Cognitive Psychology

Vigilance, Focused Attention, and Divided Attention

Lesson III: Attention
module 13

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What is attention?

- Humans don't process all incoming sensory stimulation that is available
- Human information processing starts very early by seeking out, focusing, and selecting particular aspects of the available information
- Attention is the mechanism by which we restrict information processing to only a small fraction of the possible amount of information
- Attention includes both conscious processes and unconscious processes
- Often cognitive processes (such as object identification) are the end result of unconscious processing (visual grouping processes)

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Different views on attention

- Vigilance and signal detection
  - Waiting for one's luggage at the airport…
- Selective attention
  - Listening to a conversation at a party…
- Divided attention
  - Listening to a second conversation while still pretending to be engaged in the first one…
- Search
  - Searching for one's car in the parking lot…

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Vigilance

- **Vigilance refers to the ability to attend to a situation for an extended period of time**
  - The goal usually is the detection of "something" (more technically "a sensory event" or "signal")
- **Human performance**
  - Performance decreases with increasing time
  - Decrease can be due to
    - Loss of sensitivity (sensory adaptation)
    - Drifting attention (sometimes due to habituation)
    - Criterion changes (see signal detection theory)
- **Problem of fatigue**
  - Availability of frequent rest periods important

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Why is vigilance important? Plant operator

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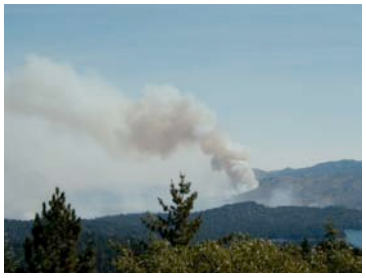
Why is this important?

This is a classic example of signal detection...



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Signal detection theory (SDT)

- **Perception can be viewed as decision making under uncertainty**
  - "Is that smoke over there, or just a cloud …?"
- **What we "decide" to perceive is based partially on the following**
  - The strength of the perceptual event (signal)
  - The amount of background events (noise)
  - A subjective threshold of the relative strength of signal to noise (criterion)
  - The benefits of detecting a signal vs. the costs of not detecting it or falsely detecting it
  - Expectancies (base rates - how likely is this?)
  - Selective attention

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Correct vs. false responses in SDT

real world \ observers reaction		report signal "fire!"	report no signal "no fire"
signal present	*fire is starting*	hit $1,000	miss $100,000
signal absent	*nothing*	false alarm $500	correct rejection $0

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Correct vs. false responses in SDT

real world \ observers reaction		report signal "guilty!"	report no signal "not guilty"
signal present	*person is guilty*	hit good	miss bad
signal absent	*person not guilty*	false alarm very bad	correct rejection good

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Selective attention: A fitting description

William James (1890)

> [Attention] is the taking possession of the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thoughts.
>
> ... It implies withdrawal from some things in order to deal effectively with others.

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Dichotic listening and shadowing procedures

- An example for selective attention

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Selective attention: Dichotic listening (Cherry, 1953)

- People can attend selectively to particular events or objects
- Cherry was the first to systematically investigate how humans attend to one of two simultaneous acoustical events
- His studies showed that...
  - Participants knew little about the content, language, well-formedness, etc. of the unattended message
  - Did notice gross features of the speakers (male / female, differences in tone of voice)
- We will revisit this phenomenon again in the next modules

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Divided attention

- **People can perform more than one task at a time (multi-tasking)**
  - Driving and reading billboards
  - Walking and chatting with a friend
  - Listening to a web-lecture and watching tv (we will see soon how well this might work;-)
- **Attentional resources can be allocated to different tasks depending on the processing needs**
  - When driving on an icy road, the driver doesn't read the billboards any more
- **Attentional resources are limited**
  - Tasks demand different amounts of attention

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Controlled vs. automatic processing

- **Cognitive processes can be differentiated based on the amount of cognitive control they require**
  - Tying shoe laces vs. imagining to walk home
  - Routine tasks vs. solving new problems
  - Continuum: total control to totally automatic
- **Learning, automatization, proceduralization**
  - Most tasks require less control after practice
  - Separate steps are integrated into one
  - Information is processed in larger units
  - Less step-by-step verification

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Controlled vs. automatic processing

Characteristic	Controlled	Automatic
Effort	**Intentional**	**No effort**
Conscious	**Fully available**	**Usually not**
Resources req.	**Large demand**	**Negligible**
Type of processing	**Serially**	**Parallel**
Speed	**Slow**	**fast**
Flexibility	**High**	**Low**
Level of processing	**High (analysis)**	**Low**
Difficulty	**Variable**	**Variable**

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The "limited attentional resources" view

- **The cognitive system has limited resources**
  - One general resource
  - Multiple (modality-)specific resources
- **Attentional processes require resources**
  - Each process uses up part of the resources
  - Processes compete for resources
  - Automatization reduces the amount of resources needed to perform the task
- **Divided attention**
  - Multiple attention demanding processes can be active at the same time as long as they don't require all of the resources

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Examples of automatization

- **Divided attention: Dual tasks**
  (Spelke, Hirst & Neisser, 1976)
  - Practicing reading for comprehension and writing down dictated words
  - Practice both tasks 5 days a week (85 sessions)
- **Performance**
  - In line with expectations, participants were much worse at performing both tasks simultaneously than in isolation
  - After enough practice, this difference vanished
  - Even when semantic categorization was required for dictated words, performance bounced back to normal performance in the dual task

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The risks of automatization: Classification of slips (James Reason,1990)

- **Capture error:**
  - automatic process takes over even though a deviation was planned
- **Omission/perseveration:**
  - because of an interruption steps are missed or repeated
- **Data-driven errors:**
  - Sensory information initiates / modifies the planned action
- **Loss-of-activation error:**
  - After the initiation of an action important information is lost (what am I doing?)