

*Master in Computer Science and Engineering
Sapienza Università di Roma*

Human-Computer Interaction

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Designing Mobile Interfaces

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Why HCI?

- Human–Computer Interaction (HCI) is research in the design and the use of computer technology, which focuses on the **interfaces between people (users) and computers**.
- HCI researchers **observe** the ways humans interact with computers and **design** technologies that allow humans to interact with computers in novel ways.



Goal of HCI

- Allow effective **operation** and **control** of the machine from the human-end while the machine simultaneously feeds back information that aids the operators' decision-making process.
- To bridge the gap between **humans** and **technology**, making digital systems more accessible, efficient, and satisfying to use.



User Interface (UI)



- It is the **point of interaction** between a human user and a computer, software, or device. It's essentially what allows you to control and interact with technology.
- The **space** where interactions between humans and machines occur.

GUI (Graphical User Interface)

- Employs graphical elements like **windows** and **icons** for interaction.
- Utilizes **menus** for commands and a **pointer** for navigation.
- **WIMP interaction** was developed at Xerox PARC (see Xerox Alto, developed in 1973) and popularized with Apple's introduction of the **Macintosh** in 1984.
- Defines the desktop metaphor of user interfaces.



TUI (Touch User Interface)

- A TUI lets users interact directly with a digital device by **touching** the screen, using gestures like **taps** and **swipes**.
- Touch user interfaces, offering intuitive interactions especially on **mobile**, have become **ubiquitous** due to smartphone and tablet adoption and touchscreen technology advancements



The Mobile Revolution



- **Portability:** Mobile phones offer unparalleled convenience and accessibility due to their small size and constant availability.
- **Intuitive Interface:** Touch interaction provides a more natural and direct way to interact with devices compared to traditional mouse and keyboard input.
- **Technological Advancements:** Improvements in touchscreen technology, processing power, and software have made mobile phones capable of handling complex tasks, rivaling computer functionality.

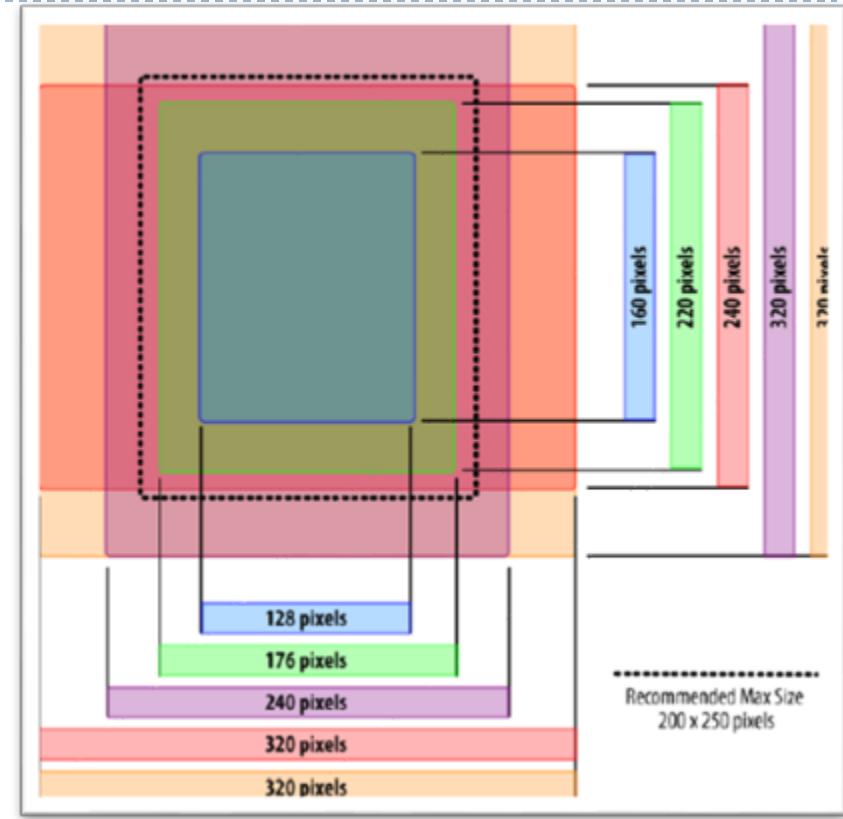
Why Mobile Design?

- Mobile design is unique and requires a **dedicated approach** and not just an adaptation from the desktop.
- Mobile interface design necessitates original, **platform-specific solutions** that are **contextually aware** of the unique mobile environment.



Challenges of Mobile Design

- **Limited screen space** - Information and options must be concise; avoid extraneous elements.
- **Diverse screen dimensions** - Design must adapt effectively to varying screen widths.
- **Changing usage environments** - Design should accommodate diverse lighting and settings.



Challenges of Mobile Design cont

- **Touch Screens:** Touch accuracy is challenging on small screens.
 - Good design ensures targets are easily tappable.
- **Typing difficulty:** Typing extensive text is cumbersome on mobile.
 - Good design minimizes or eliminates typing needs.
- **Limited user attention:** Mobile users are often distracted.
 - Users glance at interfaces while multitasking.
 - Focused attention is less frequent than on a computer.
 - Good design accommodates distracted users.



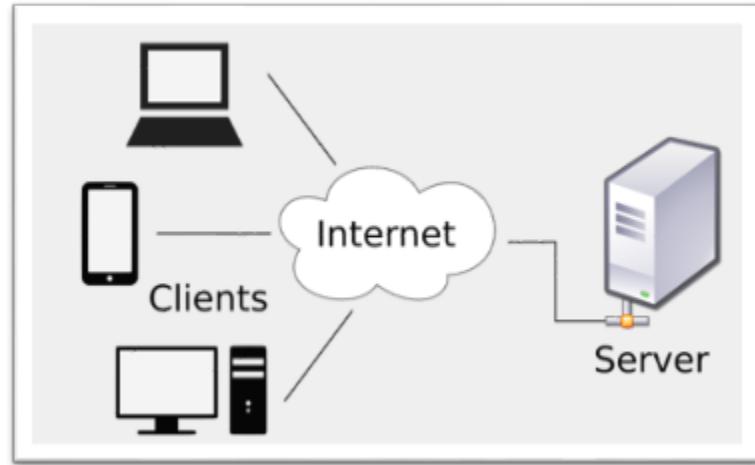
Designing Usable Mobile Interfaces

3 Key Ingredients -

- 1. Use design guidelines and mobile patterns**
- 2. Prioritize the initial user experience**
 - a. The first impression of a mobile interface is critical.
 - b. Even with excellent design, code, and backend, a confusing interface leads to user failure.
- 3. Use prototyping**
 - a. Employ advanced tools for mobile interface mockups and interaction design.

Systems: Client-Server

- Architecture where client requests resources, server provides them.
- Separates user interface (client side) from data processing (server side).
- Enables centralized data management and distributed access.
- Access from any device, anywhere

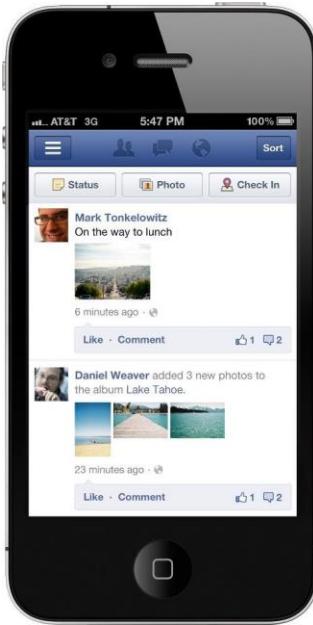


Multiple Interfaces

- **Accommodating Diverse User Interaction** - Systems need diverse UIs (desktop, web, mobile, voice, gesture) for varied user interactions.
- **Ensuring a Consistent User Experience** - Multiple interface design ensures a consistent, cohesive user experience across platforms, meeting users' expectations.
- **Enabling Seamless User Journeys** - Seamless experience requires synchronizing data and user actions across devices, preserving user progress.



Interacting with computers vs. Interacting with other people through computers



Design Guidelines

- **User-centered Design (UCD)** is a design process that prioritizes the needs, wants, and limitations of end-users at each stage of the design process.
- One of the central problems of a UCD process is **how to provide designers with the ability to determine the usability consequences** of their design decisions.
- The majority of design rules for interactive systems are suggestive and **general guidelines**.

Design Guidelines

cont

- Several books and technical reports contain huge catalogs of guidelines.
 - **Abstract guidelines** applicable during early life-cycle activities
 - **Detailed guidelines** (style guides) applicable during later life-cycle activities
- Different collections (**Shneiderman's 8 golden rules**, **Norman's 7 principles**)
- *Understanding justification for guidelines helps in resolving conflicts.*

Why Shneiderman's 8 Golden Rules?

- *They provide a convenient summary of the key principles of the interface design.*
- *They need to be interpreted for each new situation.*
- *Intended to be used during design can also be applied to the evaluation.*



Shneiderman's 8 Golden Rules

- 1. *Strive for Consistency*:** Consistent UI elements and interactions.
- 2. *Enable frequent users to use Shortcuts*:** Enable power users to perform familiar actions quickly.
- 3. *Offer Informative Feedback*:** Inform users about what's happening.
- 4. *Design Dialogues to Yield Closure*:** Let users know when a task is complete.



Shneiderman's 8 Golden Rules cont

5. Offer Error Prevention and simple Error

Handling: Minimize errors and provide easy recovery.

6. Permit easy *Reversal of Actions*:

Make users feel in charge.

7. Keep *Users in Control*:

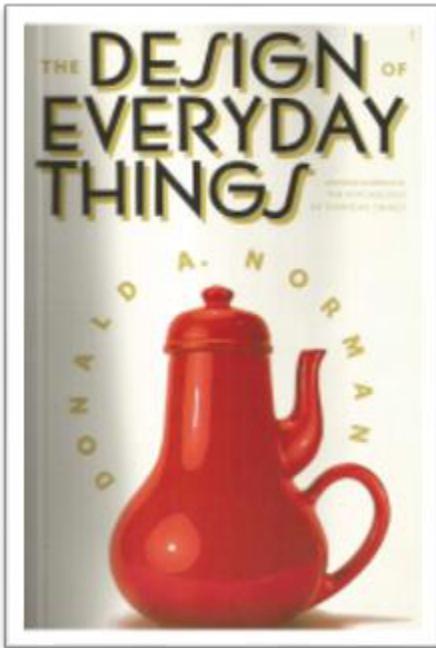
Simplify and avoid overwhelming the users and support internal locus of control.

8. Reduce *Short-term Memory Load*:

Reduce users' short-term memory load with clear, accessible information.



Norman's 7 Principles



Transforming Difficult Tasks into Simple Ones

In his classic book "The Design of Everyday Things" (La Caffettiera del Masochista) **Donald Norman** Summarizes User-Centered Design in Seven Principles.

Norman's 7 Principles cont

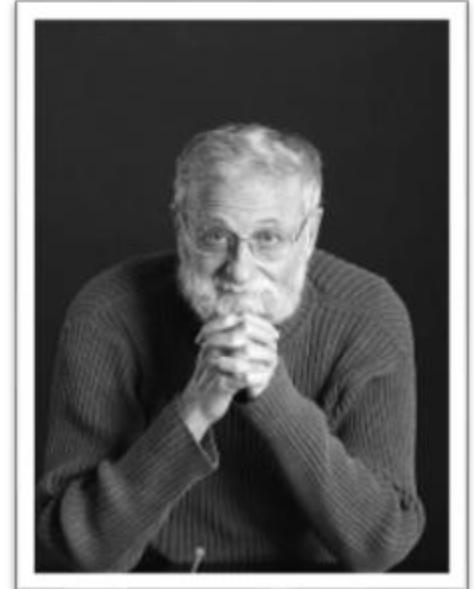
1. Use both **knowledge in the world** and **knowledge in the head**.

- a. Provide the necessary knowledge within the environment. Support the user in building a proper **mental model**.

2. Simplify the structure of tasks

Avoid **excessive memory load**:

- a. **Mental aids** (to keep track of stages in complicate tasks)
- b. More information and better feedback (using **technology**)
- c. **Automate** the task or part of it
- d. **Change** (simplify) **the nature** of the task



Norman's 7 Principles

cont

*Example: Change the **nature of the task** (using Velcro)*



Norman's 7 Principles

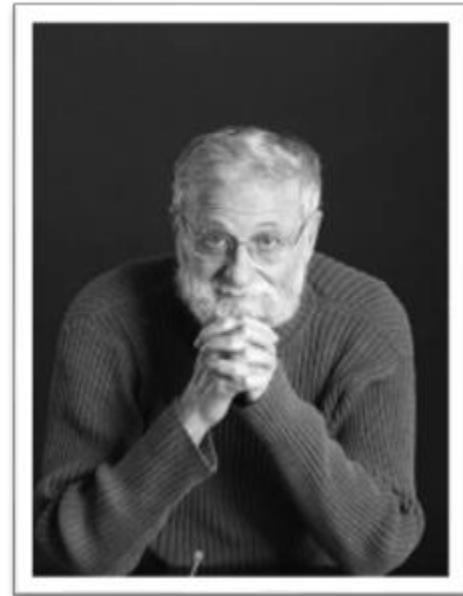
cont

3. Make things **visible**.

..so that people know **what is possible** and **how to do** them.
People should know **what is currently going** on and what to do next.

4. Get the **mapping** right

- a. Make sure that the user can **determine the relationships**
- b. **Intentions** -> possible actions
- c. **Actions** -> their effects on the system



Norman's 7 Principles cont

Weak Mapping



Good Mapping



Norman's 7 Principles cont

Good Mapping: Larger > More Valuable



Norman's 7 Principles cont

5. Exploit the power of constraints, both natural and artificial

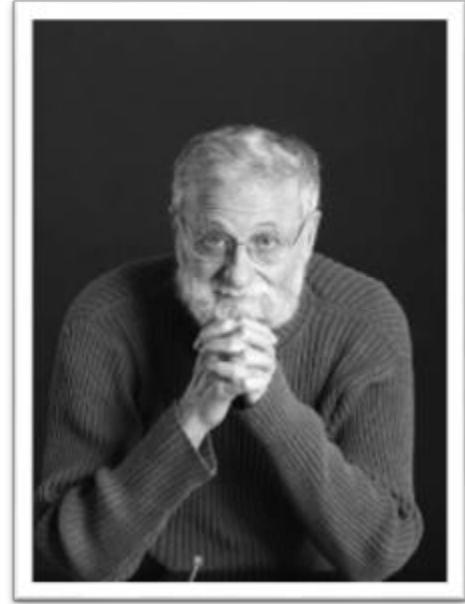
- a. Constraints force the user to perform only the right action in the right way (e.g. puzzle)

6. Design for error

- a. Assume that any error that can be made will be made
Design for recovery

7. When all else fails, standardize

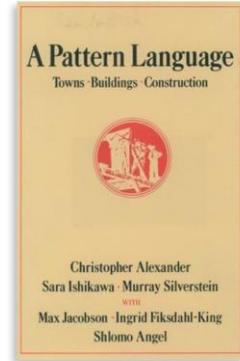
- a. Standardization is a way to deal with things that cannot be designed without arbitrary mappings (e.g. car driving controls)



Design Patterns

- One way to approach UI design is to learn from **examples** that have proven to be successful in the **past**.
- Design Patterns are **solutions** to a **recurrent problem** within a specific application domain.
 - They allow to **capture** and **reuse** the knowledge of what made a system – or paradigm – successful and **apply** it again in new situations.

Christopher Alexander, an Austrian-born architect, initiated the pattern concept in 1977 by describing 253 design patterns to common problems in architecture in his seminal book: A Pattern Language: Towns, Buildings, Construction.



A Design Pattern (In Architecture)

Pattern 159: Light on two sides of every room

Problem: People, when they have a choice, will always gravitate to those rooms which have light on two sides, and leave the rooms which are lit only from one side unused and empty.

Pattern: Locate each room so that it has outdoor space outside it and on at least two sides, and then place windows in these outdoor walls so that natural light falls into every room from more than one direction.



Solution is only **partially specified**.

No further details are provided!

Where the windows should be located?

At what angle they should be to each other?

The pattern implementation depends on the context and designer's creativity.

HCI Design Patterns

Characteristics of Patterns

- Capture design **practice** not theory.
- Capture the **essential** common properties of good examples of design.
- Represent design knowledge at varying levels: social, organisational, conceptual, detailed.
- Can express what is **humane** in interface design.
- Are **intuitive** and **readable** and can therefore be used for **communication** between all stakeholders.

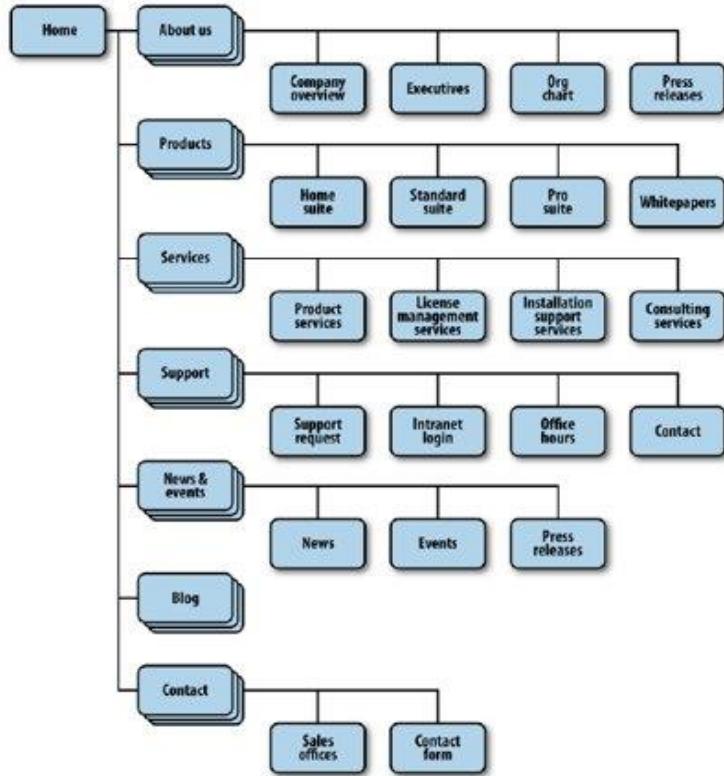
The Pillars of Usable Mobile Design

- ***Information Architecture***
 - The **organization** and **structure** of data within an informational space. In other words, how the users will get to information or perform tasks within an application.
- ***Interface Design***
 - The **design of the visual paradigms** from which the user will assess meaning and direction given the information presented to her/him.
- ***Interaction Design***
 - The **design of how the user can participate with the information present**, either in a direct or indirect way, meaning how the user will interact with the application to create a more meaningful experience and accomplish her/his goals.
- ***Information Design***
 - The **visual layout** of information presented to the users.

Information Architecture

- Information architecture represents the **core** of the user experience.
- From a simple mobile website to an iPhone/Android application, the information architecture defines **how the information will be structured**.
 - A well-engineered product with good visual design **can still fail** because of **poor information architecture**.
 - The truly successful mobile products always have a **well though** and **defined information architecture**.
- The first deliverable to define information architecture is the **site map**.
 - **Site maps** visually represent the **relationship of content to other content** and provide a map for how the user will **travel through the informational space**.

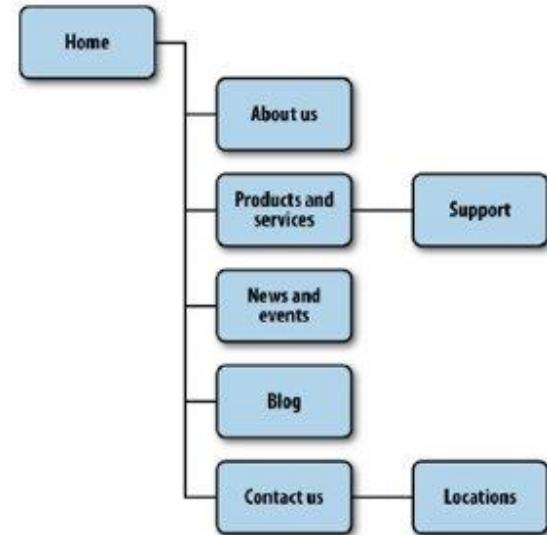
A bad Site Map for Mobile



- **What risk is there to the users for making a wrong choice?**
- Imagine a road with a fork in it. We can go either left or right.
- The risk that we will make the **wrong choice** is only **50%**, meaning that we have a **better than good** chance that we will get to where we want to go.
- But imagine three roads. Our chances have dropped to **33%**.
- Four roads drop your chances to **25%**, and five roads takes you down to **20%**.
- The risks for making a wrong choice increase....

Limit Opportunities for Mistakes

- In the mobile context, **tasks are short** and **users have limited time** to perform them.
- **Limit users' options:** A mobile information architecture should provide **5 navigation areas or less**.
- The risks to make the wrong choice are minor.
- **Suggestion:** Make the path through the information you present **logical** and **easy to predict**.
- Put **markers** to let them know where they are.
- Put always a **back-button**.
- *When mobile users select the wrong path, they should be able to immediately click back to where they started and go down another path, eliminating the wrong choices to find the right ones.*



Interface Design

- Interface design analyzes the visual layout of content presented to a mobile user, and how the user assesses meaning and direction from it.
 - The greatest challenge to creating a mobile design that works well on multiple screen sizes is filling the width.
 - A traditional solution is the use of vertical designs.
 - The interface design is a cascade of content from top to bottom, similar to a newspaper.
 - The contextual information lives at the top.
 - The content consumes the majority of the screen.
 - Any exit points live at the bottom.
 - For content-heavy sites and applications this solution works, since the width of mobile devices is almost the perfect readability, presenting not too many words per line of text.

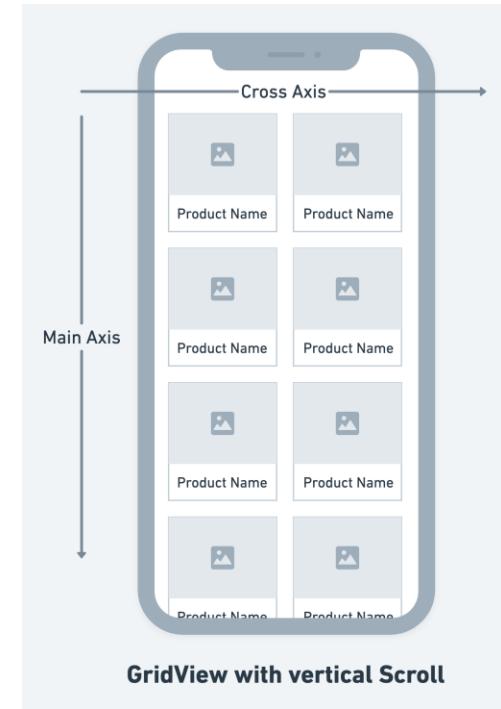


Interface Design: Challenge

- The problem is when it is required to present a **large number of tasks or actions**.
 - The easiest and most compatible way is to present a stacked list of links or buttons, basically one action per line.
 - However, the presence of too many actions together quickly clutters the design...
- There exist some **design principles** to build effective visual layouts.

Axis

- Axis is the most basic and common information principle for organizing content.
- It consists of an imaginary line that is used to align a group of elements in an interface.
- When elements are arranged around an axis, the design feels ordered.
 - Users enjoy designs that are ordered because they feel more stable and comfortable.



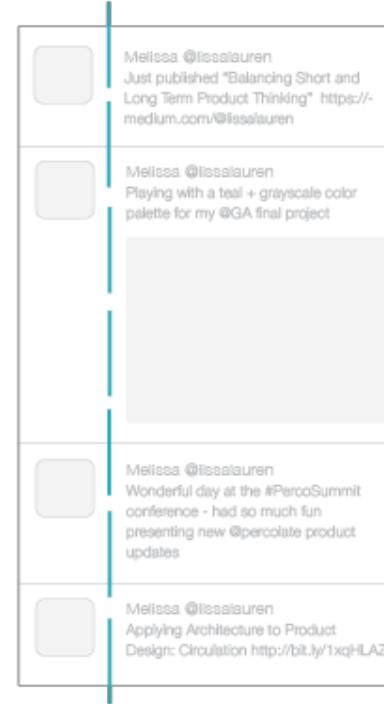
Example of Axis

*Albums list (iTunes in iOS).
A vertical axis neatly aligns album
covers on the left side of the
screen.*



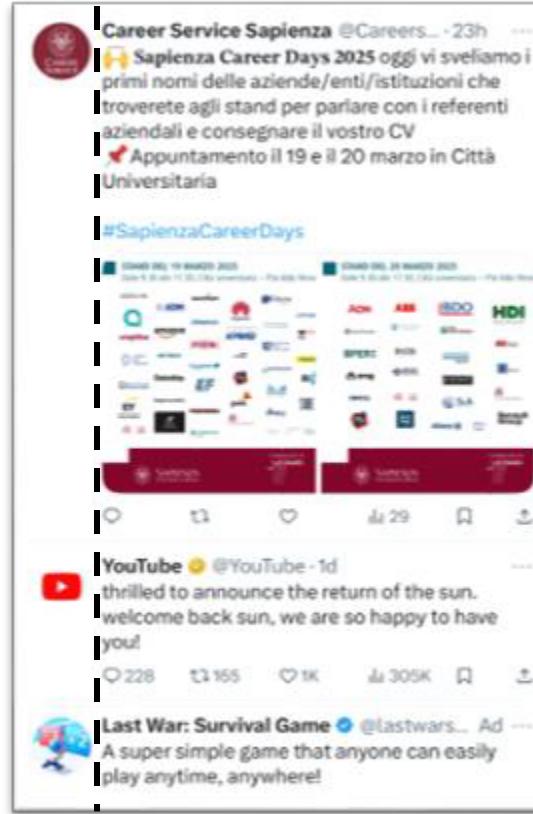
Axis Reinforcement

- Axis can be made more apparent if the **edges of surrounding elements are well defined.**
- A common example of this concept in architecture is a city street.
 - The city street is an axis that is reinforced by the buildings on both sides.
 - If a portion of the street is missing a building on one or both sides, the street's axis would not feel as strong.



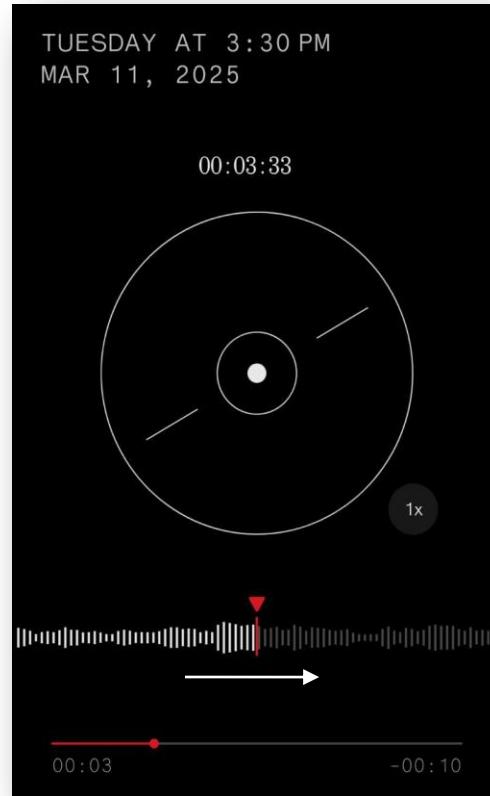
Example of Axis Reinforcement

*Timeline in the Twitter app (iOS).
A vertical axis helps to define a
section for avatars on the left and
a section
for tweet content on the right.*



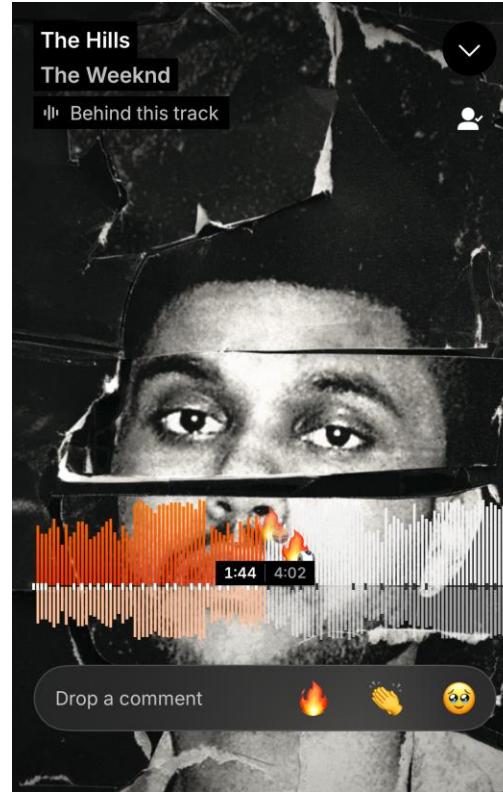
Axis Movement

- When we encounter something linear, such as an axis, we naturally follow the line in a direction.
- Lines encourage **movement** and **interactions**.
- The direction of movement depends on the **end points**. A defined end point signals a place to start or stop.



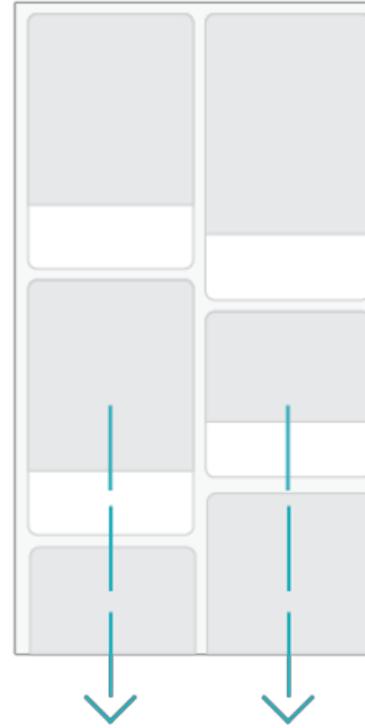
Example of Axis Movement

*Music scrubber in the **SoundCloud** app (iOS).
The scrubber is represented as a left-right axis,
and slide the scrubber to the right
until you reach the end of the song.*



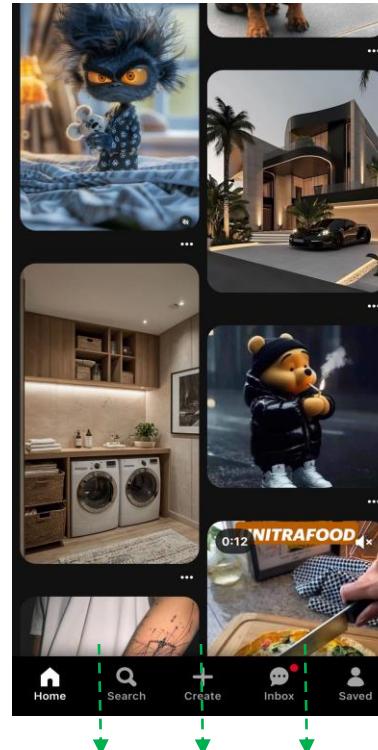
Infinite Axis

- If an **end point is undefined**, you will follow the axis until you reach something of interest or are tired of interacting with the axis.
- The concept of an undefined end point is realizable through **infinite scrolls**.



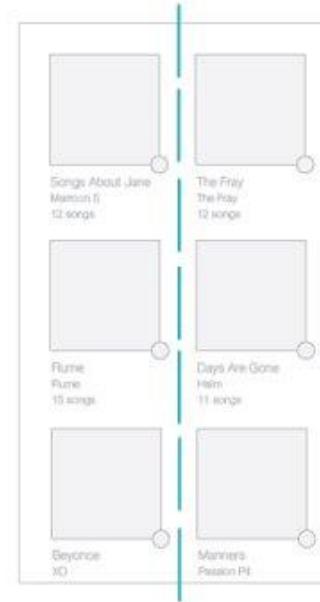
Example of Infinite Axis

The main feed of the Pinterest app (iOS), encourages you to scroll down the page for as long as you're interested in viewing pins



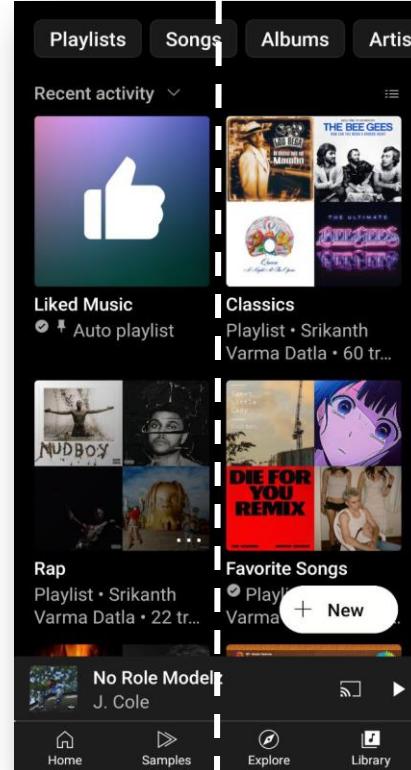
Symmetry

- Elements are arranged in the **same way on both sides of an axis**.
- **Perfect symmetry** is when elements are exactly the same on both sides.
- The design feels harmonious and it is easy to read, both top-bottom and left-right.
- Conversely, if the arrangement of elements is different on both sides of an axis (**asymmetry**), the design is felt as unbalanced and uncomfortable.



Examples of Symmetry

Arrangement of music covers in the YT Music app (Android). Elements on both sides of the screen have the same format.



Example of Asymmetry

Although the left and right columns have the same width (Pinterest for iOS), **the height of elements in each column varies**.

This variance makes it difficult to scan from left-right. **Even the slightest bit of asymmetry can throw off the balance and comfort in a design.**



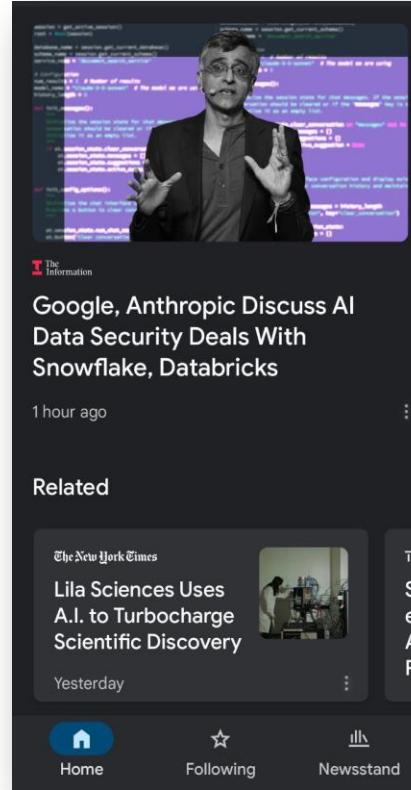
Hierarchy (by size, shape, placement)

- Hierarchy is obtained when an element **appears more important** in comparison to other elements in a design.
- In **hierarchy by size** there is an element that is larger than the other elements in the interface.
- In general we look first at the largest element.
 - If there are five windows on the front of a building, and one is twice the size of the others, our attention will focus on the biggest window first.

Applying Architecture to Product Design blog.percolate.com	
Our Values blog.percolate.com	
Design Details itunes.apple.com	
Monument Valley / Making the Game of the Year itunes.apple.com	
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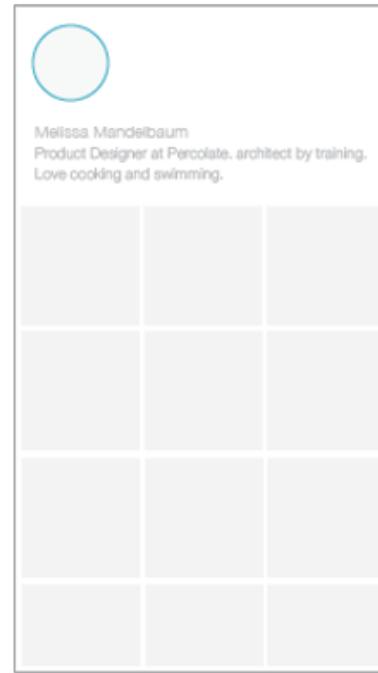
Example of Hierarchy by Size

Article list in the Google News app (Android). The header article is featured at the top, with a larger picture. Due to its size, it catches our attention first.



Hierarchy by shape

- Hierarchy can be also obtained when an element is **different** than other elements in an interface (**hierarchy by shape**).
- We naturally look first at the irregular shape in a design.
 - If there are five of the same windows and one door on the front of a building, our attention will focus on the door first.



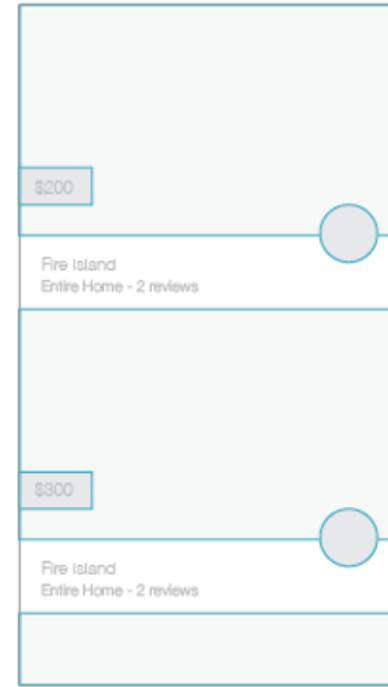
Example of Hierarchy by shape

Profile page in the Instagram app (iOS). The circular profile picture is distinctly different than the other elements.



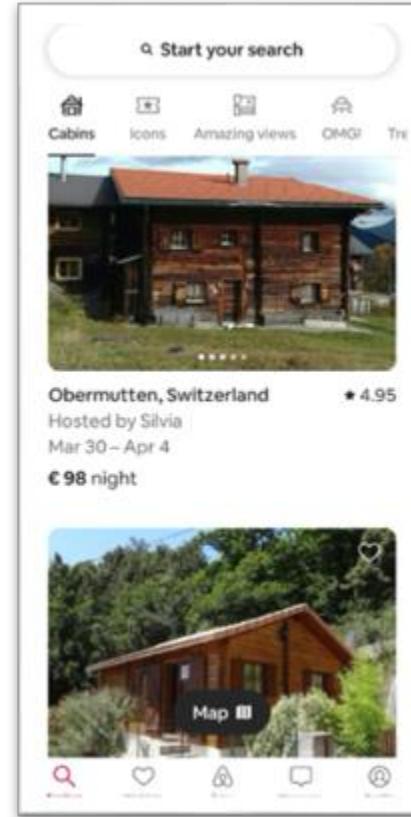
Rhythm

- Rhythm is the movement created by a **repeated pattern of forms**.
- When using an interface, you begin familiar with the rhythm and know exactly where to look for elements in the patterns.
- The best way to understand rhythm is to think of a song.
 - Songs have rhythm when a piece of the song repeats.
 - When listening to a song with good rhythm, we recognize the pattern and begin to expect the repeated piece of the song.



Example of Rythm

*The feed in the Airbnb app (for iOS).
When scanning the feed, the users already know
where the price, title, and features are placed.*



Breaks

- A break in a repeated pattern gets more hierarchical.
- Think about a song.
 - When a song has a repeated rhythm and the rhythm is broken, something quite special usually happens.

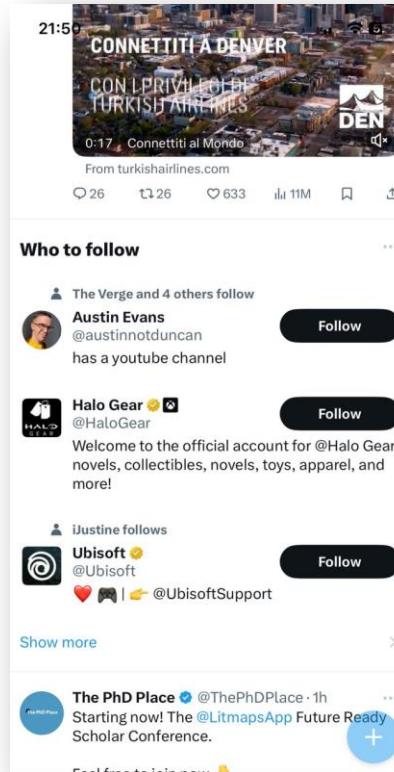
The image shows a vertical stack of three tweets from a user named Melissa (@tissalauren).
1. The top tweet is from Melissa (@tissalauren) and reads: "Just published 'Balancing Short and Long Term Product Thinking' https://medium.com/@tissalauren".
2. The second tweet is titled "Who to follow" and lists three accounts:

- Percolate (@percolate)
- Percolate Design (@percolatedesign)
- Dom Goodrum (@domgoodrum)

3. The third tweet is from Melissa (@tissalauren) and reads: "Wonderful day at the #PercoSummit conference - had so much fun presenting new @percolate product updates".
4. The bottom tweet is from Melissa (@tissalauren) and reads: "latest and greatest blog post -- Applying Architecture to Product Design: Circulation http://bit.ly/1xqgILAZ".

Example of Break

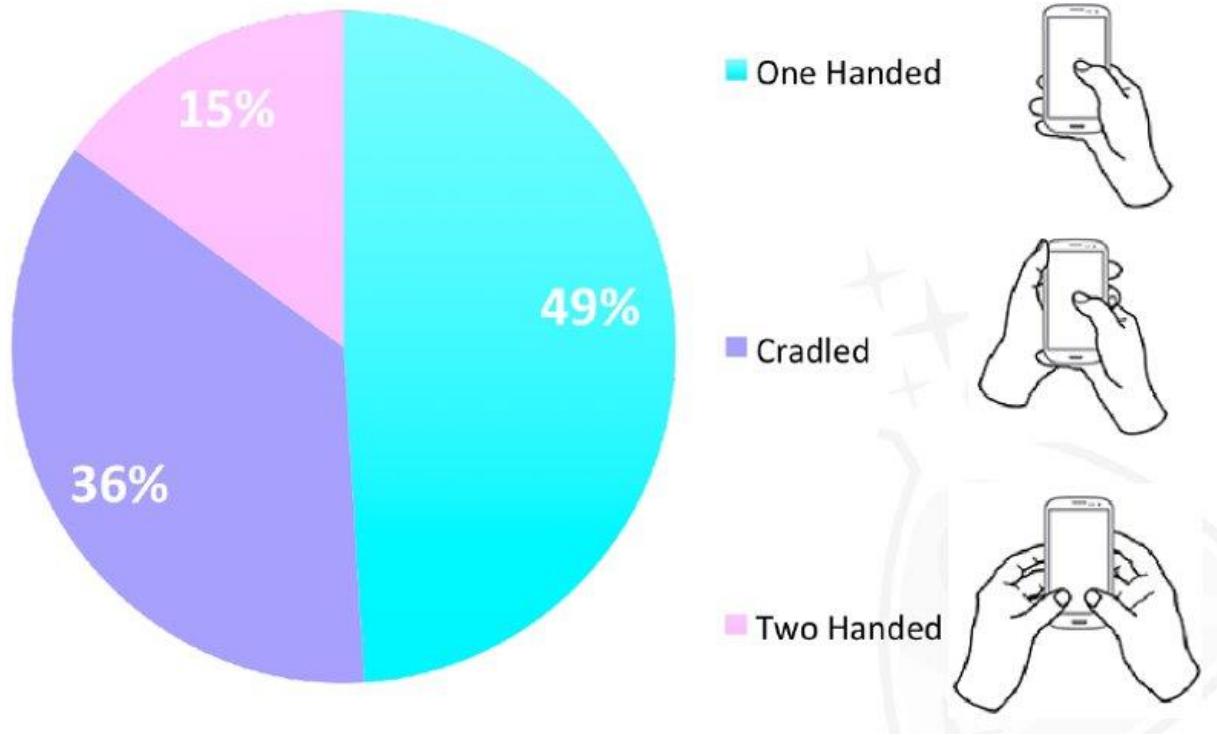
In the Twitter app (iOS), the profile feed has a rhythm and is broken by a section with suggestions of people to follow. This break appears more hierarchical and is a good way of grabbing the user's attention.



Interaction Design

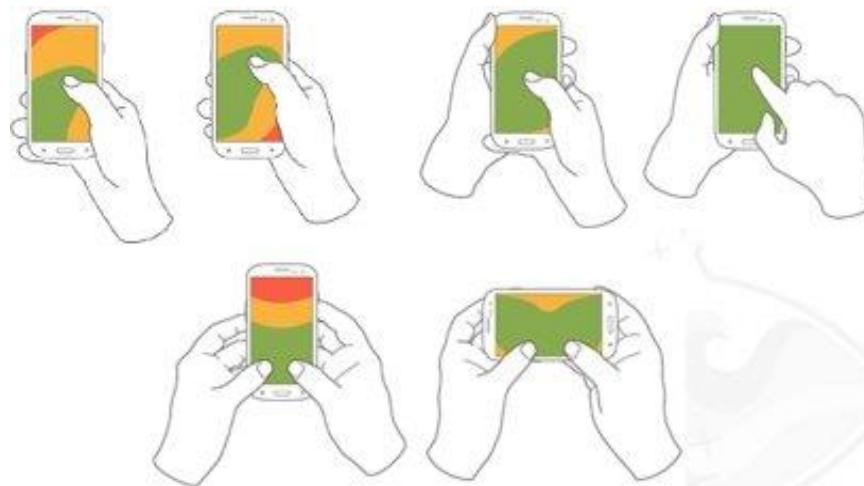
- Interaction design investigates the way people interact with their mobile devices.
- The **interaction** is any **direct** or **indirect** communication between a user and her/his mobile device.
 - **Direct interaction** involves a dialog with feedback and control throughout the whole performance of the task.
 - **Indirect interaction** may involve intelligent sensors controlling the environment.
- Three main direct interaction paradigms for mobile devices:
 - **single touch interaction**: the user literally points and clicks;
 - **multi touch interaction**: a user is allowed to perform gestures;
 - **Physical buttons** and **directional pads** to navigate to the desired location.
- Two relevant issues to tackle:
 - How do we **hold** mobile devices?
 - How do we **communicate** with a mobile device?

How do we Hold Mobile Devices?

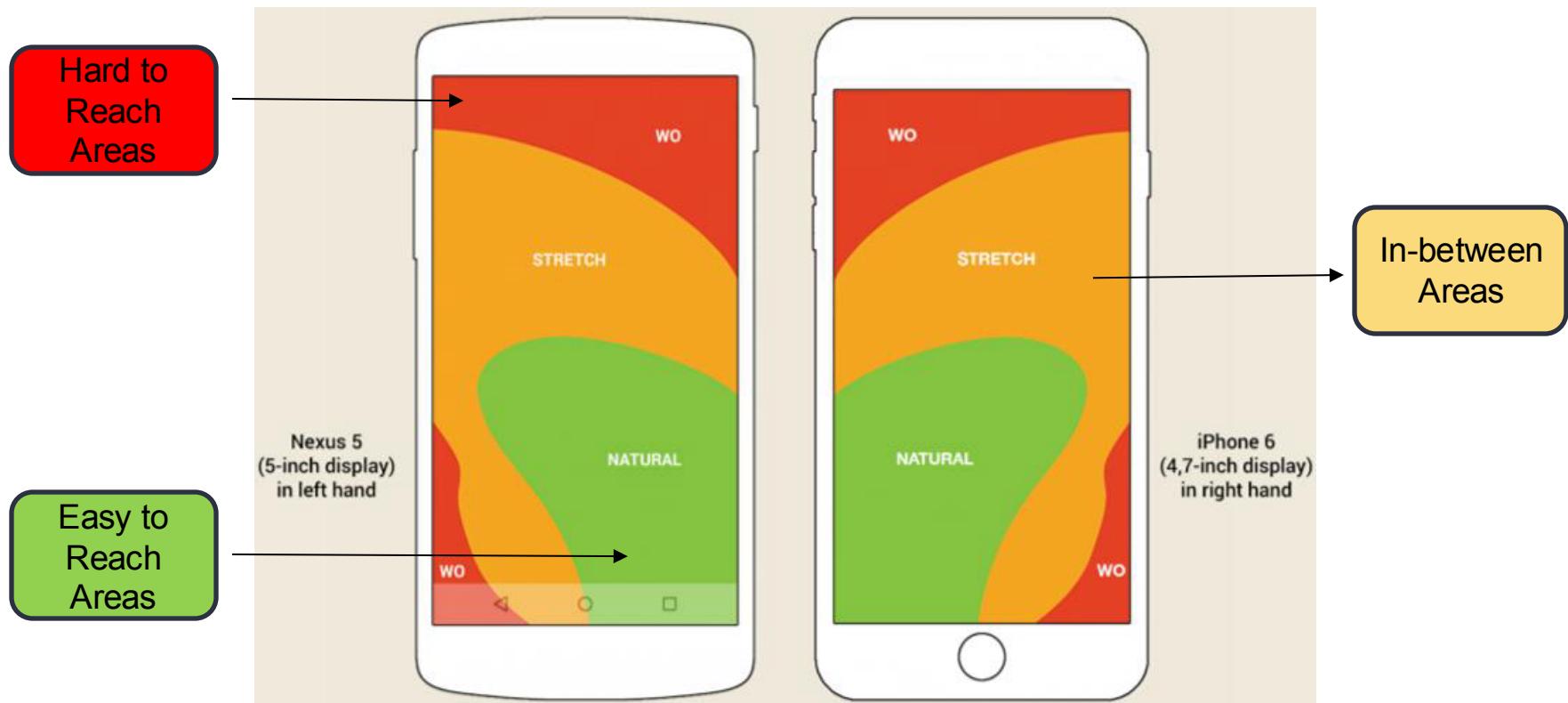


The Thumb Zone

- In his 2011 book “Designing Mobile Interfaces”, Steven Hoober coined the term **“The Thumb Zone”**, **“the most comfortable area for touch with one-handed use”**.
 - With 49% of users holding their phones in one hand, and using it with one thumb, this “mythical zone” is highly relevant for mobile designers.



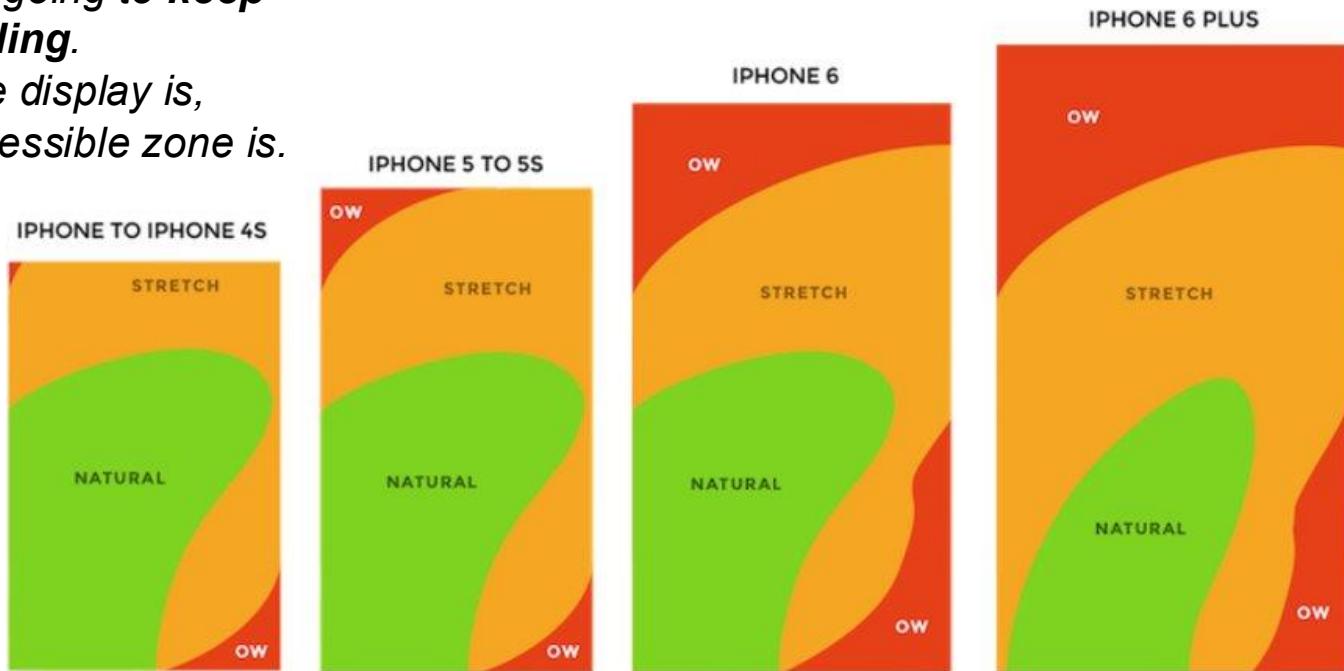
The Thumb Zone



The Thumb Zone evolution

Screen sizes are going to keep expanding.

*The bigger the display is,
the less easily-accessible zone is.*



Place relevant content within the thumb's reach

- **Important content needs to be aimed towards the thumb**, to where it is natural for the thumb to be.
- Stretch areas are in reach but can be considered a relegation area for less important touch interaction.
- Hard-to-reach areas should be avoided. The user can see them, but would rather not touch it.



Touch Interaction and Gestures

*Single & multi-touch gestures enable
predefined motions and actions
to interact with the device and
software.*



Drag item



Flick finger



Tap



Tap and hold



Nudge



Pinch



Spread



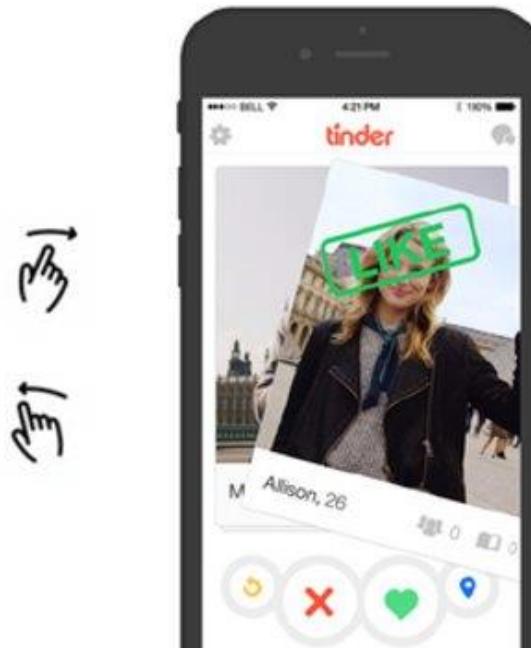
Slide finger

Flick Gesture

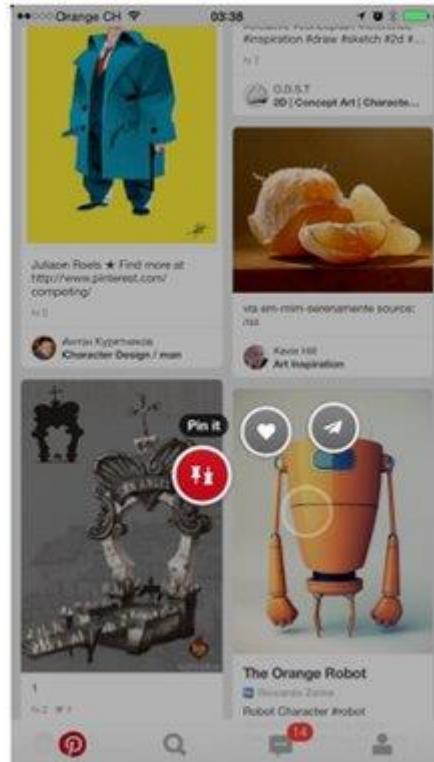
Tinder shows you interesting people nearby



Anonymously like or pass each person



Tap & Hold Gesture



Draw Gesture



Embrace Gestures with Attention

- Users expect that gestures work the same, regardless of the app they're currently running!
- Use gestures if the context they are used in, feels natural!
- Make sure users will find them!
 - Draw attention to the part of the UI where the gesture is active – maybe it could pulse the first time to signify it is interactive!
 - Perform an animation that hints to the type of gesture !
 - If you don't think users will figure out your gestures easily, don't overload them with too many help hints all at once, instead reveal them over time

Minimize the Effort Required for User Input

- **Suggestion:** Inputting information takes time and attention, **minimize it!**
 - If your app asks users a lot of input data, you have to revise your design.
- Balance any request for input by users with what you offer them in return
- Get information from the OS, when appropriate.
 - for example: contacts, address, events in the calendar...
- Use auto-completion in text fields whenever possible



Information Design

- It concerns the **visual layout** of information presented to the users. Three main aspects to consider:
- Design for “fat fingers”. Make your links and buttons large enough to hit easily
 - At a minimum, make important hit targets at least 1 cm on each side, and put some space between them.
- Design for distracted users.
 - Make the task sequences easy, quick, and reentrant, so that mistakes are easily corrected.
 - And make everything self-explanatory.
- Think about colors and typography. And think about motion.

Colors Psychology

- Users react to different colors differently, since colors **evoke emotions**.
- Thinking about the emotions that colors evoke in people is an **important aspect** of mobile design.
 - Note what some of the different colors can mean in different cultures.

BLU

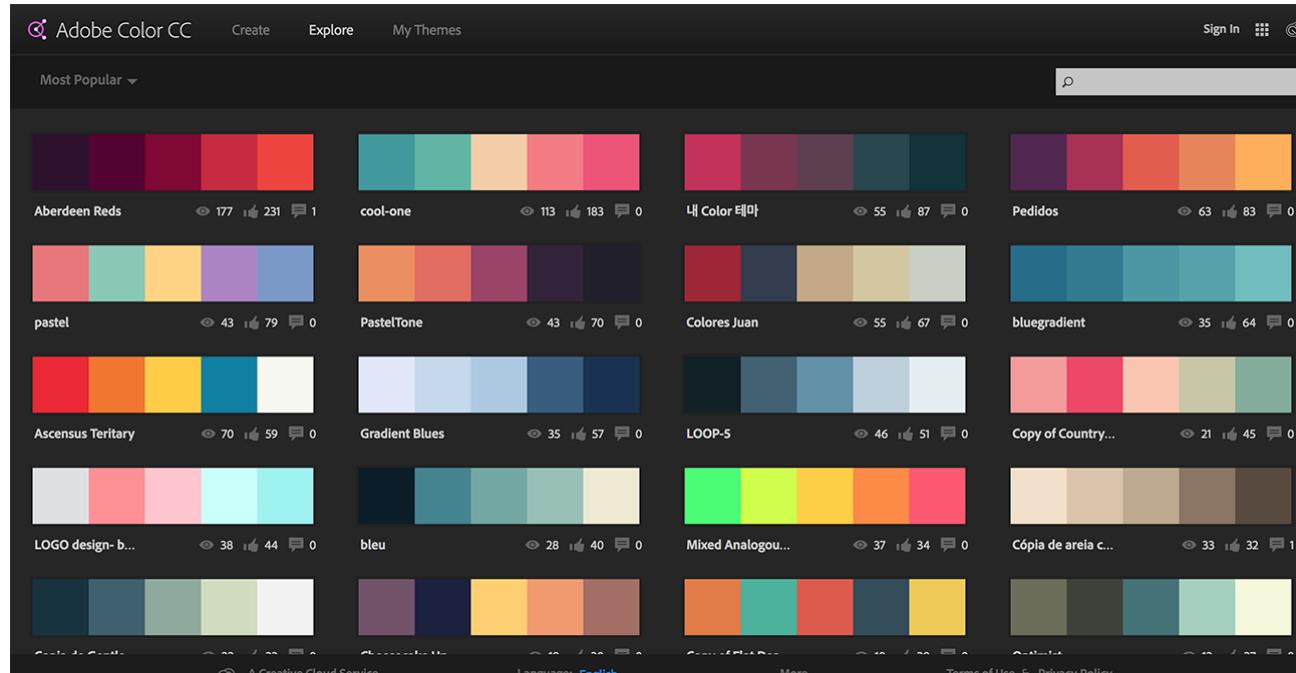
productiveness, interiors, skies, peace, unity, harmony, tranquility, calmness, trust, coolness, confidence, conservatism, water, ice, loyalty, dependability, cleanliness, technology...

RED

Passion, strength, energy, fire, sex, love, excitement, speed, heat, arrogance, ambition, leadership, masculinity, power, danger, gaudiness, blood, war, anger, revolution, radicalism, aggression, respect, martyrs, conservatism (U.S. politics), wealth (China), and marriage (India)...

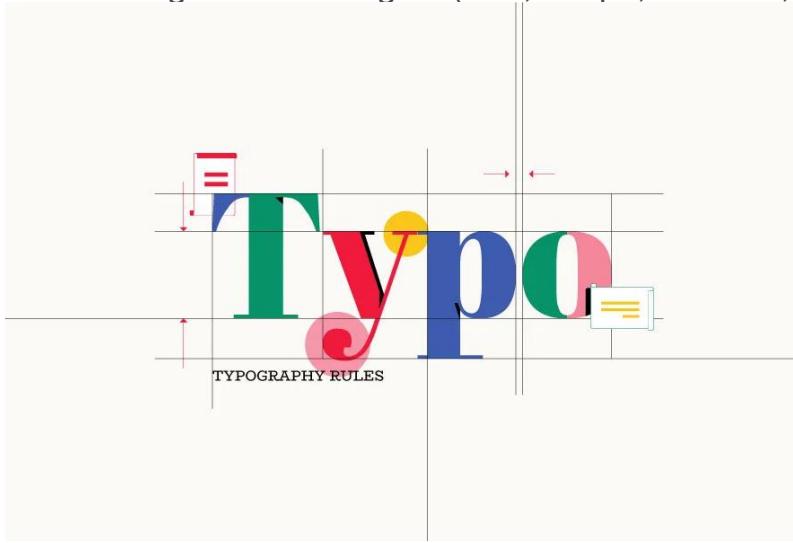
Colors Palette

Choose a predefined number of colors to be used in a mobile app.



Typography

- Typography is about:
 - Selection of the correct font
 - Understanding sizes
 - Applying conventional design methodologies (size, shape, contrast, color, position, space, etc.)



Readability Guidelines

- Use a **high-contrast** typeface
 - Devices are usually used outdoor
- Use the **right** typeface (font)



Pretty but too fancy and unreadable!

TOO NARROW

TOO NARROW

Readability Guidelines

cont

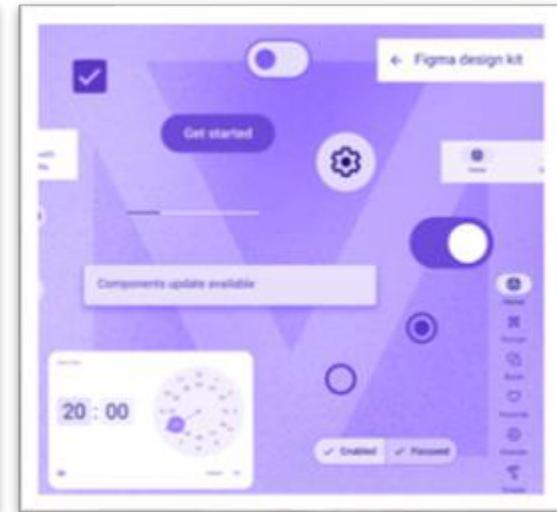
- Provide decent leading (space between two lines)



- Leave space on the right and left of each line
- Do not crowd the screen
- Generously utilize headings
 - Divide the content into paragraphs
- Use short paragraphs
 - 2-3 sentences at most

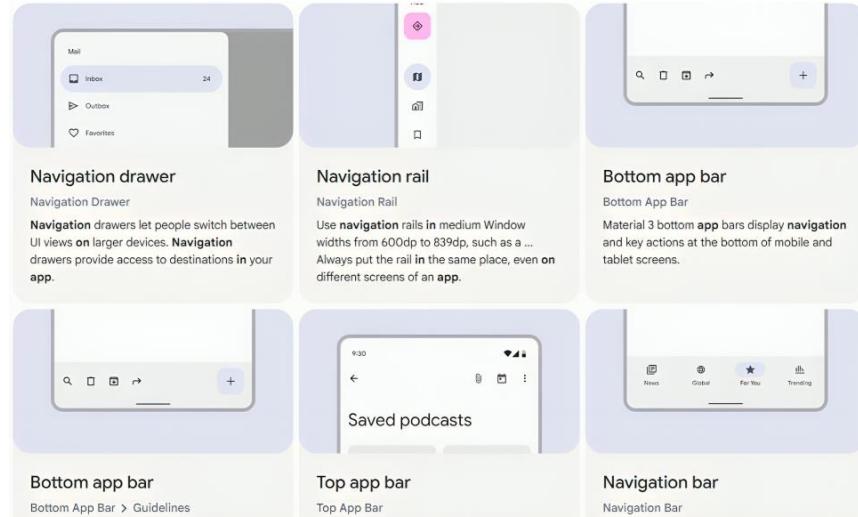
Widgets

- Widgets are **interactive UI components** used to display content and enable user interaction in Human-Computer Interaction. Some examples:
 - Labels
 - Buttons
 - Input Fields
 - Selection Tools
 - Filters
 - Progress Bars
 - Chips.



Navigation

- **Labels and Buttons** are essential for navigation, with buttons triggering actions and using clear labels, affordance, and feedback.
- Diverse navigation patterns include:
 - Hierarchical views for tree structures, using animated transitions and navigation bars.
 - Tabs for different views at the root level, with hierarchical navigation inside.
 - Pyramid pattern for navigation between sibling views using horizontal swipes.



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