SI 388
Characteristics of Memory

WEEK 6-1 (WED 11 OCT)

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Agenda for Today

- Comments/suggestions for midterm for **Wed, Oct. 18**
  - **Slide 52 -**
- Start on Memory

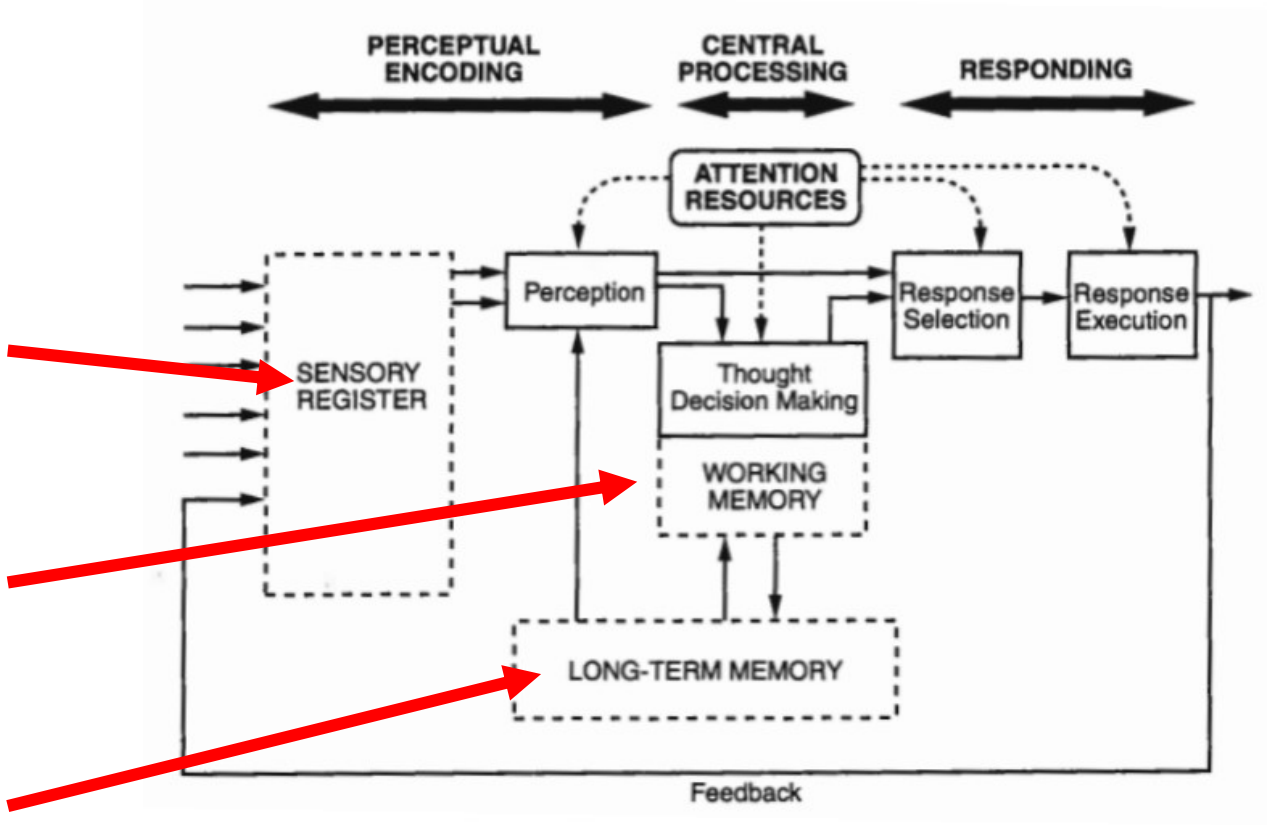
Some Memory-related Questions

- How is memory described in HCI?
- Why are some types of information easier to remember than others?
- How can UX designers create interactions that work with users' memory limitations?

Back to Wickens' HIP Model

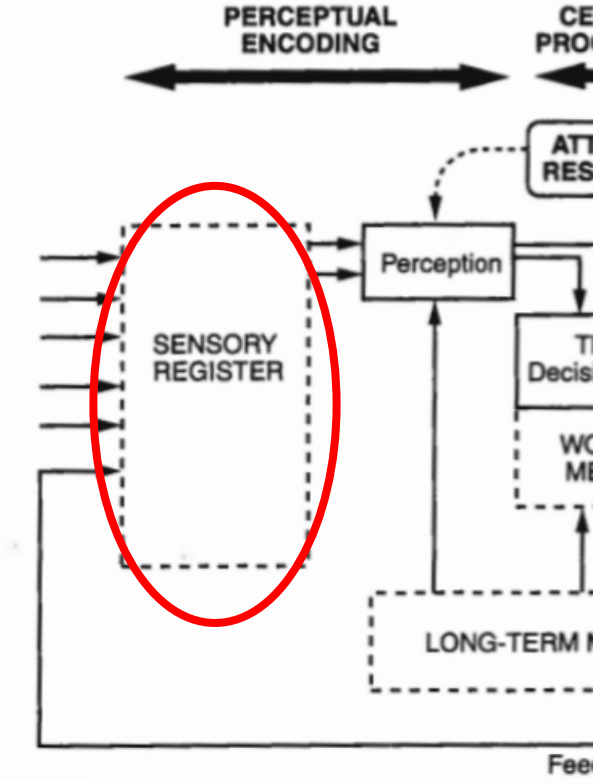
Elements of memory

- **Sensory Register** = senses hold images and sounds briefly as they're being perceived
- **Working Memory (aka Short-term Memory)** = where information is retained for fraction of seconds to a few minutes
- **Long-term Memory** = where info is retained for long term



Sensory Register

- Temporarily stores 3-5 items for sensory input while brain processes
- Very short retention
- 2 primary types:
  - **Visual** ("iconic memory"). Decays very rapidly (~250 milliseconds – 3 seconds)
  - **Audio** ("echoic memory"). Can last up to 10 sec. but typically around 3.
- Need a trigger to process and store
  - May satisfy a goal
  - Strong information scent
  - ***Attention*** is critical:
    - Selecting elements from the sensory register to commit to Working Memory
    - Remember: our attention is continually moving to The Next Thing!



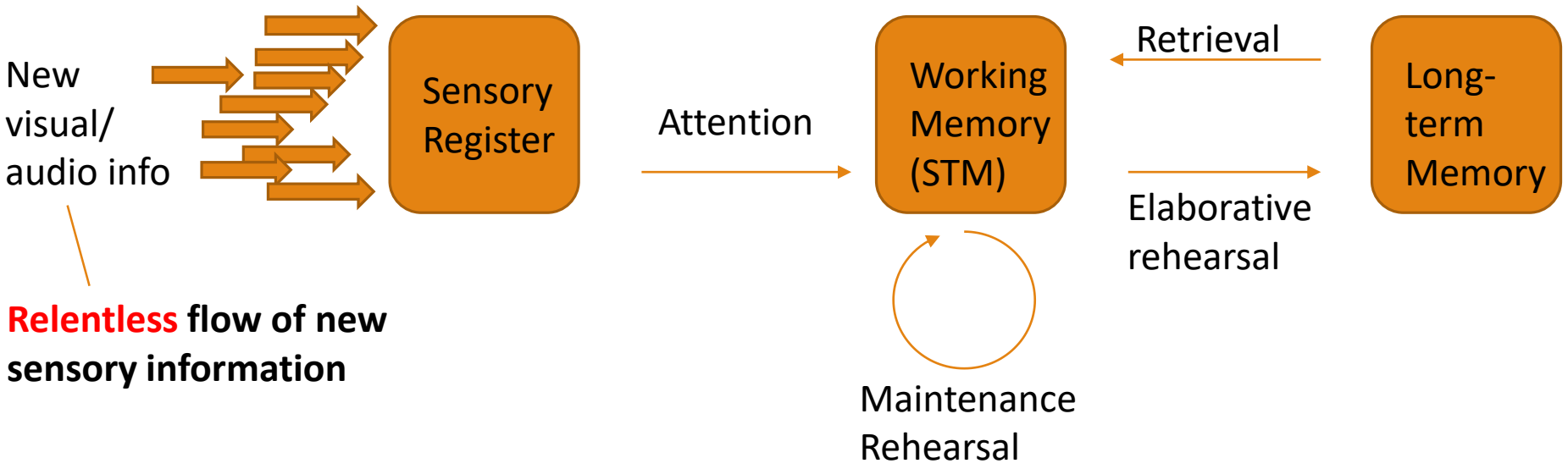
Takeaway from Sensory Register

- Drivers and pilots and video gamers rely on this all the time.
- When a driver looks down at instruments for just a split second, how many different items can they recall?
  - 3-5 items—for just an instant (500 milliseconds)!

(Sperling, 1960)

Working Memory / Short-term Memory

- We'll use both terms; they are almost synonymous



Working Memory

- **It is:** our combined focus of attention—everything we're conscious of right now!
  - Incoming perceptions + relevant long-term memories that are activated
- **It is not:** a spot in the brain where perceptions + memories "go" to be worked on (e.g. it's not the brain's microprocessor)
- An executive function: manipulating info, refreshing it, remaining aware
- 7±2 (approximately) chunks of **meaningful info** (Miller, G. 1956)
  OR 4±1 (Broadbent 1975; Mastin, 2010)
- Fades rapidly: 'half-life' is ~7 seconds for 3 chunks. **EASILY LOST**

Let’s Try An Activity

Try to remember the following items…

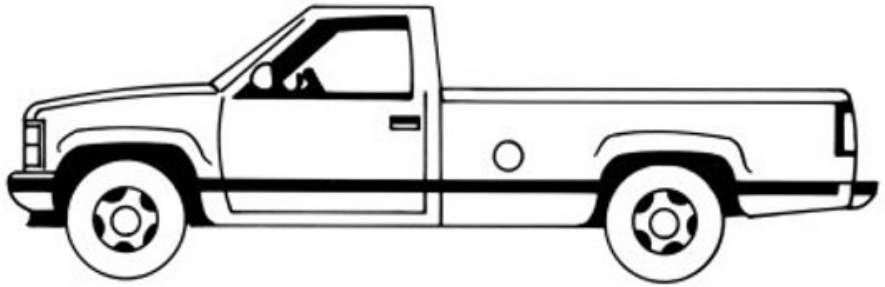

Wilson
NCAA

How many of this type of ball were shown?

(not including this one here)

Let’s Try Again: Pay Attention!

How Many Pickup Trucks?



(not counting this one here)

Working Memory: Rehearsal

Maintenance Rehearsal

- Continual refresh
  - Phonological loop = “Verbally repeating” (ex: an address or phone number ~2 seconds of info)
  - Visuospatial sketchpad = “Imagining a visual” (ex: a map with highways)
- Keeps items in Working Memory ***without committing them to LTM***

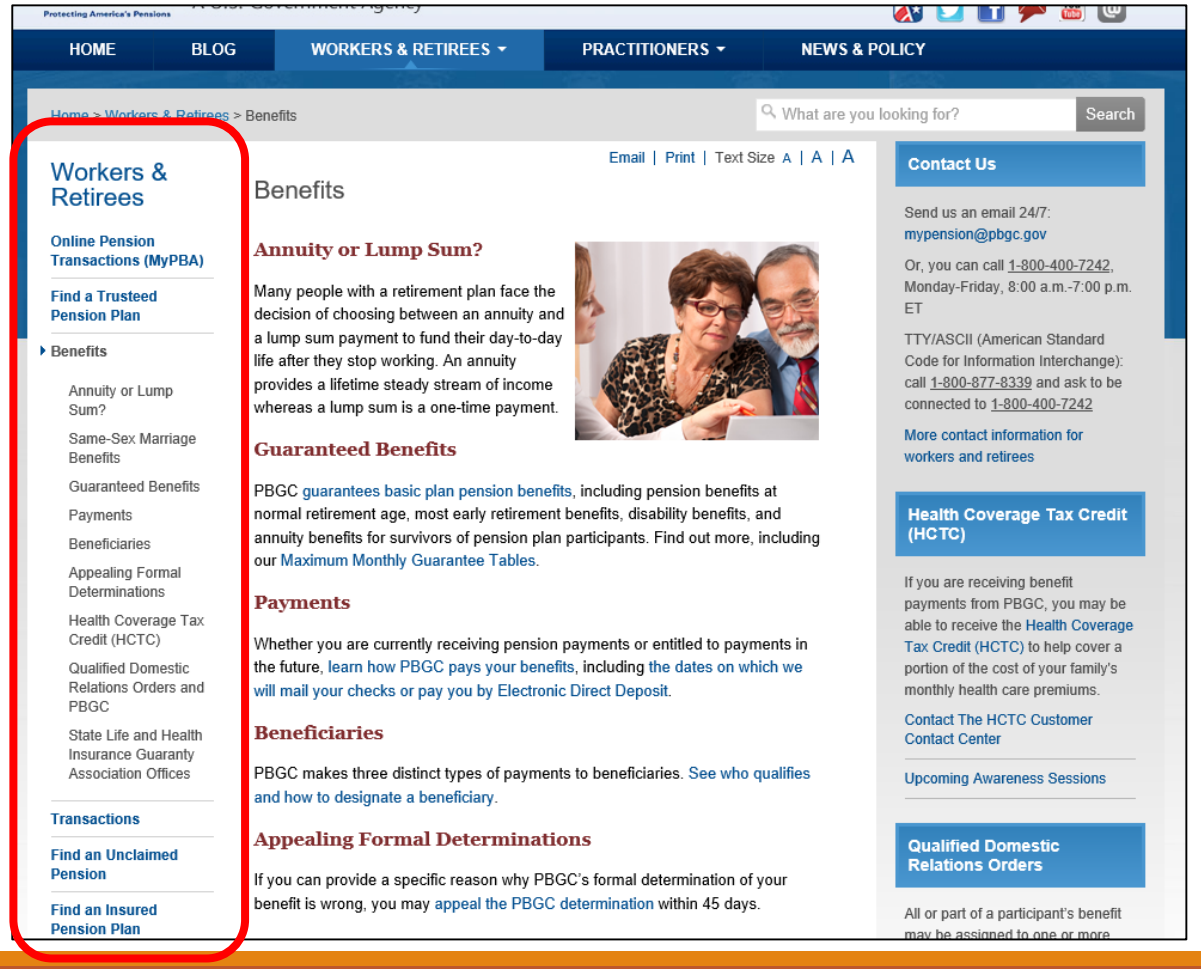
Elaborative Rehearsal (aka Deep Processing):

- Associate new info with existing knowledge
- ***Commits them to LTM***

Design Implications of Working Memory

- There are **MANY**.
- People need easy immediate access to navigation options. Don't hide them.

Use consistent Hub and Spokes navigation.

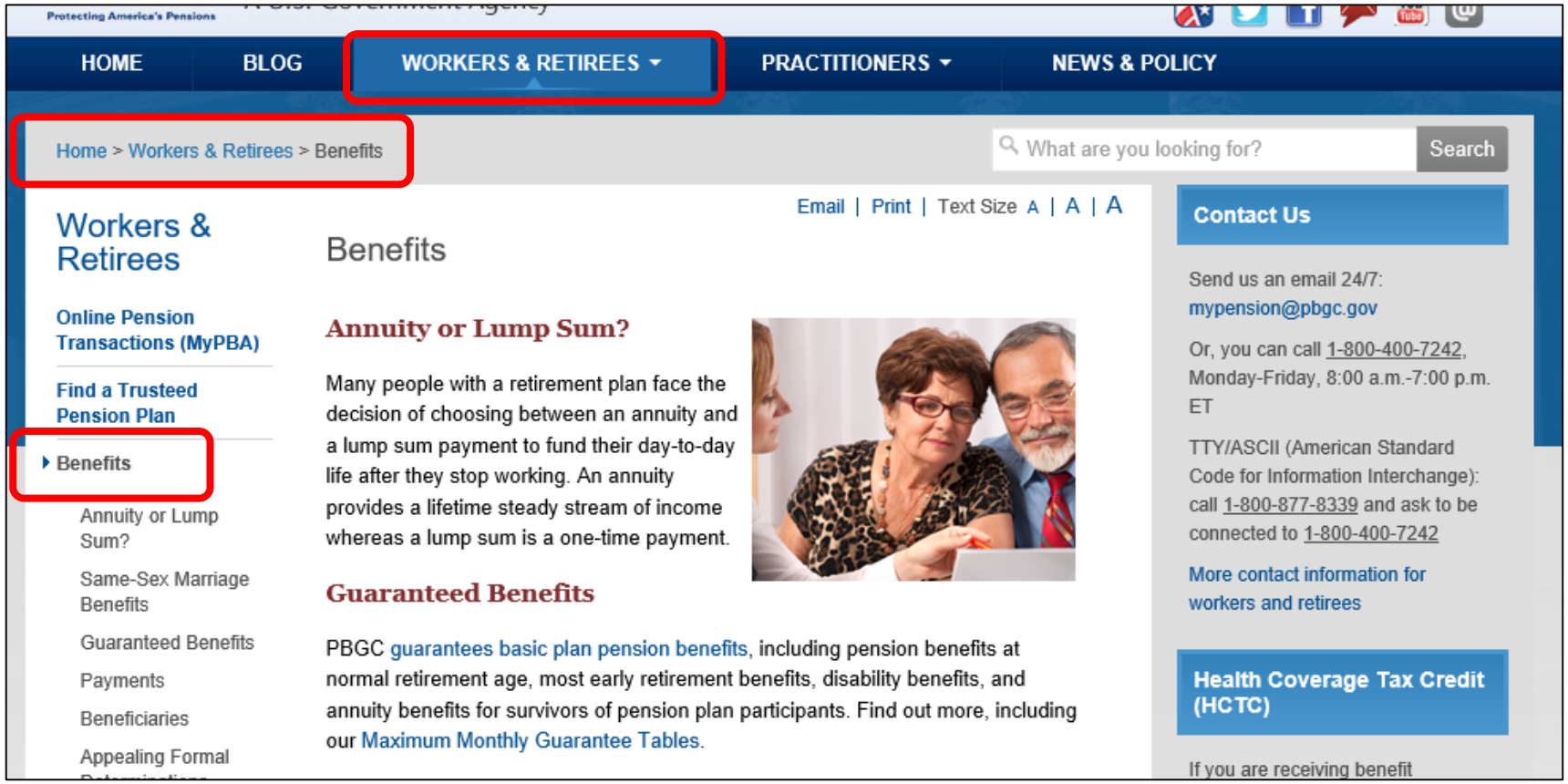


Design Implications of Working Memory

- Persistently remind users of where they are to keep them oriented.

Visually differentiate category and page.

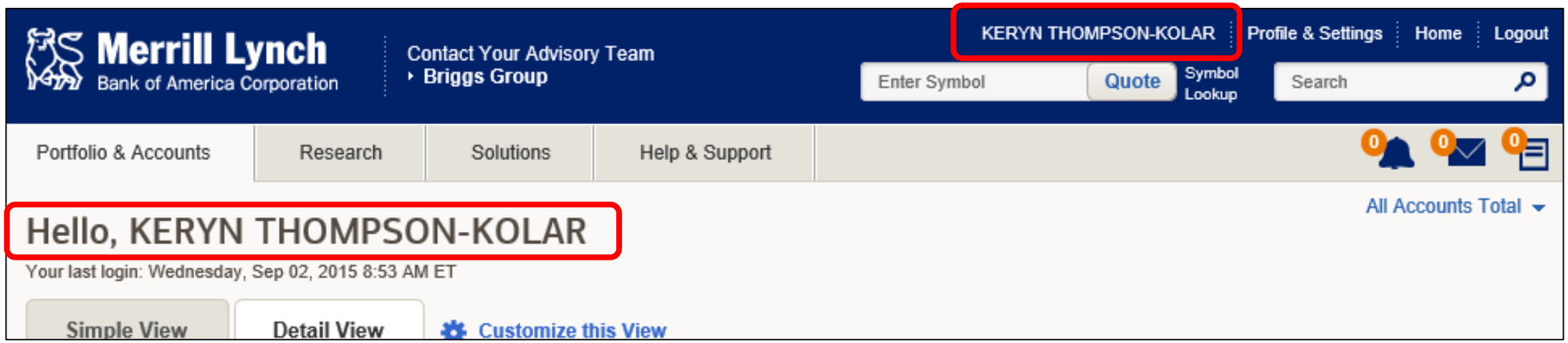
Provide conventional reminders such as breadcrumb trails.



Design Implications of Working Memory

- Remind people of their log in status – whether they're logged in or not.

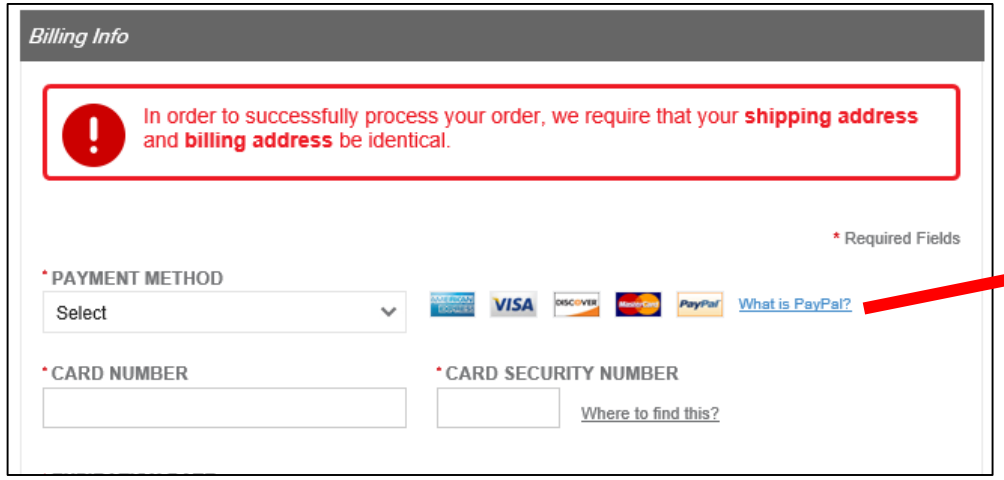
Provide persistent indication of logged-in state, and who is logged in.

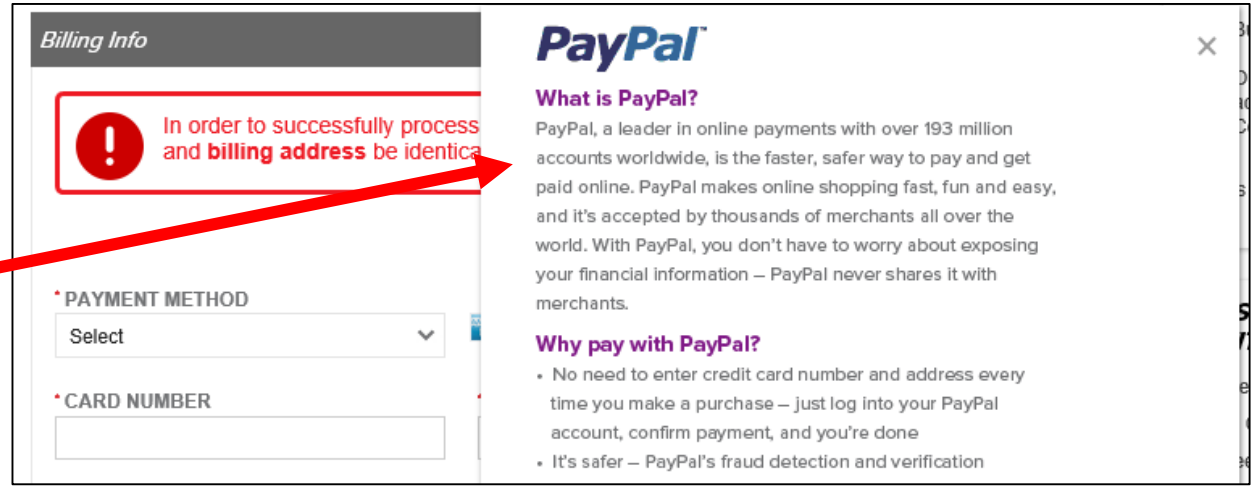


Design Implications of Working Memory

- Don't force users to remember information
- Design for visual (and audio) recognition, not recall
- Don't force them to navigate somewhere else to get info they need HERE.

Provide contextual help information at point of need.

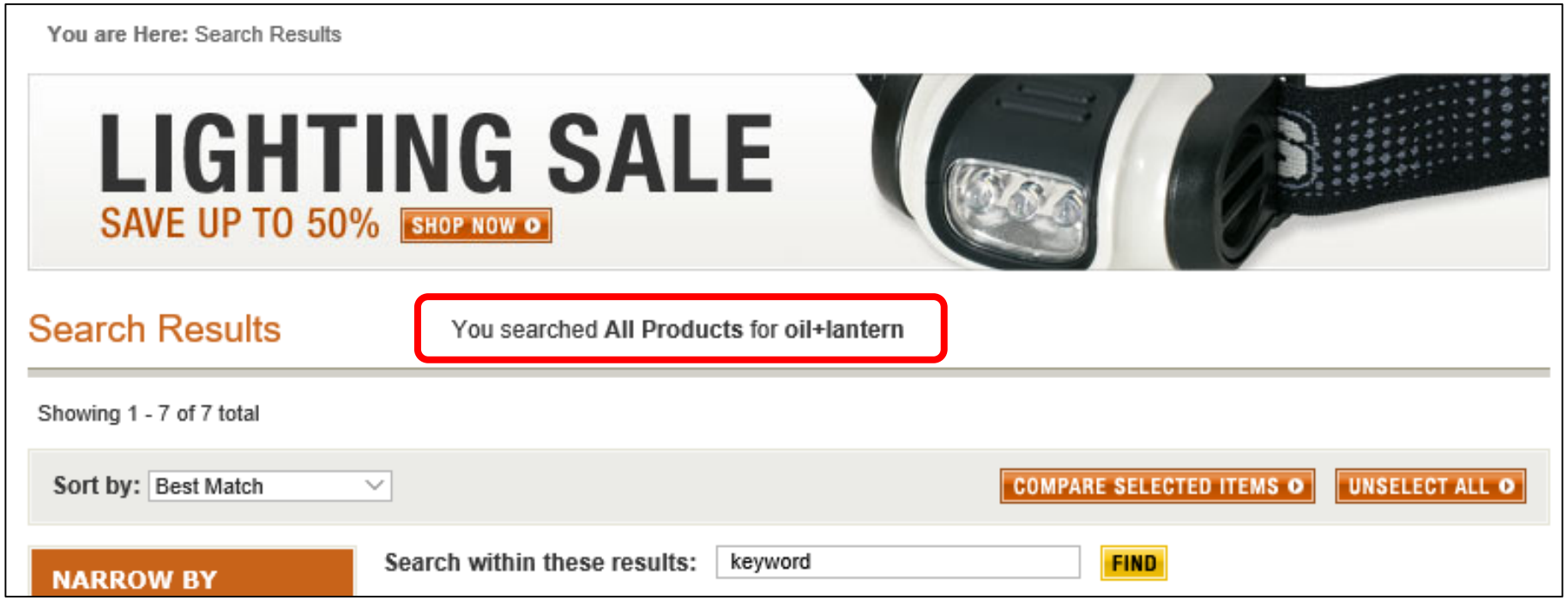




Design Implications of Working Memory

- Don’t require users to remember specific terms as they work.

Let the Search Results Page (SRP) remind users what terms they used Search for.

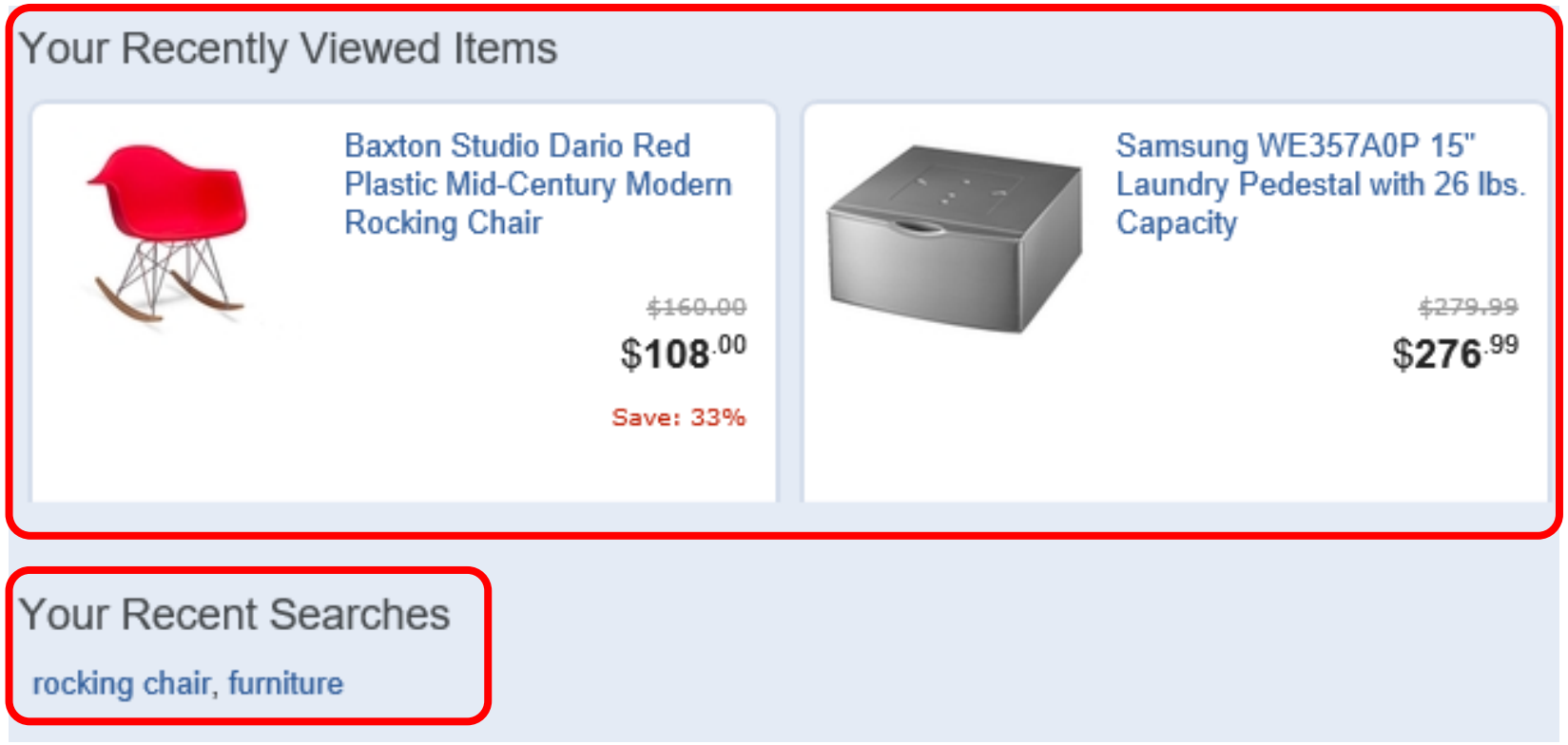


Design Implications of Working Memory

- Provide reminders and easy paths back to items they have already viewed.

Provide Recently Viewed items lists

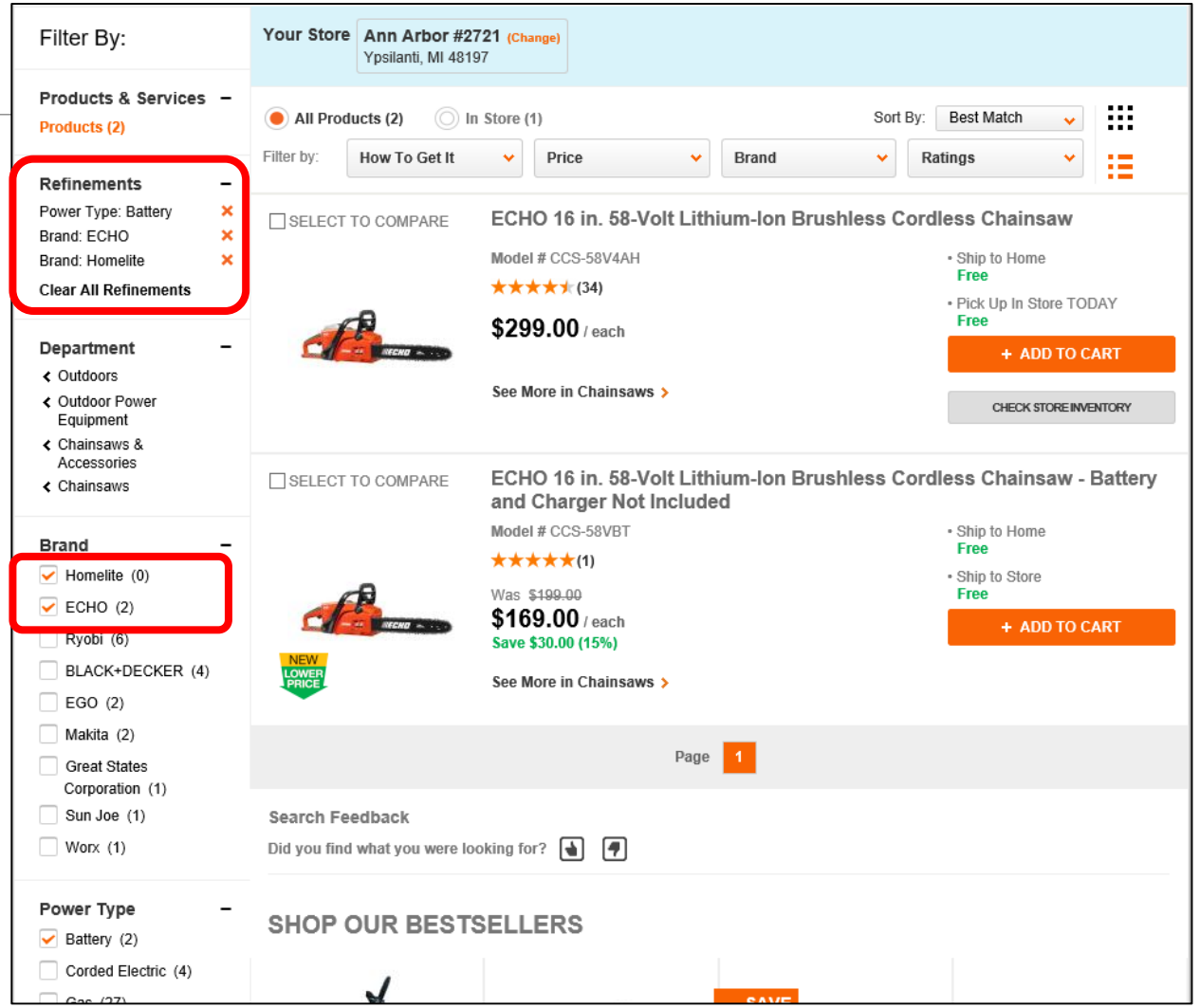
Provide Recent Searches lists



Design Implications of Working Memory

- Provide easily accessed reminders of options the user has already selected.

Display selected Refine options together and at the point of selection.

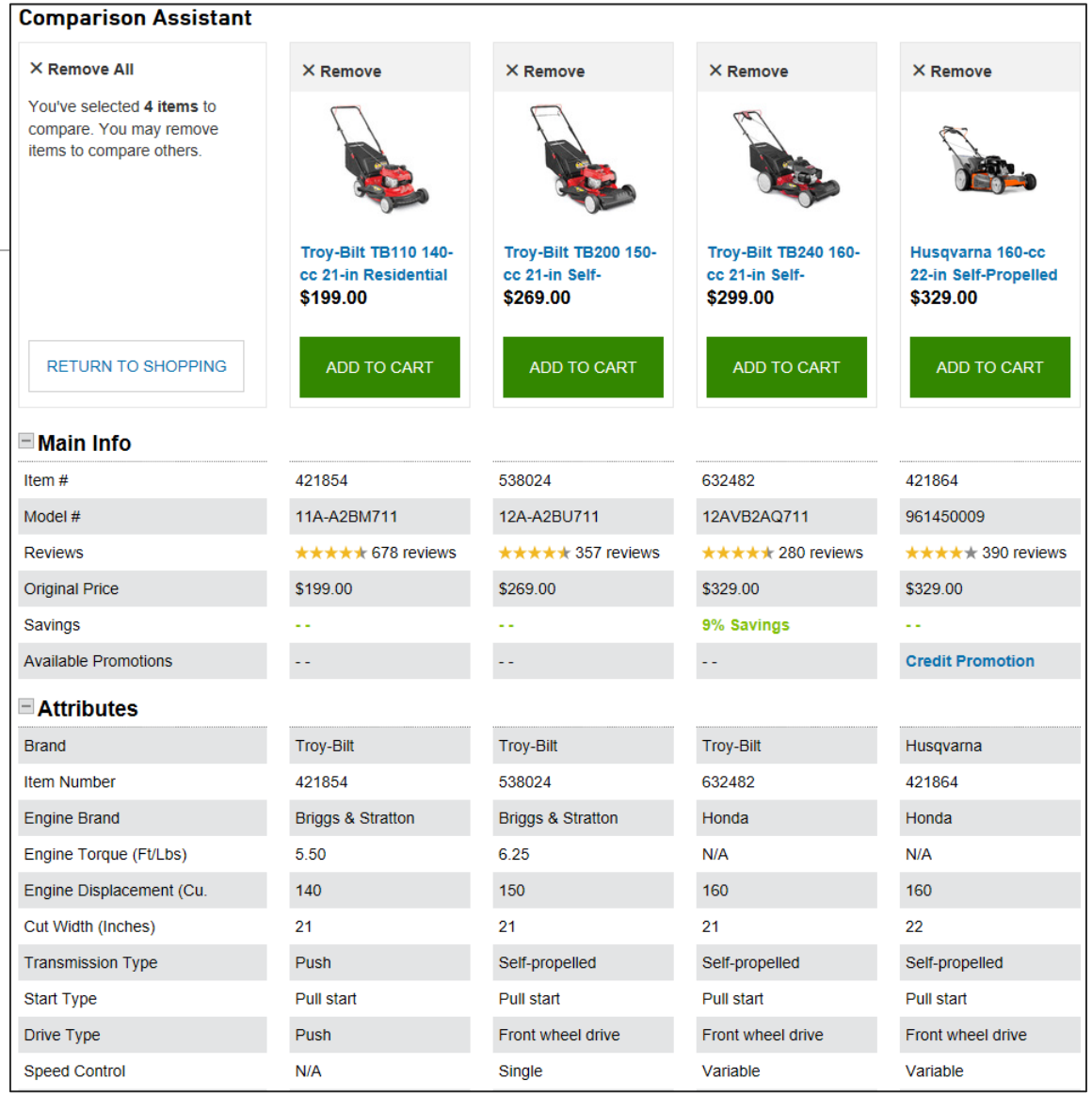


Design Implications of Working Memory

- Make it easy for users to draw comparisons between items, so users don't have to bounce from page to page, maintaining information in working memory.

Provide Comparison tools

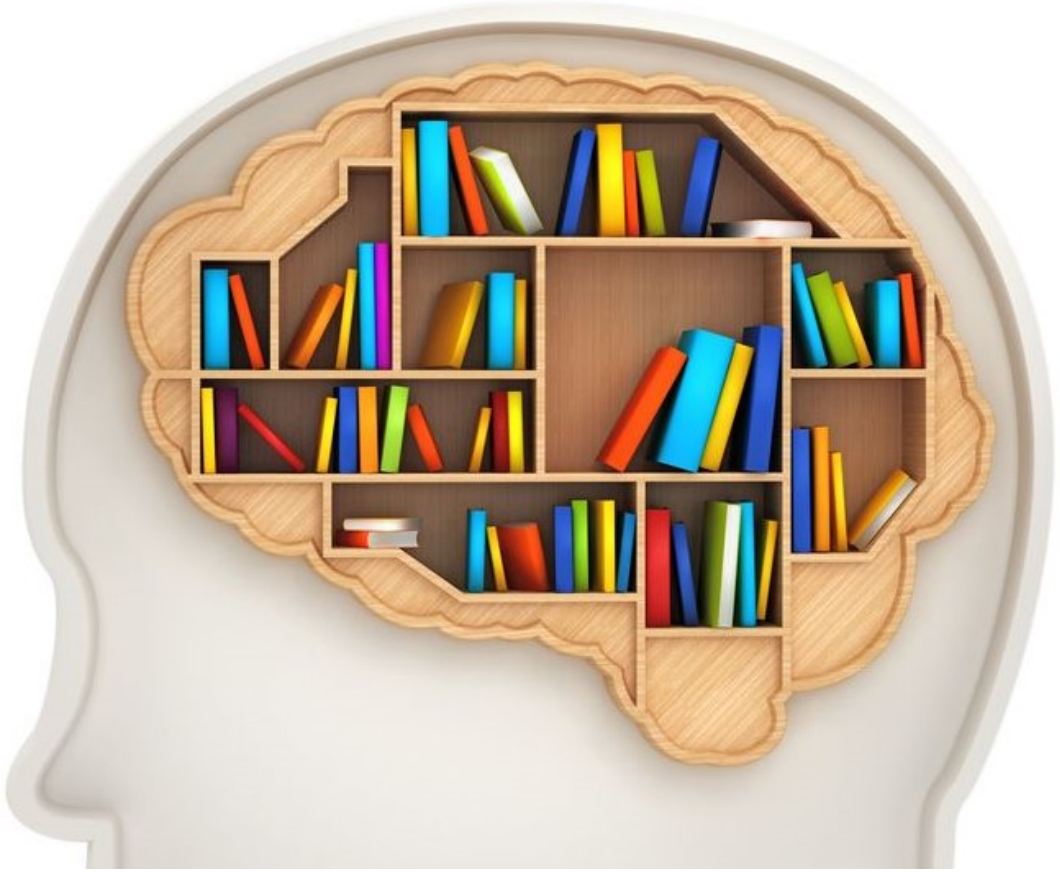
Display salient differences on listing pages



Agenda for Wednesday 10/12

- Complete the lectures on memory
- Brief preview/overview of exam concepts
  - The slides are on the 6-2 deck
- Mention about next week's midterm

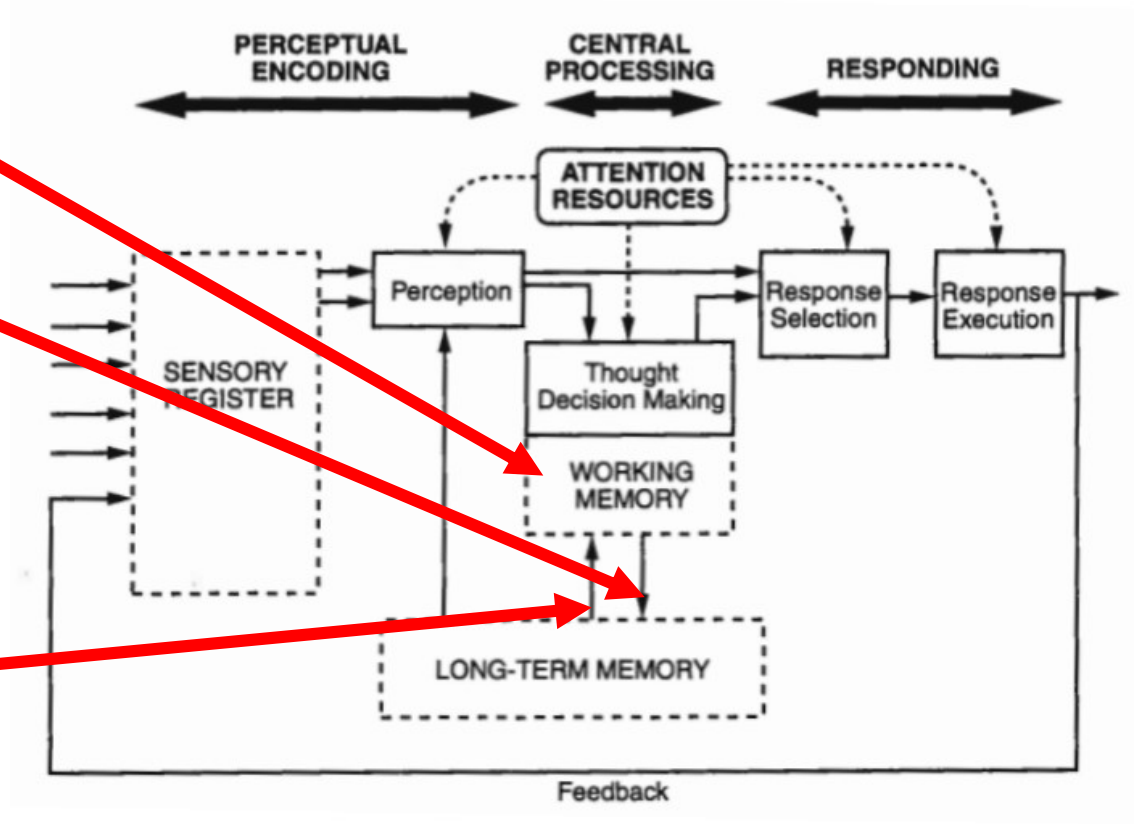
Long-term Memory



www.verywell.com

Long-term Memory

- Different from working memory.
- Is a memory **storage** area.
- Receives elaboratively rehearsed memories **from** Working Memory.
- Sends retrieved memories to working memory for Top-down Processing.



Multiple Modes of Long-term Memories

Event Memory

- Episodic information = “stuff that happened”

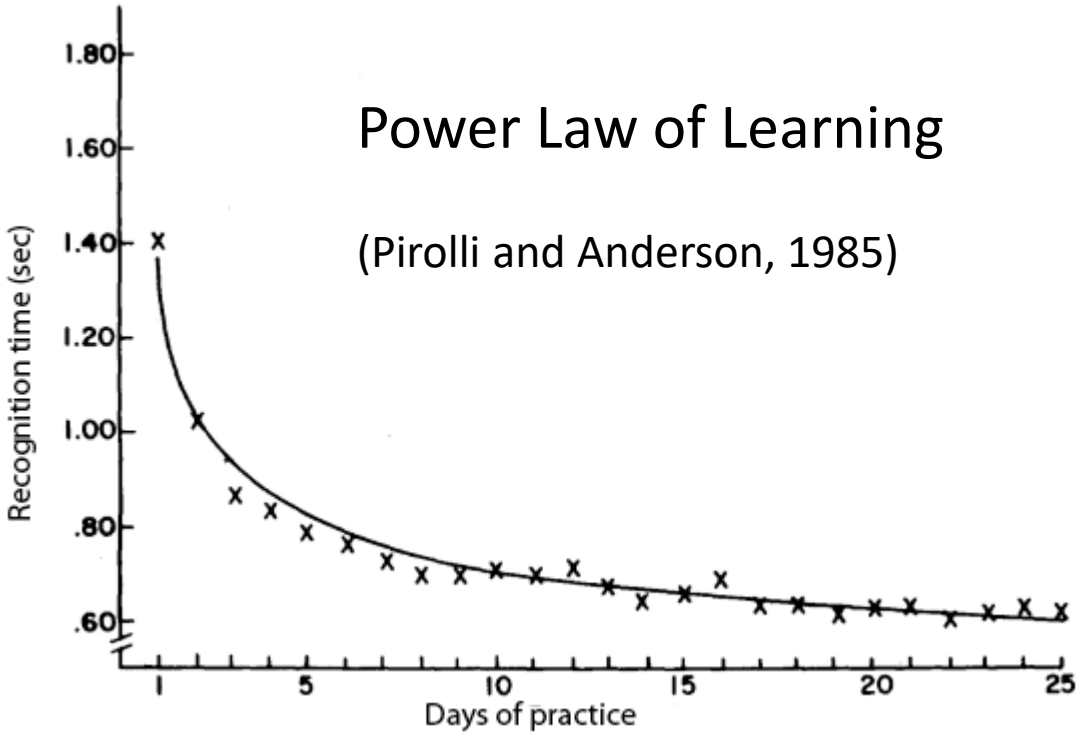
Semantic Memory

- Perceptual skills = interpreting sensory input
- Procedural skills = motor skills, how to do things
- Spatial/visual information = pictures, symbols
- Laws and properties = physical, behavioral, properties of things (schemas)
- Beliefs and attitudes = subjective feelings
- Prospective = Remembering to do an activity at a prescribed time

Factors Affecting Recall from LTM

Strength = determined by *recency* and *frequency* of use.

- **Power Law of Learning** = practice and recall are in logarithmic relationship
- Means practice has diminishing returns (varies by task/item)



Power Law of Learning

(Pirolli and Anderson, 1985)

Factors Affecting Recall from LTM

Associations

- Number of different associations is called depth of coding.
- Deep coding boosts likelihood of recall
  - **Elaborative (deep) processing** increases number of associations by adding meaningful associations.
  - More modes coded, meaningful processing
- **Rote memory** is fragile

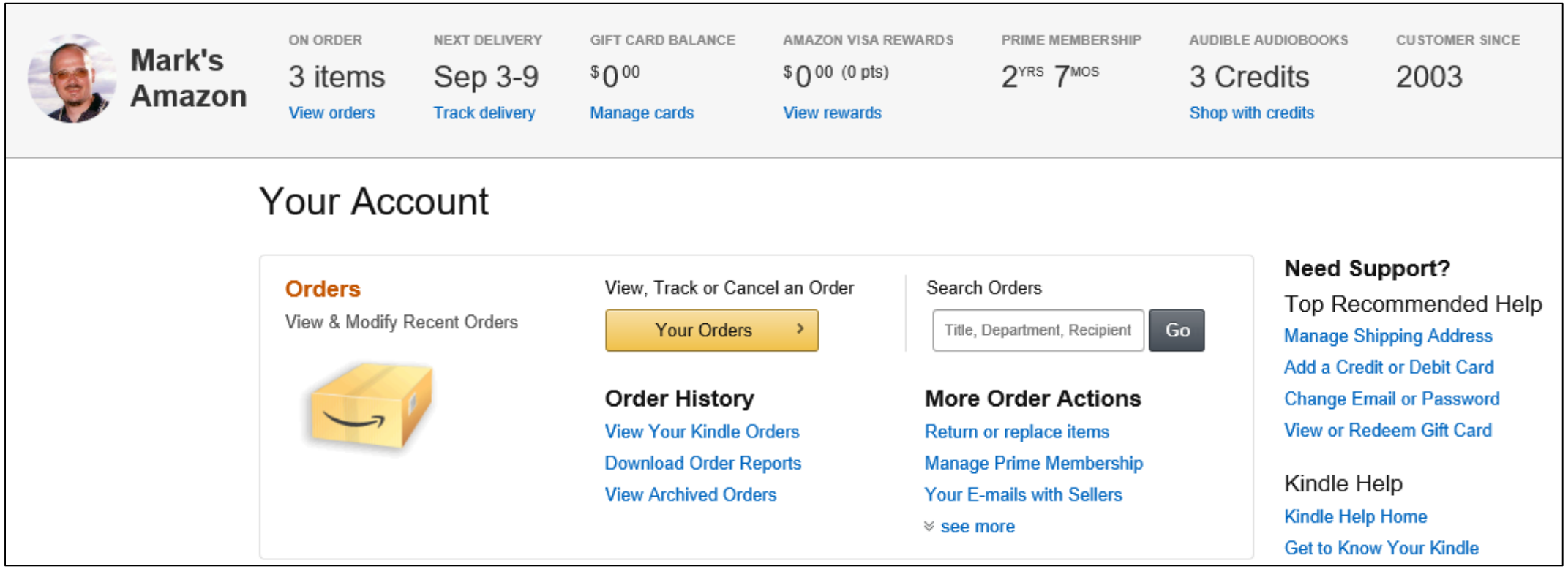
Other Characteristics of Long-term Memory

- We mis-remember a lot, especially as we age.
- We lose **weakly coded** memories. Even if used to be frequently used and/or strong.

- Emotions affect it.
  - **State-dependent memory theory** = the emotional state we were in when affects our recall later
  - Memories learned in highly emotional states are better retained, **but not more accurately**.

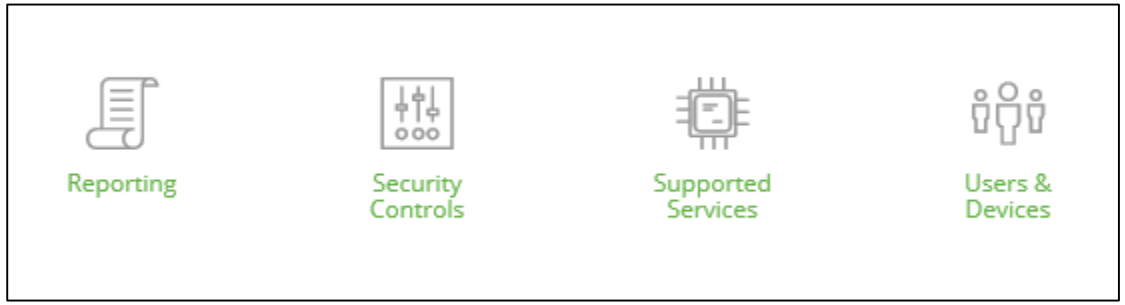
Implications of LTM for Design

- Most systems can enhance memory; remember for you. *Leverage that.*

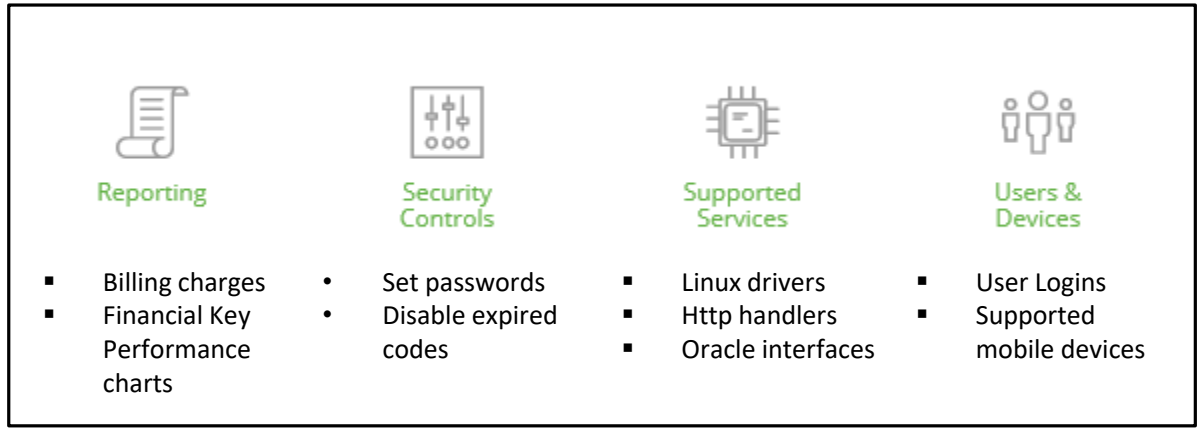


Implications of LTM for Design

- Context triggers memory associations, so provide more context.



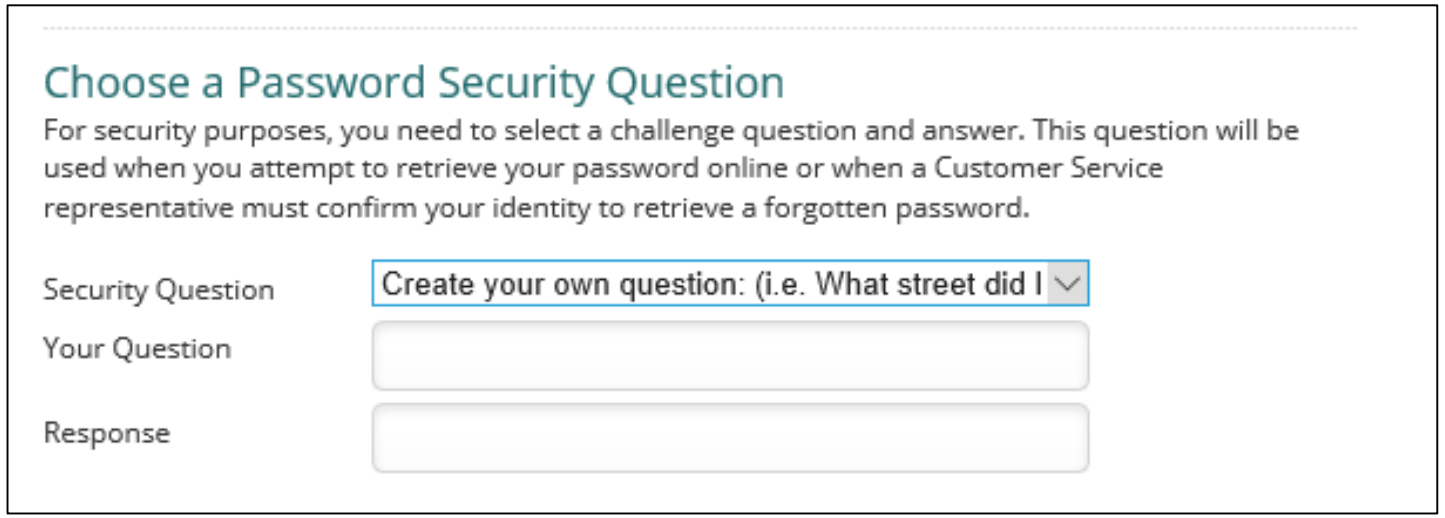
Use "scope notes" to provide that additional context, allowing repeat users to more easily recall where information lives.



Implications of LTM for Design

- Be clear about what a system is asking for when it involves LTM.

Allow customers to create their own security questions to ensure they're picking something that is easily recalled from LTM.



Summary (for now)

- Memory consists of multiple stages, each with different properties
- Working Memory processes new information and retrieves from Long-term memory
- Elaborative processing adds associations, making memories easier to recall from LTM
- Designers need to work within constraints of human memory
- Interfaces can assist memory b:
  - Providing context
  - Storing info that can be easily retrieved (make it easy)

Midterm Brief Review:
Exam is Wed, Oct 18th in THIS ROOM

- ❑ No class Monday (as marked on Schedule)
- ❑ 20 multiple choice + 15 fill in the blanks = 35 questions
- ❑ Should take most people ~55 minutes, but you'll have until Noon
- ❑ **Don't** need a Greenbook/Bluebook – **Do need** a pen/pencil
- ❑ You can bring one 3x5 card, both sides
- ❑ No bio breaks during the exam. You leave, you're done
- ❑ I will answer questions, but share them with whole room
- ❑ If you have an SSD Accommodation, please email me privately at mdmtk@umich.edu by 5pm Thursday, Oct. 12 so I can reserve private rooms.
  I want to make sure that reservation is totally accurate.

~1.5 minutes per question.

No calculations.

Study Hints

- ❑ Review the lecture decks
- ❑ Revisit the chapter readings
- ❑ Emphasis **isn't** on the design implications, but may show up
- ❑ My goal is straightforward
- ❑ Populate your 3x5 card strategically

Midterm Brief Review: Assorted Topics

Week 2: Anthropometrics

- ❑ Tactile perception
- ❑ Haptic perception
- ❑ Diectic reference
- ❑ Physical affordance
- ❑ Digital affordance
- ❑ Metaphor
- ❑ Strong Convention
- ❑ Fitts' Law
- ❑ Accot-Zhai Steering Law
- ❑ Thumb zone
- ❑ Gestures
- ❑ Target size
- ❑ Padding

This is not a comprehensive list.

Midterm Brief Review: Assorted Topics

Week 3: Information Processing Theory

- ❑ Perceptual priming
- ❑ Current context
- ❑ User goals
- ❑ (Perceptual) filtering
- ❑ Salience
- ❑ Expectancy, Value, Effort
- ❑ Working memory
- ❑ Attention resources
- ❑ Top-down processing
- ❑ Bottom-up processing
- ❑ Chunking

This is not a comprehensive list.

Midterm Brief Review: Assorted Topics

Week 3-4: Visual Perception

- ❑ Cones, Rods
- ❑ Retina
- ❑ Fovea
- ❑ Subitizing
- ❑ Depth & Surface Cues
- ❑ Pop-out Effects
- ❑ Preattentive Processing
- ❑ Dashboards
- ❑ Gestalt Principles of Grouping
- ❑ Visual hierarchy
- ❑ Expectations
- ❑ Salience
- ❑ User goals
- ❑ Foveal vision
- ❑ Parafoveal vision
- ❑ Peripheral vision

This is not a comprehensive list.

Midterm Brief Review: Assorted Topics

Week 5: Attention

- ❑ Attention resources
- ❑ Sensory channels
- ❑ Goal-directed Attention
- ❑ Stimulus-driven Attention
- ❑ Searchlight Metaphor
- ❑ Visual Scanning: Supervisory control
- ❑ Visual Scanning: Target search
- ❑ Display clutter
- ❑ Inhibition of return
- ❑ Search duration function
- ❑ Task structure
- ❑ Automatic Processes
- ❑ Information Scent
- ❑ Information Foraging Theory

This is not a comprehensive list.

Midterm Brief Review: Assorted Topics

Week 6: Responsiveness Thresholds

- ❑ Perceived responsiveness
- ❑ Objective vs. Subjective time
- ❑ Time Just Noticeable Differences
- ❑ Characteristics of Responsive Systems
- ❑ Active Phase
- ❑ Passive Phase
- ❑ Causal Event Time Gap
- ❑ Audiovisual “Locking” Limit
- ❑ Attentional Blink
- ❑ Human Conversation Gap
- ❑ User Flow of Thought Limit
- ❑ Direct UI Control Limit
- ❑ Maximum “unit task” Attentional Limit
- ❑ “Busy Indicator”
- ❑ “Progress Indicator”
- ❑ Flow State

This is not a comprehensive list.

Midterm Brief Review: Assorted Topics

Week 6: Memory

- ❑ Sensory register
- ❑ Working memory
- ❑ Long-term memory
- ❑ Maintenance rehearsal
- ❑ Elaborative rehearsal (aka Elaborative Processing)
- ❑ Miller's Magic Number
- ❑ Limits to Working memory (7 +/-2, 4+/-1)
- ❑ Phonological loop
- ❑ Visuospatial sketchpad
- ❑ Memory associations
- ❑ Semantic memory
- ❑ Event memory
- ❑ State-dependent memory
- ❑ Power Law of Forgetting
- ❑ Interference
- ❑ Comparison functionality
- ❑ Recognition vs. Recall
- ❑ Recall
- ❑ Reminder functionalities
- ❑ Thumbnail images
- ❑ Consistent look & feel
- ❑ Forewarning icons
- ❑ Autocomplete & Autosuggest
- ❑ Procedural memory
- ❑ Rote memory

This is not a comprehensive list.