(In)Attention and Visual Awareness
IAT814

Week 5 Lecture B
4.02.2009

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Administrivia

- Assignment 2 (already!)
  - I will be assigning slots based on an inverse order from last assignment
  - 15 minute presentation
  - ~10 page paper

- The final project
  - Schedule individual meetings with me next week to clear scope
  - Read the guidelines on the policy page
  - This course has human ethics approval

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This is a useful topic

- Understand why you can get students to shut their devices in class ☺
- Complaints about inattentive and distracting behaviour
  - Talking
  - Texting
  - Surfing and gaming on laptops

- More fundamentally, inform us on limited and realistic expectations

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What is Attention ?

- "Everyone knows what attention is. It is the taking possession by the mind in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought...It implies withdrawal from some things in order to deal effectively with others, and is a condition which has a real opposite in the confused, dazed, scatterbrained state."
  William James (1890, p. 403)

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What is attention?

- the process whereby a person concentrates on some features of the environment to the (relative) exclusion of others

- The concentration of mental effort on sensory or mental events

- The ability to "pay" attention at both a low and high level is fundamental to how we manage to process information and control external tools and machines in the world.

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Recap from Monday: bottom-up attention

- Some features are processed efficiently, possibly in parallel, across the visual field.
- These basic features include color, orientation, shapes, motion.
- Search for items based on single features leads to efficient search.
- The items "pop out" of the surrounding distractors.

- Search for conjunction of features is inefficient.
- An example would be searching for a red square among blue squares and red triangles.
- We must examine each item individually to find the target.

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What this tells us

- Inefficient searches show that we are not aware of everything in the entire scene at the same time.

- We constantly shift our gaze and our attention to look at different parts of the scene and examine them in detail.

- We think we see the scene in detail, but we don't.

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Task-driven

- Yarbus (1967) recorded observers' fixations and saccades whilst answering specific questions given to them about the scene they were viewing.
- Saccadic patterns produced were dependent on the question that had been asked.

- Implication [Ward 07]– if we don't perceive parts of the scene what's the point rendering it to such a high level of fidelity?!

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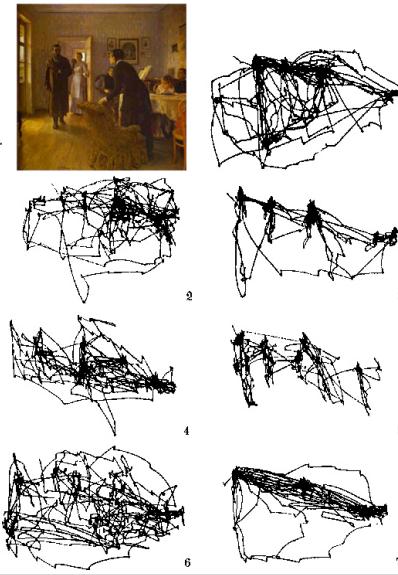
A Game

- Two teams: white and black shirts
- Each team passes a ball
- Count how many times the black-shirt team passes
- You need to be very focused to get it right.

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- http://viscog.beckman.uiuc.edu/flashmovie/15.php

- Discussion: what are the practical implications of this for everyday life?

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Inattentional blindness

- Phenomena of inability to perceive features in a visual scene if they are not being attended to.

- Are there only some kinds of things we see when we are not attending?

- What is the relationship between attention and perception?

- How much, if anything, of our (visual) world do we perceive when we are not attending to it?

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Attention

Determines
- What information makes it "in" through perception
- How that information is cognitively processed
- How we subsequently act or interact

- In all modalities you are faster and more accurate when you consciously attend to a task

- Attention has a limited capacity

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Early and late selection

Early selection:
- Low level features determine what gets through, or cues
  – Volume
  – Motion
  – Brightness
 – "onset"
  – Attentional "grab"

Late selection
- Everything gets through perceptual filter
- Selection is based on importance of recognised percept
- Problems with determining complexity of single channel switching.

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Main models in attention research

- Selective attention (focused):
  – Whether we become aware of sensory information
  – Non-random selection
  – Stream/bottleneck model

- Divided Attention (multitasking)
  – Attention can be split between multiple tasks
  – Allocation approach
  – Is what some of you are doing right now

- Control and Automaticity

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Selective Attention
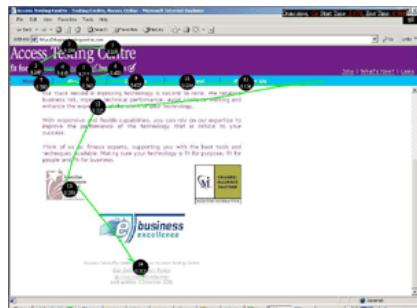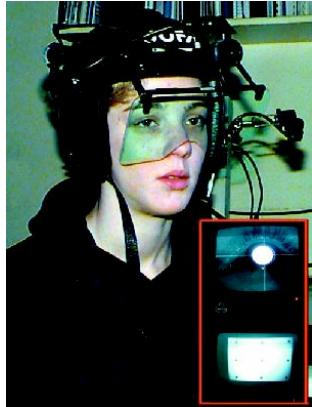
- Spotlight model
- Eye movements/fixation

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Divided attention

- More recent models of attention as a resource that is allocated between processes

- Top-down, consciously driven "spotlight" set: focus of attention
  - How many foci can we maintain?
  - What kinds of tasks demand more resources than others?

- Bottom-up, stimulus driven "demand" events
  - Involuntary response to perceptual cue
  - Flashing light or alarm bell

- How much can we attend to? No established capacity

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Conscious attention and restricted awareness

- Can we be conscious of things without attending to them?

- Are there only some kinds of things we see when we are not attending?

- If we don't have a highly salient cue of some kind, we will miss changes in the world
  - Motion
  - Sound
  - sensation

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- Demo http://www.usd.edu/psyc301/ChangeBlindness.htm

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- We are constantly making rapid eye movements, known as saccades, as we scan a scene.
- Vision is suppressed during saccades.
- People fail to notice large changes in the scene if the change occurs during a saccade. (McConkie, Grimes, Ballard and others).
- People also fail to notice large changes in the scene if they occur during a brief disruption (e.g. short blank period).
- This is known as *change blindness*. (Rensink et al., 1996)

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- A cut between scenes, with a change in camera angle, can also induce change blindness. Simons and Levin showed this in a series of experiments.
- Can you detect the changes?
    - http://viscog.beckman.uiuc.edu/grafs/demos/11.html
- Only 1 in 10 people detected a change.
- Change blindness occurs even for objects that are the center of attention:
    - http://viscog.beckman.uiuc.edu/grafs/demos/23.html
- Only 33% of 40 people noticed the main change.
- Disruptions in real life can also lead to change blindness:
    - http://viscog.beckman.uiuc.edu/grafs/demos/12.html

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What's going on?

- What causes change blindness?
  - We don't see the entire scene in detail.
  - Only the region attended to is seen in detail.
- We constantly shift our eyes to see other parts of the scene in detail.
- Only attended regions get into short term memory.
  - Briefly presented pictures are quickly forgotten (Intraub, 1981; Potter, 1976)
- We must serially scan the picture, item by item, to find the one that is changing.
- Attention is not enough.
  - Change in actors show that attention is not enough.
- We must intentionally process the details in order to detect the changes.

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Automatic and controlled processing

Automatic processing (automaticity):

- Highly familiar and learned/known tasks
- Do not require conscious attention
- Occur without intention
- Not available for conscious inspection
- Well practiced responses
- Unaffected by capacity
- Fast
- Difficult to modify

- Driving a car
- reading

Controlled attention

- Require conscious attention
- Takes resources
- Limited capacity
- Not well practiced
- Slow

- Driving on the other side of the road
- Reading unfamiliar/rare words

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Automaticity: the Stroop Effect

- blue   green   red   yellow
- blue   green   red   yellow
- ▮   ▮   ▮   ▮
- blue   green   red   yellow

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There's never enough of it to go around

- "What information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention, and a need to allocate efficiently among the overabundance of information sources that might consume it."

  --Herbert Simon, The Sciences of the Artificial

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The real-life nature of the issue

- CF-5 cockpit

The cell phone study

- Cell phone use in driving has been linked to 400% increase in accidents

- Assumptions: issue is interference due to handling the cell phone

BUT

- No reduction in accidents for those who used hands' free models.

- Why??

The cell phone study conclusion

- Cell phone use is an automatic process

- During normal car conversations there will be lulls when the driver stops responding/talking because the road conditions require more attention

- The passenger is aware of the change in conditions and simply waits for the conversation to continue…

- A cell phone caller will increase the demands on the driver, "Hello? Are you still there? Can you hear me now?

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Factors affecting attention

- Stress
  - Environmental stressors
    - Noise, heat, light
  - Physical conditions
    - Fatigue, impairment (e.g. blurred vision)
  - Psychological factors
    - Fear, anger, boredom, excitement

- Optimal level of arousal
  - Performance deteriorates after it is reached

- Current level of demand
  - It's not an unlimited resource!

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Designing for attention

Two basic goals
1. Provide relevant information without overloading the user

2. Attract and engage the user's attention appropriately
   – Situation awareness

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- How to best represent information in a display so that a user finds relevant information?
- How best to avoid distraction?

  – Salience (how perceptually efficient and attractive it is)
  – Expectation (what and where I expect to see it)
  – Value/Pertinence (relates to emphasis)
  – Effort (how much work do I have to put in to find/see/decode it?)

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Three Specific Tasks

- Supervisory Control Sampling

- Target Search/Sampling

- Structured Visual Search

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1. Visual supervisory control

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Design Principles

- Visual scanning in info displays - monitoring (vigilance)
- Situation awareness

1. Build on mental models
2. Consider direction of scanning and group components
3. Provide sampling reminders
4. Create expectation via preview
5. Reminders during failure
6. Do not use highly salient cues for low-priority events

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2. Visual Target Detection

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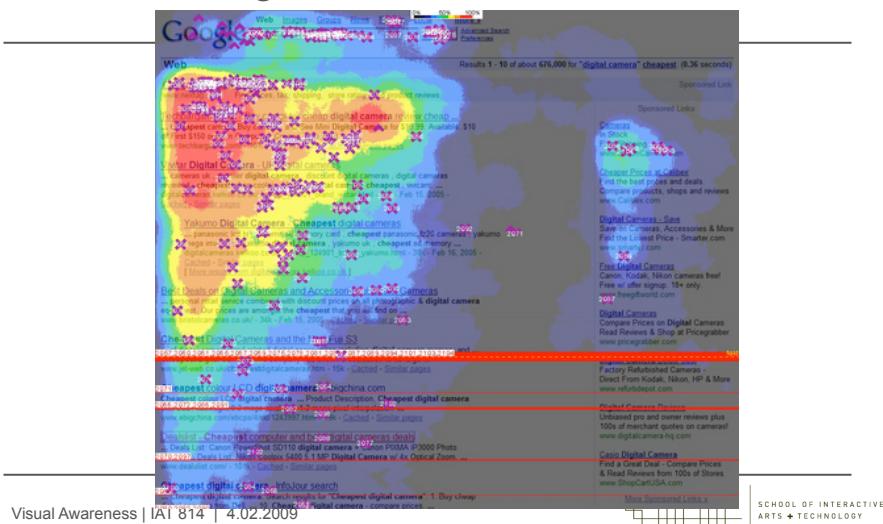
Design Strategies

1. Serial vs parallel search?

2. Order and conflation of dimensions

3. Guidelines for Target properties which will induce faster search

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Target Properties Inducing Parallel Search

- Discriminability from background elements
  - color, size, brightness, and motion

- Simplicity
  - Defined only by one dimension
  - No conjunctive search (look for the red square)

- Automaticity:
  - highly familiar

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Design Principles

Visual target search in info displays

1. Leverage or train expectation
2. Use salience
3. Combine display & conceptually driven cues
   – Avoid singletons
   – Avoid edges
4. Consider effects of aging

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3. Structured Visual Search

- Design structure of search

- Menus

- Minimize time to frequent targets
  – Top down
  – Linear search
  – Avoid similarity

- Speed is proportional to distance from top

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Rapid Serial Visual Presentation

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Divided & Focused Attentions (Reconsider)

- We're bad multitaskers

- Unless one task is automatic

- Less effect for different modalities

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Summary

- Attention determines perception
- General factors
- Three tasks and task-specific factors
- Principles for design

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