PSYC 10004-6 – FOUNDATIONS OF PSYCHOLOGY
Introduction to Cognitive Psychology

Lecture 5 – Attention

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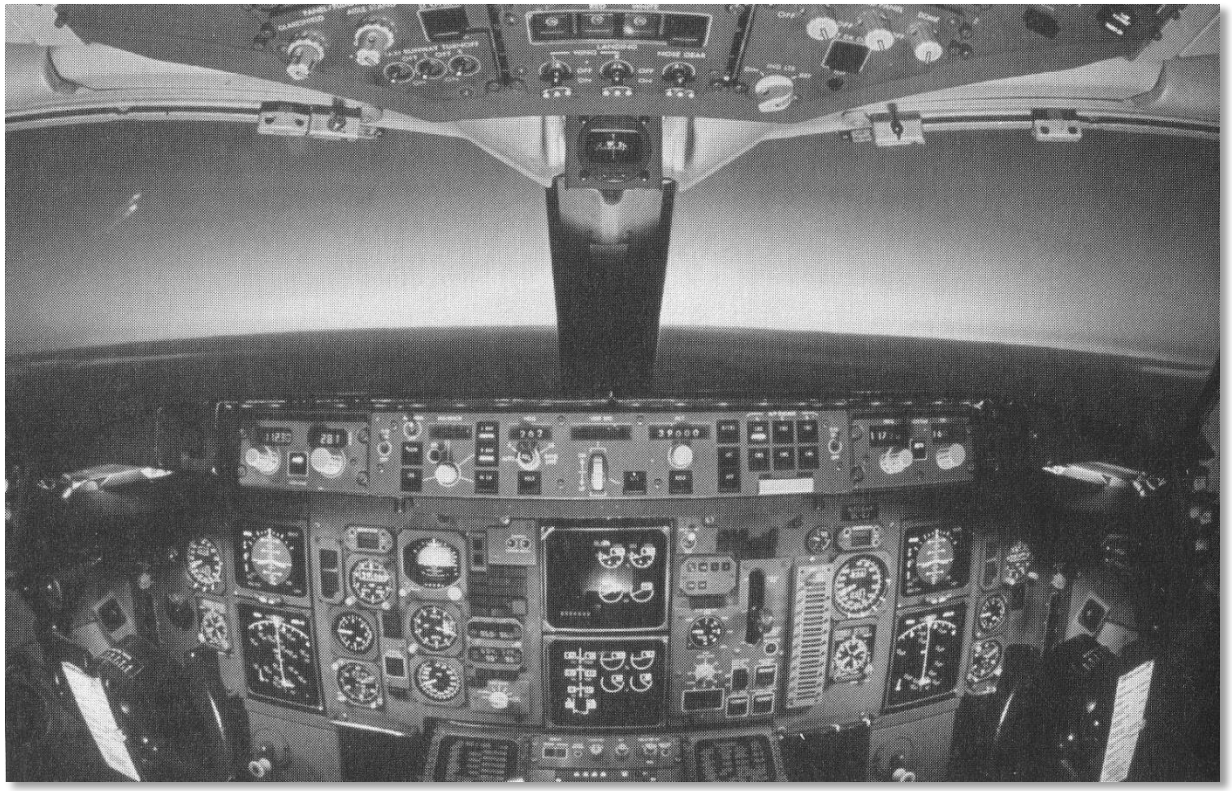
Additional reading

- Any recent textbook on Cognitive Psychology, such as Ashcraft & Radvansky (2010)

Aims of lecture

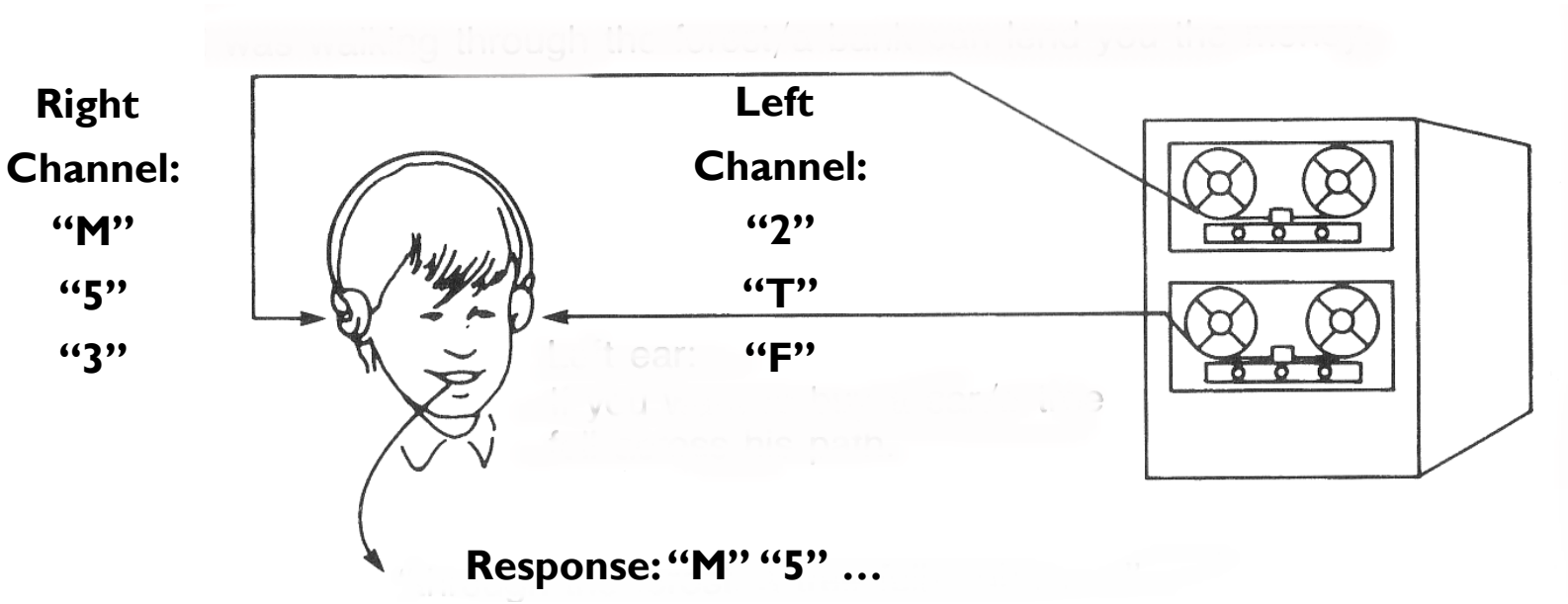
- sensory channels provide enormous amount of information – see previous lectures
- some *selectivity* is required to keep information to manageable size
- *attention* filters out irrelevant information and allows *focus on what is relevant* in a given situation
- only sensory information to which we are attending enters conscious awareness

Selective and divided attention



Dichotic listening task

- two different messages transmitted to the two ears
- participant is asked to “shadow” one of the messages while ignoring the other
- after a particular episode/trial, s/he can be asked questions about the unattended information

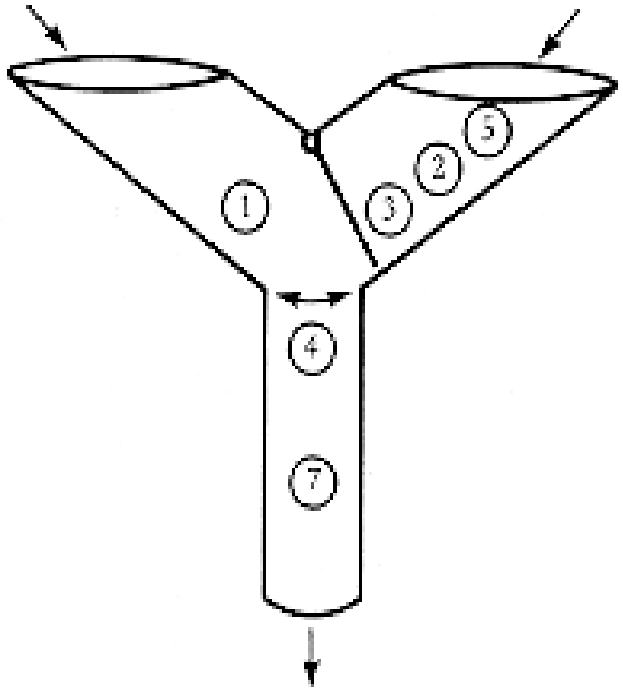


Dichotic listening - Cherry (1953)

- participants almost entirely unaware of information presented to the unattended ear:
  - knew whether or not a voice was presented
  - could report *physical* attributes of the voice (e.g., gender of the speaker, etc.)
  - knew very little about the *content* of the message
  - unable to report the language
- implication: information in the unattended message is processed only to a very "shallow" degree

Broadbent's filter model (1958)

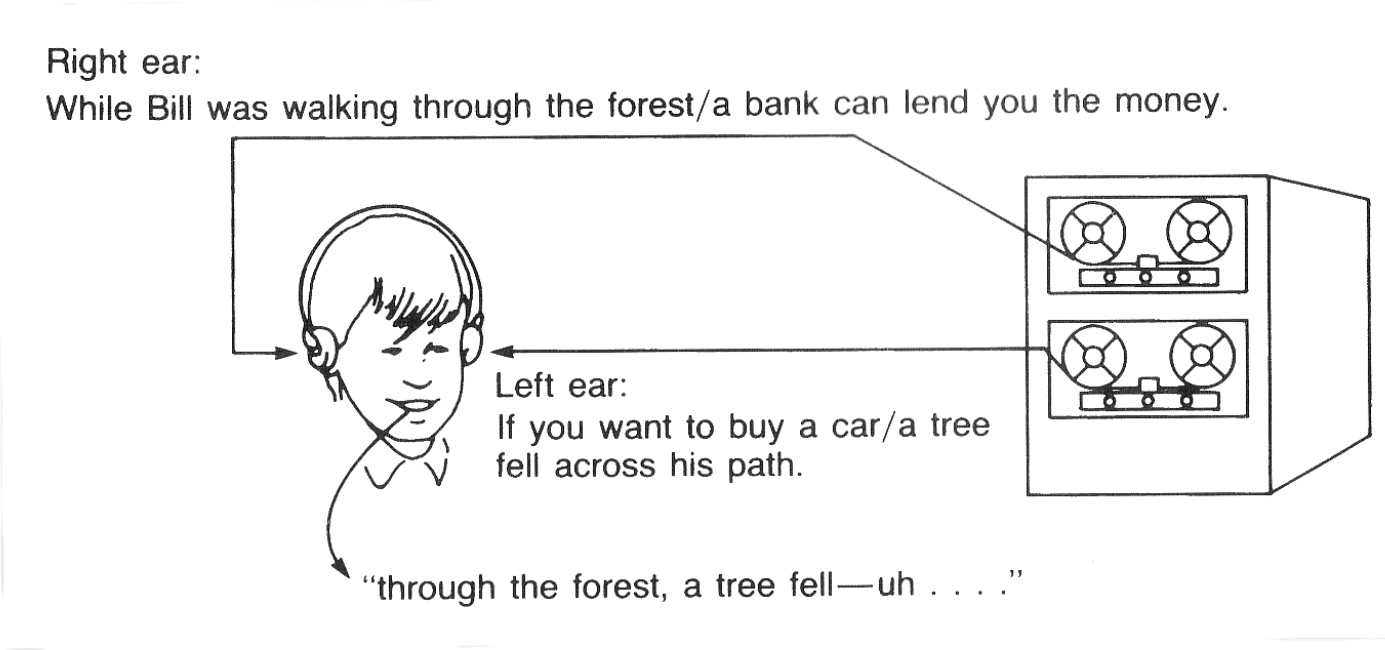
- "chunks" of sensorial information are represented as balls
- attentional selection symbolised as Y-shaped tube through which information must pass
- information enters through sensory channels and is filtered as it proceeds
- tube accepts only one ball at a time, with hinged flap acting as a filter



But: Moray (1959) …

- reported a surprising finding: participants able to report if their *name* is presented on the unattended channel
- "cocktail party phenomenon" – highly pertinent stimuli (such as one's name) can suddenly capture one's attention in a noisy environment
- such effects of "high priority" appear problematic for static filter model such as Broadbent's

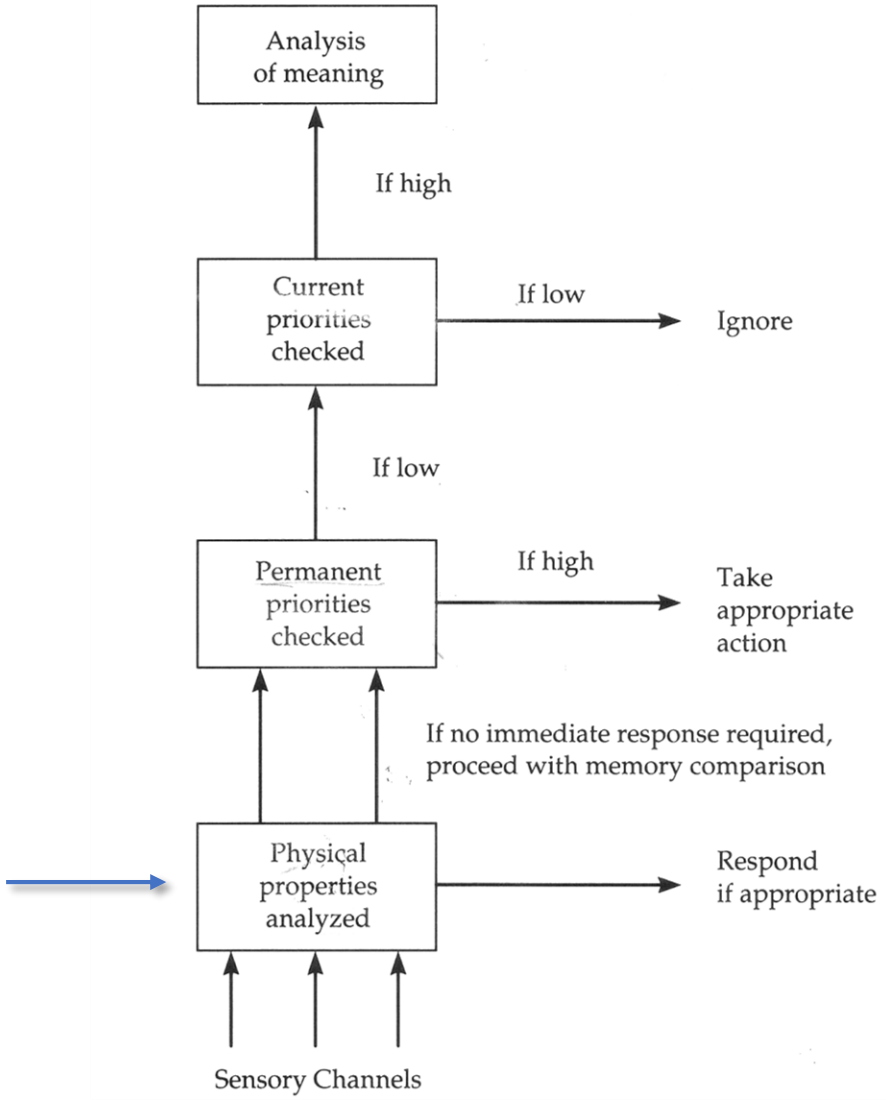
Treisman (1960) – further unexpected findings…



- fragments from unattended channel are occasionally reported if they are *congruent with the context of the attended message*
- implies that unattended information must have been processed to certain extent!

Treisman's (1960) attenuation model

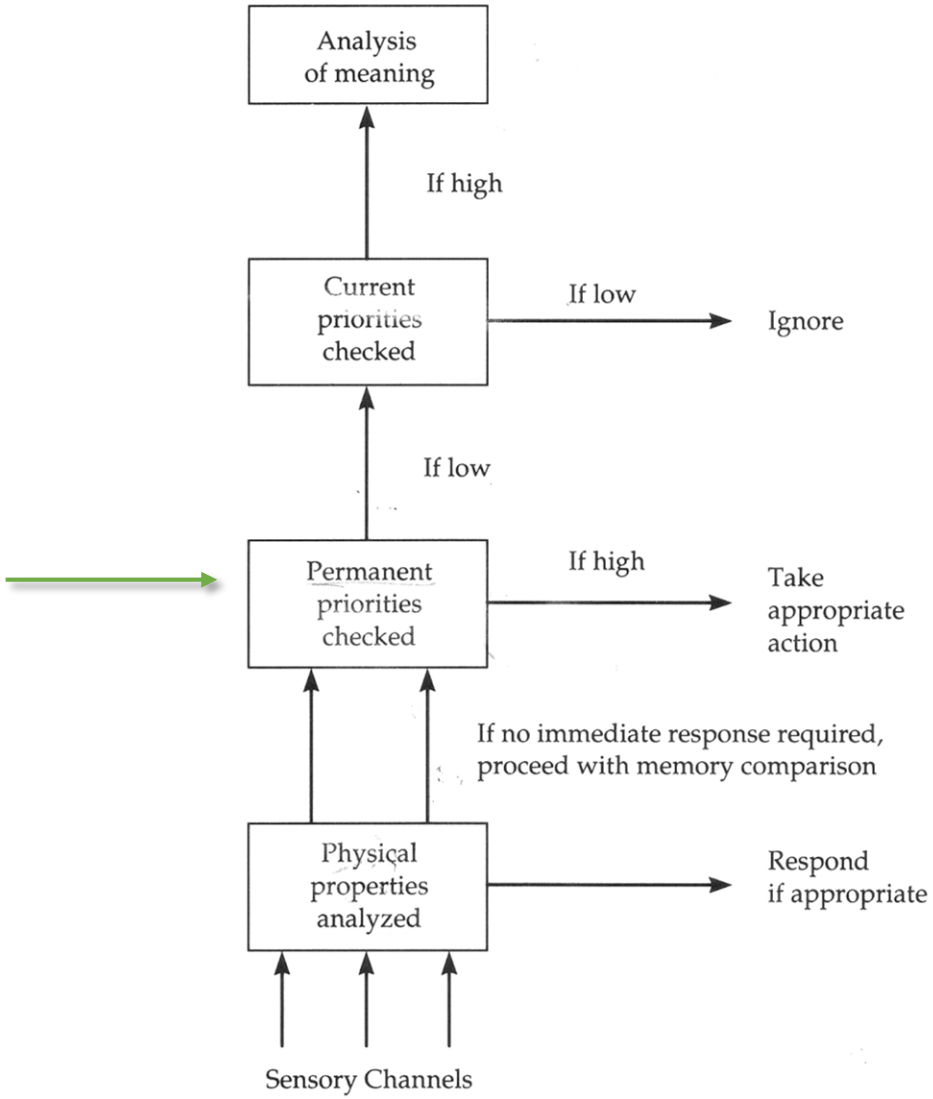
- unattended information is not entirely blocked (as e.g., in Broadbent's model)
- instead, attention acts as a *selective filter*



- first, physical properties of sensory information are analysed (voice, etc.)

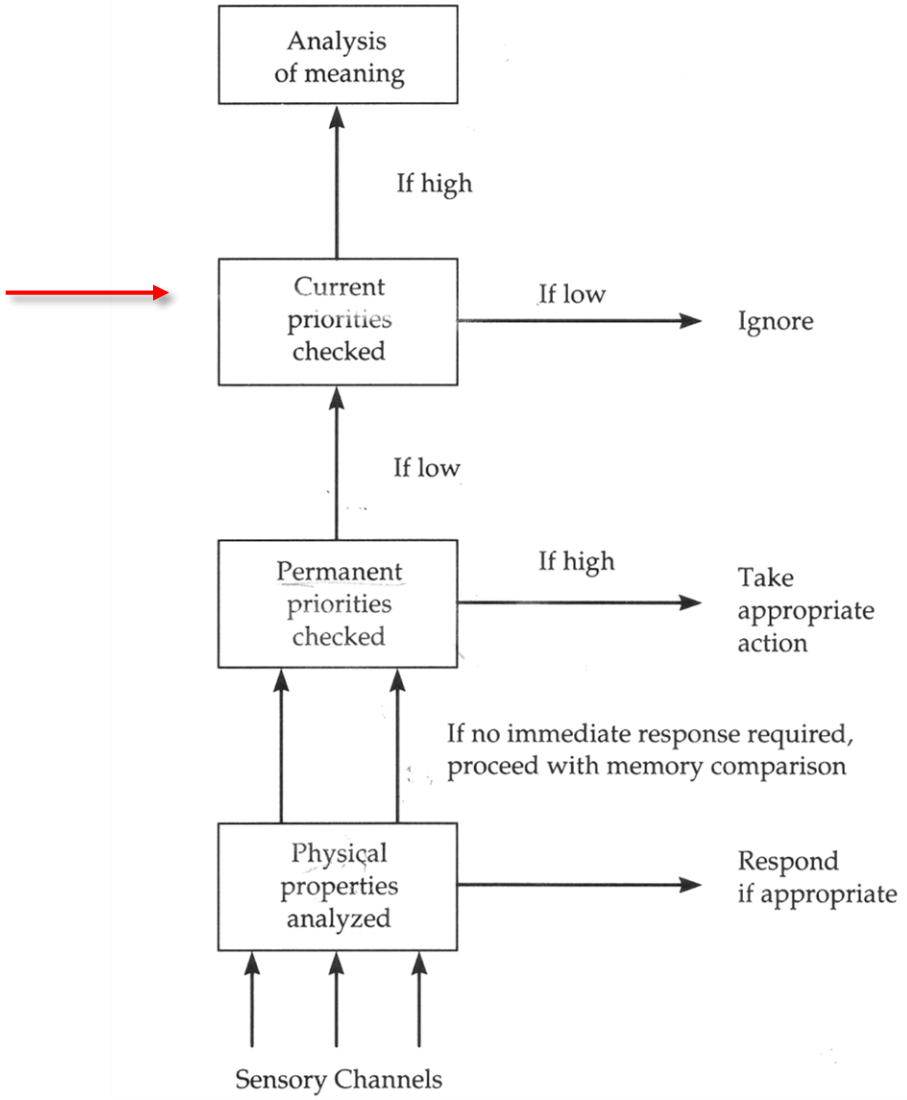
Treisman's (1960) attenuation model

- next, knowledge about words is accessed ("mental lexicon")
- entries in the mental lexicon are stored in terms of frequency of occurrence, relevance, etc. ("permanent priorities"), and have varying recognition thresholds



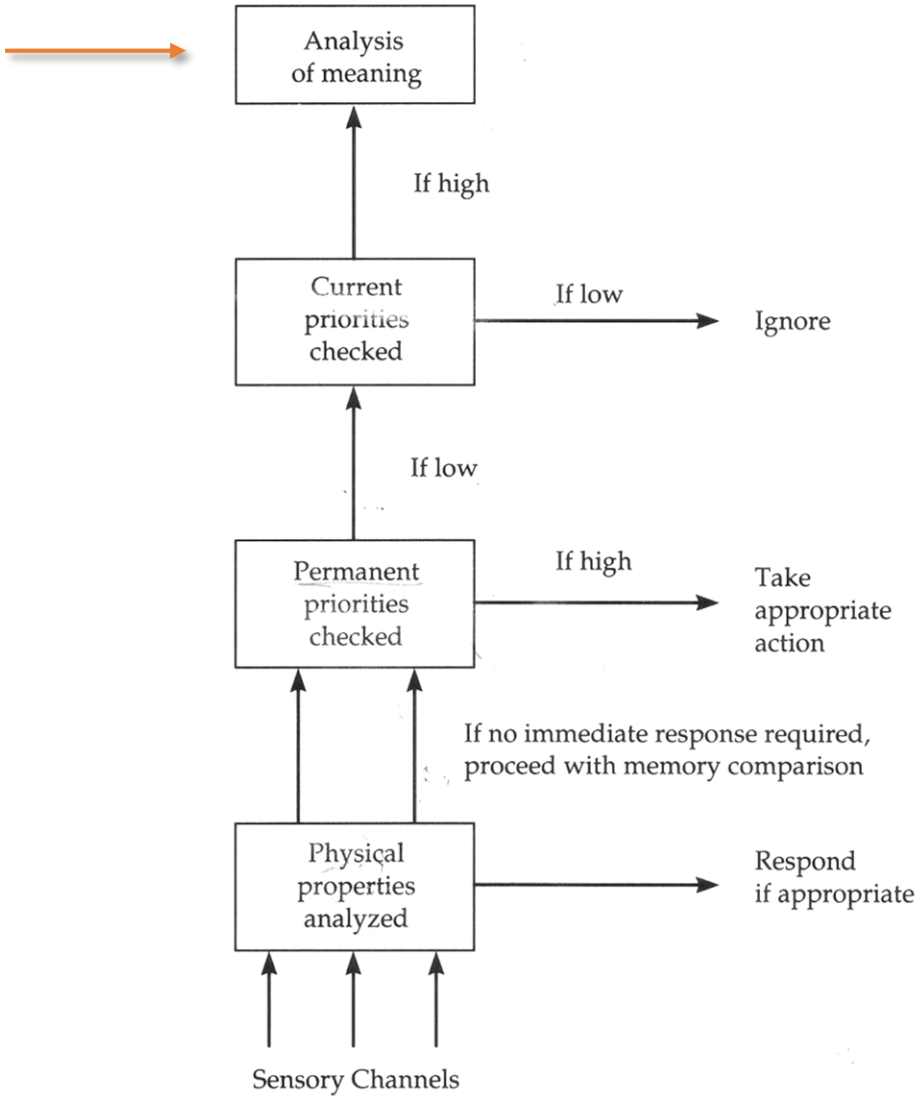
Treisman's (1960) attenuation model

- thresholds can also be temporarily lowered by expectations ("current priorities")



Treisman's (1960) attenuation model

- if signal passes both filters, its meaning is analysed

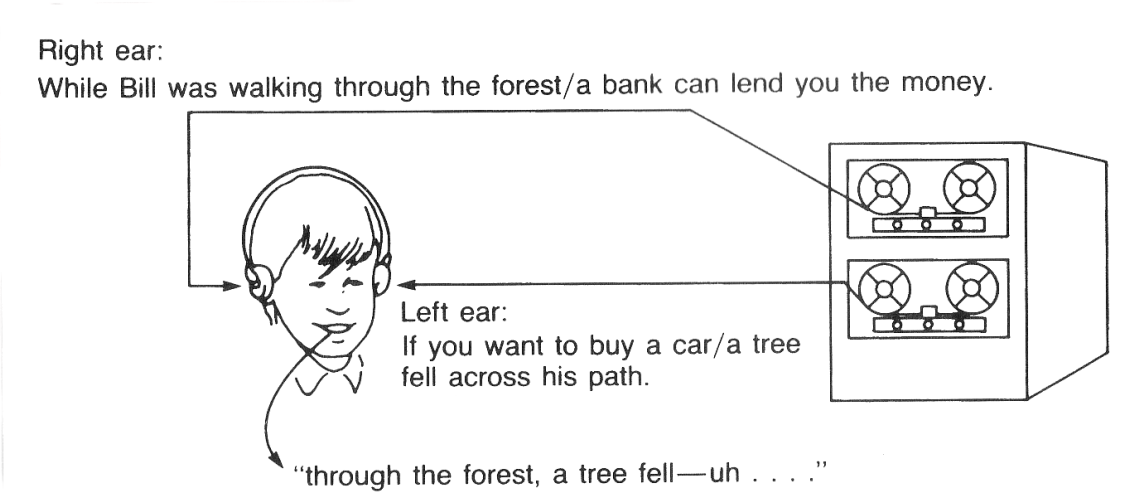


Moray's (1959) "cocktail party" effect explained

- one's own name has high relevance, and frequency of occurrence, in one's mental life
- corresponding entry in the mental dictionary has high permanent priority (i.e., low threshold)
- occurrence of name on the unattended channel likely to be noticed and result in the appropriate action

Treisman's (1960) results explained

- expectations can *temporarily* lower the thresholds of words in mental dictionary
- hence, fragments of unattended information will sometimes access meaning if they fit into the context of the attended message



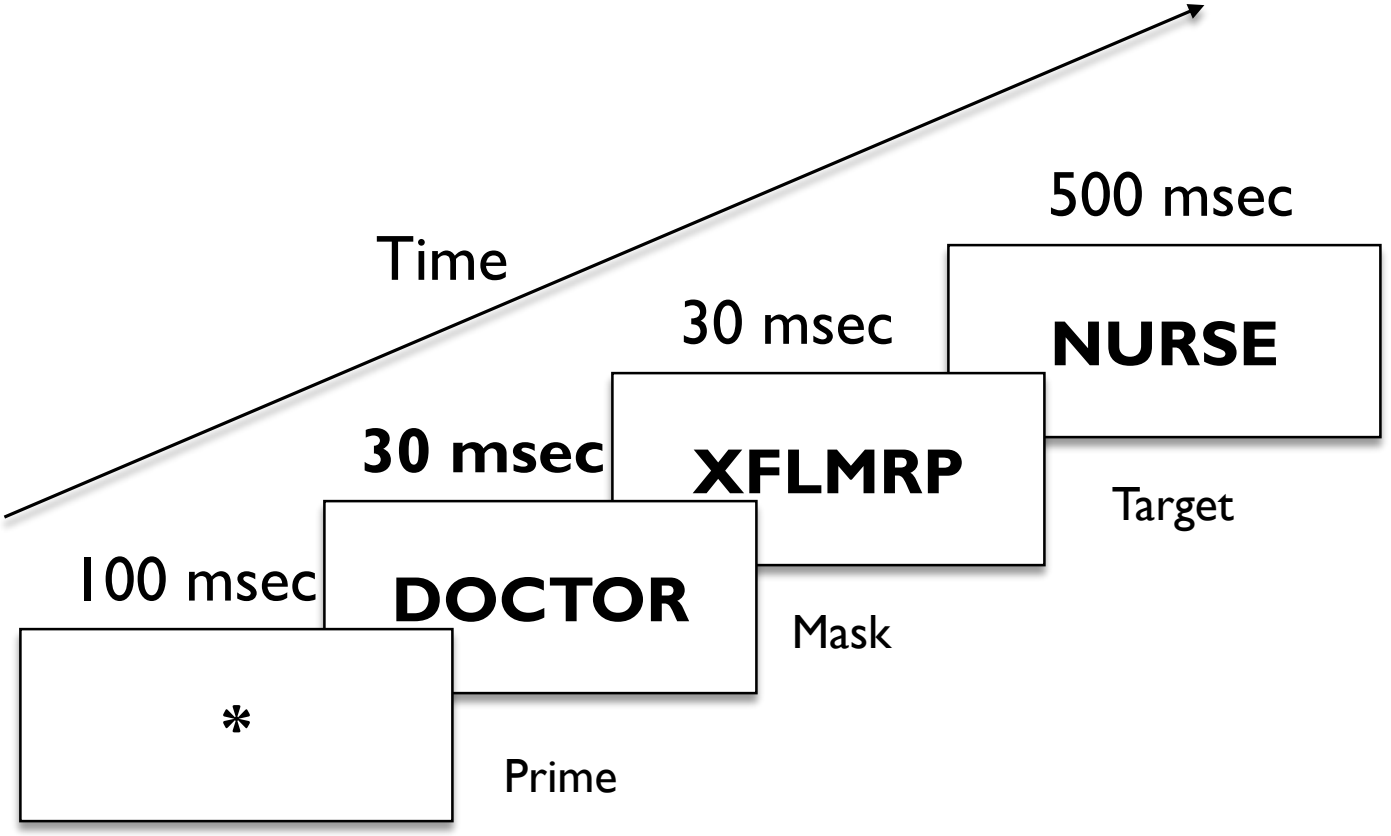
Interim summary - Where does the attentional bottleneck occur?

- *Early selection* theories (e.g., Broadbent, Treisman):
  - bottleneck occurs before the stage of pattern recognition
  - unattended stimuli can only be processed if attention is switched (Broadbent), or recognition threshold of information is low (Treisman)
- according to both theories, unattended information is usually not processed to the level of meaning

Late selection theories (e.g., Deutsch & Deutsch, 1963)

- contrary to theories outlined so far, *all* sensorial information is processed nonselectively and in parallel*, up to the level of meaning (!)*
- output of sensorial processing is placed in short-term memory
- information in STM is quickly lost (unless rehearsed) – loss acts as attentional bottleneck
- selection of information regarding conscious awareness occurs only *after* analysis of meaning

Evidence for late selection

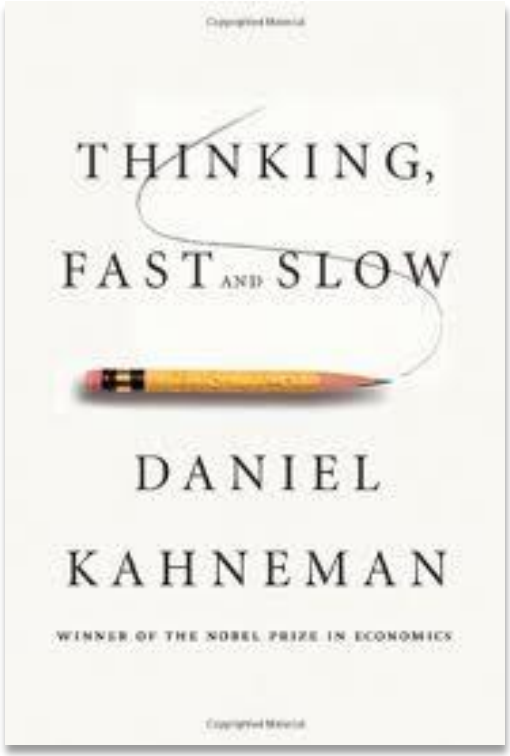


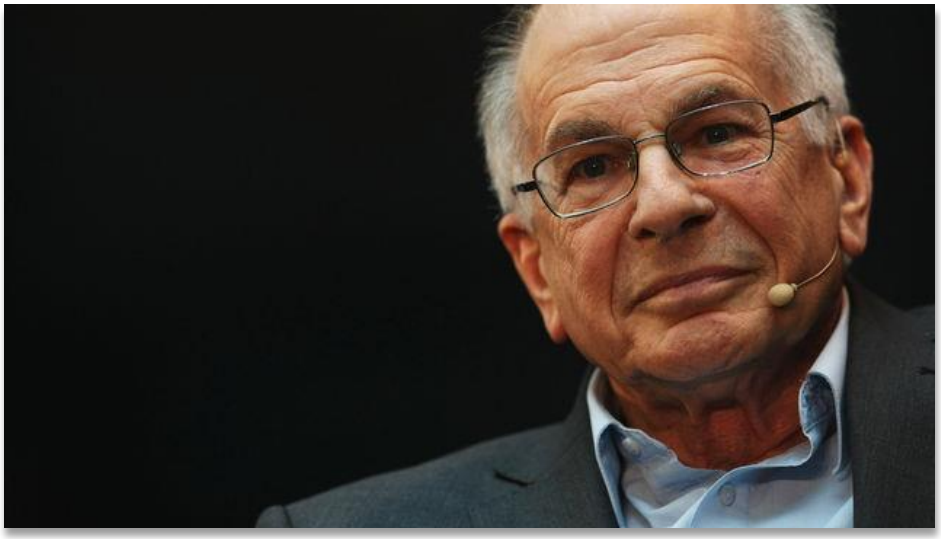
- "subliminal perception" (e.g., Marcel, 1983)
- some evidence that very briefly presented prime words are semantically processed and affect ("prime") processing speed of subsequent, semantically related target words

Mid 1970s: Shift of research perspective

- early theories of attention were preoccupied with attempts to locate the attentional bottleneck
- no agreement on the exact location of bottleneck - empirical results contradictory, with some evidence arguing for and against early and late selection
- more recent theories place an emphasis on *capacity*
- central assumption: performance in any non-trivial task is costly and requires mental effort

Daniel Kahneman – current bestseller…



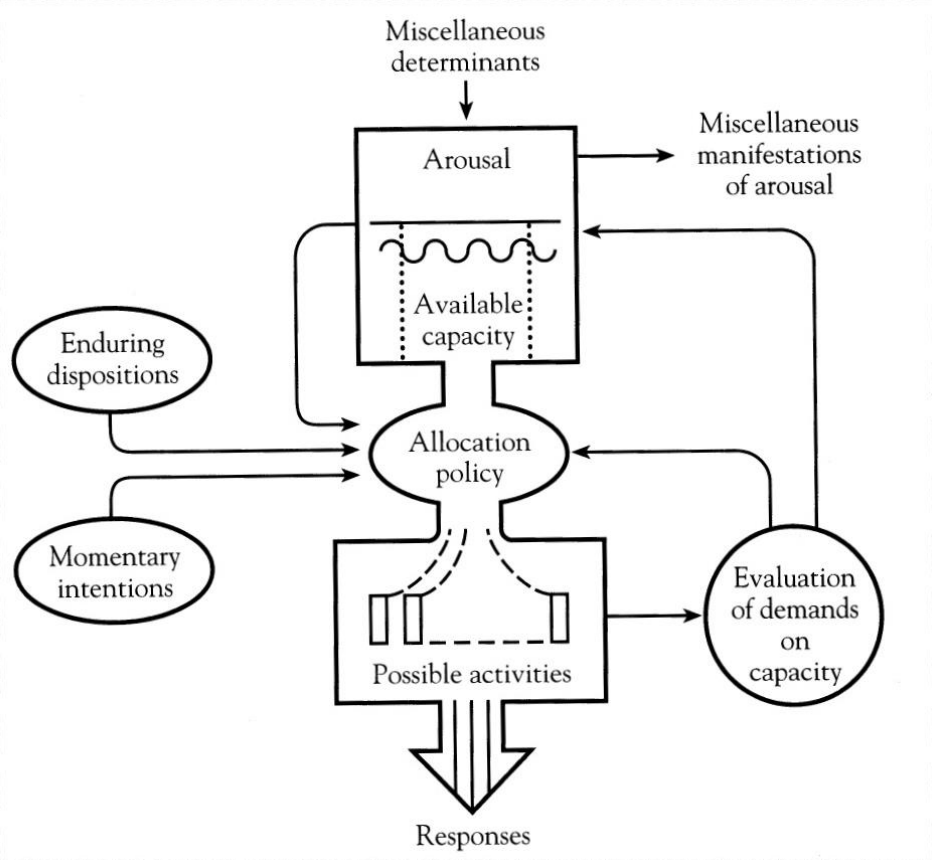


Kahneman (1973) - Capacity theory

- frequent inability to perform two tasks at once is not result of built-in attentional bottleneck
- rather, people have *limited-capacity pool of attention* to carry out mental activities
- if an activity is hard, it uses up all or most of attentional capacity
- availability of attentional resources is determined by a number of factors including:
  - arousal (determined by alertness, circadian rhythm, medication, etc.)
  - individual differences/dispositions
  - momentary intentions
  - task demands

Capacity theory of attention

- humans have substantial control over how their attention is allocated
- performance declines if attentional demand exceeds supply
- attention model must account for how people allocate limited capacity of attentional resources



Dual-task experiments

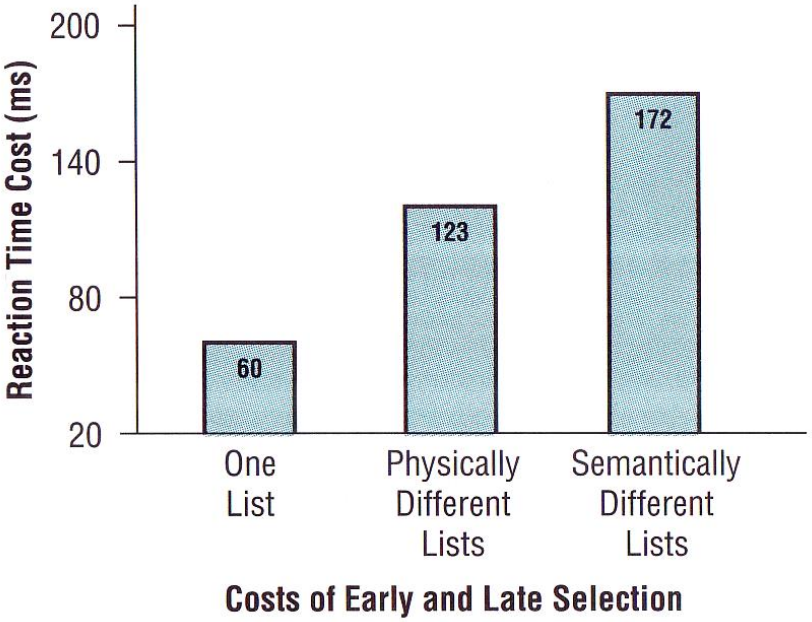
- a way of testing capacity theory of attention!
- dual-task experiment: individuals carry out two tasks at once, and measuring the effects of one task on the other
- if one task affects performance on the other, then they share common attentional resources

E.g. Johnston & Heinz (1978)

- *primary task* – a light flashes repeatedly and at random intervals, and participants press a button as quickly as possible when they detect it
- *secondary task* – at the same time, individuals "shadow" words simultaneously presented to both ears, either
  - by *simple repetition* (i.e., identical message was delivered to both ears) - EASY
  - according to *physical* category ("shadow what the female voice said") - HARDER
  - according to *semantic* category ("shadow the word that is a city") – HARDEST
- if speed of detecting the randomly flashing light (primary task) is affected by difficulty of shadowing (secondary task), then assumption of shared attentional pool would be supported

Johnston & Heinz (1978) - results

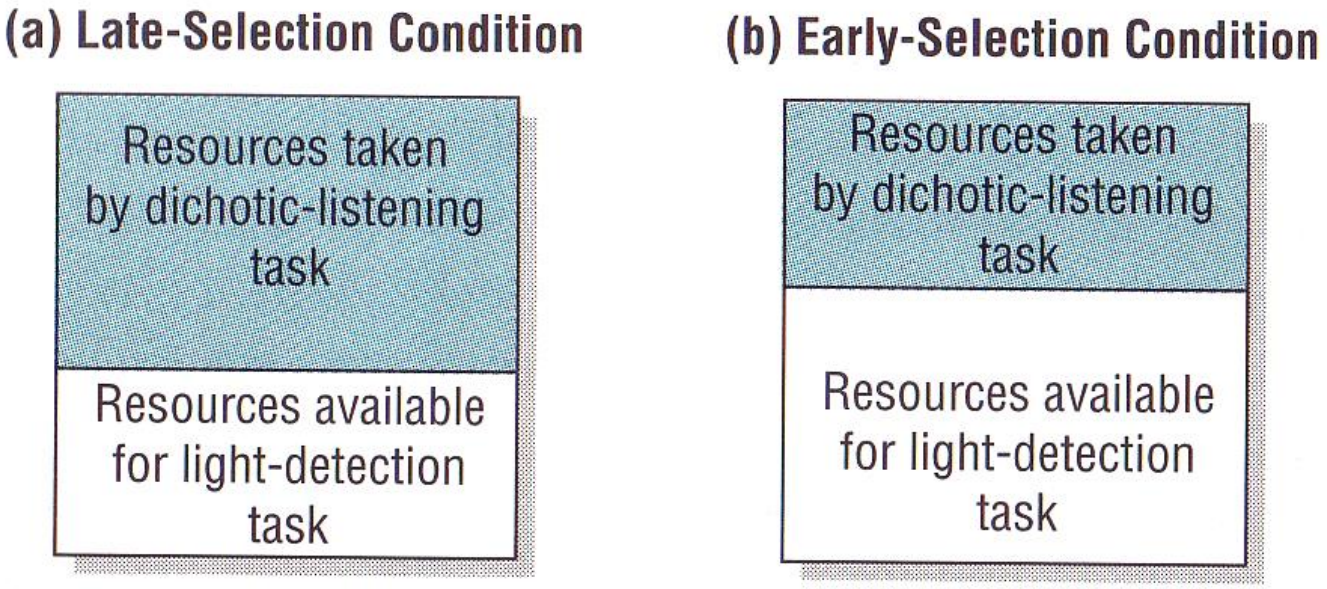
- response times to detect flashing light were
  - *fastest* when participants simply shadowed the message ("one list" condition)
  - *slower* when participants shadowed according to physical criterion
  - *slowest* when participants shadowed according to semantic criterion



Costs of Early and Late Selection

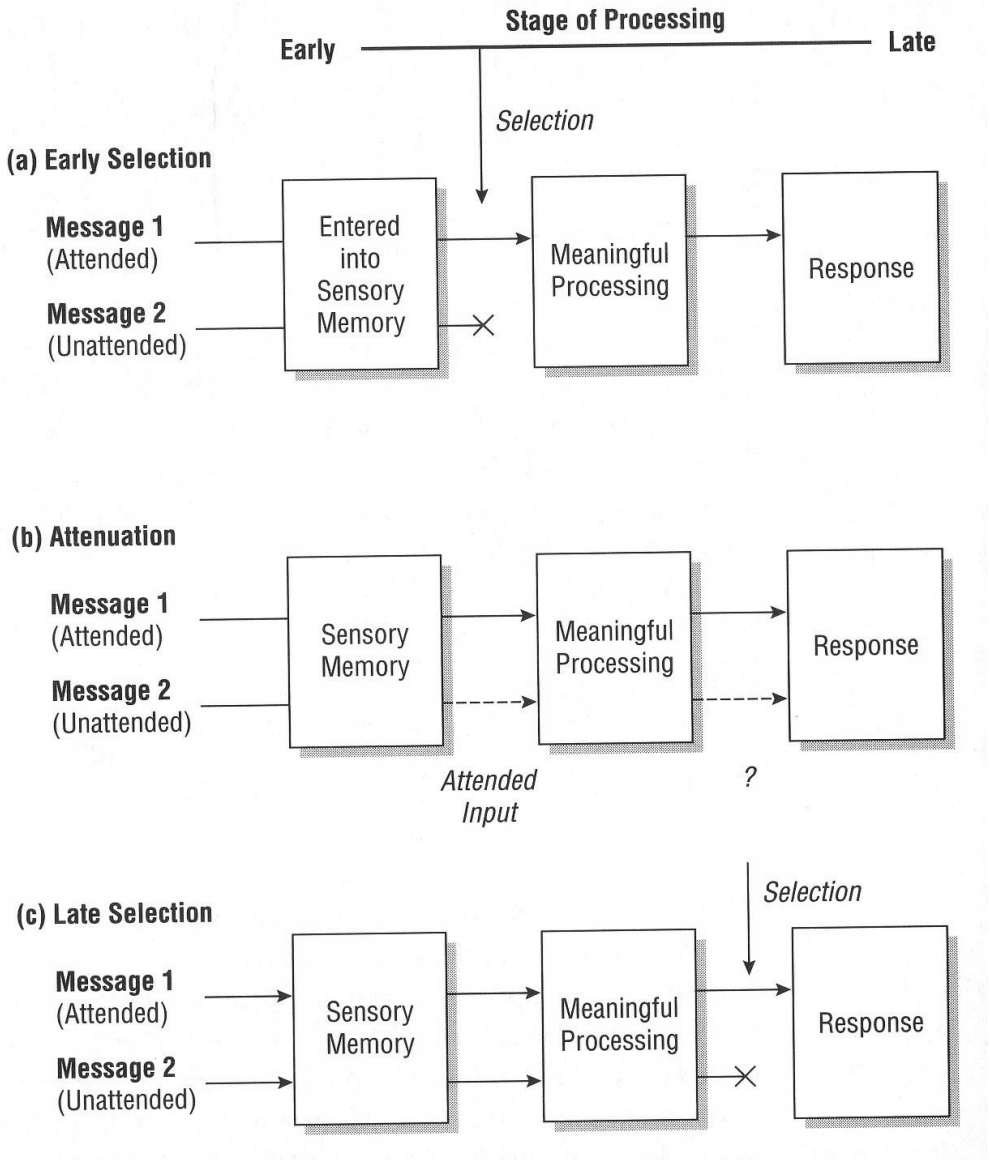
Reaction time <u>cost</u>: here, the difference between single-task responding to light (without any shadowing), and the dual task situation

Johnston & Heinz (1978)



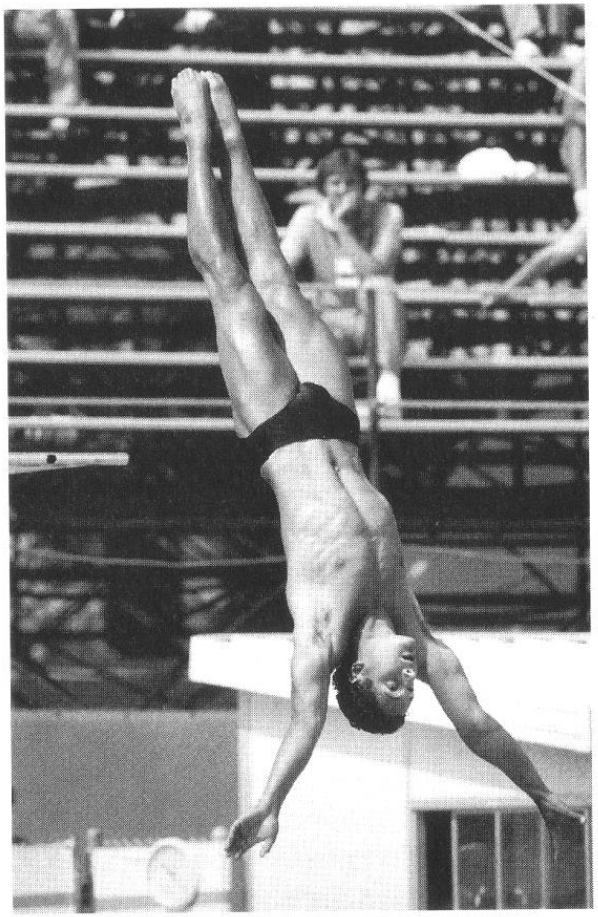
- selective attention requires capacity
- early selection mode (physical condition) requires less capacity than late selection mode (semantic condition)
- attention comes at a cost!

Interim summary – early vs. late attentional selection



Attention and automaticity

- complex activities are initially intensely attention-demanding
- with increasing skill, performance acquires more *automatic* processing mode
- shift from attention-demanding to automatic mode of processing occurs through *practice*



BANANAS VOMIT

Kahneman (2011), “Thinking, fast and slow”, p. 50

A lot happened to you during the last second or two. You experienced some unpleasant images and memories. Your face twisted slightly in an expression of disgust […]. Your heart rate increased, the hair on your arms rose a little, and your sweat glands were activated. In short, you responded to the disgusting word with an attenuated version of how you would react to the actual event. All of this was completely automatic, beyond your control. […]

The state of your memory has changed in other ways: you are now unusually ready to recognize and respond to objects and concepts associated with “vomit,” such as sick, stink, or nausea, and words associated with “bananas,” such as yellow and fruit, and perhaps apple and berries. This complex constellation of responses occurred quickly, automatically, and effortlessly. You did not will it and you could not stop it.

Posner & Snyder (1975)

- mental processes can generally be divided into *automatic* and *conscious/controlled*
- automatic processes are fast and not capacity-demanding; conscious ones are slower, and more demanding

DIAGNOSTIC CRITERIA FOR AUTOMATIC AND CONSCIOUS PROCESSING

Automatic	Conscious
The process occurs without intention, without a conscious decision.	The process occurs only with intention, with a deliberate decision.
The mental process is not open to conscious awareness or introspection.	The process is open to awareness and introspection.
The process consumes few if any conscious resources; that is, it consumes little if any conscious attention.	The process uses conscious resources; that is, it drains the pool of conscious attentional capacity.
(Informal) The process operates very rapidly, usually within 1 s.	(Informal) The process is slow, taking more than a second or two for completion.

John Ridley Stroop (1897-1973) – creator of a landmark task

- in a seminal article from 1935, created a landmark task in cognitive psychology
- see MacLeod, C. M. (1991) for a review of more than 400 (!) articles using Stroop tasks

Stroop (1935) – A demonstration of automaticity

- task: name the ink of the word, and try to ignore the word itself:

Stroop (1935) – A demonstration of automaticity

- task: name the ink of the word, and try to ignore the word itself:

- massive degree of interference (slowing down) when the word mis-cues responses

Automaticity account of Stroop effect

- "Stroop conflict" – a situation in which individuals find it difficult to ignore one dimension when responding to the other:

BLUE

- *ignored* dimension (in this case, word) is
  - highly practiced and overlearned
  - unintentionally and automatically processed to high level without demanding mental capacities
- *target* dimension (here, colour)
  - less automatic, and requires more effort
- incompatible information between dimensions creates conflict, resolution of which requires effort and time

Summary and key points

- early debates on attention were mainly framed in terms of “early” vs “late” attentional selection
- more recently, notion of limited capacity *pool of attentional resources* has become widely accepted
- activities which are initially highly attentionally demanding become more automatic via *practice*
- the Stroop task can be explained in terms of the to-be-ignored dimension (the word) undergoing highly automatic processing, and conflicting with the less-automatised dimension (colour naming)

References

Broadbent, D. E. (1958). *Perception and communication.* Oxford: University Press.

Cherry, E. C. (1953). Some experiments on the recognition of speech with one and with two ears. *Journal of the Acoustical Society of America, 25*, 975–979.

Deutsch, J. A., & Deutsch, D. (1963). Attention: Some theoretical considerations. *Psychological Review, 87,* 272–300.

Johnston, W., & Heinz, S. P. (1978). Flexibility and capacity demands of attention. *Journal of Experimental Psychology: General, 107*, 420-435.

Kahneman, D. (1973). *Attention and effort.* Englewood Cliffs, NJ: Prentice Hall.

MacLeod, C. M. (1991). Half a century of research on the Stroop effect: an integrative review. *Psychological Bulletin, 109,* 163-203.

Marcel, A. J. (1983). Conscious and unconscious perception: Experiments on visual masking and word recognition. *Cognitive Psychology, 15*, 197-237.

Moray, N. P. (1959). Attention in dichotic listening: Affective cues and the influence of instructions. Quarterly *Journal of Experimental Psychology, 11,* 56–60.

Posner, M. I. & Snyder, C. R. R. (1975). Attention and cognitive control. In R. L. Solso (Ed.*), Information processing and cognition: The Loyola symposium.* Hillsdale, NJ: Lawrence Erlbaum.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18(6),* 643-662.

Treisman, A. (1960). Contextual cues in selective listening. *Quarterly Journal of Experimental Psychology, 12,* 242–248.

Treisman, A., & Gelade, G. (1980). A feature integration theory of attention. *Cognitive Psychology, 12*, 97–136.