

9.63 Laboratory in Cognitive Science

Fall 2005

Lecture 9

Experimental Paradigms in Cognitive Science

Aude Oliva

Ben Balas, Charles Kemp

Approaches in Cognitive Science

Truth is ... In eternal abstract ideas of what objects represent—not in the objects themselves!

Truth is ... In the concrete world of objects that our bodies sense—in the objects themselves!

Rationalist

Empiricist

Cognitive Scientists base empirical observation on theory, but in turn use these observation to revise their theories

Paradigms

- What is a paradigm ?
- - An experimental method that is appropriate for studying particular phenomena.
- Questions to ask for a paradigm:
- (1) What questions or issues does the paradigm emphasize ? (goal of the paradigm)
- (2) What assumptions/hypothesis underlie the paradigm?

Attention

- Attention is concerned with resources and their limitations.
- At any given time, people have a certain amount of mental energy to devote to all the possible tasks and all the incoming information.
- If we devote portion of resources to one task, less is available to others.
- The most complex and unfamiliar the task, the more mental resources must be allocated to that task

Paradigms for Studying Attention

- Selection
 - Intelligent Selection
 - Inattention Paradigm
 - Inattentional Blindness
 - Attentional Blink
 - Change Blindness
 - Inattentional Amnesia
 - Visual Search
- Costs and Benefits
 - Attentional cuing paradigm
 - Voluntary vs. Involuntary
 - Shifting attention

Selective and Divided Attention

- Selective attention: we choose to attend to stimuli and ignore others
The concentrated focus of attention on particular stimuli or some information of those stimuli enhances our ability to manipulate them for other cognitive processes
- Divided attention: we allocate our available attentional resources to coordinate performances on more than one task at a time

Selective attention paradigm

- How do cognitive psychologists study what information people process about things to which they are not paying attention ?
- How do we present people with some information by making sure that they do not pay attention to it ?
- Simply instructing them to not pay attention is almost guaranteed to have the opposite effect (e.g. for the next 20 seconds, pay no attention to the feelings of your finger)

Selective attention: Paradigm of dichotic presentation

- The dichotic listening task: a person listen to an audiotape over a set of headphones. On the tape are different messages recording so as to be heard simultaneously in opposite ears.
- Participants are played 2 different messages and are asked to shadow (repeat aloud) one of them. This is a difficult task (150 words per minute)
- Then, participants are asked what they remember from either message (the attended message and the unattended message)
- Logic: the person must concentrate on the message to be shadowed. The task requires a great deal of mental resources. Fewer resources are available to process information from the non-attended message.

Figure removed due to copyright reasons.

Selective attention: Paradigm of dichotic presentation

- Information about the unattended message: participants could report whether the message contain speech or noise and if speech, whether the voice was a man or a woman.
- They could not remember semantic content.
- When language was switch from English to German, participants did not notice the switch
- Even if a list of words was repeated 35 times in the unattended ear, participants failed to recognize the occurrence of most words.

Selective attention: the gating mechanism

- To explain these findings, Broadbent proposed a filter theory of attention which states that there are limits of how much information a person can attend at any given time.
- If the amount of information exceeds the capacity, the person uses an attentional filter to let some information through and to block the rest.
- The "filter" can block some aspect of the information and let some other go.
- For Broadbent, we filter information right after we register it in the sensory level: information requiring higher analyses (like content, meaning, language) was not passing through the "gate".
- Some perceptual information (e.g. voice type, pitch) may pass through the gate

Figure removed due to copyright reasons.

Movie time ! 😊

- Dan Simon's movie...
- you will see two teams of basketball players. One wearing white shirts and one wearing black shirts. **Count the total number of time the white team passes the ball.**
- Then, I will ask you the result and we will see how many people are right.

• From "surprising studies of visual awareness". VisCog productions. Dan J. Simons (2003)

Selective visual attention Neisser & Berklen (1975)

- They created a selective looking task by having participants watch one of two visually superposed films. One film shows a hand-game, the second film show 3 people passing a basketball.
- Participants were asked to attend (shadow) to one of the film (selective attention) and to press a key whenever a target event occurs (a hand slap or pass in the game).

Selective visual attention: Neisser & Berklen (1975)

- Results: participants could follow the attended film easily, and could ignore occurrence of the target in the unattended film.
- Participants failed to notice unexpected events in the unattended film (but imagine the movies are in front of your eyes!). Participants monitoring the ball game failed to notice that in the hand game film, one of the players stopped hand slapping and began to throw a ball to the other player.

Selective attention in the wild

- **Real world situations**
(*Simons & Levin, 1998*)
 - Surreptitious substitution of a person (experimenter) asking directions to a pedestrian (participant). After 15-30 s two people interrupted the conversation by carrying a door between the two individuals. The experimenter was substituted when the door blocked him from the view of the participant. The two experimenters were wearing different clothes, were of differing heights, and had distinguishable voices.

Simons, D. J., & Levin, D. T. (1998). Failure to detect changes to people during a real-world interaction. Psychonomic Bulletin and Review, 5, 644-649.

Real world situations

Images removed due to copyright reasons.

Real world situations

- Experiment 1.
 - Only 7 of 15 pedestrians noticed the change.
 - The 7 participants were students with similar age as experimenters
 - Experiment 2
 - Construction workers
 - 12 pedestrian of younger age → Only 4 reported to have detected the change.
- Image removed due to copyright reasons.

Change blindness phenomena

- Change blindness is a phenomenon in visual perception where 'visible' changes occurring in a scene go unnoticed. This failure to detect change occurs even when changes in the visual scene are very large and when observers are explicitly instructed to look for changes.

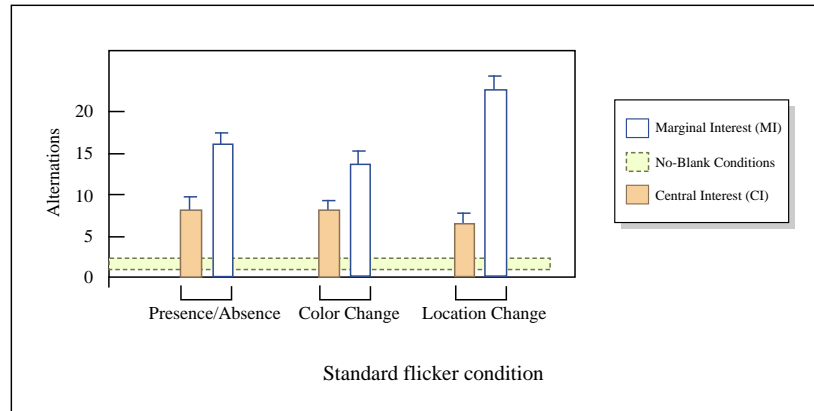
Change Blindness's paradigm

- **"Flicker paradigm"**

Figure removed due to copyright reasons.

Sequence is repeated 60s or until participant detects change

Change Blindness: Results



Graph by MIT OCW.

Factor 1: Type of change (3 levels)

Factor 2: Location of the change ("Center of interest" and "marginal interest")

Possible explanations of change blindness

- Simons (2000) distinguishes 5 possible explanations of change blindness results:

- Overwriting
- First impressions.
- Nothing is stored.
- Nothing is compared.
- Feature combination.

Images removed due to copyright reasons.

Overwriting

- **Overwriting**

- If representation of the first image is not abstracted it is replaced by the blank interval or by the subsequent image. Successful change detection occurs only for attended objects.
- Images removed due to copyright reasons.

First impressions

- **First impressions**

- Failure to encode features of the changed scene (but not initial image).
 - The goal of perception is to detect meaning first → If meaning is consistent across the change, the visual details of the changed image are not represented.
- Images removed due to copyright reasons.

Nothing is stored

- **Nothing is stored**

- Strong version → Only information that has been abstracted from the percept will be retained. Change detection should be impossible without abstraction. Few if any visual details of the second image would be retained after it disappears.
- Weaker version → some visual information (that needed on the next fixation) may be preserved across views (e.g. encode locations of objects but no features).

Images removed due to copyright reasons.

Nothing is compared

- **Everything is stored but nothing is compared**

- the visual/cognitive system may assume the views are consistent unless something in the meaning of the scene or task, triggers a comparison. Observers may fail to detect changes even if they have represented all of the details.
- Suggests the possibility that an implicit trace from a feature or object can be preserved, even when observers do not consciously perceive it.

Images removed due to copyright reasons.

Feature combination

- **Feature combination**

- Some features/objects might be retained from the first view and others might be retained from the second view. These features are recombined in a new representation (misinformation paradigm in eyewitness recognition research)

Images removed due to copyright reasons.

Other Remarks about Change Blindness

Scenes seem to be minimally represented in memory → Visual information is transferred via an attentional "bottleneck" to a very low capacity short term visual storage.

Visual transients → attracts attention (change, where).

Way image is encoded → encode location before change (what changed).

Advanced: Gradual or Progressive Change

Figure removed due to copyright reasons.

Please see:

Simons, D. J., S. L. Franconeri, and R. L. Reimer.

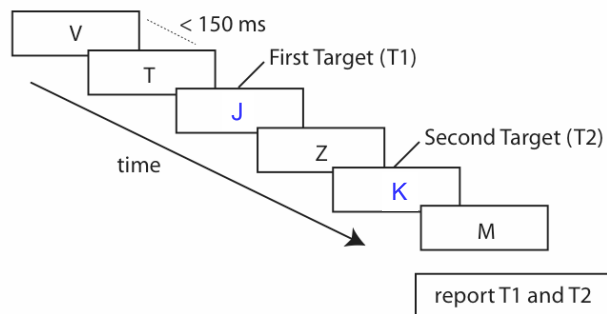
Figure 3 in "Change blindness in the absence of a visual disruption."

Perception 29 (2000): 1143-54.

Attentional Blink

- Attentional Blink is a phenomenon that occurs in RSVP tasks in which two targets are presented among distractors items.
- In studies of temporal attention, there is a reliable finding that attention is not available to identify or detect a second target for about 500 msec, after successful report of a first target
- A two stage model of the attentional blink: a rapid and initial representation of visual items followed by a slow, capacity limited and attention demanding consolidation of these items

Demos of Attentional Blink



A sequence of 19 letters will appear (each letter for 100 msec). Your task is to determine whether the letter J or K were in the sequence (press the J key or the K key) If you see both letters, press each in any order. If you do not see any letter, do not press either key

Attentional Blink

- RSVP: rapid serial visual presentation
 - 11 items/second, first target remembered
 - IF 2nd target comes $>500\text{ms}$ after 1st, also remembered
 - BUT, if 2nd target comes 200-500ms after first target, it is completely missed.
- After the 1st target grabs attention, there is a period when attention cannot be diverted to a new target

Figure removed due to copyright reasons.

Selective attention in scale space

Images removed due to copyright reasons.

Please see:

Schyns, Philippe G., and Aude Oliva.

Figure 1 in "Dr. Angry and Mr. Smile: when categorization flexibly modifies the perception of faces in rapid visual presentations." *Cognition* 69 (1999): 243-265.

Man vs. woman?
Expressive vs. non-expressive?
Neutral, angry or happy?
Mary or John ?

Selective attention in scale space

Images removed due to copyright reasons.

Please see:

Schyns, Philippe G., and Aude Oliva.

Figure 1 and 3 in "Dr. Angry and Mr. Smile: when categorization flexibly modifies the perception of faces in rapid visual presentations." *Cognition* 69 (1999): 243-265.

Different face categorizations elicited a different usage of spatial scales

Divided Attention

- We often manage to engage in more than one task at a time and we shift our attentional resources to allocate them as needed
- Example: experienced drivers easily can talk while driving under most circumstances, but they can quickly shift all their attention from talking and toward driving...
- Question: how difficult is it to do 2 or more tasks at once ?
- => Dual-task performance

Divided attention while driving: a dangerous dual task

- A dual task performance in the real world.
- Legislation: prohibit drivers from talking on cell phones while behind the wheel.
- Using cell phones while driving is believed to be a major cause in 50% of highway accidents.
- The argument is: talking on a cell phone distracts the driver's attention from navigating the vehicle on the road

Talking on a Cellular Telephone Dramatically Increases Sustained Inattention Blindness

Brian Scholl, Nicholas Noles,
Rachel Sussman, & Vanya Pasheva

Yale
Perception & Cognition
Laboratory

<http://www.yale.edu/perception/>

Multiple-Object Tracking

1. Requires *sustained* attention (vs. shifts)
2. Inherently *active* tracking (vs. monitoring)
3. No required strict timing constraints!
4. Yields relatively large & salient effects
5. *Can easily vary the attentional load . . .*

• Scholl et al (2003)

Method Notes

- Natural cellphone conversation
- MOT: Track 3 in 7 black circles
- Extra items: 4 white Ls
- Tracking for 15 s, UE (red cross) visible for 5 s
- 20 subjects / condition
- 4 Track-only trials preceding critical trial

• Scholl et al (2003)

Results (UE =)

		Tracking Task	% Noticing
Image removed due to copyright reasons.	Baseline	77.2%	70%
	Cellphone	78.4%	10%

• Scholl et al (2003)

Results (UE =)

	Tracking Task	% Noticing
Baseline	77.2%	70%
Cellphone	78.4%	10%
Talking	75.1%	25%
Listening	78.9%	5%
Shadowing	76.4%	25%

Image removed due to copyright reasons.

- Scholl et al (2003)

Implications

... for Human Factors (+Policy)

- Inattention blindness may be a critical cause of collisions

... for Psychology

- Perception research can be ecologically valid!
- The multi-modal nature of attention
- Interference between modalities.

- Scholl et al (2003)