Human-Computer Interaction (HCI)

DECO2500/7250

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06

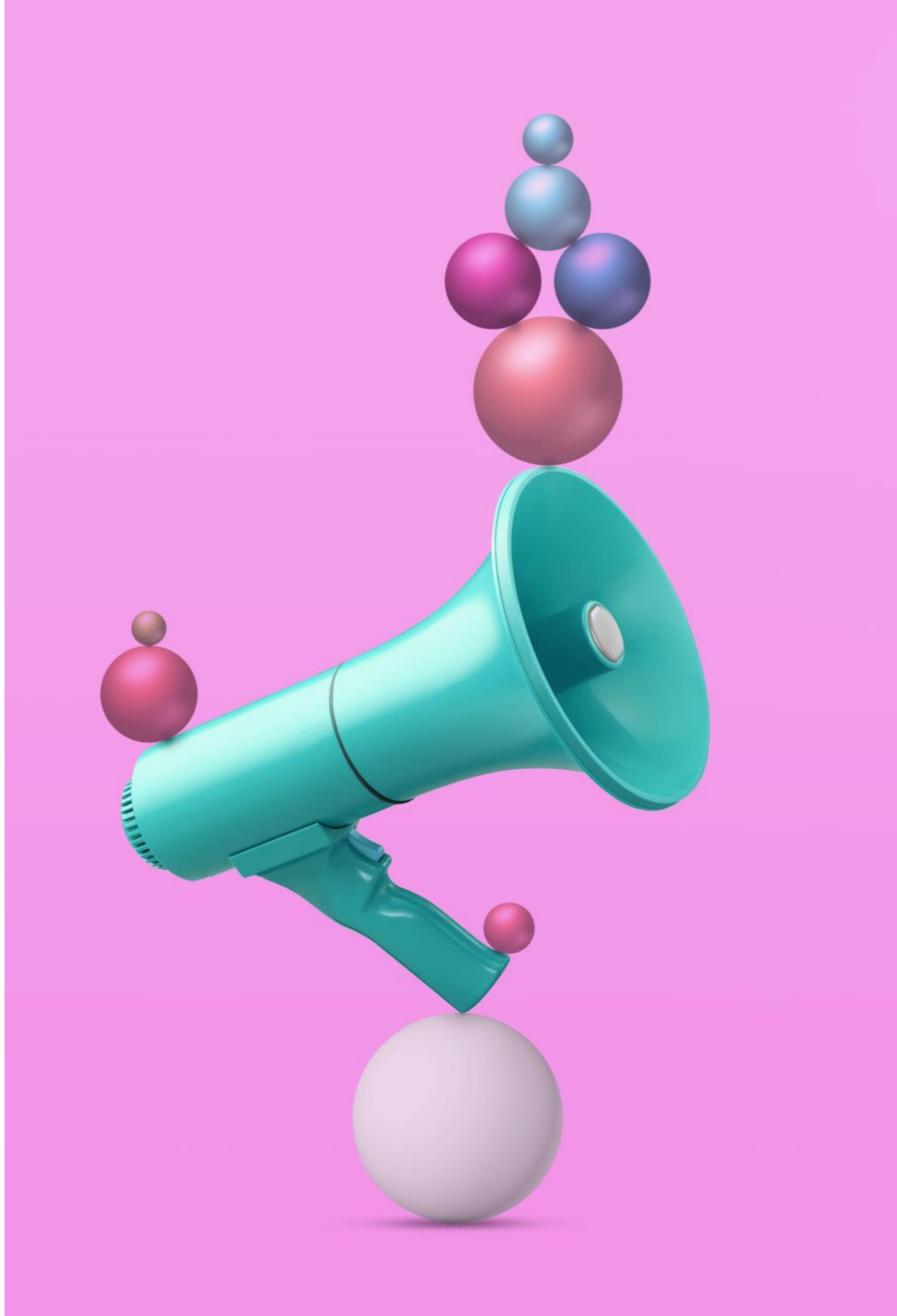
Interaction: Usability and Interfaces

In this session…

- Usability
- Interaction
  - Interface Metaphors
  - Reducing Cognitive Load:
    - Miller's Law
    - Gestalt's Theory
    - Hicks Law
    - Fitts' Law
    - Design Patterns and Consistency
- Interface Inquiry Assignment

Announcements

- **Team Charter due by the end of this week (31/03/23) by 5pm**
  - *Blackboard > Assessment > Design Proposal > Team Charter Submission*
  - Please only submit your team charter once, when your team has been finalised
  - Any team member may submit on behalf of the entire team
  - Students without a team by the end of the week will be placed in one
- No studios next week (week 7)
  - ‘Drop-in’ sessions will be announced on Blackboard instead



What is Usability?

- "The extent to which a product can be used by specified users to achieve specified goals, with effectiveness, efficiency and satisfaction in a specified context of use. " *ISO 9421-11 Standard on Usability*
- "…Quite simply: if your product is not usable, its UX will be bad, and users will leave you for your competitors." *Interaction Design Foundation*

Perspectives of Usability

Effectiveness	• Whether users can complete their goals with a high degree of accuracy
Efficiency	• Is about speed. How fast? How many steps?
Engaging	• Not just about looking nice but also looking *right* to the user and for the context
Error Tolerance	• Ensure that a user can easily recover from an error and get to what she or he was doing.
Easy to Learn	• Users need to be able to learn how to use the system easily - it is second nature

Whitney Quesenberry (2001), The 5Es

Perspectives of Usability

Discoverability	Feedback	Conceptual Model
Affordances	Signifiers	Mapping
	Constraints	

Don Norman, "The Design of Everyday Things” (Chapter 2)

Metaphors

- "A figure of speech in which a word or phrase is applied to an object or action to which it is not literally applicable" *Oxford Dictionary*
  - E.g. "*The toast jumped out of the toaster*"
- Interface metaphors can help the user understand the interface

Image source: https://www.shutterstock.com/image-vector/vector-illustration-male-surfer-rides-big-352665830

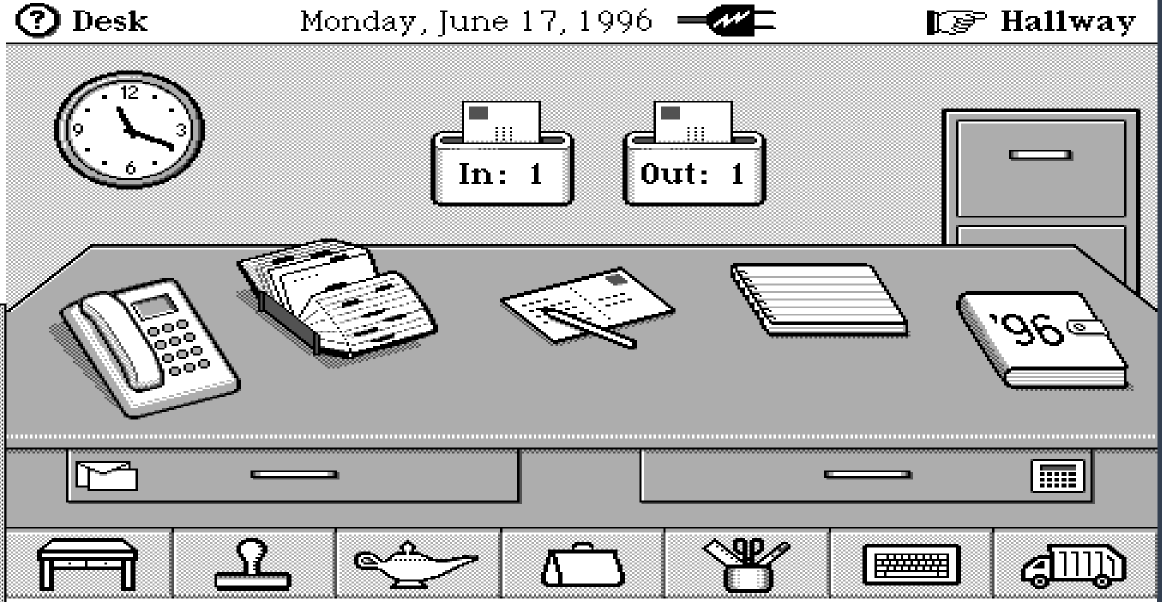
Interaction Metaphors

- "Cognitive models for interaction that can profoundly influence the design of interfaces to data spaces" (Ware, 2013)
- Used to communicate new ideas and help people understand the type of interaction that we expect to take place
- Describe a pattern. Can classify patterns and make them distinct from others
- Communicate affordances – what an object is, its purpose, and how people can interact with it
- Help novices become experts by helping them relate it to the real world

Ware, C., 2013. Chapter Ten - Interacting with Visualizations. *Information Visualization (Third Edition),* https://doi.org/10.1016/B978-0-12-381464-7.00010-7

Desktop Metaphor

Macintosh interface



Xerox Star (1981)

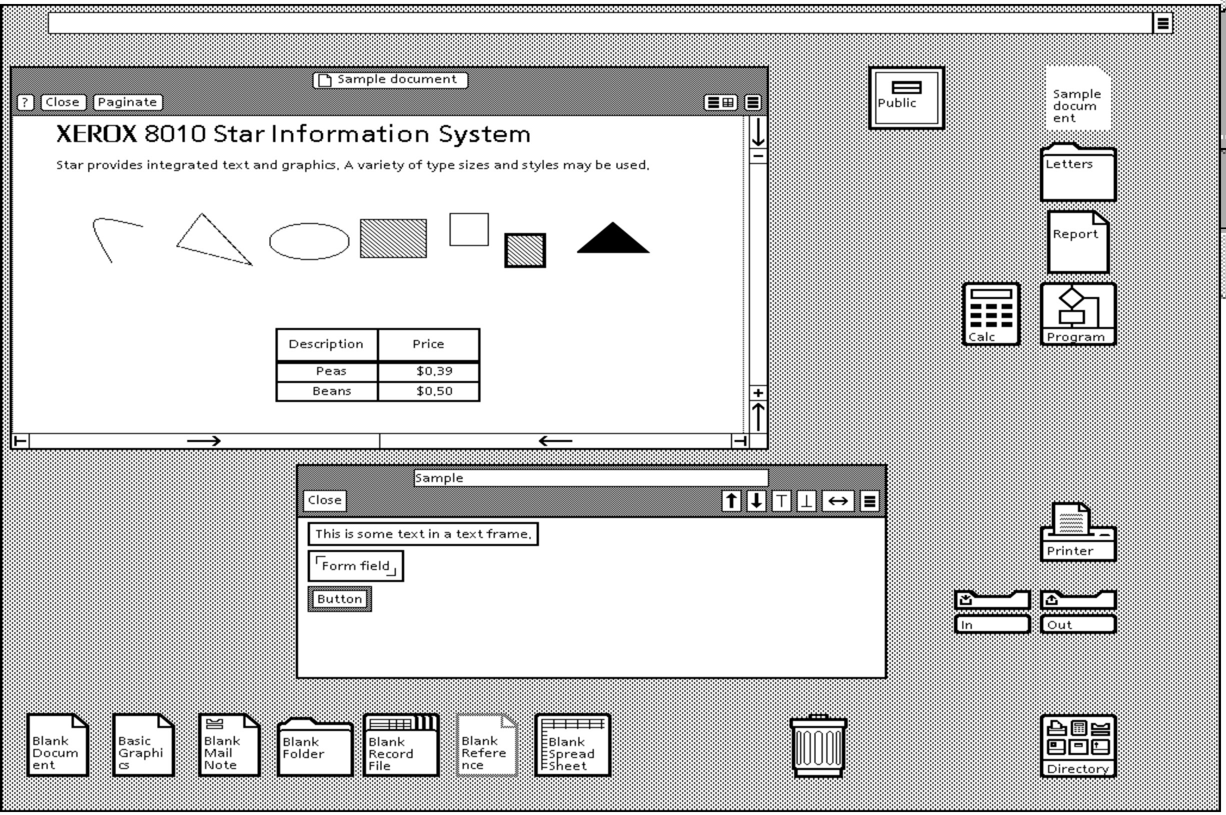


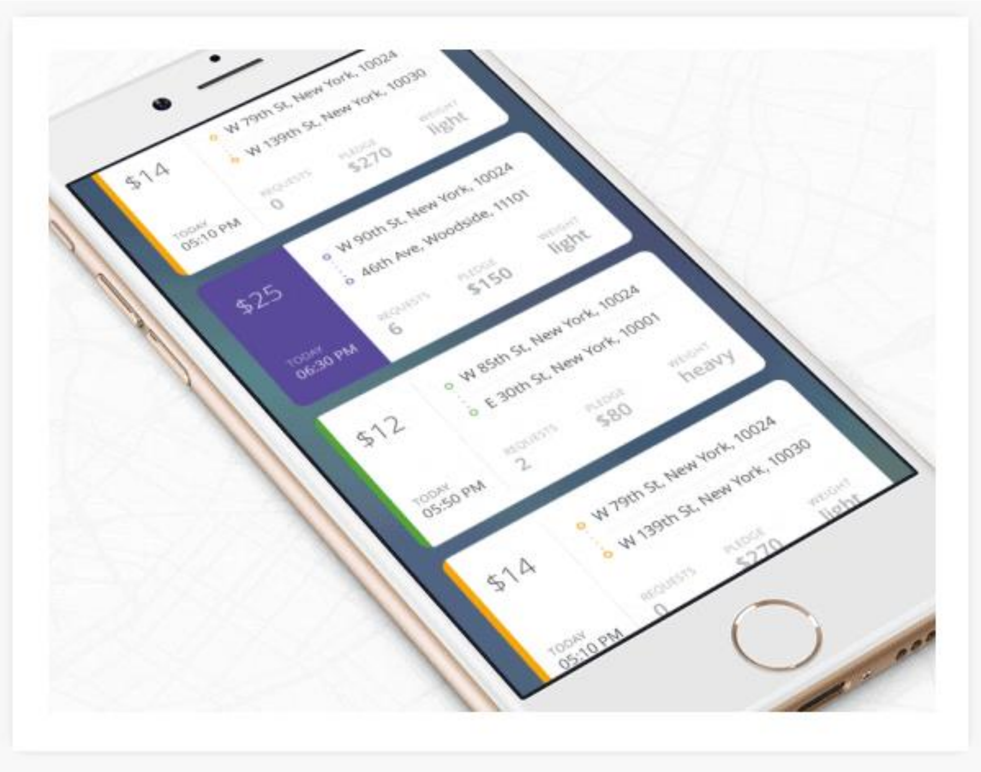
Image source: https://blog.hightail.com/trashing-desktop-metaphor/ https://www.nngroup.com/articles/anti-mac-interface/

Interface Metaphors

Card-Based Metaphors

Image source: https://uxplanet.org/using-card-based-design-to-enhance-ux-51f965ab70cb

Card-Based Metaphors



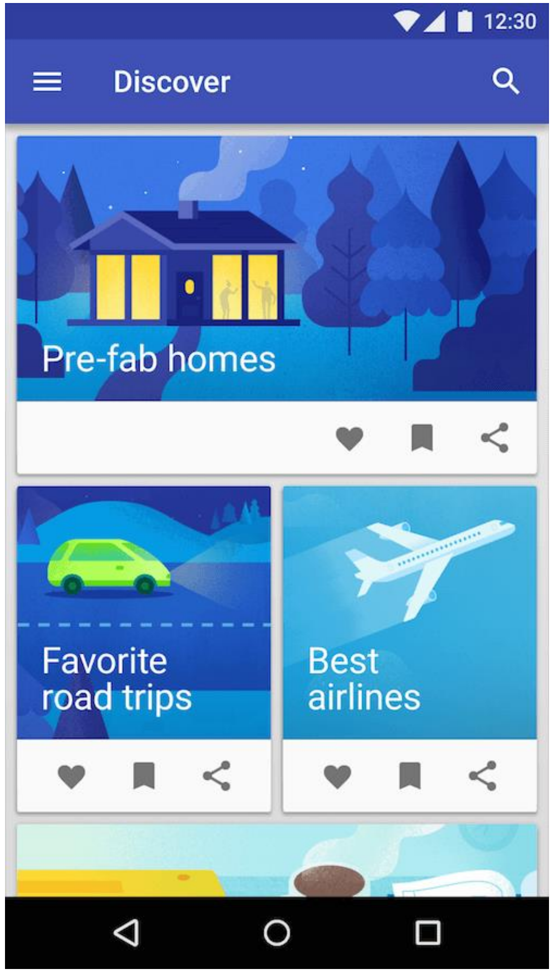


Image source: https://www.smashingmagazine.com/2016/10/designing-card-based-user-interfaces/ https://uxplanet.org/using-card-based-design-to-enhance-ux-51f965ab70cb

Benefits of Card-Based Metaphors

- Content is chunked
  - Helps users to scan information by dividing content into sections
- Easy to Process
  - Information can be communicated and digested quickly
- Visually Attractive
  - Relies on images, which are attractive and immediately catches the eye

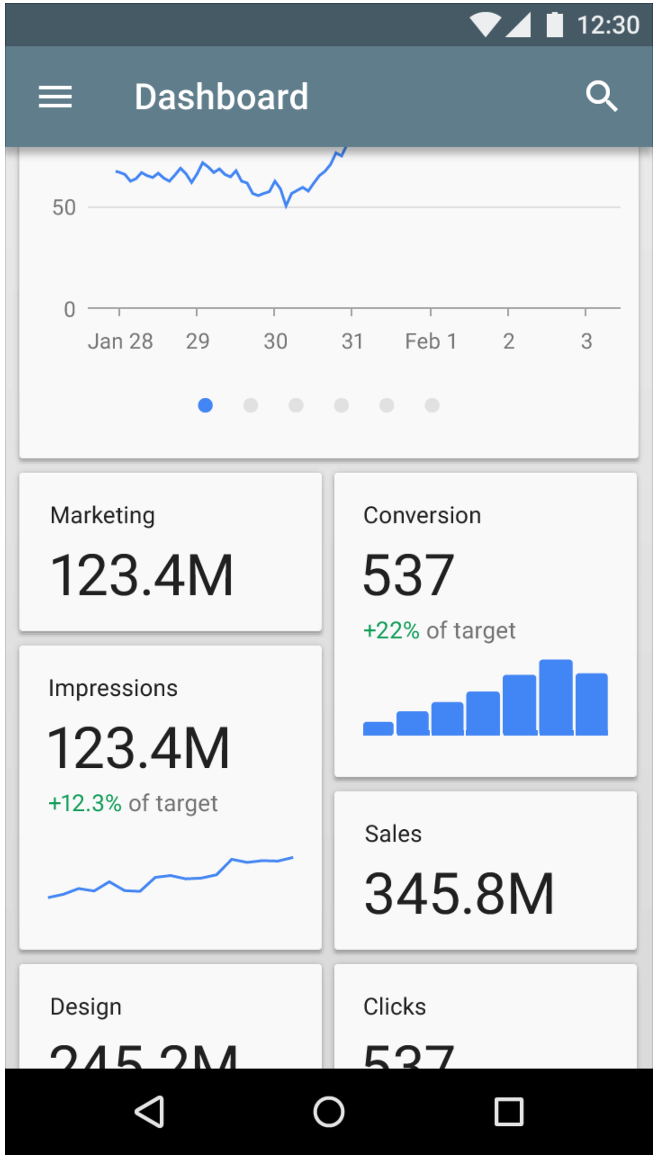


Image source: https://www.smashingmagazine.com/2016/10/designing-card-based-user-interfaces/

Benefits of Card-Based Metaphors

- Beneficial For Various Screen Sizes
  - Easily manipulated for multiple screen sizes (consistency)
- Easy for Thumbs
  - Users instinctively understand the interaction of turning a card over or swiping for more information

Image source: https://www.smashingmagazine.com/2016/10/designing-card-based-user-interfaces/

Human Memory Limitations

- Sensory memory
  - Fraction of a second up to 2 seconds
- Short-term/working memory
  - Small amount of information held (approx. 7 items or less) for a short period (usually from 10 to 15 seconds
- Chunking
  - +61(0)733651190
- Stacking
  - Leaky
  - Closure

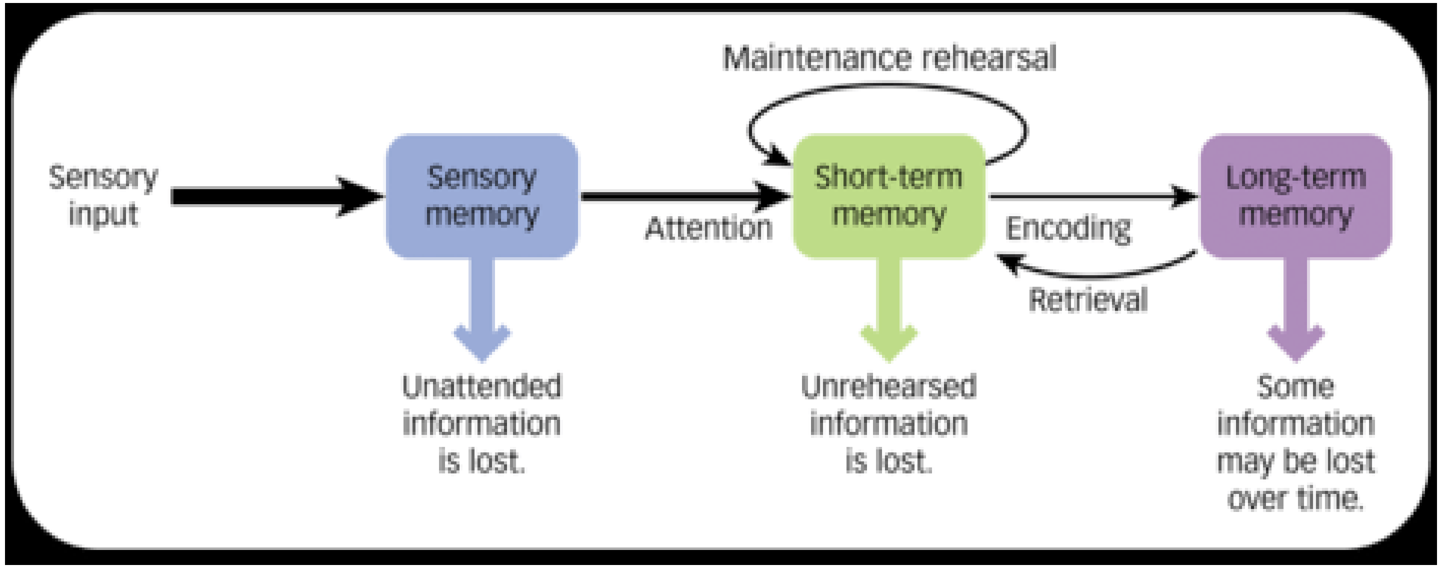
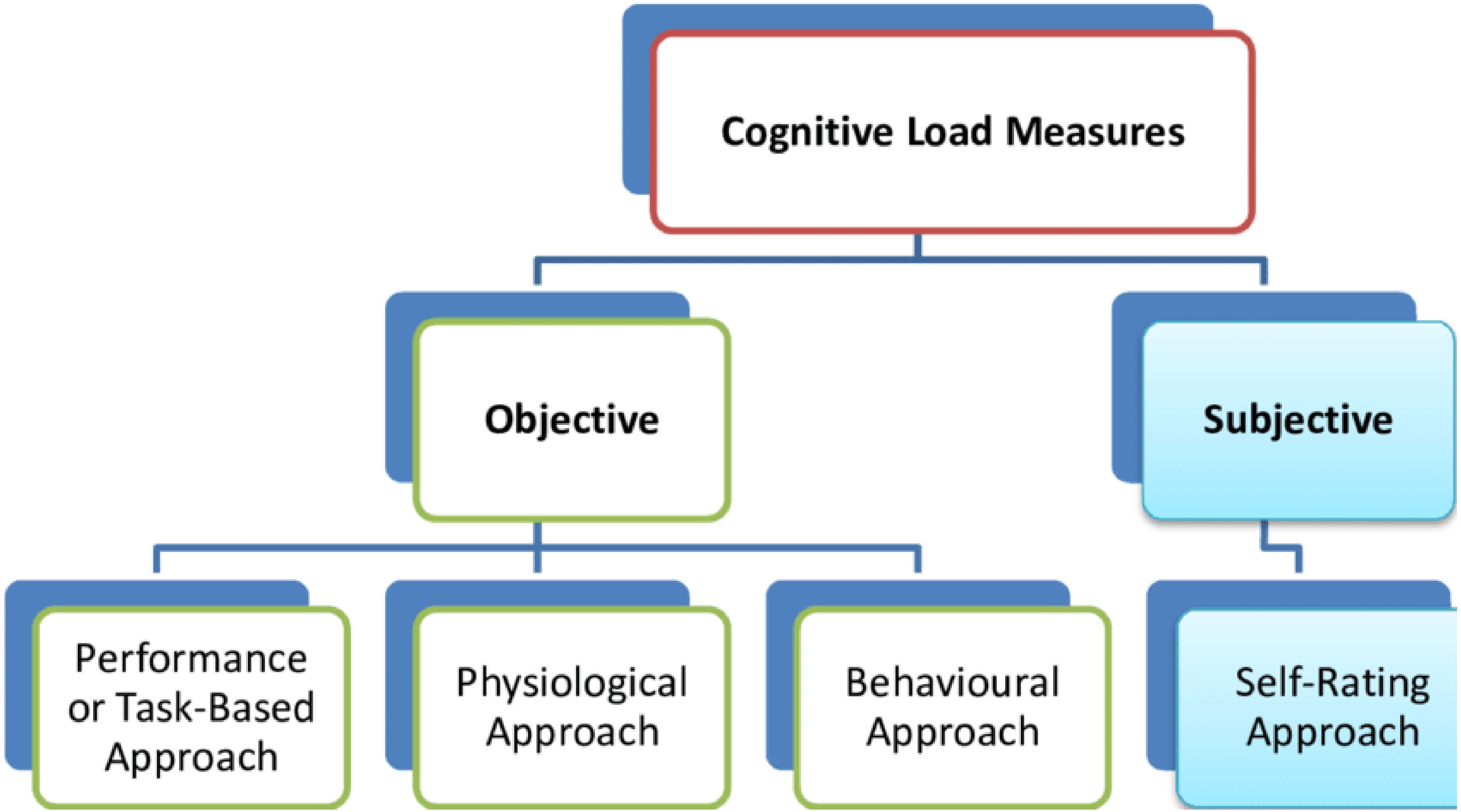


Image source: https://irenevigueguix.wordpress.com/2017/12/13/how-human-memory-works/

Human Memory Limitations

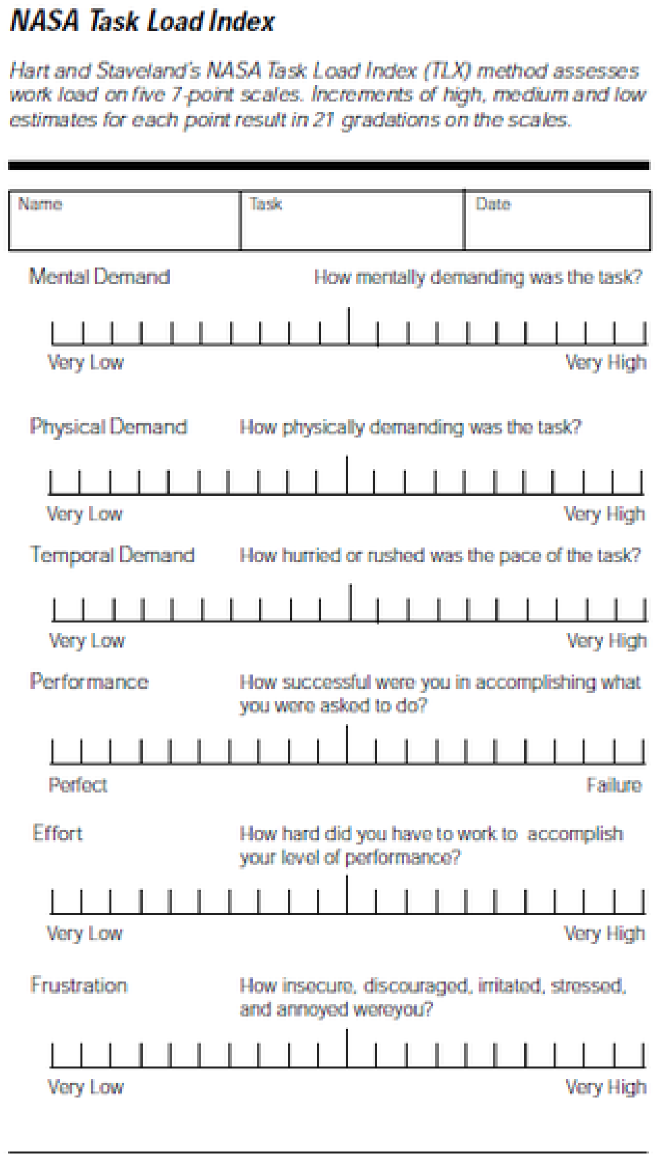
- Long Term memory
  - Organisation and structure important
  - Very high Capacity
  - Retrieval not guaranteed
- Interface considerations
  - Recognition, recall, shortcuts, muscle memory

Measuring Cognitive Load



NASA task load index (NASA TLX)

- Tool for measuring and conducting a subjective mental workload (MWL) assessment
- It allows you to determine the MWL of a participant while they are performing a task
- It rates performance across six dimensions to determine an overall workload rating


NASA Task Load Index

Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.

Name	Task	Date

Mental Demand — How mentally demanding was the task?
Very Low — Very High

Physical Demand — How physically demanding was the task?
Very Low — Very High

Temporal Demand — How hurried or rushed was the pace of the task?
Very Low — Very High

Performance — How successful were you in accomplishing what you were asked to do?
Perfect — Failure

Effort — How hard did you have to work to accomplish your level of performance?
Very Low — Very High

Frustration — How insecure, discouraged, irritated, stressed, and annoyed wereyou?
Very Low — Very High

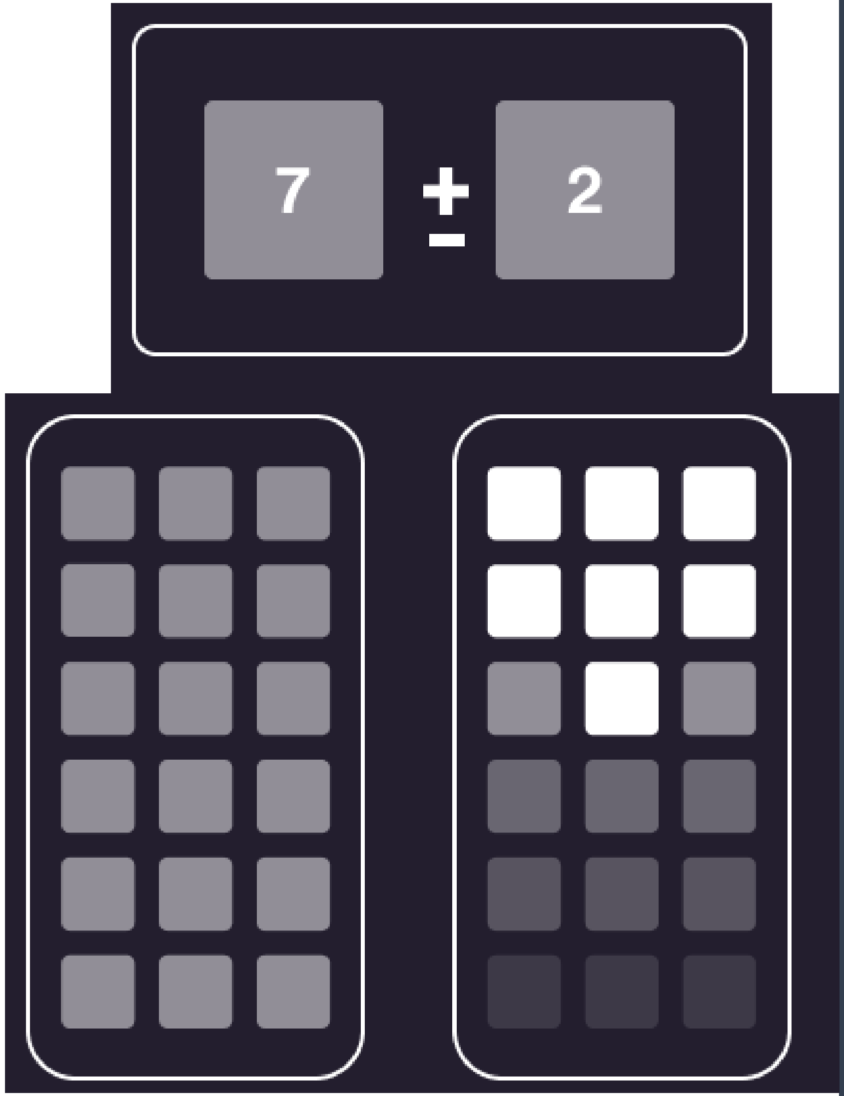
Reducing Cognitive Overload

- A number of principles can be drawn upon from cognitive science to increase the usability of software
  - Miller's Law
  - Gestalt's Theory
  - Hicks Law
  - Fitts' Law
  - Design patterns and consistency

Image source: https://exploringyourmind.com/john-swellers-cognitive-load-theory/

Chunking – Miller's Law (1956)

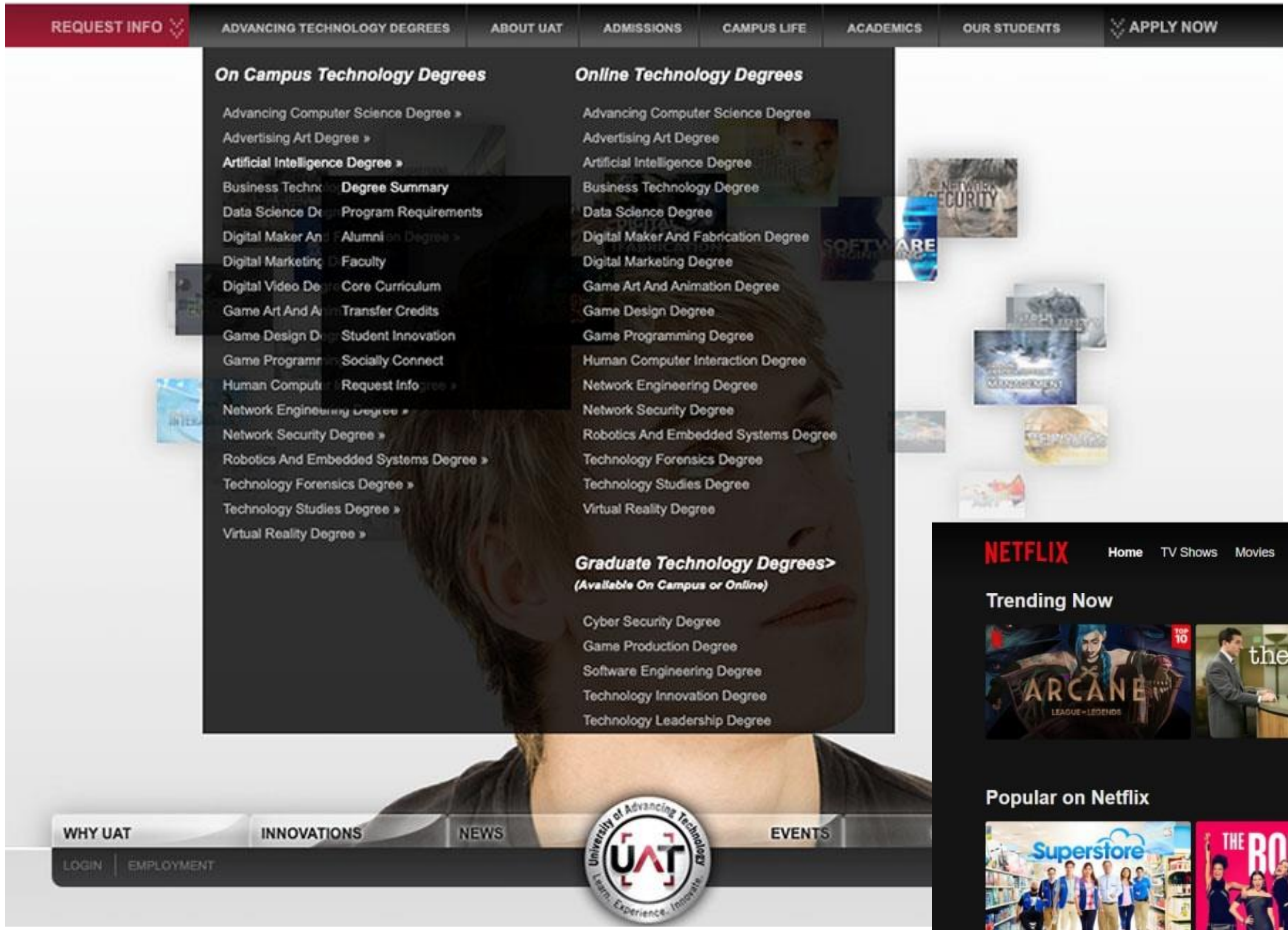
- The average person can only keep 7 (plus or minus 2) items in their working memory
  - 7 plus or minus 2 Rule
- Chunking = The function of grouping information together related by perceptual features
- Organize content into smaller chunks to help users process, understand, and memorize easily
- Short-term memory capacity will vary per individual, based on their prior knowledge and situational context



Miller, G.A., 1956. The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological review*, *63*(2), p.81.

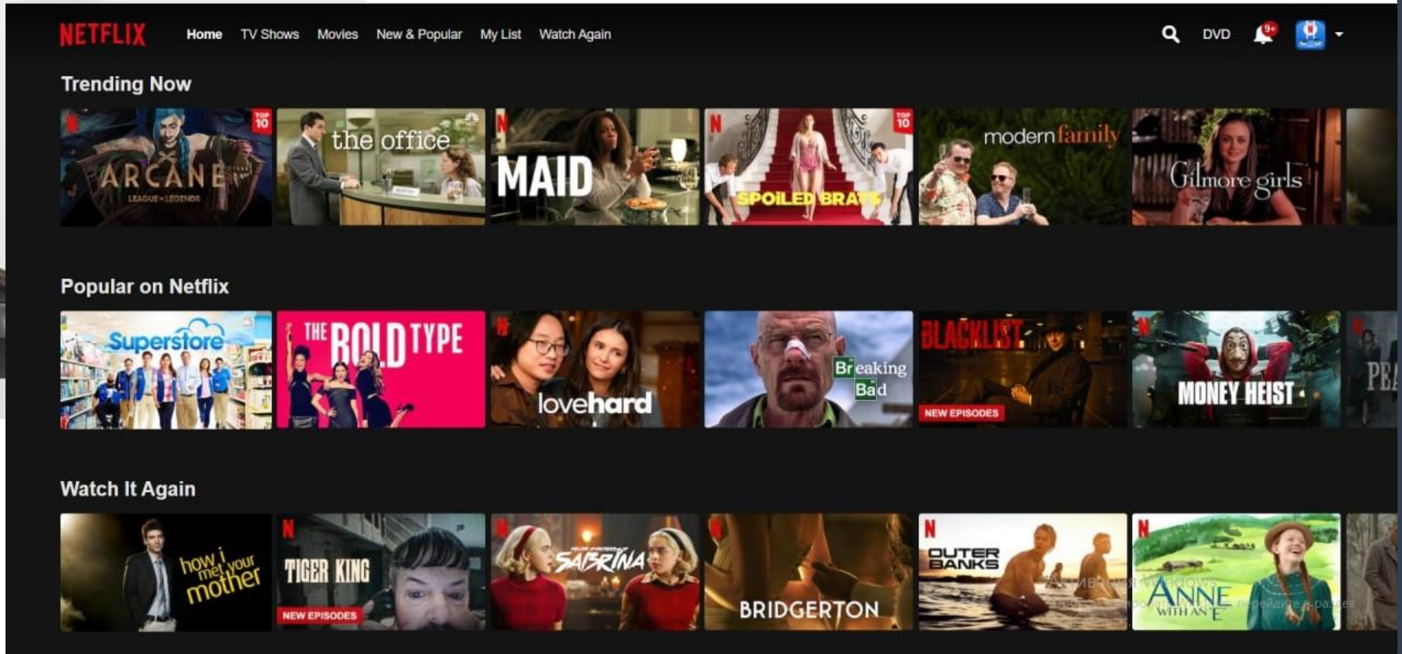
Chunking – Miller’s Law

Chunking – Miller's Law



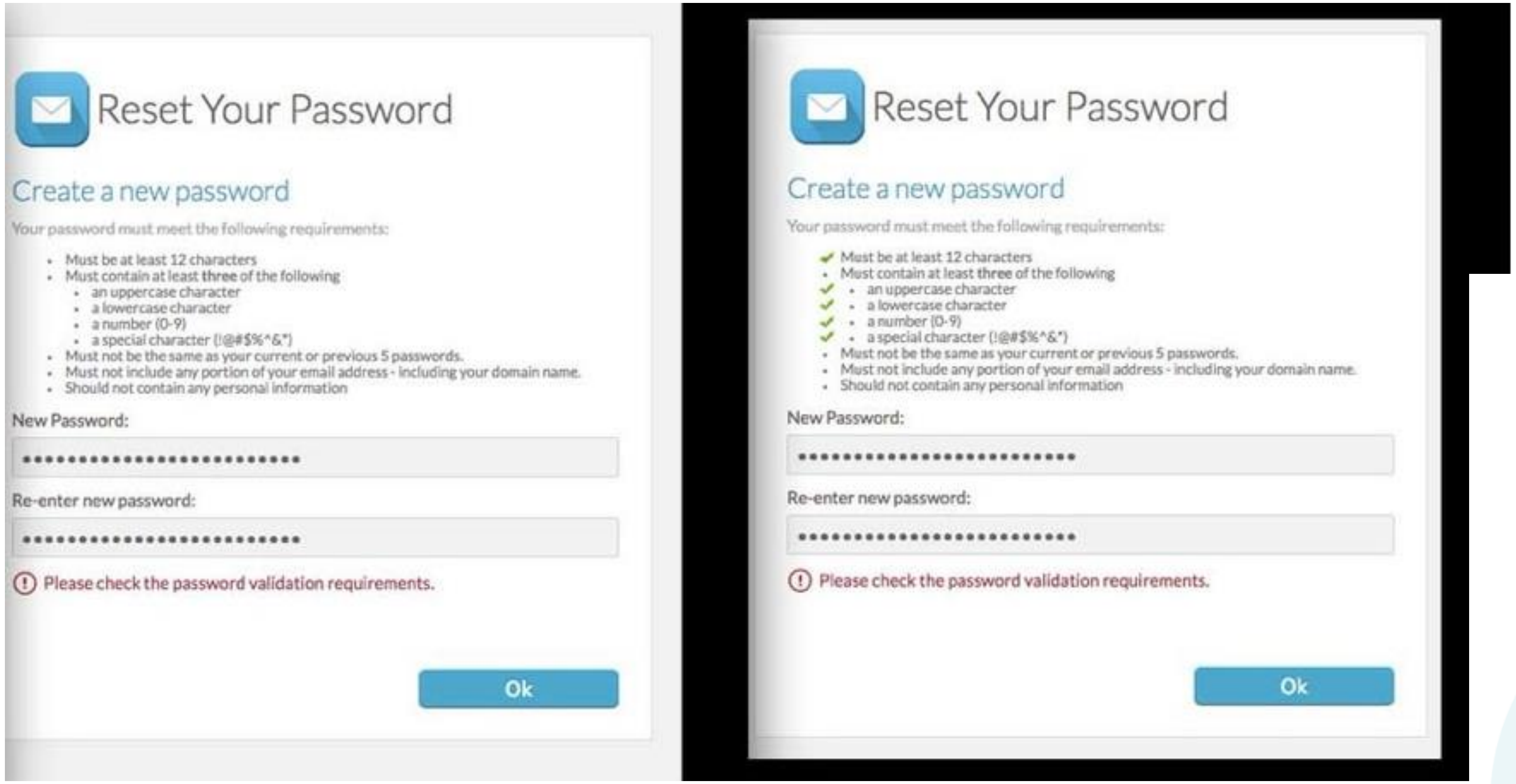
1

Which one applies Miller's Law better?



2

Chunking – Miller's Law



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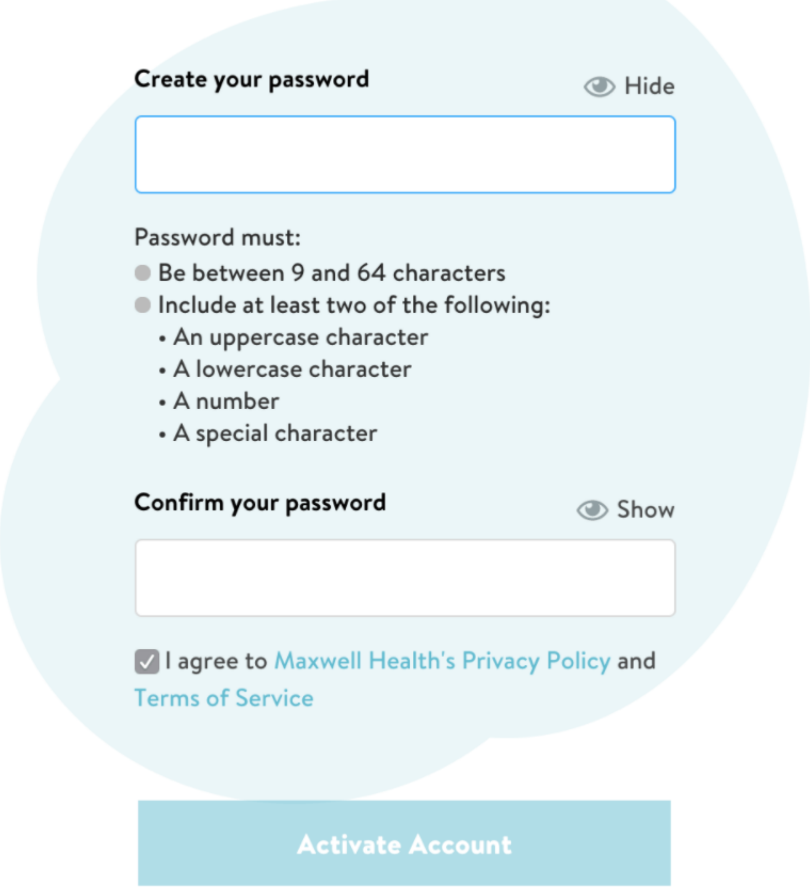
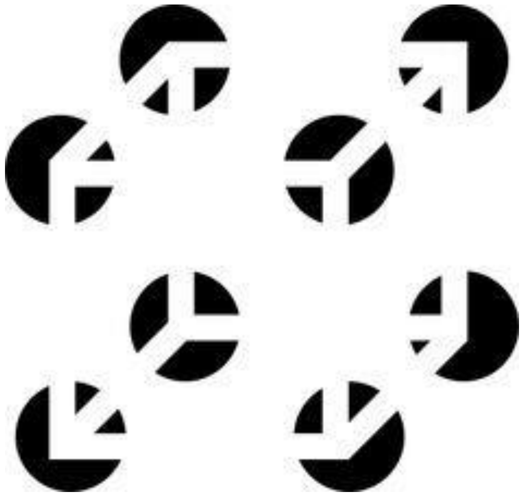
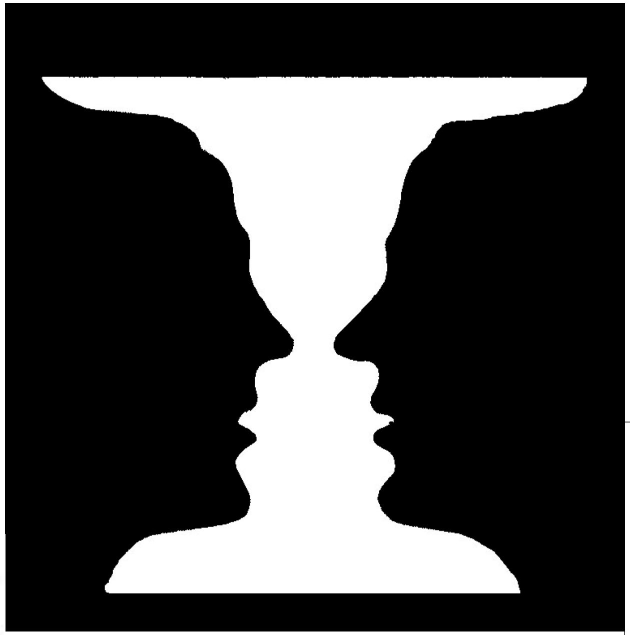


Which one applies Miller's Law better?

2

Gestalt's Theory





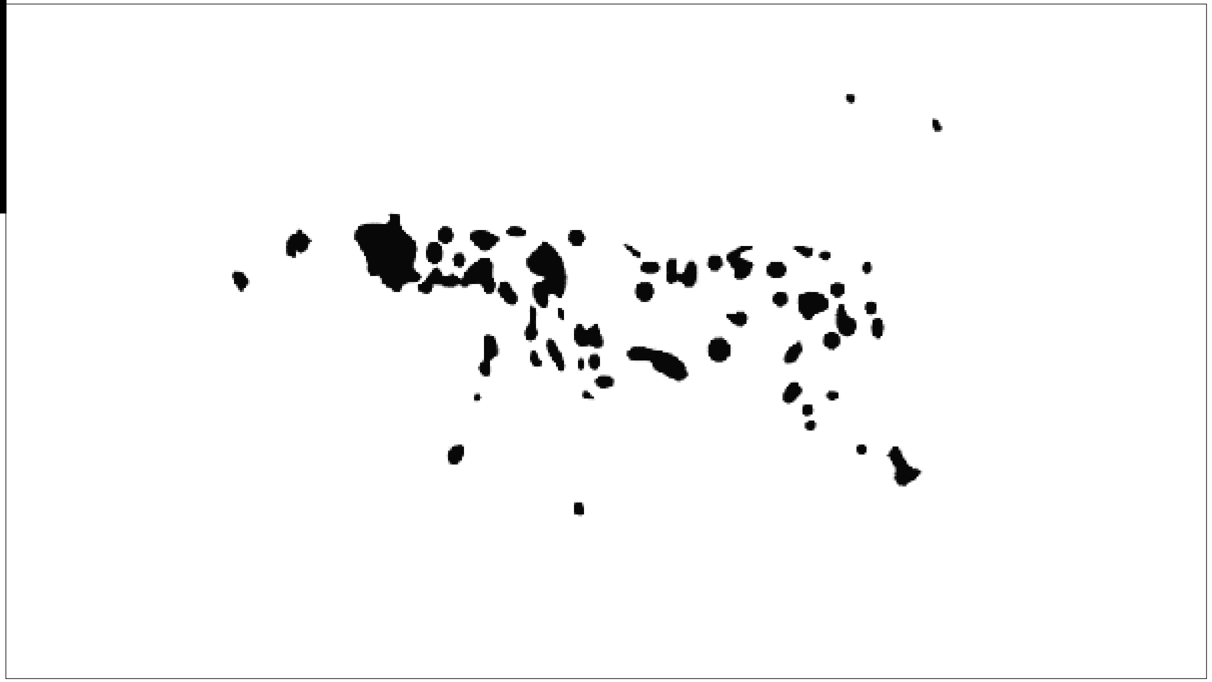


Image sources: https://www.pinterest.com.au/pin/14566398773713448/ https://www.mbaskool.com/business-concepts/marketing-and-strategy-terms/4074-gestalt-theory.html
https://www.usertesting.com/blog/gestalt-principles/ https://www.psywww.com/intropsych/ch04-senses/gestalt-psychology.html#thewhole

Gestalt’s Theory

- Conceived by German psychologists, Max Wertheimer, Kurt Koffka Wolfgang Kohler and Christian von Ehrenfels, in the 1920s
  - Gestalt = 'shape' or 'form'
- “The whole is other than the sum of the parts” – Kurt Koffka
- Our brains are built to see structure and patterns in order for us to better understand the environment that we’re living in

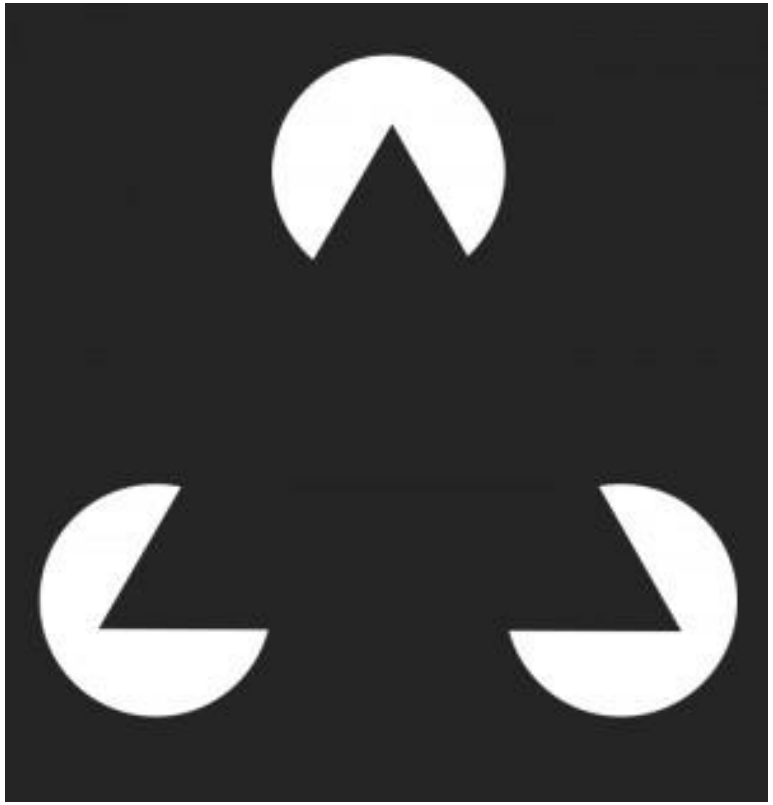
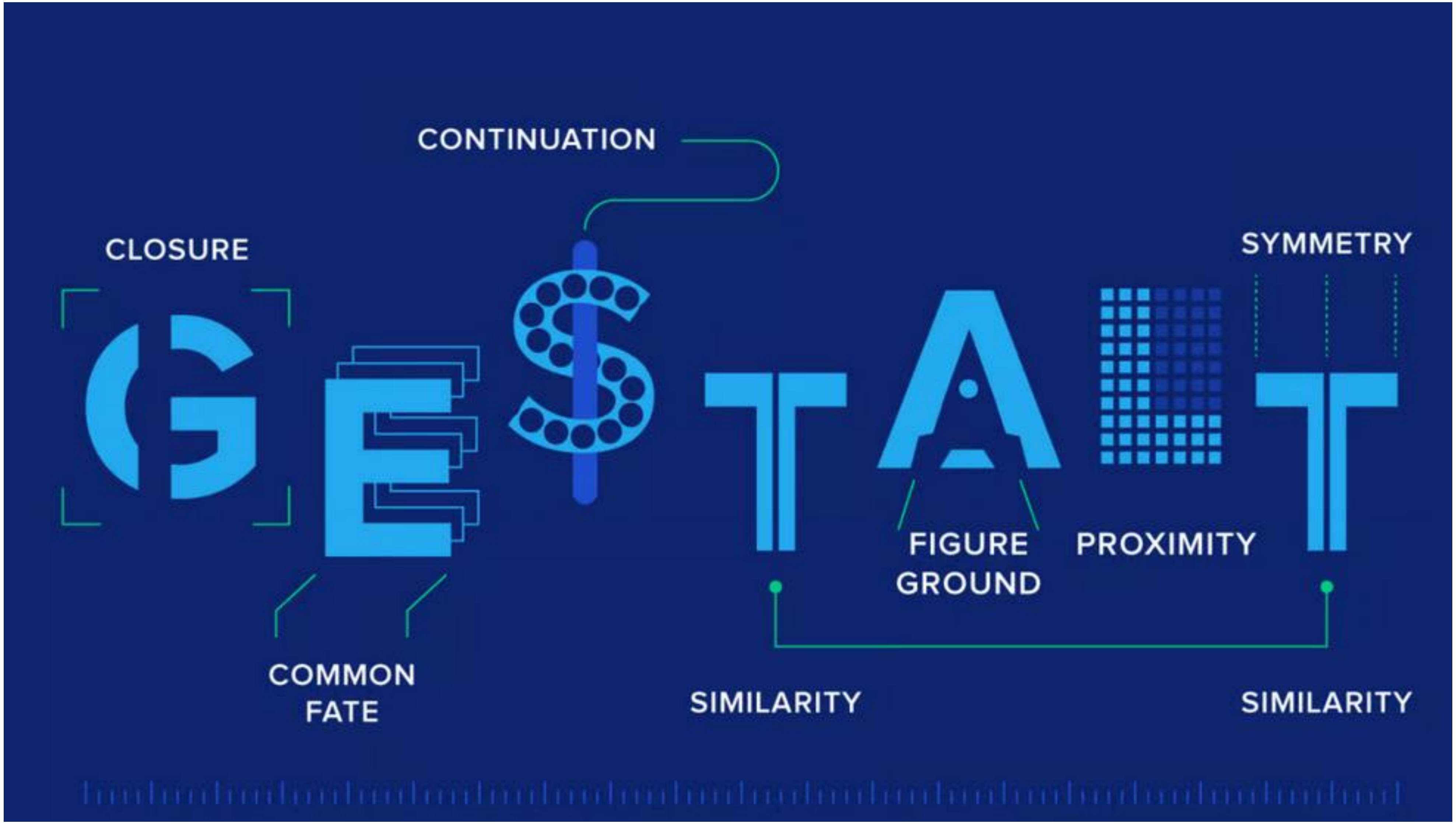


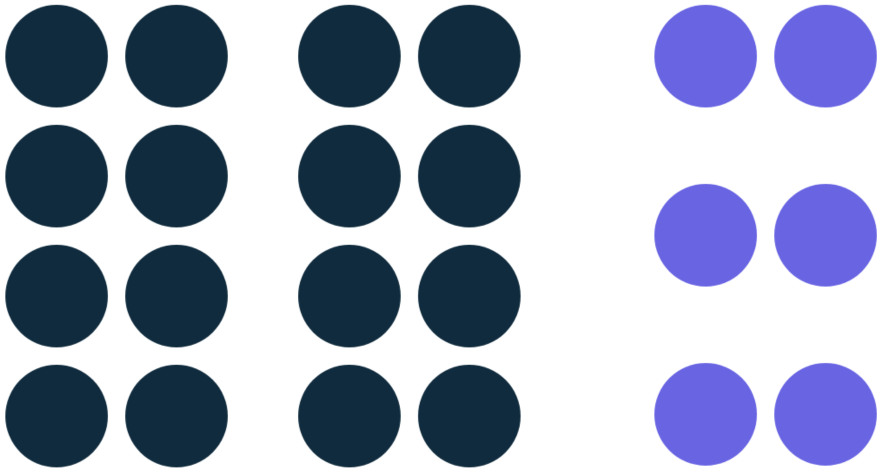
Image source: https://www.usertesting.com/blog/gestalt-principles/

Gestalt’s Theory



Proximity and Similarity

- Proximity
  - The distance between objects in a display influences our perception of how objects are organized
  - Things that are close together go together
  - Similar information should be grouped together to simplify layouts and vice versa
- Similarity
  - Objects that look similar are perceived to be more related and are often are put together
  - Can help to organise and categorise objects within a group (colour, size, shape, etc.)



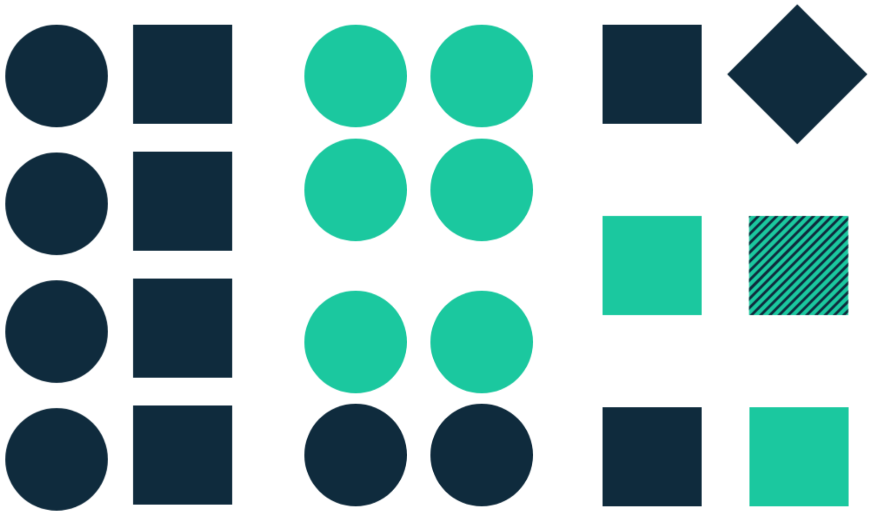
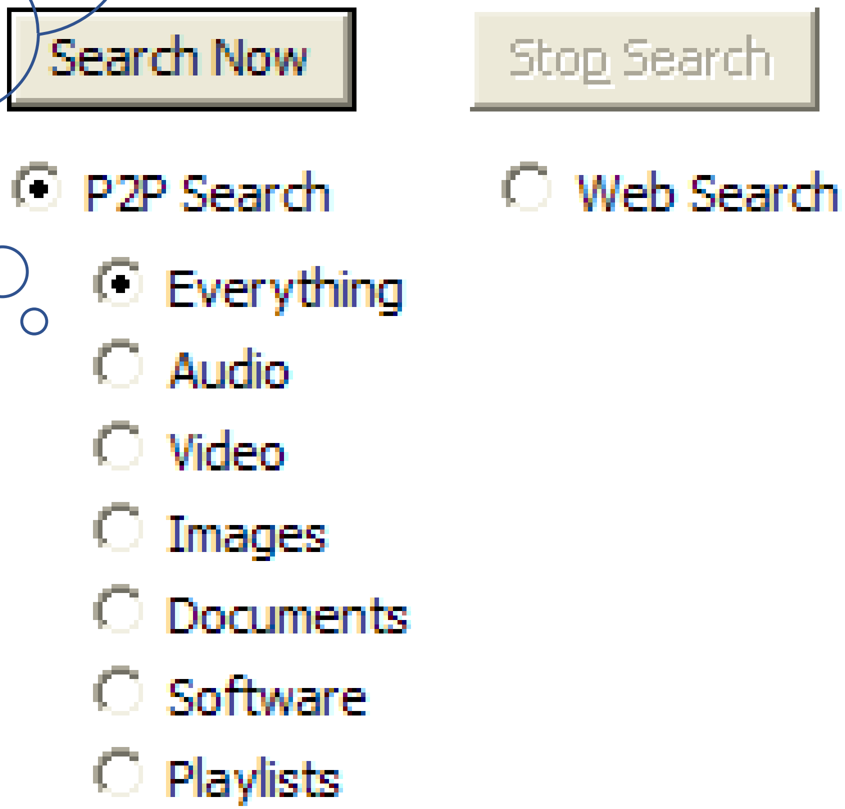


Image sources: https://medium.muz.li/gestalt-principles-in-ui-design-6b75a41e9965

Proximity and Similarity

Similarity
Colour is used to group items together

Proximity
Grouping radio buttons together signals an association



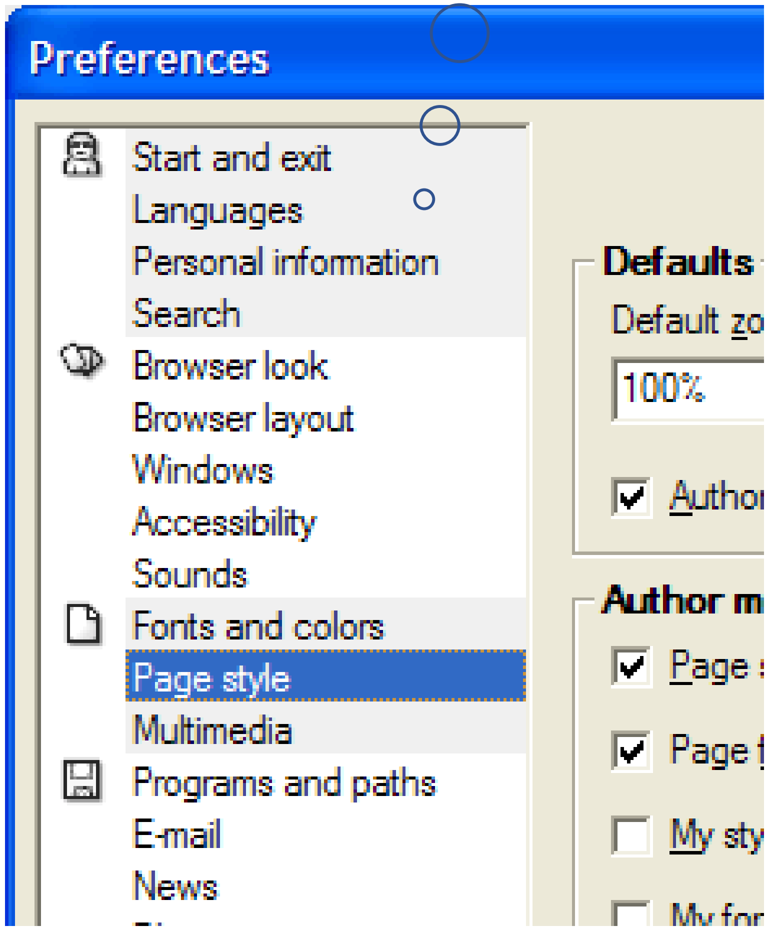


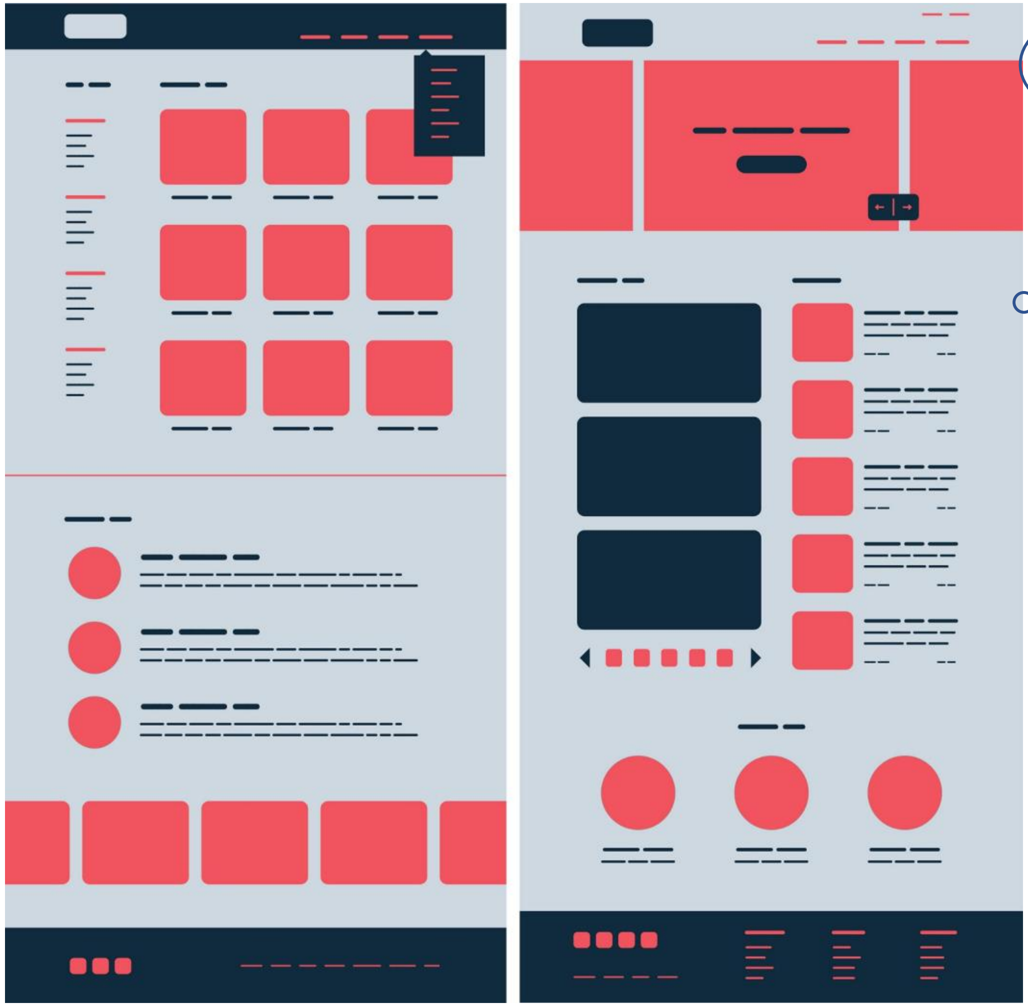
Image sources: https://www.interaction-design.org/literature/book/the-glossary-of-human-computer-interaction/gestalt-principles-of-form-perception

Continuity and Closure

- Continuity
  - Items in a line or curve are thought to be more related
  - When lines intersect we see two lines rather than four lines that join at a point
- Closure
  - Humans prefer complete shapes
  - Any gaps are automatically filled in with bits that don't exist to perceive a complete image
  - This includes extending lines to form an unbroken object

Image sources: https://medium.muz.li/gestalt-principles-in-ui-design-6b75a41e9965

Continuity and Closure



Continuity
Arrangement of rows and columns

Closure
Often used in icons to communicate

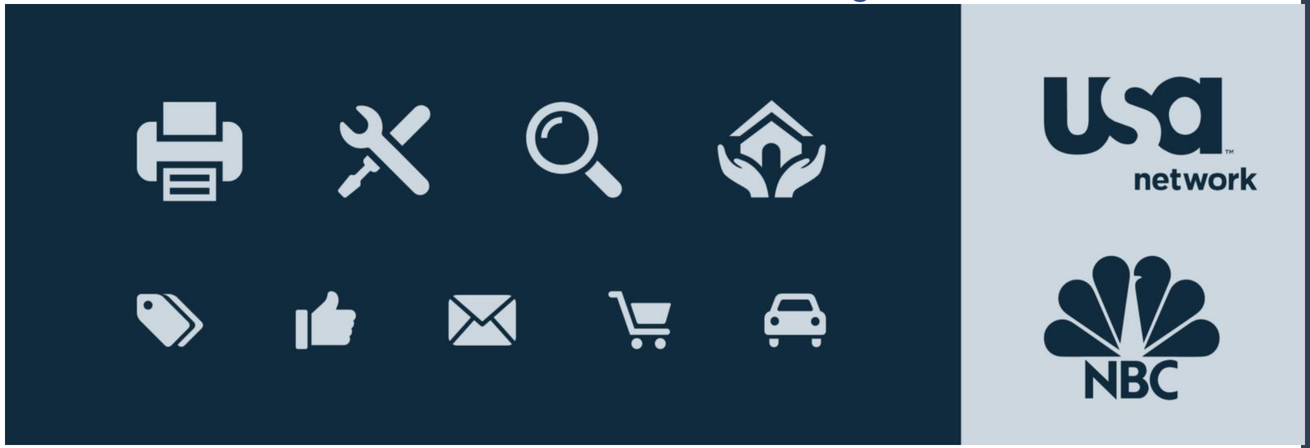
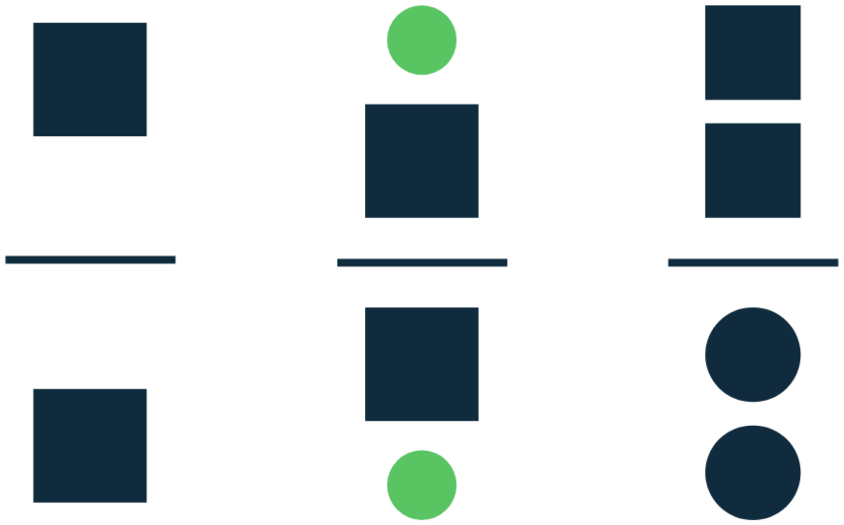
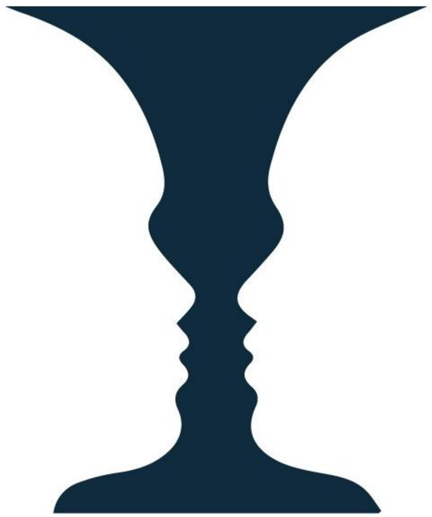


Image sources: https://medium.muz.li/gestalt-principles-in-ui-design-6b75a41e9965

Symmetry and Figure/Ground

- Symmetry
  - When humans see symmetrical items there is an assumption that a connection exists to form a whole
  - Complexity is reduced by parsing complex images into the simplest one
- Figure/Ground
  - Our minds separate images into a foreground (figure) and a background (ground)
  - This results in one view becoming more overriding, while the other one will be harder to see





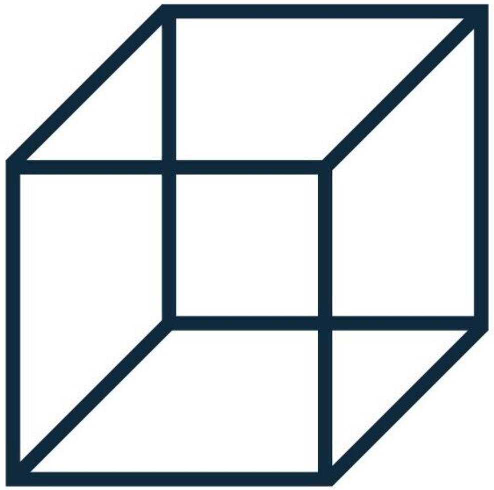
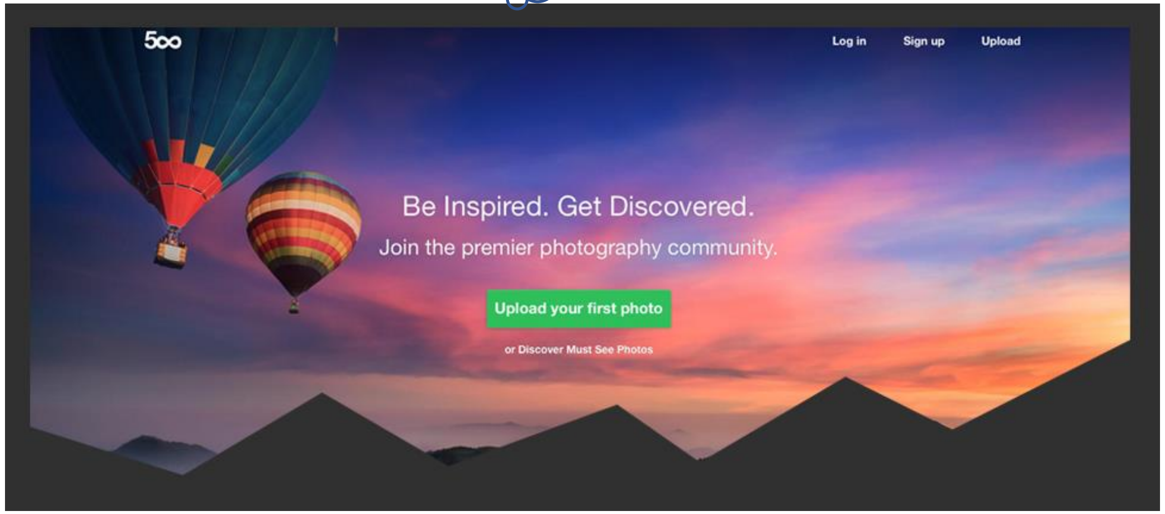


Image sources: https://medium.muz.li/gestalt-principles-in-ui-design-6b75a41e9965

Symmetry and Figure/Ground

Symmetry
Can be used in galleries, banners, navigation, etc.

Figure/Ground
Shapes are separated from the background



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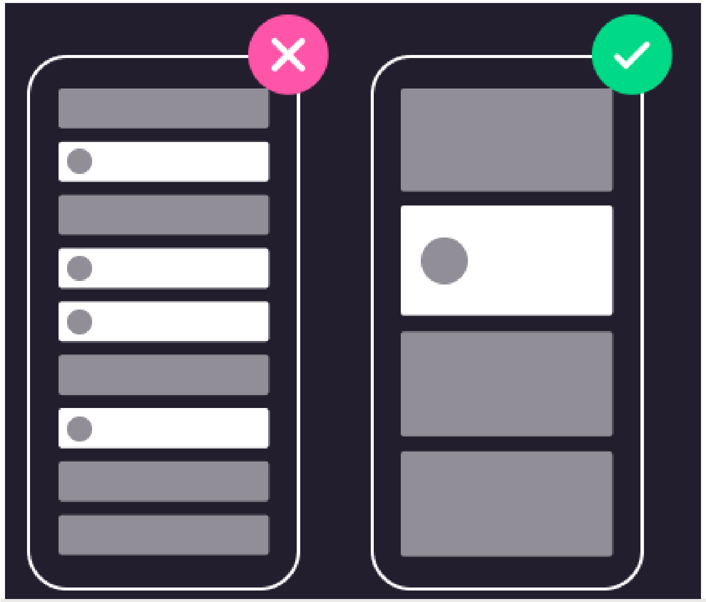
Common Fate

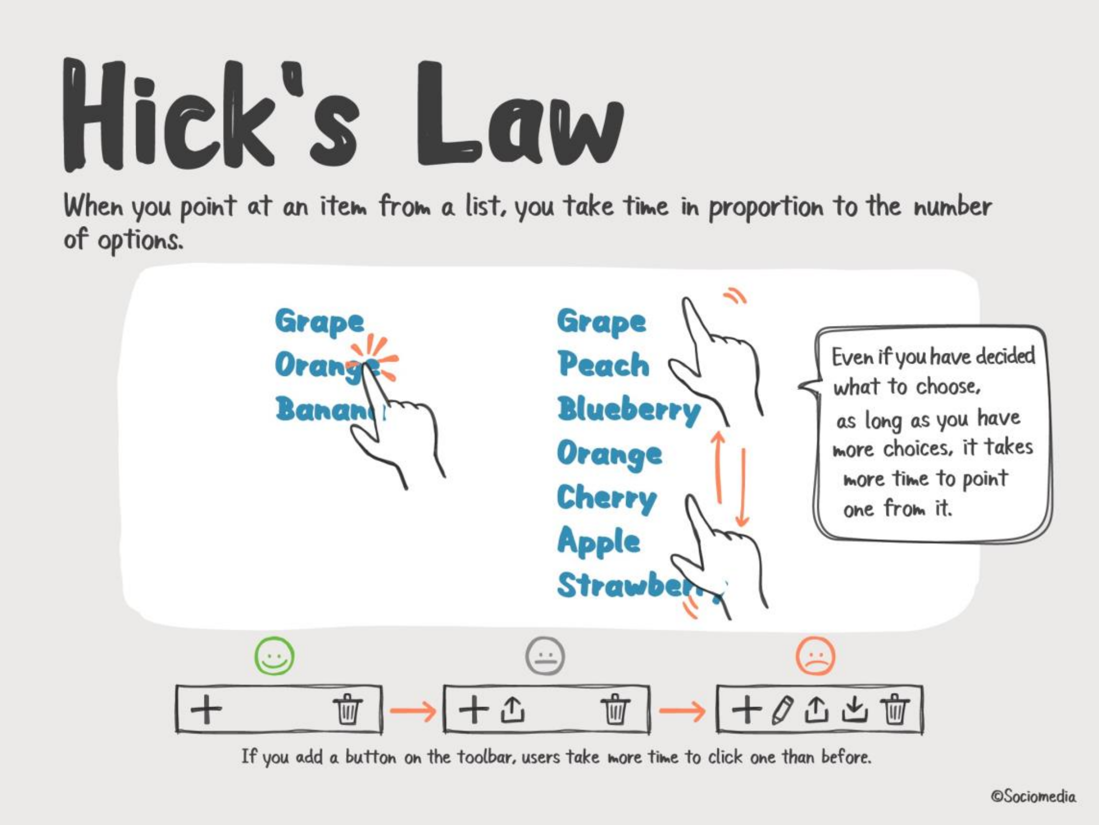
- Common Fate
  - When elements move towards the same direction they are thought of as being more related
  - Concerned with moving object (similar to proximity and similarity)
  - Things that move with similar patterns are seen as being grouped

Image sources: https://medium.muz.li/gestalt-principles-in-ui-design-6b75a41e9965

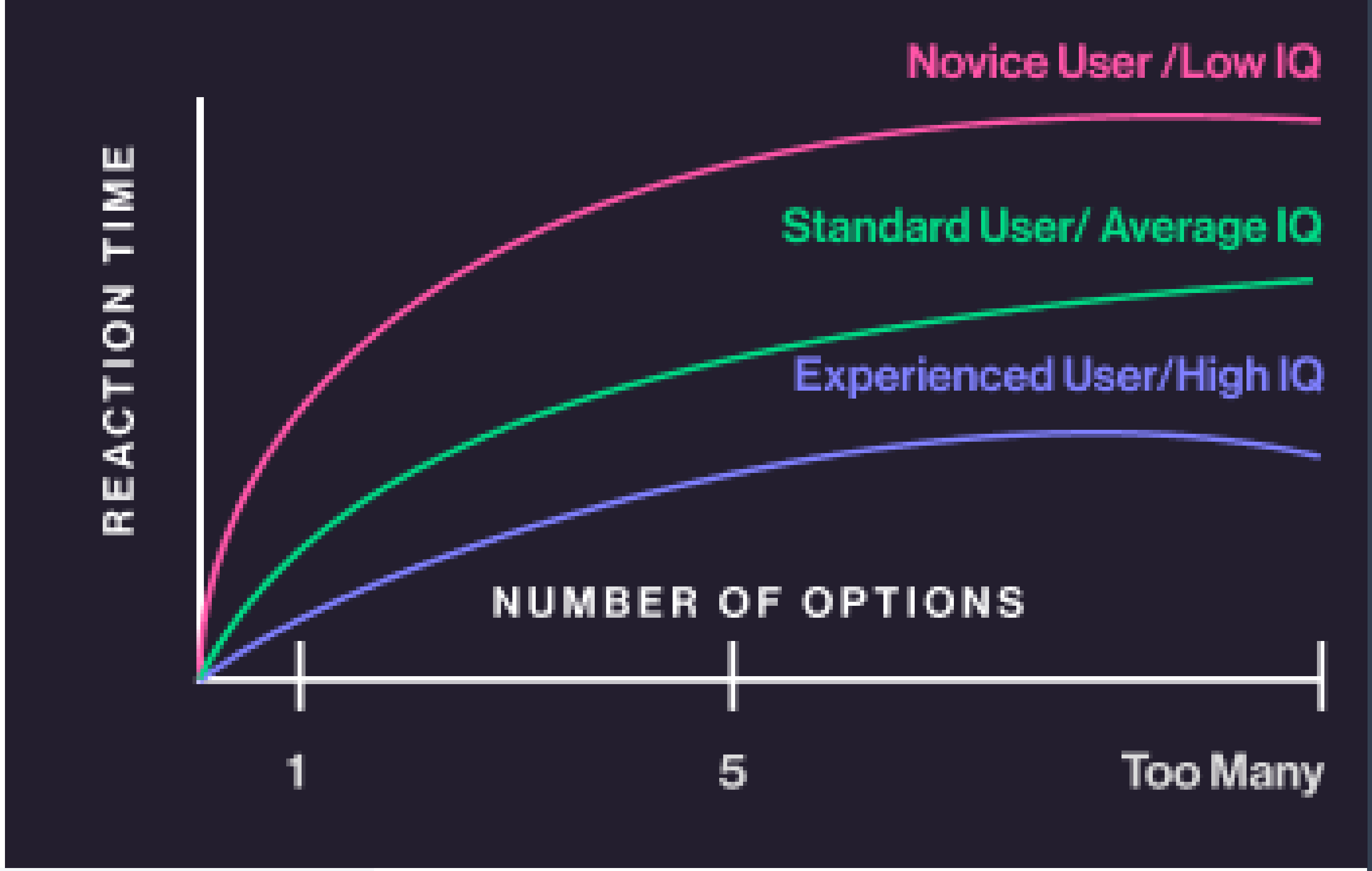
Hick’s Law

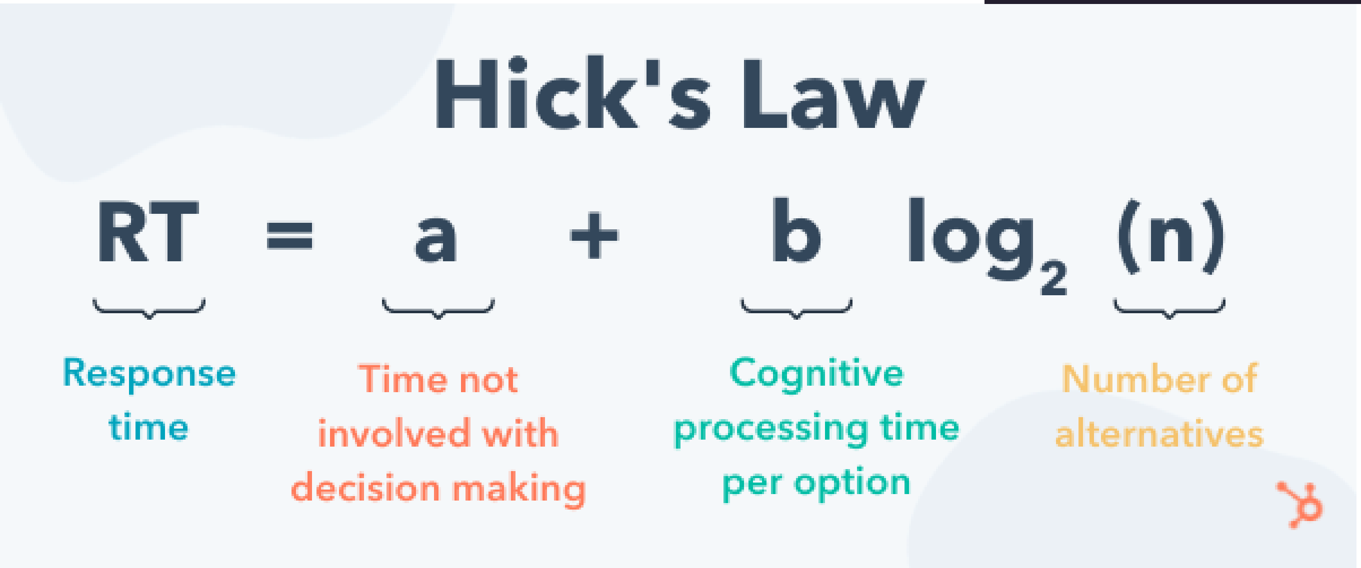
- The time it takes for a person to make a decision as a result of the possible choices he or she has
  - Increasing the number of choices will increase the decision time logarithmically
- The more choices that are presented to a user, the longer it takes them to make a decision
- Important for designers to not overcomplicate and build too much functionality into an application



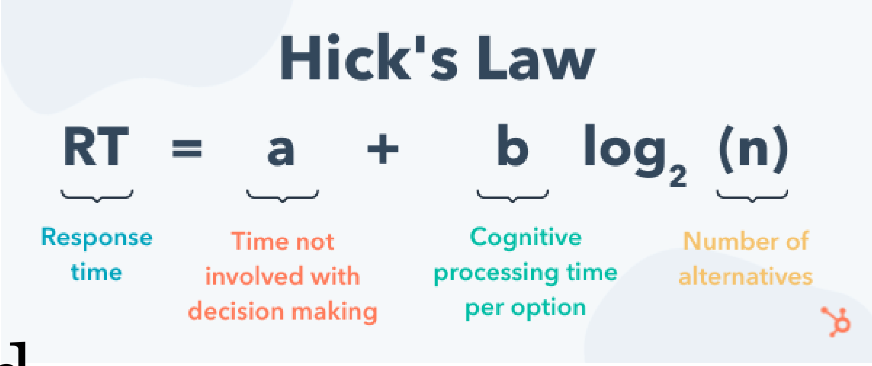


Hick’s Law


Novice User /Low IQ
Standard User/ Average IQ
Experienced User/High IQ
REACTION TIME
NUMBER OF OPTIONS
1
5
Too Many

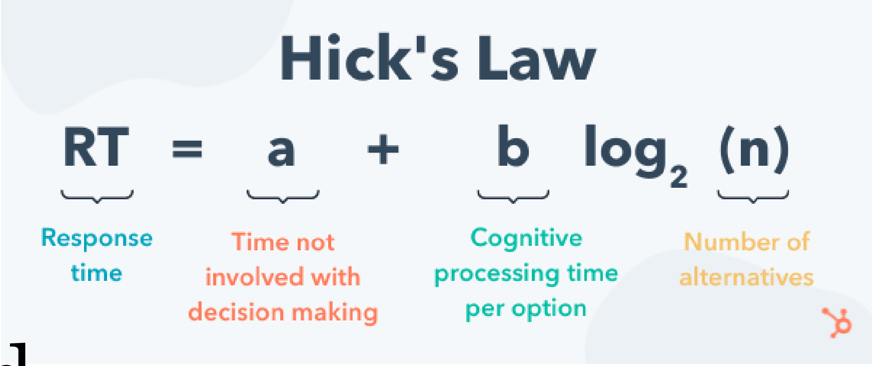

Hick's Law
RT = a + b log2 (n)
Response time
Time not involved with decision making
Cognitive processing time per option
Number of alternatives

Hick’s Law Example



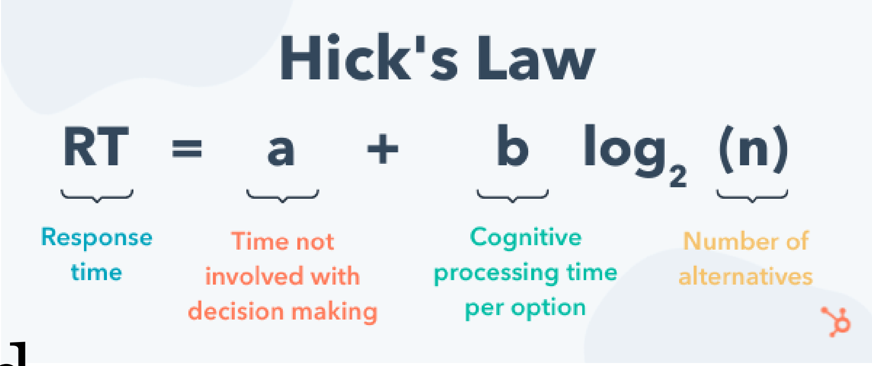
- Your phone starts playing a sound…

Hick’s Law Example



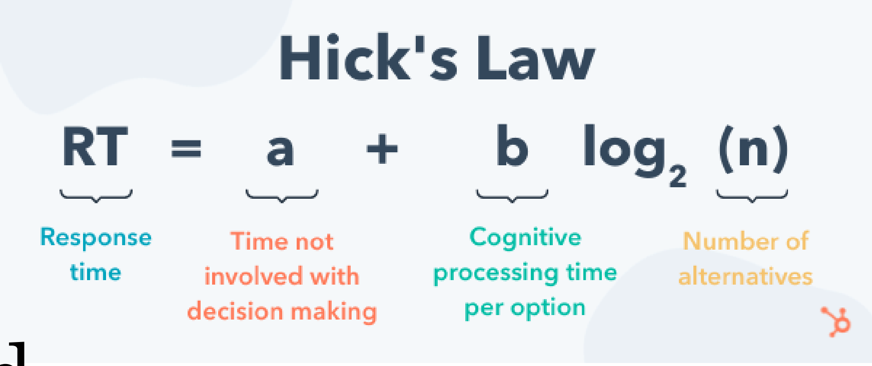
- Your phone starts playing a sound…
- It takes three seconds to detect that the sound is an alarm you set ($a = 3$)

Hick's Law Example



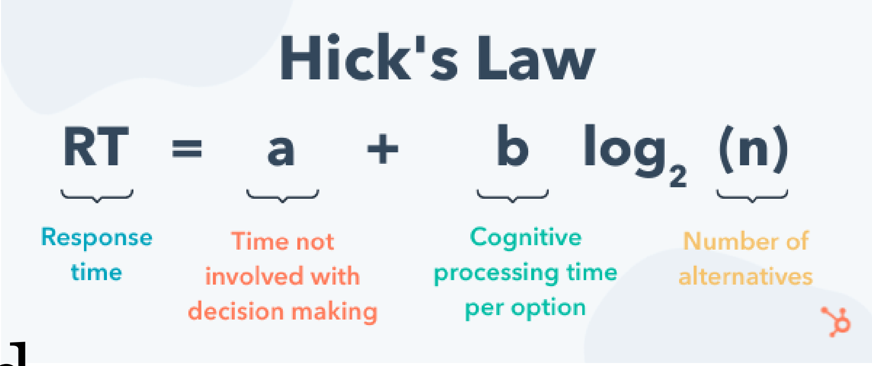
- Your phone starts playing a sound…
- It takes three seconds to detect that the sound is an alarm you set (a = 3)
- As you're human (b = 0.155 sec.)

Hick's Law Example

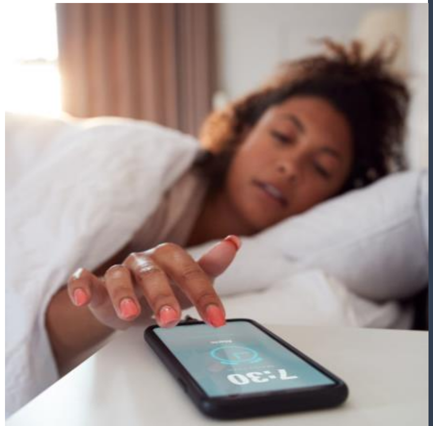


- Your phone starts playing a sound…
- It takes three seconds to detect that the sound is an alarm you set (a = 3)
- As you're human (b = 0.155 sec.)
- You have four buttons to turn off the alarm: snooze, stop, home button, and power button (n = 4)

Hick’s Law Example



- Your phone starts playing a sound…
- It takes three seconds to detect that the sound is an alarm you set (a = 3)
- As you’re human (b = 0.155 sec.)
- You have four buttons to turn off the alarm: snooze, stop, home button, and power button (n = 4)
- RT = (3 sec) + (0.155 sec)(log2 (4)) = 3.31 sec.

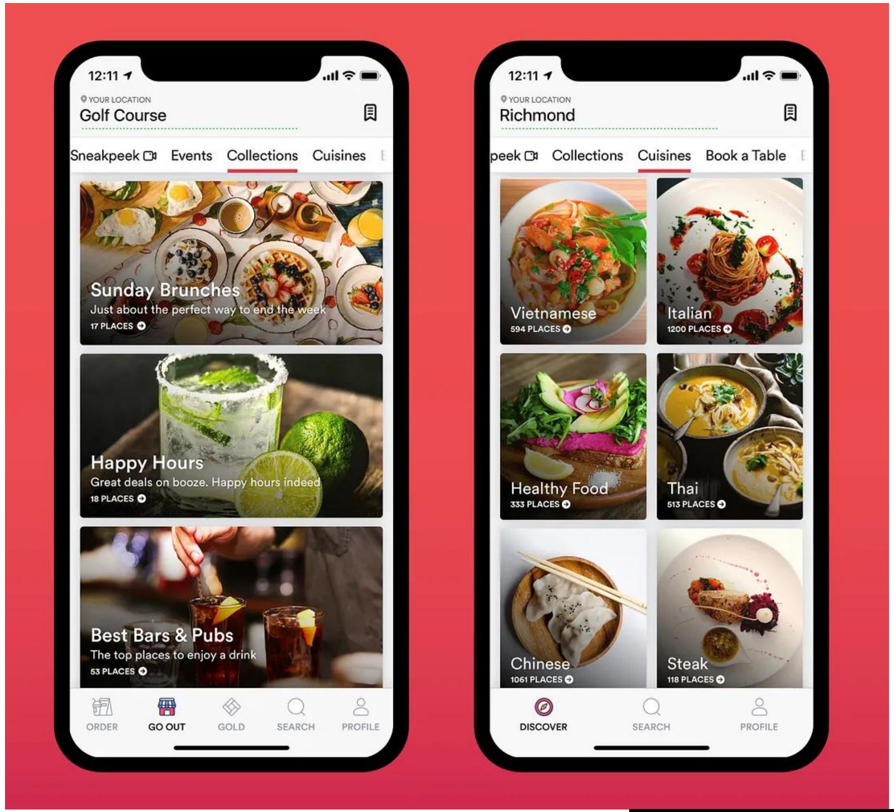


Examples of Hick's Law

Instagram Double Tap: The user has 3 major choices with respect to the content they see — Like it, Comment on it and Share it.

- **Infinite scroll in Instagram:** An abundance of choices keeps the user engaged in its app for as long as possible

Examples of Hick's Law

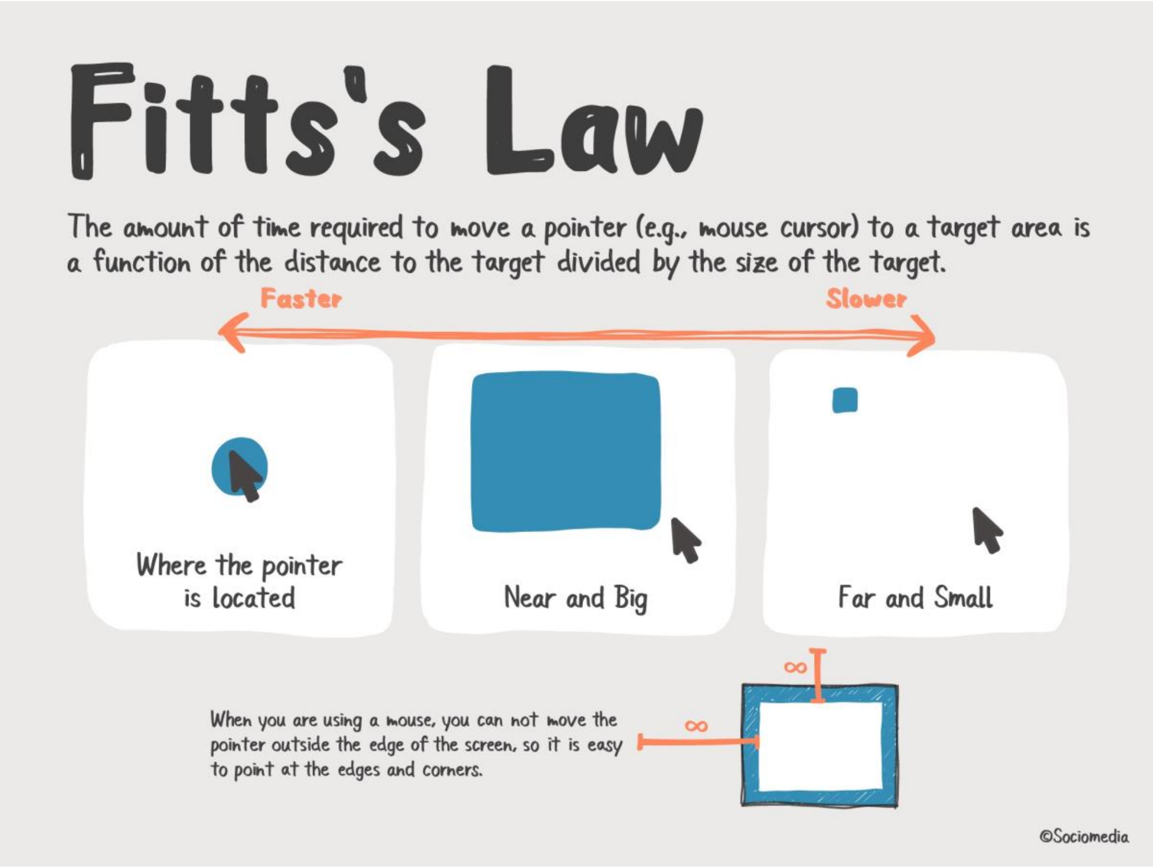


Zomato ample choices: the user is presented with numerous choices, thereby increasing the decision-making time while constantly exposing them to food pictures

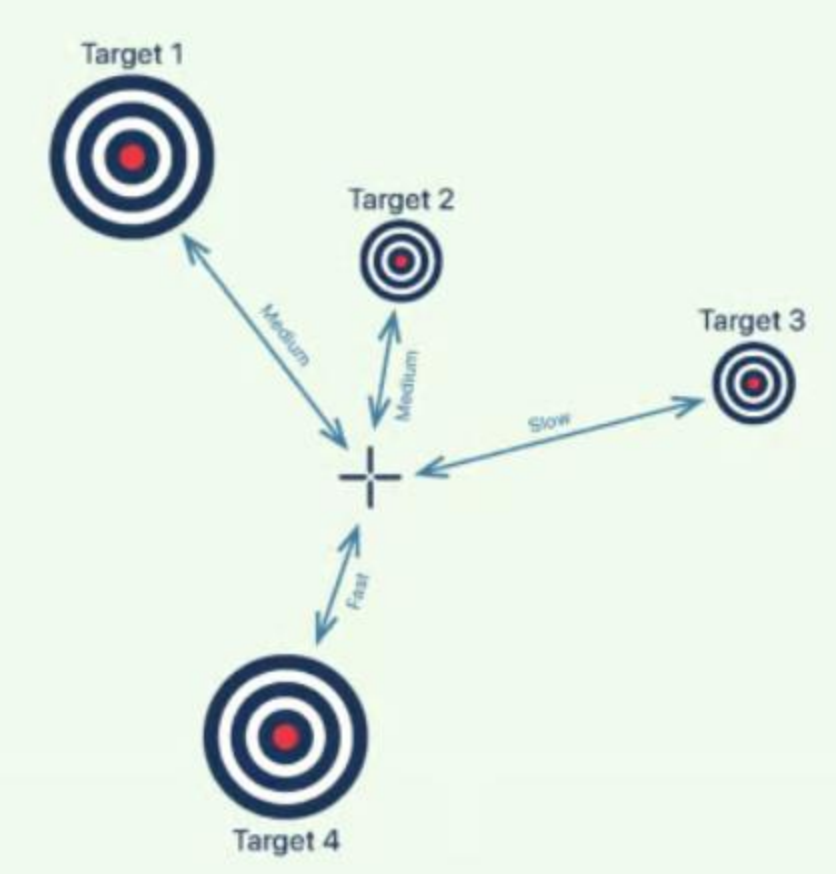
"The Top 10 in your country" by Netflix: People are inclined to make decisions about watching those shows in lesser time

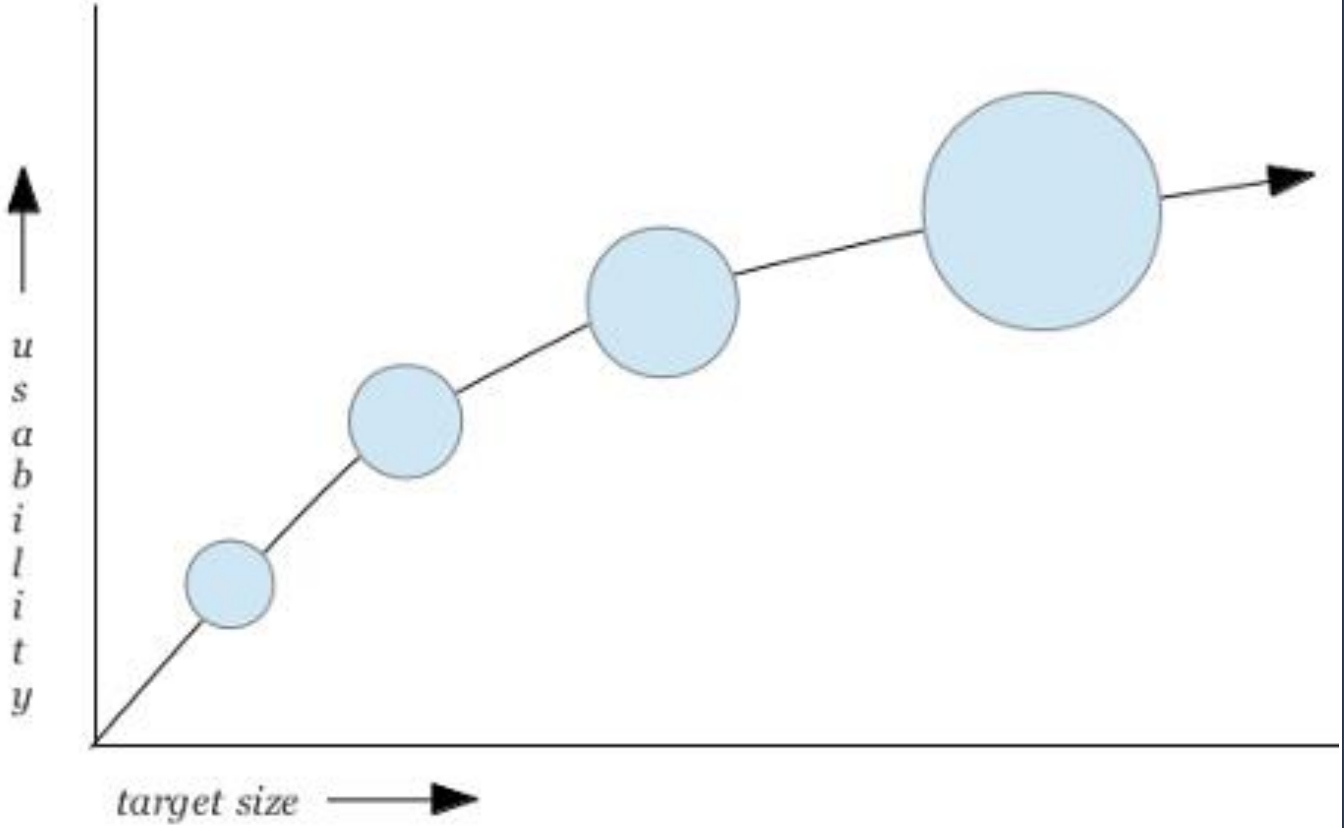
Fitts' Law

- A model of human movement that is used to accurately predict the amount of time taken to move to and select a target
- Movement through a graphical user interface
- Gives us the relationship between the time it takes a *pointer* (such as a mouse cursor, a human finger, or a hand) to move to a particular *target* (e.g., physical or digital button, a physical object) in order to interact with it in some way (e.g., by clicking or tapping it, grasping it, etc.):



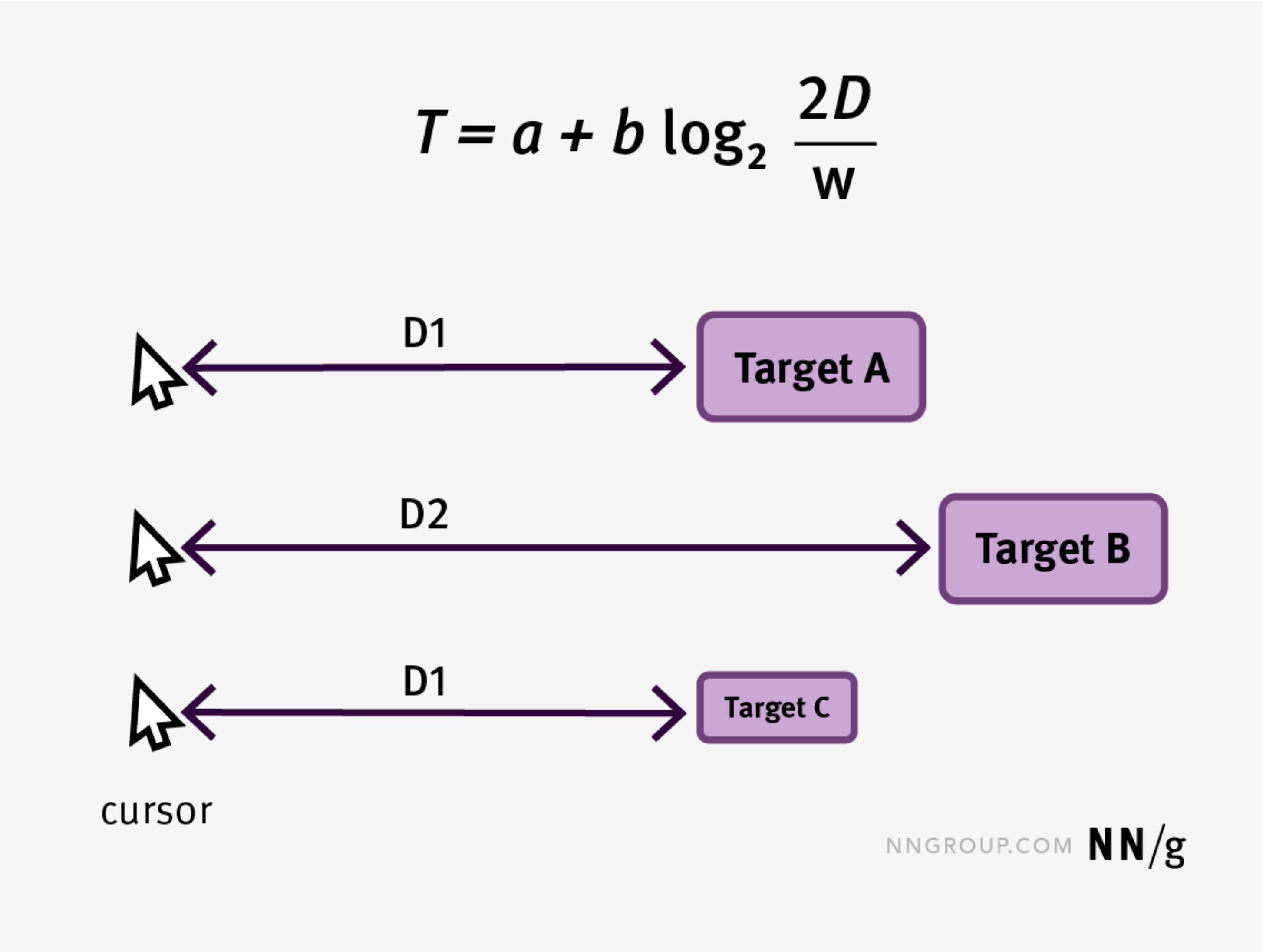
Fitts' Law





$$T = a + b\ \log_2 \frac{2D}{w}$$

Fitts' Law

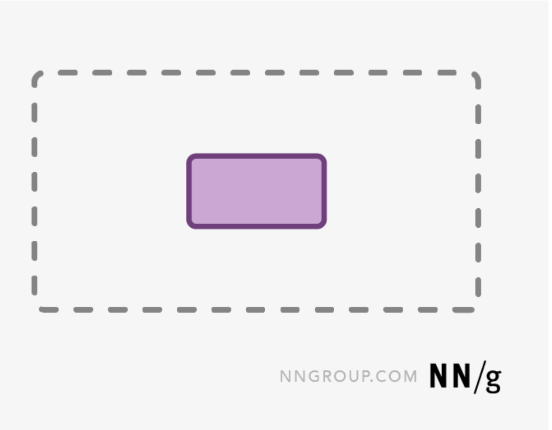


$T = a + b \log_2 \frac{2D}{W}$
D1
Target A
D2
Target B
D1
Target C
cursor
NNGROUP.COM NN/g

Fitts' Law and UX: Optimizing Target Size

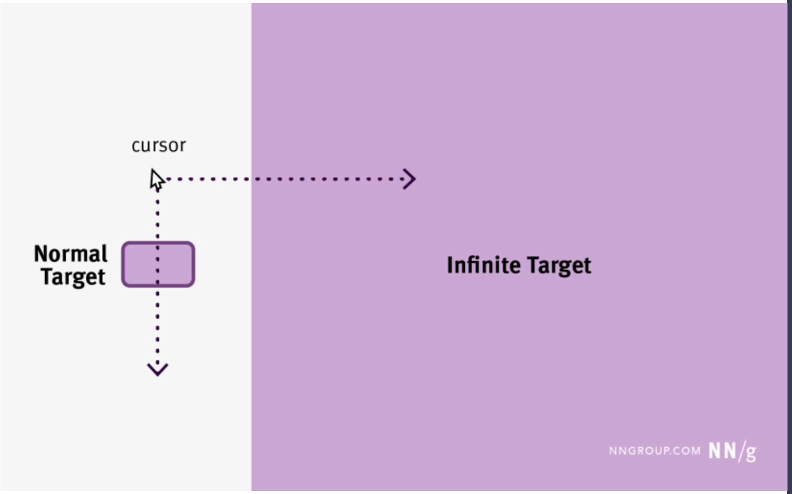
- Bigger Is Better:
  - People will be faster to click, tap, or hover on bigger targets
  - Error rates go down as target sizes increases

- Icons Plus Labels
  - Text labels reduce icon ambiguity and makes it easy to understand
  - Improves movement time to that particular target
- Padding Is Not Enough
  - A padded target is usually a small target that has a bigger invisible active area around it
  - Padding will help prevent some overshooting errors (if they realise it's there)

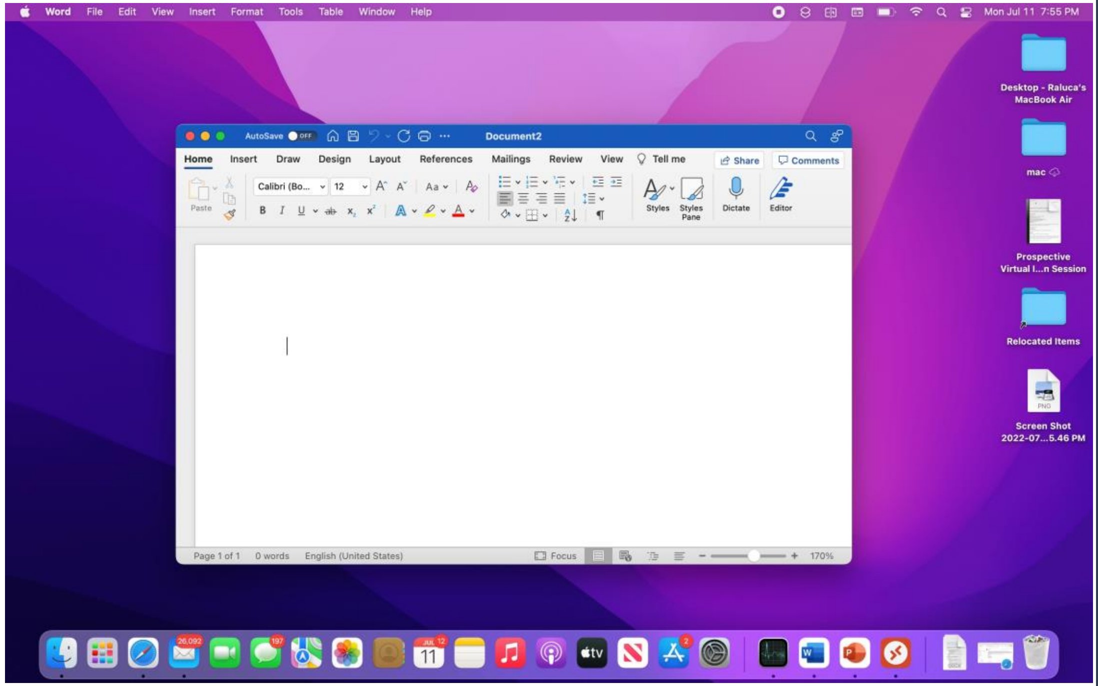


Fitts' Law and UX: Optimizing Target Size

- Infinite Targets Along Screen Edges:
  - The final-movement component can be greatly reduced if the target is very big — or even infinite
  - Screen edges act as natural walls for the cursor — as soon as the pointer reaches an edge, it cannot move beyond it, regardless of the speed with which that wall has been hit.

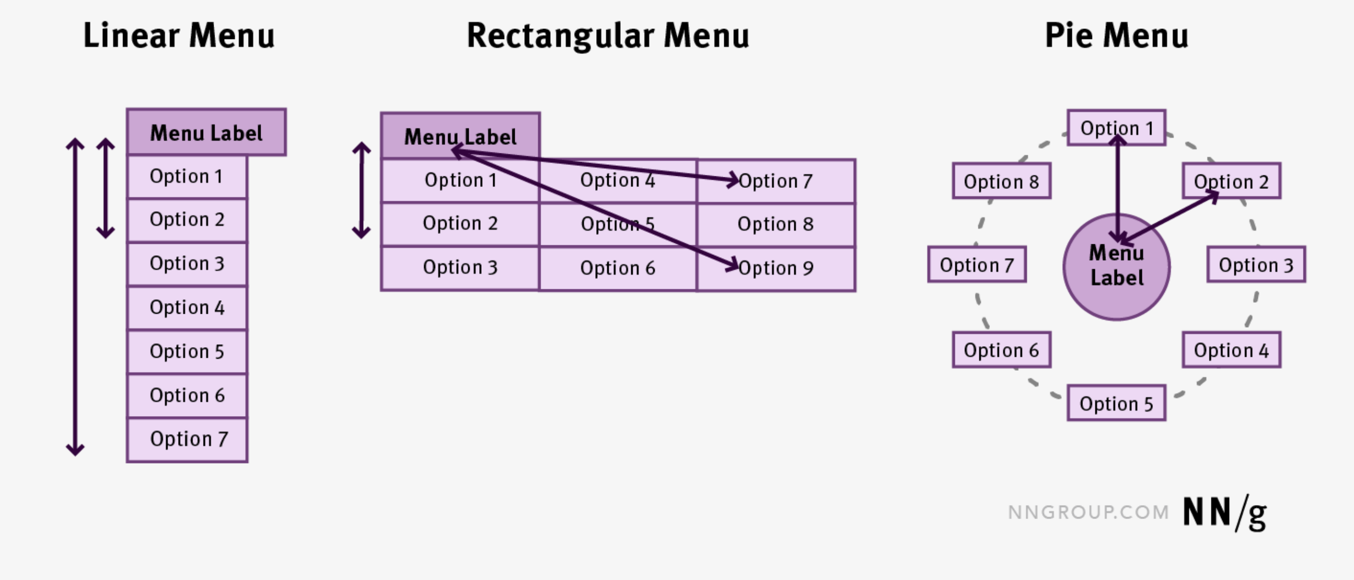


- Don't Crowd Targets:
  - Targets too close to each other is a risk that people will accidentally overshoot and accidentally trigger the wrong target
  - Especially likely to happen if the targets are small.



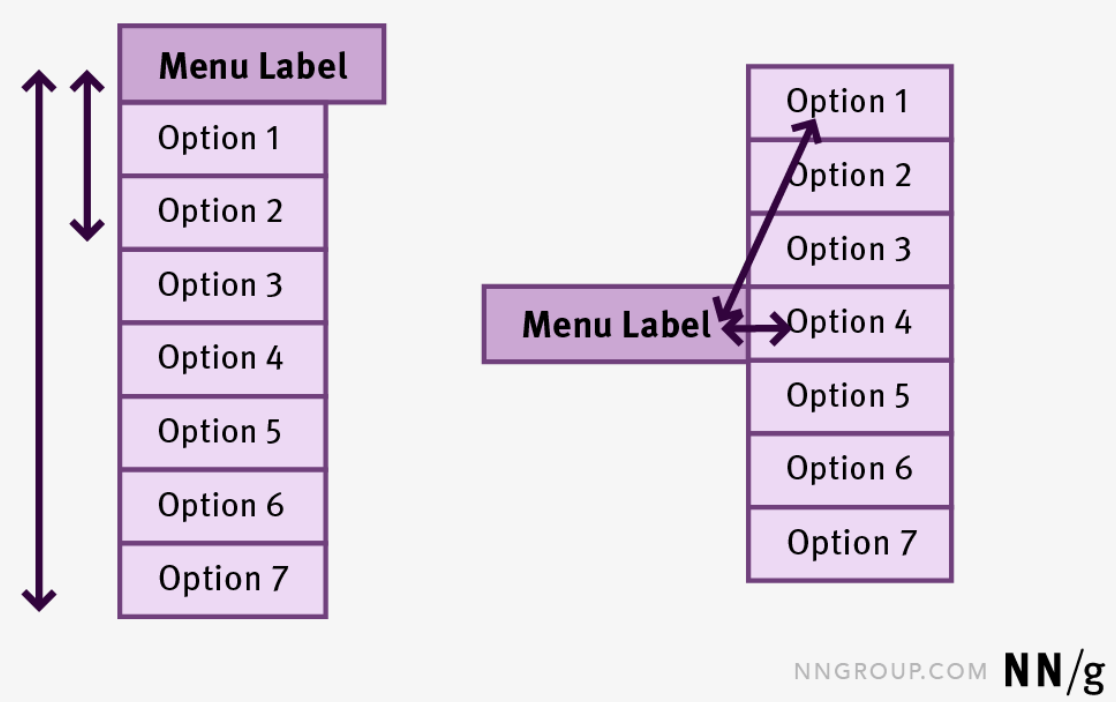
Fitts' Law and UX: Optimizing Distance to Target

- Menu Design:
  - The average distance from menu handle to a menu element depends on the type of menu
    - Linear Menu: Items are arranged in a straight line
    - Rectangular Menu: Items are arranged along both the horizontal and vertical dimensions
    - Pie Menu: All elements are placed on a circle around the handle and thus are equally far away from the handle



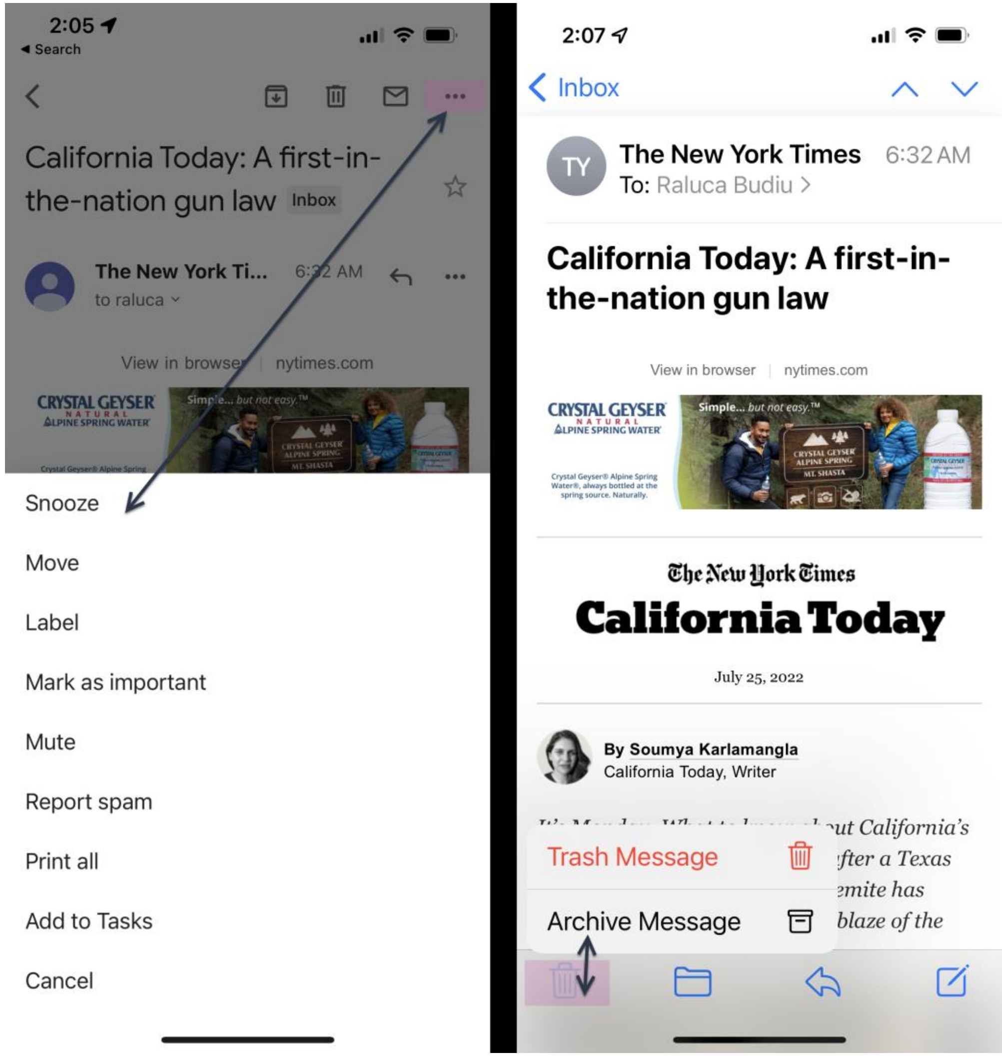
Fitts' Law and UX: Optimizing Distance to Target

- Linear Menu:
  - The distance from the menu handle to the first element is the shortest
  - The distance to the last element in the menu is the longest
  - The average movement time can be improved by aligning the handle with the middle of the menu



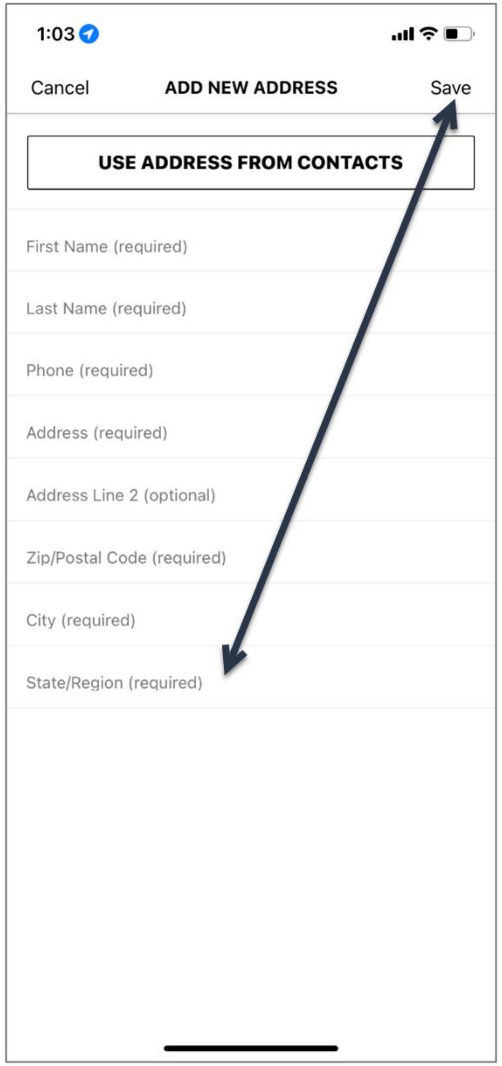
Fitts’ Law and UX: Optimizing Distance to Target

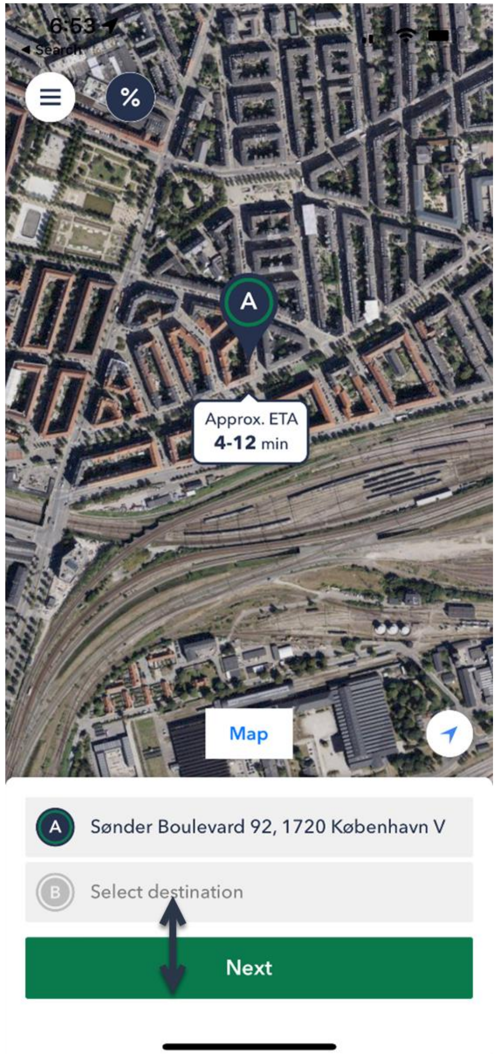
- Linear Menu:
- In mobile devices, some contextual menus show the associated options in a bottom sheet that appears far away from the menu label
- This design is suboptimal, since it forces the users to waste movement time
- Ideally, the options should appear close to the label.



Fitts' Law and UX: Optimizing Distance to Target

- Place Related Targets Close to Each Other:
  - Minimizes the distance between them and optimizes overall task time





Interaction Design Patterns

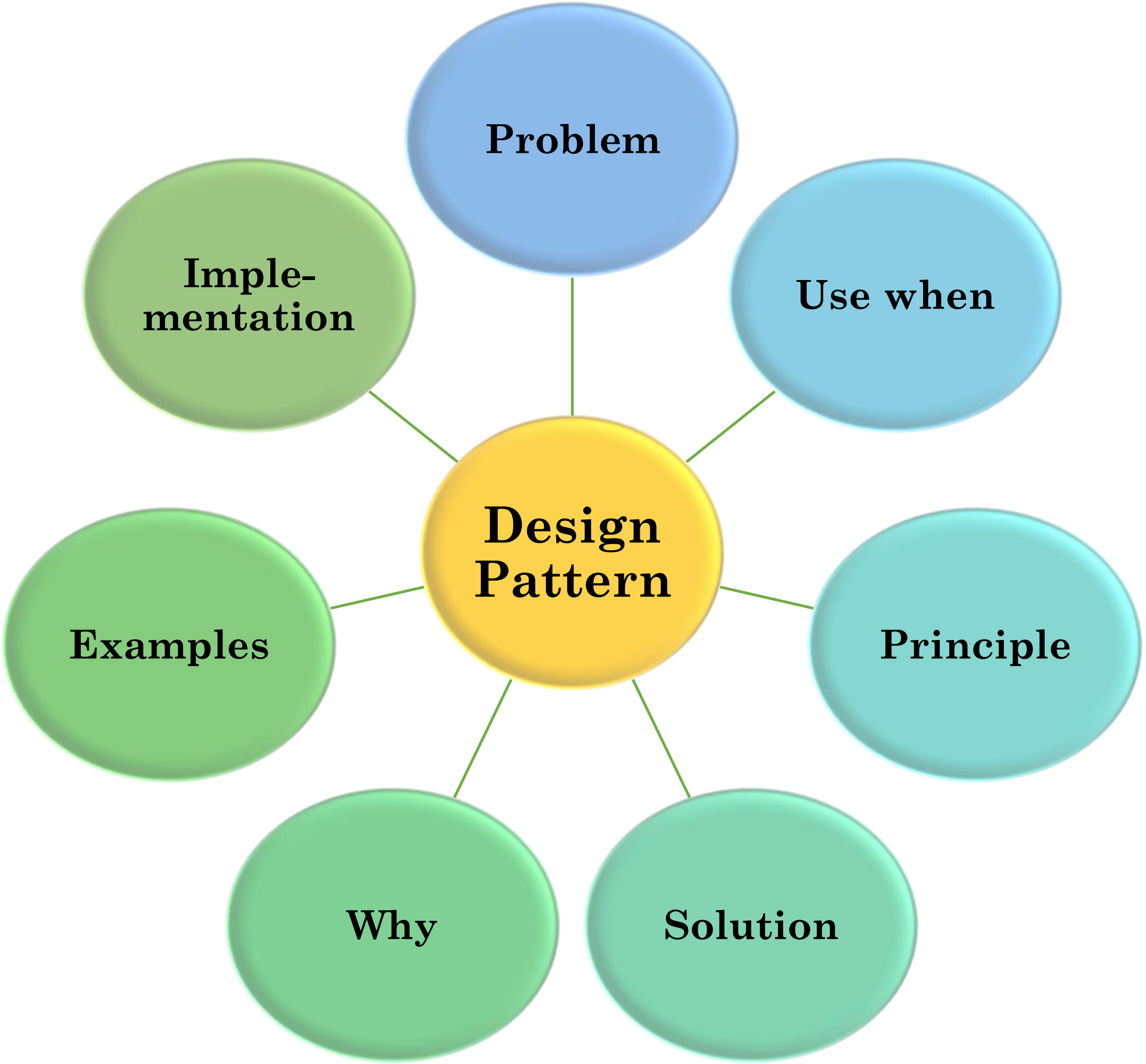
- Interaction design patterns are an important tool for knowledge sharing
- Reusable/recurring components that designers use to solve common problems in user interface design
- Users of the pattern can see the problem and solution
- Understand the context where the idea has worked before
- Access a rationale for why it worked

Interaction Design Patterns

- A key feature of design patterns is that they can be implemented in many different ways
- Design patterns are recurring solutions that solve common design problem that are a quick way to build interfaces
- Go Back to a Safe Place
  - The "Home" button on a Web browser
  - Provides a way to go back to a checkpoint

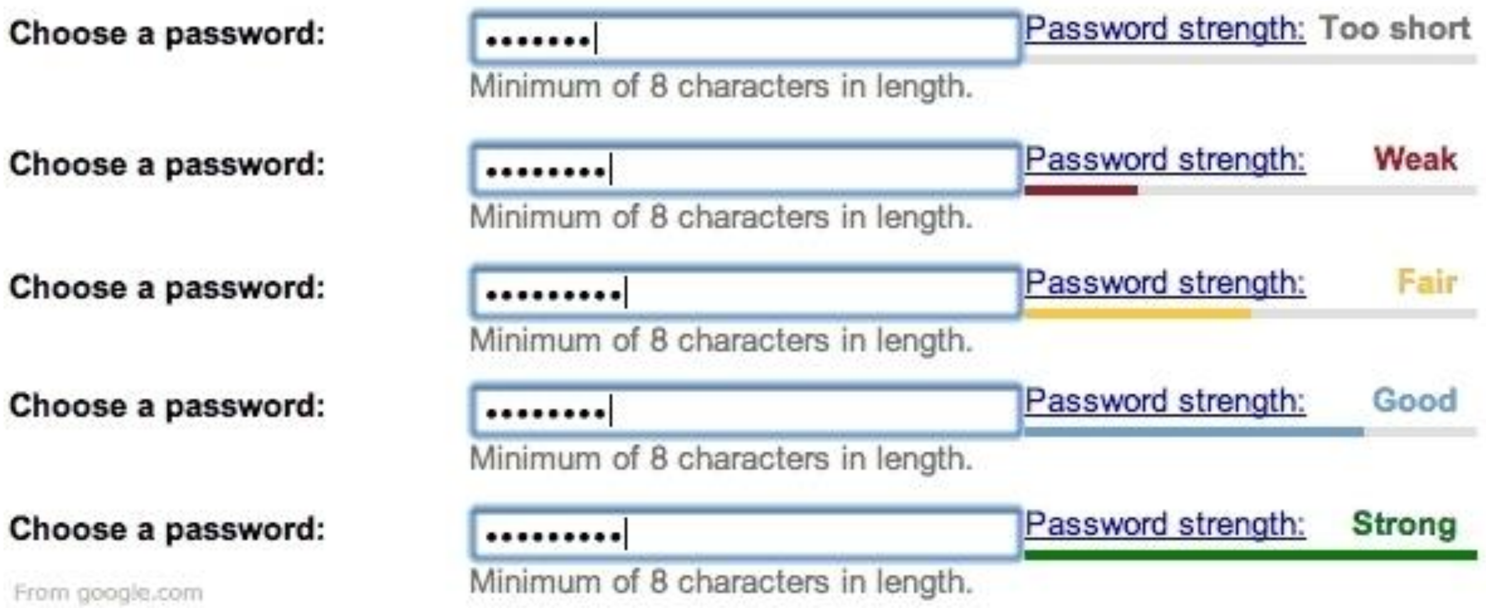
https://ui-patterns.com/patterns

Interaction Design Patterns



https://www.interaction-design.org/literature/book/the-glossary-of-human-computer-interaction/interaction-design-patterns

Interaction Design Patterns



https://ui-patterns.com/patterns/PasswordStrengthMeter

Consistency

- Interfaces should be designed to have similar operations and use similar elements for achieving similar tasks
- A consistent interface follows rules, such as using the same operation to select all objects
- Interfaces that are consistent are easier to learn and use
- Only a single mode of operation has to be learned that is applicable to all objects

Types of Consistency

Visual

- Increases learnability

Functional

- Increases predictability

Internal consistency

- Improves usability and learnability

External consistency

- The user's knowledge for one product can be reused in another

Interface Inquiry Assignment

Read the brief

Select only ONE task to direct the inspection of the user interface by Week 7 and inform your tutor of your selection

Select ONE Expert Evaluation method and ONE other User-based evaluation method to undertake

Week 13: Provide a critique of the work in-class to your tutor (identity verified assessment) – *Hurdle: students must achieve at least a Pass (+/-) for the critique portion of the task to be eligible to pass the entire assessment*

Summary

- Usability is part of a broader term of "user experience" and refers to the ease of access and/or use of a product or website
- There isn't just one perception of usability and no one is the sole right one
- Interface metaphors can help users understand the interface by combining recognizable knowledge with new knowledge
- A number of laws and principles can be drawn upon from cognitive science to increase the usability of software and reduce cognitive load

Next Time…

- In our next session, we will look at **UX Goals and Metrics**