

# **SEBENTA**

(conjunto da informação dos slides de forma organizada)

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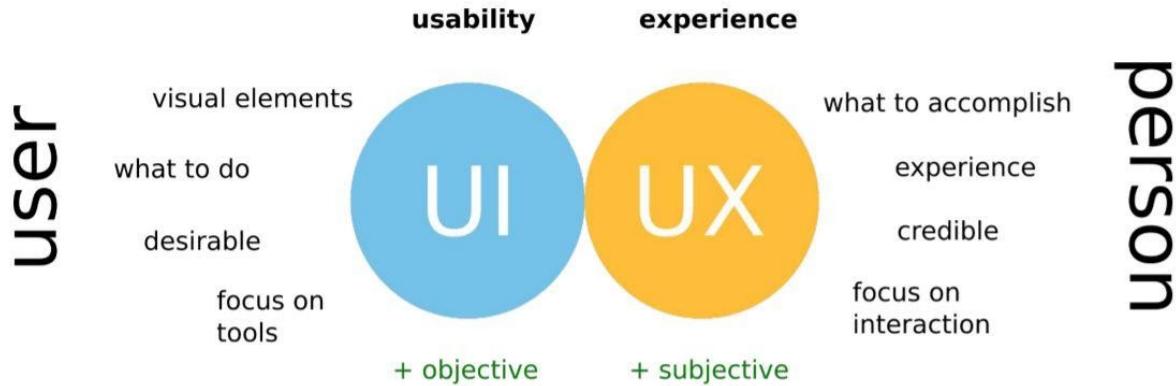
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# 1. Introduction

- **Human-computer interaction (HCI):** is a multidisciplinary field of study focusing on the design of computer technology and, in particular, the interaction between humans and computers.
- Involves multiple fields of study like Behavioral Sciences, Computer science/engineering and Design.

## 1.1. User interface and user experience (UI/UX)

- UX design is all about the overall feel of the experience, while UI design is all about how the product's interfaces look and function.
- **User Interface - UI**
  - “Visible” part of the system (may include sound, haptics...)
  - Enables the users to
    - Interact with the system
    - Perform their tasks
    - Get feedback/information from the system
  - The user operates/interacts over/through the interface
- **User Experience (UX)**
  - The whole experience with a system, technology, device
  - Not only the direct interaction with the artefact, but the overall context
  - Involves affective component (emotions while using)



## 1.2. Design myths

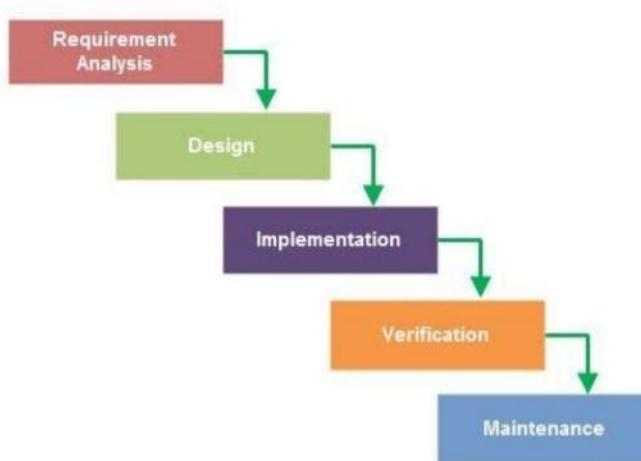
- “Good design means good graphics”
  - Visuals are important to communicate, but not enough for good interaction.
  - We also have to consider goals, expectations, tasks...
- “Marketing dept. knows the users”
  - Marketing is (for the most part) focused on demographics, not on the human behavior while using
  - What the users report is often different of what they do and feel.
- “Good design is common sense”
  - Common sense is not necessarily right.
  - It takes experts and work for good design
- “The interface is designed in the end”
  - The needs of the users should dominate the design of the interface. And the needs of the interface should dominate the design of the rest of the system.
  - 1º User needs; 2º Interface design; 3º Functionality
  - Design flaws detected at the end cost a lot of time and money.

## 1.3. Mantras

- Know your users (physical, cognitive, sensorial abilities; social context, background, etc.)
- “The user is not like me” (we shouldn’t design based on our opinions, because we may not be a typical user)

## 1.4. Design processes

### 1.4.1. Waterfall model



- **Problems:** Assumes all is completely known and specified very early on, only tests functionally after implementation

### 1.4.2. Fail fast philosophy

- Fail fast, early and often

### 1.4.3. Iterative design process

- Iterate over low-cost prototypes
  1. Ideate/design
  2. Prototype
  3. Test/evaluate
  4. Repeat

## **2. User research**

### **2.1. Main people involved**

#### **2.1.1. Users**

- Those who will use the product
- Have needs and expectations
- Their experience with the product will dictate the actual product's success
- Should be in the center of the process (User-Centered Design)

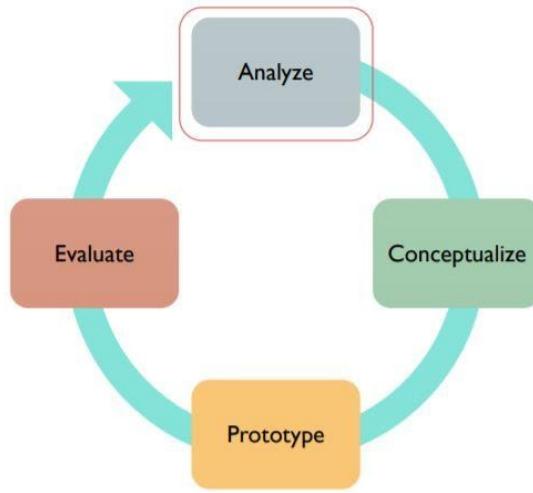
#### **2.1.2. Stakeholders**

- Define the initial motivations and main goals
- Point to high-level requirements
- May be wrong in their assumptions of the user's needs and expectations

#### **2.1.3. Designers**

- Research the users, to know their needs and expectations (and more)
- Understand the stakeholders and the product being proposed
- Bridge the gap between both, by designing and integrating over interfaces taking all into consideration

## 2.2. Iterative design cycle



1. Initial briefing
2. User research
3. Requirement synthesis

## 2.3. Initial briefing

- Based on the overall goals by the stakeholders
- Should not be too specific or constrained
- Should not assume much about the users or the interface
- Will be detailed/refined with the results of user research

## 2.4. User research

- Focus on:
  - potential users
  - their characteristics
  - the tasks they need/want to accomplish
  - the context in which they operate
  - their expectations
- The users are the ones that will use the product/system in the end
  - Not necessarily who decides to buy the product, or who is creating the product
  - A product may have more than one type of target users
    - E.g. doctor and nurse
    - May justify different interfaces
- 11 questions we should answer:
  - Who will use the system?
  - What tasks are currently performed?
  - What tasks are desired? (only question regarding future)
  - How are tasks learned? (Is there any previous knowledge required?)
  - Where are the tasks performed?
  - What is the relation between the user and information? (Identify sensitive and/or shared information. Do users feel comfortable sharing such information?)
  - How do they access the information?
  - What other instruments are available?
  - How do users communicate with each other?
  - How often are tasks performed?
  - Are there time constraints?
  - What happens if something goes wrong?

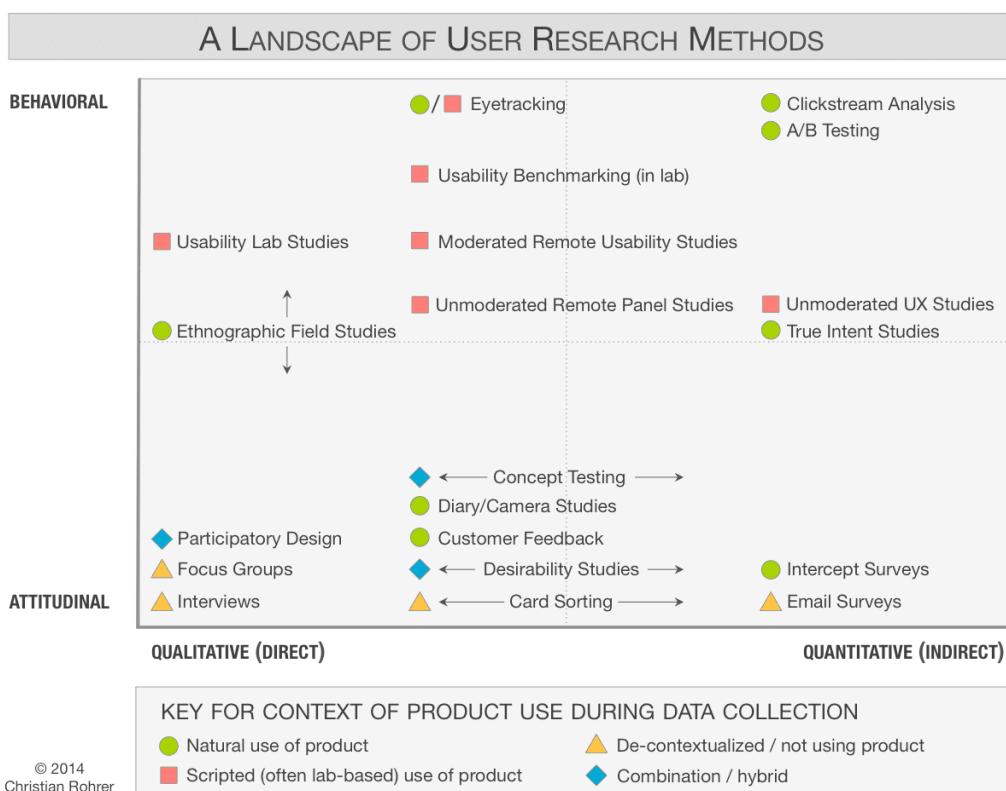
- More questions:
  - How are the users defined?
    - What do they know about the tasks?
      - previously known, recently introduced, new
      - How they have learned them
      - Their level of expertise
    - What do they know about the tools?
      - they currently use
      - How they use them
    - What mental models do they have?
      - How they interpret internally the system
      - What vocabulary they associate with elements and tasks (conceptual model)
  - How do the users differ individually?
    - Within a user population, there are individual differences that may lead to sub-groups of users
      - Personal traits (learning methods or work methods)
      - Physical differences (visual acuity, hearing, disabilities, age-related features)
      - Cultural differences (LTR vs RTL, expressions, symbols, age-related)
      - Motivation and attitude differences (eager for new things vs resistance to change)
  - How users' expertise evolves during product usage?

Topics	Beginner	Advanced Beginner	Competent	Expert
Fears	Fear of failing and unknown	Loses fear	-	-
Focus	Doesn't know initially what to do, only focus on tasks required	Knows enough to execute needed tasks, and focuses on that	Can predict and plan better how to execute a task	Highly motivated
Learning	Do tasks instead of concepts	Do tasks instead of concepts	Recognize that and are willing to learn more to do more/better	Concepts and theories beyond regular use

<b>Mental Model</b>	Rudimentary (if any)	Create an empirical mental model, oriented to their usage	By longer exposure create a solid mental model	Broad and consistent
<b>Problem solving</b>	-	-	Can diagnose and solve problems	Complex problems
<b>Notes</b>	Previous experience with other systems may help	80% of the users don't go over this level. This is a level for which to optimize the interface design	-	Typically are a very small fraction of the user base

## 2.5. User research methods

- **Quantitative:** numeric and quantifiable information (for example, task completion time)
- **Qualitative:** observational and subjective information of the experience (for example, questionnaire)



## 2.6. Ethnography

- Aims to achieve an in-depth understanding of a culture through long-term engagement and analysis
  - what members do
  - why they do it
  - what they experience while doing it
  - how their action fits their culture

### 2.6.1. Characteristics

- Contextual
  - performed where people live, work, act
- Naturalistic
  - avoids (intentional) manipulation of existing conditions
- Longitudinal
  - sustained engagement with the setting under study
- Collaborative
  - research performed together with participants
- Interpretative
  - researcher is deeply involved in research and is part of it
- 'Being there'
  - effort to pursue experiences as community members

### 2.6.2. Methods

- Direct observation
- Shadowing (follow someone around)
- Diary studies (filled by participants)
- Interviews
- Experience sampling (prompts to solicit data sent at specific times)
- Data logging

## 2.7. Observation

- Monitoring the behaviour and activities of individuals and communities, to gain in-depth understanding about them
  - ‘Basic set’ of focuses:
    - What people do
    - What people say
    - How people do it
    - Why they do it
  - ‘Design set’ of focuses:
    - What works well and what doesn’t
    - What tools are involved in actions
    - What knowledge and expertise people mobilize
    - What are the breakdown points
    - What people do when they find breakdowns

## 2.8. Personas

- A Persona is a user archetype you can use to help guide decisions about product features, navigation, interactions, and even visual design.
- Provide us with a precise way of thinking and communicating about how users behave, how they think, what they wish to accomplish, and why. It helps a team avoid designing for themselves.
- A Persona is Not...
  - Based on demographics or market segments
  - Drawn from gut feelings about your audience
  - User profiles or stereotypes

- Rich description of one of a set of typical users
  - Name, photograph, some personal details regarding leisure times and occupations
  - user's skills, attitudes, tasks and environment
  - described specifically ("has a dog named Billy" instead of "has a dog")
- A Persona is not a real person, but a realistic one, that can be related to (should not be based on or use data of someone you know)
- Personas should be complemented with a series of context/activity scenarios
  - A description - story - of a context in which an activity is carried out through our product/system.
  - Example: Paulo wants to know quickly how much one of his employees spent on food and travel expenses last week. He accesses the company's employees section, selects the person in question and consults the history of the last recorded expenses.

### 2.8.1. Rules to create Personas

- Keep them simple and memorable
- They should be separated by goals, not behavior
- Focus on satisfying the widest audience, not the sales audience
- Add a little personal detail, but not so much they appear phony
- Focus on 3 or 4 goals per persona
- Create personas in context of a specific project
- Personas represent behavior patterns not job/role descriptions
- Keep your persona set small
- There is not a direct correlation between market segments and personas
- Focus on goals, not tasks. Tasks are things we do to achieve goals
- Describe users performing tasks (with our system)
- While interviewing potential users, although many are very different, patterns begin to emerge putting the users into distinct group sets. These groups are defined by:

- Motivations
- Needs
- Frustrations / “Pain-Points”

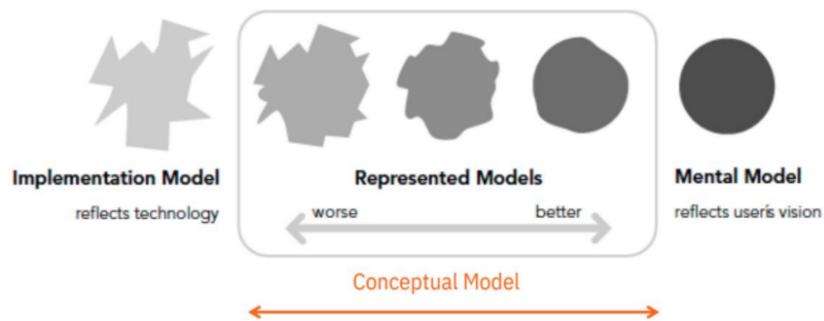
## 3. Ideation

- There is one belief that permeates academic literature and has influenced nearly all gated product development processes: it is the notion that innovation begins with an idea. This is the myth that misleads. An idea is the output of the innovation process, not the starting point.
- Making ideation the starting point of the innovation process, turns innovation into a guessing game. Why? Because it is nearly impossible to have a big idea before knowing what customer, job-to-be-done, ... unmet needs, and price the idea has to address.

### 3.1. Conceptual model

- What people can do with the system
- What concepts the team needs to understand to use the system
- It refers to objects, attributes and actions in the task domain
- What are the mappings between them
- Allows the team to arrange ideas before designing the U.I.
- If possible explore metaphors well-known to the users
- It is expressed in terms of the concepts of the intended users' tasks:
  - The data users manipulate
  - How it is organized
  - What users do to it
- It is not:
  - It's not the user interface

- It is not system architecture
- It's not about the look and feel
- It doesn't mention keys to press; Mouse actions, graphics and screen organization, commands, dialog boxes, error messages,etc.
- Does not specify type of interaction
- It is not the user's mental model



## 3.2. Functional requirements

- Define a set of functional requirements based on the personas and their context/activity scenarios, and taking the conceptual model into account

## 3.3. Task selection

- A list of specific tasks that:
  - Illustrate the use of the system
  - Cover the requirements
  - Should be the basis for future evaluation
- The tasks should be:
  - Real and representative
  - "What", and not "How" (no mention to the interface)
  - Specific in terms of intents and goals
  - Complexity mix (simple/common vs complex/rare)
  - Identify the (type of) user(s)

## 3.4. Usability requirements

- Used to evaluate the usability
  - Set of requirements per previously defined task
  - Should include efficacy, efficiency and satisfaction measures
- **Efficacy:** Quality with which the user achieves the goals
- **Efficiency:** Resources spent to achieve the objectives
- **Satisfaction:** Users' subjective reaction the use of the system

## 3.5. Design sprints

- Design sprints allow the quick generation of multiple ideas and iterate over them
- Rules:
  - Ideate individually first
  - Bring ideas to the group
  - Share in an open-minded way
  - Generate more ideas
  - Generate in parallel, not in sequence
  - Avoid closing in on an idea too early
  - Don't interrupt other people's ideas
  - Prototype ideas to validate feasibility and interest
- Basic method of Design Sprint:
  - Each team member sketches 8 different ideas in 8 min.
  - The goal is to go beyond the first idea (often the least innovative) and to generate a wide variety of solutions for your challenge
  - Each team member has then 3 minutes to share the ideas and discuss with the group.

# 4. Prototyping

- **Prototype:** Concrete, yet partial representation of the system
- Reduce time and costs to produce something users can test
- Allow for fast exploration of different alternatives
- Facilitate easy fixing of issues found

## 4.1. Characteristics

- **Fidelity** relates to the visual appearance of the prototype (fonts, colors, images, etc.)
- **Functionality** focuses on system response, whether it executes on a computer system or requires human intervention
- **Horizontal prototypes** have a broad but shallow coverage of tasks
- **Vertical prototypes** focus on specific parts in depth (frontend down to backend)

## 4.2. Content inventory

- Data requirements define the information and objects that must be represented in the system interface and how they will be used. These requirements and attributes are useful as they allow us to know how the information will be stored and formatted.
- Rules for Content Definitions:
  - Write in a positive way
    - "The system will redirect the user to page X" instead of "The system will not allow the user to access page Y".
  - Descriptions should be specific. Ambiguous situations should be avoided.
    - "Videos with more views in the last week will appear at the top of the list" instead of "Most popular videos will be featured"

- Avoid subjective language
  - "The appearance of the page will respect the document with the company's visual identity guides" instead of "The page will have a trendy and appealing style".
- Use of quantitative data
  - "The system must be able to support 1000 users simultaneously" on detriment of "the system must have a high level of performance".

## 4.3. Techniques

- Experiential
  - Storyboarding
  - Bodystorming
  - Wizard of Oz
- Low-Fidelity/Functionality prototypes
  - Paper
  - Mock-ups
- Mid/High-fidelity/Functionality prototypes
  - Interactive Mock-ups
  - Functional prototypes

### 4.3.1. Storyboarding

- A series of drawings that tell a story
- A mix between comics and movie script
- Drawing skills are not very important
- It is about communicating the concept
- Depicts settings, context and sequences of actions/events

- Context: People, environment, tasks
- Sequence: Motivation for goal, steps taken, task details (no UI)
- Goal: Motivation for using the system, what is achieved, what needs are fulfilled

#### 4.3.2. Bodystorming

- Experience physically a situation
- Imagine systems in context
- Generate ideas on tasks/functionalities
- Do role play
- Important steps:
  - Choose the place
  - Prepare the space and materials
  - Recruit, test and observe
  - Debriefing with users and observers

#### 4.3.3. Wizard of Oz

- Functionalities of the system are simulated by a human (hidden or not)
- Useful for early concept testing/simulation of complex or demanding systems (e.g. speech or gesture recognition, AI...)

#### 4.3.4. Paper

- Can be built with simple materials and tools (Paper, cardboard, glue, tape, markers, pencils, scissors, cutting knife, molding paste).

#### 4.3.5. Mock-ups

- Representations of the interface in a more detailed way

- Usually created with software
- Can be **lo-fi** (e.g. wireframe) or **hi-fi** (e.g. actual hi-res widgets)
- Can be printed out to test as paper prototypes, or used digitally (desktop, mobile)
- Good for UI consistency, more scalable than sketching, and still faster and cheaper than coding
- Cons:
  - Can be slower than sketching for small/initial prototypes
  - Flow has to be induced by the tester
  - If hi-fi too early, can bias the user

#### 4.3.6. Interactive Mock-ups

- Use tools to add interactivity to mock-ups
- Can be simple “hyperlinking” between screens through clickable/tappable areas
- Can have some more complex interactions, but not actually programmed

#### 4.3.7. Functional prototypes

- Prototypes that already implement part of the logic of the functionalities
- Can be in the final platform, or in some rapid prototyping platform
- Usually vertical, but can be horizontal
- May be lo-fi or hi-fi (although usually at this point there are already hi-fi mock-ups available)

## 4.4. Tools

Name	URL	License/notes
Quant-UX	<a href="https://quant-ux.com/">https://quant-ux.com/</a>	Free, open source. Interesting
PenPot	<a href="https://penpot.app">https://penpot.app</a>	Open source, online, but could be self-hosted. Real-Time Collaboration
Figma	<a href="https://www.figma.com">https://www.figma.com</a>	Free version is a good solution
Webflow	<a href="https://webflow.com">https://webflow.com</a>	Free version seems a good solution
Just in Mind	<a href="https://www.justinmind.com/">https://www.justinmind.com/</a>	Free version seems a good solution
Pencil Project	<a href="http://pencil.evolus.vn">http://pencil.evolus.vn</a>	Free, local app, open source
InVision	<a href="https://www.invisionapp.com">https://www.invisionapp.com</a>	Free version could be a good solution
Framer	<a href="https://www.framer.com">https://www.framer.com</a>	Free version seems a good solution
wireframe.cc	<a href="https://wireframe.cc">https://wireframe.cc</a>	Free interesting, but UI seems limited, and single page
Draftium	<a href="https://draftium.com">https://draftium.com</a>	Free version could be a good solution
Marvel	<a href="https://marvelapp.com/">https://marvelapp.com/</a>	images only, free very limited
Origami	<a href="https://origami.design">https://origami.design</a>	Interesting, but Mac only
Antetype	<a href="https://www.antetype.com">https://www.antetype.com</a>	Mac app only, apparently free and no account/online requirements
Prott	<a href="https://prottapp.com/">https://prottapp.com/</a>	Free version very limited
Pidoco	<a href="https://pidoco.com/en">https://pidoco.com/en</a>	Free version very limited
Axure	<a href="https://www.axure.com">https://www.axure.com</a>	Paid

Adobe XD	<a href="https://www.adobe.com/products/xd.html">https://www.adobe.com/products/xd.html</a>	Paid
Sketch	<a href="https://www.sketch.com/">https://www.sketch.com/</a>	Paid
Balsamiq	<a href="https://balsamiq.com">https://balsamiq.com</a>	Paid
UXPin	<a href="https://www.uxpin.com/">https://www.uxpin.com/</a>	Paid
Moqups	<a href="https://moqups.com">https://moqups.com</a>	Paid
Flinto	<a href="https://www.flinto.com/">https://www.flinto.com/</a>	Paid, Mac only
proto.io	<a href="https://proto.io">https://proto.io</a>	Paid
Fluid UI	<a href="https://www.fluidui.com/">https://www.fluidui.com/</a>	Paid
MockPlus	<a href="https://www.mockplus.com">https://www.mockplus.com</a>	Paid
MockFlow	<a href="https://mockflow.com">https://mockflow.com</a>	Free version a bit limited
ProtoPie	<a href="https://www.protopie.io/">https://www.protopie.io/</a>	Has a plan for students/teachers, otherwise paid

## 5. Evaluation

- The design process consists of:
  - Interdisciplinary team
  - Competence-based leadership (Not seniority)
  - No hierarchy (Everyone contributes ideas)
  - Start with secondary research (for example, injuries, theft, etc.)
  - Observation(for example, going to the supermarket)
  - Listening to experts who know the context (for example cashiers, customers, etc.)
  - Iterative design
  - Brainstorm (No bad ideas)
  - Parallel design (Assign people with different points of view)

- Choose/vote ideas/solutions
- Mix and assign ideas
- Produce prototypes (Low, medium and high fidelity)
- Test prototypes

## 5.1. 5W and 1H approach

- **Why?** Why should we do evaluation?
  - to check if users can use the product and if they like it
- **What?** What do we want from the evaluation?
  - a conceptual model, early prototypes of a new system and later, more complete prototypes;
  - finished products
- **Where?** Where should we perform evaluation?
  - in natural or laboratory settings
- **When?** When should we do this evaluation?
  - during design;
  - or on finished products to assess if the requirements are met and to collect information to develop new products.
- **Who?** Who must be involved in the evaluation?
- **How?** Which evaluation methods to use

## 5.2. Types of assessment

- **Formative**
  - During the design process
  - Results inform the next design phase
  - Direct observation in the laboratory

- "What happens during the interaction?"
- Should have about 15 participants for one iteration or 5 participants for 3 iterations.
- Methods:
  - Think aloud
  - Wizard-of-Oz
  - Interviews / Questionnaires

- **Summative**

- Final evaluation to measure success
- "What is the result of the interaction?" (time, errors, ...)
- Performance measures, "don't tell" where to refine
- At least 10 to 20 participants, to have a sample large enough for statistics.
- Methods:
  - Usability testing
  - A/B testing

- **Involving end users**

- The participants should be representatives of the target users (or approximate). They should also know the tasks, domain and vocabulary and there must be a balance in gender, age, etc.
- Methods:
  - Field studies
  - Usability testing

- **Not involving end users**

- Methods:
  - Analytical evaluation

### **5.3. Field studies**

- The main feature of field studies is that they are performed in natural environment
- They aim at understanding what people do naturally and how products mediate their activities
- They can be used to:
  - Help to identify opportunities for new technology;
  - Establish requirements to design
  - Facilitate the introduction of technology
  - Evaluate technology
- Interviews and observation are the main techniques used

### **5.4. Usability testing**

- Evaluation approach that involves measuring typical user's performance on typical tasks
- Records the number and kind of errors that users make and the time that it takes to perform a task;
- Users interactions are recorded by logging and video;
- User satisfaction interviews and questionnaires are used;
- Studies controlled by the evaluator and performed in a controlled environment;
- Optimal performance levels and minimal acceptance levels are defined
- Usability measures:
  - Time to complete task
  - Number of mistakes made
  - Number of completed tasks
  - Number of clicks

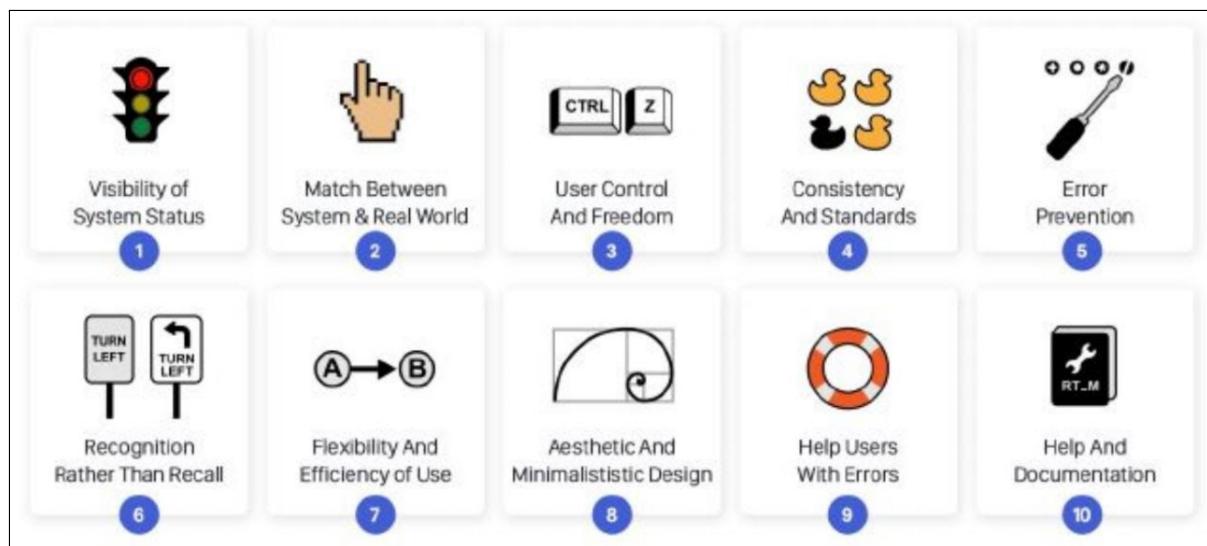
- Number of help queries
- User satisfaction
- Etc.

## 5.5. Analytical evaluation

- An approach to evaluation that does not involve end-users
- Two main methods are used:
  - **Heuristic evaluation**
  - **Predictive evaluation**

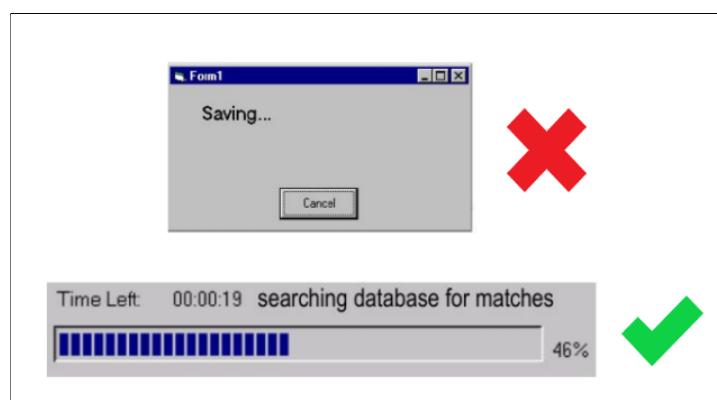
### 5.5.1. Heuristic evaluation

- Method guided by heuristics (guidelines and standards) and walkthroughs to identify usability problems;
- Walkthroughs involve experts in walking through scenarios with prototypes of the application
- Good for evaluating initial designs and prototypes
- Advantages:
  - Fast
  - Cheap
  - Easy to use
- **Usability heuristics:** Designers use to guide, evaluators to assess



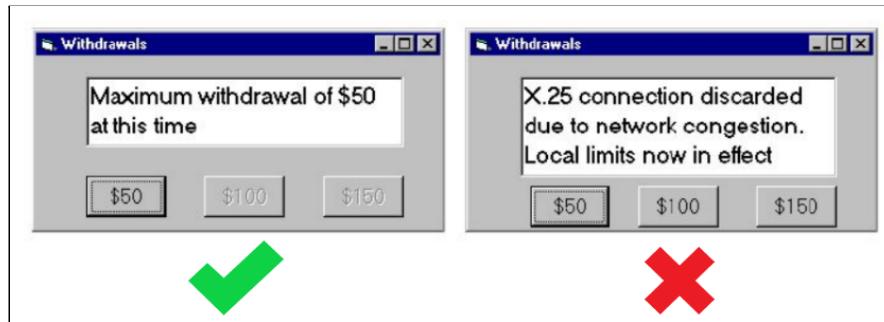
## 1. Visibility of the system status

- The system should always keep users informed about what is going on through appropriate feedback within reasonable time.
- Report what is going on clearly and objectively
- In proper time
  - < 0.1s: no indicators needed
  - 0.1s - 1s: cursor change
  - 1s - 10s: time remaining
  - > 10s: progress indicators



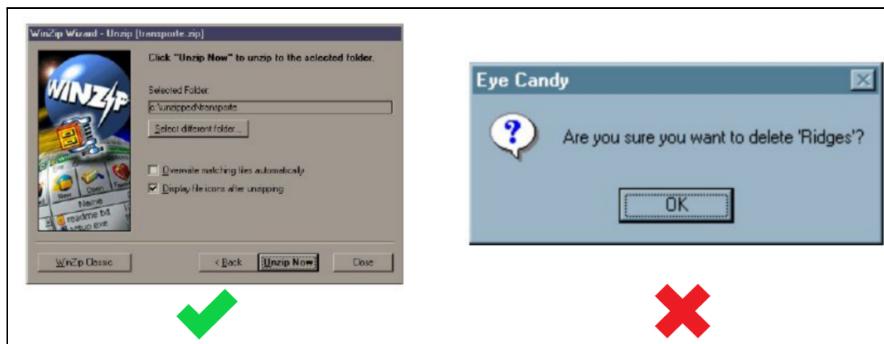
## 2. Match between the system and the real world

- The system should speak the user's language, with words, phrases, and concepts familiar to the user rather than system-oriented terms.
- Follow real-world conventions, making information appear in a natural and logical order.
- Recall conceptual model



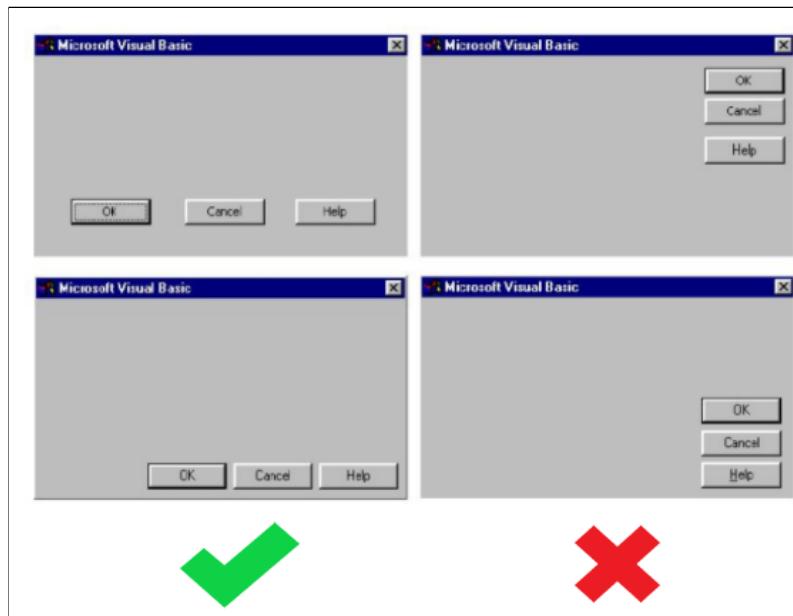
## 3. User control and freedom

- Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.



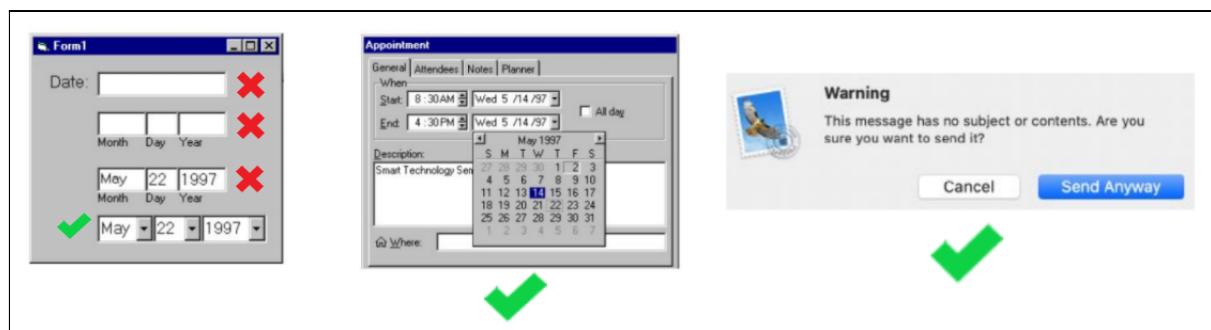
## 4. Consistency and standards

- Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.



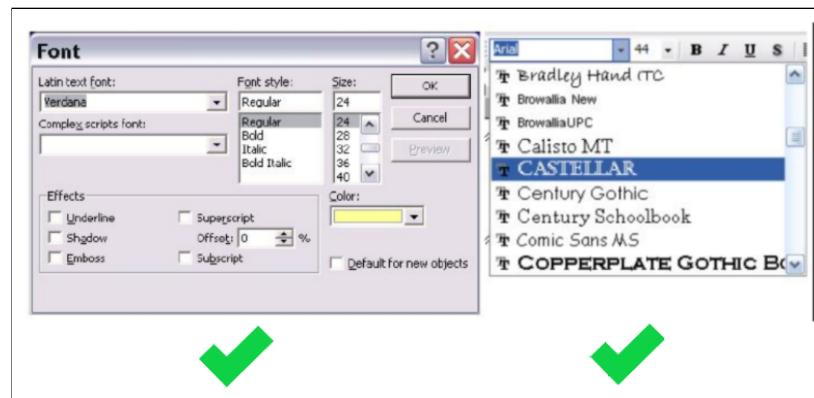
## 5. Error prevention

- Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit the action.



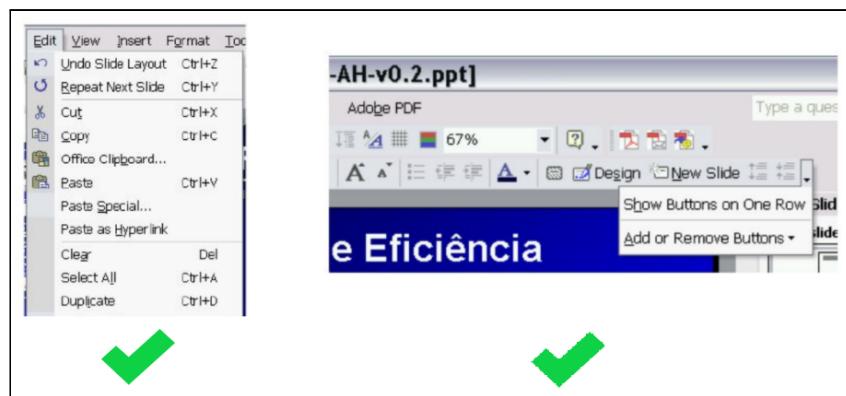
## 6. Recognition rather than recall

- Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.



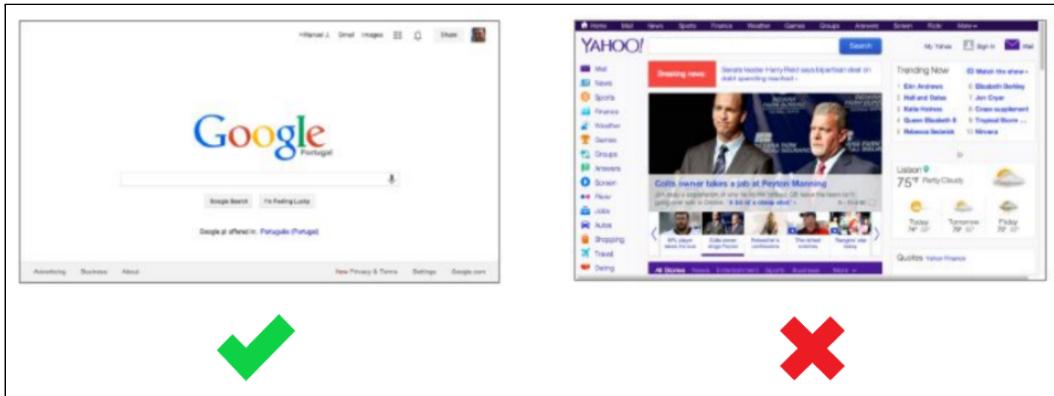
## 7. Flexibility and efficiency of use

- Accelerators - unseen for the novice user - may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.



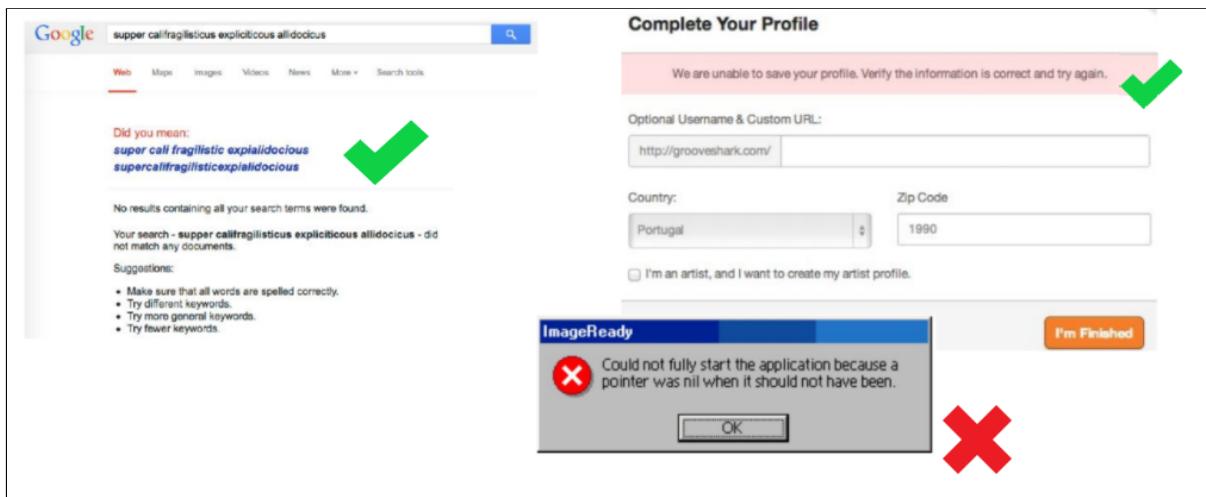
## 8. Aesthetic and minimalist design

- Dialogues should not contain information that is relevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.



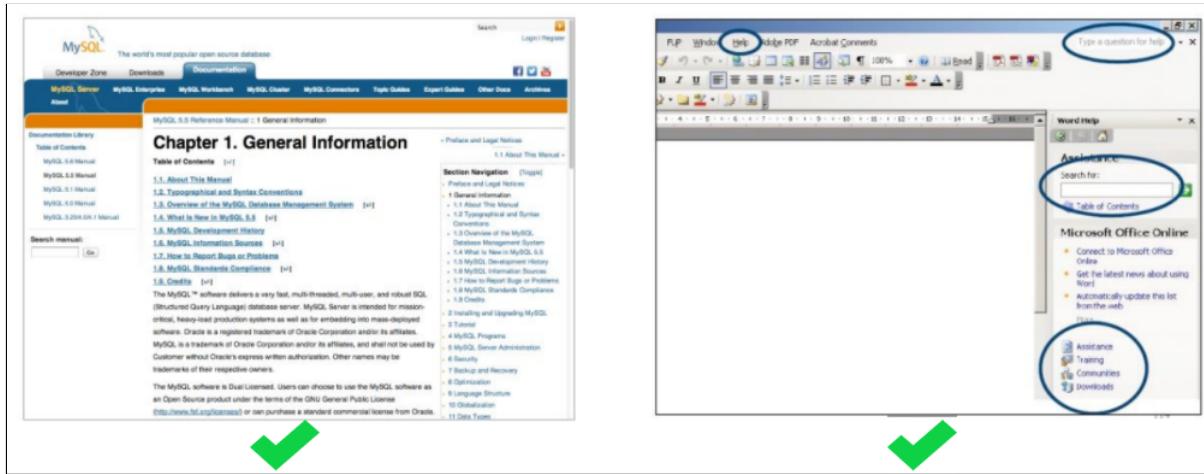
## 9. Help users recognize, diagnose, and recover from errors

- Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.



## 10. Help and documentation

- Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.



### 5.5.2. Predictive evaluation

- Methods based on theoretical models to predict user performance.
- Provide a way of evaluating products or designs without directly involving users.
- Less expensive than user testing.
- Usefulness limited to systems with predictable tasks (for example, telephone answering systems, mobile phones, etc.)
- Based on expert error-free behavior
- Examples:
  - GOMS (Goals, Operators, Methods, Selection rules)
  - KLM (Keystroke Level Model)

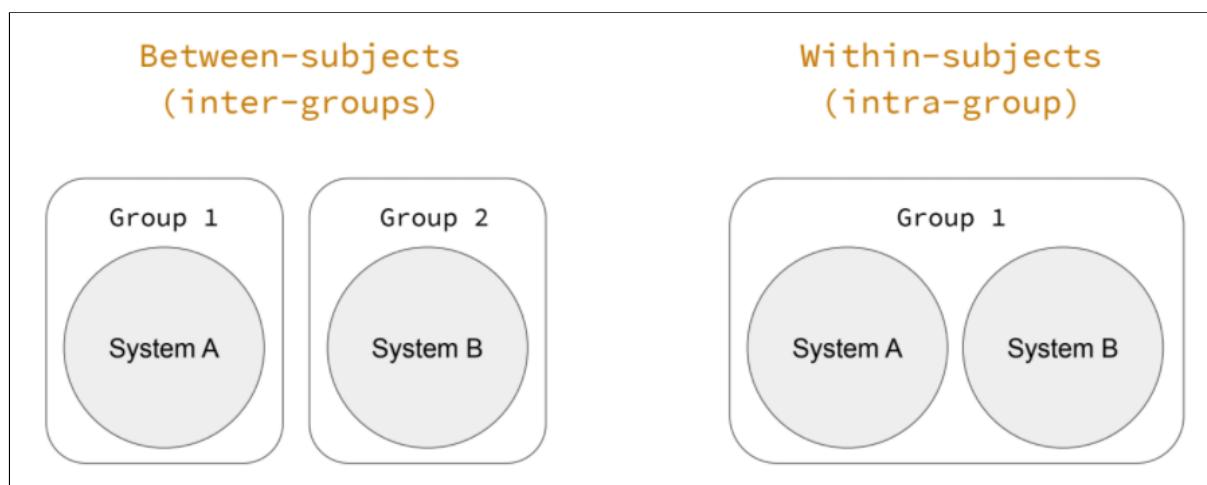
Operator	Description	Time (sec)	Operation	Operator	Time
K	Pressing a single key or button Skilled typist (55wpm) Average typist (40 wpm) User unfamiliar with keyboard Pressing shift or control key	0.35 0.22 0.28 1.20 0.08	Mentally prepare	M	1.35
P	Ponting with a mouse or other device to a target on a display	1.10	Reach for mouse	H	0.4
P1	Clicking the mouse or similar device	0.20	Move cursor to just before the word "not"	P	1.10
H	Homing hands on the keyboard or other device	0.40	Click and hold mouse button down (half a P1)	P1	0.1
M	Mentally prepare to do something, e.g. make a decision	1.35	Drag the mouse across "not" and one space	P	1.10
R(t)	System response time	t	Release the mouse button (half a P1)	p1	0.1
		Home in on delete key		H	0.4
		Press delete key		K	0.22
		Total predicted time			4.77

KLM example

## 5.6. Evaluator activities

1. Experiment with and establish a feel for the scope of the system.
2. Review the materials provided to familiarize yourself with the system design. Perform the user actions that you feel would be taken to perform the user tasks.
3. Identify and list any areas of the system that you feel are counter to the heuristics. List all of the concerns that you note, including what seem to be duplicates. Be sure to clearly describe what you find, including where in the system it was found.
4. Each evaluator reviews the product at least twice: once to become familiar with the system and a second time to inspect the system against the set of heuristics.

## 5.7. A/B testing



- **Inter-groups:** two different groups test different systems.
- **Intra-group:** one group tests two different systems. The order may play a role (for example, the group by using the system A, may be learning how to use the system B, giving the false sense that B is easier to use). So elements should have systems in different orders (Randomized, Sequenced, Latin-Squares).

## 5.8. Variables to be tested

- **Dependent variables**
  - Its value depends on the system to be tested
  - Variables measured in the study (for example, time, errors, SUS)
  - Related to the purpose of the prototype
- **Independent Variables**
  - They do not depend on the variables we are measuring
  - Solution characteristics (for example layout, color, etc. )
  - Characteristics of the participants (for example age, etc.)

## 5.9. Data types

- **Quantitative** (quantity, specific and measurable)
  - Did you complete the task? Yes/No
  - How long did it take?
  - How many errors?
  - Which one did you prefer? A or B?
- **Qualitative** (quality, "open")
  - "What did you like most about the experience?"
  - "What do you think of the home screen?"
- **Objective**
  - They do not depend on the predisposition (bias) inherent to the human being
  - For example: time, errors, heart rate, etc.
- **Subjective**
  - Enhances the user's perception
  - For example: preference, SUS, etc.

The System Usability Scale Standard Version		Strongly disagree	Strongly agree				
		1	2	3	4	5	
1	I think that I would like to use this system.		<input type="radio"/>				
2	I found the system unnecessarily complex.		<input type="radio"/>				
3	I thought the system was easy to use.		<input type="radio"/>				
4	I think that I would need the support of a technical person to be able to use this system.		<input type="radio"/>				
5	I found the various functions in the system were well integrated.		<input type="radio"/>				
6	I thought there was too much inconsistency in this system.		<input type="radio"/>				
7	I would imagine that most people would learn to use this system very quickly.		<input type="radio"/>				
8	I found the system very cumbersome to use.		<input type="radio"/>				
9	I felt very confident using the system.		<input type="radio"/>				
10	I needed to learn a lot of things before I could get going with this system.		<input type="radio"/>				

SUS - System Usability Scale

## 5.10. Side effects

- Reward limits creativity. Users focus on reward
- Hawthorne / Observer Effect: When being observed, users behave differently
- Novelty effect: Positive impressions may wear out after some time
- Survivor bias: Focusing on existing (surviving) solutions may miss important information regarding others

## 5.11. Ethics

- Tests can create stress, discomfort, etc. You are responsible for anticipating and easing
  - Participants are volunteers
  - Informed consent
  - Avoid pressure to participate

- Inform participants that they can terminate at any time
  - Emphasize that it is the system being tested, never the users
  - Anonymizing the data / protect data
- Take into account vulnerable populations (Children, People with disabilities, Minorities)
- Individuals have autonomy and choice
- Not to be used as a means to an end
- Protect the most vulnerable
- Use Informed Consent
- Obligation to do good
- Obligation not to harm
- Obligation to prevent harm
- Minimize risks, maximize benefits
- Kindness beyond duty
- Risk and Benefits Assessment
- Ensuring equality
- Sharing risks and benefits across the sample
- Fair participant recruitment
- Basic Ethical Considerations:
  - Time
  - Comfort
  - Information
  - Privacy
  - Control

## 5.12. Qualitative analysis

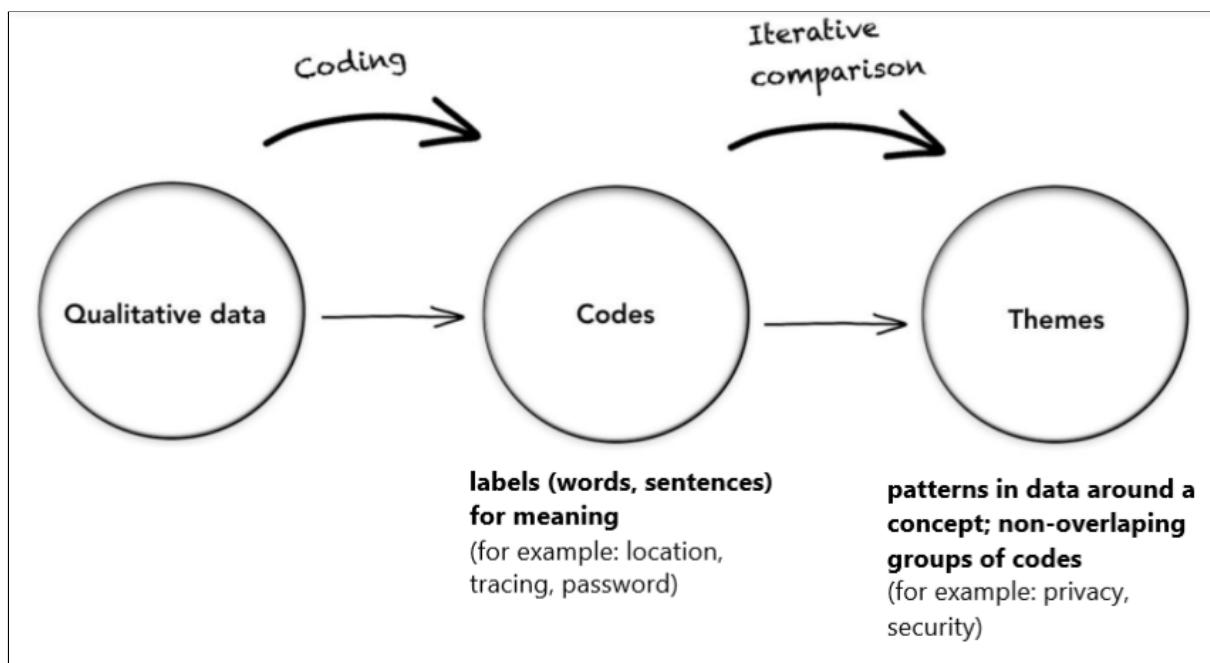
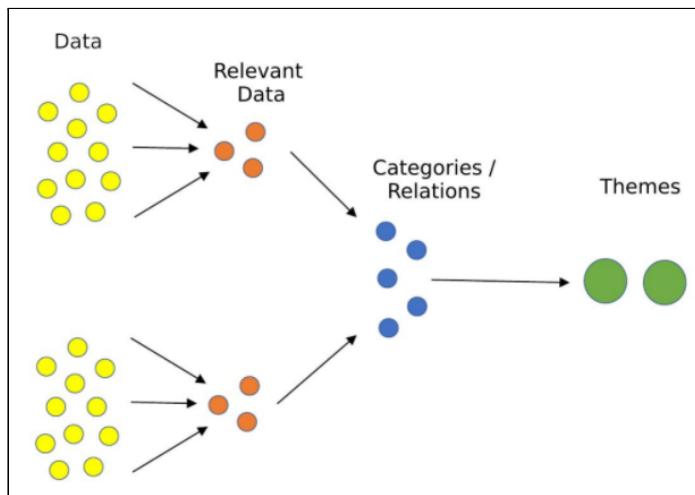
- Non-numeric data (Text, images, audio and video recordings...)
  - Capture qualitative information (Attitudes, Behaviours, Experiences, Motivations)
  - Descriptive nature (Describing events, opinions, ...)
  - Explanatory (Explaining events, reactions, ...)
  - **Techniques:**
    - Word clouds
    - Thematic analysis
    - Sentiment Analysis
    - Factorial Analysis

### 5.12.1. Word clouds

- Easy to produce
  - Only represent word frequency
  - No content analysis
  - Examples:
    - <https://www.wordclouds.com>
    - <https://tagcrowd.com>

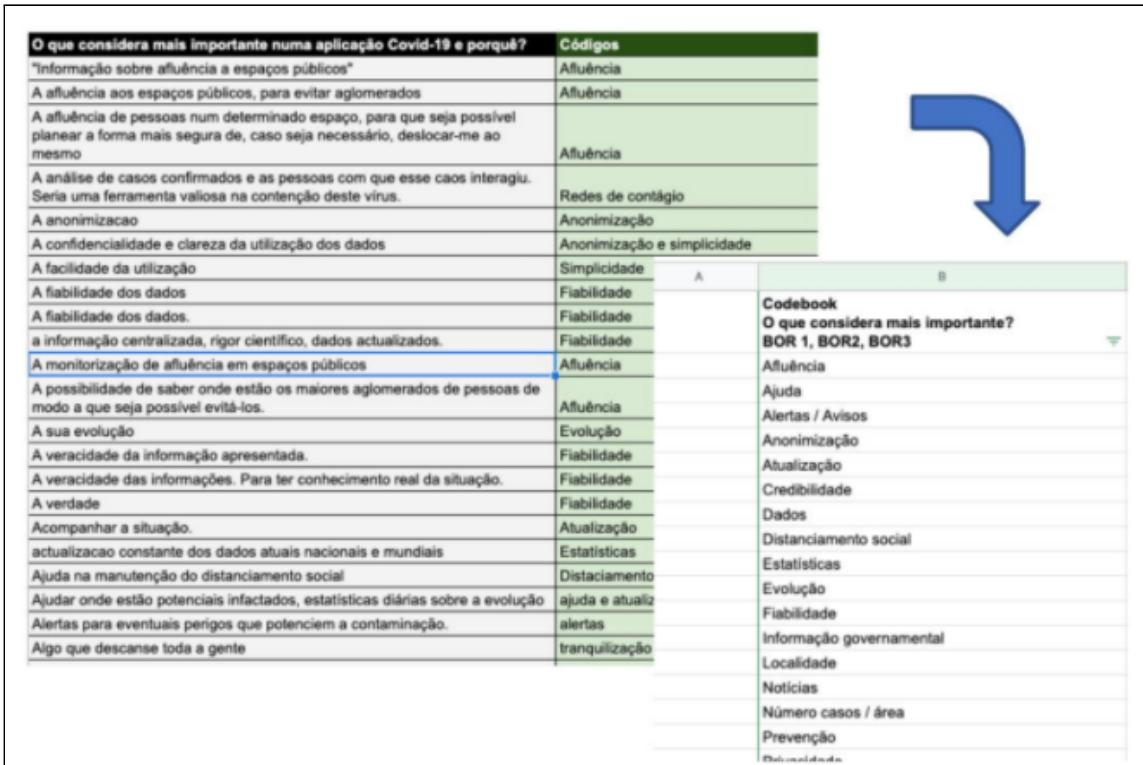
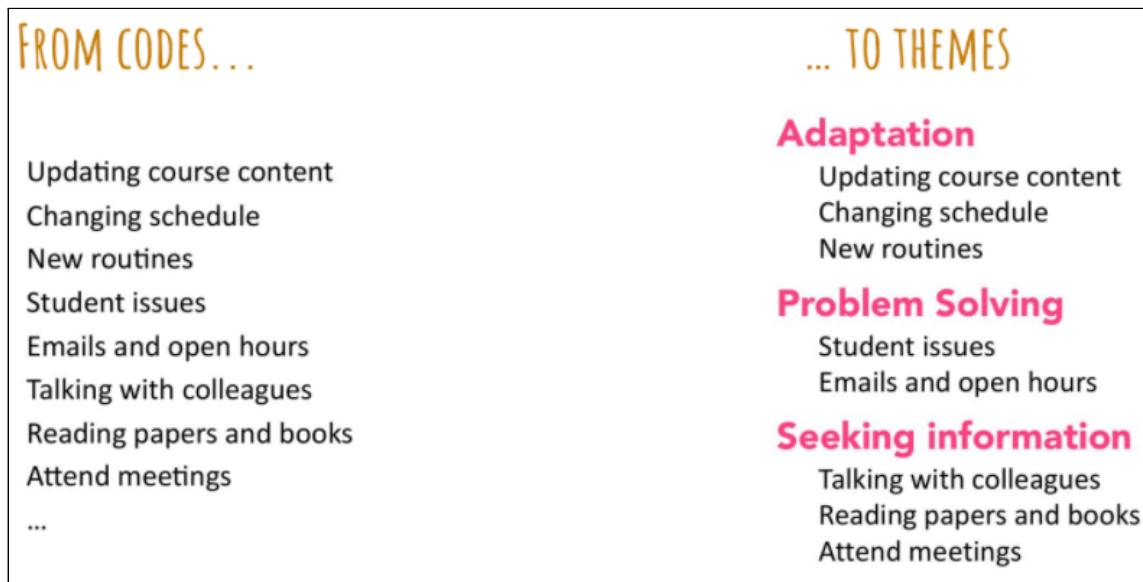
### 5.12.2. Thematic analysis

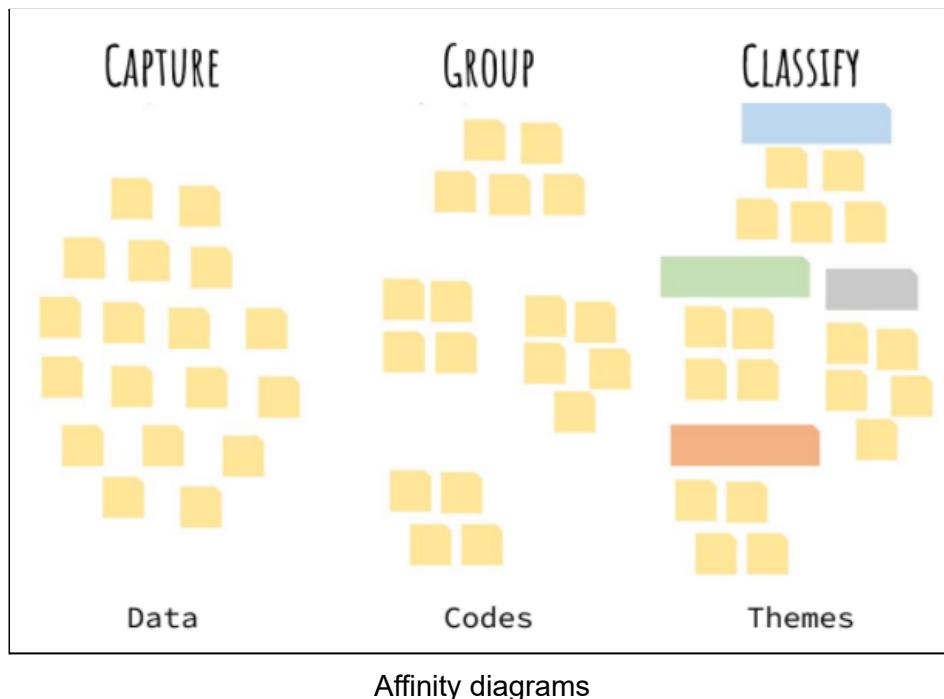
- Subjectivity is part of the process
  - Accept it, but use a systematic approach.



- Two approaches:
  - **Emergent** - grounded theory
    - Nothing predefined
    - Codes arise from the analysis
  - **Structured** - Framework Analysis
    - Codes are predefined
    - For example, from a list of key concepts

- Examples:





### 5.13. Quantitative analysis

- We test, but to infer anything we need to examine the variables and the data
- We do this to
  - Identify possible mistakes
  - Detect patterns
  - Make sure conclusions are correct
  - Generate and test hypotheses
  - Avoid problems later
- Variables:
  - Dependent
  - Independent

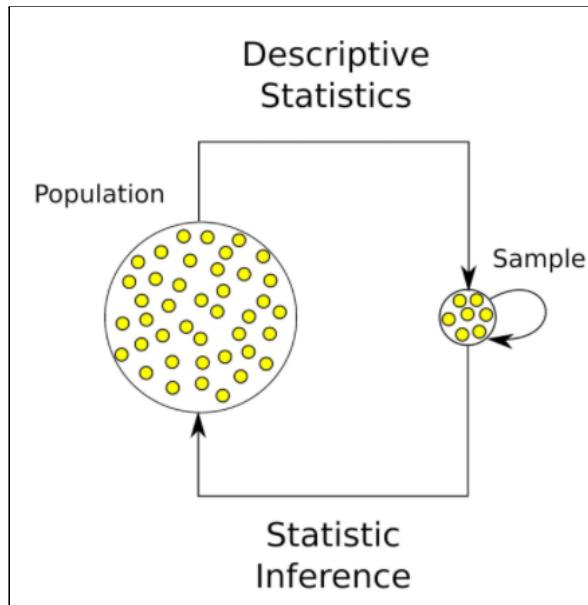
- Measures:

- Nominal (Color, brand, name)
- Ordinal ([light, medium, heavy] [unhappy, neutral, happy])
- Continuous (Age, height, weight, time, nr. of errors)

- Techniques:

- Statistic analysis
- Descriptive statistics
- Statistic Inference

### 5.13.1. Statistic analysis



### 5.13.2. Descriptive statistics

- Typically first step to examine data
- Characteristics that summarise the sample

- Typical measures

- Mean
- Standard Deviation (St. Dev.)
- Median
- Quartiles
- Mode

## MEAN AND STANDARD DEVIATION

$$\bar{x} = \frac{\sum x_i}{n}$$

Mean

$$SQ = \sum (x_i - \bar{x})^2$$

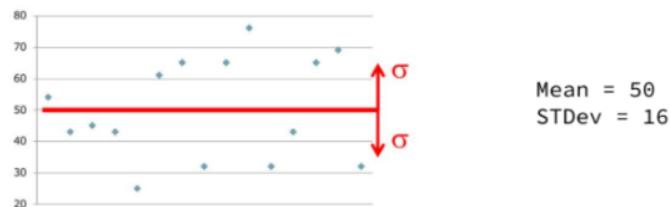
Sum of Squared Differences  
(SSD)

$$s^2 = \frac{SQ}{n-1}$$

Variance

$$s = \sqrt{s^2}$$

Standard Deviation  
(St.Dev)



## MEDIAN

9, 4, 15, 2, 8, 1, 1, 4, 2, 2, 12, 3, 2, 1, 9

1, 1, 1, 2, 2, 2, 2, 3, 4, 4, 8, 9, 9, 12, 15

## QUARTILES

1, 1, 1, 2, 2, 2, 2, 3, 4, 4, 8, 9, 9, 12, 15

Q1  
25%

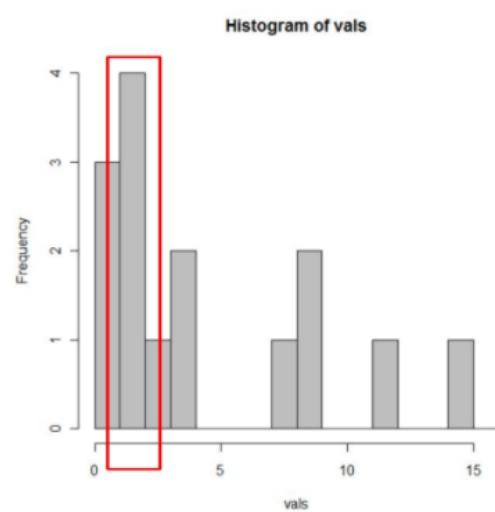
Q2  
50%

Q3  
75%

## MODE

1, 1, 1, 2, 2, 2, 2, 3,  
4, 4, 8, 9, 9, 12, 15

= 2



- Nominal variables: Mode
  - “How many prefer A, B or C”
- Ordinal variables: Median, Mode, Quartiles
  - “Satisfaction level between 1 and 5”
- Continuous variables: Mean, StDev, Median, Quartiles
  - “Average time to perform a task”

## 5.14. Statistic inference

- How to infer from a sample conclusions applicable to the population?
  - Hypothesis testing
- 1. Choosing a representative sample (Must be a subset of the population that covers its main variations in similar proportions)
- 2. Formulating a null hypothesis (Hypothesize that there is no relation between different variables, and test that)
- 3. Performing the tests (Collecting data)
- 4. Applying statistical treatment (Different methods depending on the variables/null hypothesis)
- Types of hypothesis:
  - $H_0$  - **Null Hypothesis**: assume one thing does not affect another. For example, “The new icons do not affect user performance”
  - $H_1$  - **Experimental Hypothesis**: assume what we want to verify. For example, “The new icons improve user performance”

- **Confidence Level**
  - The probability of assuming  $H_1$  is true, but being wrong is designated by  $\alpha$  (alpha)
  - The confidence level (“grau de confiança”) is  $(1-\alpha)$
  - Typical values of  $\alpha$  used are 0.1, 0.05 or 0.01, with the correspondent confidence levels of 90%, 95% or 99%
- Statistical tests:
  - T-student for mean values
  - Confidence intervals
  - Chi-square (“Qui-quadrado”)
  - Pearson correlation coefficient (PCC, or Pearson’s r)

#### 5.14.1. T-student for mean values

- Used for continuous variables: time, errors, height, SUS, etc.
- Compare two mean values. For example, the mean selection time of an icon with a trackpad vs a mouse.
- T-student assumes the sample has a normal distribution. If that is not known, there are normality tests to check it. However, values measured in nature tend to normality if using samples with at least size 30.

#### 5.14.2. Confidence intervals

- For a given confidence level (e.g 95% or  $\alpha = 0.05$ ) and a sample, the probability that the mean of the population is outside the confidence interval is  $\alpha$
- Used for continuous variables: Time, errors, height, SUS, etc.
- Compare a mean with a concrete value. For example, Selection time below 5 seconds?

### 5.14.3. Chi-square

- Used for nominal variables. For example: preferences
- Compare expected frequencies vs observed. For example, users prefer to use the trackpad instead of the mouse?

### 5.14.4. Pearson correlation coefficient

- Used to determine if two variables are related, for example, if variation in one implies variations in the other, and vice-versa
- Value varies from
  - -1 (inversely correlated) to
  - 0 (not correlated/independent) to
  - 1 (directly correlated)

## 6. Multimodal Interaction

- The combined use of multiple types - modalities - of interaction between users and system.
- Includes both input and output.
- User to system by many different means
  - Direct (for example, touch)
  - Indirect (for example, heart rate)
- System to user via five senses. Although most common are audio and visual.

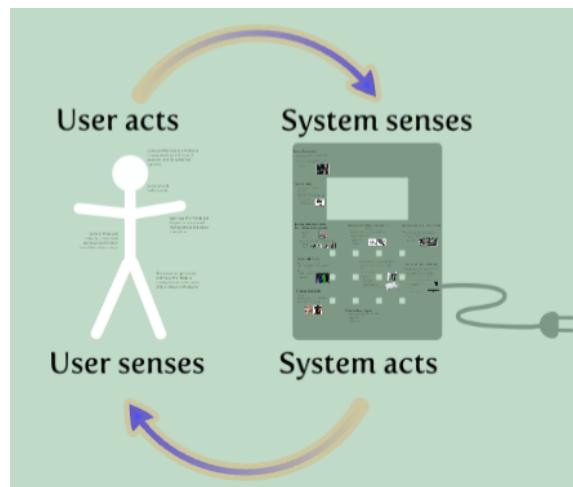
### 6.1. Combining modalities

- The number of modalities and their appropriate combination can be key to more effective and natural interfaces.
- The combination provides

- Advantages (for example, higher context and influence)
- Challenges (for example, coherence and control requirements)

## 6.2. Communication environment

- Users and systems share an environment that serves as means for their communication/interaction.
- Multimodalities rely on exploring different combinations of actuating and sensing within that environment.



- Users
  - Use their face as a means to convey emotions and focus of attention, and for controlled signaling
  - Talk and make sounds
  - Use their hands and fingers for fine-grained manipulations and object interaction
  - Assume poses, gesticulate, and move their body to convey different information and to interact with objects
  - Some of these and others (for example, heart rate) can be uncontrolled or controlled unconsciously
- Systems
  - Sensing facial actions
  - Sensing sound

- Sensing hand/finger-based, fine-grained manipulations
- Sensing body motion
- Sensing biosignals
- Other indirect input

### 6.2.1. Systems sensing facial actions

- Human faces have many elements and features and can be very expressive
- Systems can extract information about the user at different granularities, being the most common:
  - Face orientation
  - Eye gazing
  - Facial expressions

### 6.2.2. Systems sensing sound

- In the lowest level, microphones are typically used
- Depending on applications, different levels of sensing can be achieved via Hardware or Software:
  - Sound detection
  - Voice commands
  - Speech recognition

### 6.2.2. Systems sensing hand/finger-based fine-grained manipulations

- Basic interfaces:
  - Knobs
  - Sliders
  - Push buttons

- Those are foundations of more task-oriented combos:
  - Keyboards
  - Keypads
  - Joysticks
- For positional control/input, a series of indirect input devices (as in operating in a space different from the output) became also common:
  - Mouse
  - Digitizing pen
  - Trackball
  - Trackpad
- Providing a closer relation between the input and output spaces, direct manipulation input devices became increasingly more available
  - Lightpens
  - Single touch
  - Multi-touch

### 6.2.3. Systems sensing body motion

- Due to their broader range and coarser granularity, body motion capture (full or partial) presents different challenges and specificities.
- Means for sensing body gestures can be roughly divided in two classes:
  - Contact-based
  - Contactless
- **Contact-based methods**
  - Require actual sensors to be in contact with the body
  - May limit or influence the motion

- Examples of devices:
  - Wiimote
  - Mobile phone
  - Balance board
  - Other motion/position-sensor-based methods, for example, Polhemus sensors and others
- **Contactless methods**
  - Rely on sensors that are not connected to the body (although some may require body markers)
  - High-end motion-capture systems (more expensive, more precise, more specific)
  - Low-end video-based motion capture systems
  - Low-cost depth-cam based (Kinect/Xtion and Leap)
  - Proximity sensing

#### 6.2.4. Systems sensing biosignals

- Heart rate
- Brain activity (EEG - electroencephalography)
- Skin Conductance
- Muscle (EMG - electromyography)

#### 6.2.5. Other indirect input

- Some examples of symbolic input / input by proxy:
  - Fiducials / tangible I/F
  - QR / Bar codes
  - RFID
  - Magnetic cards

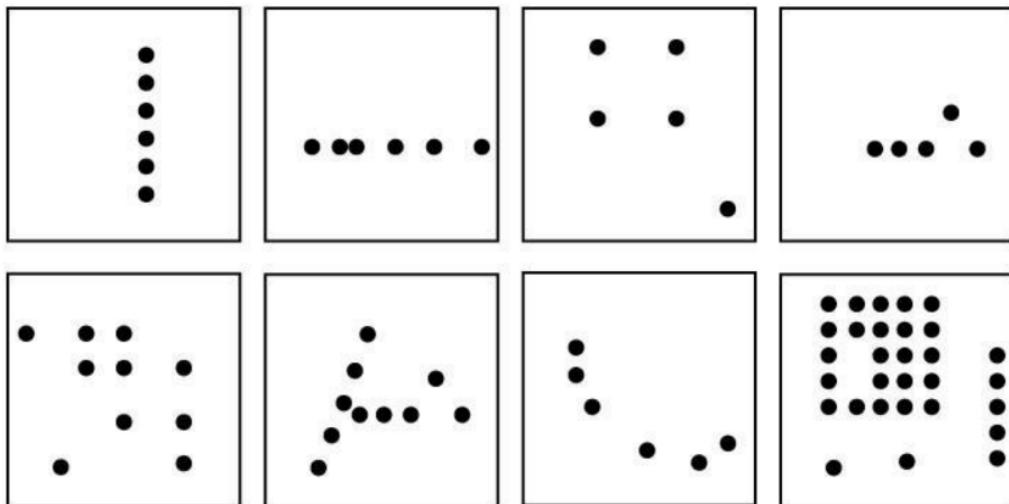
# 7. Visual design

- Visual details like fonts, colors, alignment, and images.
- Advantages:
  - Creates a usable experience
  - Express the complex brand traits such as friendliness, reliability, or innovation.

## 7.1. Elements of visual communication

### 7.1.1. Dot

- Mark positions in space

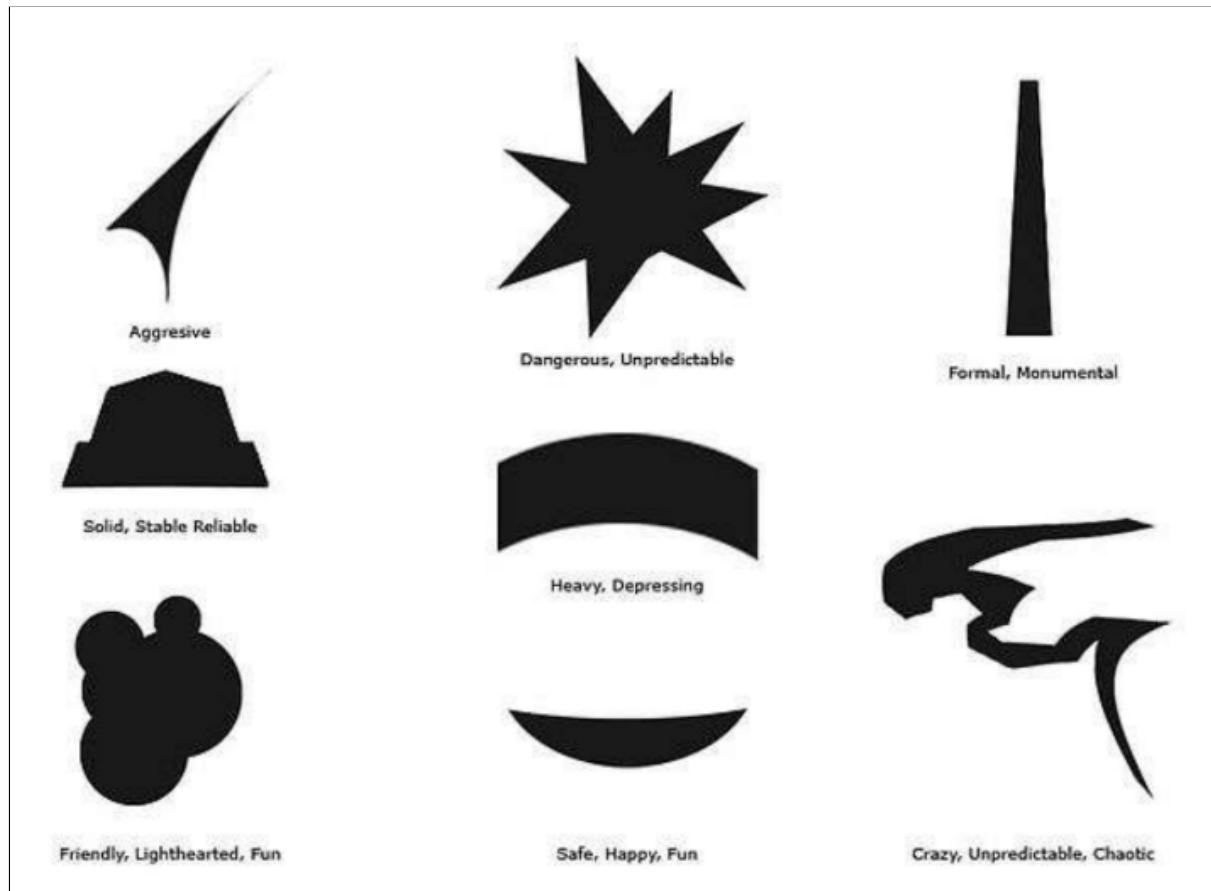


### 7.1.2. Line

- Composed of a series of points;
- The lines can direct, separate, transmit expression, create rhythm and even suggest emotion;
- Lines can create other elements.

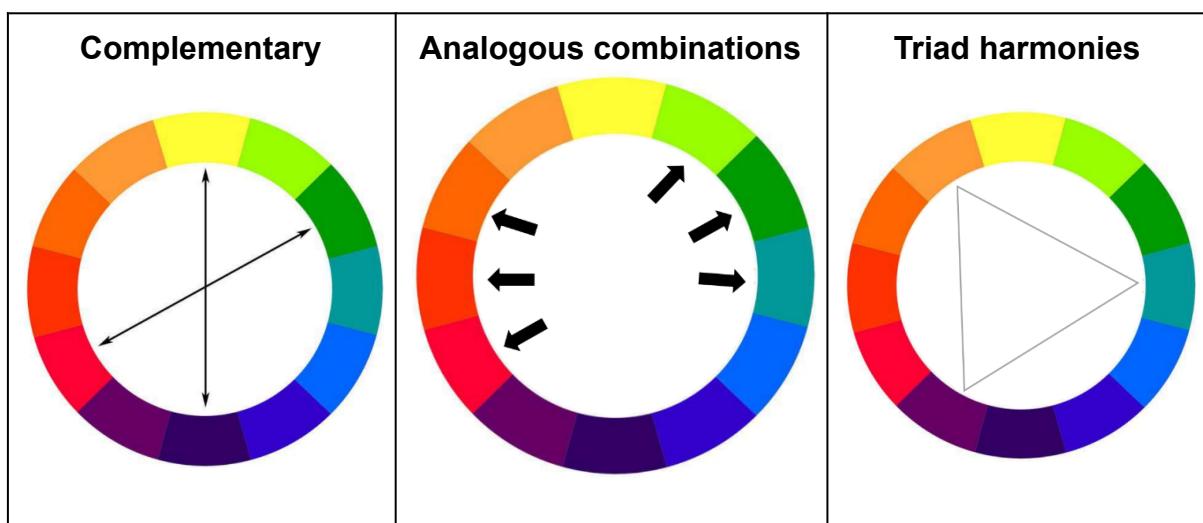
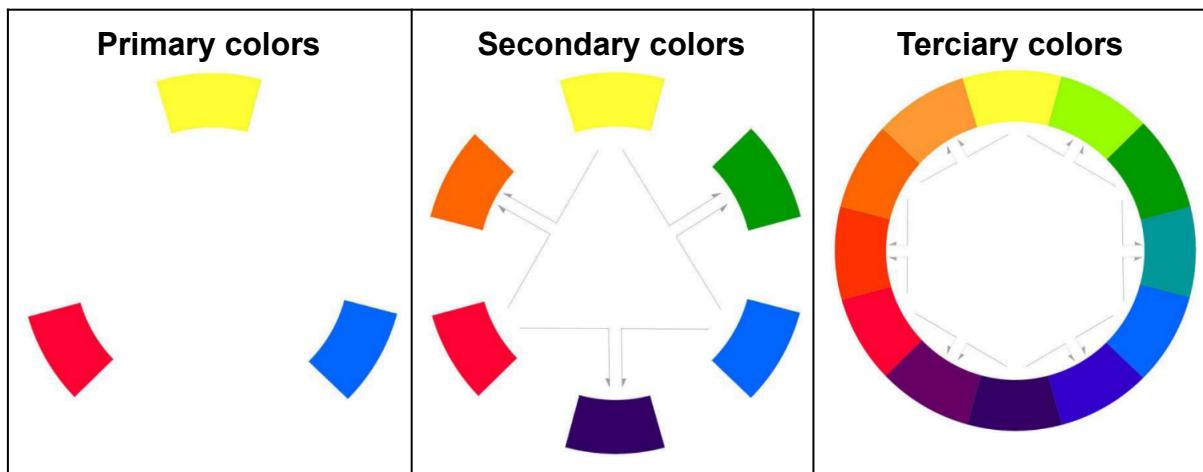
### 7.1.3. Shape

- Is in everything we see.
- It is a vehicle for color, tone, texture size and direction;
- A form can not exist without generating another form that is its negative.



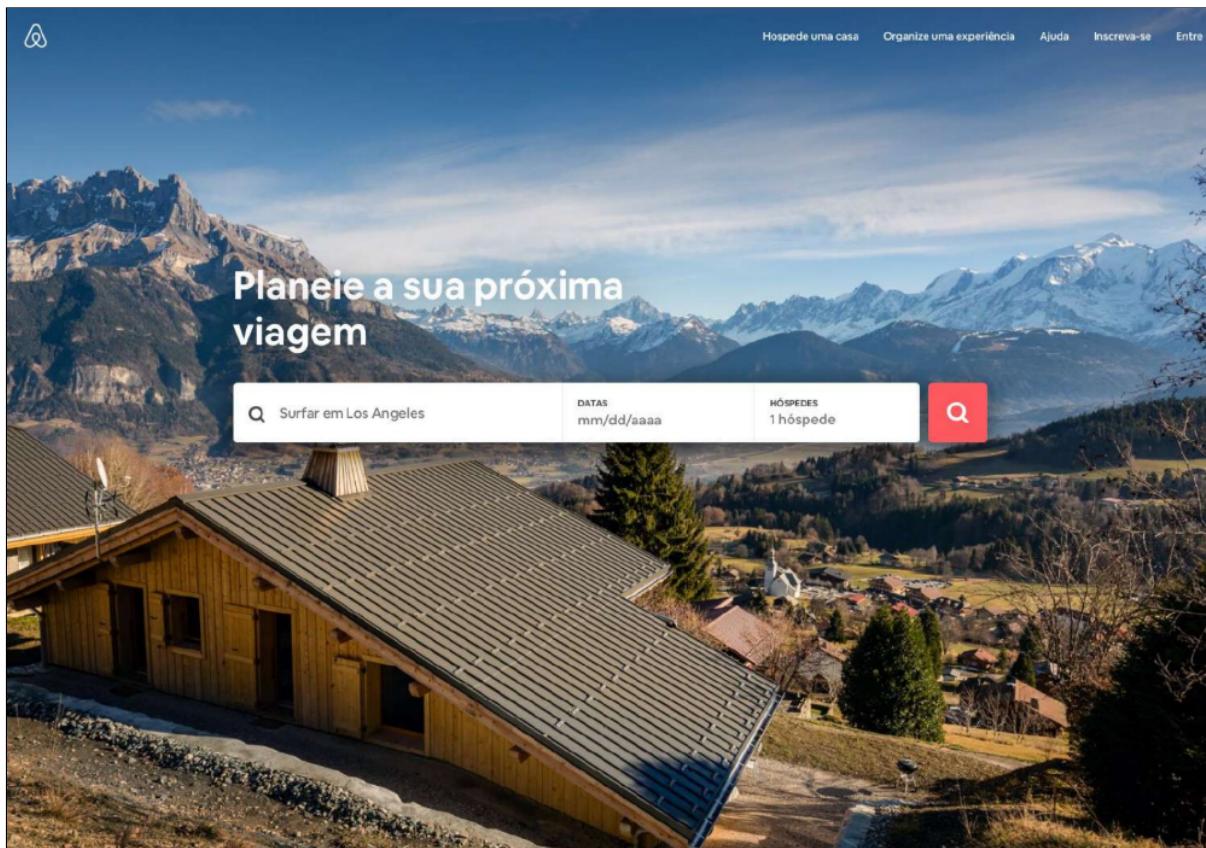
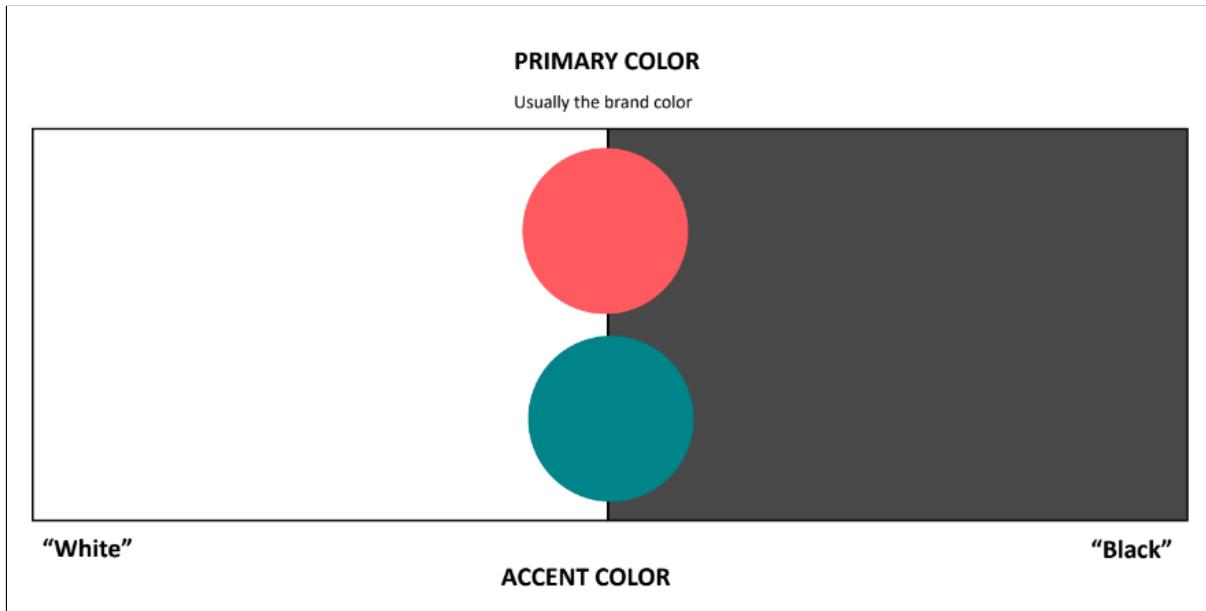
#### 7.1.4. Color

- Color communicates optically and emotionally;
- There are several theories about the use of color, some of them contradictory to each other;



	Passionate, aggressive, important
	Playful, energetic, cheap
	Happy, friendly, warning
	Natural, stable, prosperous
	Serene, trustworthy, inviting
	Luxurious, mysterious, romantic

- Case study: Airbnb



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Alguém da Airbnb irá avaliar a página da sua experiência. Se está a cumprir os nossos padrões de qualidade, poderá adicionar disponibilidade e começar a hospedar!

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HORSEBACK RIDE  
**Montserrat on horseback**  
Barcelona  
6 hours total

< Voltar

**Paris**

Anfitrião Gravados Viagens Mensagens Ajuda

**DISABLE COLOR**

**fevereiro de 2019**      **março de 2019**

Sexta	Sábado	Domingo	Lunes	Martes	Viernes	Sabado	Domingo
24	25	26	27	28	29	30	1
1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	

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**Camas**

Quarto 1 1 cama de casal	Espaços comuns 1 sofá-cama

**Acessibilidade**

Acesso sem degraus para a entrada da casa	Caminho bem iluminado até à entrada
---	-------------------------------------

**Disponibilidade**

Estadia mínima de 30 noites - Atualizado hoje

[Limpar datas](#)

fevereiro de 2019							março de 2019									
Su	Dom	Seg	Ter	Qua	Qui	Sext	Su	Dom	Seg	Ter	Qua	Qui	Sext	Su	Dom	
1	2	3					1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	11	12	13	14	15	16	17	18	19	20
18	19	20	21	22	23	24	25	26	27	28	29	30	31			
25	26	27	<b>28</b>													

**€1.680** permês  
 4.5

Datas: 28/02/2019 → 31/03/2019

Hóspedes: 1 hóspede

Alojamento: €2.006

Desconto no preço de 14% mensal: -€281

Taxa de limpeza: €40

Taxa de serviço: €204

Impostos de ocupação e taxas: €29

Total: €1.998

[Reservar](#)

Ainda não será cobrado

**Novo preço mais baixo**  
O preço para os dias da sua viagem acabou de baixar €442.

Denunciar este anúncio

**96 Comentários** [Pesquisar comentários](#)

Error! A **problem** has been occurred while submitting your data. ×

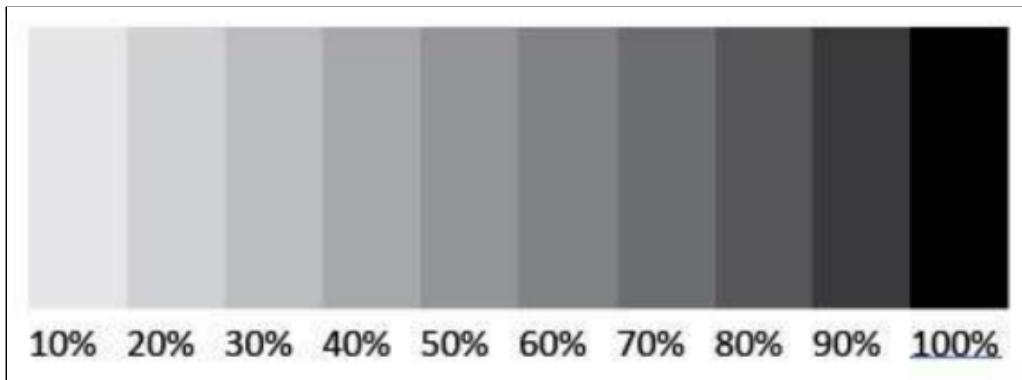
Success! Your **message** has been sent successfully. ×

**ERROR COLOR**

**SUCCESS COLOR**

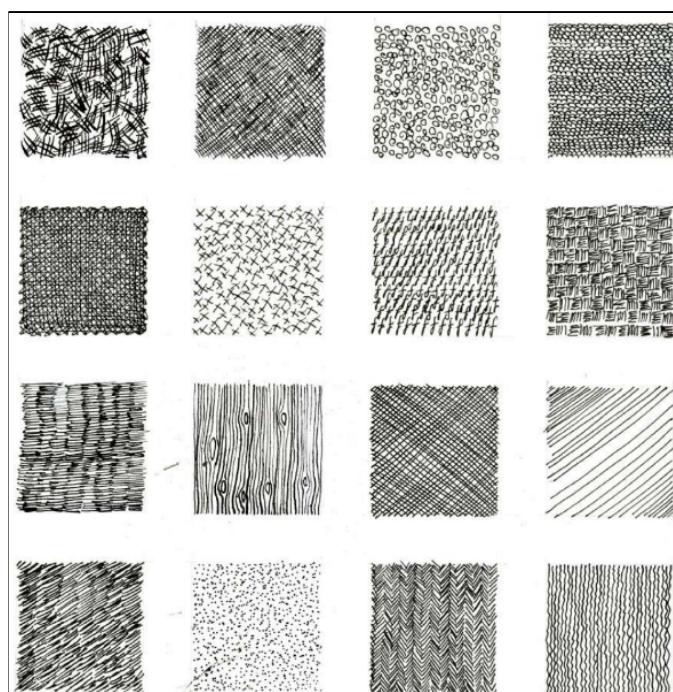
### 7.1.5. Tone

- Usually the tone has the function of emphasizing the form;
- It also describes the direction and type of light (soft or rough);
- Can communicate emotions, feelings or ideas;
- It appeals to our senses.



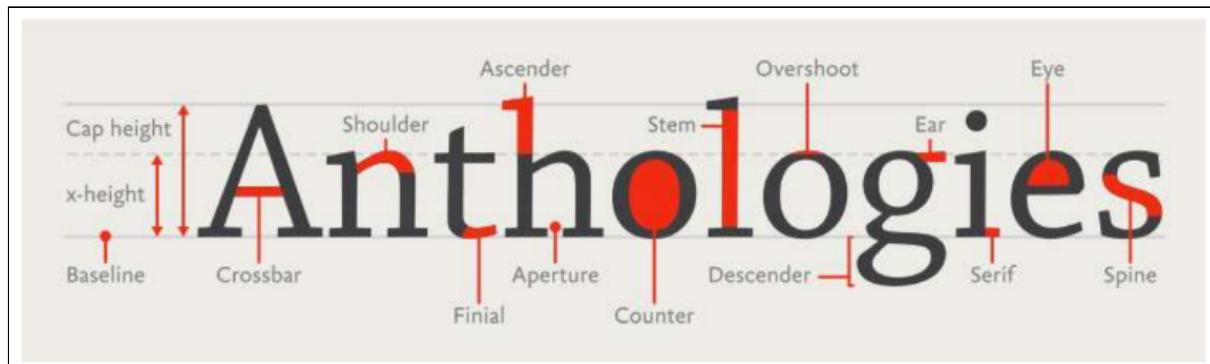
### 7.1.6. Texture

- Texture defines the appearance and feel of a surface;
- In 2D forms the texture is visual - it presents the appearance (through which we can infer a sensation).



### 7.1.7. Typography

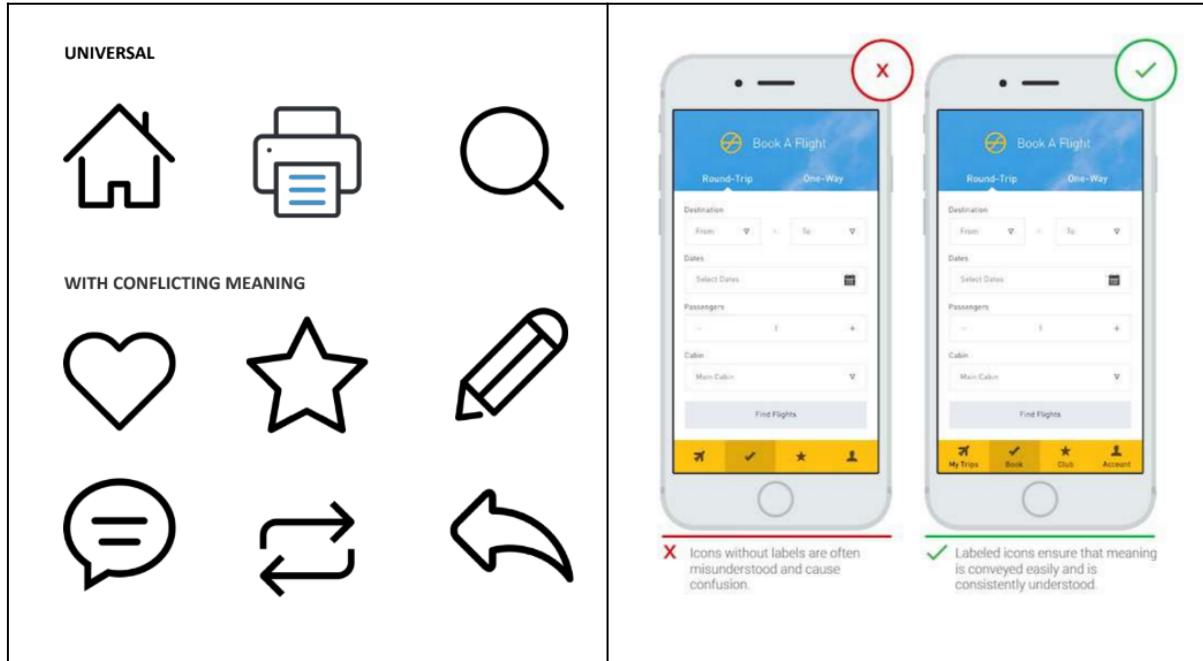
- “Typography is what language looks like.”
- Typography in practice is not choosing fonts or making fonts, it’s about shaping text for optimal user experience.



- **Legibility** is based on the ease with which one letter can be told from the other.
- **Readability** is the ease with which the eye can absorb the message and move along the line.
- Characteristics of good typography:
  - Has a visual hierarchy;
  - Letter forms are balanced and dynamic;
  - Readable on the screen;
  - Appropriate to the context.

## 7.2. Icons

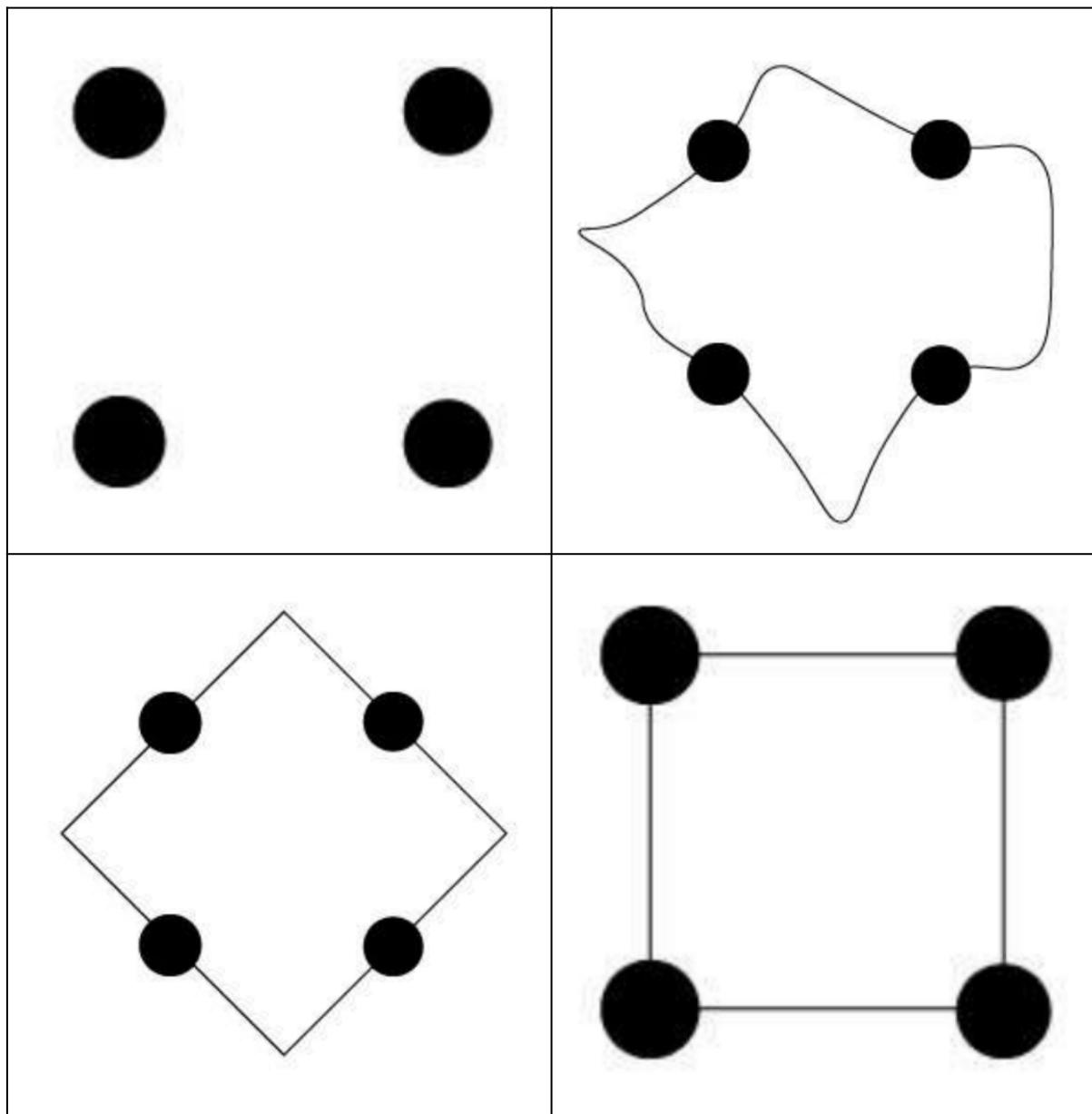
- An icon is a simplified image serving as an intuitive symbol that is used to help users to navigate the system. Typically, icons are hyperlinked.



## 7.3. Principles of visual communication

### 7.3.1. Gestalt theory

- When we look at something, we have organized what we are seeing according to a pattern or form instead of seeing it as a set of separate elements.

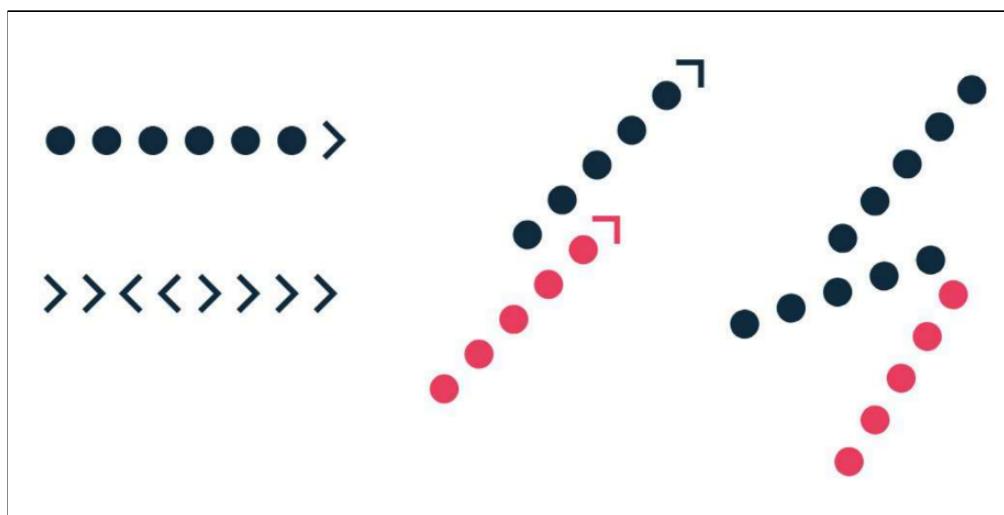


### 7.3.2. Continuity

- Our perception tends to relate forms that follow a fluid direction, especially in a line or in a curve, interpreting them as a whole.
- Some visual solutions guide the user and help him move the gaze from one area of composition to another for a more detailed reading.

### 7.3.3. Common destination

- Objects or shapes tend to be understood as a whole if they move together.
- The movement allows to create a relation between the different elements of Interface and help users to learn and remember spatial relationships.
- Creating relationships through movement is increasingly important when drawing for screens of different sizes.



### 7.3.4. Figure/ground

- The objects or shapes are perceived together with the background;
- In some situations the background can be confused with the object itself.
- The background should be treated as one more graphic element that contributes, as much as the other elements, to the visual composition.

## Law of Figure Ground

Our goal is to highlight the search bar when it is active

Do

Visual Perception:  
The main focal point is the field



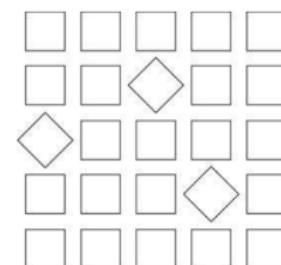
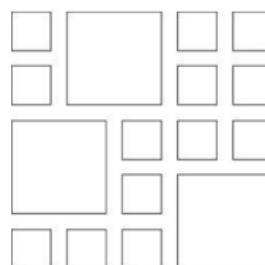
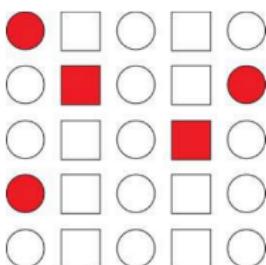
Don't

Visual Perception:  
The main focal point is not really identifiable, so the cognitive load is higher.



### 7.3.5. Similarity

- Similar objects or shapes tend to be seen as a whole.
- The visual elements must share more than the proximity.
- Its shapes must be similar. Without similarity between the elements it is not possible to create a quiet environment.



### 7.3.6. Proximity

- Close objects or forms are perceived as groups;
- Grouping different elements facilitates the perception of complex information;
- Elements should be grouped together to create unity and to facilitate the understanding of complex information.

**1. Tell us about yourself...**

My Name First Name  Owoh

Gender - Select One -

Birthday - Select Month -  Day  Year

I live in United States

Postal Code

**2. Select an ID and password**

Yahoo! ID and Email  @

Password  Password Strength

Re-type Password

**3. In case you forget your ID or password...**

Alternate Email

1. Security Question - Select One -

Your Answer

2. Security Question - Select One -

Your Answer

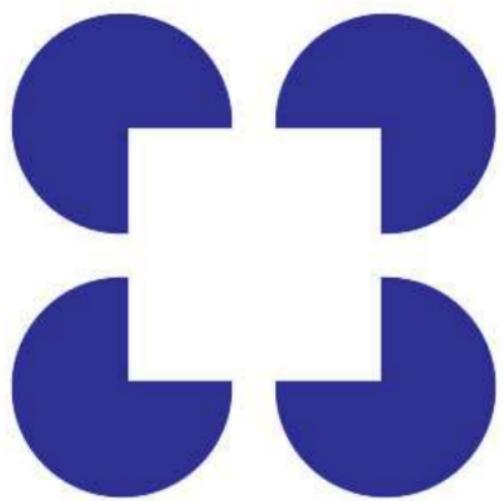
### 7.3.7. Symmetry & Asymmetry

- **Symmetry** implies order and balance which, in turn, suggests tranquility and stability.
- **Asymmetry** suggests movement and activity corresponds to the creation of order and balance between opposing and unequal elements.
- Both imply a clear awareness of the role of empty space between forms and their use directly affects the message.



### 7.3.8. Closure

- Refers to the ability of our brain to predict the missing parts.
- Closing is then an effect of perception that creates a visual connection between the missing parts.
- This principle applies when we perceive complete figures when they are not in reality.



### 7.3.9. Contrast

## BAD CONTRAST

The screenshot shows a grid of six features: Templates, Customization, Domains, Social, SEO, and Analytics. Each feature has an icon and a brief description. The text is very small and light gray against a white background, making it difficult to read.

Templates	Customization	Domains
Squarespace websites are created with modern browsers and mobile devices in mind. They employ the latest HTML, CSS and Javascript techniques.	Make any design your own using the Style Editor. Personalize fonts, colors, and layouts to create the custom look you want.	Squarespace makes adding your custom domain simple; and every annual account receives a free custom domain.
Social	SEO	Analytics
Import. Sync. Publish. Make your website the center of your online identity on the web with our powerful social integrations.	Squarespace websites are loved by search engines. They include clean article links, proper tagging, XML sitemaps, and valid XHTML code.	View the traffic and behavior of visitors in real-time. Learn where they're coming from, and what search keywords they're using to find you.

### On Web Typography

by Jason Santa Maria, November 17, 2009

Published in Graphic Design, Typography & Web Fonts

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