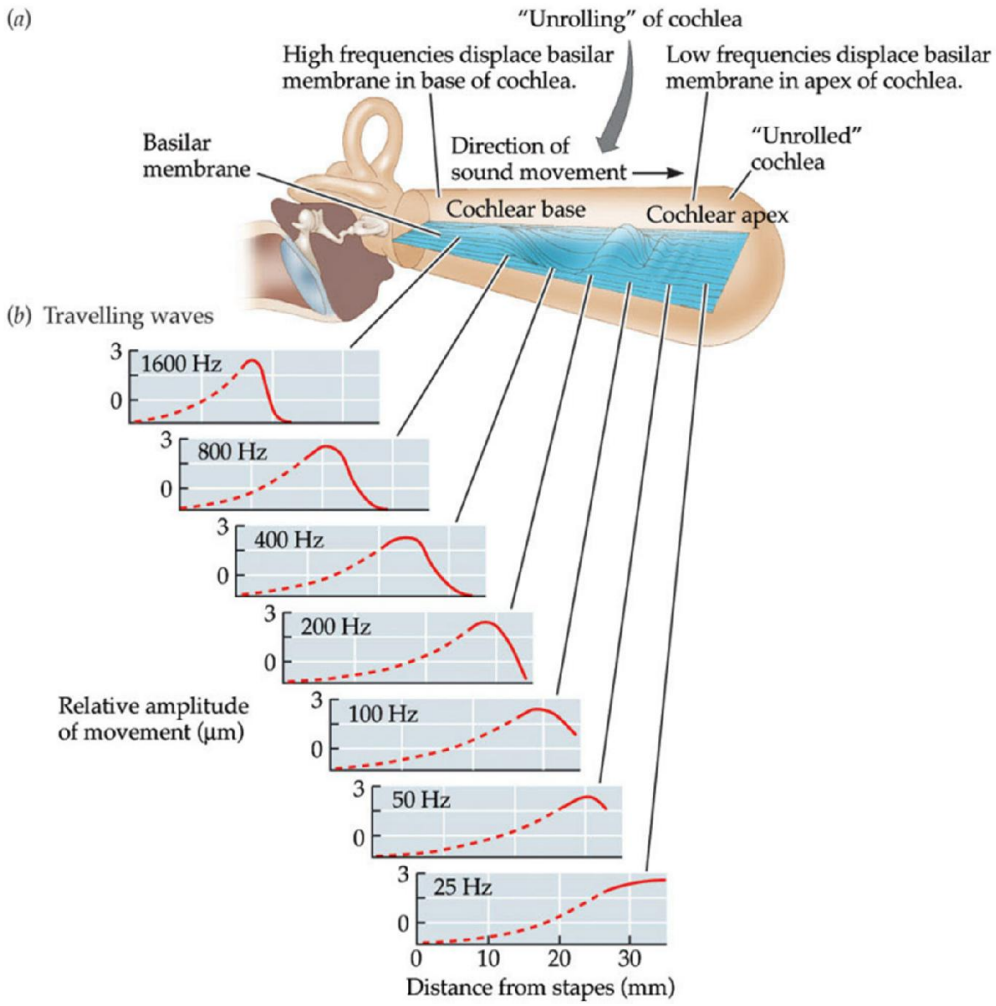
#### # Ekman & Friesen (1971)

- Tried to show that **certain basic emotions are universally recognised** and understood to signify the **same psychological state** of the individual.




- The **ultimate goal is to maintain contact with the mother**:
  - The **avoidant infant** avoids the mother at times of optimal need. This does not mean he does not have strong attachments with the mother. He has simply learnt a non-optimal response which inhibits his distress so that he can maintain contact with his mother. In this case, attachment does not deal with his anxiety.
  - The **ambivalent/resistant infant** shows a simultaneous mixture of secure base behaviour and aggression. The infant understands attachment requires him to maintain tension and receive consistent care.
- **Patterns of attachment organisation: ABC system**
  - Attachment behaviours, especially following reunion, are *organised* and fall into one of 3 distinct and reliable patterns.

| (A) Avoidant | (B) Secure | (C) Ambivalent / Resistant |
|---|---|---|
| 25% | 65% | 10% |
| **Minimises attachment relationship** | **Flexible, secure base behaviour** predominates (*in times of need*) | **Maximisation of attachment relationship** (*ineffectively* – needs and resents care at the same time) |
| **Ignores/avoids mother on reunion**. Often not upset by separation and shows almost **no distress on reunion** (*because infant actually wants to be close to mother*). Does not use mother as a secure base. Takes little/no comfort from her presence. | **Any distress during separation quickly resolves on mother's return**, by seeking her out as a secure base, taking comfort from her presence. | **Seeks contact/proximity with very strong protests/distress**. However, any **effective secure base behaviour contradicted by angry resistance** (e.g. hitting, increased distress on proximity). Proper contact is never made: vicious cycle of infant pushing mother away and mother comforting child. |
| **Does not seek proximity/contact**. Limited exploration/play can be a defensive strategy to avoid it. | **Stays in proximity/contact until reassured** and ready to return to (genuine, high quality) exploration/play. | **Often seeks, then rejects proximity/contact**. A preoccupation with the mother on reunion delays/prevents return to exploration/play. |




## # Current Reconciliation

- The two processes seem to work together differentially at different frequency ranges.
- For <u>frequencies < 3000 Hz</u>, we use the net neural activity of neurons in the basilar membrane to code for frequency.
  - Supports **frequency theory**.
- For <u>frequencies > 1000 Hz</u>, we use place responses of the basilar membrane.
  - Supports **place theory**.
- Therefore, for frequencies between 1000 and 3000 Hz, **both frequency and place theories work cooperatively** to code for frequency.

## » Tonotopy

- Neural signals about frequency are relayed to the **primary auditory cortex** (PAC) in the temporal lobe.
- PAC exhibits **tonotopy**: systematic organisation of tuning of neurons that respond to sounds of certain pitch.
  - Neurons at the front of the PAC process low frequency sounds while those at the back process high frequency sounds.
  - Continuous increase in preference for frequencies resembles place responses along basilar membrane.
- **Secondary auditory cortex** (SAC) is responsible for integrating neural messages from the PAC to extract information about more complex sounds (e.g. speech) and changes in frequency over time.

        - Ice has high reflectance as it reflects a lot of light.
        - Liquid water has low reflectance as it absorbs a lot of light.
        - Used in global warming argument.
- **Luminance** is the light entering our eyes.
    - It refers only to the light that reflects off the object and *enters our eyes*.
    - Luminance is a proximal stimulus: can be measured by visual system and used to recognise objects; sensed by photoreceptors in the eye.
    - **Image patterns are luminous distributions**: *high luminance = lots of light entering the eye*.
- Example:
    - **Illumination**: Turning on a torch causes light to spray out of the torch. The light moves through space and hits an object's surface.
    - **Reflectance**: The object reflects or absorbs the illumination.
    - **Luminance**: The light reflects off the wall and enters our eyes.
- When illumination changes, luminance changes as well but reflectance stays constant.

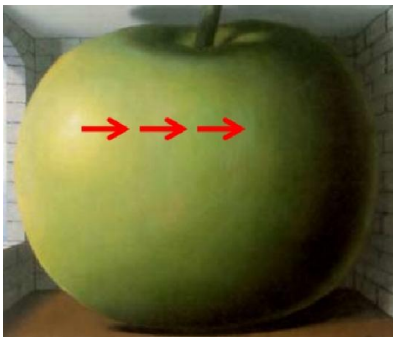
### » Object Recognition Using Image Patterns

*How do we use image patterns to recognise objects?*

- One approach has been to focus on **edges** (*not objects*).
- In a complex image (e.g. apple), we focus on the edges rather than the apple itself.

## The Edge Classification Problem

- Although we can recognise the edges instantly, it is because the visual system has already solved this problem.
- The edge classification problem is the problem of understanding how brains separate the different ingredients of an image - the different edges. Once the ingredients mix, they are difficult to separate.
    - *Note: The classification problem is not limited to edges; includes luminance gradients.*
- The edge classification problem is a difficult problem but is easier than trying to understand how we recognise whole objects.



### » Ingredients

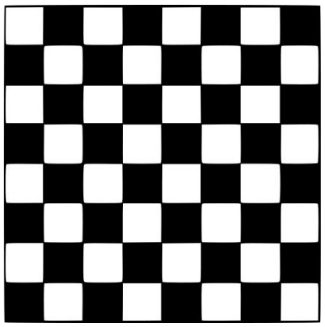
#### # Reflectance Edge

- Generated when there is a change in **object colour** (e.g. from white brick to dark mortar).
- Influences the pattern of light that reaches the eye.

#### # Luminance Gradients ('Blurry Edges')

- Gradual changes in luminance (amount of light reaching our eyes).
- Due to an **object's shape** (**shading**): curve of the apple means less illumination is hitting darker parts.
    - They are not due to intrinsic reflectance (colour of the object changing from light to dark).

Reflectance edges



Occluding edges

### # Generalized anxiety disorder

- Generalized anxiety disorder is marked by a **chronic, high level of anxiety** that is **not tied to any specific threat**.
  - Victims worry about minor matters in the hope that this will ward off negative events.
- Physical symptoms are different from 'panic' (not as intense as panic)
  - Tension, irritability, restlessness, sleep problems.

### # Phobic disorder

- Phobic disorder is marked by a **persistent and irrational fear** of an object or situation that presents **no realistic danger**.
  - The anxiety has a **specific focus** (e.g. animals, natural environment, situational).
  - Social phobia is fear and avoidance of social situations.
- This fear seriously interferes with everyday behaviour.
  - Victims realise that their fears are irrational, but are unable to calm themselves when confronted by a phobic object.

### # Panic disorder

- Panic disorder is characterized by **recurrent attacks** of overwhelming anxiety that usually occur **suddenly and unexpectedly**.
- After a number of panic attacks, victims become apprehensive of both the panic attack and the stimuli.
- Eventually leads to **agoraphobia** (fear of going out to public places; situations or events associated with panic).

### # Obsessive-compulsive disorder (OCD)

- OCD is marked by persistent, uncontrollable intrusions of unwanted thoughts (**obsessions**) and urges to engage in senseless rituals (**compulsions**).
  - **Obsessions** are repeated, intrusive, irrational thoughts that cause severe anxiety.
  - **Compulsions** are ritualized behaviors to relieve the anxiety caused by obsessions.
- Obsessions lead to compulsions.
- Cognitive-behavioural therapy: *exposure response prevention*
  - Prevent compulsions from occurring via cognitive restructuring.
  - Stop **OCD cycle**: **obsessions** → anxiety → **compulsions** → relief → **obsessions**

### # Posttraumatic stress disorder (PTSD)

- PTSD involves **enduring** psychological disturbance attributed to the experience of a **major traumatic event**.
- Occurs after a **traumatic stressor**: experience or witness an event that involves or threatens death or serious injury or threat to one's physical integrity.
  - Individual's response included intense fear, helplessness and horror.
- Symptoms include:
  - Re-experiencing of the event
  - Avoidance and numbing
  - Hypervigilance (increased arousal)
    - Sleep disturbance, anger, irritability, poor concentration, startle.
- Treatment focuses on gradually exposing patient to the stressful traumatic situation.

## » Treatment of Anxiety Disorders

- Cognitive Behavioural Treatment
  - Aim to **reduce (biased) threat appraisal**.
    - *How likely/bad that the event will happen*?
  - **Cognitive** techniques:
    - Thought-diaries to identify automatic thoughts.
    - Thought challenging: e.g. *what's the evidence*?