### Attention

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http://compcogscisydney.org/psyc2071/



#### Structure of the lecture







#### Part I: Some definitions

"Attention is...the taking into possession of the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought.

- William James, 1890





How many things are we paying attention to?

"Attention is...the taking into possession of the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought.

How many things are we paying attention to?

"Attention is...the taking into possession of the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought.



What kind of thing are we paying attention to?

How many things are we paying attention to?

"Attention is...the taking into possession of the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought.



What kind of thing are we paying attention to?



Are we actively controlling this attention or not?

## How many targets?

- Focused attention (or selective attention)
  - Attending to one thing and ignoring other things

At the park, if I have one child my attention is focused on what that child is doing... my child is the <u>target</u> of my attention



# How many targets?

- Divided attention (multitasking)
  - Tracking multiple things & responding as necessary

If I have multiple kids in my care, however, my attention is now divided between them

(This is much harder!)



# What kind of target?

- External attention: the target of attention is something in the perceptual environment
  - Auditory attention paying attention to sounds
  - Visual attention paying attention to visual stimuli
  - Cross-modal attention attending to multiple senses







Visual

Auditory

Cross-modal

# What kind of target?

#### Internal attention

 The target of attention is something that you're thinking about, and not part of the perceptual environment

> Daydreaming directs attention inwards to one's own thoughts



### What controls attention?

- Active attention (endogenous):
  - Exercising top-down control over our own attention in order to achieve our goals



### What controls attention?

- Passive attention (exogenous):
  - Bottom up control over attention, where something in the environment (e.g., loud noise) demands attention



## Summary

How many?	What kind?	Control?
Focused vs	External vs	Active vs
Divided	Internal	Passive

## Summary

How many?	What kind?	Control?
Focused vs	External vs	Active vs
Divided	Internal	Passive

# Part 2: Auditory attention



# The cocktail party problem

#### Schematic illustration



Theoretical idea?



An <u>"attentional filter</u>" separates the sources and selects the target for processing



Male voice: Blackheath or Blackburn?

Female voice: illustrious or illumination?

## The shadowing task



**RIGHT EAR:** Someone must have laid false accusations against Josef K

LEFT EAR: Why does Ross, the largest of the friends, simply not eat the others?

Early results (Cherry 1953, Moray 1959):

- We're good at shadowing the target source
- Very little is processed from the other source
- Suggests...

### Early selection (Broadbent 1954)



"Pre-attentive" low-level analysis picks up some of the basic properties of the different signals

## Early selection (Broadbent 1954)

Attention selects a <u>target</u> for further processing: we become fully conscious of <u>that</u> signal



Processing of the unattended signals stops, and we are aware only of the results of the preattentive analysis

#### Problems with Broadbent's filter



### Semantic\* content drives attention?

(\* semantics = meaning)



#### RIGHT EAR: Someone must have laid false not eat the others?

#### LEFT EAR: Why does Ross, the largest of the friends, simply <u>accusations</u> against Josef K

Gray & Wedderburn (1960)... semantic content switched ears, and people smoothly track it

# Semantic content of unattended source influences processing



"robot, cockroach, <u>um... lost</u> yellow, terminus" RIGHT EAR: robot, cockroach, <u>lost</u>, yellow, terminus

LEFT EAR: green, dispense, <u>missing</u>, quick waiter,

Lewis (1970) presented synonyms in both ears. <u>Semantic interference</u> occurs, with reaction time (RT) slower when the synonym is presented.

# And some words "pop out" at you even when you're not listening



(\*note: this is passive attention)

#### Late selection



(Deutsch & Deutsch 1963)

#### Attenuation theory

Every signal is processed up to the point where it can be separated from the target, and then processing stops



(Treisman 1964)

### Summary



Very little conscious awareness of unattended source

But there are special words that "pop out", and there is some semantic interference from unattended source

Suggests late selection or attenuation

# Part 3: Do we get the same effects in visual attention?





# Visual analog of the shadowing task

(Rock & Gutman 1981)





At test, people were shown each shape in isolation and asked if they had seen it...

Original item (attend to RED)



At test, people were shown each shape in isolation and asked if they had seen it...



Shapes originally in the attended colour are recalled At test, people were shown each shape in isolation and asked if they had seen it...



Shapes originally in the attended colour are recalled

Shapes originally in the unattended colour are not

# Conclusion: similar results in visual attention as in auditory attention



# Analog of semantic interference?



#### Negative priming (Tipper 1985)

RIGHT EAR: robot, cockroach, <u>lost</u>, yellow, terminus

LEFT EAR: green, dispense, <u>missing</u>, quick waiter,







As before we have overlapping objects in different colours

The task is to name the **RED** object





Semantically related prime in the UNATTENDED stream...



Requires late selection because the *meaning* of "wolf" has an effect





Again, visual attention seems to be very similar to auditory attention

#### Part 4: Visual search



#### Examples of visual search problems



Is there a weapon here?



Where are my kids?



Which buildings are lit up for Vivid?

Let's do some desk-slapping! Your task is to find this shape:







#### Serial search

- That second one was more difficult than the first one.
- The more distracting objects we have (set size), the harder it is to find the target....



More desk-slapping! Your task is to find this shape:







#### Parallel search

- That last one was still very easy.
- It seems no more difficult than the first one.
- So: more distractors ≠ harder search



# "Pop out" effects

- When the target is defined by a specific feature (e.g., colour) it seems to "pop-out".
- The "set-size" (number of distractors) makes no difference.
- Doesn't matter much what kind of feature it is (colour, shape, size, orientation, motion, depth)...













## Detecting features occurs in parallel

- "Feature maps" analyse the visual field and extract these primitive features in parallel.
- Hits on a particular analyser map lead to fast detection of the target item.



All the distinctive items "pop out" suggesting that each feature is processed separately

(Triesman 1986: feature integration theory)

## <u>Binding</u> features into objects is not

- When the target is a combination of attributes ("conjunction"), a slow **serial** search process is needed.
- We can extract the features (red and blue) in parallel
- But we need attention "bind" them into objects.



(Triesman 1986: feature integration theory)

#### **Theoretical implication**



Early in processing the features aren't bound together into objects

Binding happens late and requires attention Report the two **black** numbers. One will appear to the left, one to the right.



Hands up if you saw a purple T Hands up if you saw a red R Hands up if you saw a green X

#### Illusory conjunction

# 9 O T X 3



(Note: Branka Spehar talked about illusory conjunctions & the binding problem)

- Illusory conjunctions support Triesman's feature integration theory.
  - Feature extraction occurs automatically and in parallel; object recognition requires feature binding.
  - (Accurate) binding of features requires slow serial attentional processing of stimuli.
  - If this is not allowed, then errors in binding will occur and will be based on features extracted automatically during early perceptual processing







# Key topics

- Part I Different kinds of attention
- Part 2
  - Cocktail party problem
  - Early selection, late selection, etc
  - Semantic interference
- Part 3
  - Visual analogs of shadowing tasks
  - Negative priming effects
- Part 4
  - Serial vs parallel search
  - When do pop out effects occur?
  - Feature integration theory

### But there's lots more to attention!



Auditory attention



Visual attention



Attention & learning



Divided attention



#### Disorders of attention