

SI 388

Attention & Performance

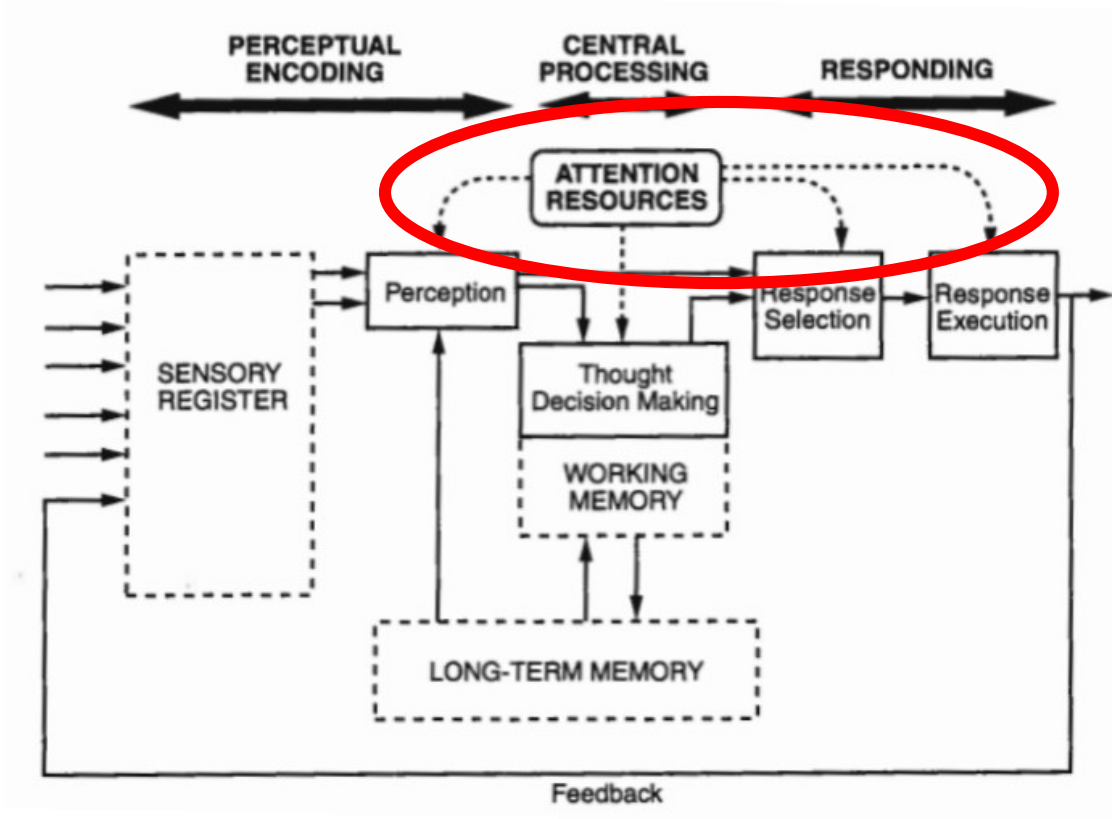
WEEK 5-1 (MON 2 OCT)

MARK THOMPSON-KOLAR, MSI, MA

Agenda for Today

- ❑ Schedule was updated in Canvas.
 - ❑ No big changes, just shifting some topics and in-class exercise dates.
- ❑ Note about Wednesday
 - ❑ Class starts at 11:10 am (I have a faculty meeting until then).
- ❑ Teach A Chapter: Groups 5, 6
- ❑ Finish Perception 4-2 lecture
- ❑ Lecture 5-1: Attention and Performance

Human Information Processing Model



- ❑ **Cognitive resources** = capacity for attention or mental effort
- ❑ **LIMITED!**
- ❑ Allocated to processes as needed
- ❑ Brain handles bottlenecks through *selective attention*

Types of Attention

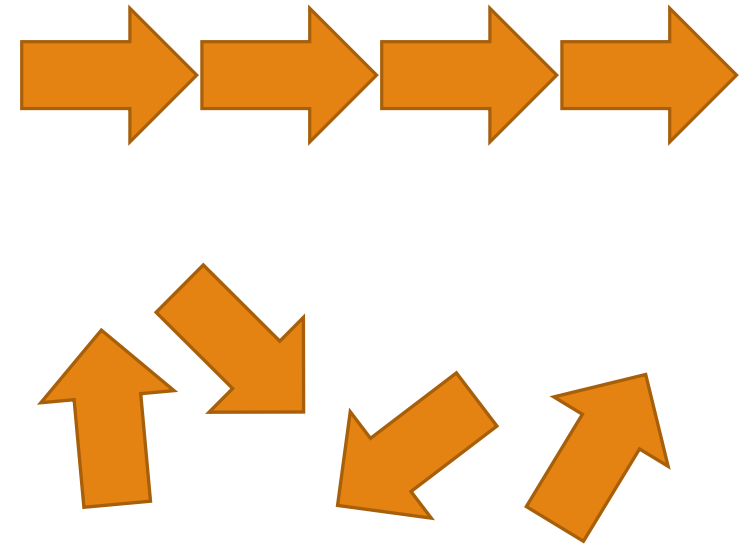
❑ **Goal-directed Attention** = (*endogenous control*). Our intentional *goals* direct our attention to filter out stimuli we're not interested in.

❑ Goals (and Effort Value)

❑ **Stimulus-driven Attention** = (*exogenous control*). Salient factors cause us to filter out less-salient stimuli.

❑ Salience

❑ Class has mixed these types in previous lectures (they're both *selective attention*).



Searchlight Metaphor

- ❑ People can only focus on “one thing at a time”
- ❑ Attending to something different like redirecting the light
- ❑ Beam picks up wanted *and unwanted* information
- ❑ Is a useful (simple) metaphor for HCI



Searchlight Metaphor – Audio

Particularly appropriate for visual channel, but **also true for audio channels**.

- ❑ Humans can only attend effectively to *one* audio message when more than one audio message is presented.
- ❑ Attention can be based on physical characteristics, such as pitch or intensity.
- ❑ Attention can be based on meaning — semantic content.



Auditory Attention



❑ **Cocktail party effect** = people can focus their auditory attention on a particular stimulus (conversation) while filtering out lots of other stimuli (activity).

https://en.wikipedia.org/wiki/Cocktail_party_effect

❑ Example of *goal-directed attention*.

Visual Scanning and Attention

Revisiting a few perception concepts with emphasis on attention

- ❑ Foveal vision connects perception and attention
- ❑ Visual system uses saccades and fixations to scan visual field
- ❑ Scanning processes:
 - **Supervisory Control.** Directing attention in particular patterns based on *expected* information. (Top-down process, based on memories)
 - **Target Search.** Looking for info in unknown location (Primarily bottom-up)

Visual Scanning Processes

Supervisory control
Scanning where you expect information to be located

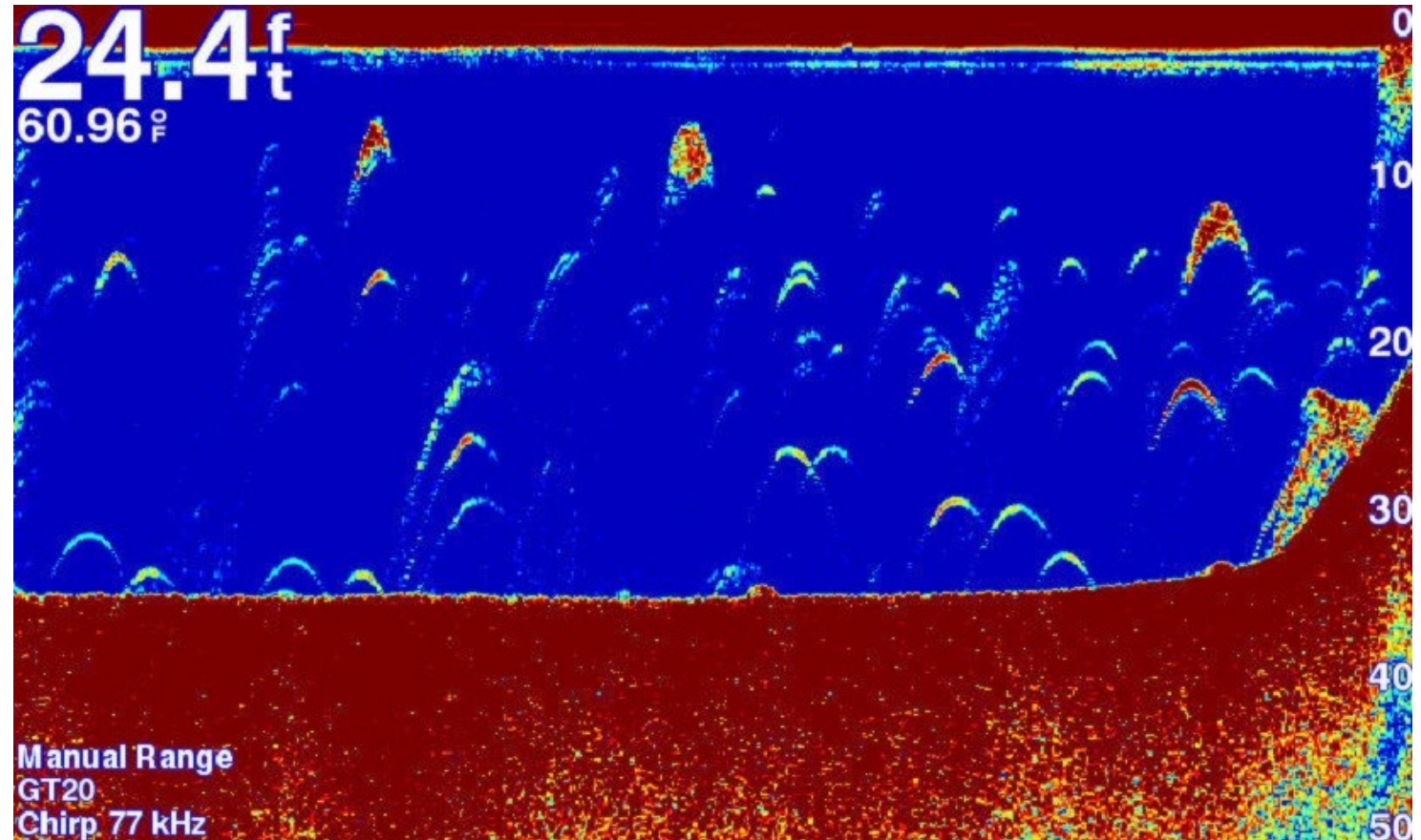
Ex: Vehicle dashboards



Visual Scanning Processes

Target search

Looking for information in an unknown location: It's never certain where the fish indicators will be on the screen.



Visual Scanning Processes

Travel results page

Eye-tracking results for users in a study asked to identify “Where do these getaways go”?

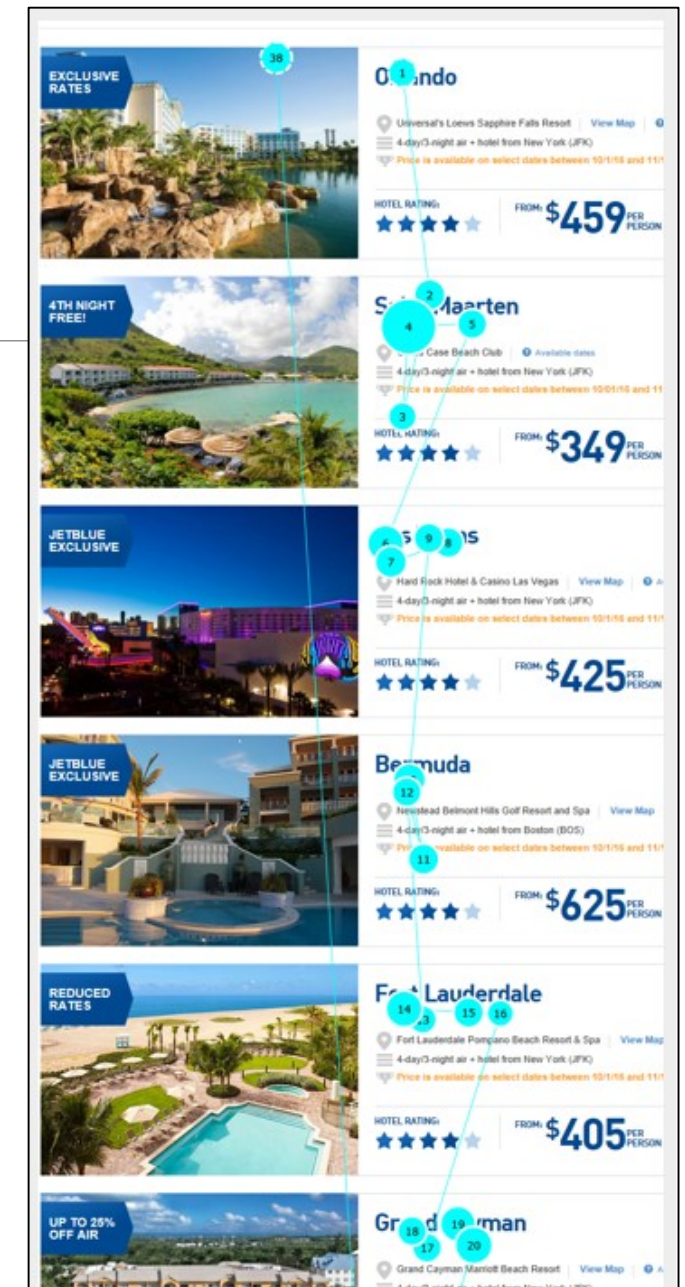
Eyes scan down the names, avoiding most other information.

They don’t go all around. Very disciplined.

Is Supervisory Control scanning

Pernice, K. (2017). Scanning Patterns on the Web Are Optimized for the Current Task.

<https://www.nngroup.com/articles/eyetracking-tasks-efficient-scanning/>



Making Sense of Visual Elements Requires Attention

- ❑ **Binding Problem** = Mystery of how brain combines various visual features together to produce perception
- ❑ *Attention* to the visual features is required
- ❑ Theory: Attention suppresses responses to all features in the receptive field **except** what's being attended to

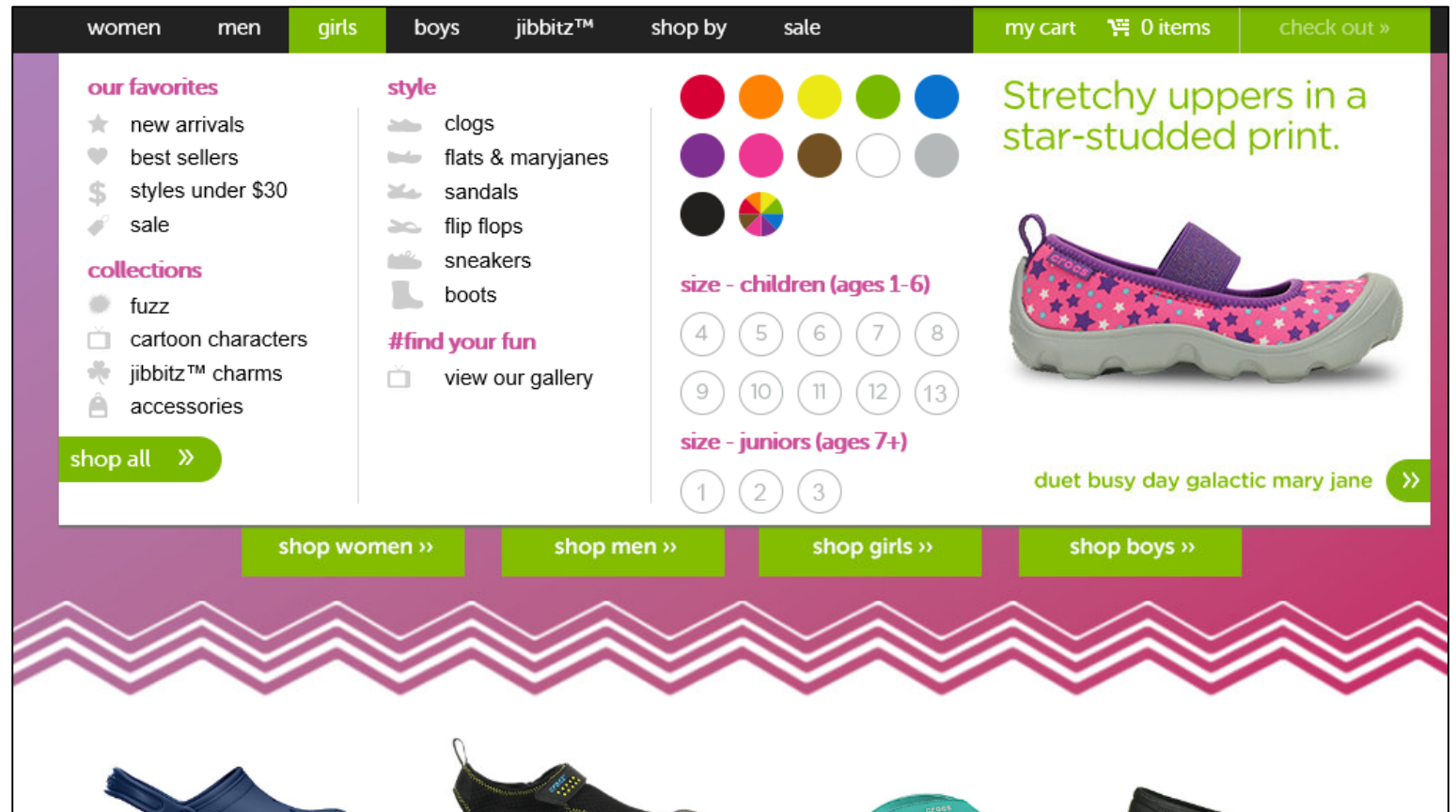
Check out the video...

Binding Problem - Attention

**Count how many times
the players wearing
white pass the ball**

Focused Attention: Design Implications

- ❑ Attention is necessary to find items of interest
- ❑ Pop-out effects overloaded by so many salient elements.
- ❑ Excessive stimuli compete for limited attention resources.
- ❑ Emphasize what your data shows you to be MOST important to your users.



Focused Attention: Design Implications

- ❑ If a task is immersive for users, reduce distractions.
 - Remove all unnecessary navigation
 - Use lots of white space
 - Provide firm visual lines via left alignment (facilitates easier eye saccades)

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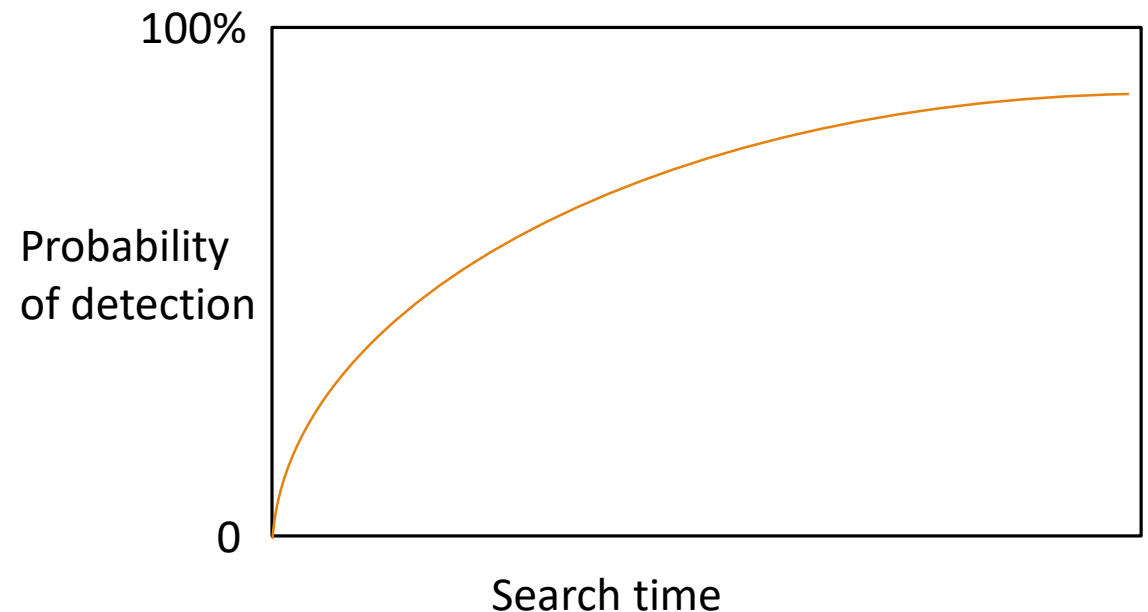
SEND TO TECHSMITH

Inhibition of Return

- ❑ **Inhibition of return** = principle that people are slower to return their attention back to regions or object *they already have looked at*
- ❑ Design implication: Be wary of changing pages where people previously looked.
 - ❑ Error messages only at the top of the page, outside of Foveal Vision.
 - ❑ Settings that change as result of further selections
 - ❑ Add salience in such instances ^.

Search Duration and Attention

- ❑ How long will you look if you're not sure anything is there?
- ❑ Probability of detecting a 'flaw' as a function of time
- ❑ Each minute of search, the less likely you are to find the target in the next minute
- ❑ There is an optimum amount of time to search in particular situations



Drury, C. (2002). Good Practices in Visual Inspection. Applied Ergonomics Group. Williamsville, NY.

Search Duration and Attention

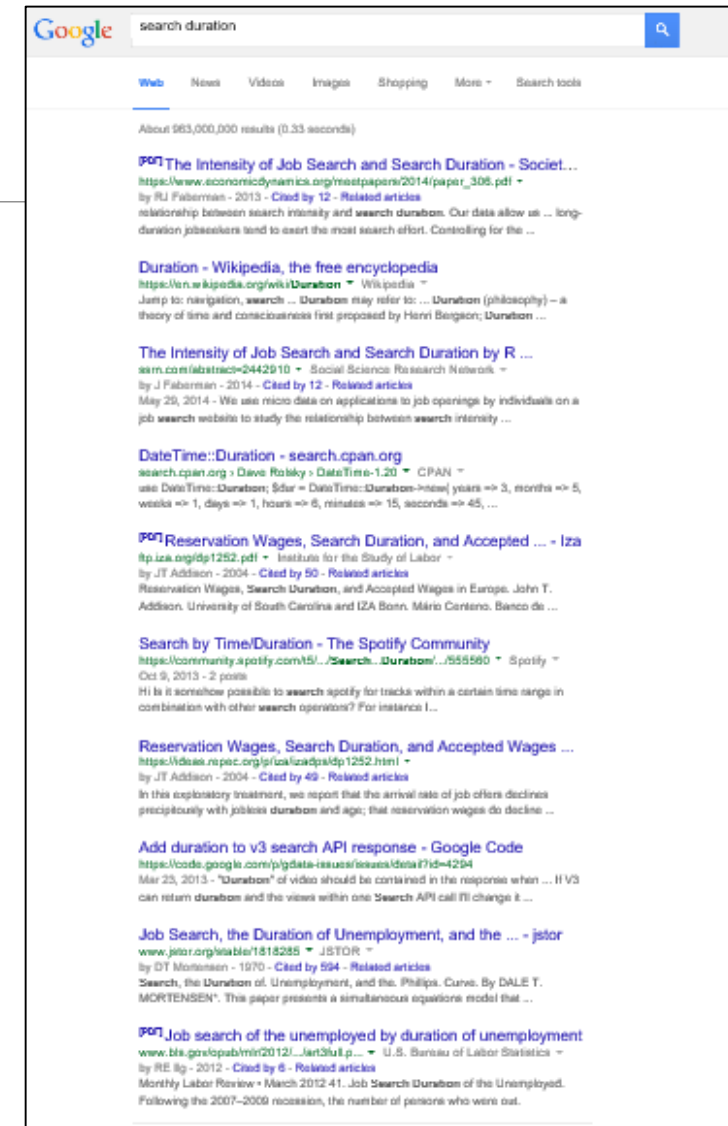
More design implications:

❑ Search Results Pages (SRPs): Most users don't go past first

- Page 1: 92% of page traffic
- Page 2: 5% of page traffic
- Page 3: 1% of page traffic
- Page 4+: <0.5% of page traffic

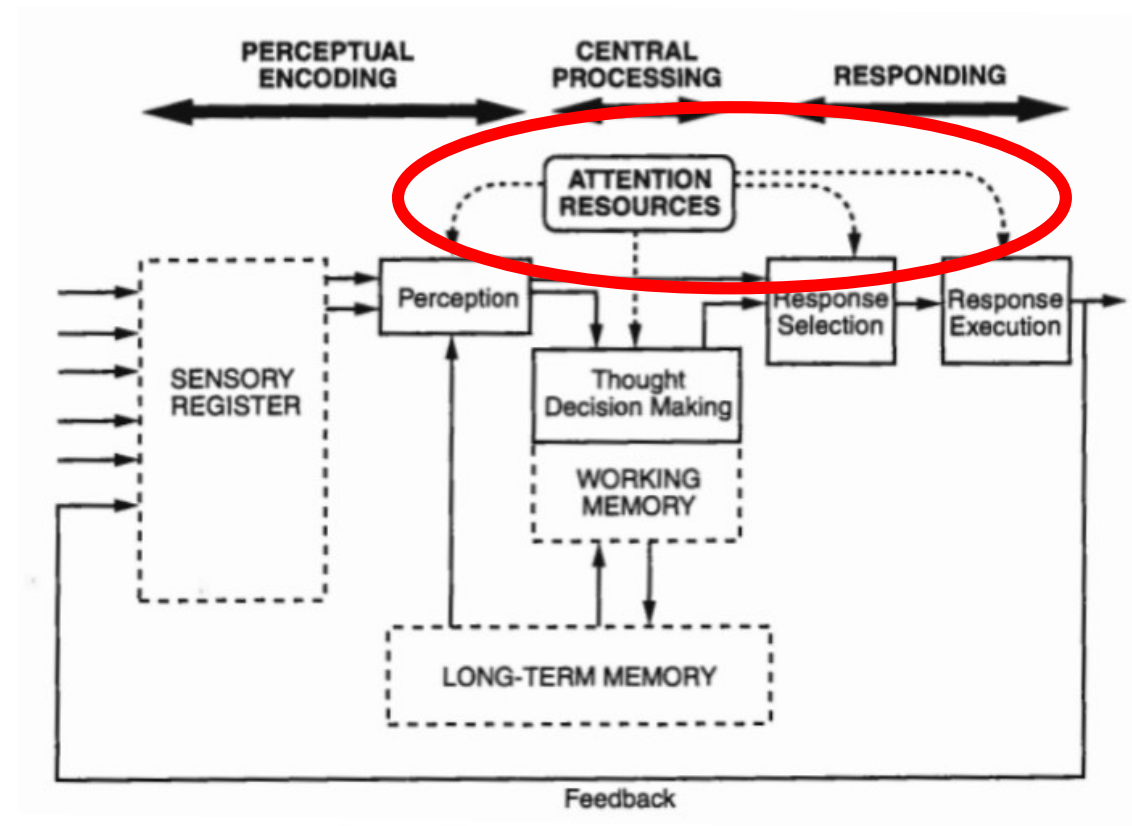
(Chitika Insights, June 2013. <https://chitika.com/google-positioning-value>)

❑ Web page design: Users in general **much less likely** to scroll down below the fold (Varies by site – shown by heat-mapping analytics)



Wickens (again): ‘Divided’ Attention – Multiple Resource Theory

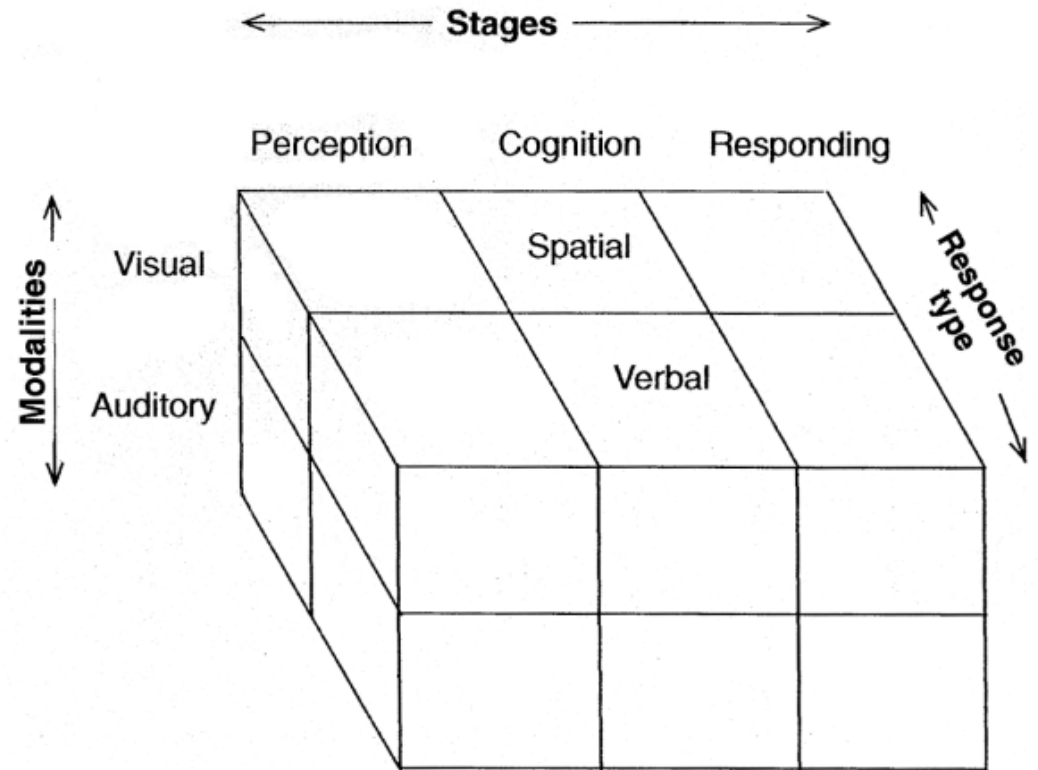
- ❑ Multiple Resource Theory
- ❑ The **structure** of the tasks matters
- ❑ Attentional resources are always limited, but there are different “pools” of resources available ...



Divided Attention and Time Sharing

Multiple Resource Theory

- This 3D model represents it
 - **Processing Stages:** Perception, Cognition, Responding
 - **Types of Inputs (Modalities):** Visual, Auditory (also Haptic)
 - **Types of Coding:** Spatial, Verbal
 - **Types of Responses:** Spatial, Verbal
- Tasks using different resources will be easier to share (each cube on the model)

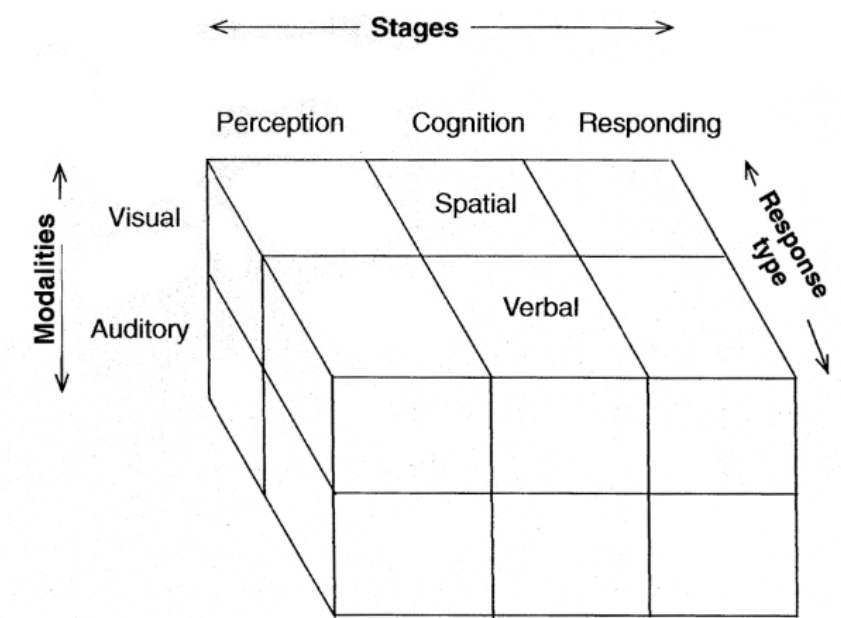


Wickens' Multiple Resource Model of Attention. From C.D. Wickens (1984).

Divided Attention and Time Sharing

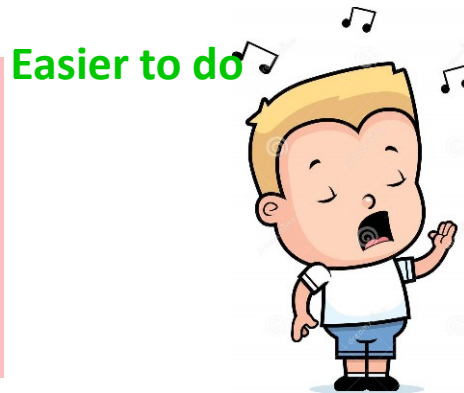
Multiple Resource Theory

- Tasks using different resources will be easier to share (each cube on the model)



Playing Super Smash Bros.

- Perception: Visual
- Cognition: Spatial
- Response: Haptic

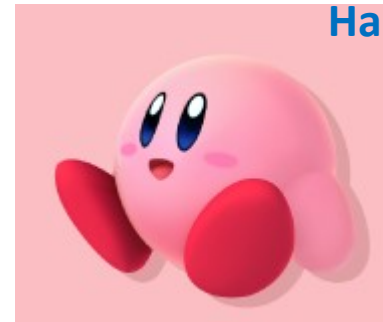


Easier to do

Singing the game's theme

- Perception: Auditory
- Cognition: Verbal
- Response: Verbal

WHILE



Playing Super Smash Bros.

- Perception: Visual
- Cognition: Spatial
- Response: Haptic

Harder to do:

WHILE



Commenting on Facebook

- Perception: visual
- Cognition: spatial and verbal
- Responses: Haptic, verbal

Multitasking Behind the Wheel



Tasks that require same perceptual, cognitive, and response resources as required for actually driving:

*Visual cognition,
haptic response*

These tasks also require visual focus on completely different object (phone)

The other tasks use *different* modalities, different responses

CELL PHONE TASK	<i>Risk of Crash or Near Crash event</i>
Light Vehicle/Cars	
Dialing Cell Phone	2.8 times as high as non-distracted driving
Talking/Listening to Cell Phone	2.3 times as high as non-distracted driving
Reaching for object (i.e. electronic device and other)	1.4 times as high as non-distracted driving
Heavy Vehicles/Trucks	
Dialing Cell phone	5.9 times as high as non-distracted driving
Talking/Listening to Cell Phone	1.0 times as high as non-distracted driving
Use/Reach for electronic device	6.7 times as high as non-distracted driving
Text messaging	23.2 times as high as non-distracted driving

Virginia Tech Study: http://www.vtti.vt.edu/PDF/7-22-09-VTTI-Press_Release_Cell_phones_and_Driver_Distraction.pdf

Automaticity

Strategic Process = Skill that **only** can be performed reliably with attention.

Automatic Process = Tasks practice → more automatic (**require less to no attention** to do):

Touch typing, reading, driving, flying a plane, riding bicycle—almost anything with enough practice!

Pluses of automaticity

- ❑ Allows people to perform multiple tasks simultaneously
- ❑ Allows people to build complex skills
- ❑ Requires little or no attention, maximizes attentional resources

Minuses of automaticity

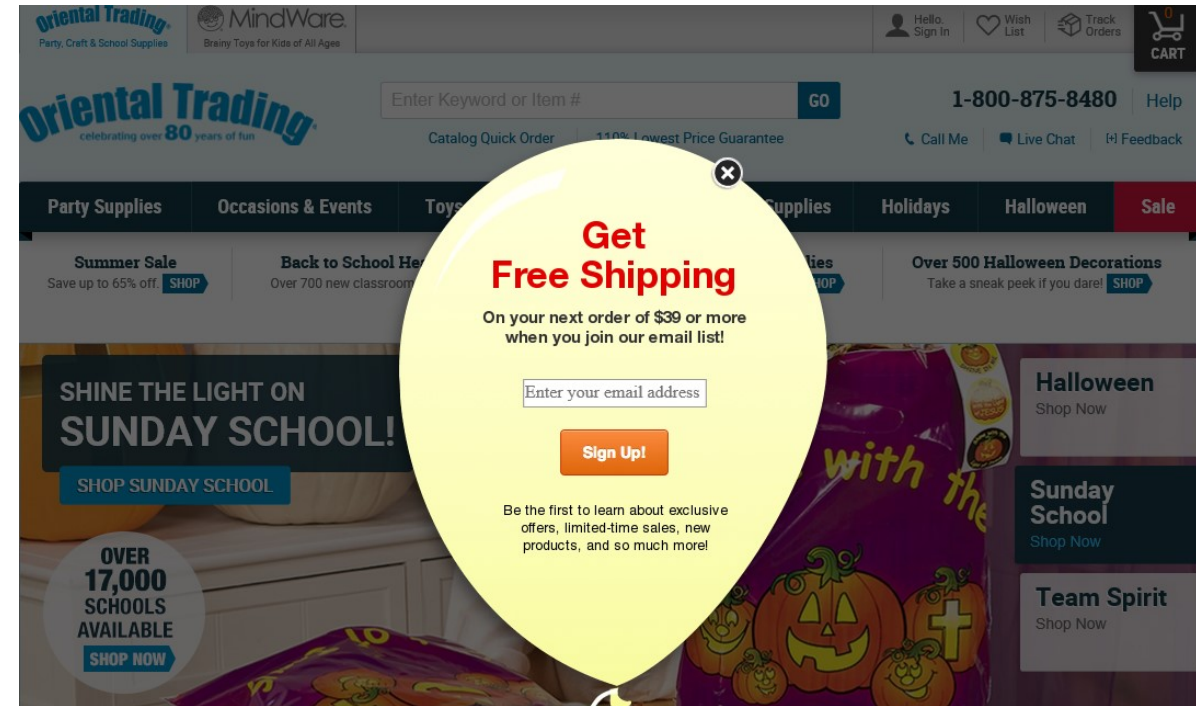
- ❑ People can make mistakes due to carelessness
- ❑ People can overlook important details

Beliefs Affect Selective Attention on Info

- ❑ People tend to seek and attend to information that confirms their **already-held beliefs**.
- ❑ People **ignore** or require **additional validation** of information that differs from their beliefs.

Implications for design:

- Expect people to filter out lots of information your site/app provides, period
- Don't assume what's "obvious" to you = obvious to your users
- If the info is critical, make it highly salient



This site seems to want customers to be aware of what?

Information Scent

❑ Drawn from **Information Foraging theory** in 1990s. en.wikipedia.org/wiki/Information_foraging

❑ People try to achieve **maximum benefit** for **minimum effort**.

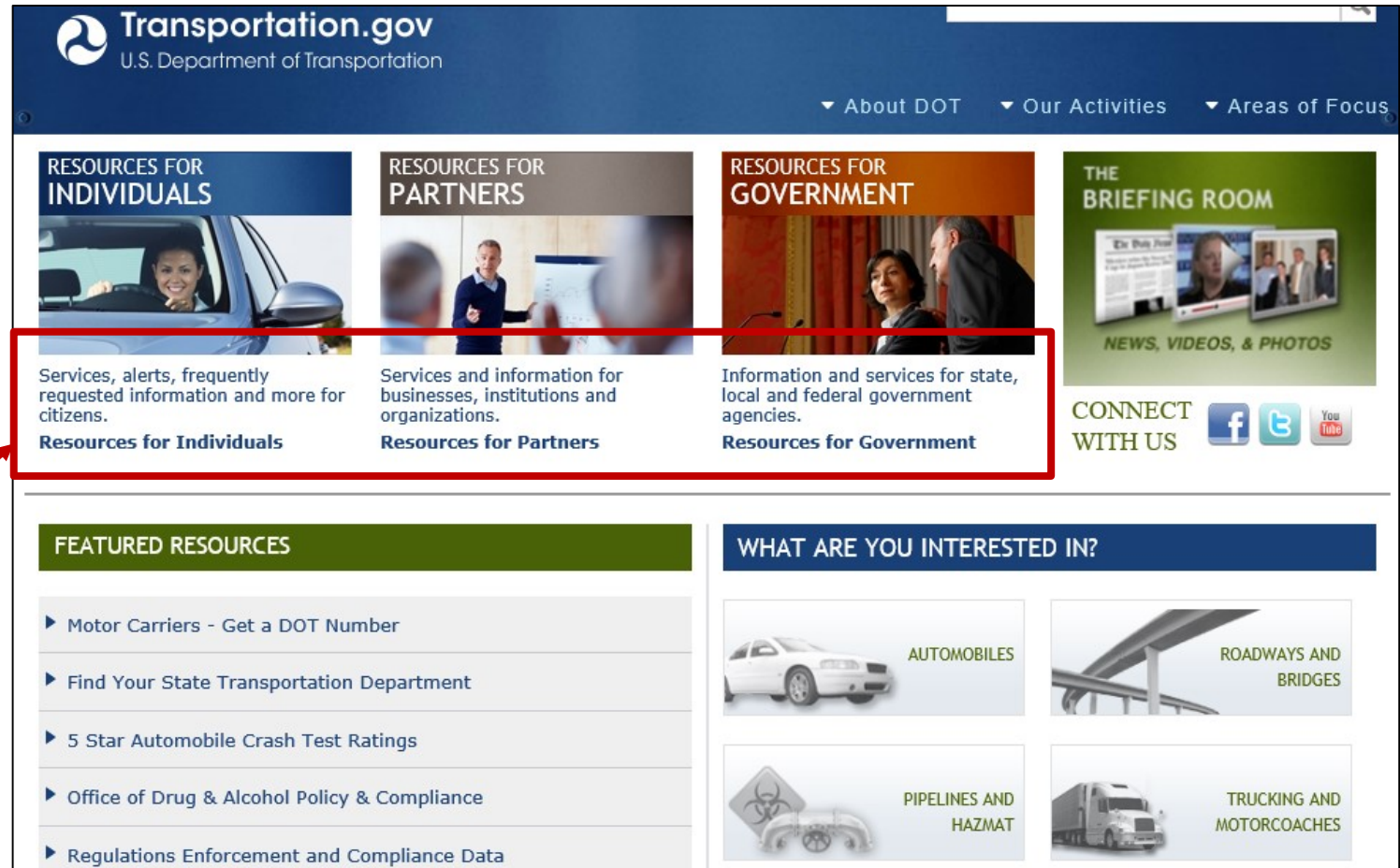
Users assess whether their path exhibits cues related to the desired outcome. Informavores will keep clicking as long as they sense they are on a trail to the information they desire. The 'scent' must keep getting stronger and stronger, or people give up, and progress must seem rapid enough to be worth the predicted effort to reach the destination.

Nielsen, J. 2003. <http://www.nngroup.com/articles/information-scent>

❑ Users just leave when the 'scent' is too faint

Information Scent

- ❑ What of the information scent of this homepage?
- ❑ What **types** of Informavores would be 'well fed' here & continue deeper?
- ❑ *Scope note* = explains the "scope" of the destination content.



Odds and Ends about Attention

Other attributes that draw our attention strongly:

- ❑ **Movement** (it's salient and can be processed in parallel, as we know from Perception)
- ❑ **Threats** (wild animals, burglars)
- ❑ **Sex or food**

Largely stimulus-driven attention



Face Recognition and Attention

- ❑ Humans have brain mechanisms optimized to attend to and recognize faces
- ❑ We have difficulty recognizing facial parts when not in facial context
- ❑ **Prosopagnosia** = difficulties recognizing faces after temporal lobe injury



Attention Summary

- ❑ Humans' ability to **attend** is remarkably good—but limited by resources
- ❑ **Selective attention** allows brain to handle stimulus bombardment
- ❑ We alternate between **goal-directed** and **stimulus-driven attention**
- ❑ We use a mix of **supervisory control** and **target search** for scanning
- ❑ The **Searchlight** is a useful metaphor for UX work
- ❑ More advanced than the searchlight is Multiple Resource Theory, which shows the **types** of simultaneous tasks determine how well they can be handled
- ❑ Practice can make **strategic processes** (tasks) more **automatic**
- ❑ **Information Scent** helpful for designing information architecture/layering