Human-Computer Interaction

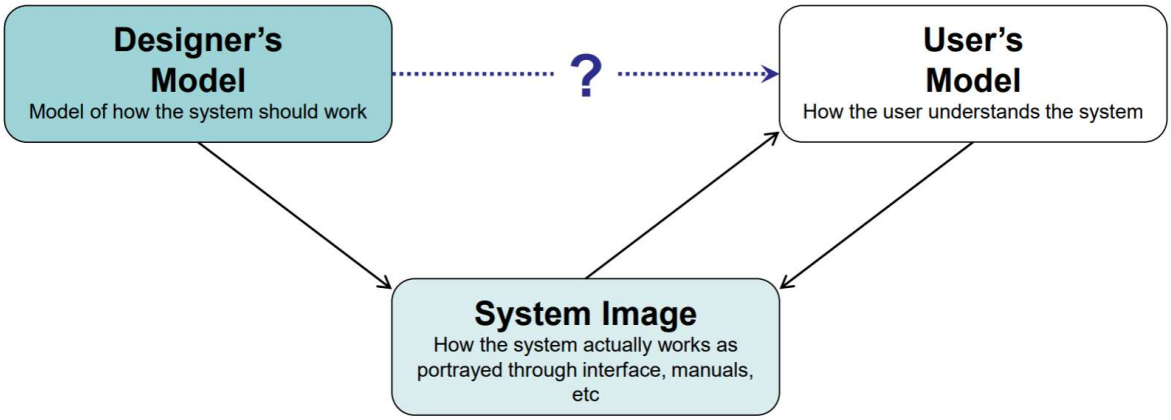
What is HCI?

"The study, planning, and design of interaction between people and computers."

Inherently multidisciplinary – involving computing, software engineering, psychology, cognitive science, and social sciences.

HCI is not fundamentally about the laws of nature. Rather, it manages innovation to ensure that human values and human priorities are advanced, and not diminished through new technology. This is what created HCI; this is what led HCI off the desktop it will continue to lead HCI to new regions of technology – mediated human possibility. This is why usability is an open-ended concept, and can never be reduced to a fixed checklist.

- Based on Norman (1998):



Summary of HCI History

Moving from expert systems to widely available technology – a closing gap between designer and user. Pervasive in daily lives, necessary to participate in society.

Why study HCI?

Regardless of how complex or useful a device is, you need to design it so that a user can use it to fulfil the functions its supposed to. Its interested in aspects related to hardware, software, and different user groups.

Human Factors and Ergonomics

Understanding the human element in design of technology – designing equipment and devices that fit the human body and its cognitive abilities.

Cognitive Ergonomics

Related to human factors – specifically the study of cognition in the HCI context: optimise human well-being and performance, taking into account the human's cognitive limitations e.g. attention, memory, workload, etc.

Usability and Accessibility

Usability is the design of interfaces that allow people to do their work without becoming frustrated. It is based on cognitive psychology – understanding what people are capable of and comfortable with in terms of perception, memory, and cognition.

Accessibility addresses the need to make systems available to people regardless of disability, circumstance, background, etc.

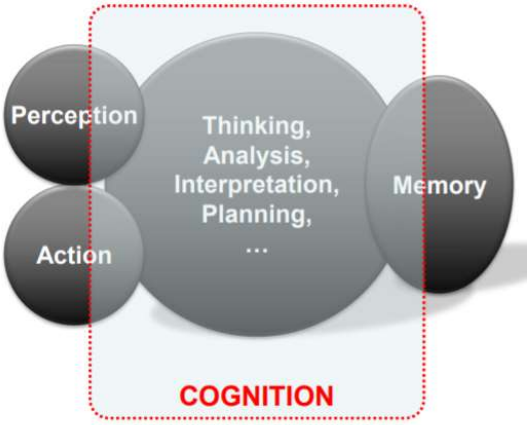
User Experience

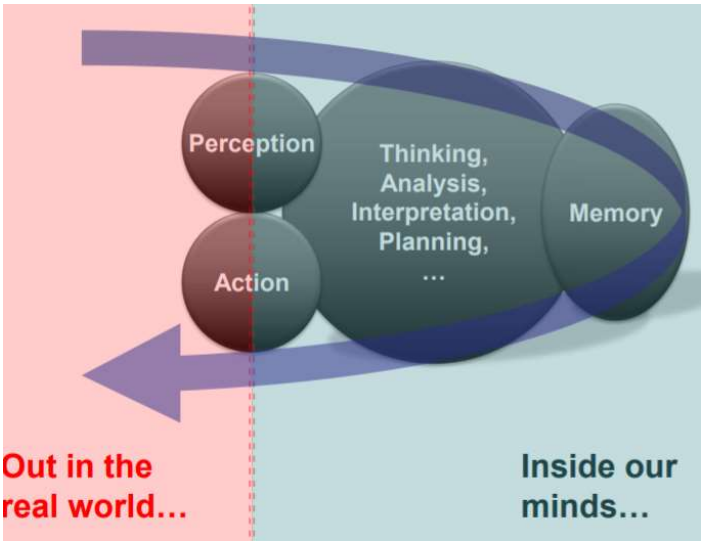
Putting the user at the centre of everything – requirements, design, prototyping, development, and evaluation. Affected by cognitive abilities, subjective experience, narratives, and cultural impact.

Dialogue is the key – constant, constructive dialogue between designers, users, and communities.

Cognition in HCI

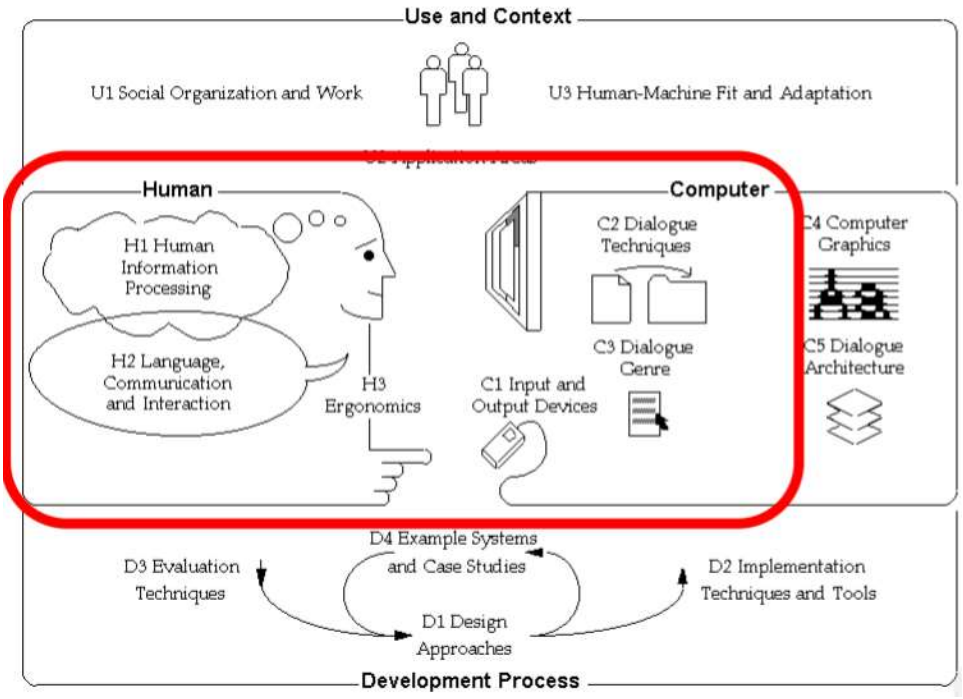
Cognition: Deals with our perception – how we encounter the world, how we process information about it, and how we store/recall it. Our ability to make sense of the world around us and respond appropriately.





We should be concerned with cognition if we're developing software because our body is our interface to communicate with technology.

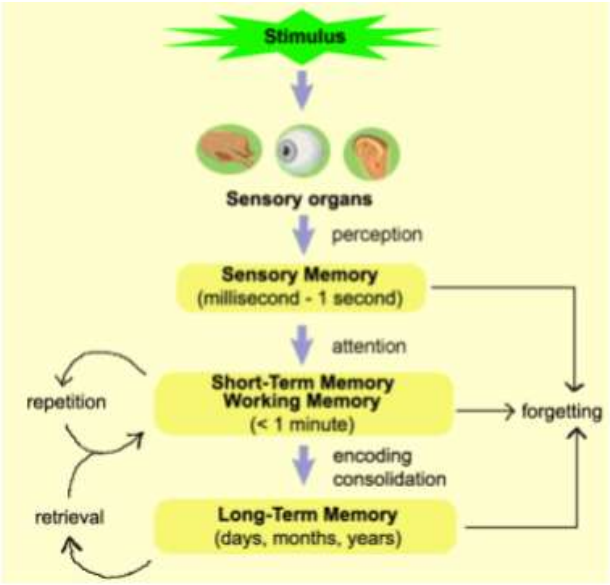
Cognitive Science: Science concerned with (human) information processing



Particularly relevant to HCI: Perception & Attention, Memory, Learning

Perception: Receive information through senses – sight, hearing, touch. Process information to acquire knowledge and understanding, and then to do other stuff.

Interestingly, the study of visual perception offers evidence that the world or the image is not 'given', but constructed. What we can perceive is very different to what we do perceive.



- We receive input
- We need to assimilate it
- To construct our understanding
- Based on experience

- Brain interprets and makes sense of input in the light of previous knowledge and experience

We can't process everything we see and hear and the information we extract, for example, from computer interfaces depends on: motivation, arousal, individual differences, cultural differences, attention

Attention is the cognitive process of selectively concentrating on one aspect of the environment while ignoring other things.

Attention has also been referred to as the allocation of processing resources.

The way we perceive the world around us is entirely dependent on how the brain interprets and constructs meaning

We attend to different inputs selectively, otherwise we would not be able to cope

Perception is active and constructive, not just receptive

Implications: perception is not perfect, it can be fooled, when designing – must help users construct the correct interpretation

Active perception: we search for meaning, scan input very quickly, look for meaningful patterns. We ignore what doesn't make sense or can't be easily decoded

Interpreting input: brain makes assumptions/interpretations, fills in missing details, ambiguity causes us to 'see' different things i.e. the way we perceive the world around us is entirely dependent on how to brain interprets and constructs meaning. We also have built-in predispositions

Implications for design:

Our brain is desperate to make sense of the information that it receives – but it can sometimes be overwhelmed

- Do not bombard to user with every function at the same time
- Draw users' attention to appropriate functions at appropriate times
- Fine grain details should be accessible only when needed

Memory: how we store new information, remembering. Theorists suggest there is a short-term, working, and long-term memory. Computer analogy: registers, RAM, storage.

STM: forget most things, limited capacity 7+/- 2, recall vs. recognition – recognition is easy, recall is difficult

Gestalt Psychology: our brains want to find patterns and group information together to make sense of the world

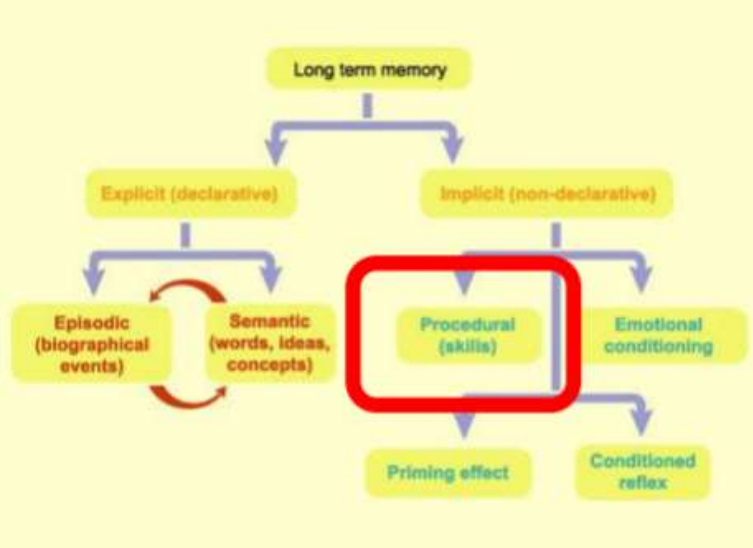
Working Memory: an area where current processing takes place in conjunction with inputs from STM and LTM. New information + old knowledge – problem solving.

STM & Working Memory: information is easily lost before transfer to LTM – disruption/interruption, visual distraction

Anxiety, frustration, distraction impede information processing

Familiarity aids information processing and chunking – use this in design and development

LTM: very large (infinite?), associative – time needed to retrieve, involvement in working memory process



Recognition and Recall: people are better at recognizing things they have previously experienced than recalling those things from memory because recognition tasks provide memory cues that facilitate searching through memory. E.g. command line vs. GUI.

Implications:

- When using a computer, people are already using quite a lot of short term and working memory
- Remember, they are normally doing a task, using the computer as a tool
- You shouldn't have to think about the tool

Reduce memory load

- Don't make people remember information, it should be on screen if needed
- Recognition over recall
- Show menus and paths
- Maintain consistency – of screen components, menu structures, commands
- Make navigation clear and obvious

Recognition and Recall: remember, people are better at recognizing things they have previously experienced than recalling those things from memory.

Expert interfaces: in some cases, recall is more efficient than recognition. Whether it makes sense for people to learn how to use an interface depends on the context of use.

Learning is acquiring new knowledge, behaviours, skills, values, preferences or understanding. Generally, after learning you can do something that you couldn't do before. People learn from experience and from consequences.

Learning from consequences:

- Successful actions will generally be repeated
- unsuccessful actions wont
- Depends on the feedback that you receive
- It is crucial that the feedback is timely and specific, the system should be responsive
- Problems occur when feedback is not specific enough to allow us to infer cause-effect relationships

Learning:

Learning from direct consequences is important, but quite easy. Other things are not so easy to learn depending on a number of factors, for example, unstructured material is very hard to learn. We need to order, categorise, and make sense of things.

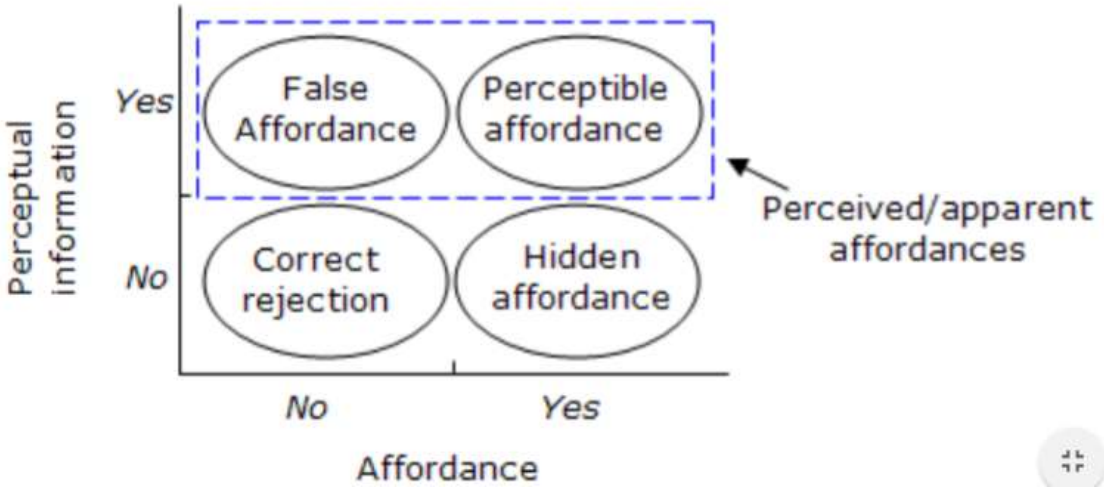
We learn something when its useful

Learning is fastest when we can:

- Identify cause and effect
- Use prior knowledge (memory) to interpret
- Make connections, make things meaningful
- Make things obvious, intuitive - affordances

Affordances: the perceived properties of the object that suggest how one could use it

Separating affordances from the perceptual information that specifies affordances. Adapted from Gaver (1991).



Taking advantage of this in design: e.g. labels (intuitive), metaphors (leveraging real world function), patterns (leveraging previously learned behaviours)

Learning computer systems

- The user should have as little learning as possible to do – they are interested in the task, not the system (time spent learning the system is perceived as a waste of time)
- Make use of existing knowledge and affordances
- System should be transparent rather than obstructive
- It should be obvious to see cause and effect between actions of user and consequences on the system or task
- Help users learn your system, but get the timing right
- Don't prevent users from achieving what they're actually trying to accomplish
- Make help optional

Usability

Usability

- Measures the quality of a user's experience when interacting with a product or a system
- In general, usability refers to how well users can learn and use a product to achieve their goals and how satisfied they are with that process
- "Accomplish their tasks quickly and easily through the use of a product. Usability may also consider such factors as cost-effectiveness and usefulness."
- A key methodology for carrying out usability is called user-centred design

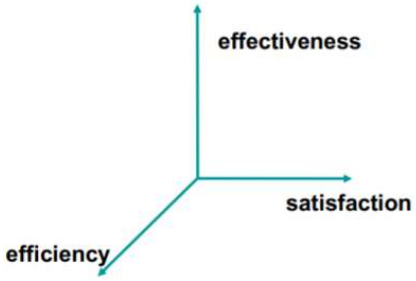
Why usability is needed:

- Millions of websites offer users information, goods, services, and entertainment. But many of these sites are difficult to use, don't work properly, and ultimately don't attract or keep users
- Research shows that people cannot find the information they seek on websites about 60% of the time: wasted time, reduced productivity, increased frustration, and loss of repeat visits and money

How its defined:

Two international standards further define usability and human-centred design:

- Usability refers to the extent wo which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of user
- Human-centred design is characterised by: the active involvement of users and a clear understanding of user and task requirements; an appropriate allocation of function between users and technology; the iteration of design solutions; multi-disciplinary design



What it measures:

- Ease of learning: how fast can a user (who has never seen the UI before) learn it sufficiently well to accomplish basic tasks
- Efficiency of use: once an experienced user has learned to use the system, how fast can he or she accomplish tasks
- Memorability: if a user has used the system before, can he or she remember enough to use it effectively the next time or does the user have to start over again
- Error frequency and severity: how often do users make errors while using the system, how serious are these errors, and how do users recover from these errors?
- Subjective satisfaction: how much does the user like using the system?

Usability Heuristics:

- Essentially rules of thumb that experts use to ensure that their software follows established usability principles
- They are used primarily because they have been found useful
- Applied before software is exposed to real people
- A lot of these concepts are based on our understanding of perception, memory and learning (cognitive psychology)

Norman's Design Principles:

- Helpful for guiding the design process
- Evaluate design ideas or prototypes
- Principles:
    - Visibility
    - Affordances and constraints
    - Feedback
    - Natural mapping
    - Good conceptual model
- Visibility: make functional parts available, easily visible (visible through sight, sound, touch)
- Affordances and constraints: properties that things have and invite some actions
- Feedback: the user should be informed timely and effectively about the outcomes of the actions that they are carrying out
- Mapping: natural relationships between controls and the things controlled. Poor mapping is evident when a control does not relate visually or symbolically with the object it affects, requiring the user to stop and think
- Good conceptual model: our mental simulation of a device's operation (mental model). These can be based on mappings, affordances, and constraints.

Nielsen's 10 usability heuristics:

1. Visibility of system status
2. Match between system and the real world
3. User control and freedom
4. Consistency and standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalistic design
9. Help recognize, diagnose, and recover from errors
10. Help and documentation

- Visibility of system status: what is the system doing? The user has to be informed of the system's current status

- Match between system and the real world: the system should speak the user's language, follow real-world conventions – making information appear in a natural and logical order using the conceptual model of the user
- User control and freedom: users often choose system functions by mistake and will need a clearly marked 'emergency exit'
- Consistency and standards: words, situations, or actions have to mean the same thig. Follow platform conventions and standard.
- Error prevention: prevent problems and errors – provide clear messages about the effects of irreversible actions
- Recognition rather than recall: are objects, actions, and options visible? The user should not have to remember information from one part of the dialogue to another
- Flexibility and efficiency of use: provide shortcuts for expert users
- Aesthetic and minimalistic design: dialogue should no contain irrelevant or rarely needed information.
- Help users recognise, diagnose, and recover from errors: error messages should be expressed in plain language (no codes) and should indicate the problem and suggest a solution
- Help and documentation: any such information should be easy to search for and has to be focused on the users

Accessibility

Accessibility:

The extent to which products, services, environments etc. are accessible to as many diverse users as possible, in as many diverse contexts as possible.

Also referred to as inclusive and universal design.

We normally talk about accessibility in the context of disabilities and that's usually where it matters most, but at the heart of it accessibility is about maximising access for everyone.

Usability vs Accessibility:

Usability: refers to the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use.

Accessibility relates to usability in that they both deal with how well people can use a system, but they differ primarily in the scope; usability is about specific users and contexts and accessibility is about as many diverse users and contexts as possible.

When we say 'diverse' users we literally mean that. It means diversity in all its forms, whether having a disability of not, every user has needs that may limit the way they do things.

Even a young adult able-bodied English-speaking person is a target for accessibility research.

The elderly have special needs that don't necessarily fall under a category of disability, accessibility is naturally about them as well.

It is also about children, who see and interact with the world very differently. Systems designed for adults are often unusable for children.

Diversity isn't just about limitations – it's about abilities too. A person might need special design considerations because they are very good at something.

It's important not to make assumptions about people's abilities based on your own pre-conceptions of what they are or not capable of doing.

Accessibility is not just about your physical traits, but also about your cultural background. Most notably, language can be a strong barrier for a user.

Accessibility can be about the smallest things. Two young adult able-bodied males from the same town who speak the same language can have vastly different experiences using a system due to something as simple as the size of their hands.

Whatever kind of user you are, accessibility becomes relevant when the environment you are in makes it difficult to do something you want to do.

Ultimately, more focus is on issues where daily life can be a struggle. It's often people who need accessibility the most who are forgotten about in the design of new technologies, even to the point of making their lives more difficult.

Accessibility is not just about making life easier and more manageable, sometimes not making something accessible is a violation of people's rights.

e.g. a government service for registering to vote needs to be accessible to as many people as possible; excluding someone from the democratic process because of a failure in HCI design cannot be accepted in a democratic society.

In the UK, there are laws in place to promote a "fair and more equal society". Providing accessibility in public services is a legal requirement under these laws.

An introduction to the Equality Act 2010

A new Equality Act came into force on 1 October 2010. The Equality Act brings together over 116 separate pieces of legislation into one single Act. Combined, they make up a new Act that provides a legal framework to protect the rights of individuals and advance equality of opportunity for all.

The Act simplifies, strengthens and harmonises the current legislation to provide Britain with a new discrimination law which protects individuals from unfair treatment and promotes a fair and more equal society.

The nine main pieces of legislation that have merged are:

- the Equal Pay Act 1970
- the Sex Discrimination Act 1975
- the Race Relations Act 1976
- the Disability Discrimination Act 1995
- the Employment Equality (Religion or Belief) Regulations 2003
- the Employment Equality (Sexual Orientation) Regulations 2003
- the Employment Equality (Age) Regulations 2006
- the Equality Act 2006, Part 2
- the Equality Act (Sexual Orientation) Regulations 2007

In the UK there are laws in place to promote a "fair and more equal society." Providing accessibility in public services is a legal requirement under these laws.

The government, along with many other organisations, has issued extensive guidelines for developing accessible services.

UK Legislation:

The Equality act in the UK makes it a legal requirement to…

- "takes such steps as it is reasonable" to ensure an equal experience for people with disabilities as compared to those without
- "take as such steps as it is reasonable" to fix any physical features that make it difficult for people with disabilities to navigate the space compared to those without disabilities

- “take as such steps as it is reasonable” to provide an auxiliary aid to someone with a disability if without the auxiliary aid they do not have the same access as someone without a disability

At the core of UK accessibility legislation is the requirement to take ‘reasonable’ steps to make your services usable by as many people as possible.

Accessibility features in public buildings are becoming more and more common as a result. Some of these features might be invisible to those that don’t need them.

Accessibility in HCI:

- What specific issues arise due to the use of technology in daily life?
- What types of users need special considerations when designing interfaces?

Impairments and Disabilities:

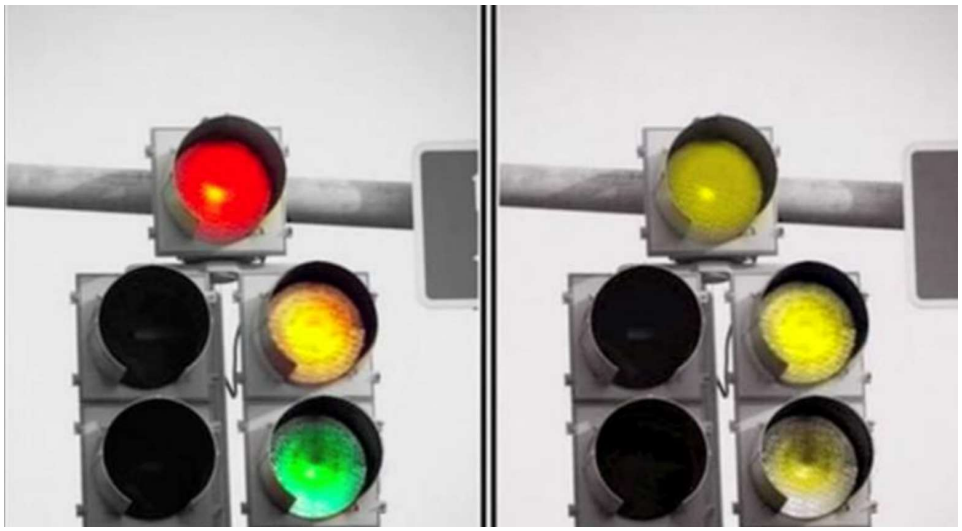
- Visual: blindness, low vision, colour blindness
- Auditory: deafness, hard of hearing
- Motor: paralysis, neurological disorders
- Cognitive: memory loss, ADD/ADHD, dyslexia, autism

Colour Blindness:

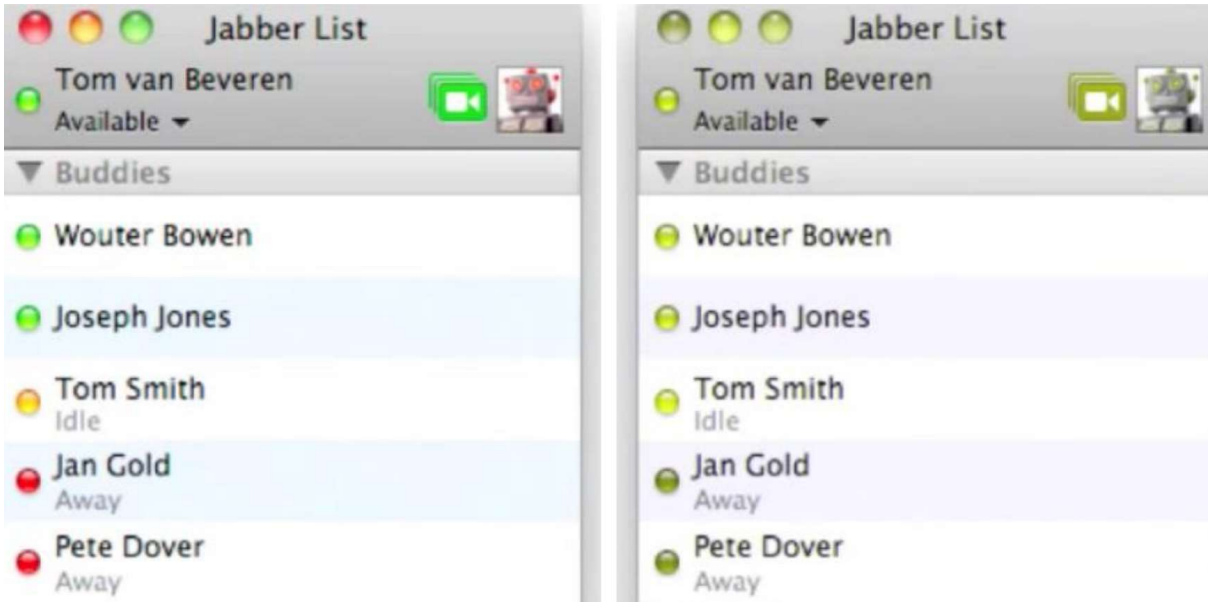
Around 4.5% of the world has some form of colour blindness. There is so much that can be done that isn’t being done to help - it’s a fairly straightforward problem with many existing and cost-effective solutions that simply aren’t being implemented.

People with colour vision deficiency (CVD) do not see colour the same way as the majority of people, specifically, they have trouble seeing certain colours or telling them apart. Affects 8% of men and 0.5% of women.

Bad design examples…



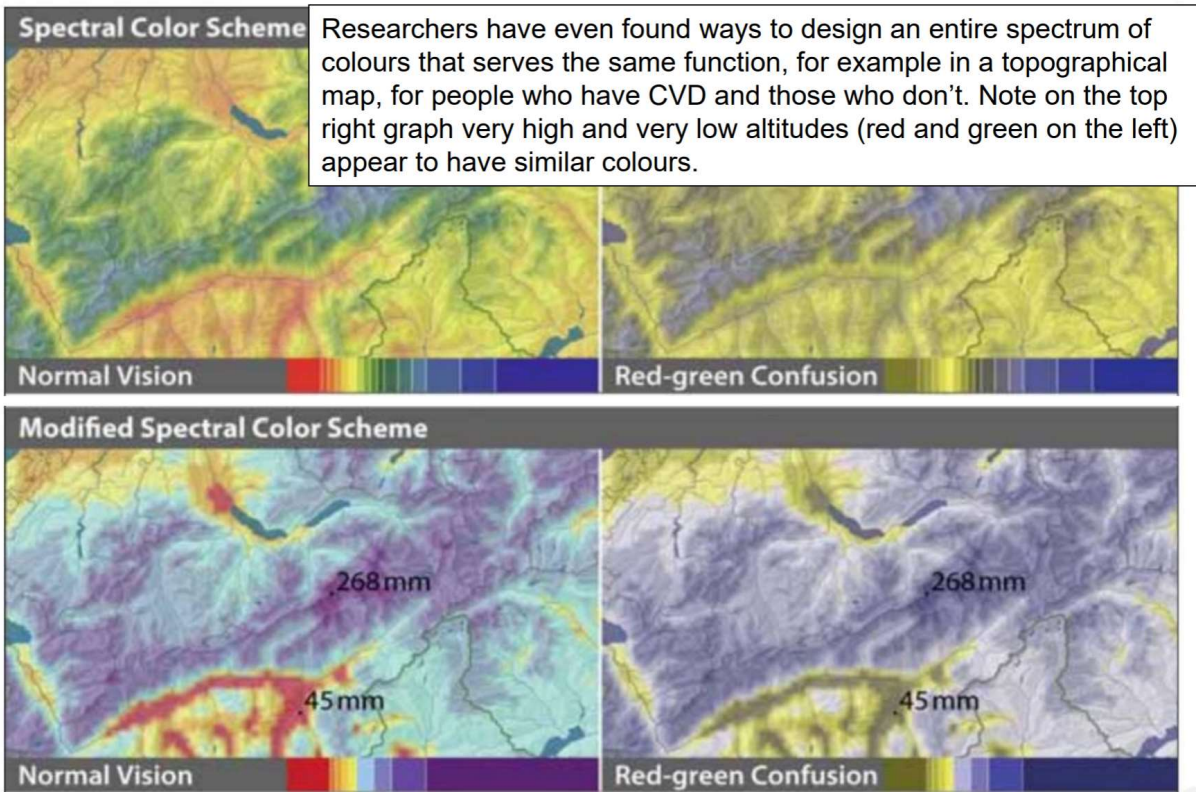
For the longest time, we’ve been actively choosing colour schemes on systems we wake that makes life needlessly difficult for a significant portion of the population.



Even in games – game developers have often ignored the fact that not everyone sees colours the same way, and continue to code certain information using only colours.

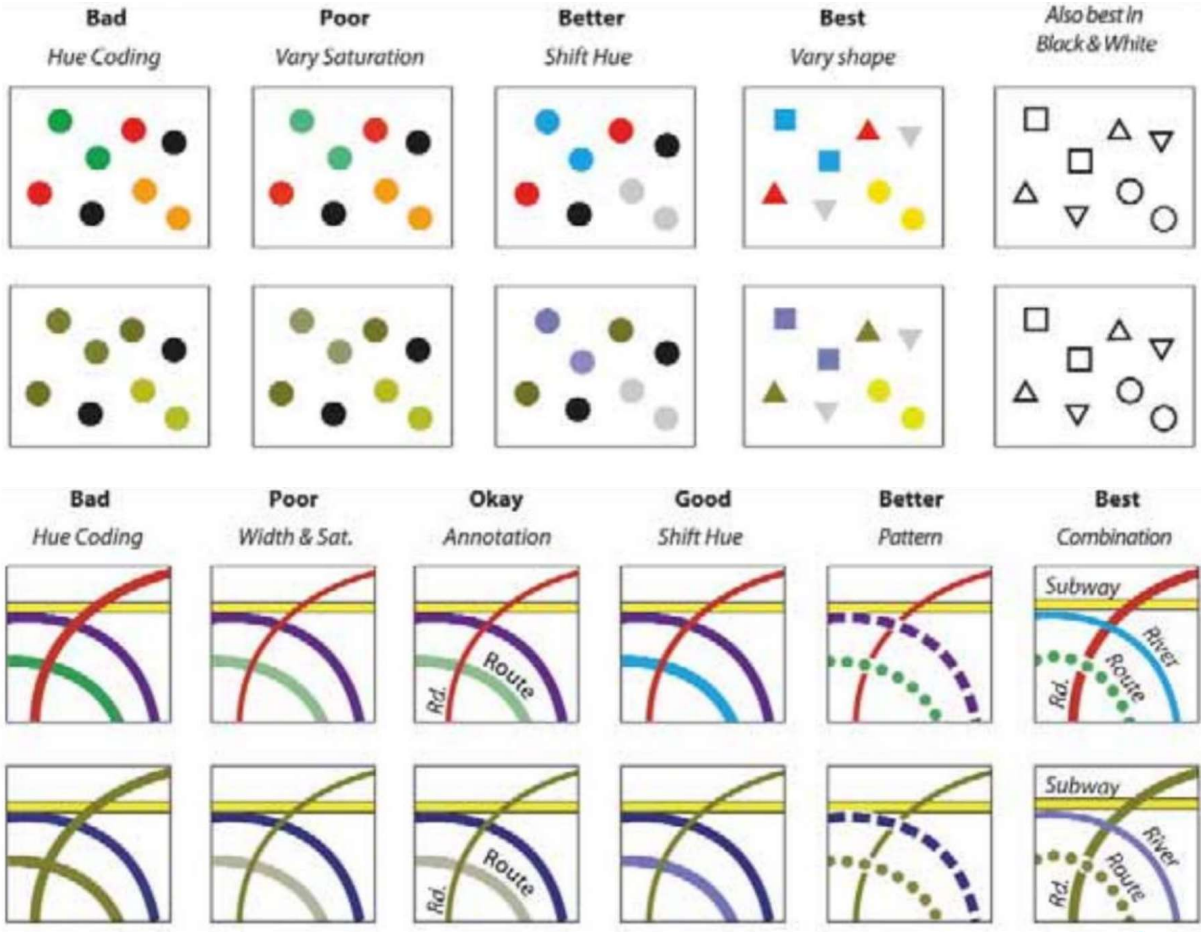
BBC did a feature on this and they asked Nintendo why they don't do things differently and their response was: "it is not possible to cater to the needs of all players 100% of the time".

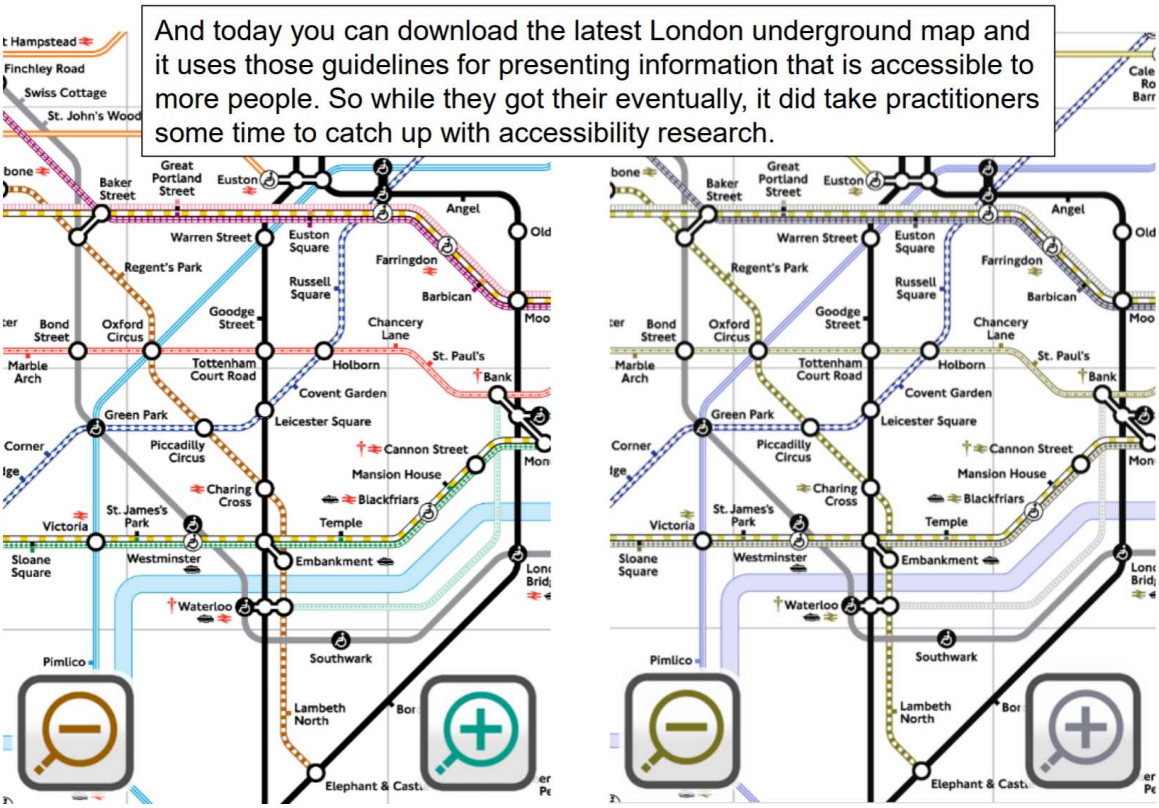
While it might be true that you can't cater to everyone all the time, there's lots that can be done to make things better. Others have taken steps to address this. Call of Duty: Black Ops usually shoes enemy and ally names in red and green respectively, which makes things very difficult for people with red-green blindness of deficiency. But Activision introduced a colour-blind mode, where they use orange and teal instead. A small change unlocks the game to a large number of people without causing any detrimental effect to people without CVD.



Researchers have even found ways to design an entire spectrum of colours that serves the same function, for example in a topographical map, for people who have CVD and those who don't. Note on the top right graph very high and very low altitudes (red and green on the left) appear to have similar colours.

Design tips…





Other disabilities:

Designing for users with low vision

Do...

- use good colour contrasts and a readable font size
- publish all information on web pages
- use a combination of colour, shapes and text
- follow a linear, logical layout
- put buttons and notifications in context

Don't...

- use low colour contrasts and small font size
- bury information in downloads
- only use colour to convey meaning
- spread content all over a page
- separate actions from their context

Designing for users of screen readers

Do...

- describe images and provide transcripts for video
- follow a linear, logical layout
- structure content using HTML5
- build for keyboard use only
- write descriptive links and headings

Don't...

- only show information in an image or video
- spread content all over a page
- rely on text size and placement for structure
- force mouse or screen use
- write uninformative links and headings

Designing for users on the autistic spectrum

Do...

- use simple colours
- write in plain English
- use simple sentences and bullets
- make buttons descriptive
- build simple and consistent layouts

Don't...

- use bright contrasting colours
- use figures of speech and idioms
- create a wall of text
- make buttons vague and unpredictable
- build complex and cluttered layouts

Designing for users who are Deaf or hard of hearing

Do...

- write in plain English
- use subtitles or provide transcripts for videos
- use a linear, logical layout
- break up content with sub-headings, images and videos
- let users ask for an interpreter when booking appointments

Don't...

- use complicated words or figures of speech
- put content in audio or video only
- make complex layouts and menus
- make users read long blocks of content
- don't make telephone the only means of contact for users

Cultural Differences:

- Groups of people learn idioms e.g. red = danger, green = go/safe
- They differ in different places e.g. light switches; UK = down is on, US = down is off
- People from different cultures may have difficulty understanding or dealing with certain situations because of some assumptions the designer makes about their cultural background. For example, red might mean danger for western cultures, but denotes celebration and joy in parts of Asia.
- Language and cultural assumptions can be a hindrance. It is best to use a combination of indicators (e.g. colour & text) rather than assume your user knows a certain language or worse, that they share your implicit cultural knowledge.
- Designing for people from a different culture id part of accessibility
- This is why, for some things where misreading a sign can be life-threatening, standardisation is required to make sure that everyone, everywhere know what certain symbols mean.

Situational Impairments:

A difficulty accessing a system due to the context or situation one is in, as opposed to a long-term physical or cognitive impairment.

A short-term injury might mean you will have significant difficulty doing some things for a certain period of time.

Driving a car is a form of situational impairment. Your attention is (or at least should be) so focused on the road ahead that you can't spare too much of it to change the radio station. Now with touch screens controlling most of the car functions, this is getting even more difficult because you need to look at a touch screen to operate it, whereas knobs and buttons, after some practice, can be done on touch alone.

Voice command systems such as Alexa and Google Home provide touch-free interfaces that, whilst clearly beneficial for someone with limited motor abilities due to paralysis or missing limbs, can be just as beneficial for someone whose hands are temporarily unavailable to interact with a system.

Weather can cause situational impairment, and you might find yourself enlarging the text or using high-contrast mode because it's too sunny, both normally accessibility features.

Or if it's too cold, touch screens are a big challenge for people who don't have a stylus, inductive gloves, or the cold resistance of a Scandinavian. This makes inductive gloves and a touch-screen stylus accessibility-enhancing accessory for your phone.

The Audio book is the iconic example of an accessibility tool that is used by everyone. While it's perfectly suited for blind people who want to read a book, it has made life easier for anyone who wants to read a book while driving, walking, cooking, etc.

Two approaches to accessibility:

1. Accessible design: design technology to be accessible
2. Assistive technology: using technology to make the world more accessible

Accessible Design:

Design focused on diverse users to maximise the number of potential users who can readily use a system in diverse contexts.

This can be achieved by…

1. Designing systems that are readily usable by most users without any modification
2. Make systems adaptable to different users (by providing adaptable user interfaces)
3. Having standardized interfaces to be compatible with assistive products and assistive technology

Designing Accessible Systems:

This starts with the initial idea for your system

Step 1: think about potential user groups

- Who do you envision would use your system?
- Go through the list of disabilities and other factors that might hinder access, and try to identify core problems
- Don't make assumptions about users' needs based on their abilities

Step 2: Research strategies to design accessibility

- Existing standards are a good starting point
- Look at resources that end user organizations offer. Often they provide some insights into daily challenges and needs

Standards and Guidelines:

- Expert organisations analyse requirements
- Create lists of features and design guidelines
- Usually very extensive

ISO guidance on software accessibility – its focused on productive software. Also exists for other areas e.g. usability. It's usually extremely technical and formal.

Web Content Accessibility Guidelines (WCAG 2.1) – a W3C recommendation to make web more accessible. Four fundamental principles; perceivable, operable, understandable, robust. With so much of what we need being on the web, the W3C provided recommendation for web accessibility, which focused on these principles.

- Perceivable – information and user interface components must be presentable to users in ways they can perceive. This means that users must be able to perceive the information being presented (it can't be invisible to all of their senses)
- Operable – user interface components and navigation must be operable. This means that users must be able to operate the interface (the interface cannot require interaction that a user cannot perform)
- Understandable – information and the operation of user interface must be understandable. This means that users must be able to understand the information as well as the operation of the user interface (the content or operation cannot be beyond their understanding)
- Robust – content must be robust enough that it can be interpreted reliably by a wide variety of users agents, including assistive technologies. This means that users must be able to access the content as technologies advance (as technologies and user agents evolve, the content should remain accessible)

Perceivable

- Provide text alternatives for non-text content.
- Provide captions and other alternatives for multimedia.
- Create content that can be presented in different ways, including by assistive technologies, without losing meaning.
- Make it easier for users to see and hear content.

Robust

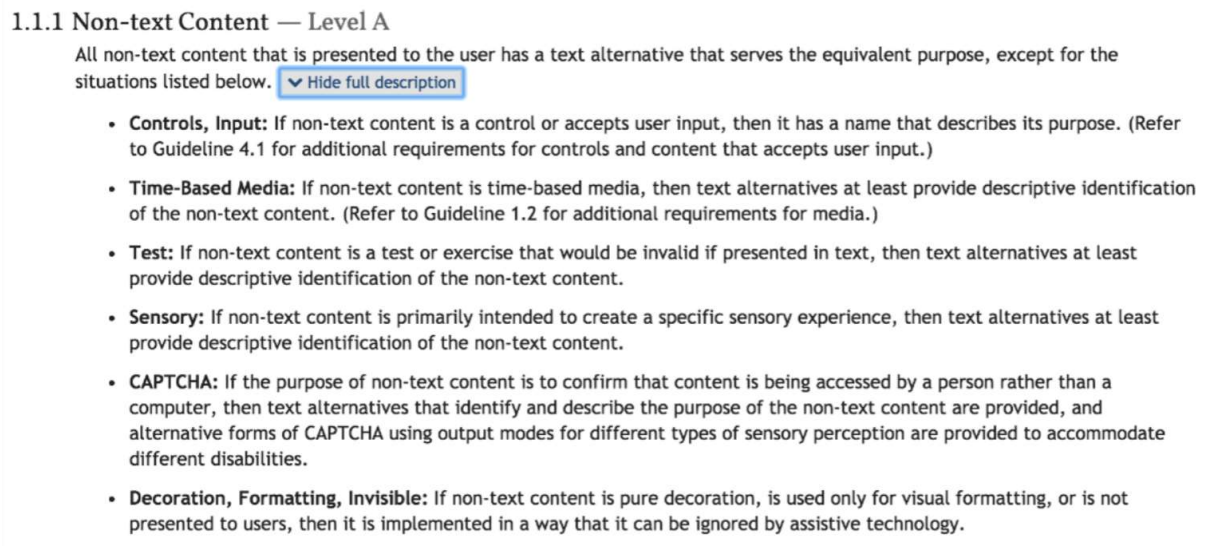
- Maximize compatibility with current and future user tools.

Operable

- Make all functionality available from a keyboard.
- Give users enough time to read and use content.
- Do not use content that causes seizures or physical reactions.
- Help users navigate and find content.
- Make it easier to use inputs other than keyboard.

Understandable

- Make text readable and understandable.
- Make content appear and operate in predictable ways.
- Help users avoid and correct mistakes.



1.1.1 Non-text Content — Level A

All non-text content that is presented to the user has a text alternative that serves the equivalent purpose, except for the situations listed below. Hide full description

- **Controls, Input:** If non-text content is a control or accepts user input, then it has a name that describes its purpose. (Refer to Guideline 4.1 for additional requirements for controls and content that accepts user input.)
- **Time-Based Media:** If non-text content is time-based media, then text alternatives at least provide descriptive identification of the non-text content. (Refer to Guideline 1.2 for additional requirements for media.)
- **Test:** If non-text content is a test or exercise that would be invalid if presented in text, then text alternatives at least provide descriptive identification of the non-text content.
- **Sensory:** If non-text content is primarily intended to create a specific sensory experience, then text alternatives at least provide descriptive identification of the non-text content.
- **CAPTCHA:** If the purpose of non-text content is to confirm that content is being accessed by a person rather than a computer, then text alternatives that identify and describe the purpose of the non-text content are provided, and alternative forms of CAPTCHA using output modes for different types of sensory perception are provided to accommodate different disabilities.
- **Decoration, Formatting, Invisible:** If non-text content is pure decoration, is used only for visual formatting, or is not presented to users, then it is implemented in a way that it can be ignored by assistive technology.

Alternative Text:

- It is read by screen readers in place of images allowing the content and function of the image to be accessible to those with visual or certain cognitive disabilities
- It is displayed in place of the image in browsers if the image file is not loaded or when the user has chosen not the view images
- It provides a semantic meaning and description to images which can be read by search engines or be used to later determine the content of the image from page context alone
- The main rule of alt text is: if a non-text component conveys content or function, it needs a textual substitute
- It should be: accurate and equivalent (content and function), be succinct, not be redundant, not use the phrases “image of…” etc. to describe the image, unless ut is important content

Best practice for designing accessible systems:

User involvement in design process

- Unique perspective
- Avoids reliance on assumptions
- Cannot be reflected by standards documents, experience reports, etc.
- Focus on abilities
- But it takes time, may be difficult to recruit, and requires additional cost

Game Guidelines:

Game designers also have access to a set of guidelines to make their games more accessible. These focus on mobility, visual, and auditory impairments.

These guidelines aren’t necessarily how you should make a game, for example some games might be simply unplayable without a mouse, or simply meant to be difficult. They do however give you some tips as what to look for if you are trying to design a game with high accessibility.

Mobility…

- Remappable keys
- No button mashing
- Camera/mouse sensitivity
- No precision needed
- No mandatory quick time events
- Timing of movement/button pressing not important
- On-screen keyboard functions properly
- Can play with only a mouse or only a keyboard
- Can move user interface elements
- Difficulty levels
- Game assists

Visual…

- No key elements of the game are identified by red and green
- Colour blind options are present
- Game presented in high contrast
- Subtitles are easy to read
- Font colour can be changed
- Font size/type can be changed
- Game menus are easy to see/read/use

Hearing…

- Subtitles are present
- Ambient noise is included
- Identifies speaker
- All audio cues are accompanied by visual cues
- Game can be successfully completed without sound

Assistive Technology:

Any item, piece of equipment, or product system, whether acquired commercially or off the shelf, modified or customised that is used to increase, maintain, or improve the functional capabilities of a person with a disability or impairment.

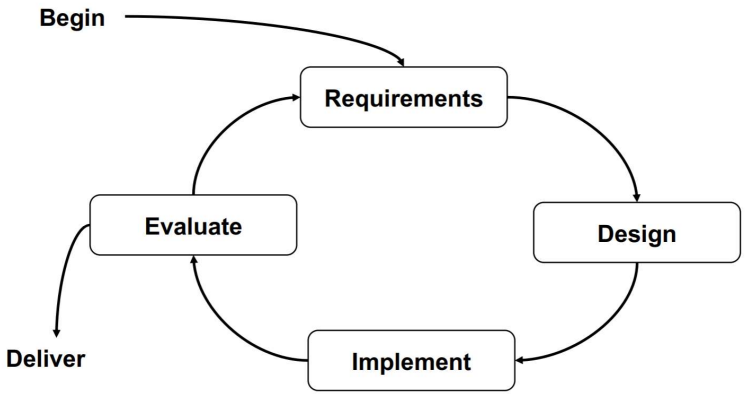
Very specialized pieces of hardware are being developed to make the world more accessible, such as this Braille display that removes the need to use screen readers or buy expensive braille printers.

Even more specialized devices. These use existing and specially designed technologies to allow people to function despite limited capabilities. They focus on what they can do and try to use that to help them achieve what they want to do.

Requirements Analysis and User-Centred Design

User Centred Design:

- The design is based upon an explicit understanding of users and the tasks carried out in their environments
- Users are involved throughout the whole design and development
- The design is driven and refined by user-centred evaluations
- The process is iterative
- The design addresses the whole user experience



- Cyclic (software development) process that starts with requirements establishment, leads over to the design and implementation of solutions which are then evaluated
- After evaluation, either exit, or a new iteration in which requirements are adapted and design and implementation are updated
- System evolves through development

Experience-Centred Design:

- Committed to dialogue with users and communities of interest
- At each stage of the iterative process there are different methodologies that have been found useful for informing design
- Lots of overlap – use the most appropriate one to find out the information you need to improve your design at each stage of the process

Requirements elicitation methods:

- Ethnography
- Probes (cultural, experimental, evocative)
- Diary studies
- Focus groups
- Card sorting tasks
- Interviews
- Drama / Role play
- Fictional inquiry

Design:

- Personas
- Scenarios
- Paper prototyping

Implementation:

- Software engineering methods
- Tools, languages

Evaluation:

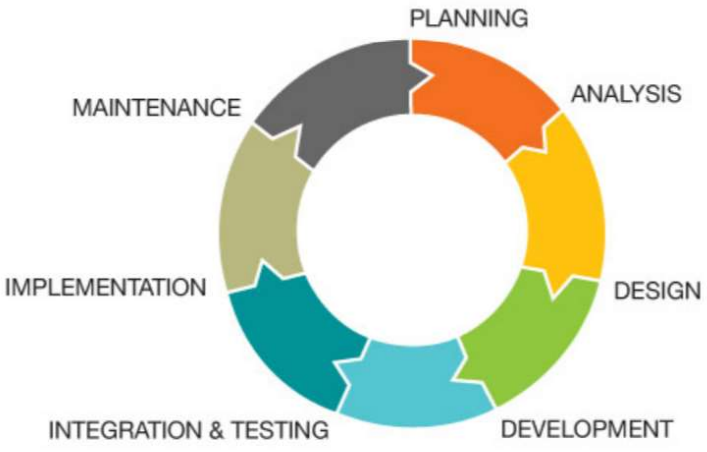
- Early: paper prototyping, experience prototyping
- Later: working prototype (lab usability study), diary study, analysis of data logfiles, interviews

The point of these is to "invite participants to creatively express something about themselves, their values, their relationships, and the ways they make sense of experience."

"…to elicit personally meaningful reflections… to understand how people experience and make sense of situations, relationships, and life events."

"…because understanding that, is what will lead you to design useful, interesting, successful technology …and (more engineeringly) it's the best way to avoid costly errors in the development process"

"A poor requirements phase can cost 100x more to fix later in a project"



Functional Requirements:

Functional Requirements are "a statement about an intended product that specifies what it should do"

Non-Functional Requirements:

- Describe product or system characteristics with respect to performance – not just efficiency, but also softer qualities such as user experience
- Describe how a system is supposed to act
- Ideally needs to be measurable so project progress and success can be assessed

Detailed Requirements:

- The 'how' – how will the functional requirements be met?
- We never know in advance
- "…to elicit personally meaningful reflections… to understand how people experience and make sense of situations, relationships and life events."

Requirements: Quick Guide:

- Identify what is important to stakeholders – this will allow you to understand what is not acceptable
- Involve the stakeholders
- Be prepared – use props, examples, prototypes to support discussion

Requirements: Summary:

- Functional and non-functional go hand in hand -define system features and execution
- Revisit throughout development process, reassess, ensure that nothing went wrong along the way
- Understand that users may have different takes on requirements, show behaviours that were not anticipated

Requirements Elicitation:

- To catch aspects regarding the experience of people in interacting with the environment
- To define problems, opportunity and challenges (instead of finding a solution)
- Contributing to the design of products that support users in having satisfied experiences
- To define requirements for the design of interfaces, services, tools, technological systems

Requirements Elicitation: Why:

- Trying to understand the impact of future technology in everyday life
- Help to explore the potentiality and constraints of individuals interaction with environment, services, artefacts, and technologies
- To prevent and study the user acceptance regarding the introduction of technology in everyday life

Requirements Elicitation: What:

- To analyse dynamics and elements which characterise relation among human being, service, and technology
- To catch also emotional aspects of interaction in our experiences
- Investigate collaborative, individual, and emerging behaviour

Requirements Elicitation: Focus:

1. Activity
2. User
3. Context
4. Tools

Requirements Elicitation: How:

1. Ethnography
2. Focus groups
3. Interviews
4. Task analysis

Ethnography:

- Direct observations of how people actually live, work, etc., allow the designer to gain understanding of how technology will fit intuitively into their lives
- "field work, then involves the disciplined study of what the world is like to people who have learned to see, hear, speak, think, and act in ways that are different. Rather than studying people ethnography means learning from people"
- Everything is viewed naively – viewed as strange
- No theoretical framework in advance
- Gives a detailed and nuanced understanding of peoples' lives
- Other methods may be difficult – people may not answer questionnaires or interviews 100% honestly

1. Identifying people and situations
2. Gaining access, consent, and trust
3. Watching, listening and experiencing
4. Remembering and recording
5. Sorting coding, analysing
6. Searching for patterns and uniqueness
7. Finding the meaning in what is happening

Focus Groups:

- Discussing ideas with target audience to elicit their feedback on developers'/designers' thoughts – not just observing, but also interacting
- They are very commonly used
- Designers meet stakeholders
- Social, personal interaction

- Public discussion
- Highlights agreement, disagreement
- People express their understanding
- The designers have a plan – they have a rough idea of the information they want to elicit (functional requirements), they provide props, materials, some guidance on discussion, they record participant responses

Interviews:

- Common method for establishing requirements
- Different types: structured, unstructured, semi-structured

Structured interviews:

- The interviewer asks pre-determined questions – similar to questionnaire
- Exactly same questions used with every participant
- Closed questions – require an answer from a pre-determined set of alternatives, works if the range of possible answers is known, people are in a rush
- Only useful if goals are very well understood

Unstructured interviews:

- Exploratory conversations around a particular topic
- Questions are open - no expectation of the format or content of answers, useful when you want to explore the range of possible opinions
- But you still need a plan – you need to be aware of what information you need to find out
- Results in rich, unstructured data

Semi-structured interviews:

- Use both open and closed questions
- Basic script so that the same topics are covered
- Begin with pre-planned questions, then probe the participant to expand on that point
- Don't lead people to conclusions
- Probe – e.g. "is there anything else you'd like to tell me?"

Task Analysis:

- Task descriptions are often used to envision new systems or devices
- Task analysis is used mainly to investigate an existing situation
- It is important to focus on relevant activities – what are people trying to achieve? Why are they trying to achieve it? How are they going about it?
- Many techniques e.g. Hierarchical Task Analysis (HTA)

Hierarchical Task Analysis (HTA):

- Involves breaking a task down into subtasks and so on. These are grouped as plans which specify how the tasks might be performed in practice

- HTA focuses on physical and observable actions, and includes looking at actions not related to software or an interaction device
- Start with a user goal which is examined and the main task for achieving it are identified
- Tasks are sub-divided into sub-tasks
- E.g.

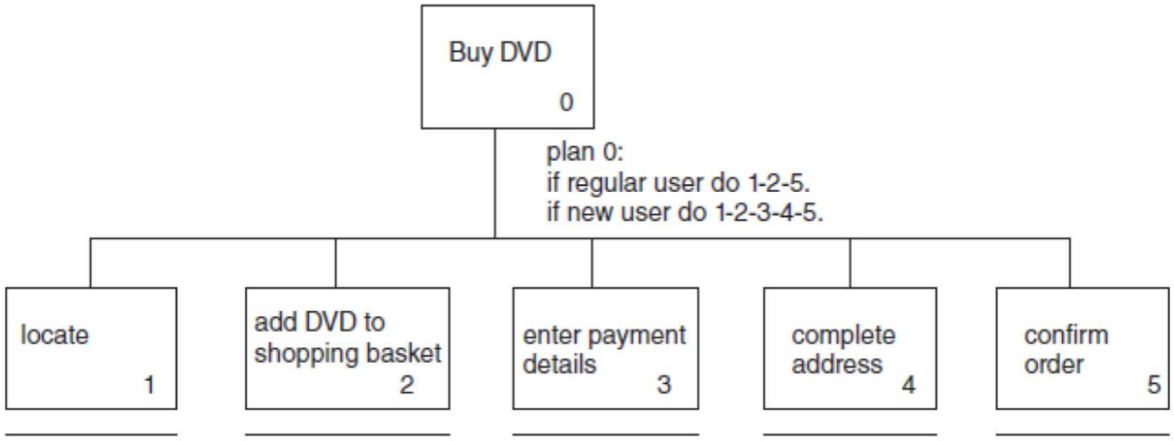


Figure 10.15 A graphical representation of the task analysis for buying a DVD

Requirements Elicitation:

- Ethnography – good to observe people in natural environment without interfering with their activities, but no insights into personal opinions and ideas
- Focus groups – good to get input from groups of people and their discussion of your ideas, will lead to interesting insights, but are hard to manage
- Interviews - a way of obtaining individual feedback, but need to make sure you are not leading participants on
- Task analysis – one way of organising the insights from the data gathered

Design:

- Personas
- Scenarios
- Task analysis

Participatory Design:

- The involvement of end-users in the development process; not just in the testing phase, but as actual designers
- Goal: "…increase the public's engagement with research, facilitate learning and change, ensure that technologies are aligned to people's needs and remove designer subjectivity"
- Allows you to gain new insights into the user's perspectives
- They may have insights that you don't have and that are impossible to imagine

- Benefits: you can work directly with your audience to adapt your project to their needs
- Challenges: are all questions appropriate? What if you're working with vulnerable audiences? Takes time, costs money, need to find the right people

Personas:

- "hypothetical archetypes"
- An original model or type after which other similar things are patterned – a prototype
- A precise description of a user and what they want to accomplish
- Imaginary but precise
- Alternative to directly involving end-users in design
- Fictional characters that are created by designers to represent target audience
- Still requires insights into needs and wishes of target audience, but does not require direct contact
- Can be based on literature, own experiences, group discussions, observations (ethnography)
- Still subjective so a bit difficult, keep in mind when playing through scenarios

Personas: Quick Guide:

- Include 'hard facts' about person
- Talk about strengths and weaknesses
- Try to create a 'full' image – include hobbies, interests, whatever makes the person unique
- Don't focus too much on the software you're trying to design – this will follow later
- When in doubt, read up about topics
- Sometimes you'll need to create several personas

Scenario-Based Design:

- A family of techniques in which the use of a future system is concretely described at an early point in the development process
- Narrative descriptions of envisioned usage episodes are then employed in a variety of ways to guide the development of the system that will enable these user experiences
- An informal narrative story, simple, 'natural', personal, not generalizable
- Helps to understand situations and actions required by the users
- Varying levels of details
- Several scenarios to cover different aspects of usage
- Scenarios are stories: setting or situation state, one or more actors with personal motivations, knowledge, and capabilities, and various tools and objects that the actors encounter and manipulate, a sequence of actions and events that lead to an outcome
- These actions and events are related in a usage context that includes the goals, plans, and reactions, of the people taking part in the episode

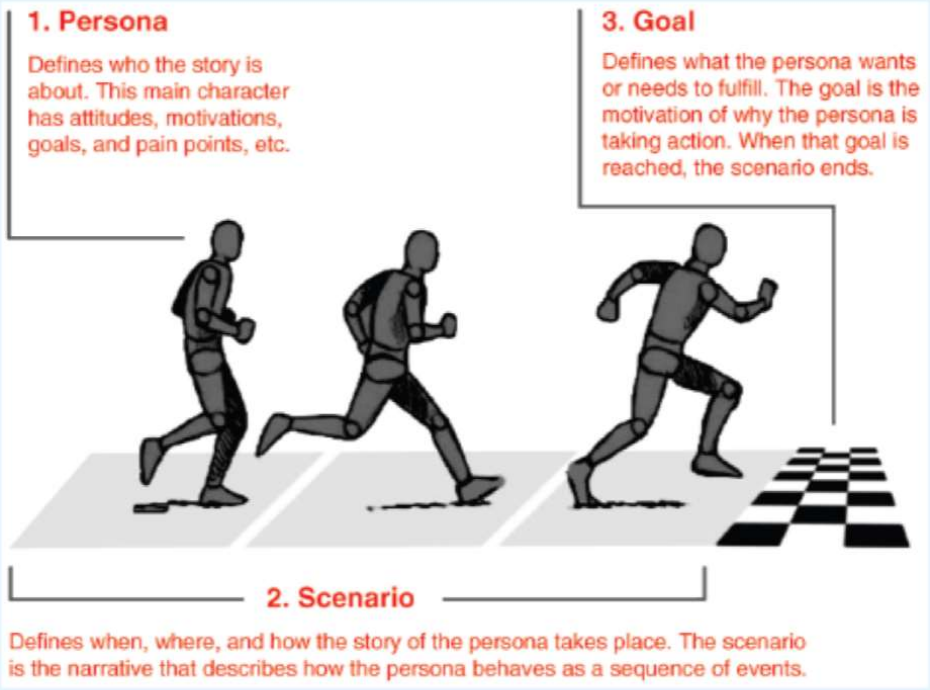
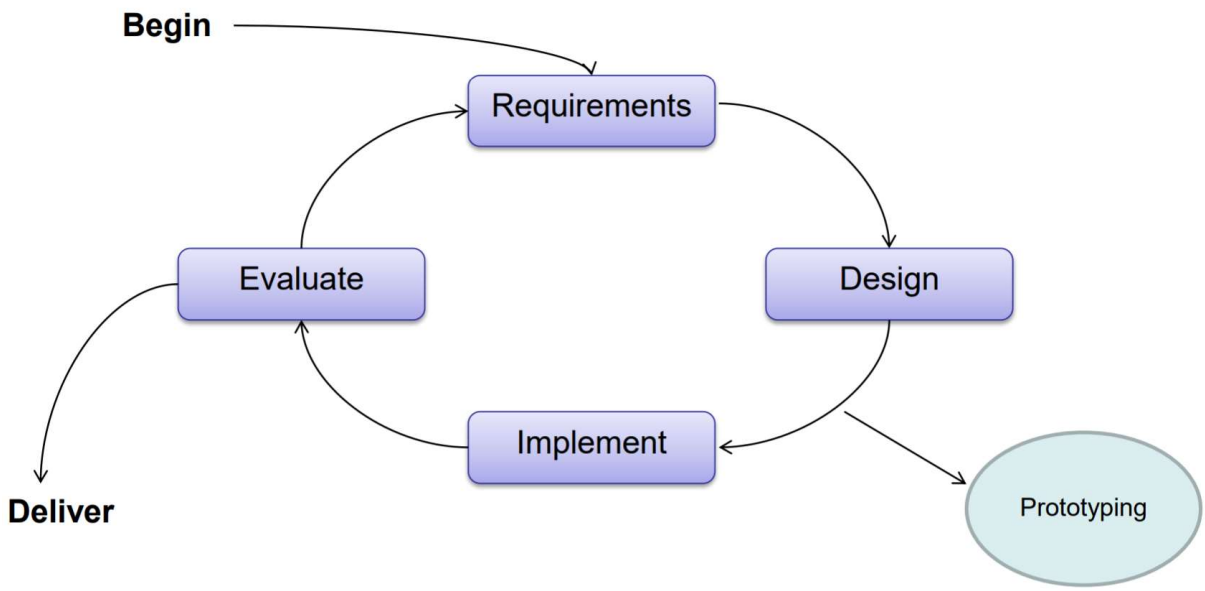


Figure 10.10 The relationship between a scenario and its associated persona

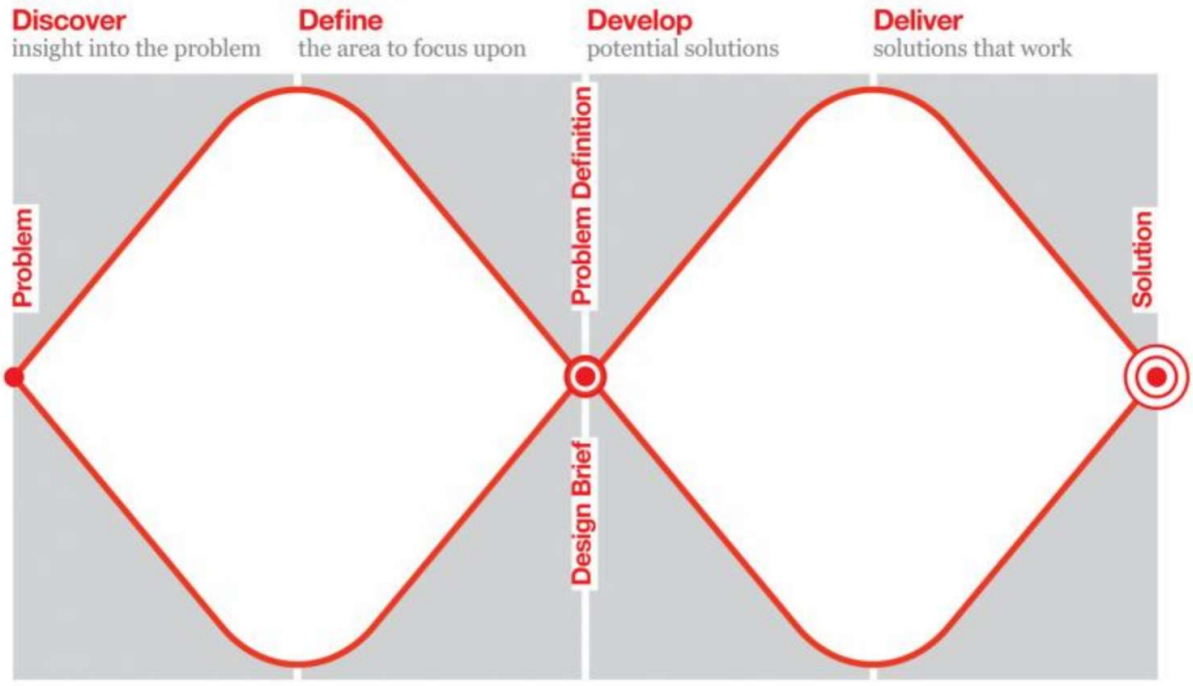
Source: http://www.smashingmagazine.com/2014/08/06/a-closer-look-at-personas-part-1/

Sketching and Prototyping

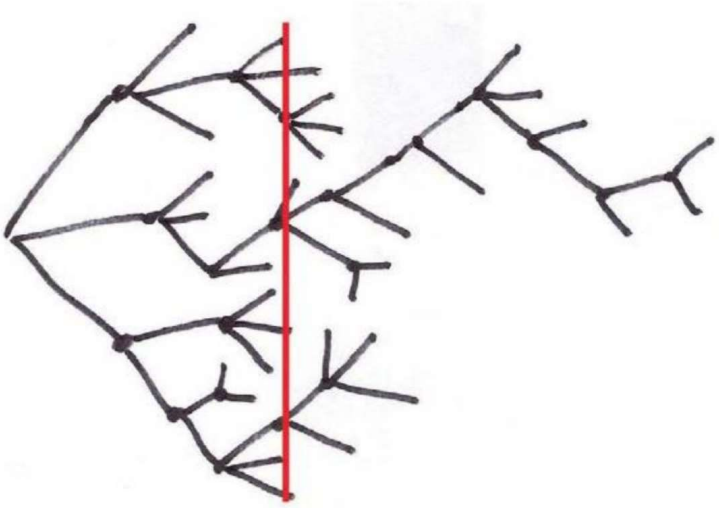
Iterative Design Cycle:



Design Double Diamond:



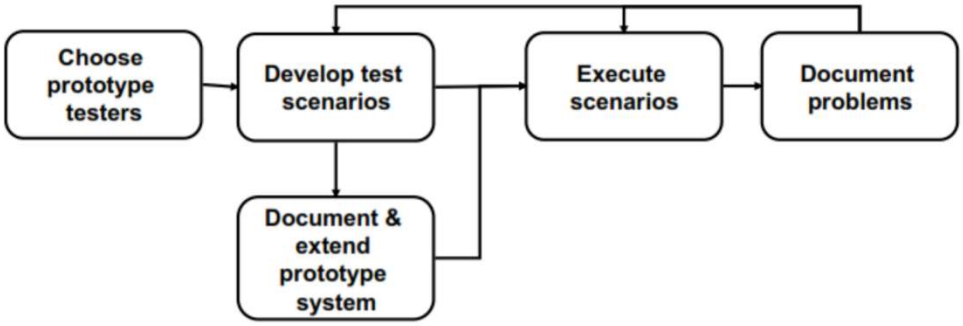
Design as Branching:



Prototyping:

- A prototype is any representation of a design idea, regardless of medium
- A prototype is a means for examining design problems and evaluating solutions
- A prototype is…
    - An instantiation of a design hypothesis
    - A means to communicate ideas and intent
    - A vehicle for evaluating design ideas
- Multiple audiences – intended users, design teams, and supporting organizations
- Prototypes can focus on different aspects of a system…
    - Functionality
    - Visual design
    - Low-fi vs. hi-fi
    - Games: vertical slice vs. gameplay prototype
- What questions do you want to answer through your prototype? What results are you looking for?
- Benefits…
    - Can help you understand the implications of design decisions
    - Can help you understand existing (and missing) functionality of your system
    - Can help you understand how end-users interact with your system
    - Can be designed to address different audiences – colleagues, management, clients
    - Can help you continuously evaluate project success
    - Can help you save time and save money
- Our design ideas don't always play out the way we expect them to
- Does system provide intended experience?
- Prototyping in Computer Science
    - Role in Software Engineering – usually, prototypes are early versions of software, i.e. alpha versions (not feature complete, or buggy)

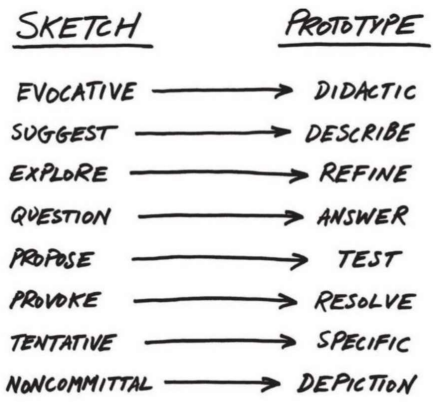
- Horizontal vs. vertical prototype – trying to include all features in low-fi prototype or creating hi-fi prototype of certain aspects
- Testing for aspects such as feature completeness, functionality, but also user interface etc.



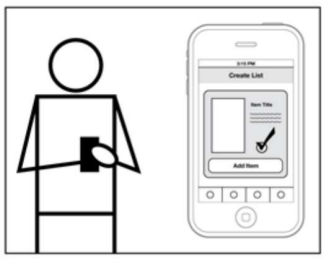
- Supports requirements specification, helps to extract and validate requirements
- Sees user goals as formal use cases, understanding the user is not always priority
- Generally hi-fi prototypes used that are expensive and not good for managing user expectations
- Traditional prototyping cannot deal with non-functional requirements e.g. reliability & performance
- Different approach: agile development e.g. scrum
- Rapid, iterative development cycles that always lead to functional system prototype
- Generally low-fi approach to prototyping
- Shifts perspective from functionality to experience
- Often applied in games industry because of focus on fun

- Prototyping in HCI…
  - We are interested in how people interact with computers
  - Not just about functionality of system, but the entire experience of using it – usability and accessibility, emotional responses
  - Two main approaches with different goals - low-fi & hi-fi
  - "Real-World" vs. digital prototyping, Hardware vs. Software prototyping
  - Low Fi Prototypes…
    - Focus on users, scenarios, and goals
    - Can throw away prototypes
    - Produced cheaply and quickly
    - Used early in the development cycle
    - Requires only basic skills – suits non-programmers
    - Get immediate feedback
    - E.g. paper prototyping, sketching, storyboarding
- Sketching
  - User experience sketching

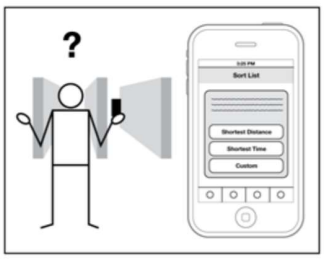
- Even faster than paper prototyping – drawing out different screens and scenarios on paper
- Switching back and forth between different views, e.g. screenshots of system, but also sketches of how users interact with the system (e.g. holding phone)
- Extends beyond mere system prototyping
- The tools may be simple, but realistically re-creating user experience can be hard



- Paper Prototyping
  - Using pens and paper etc. to create system prototypes
  - Can be a basis for emulating system functionality
  - Possibility for rapid prototyping, but hard to get polished look of final product
- Storyboarding
  - Similar to sketching, but more formalized
  - Tells entire story of user interacting with system
  - Sketches of prototype and user interactions along with short descriptions – similar to storyboards for movies
  - Advantage: accessible for other stakeholders without extensive explanations



Jack wants to buy groceries with his Lone Star Card App so he starts a list at home. As he adds items, the app notifies him if it is eligible for purchase with the Lone Star Card. Jack picks a nearby location and gets directions to the grocery store.



Once Jack arrives, he doesn't know where to start. He sorts his grocery list by Shortest Time so he can get in and get out quickly.

Once Jack finds an item on his list, he takes a picture of the UPC. The item gets crossed off his list and the a running total tells Jack how much his groceries will cost.

Jack finishes his list and gets into the checkout line. The cashier finishes scanning all his items and the total flashes on Jack's screen. Jack chooses to pay with his linked Lone Star Card funds. Jack enters his Lone Star Card PIN.

A QR code appears on Jack's screen. Jack hands his phone to the cashier who scans the screen and hands it back to Jack with a receipt.

Jack checks his remaining Lone Star Card balance and sees when his next fund refresh will ocurr next week. Jack leaves and follows the directions back home.

- Hi-Fi Prototypes
    - Meant to look like finished product – detailed, real, visual
    - Often used for graphical user interfaces (GUIs)
    - Users cannot easily describe in words… the appearance they want, how they can interact easily with the system
    - Users can recognise what is acceptable and usable
    - Software developed for the mass market
    - Get feedback from potential customers (beta testing)
    - Compare feel of product to competitors' products
    - Use of prototypes to communicate to people who are not part of the dev team
- Functionality Prototyping in HCI
    - Low-fi prototypes usually don't give many insights into system functionality in action – often focus on user interface, interaction sequences, etc.
    - HCI focuses on experience that emerges from interaction with the system
- Wizard of Oz Prototyping
    - "The phrase Wizard of Oz prototyping has come into common usage to describe a testing or iterative design methodology wherein an experimenter (the 'wizard'), in a laboratory setting, simulates the behaviours of a theoretical intelligent computer application (often by going into another room and intercepting all communications between participant and system)"
    - Assumes you have a software prototype – user interacts with software, human operator simulates responses
    - Useful for lab studies when field testing would be difficult/expensive/unethical
    - Popular in HCI to test interactions without developing complex software systems
    - Benefits: you don't need to waste you or anyone else's time implementing a system that turns out to have all the wrong features, you can test concepts without implementing anything, and you can test a variety of them without needing many resources. You can test certain features (e.g. game interface, core mechanics)
    - Challenge: faking it well – you need to create a somewhat realistic experience to elicit the kind of participant responses you're looking for
- Prototyping is a quick and cheap way of testing different design ideas and gathering feedback from prospective users
- Benefits of prototyping:
    - Helps designers think from the user's perspective – what is the workflow of the app?
    - In context of persuasive or "nudging" technologies – what is potential impact on user, what is emotional state when interacting with software?
    - May seem a very simple approach, but can bring useful insights without working with users

Evaluation & Quantitative Data

DECIDE – a framework for evaluation studies:

- Determine the evaluation goals
- Explore specific evaluation questions
- Choose the evaluation paradigm and techniques to answer the questions
- Identify the practical issues
- Decide how to deal with the ethical issues
- Evaluate, interpret, and present the data

Determine the goals:

- What are the high-level goals of the evaluation?
- Who wants it and why
- The goals influence the methods used for the study
- Goals vary and could be used to…
    - Check that user requirements are met
    - Check for consistency
    - Improve usability of an existing product

Explore the Questions:

- Questions help to guide the evaluation
- The goal of finding out why some customers prefer to purchase paper airline tickets rather than e-tickets can be broken down into sub-questions:
    - What are customers' attitudes to e-tickets?
    - Are they concerned about security?
    - Is the interface for obtaining them poor?
- What questions might you ask about the design of a cell phone?

Choose the evaluation approach and methods:

The evaluation method influences how data is collected, analysed, and presented.

Field studies typically…

- Involve observation and interviews
- Involve users in natural settings
- De not involve controlled tests
- Produce qualitative data

Identify practical issues:

For example, how to…

- Select users
- Find evaluations

- Select equipment
- Stay on budget
- Stay on schedule

Decide about ethical issues:

Develop an informed consent form

Participants have a right to…

- Know the goals of the study
- Know what will happen to the findings
- Privacy of personal information
- Leave when they wish
- Be treated politely

Evaluate, interpret and present data:

Methods used influence how data is evaluated, interpreted, and presented

The following need to be considered…

- Reliability – can the study be replicated?
- Validity – is it measuring what you expected?
- Biases – is the process creating biases?
- Scope – can the findings be generalised?
- Ecological validity – is the environment influencing the findings?

Inspection – Overview:

- Invites experts to comment on system, or that applies heuristics and guidelines
- Mainly applied in usability engineering

Inspection – Approaches:

- A heuristic evaluation uses existing heuristics to inspect systems – it asks whether the system complies with guidelines e.g. Nielsen's
- Carried out by a small number of people who produce a written report of their inspection; can be members of the development team

Inspection – Benefits:

- Quick
- Cheap
- Easily repeatable
- Applicable at most stages of the development process
- Easily translates into action items for developers
- Likely to identify the biggest usability issues that need to be addressed by developers and designers
-

Inspection – Challenges:

- What are risks and challenges? – availability and affordability of experts, correct interpretation of guidelines
- No insight into how actual users would interact with system – could miss important points

Testing – Overview:

- Testing involves users
- Based on gathering users' feedback to identify areas for improvement, validate features, or gain insights into how system affects them

Testing – Recruiting the users:

Screening participants:

- They have had no involvement in the design or development of the sit or product
- They represent a target audience
- How many participants will you need (total and within specified groups)
- The location, date, and time for testing
- How long each session will take
- How much (and in what format – cash, check, gift cards, certificates), and what if anything else you will be providing (e.g. travel or parking)

Nielsen outlines the number of participants that you need based on a number of case studies…

- Usability tests – testing 5 users lets you find almost as many usability problems as you'd find using many more test participants
- Quantitative studies (aiming at statistics, not insights): test at least 20 users to get statistically significant numbers; tight confidence intervals require more users
- Card sorting: test at least 15 users
- Eye tracking: test 39 users if you want stable heat maps

Testing – Benefits:

- Actual feedback from real people
- Insights into how people interact with your system in the lab or field
- Scientific approach to evaluations in HCI
- "Real world" testing = higher validity

Testing – Challenges:

- Requires planning, takes time
- Recruiting the right sample can be difficult
- Additional knowledge necessary to analyse and interpret results – results need to be made actionable
- People tend to like what they know – what does that mean in terms of innovation and creativity?

- Requires basic knowledge in experimental design and data analysis, and takes time

Inspection vs. Testing:

- Inspection relies on experts and heuristics
- Testing relies on users
- Can be applied at different points of the development cycle

How to decide…

- What is the status of your system? Low-fi vs Hi-fi and more polished prototypes
- What questions are you trying to answer? Interface design considerations vs user interaction
- How much time do you have? What is your budget? What is your location?

Methods can be complementary – try to run inspections before entering user testing stages

Inspections and testing can provide valuable insights into user interactions with systems

Inspections are usually quicker, testing can provide deeper insights, and both can complement each other.

Laboratory and field studies:

- Evaluation methods that test systems with users can be carried out in the lab or field
- Lab: any kind of controlled environment that you can create to test your system e.g. a room on campus, a coffee shop that you meet testers at
- Field: the 'natural habitat' of your users e.g. at the office, at home, on the train

Lab studies:

Advantages…

- Controlled environment
- Maximum surveillance potential

Disadvantages…

- Validity – it is an artificial environment
- Longitudinal evaluations tiresome for users
- Requires testing facilities (or potential confounds)

Field Studies:

Advantages…

- Natural habitat = ecological validity
- Easier longitudinal deployment

Disadvantages…

- Confounds
- User feedback may be more difficult to obtain

- Mythologically challenging

How to choose between lab and field:

- Depends on the question you're trying to answer
- User group you're working with
- Type of system you're developing
- Depends on availability of resources
- Utopia: combine both approaches to get maximum amount of insight

Lab = controlled but not necessarily realistic environment

Field = realistic but not necessarily easy to research environment

Methods	Controlled setting	Natural Setting	Without the users
Inspection	X		X
Testing	X		
Lab studies	X		
Field studies		X	

Quantitative:

- Quantitative research is interested in quantity of phenomena and asks about the experience of many (average user)
- Instruments – questionnaires, metrics
- Analysis – statistical data analysis (e.g. working with means and variance, inferential testing to understand data)
- Quantitative research works with bigger user groups
- Data analysis is relatively quick, but requires statistical knowledge
- Challenge – choosing the right instruments and getting data analysis right
- Benefit – thorough understanding of the bigger picture
- User interaction with a system can be quantified through different measures – questionnaires, observation, performance metrics
- More complex approaches e.g. biometrics – eye tracking, skin conductance

Questionnaires:

- Instrument to gather structured feedback from people – usually consists of a range of items (questions) and is focused on specific topic
- Different question/answer formats with implications for analysis of questionnaire data – closed vs open questions
- Dichotomous questions – binary: easy to analyse but pushes respondent to choose one of two categories

- Categorical questions: still pushes respondent to choose category

"What interface colour do you prefer?"

☐ **Blue**
☐ **Yellow**
☒ **Pink**

- Ranking questions: adds information - creates relationship with data

"Please rank interface colour by preference."

2 **Blue**
3 **Yellow**
1 **Pink**

- Scalar – sematic differential: explores a range of bipolar attitudes about a particular item, attitudes are represented as a pair of adjectives, choices of adjectives can be difficult

Using the interface was…

fun	**1**	**2**	**3**	**4**	**5**	**boring**
easy	**1**	**2**	**3**	**4**	**5**	**hard**

- Scalar – Likert scale: used to measure opinions, attitudes, and beliefs. Asks user to judge a specific statement on a numeric scale that corresponds to agreement or disagreement with a statement

I enjoyed using the interface.

	1	2	3	4	5	
strongly agree	O	O	O	O	O	**strongly disagree**

Observations:

- Facial expressions
- Verbal comments
- More specific aspects e.g. how user performs a gesture on a tablet, or how player interacts with motion-based game interface
- Challenge – we are no longer interested in quality of experience, but in quantifiable results – how can we record data appropriately?
- Step 1: defining quantifiable observations, basically operationalizing observable aspects of interaction
- Step 2: ensuring that observations are consistent across many participants – develop coding scheme for observations based on previously defined observations
- You need to decide on how/when to make observations… option 1: observe person while she is interacting with system "live", option 2: video record interaction and analyse recorded material. Option 1 takes less time but requires you to develop coding scheme in advance, option 2 allows you to explore recordings first

Metrics:

- Performance metrics offer objective insights into how user interacts with system…
    - Time taken to complete tasks
    - Number of tasks completed within a set time
    - Number of errors made in completing task
    - Number of times website visited
    - Number of times help consulted

    - Number of successful completions
- Relatively simple to present and analyse this type of data, but recording requires preparation
- Do not provide sufficient insights if they are sole measure – can only tell what happened, not why
- Good way of backing up questionnaire results and observations – especially if findings from questionnaires and observations contradict

Research Ethics

Historic Case Studies:

James Lind – First ever 'clinical trial' to find a treatment for scurvy. Tested 6 different treatments on groups of sailors.

Edward Jenner – Pioneered the world's first vaccine. Injected people with cowpox, then "challenged" them with smallpox, including an 8-year-old boy and later his own 11-month old son.

Walter Reed – First consent form (1900) – experimented with yellow fever, infected subjects through mosquitos. "To deliberately inject a poison of known high degree of virulence into a human being, unless you obtain that man's sanction, is not ridiculous, it is criminal." - William Osler, 1898

"Experiments, then may be performed on man, but within what limits? It is our duty and our right to perform an experiment on man whenever it can save his life, cure him or gain him some personal benefit. The principle of medical and surgical morality, therefore, consists in never performing on man an experiment which might be harmful to him to any extent, even though the result might be highly advantageous to science, i.e., to the health of others." – Claude Bernard, 1865

There were few formal guidelines…

- Human experimentation was seen as a necessary evil
- Ethics were generally left to the discretion of the investigator
- Extreme abuses were only discussed after the fact
- Many studies led to very beneficial results, but many did not
- Often preyed on the vulnerable – sick, poor, prisoners, orphans, cognitive disabilities

The Doctors Trial - At the end of World War II, Nazi doctors who conducted research on human participants were tried for crimes against humanity. This was the first time research ethics took a world stage and this led to the first internationally acknowledged guidelines for research ethics.

The Nuremberg Code (1947) …

- 10 principles to protect human subjects of scientific experiments
- Required informed and voluntary consent
- Scientifically valid research plan
- Minimize harm, maximise benefit
- Right to withdraw from experiment when unable to continue
- The Western world initially dismissed the Nuremberg Code as a "code for barbarians" and not for civilized physicians and investigators. And many researchers did not think these rules applied to them, and as such did not give them much attention.

Willowbrook Hepatitis Study - School for children with cognitive disabilities. Infected children with Hepatitis to study the development of the disease. They argued they were going to get it anyway. Things did not automatically get better after the Nuremberg Code. Not everyone took the code seriously, and unethical research continued to take place.

The Helsinki Declaration – Issued by the World Medical Association. Revised multiple times, introduced the requirement for independent review. Unlike the Nuremberg Code, the Helsinki Declaration was aimed at everyone, and was not issued in the context of a specific breach of ethics.

Tuskegee Syphilis Study - Over 400 participants as part of a study to examine the development of Syphilis. Study continued even after the discovery of Penicillin. 40 wives infected, 19 children born with Syphilis. This study triggered outcry in the US bring the US government into the debate on research ethics. This led directly to the Belmont Report.

The Belmont Report (1979) …

1. Respect for persons – people are not a means to an end
2. Beneficence – minimize harm, maximise benefit
3. Justice – sharing the burden and benefits of research

Principles of research ethics:

1. Informed and voluntary consent
2. Favourable risk-benefit ratio
3. Confidentiality and data protection
4. Independent review process for research
5. Justice and inclusiveness

Evolved from the Nuremberg Code, the Helsinki Declaration and the Belmont Report, these are the modern-day principles of research ethics.

They apply when…

You are conducting research - an undertaking intended to extend knowledge (establish facts, reach new conclusions) through disciplined inquiry or systematic investigation.

A study that involves any one of,

- Human participants in an active capacity
- The recording of personal data
- The collection of biological tissue
- Animal participants

Informed and Voluntary Consent:

- Participant is given all the information needed to make a decision on whether or not to take part in the research
- Researcher's identity – who is doing the research? Contact details

- Purpose – why is this research taking place?
- Method – what does participation in this study entail? What are the potential risks, benefits, and consequences of taking part?
- Data use – what data is being collected? How is the data going to be used? Who will have access to it? Will it be published? How and where?
- Informed consent does not mean long T&C texts that we expect users to just click past and ignore.
- Informed also means understood. Short, simple and clear. Ensure participant has read them.
- Commonly, informed consent takes the form of two documents. The researcher keeps the consent form, and the participants keeps the information sheet.
- Voluntary participation – participants chooses to take part willingly, know they are free to participate
- Right to withdraw – no penalty (material or otherwise). If participant chooses to withdraw, the study stops immediately and all data collected is deleted. This can happen after the study terminates (why contact details are important). Participant knows they can withdraw consent at any time.
- Coercion – exerting undue influence in order to incentivise participation…
    - Physical – threat of violence or harm
    - Social – peer pressure, social pressure e.g. calling in a favour
    - Institution – teacher/student, boss/employee
    - Financial – offering so much money that participants take part in contradiction to their values or self-interest
    - Indirect coercion: allowing another person to exert influence on your behalf

Consent from Vulnerable Persons:

People less able to make decisions on consent – children, people with cognitive impairments, some elderly. Also, people dependent on the researcher's organization, patients, prisoners.

- You must assume the participant is capable of making a decision, unless there is proof that they are not
- "every effort should be made to secure actively given informed consent from individual participants" – ESRC research guidelines
- "every effort should be made to develop methods of seeking consent that are appropriate to the groups being studied, using expert advice, support and training when necessary" – ESRC research guidelines
- Gatekeeper and legal guardian consent should not be used exclusively

Exception – gaining explicit consent is impractical:

Sometimes gaining explicit consent (e.g. in the case of quick questionnaires) adds more risk (by introducing the collection of personal data through names and signatures) and can

become a significant burden on an otherwise very low-risk study. Research Ethics Committees can waive this requirement when appropriate.

Exception – gaining explicit consent is impossible:

For example, in the Twitter Sentiment Analysis Study, over 20,000 tweets were analaysed so it would have been impossible to get consent from individual users

Exception – covert research:

When the researcher conceals, in full or in part, the nature of the research activity. Such as lying about who they are, what they're doing, or why they're doing it, or simply not telling the participant anything.

Only acceptable when,

- Overt research is not possible
- The study is of scientific significance
- NOT when knowing the true nature of the research would stop people from taking part

You should, if possible, reveal to the participant afterwards, and uphold the right to withdraw.

"Covert research may be undertaken when it may provide unique forms of evidence or where overt observation might alter the phenomenon being studied. The broad principle should be that covert research must not be undertaken lightly or routinely. It is only justified if important issues are being addressed and if matters of social significance which cannot be uncovered in other ways are likely to be discovered" – ESRC Framework for Research Ethics

Exceptions should be made with care…

- Particular care must be taken during this type of study
- If gaining consent is impossible it does not automatically mean the study is ethical without consent
- Highlights need for ethical approval procedures

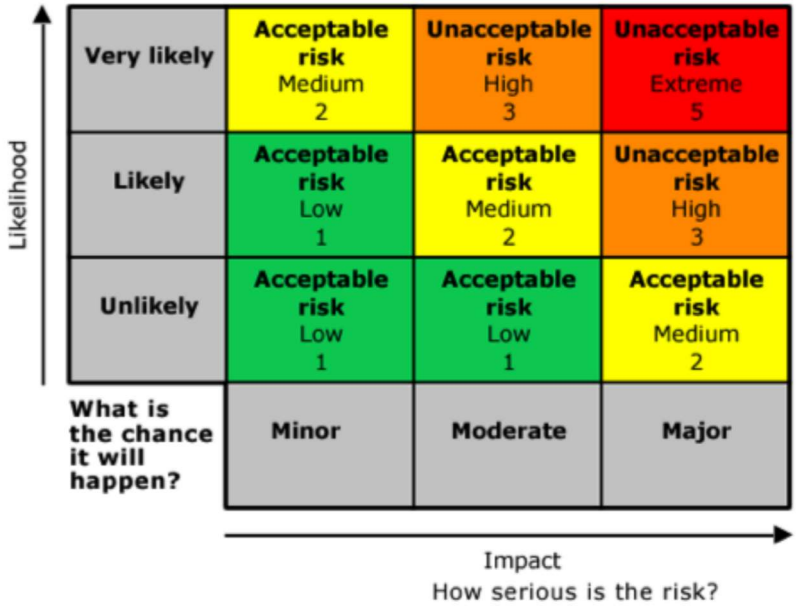
Favourable Risk-Benefit Ratio:

Maximise Benefit…

- The aim of the study should be beneficial
- The benefit must reasonably follow from prior scientific knowledge
- A study is unethical if it does not lead to benefit, or if the intended outcome is not beneficial
- A research study is unethical if…
    - It does not have a solid scientific foundation
    - It is not run by a trained competent professional
    - It does not follow well-defined procedures to ensure success

Minimizing Risk:

Depends on two factors – the likelihood of harm, and the impact of harm if it does happen



- Vulnerable groups should be given extra care
- Researches who wish to interact with vulnerable people should be cleared by DBS (Disclosure & Barring Service) – preferred in general, legally required if left alone with participants

Example…

Location-based services/games create particular risks for testing. E.g. warnings on Pokémon GO

Confidentiality and Data Protection:

- Participants in research study should be guaranteed confidentiality
    - Particularly important for studies involving sensitive or stigmatized topics
    - Even the fact that someone took part might be harmful to them if made public
- Personal data should be kept private and safe
- "personal data means any information relating to an identified or identifiable natural person; an identifiable natural person is one who can be identified, directly or indirectly" – General Data Protection Regulation (GDPR) May 2018
    - Directly: the person can be identified from the information
    - Indirectly: the person can be identified from that information in combination with other information
    - Examples of personal data: name, photograph, video, audio, email address, phone number, fingerprint
    - However, a combination of other information such as age, gender, postcode, and occupation can be enough to identify a person too

    - A study showed that you can find out the identity of a person from their browser history
- De-anonymization…
    - Identifying people from their Netflix movie ratings
    - Identifying someone's entire location history based on 4 known locations
    - Identifying someone's surname from their DNA sequences
- Current legal approaches: difficult to enforce, stifles security research, leaves vulnerabilities undiscovered
- Sensitive personal data: especially high level of care should be given to data related to a person's racial or ethnic origin, political opinions, religious beliefs, trade union activities, physical or mental health, sexual life, information about criminal offences

Best practice – Data Protection…

- Minimise personal data by keeping any necessary indeitifying information separate from the rest of your data
- Use numeric index to link identifying with non-identifying data
- You must noit fully anonymise your data
- You must still ensure your participants right to withdraw their data from your study

Best practice – data retention…

- Keep data only as long as it is required (funding bodies have specific requirements)
- Keep personal data secure – digital data should be on a password protected server, physical data should be locked in a container
- Sensitive personal data should never be left on a laptop/mobile device

Use of Cloud Services…

- US privacy laws are weaker than EU laws. So, storing personal data on cloud services whose servers are in the US would violate Data Protection Laws such as GDPR in the UK. (exception for "privacy shield" organizations)
- Data protection also involves protecting data from attacks and breaches

Best practice – data collection…

- Only collect data you need
- Avoid boilerplate questionnaires
- Never ask for sensitive personal data unless it is vital to your research

Exceptions – voluntary…

- Participants may wish to be fully identified – expert interviewers, participatory design
- Participants may partly waiver their confidentiality – for publishing photos/video excerpts, explicit and separate consent must be sought

Exceptions – statutory…

- You are legally required to report evidence of crime/intent to commit a crime, evidence of risk to vulnerable persons.
- Research data is not protected from court orders

Independent Review Process:

Decisions on whether or not research is ethical should not be left to the researcher to decide

Research Ethics Committee…

- In the UK, a Research Ethics Committee (REC) is required in any institution that takes government funding.
- Similar requirements in other countries e.g. Institutional Review Board (IRB) in the US

Justice and Inclusiveness:

- Justice – the benefits and the burdens of the research must be similarly distributed
- Inclusiveness – no group of people should be, without good reason, excluded from research activity that affects them

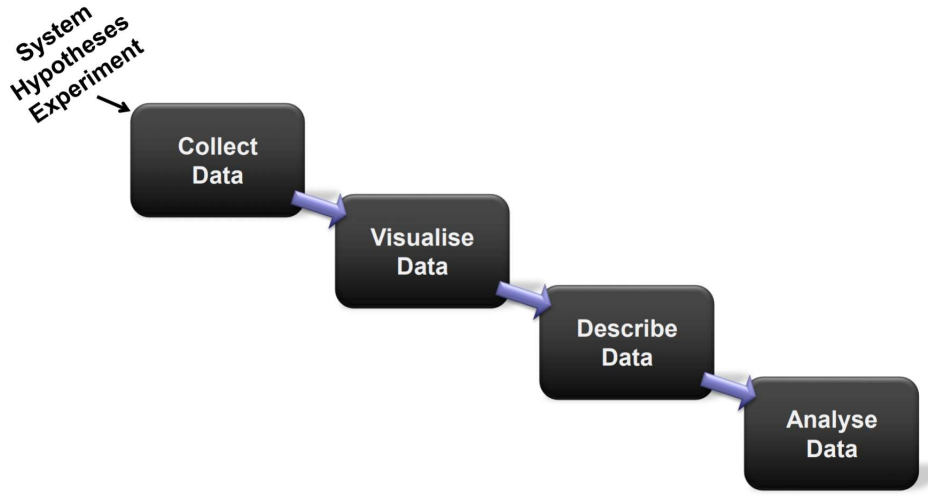
Justice:

- If your study will likely benefit a certain portion of the population, this should be reflected in the participants you use

Inclusiveness:

- You need to have a good reason to exclude someone from participating in your study
    - E.g. you can exclude young participants in a study on a new support system for the elderly
    - E.g. you cannot exclude the elderly in a study on a new fitness training monitor
    - Pregnant women, elderly, and children are often excluded from a study without good reason

Data Analytics



Data Types:

- Collecting, presenting, and analysing quantitative data are closely linked interdependent tasks
- The type of data you collect will determine how you can represent it
- There are distinct types of quantitative data:
  1. Categorical
  2. Ordinal
  3. Continuous
- Types of data go along with kinds of questions that you asked
  - Dichotomous questions and lists = categorical data
  - Ranking questions = ordinal data
  - Semantic differential and Likert scales = continuous data
- Depending on type of data, different mathematical operations can be applied

Categorical Data:

- Data is categorical if values can be stored according to category, and each value is chosen from a set of non-overlapping categories
- E.g. a person can have the characteristic of ‘dead’ with categories ‘yes’ and ‘no. Cars can be sorted by make into discrete categories
- No ranking implied

Ordinal Data:

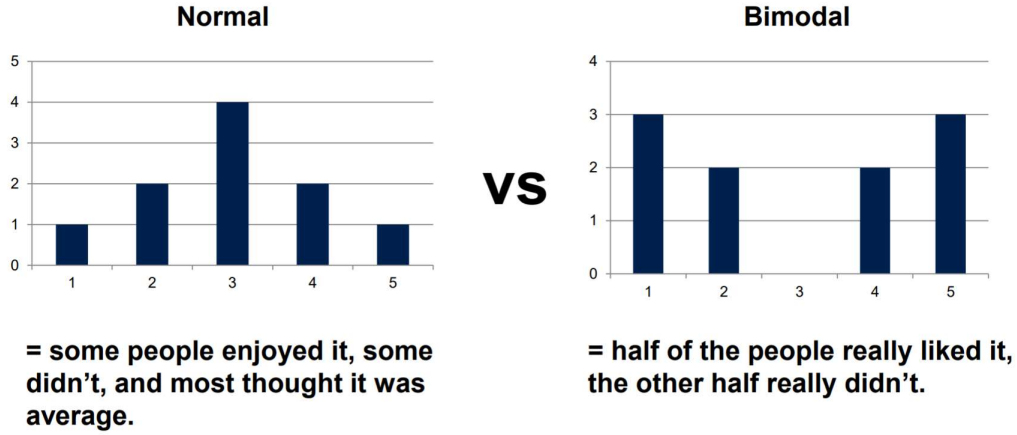
- Data is considered ordinal if values can be ranked (put in order) naturally, or have a rating scale attached
- E.g. ranking of favourite foods
- Numbers don’t always imply rank, could be a code for a category

Continuous data:

- Data is continuous if the values may take on any value within a finite or infinite interval
- You can count, order and measure continuous data
- E.g. height, time taken
- Many analysis approaches require this level of data quality – be careful when you choose statistical tests

Descriptive Stats - Distributions:

- Distribution of data can give insights and will tell you which mathematical operations and statistical tests you can apply
- Uniform, bimodal, normal/Gaussian, and skewed
- Many statistical tests require normal distribution of data
- Distributions can have a huge effect on the mean e.g.…



Descriptive Stats – Averages:

- A value that describes the entire distribution
- Mode = works on all types of data
- Median = ordinal data and up
- Mean = continuous data
- Depending on distribution, calculation method leads to different results and is more or less appropriate
- Arithmetic mean is vulnerable regarding extremes

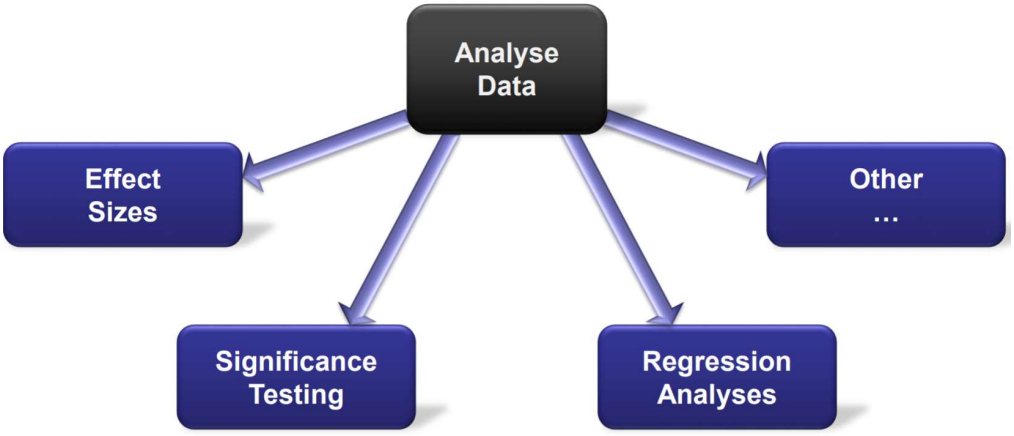
Descriptive Stats – Spread:

- Reporting the spread of data allows you to give additional information, e.g. outline extremes, and demonstrate whether your model of choice is a good fit for sample (e.g. whether mean accurately describes data)
- Range (highest and lowest) – ordinal data
- Deviation: total error, sum of squared errors, variance, standard deviation – continuous data

- Degrees of freedom are the number of observations that are free to vary

Correlation and Causation:

- Just because an association exists, does not mean that one variable causes another
- Possible alternatives:
  - Reverse relationship
  - Common third factor
  - Bi-directional relationship
  - Coincidence



Effect Size:

- When comparing two sets of data, we want to know how large the effect is
  - What is the size of the difference between my two sets of data?
  - What impact is this result likely to have?

Simple:

– The difference: $diff = |\overline{A} - \overline{B}|$

Commonly used:

– Cohen's d: $d = \frac{\overline{A} - \overline{B}}{s_{pooled}}$ $\quad s_{pooled} = \sqrt{\frac{s_A^2 + s_B^2}{2}}$

Assumes equal sample sizes

Confidence Intervals:

- Describe the level of uncertainty in a sample parameter (estimate of the population parameter) e.g. the mean of a sample
- Format: [min, max], contains the mean
- Can also calculate the CI pf a difference of means

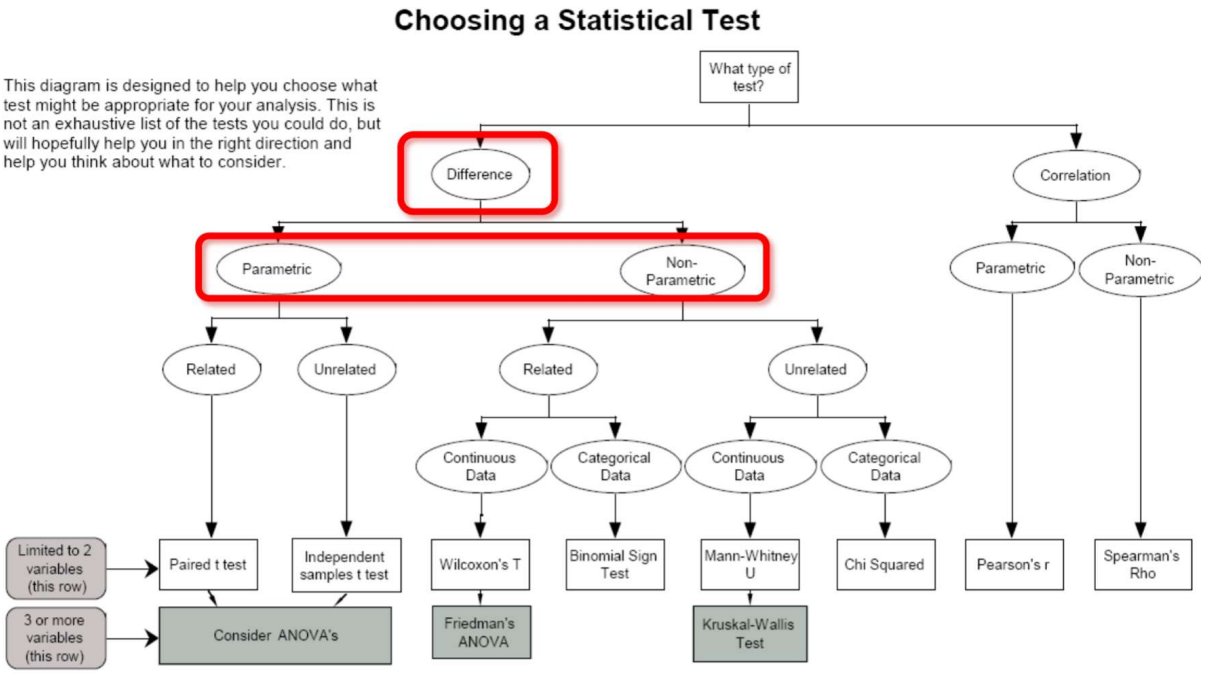
Null-Hypothesis Significance Testing:

- Basic assumption: there is no real difference between our conditions, the "null hypothesis"

- Given this assumption, what is the chance of an outcome as extreme (or more extreme) as the actual observation?
- This chance is the "p-value" – if p is small enough, then this indicates that the null hypothesis is not true

Significance Level (alpha):

- The threshold between a significant and non-significant p-value
- Essentially an arbitrary level, though strong conventions
- Thresholds by field:
    - Alpha = 0.05 is most common
    - Alpha = 0.01 more common in biological science/medicine
    - The 'five sigma' level used in Physics (e.g. at LHC)



Parametric test assumptions…

- Continuous data
- Data are normally distributed
- Similar variance
- Independent samples

The Student's t-test:

- Assesses whether the means of two sets of data are significantly different (given previous assumptions)
- Calculation of a t-statistic – a ratio: the difference in means over the variability of the groups
- Procedure:
    1. Calculate descriptive stats
    2. Calculate t-statistic

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

3. Look up threshold in t-distribution… is result significant?
4. Derive p-value from z-tables

The t-distribution:

- A probability distribution that is used to estimate population parameters when the sample size is small
- A family of distributions, each instance based on the degrees of freedom
- Table showing critical values of t for significance

Non-parametric test assumptions…

- Typically aim to use a parametric test, unless the assumptions are specifically violated
    - First look at parametric, then non-parametric
    - More statistical power (greater sensitivity to significant effects)
- Non-parametric tests: don't assume that data is distributed a particular way (normality), if you have a very small sample size

Mann-Whitney U test:

- The non-parametric equivalent to the parametric t-test
    - Test to see whether one dataset mean is significantly different from another
    - Results in a "U" statistic (rather than "t")
- Still has some assumptions…
    - Independent, randomly sampled data
    - Continuous/ordinal data
- Will still give a p-value (from the U-statistic)

Limitations of p-values:

- The p-value says nothing about the magnitude of the effect
    - A p-value of 0.001 does not imply a stronger effect than a p-value of 0.05
    - As a result, significance does not equal importance
- P-values are not reliable indicators or replicability – confidence intervals suggested as a way of providing better information about replication

95% CI:

- Cantered around the mean, covering 95% of the values in the distribution – assuming normal distribution

$$95\%\ CI = \bar{X} \pm 1.96\frac{s}{\sqrt{n}}$$

Where s = sample SD, n = sample size;
Dependence on n: the more samples, the smaller the range covered

- Can also calculate the 95% CI of the difference of two sample means (advantage: gives an indication of effect size) …
- Can calculate the expected range of differences between two normal distribution means

$$95\%\ CI_d = (\overline{X_A} - \overline{X_B}) \pm 1.96 \sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}}$$

Choose appropriately!

Correlation Assumptions:

- Linearity
- Statistical independence of errors (e.g. no dependence on time)
- Constant variance of errors (e.g. not dependent on age)
- Normal distribution of errors
  *Where error is the distance between data point and best-fit line

Qualitive Approach

Research Approach:

Evaluation methods that test systems with users can adopt – qualitive or quantitative approaches, or combine both

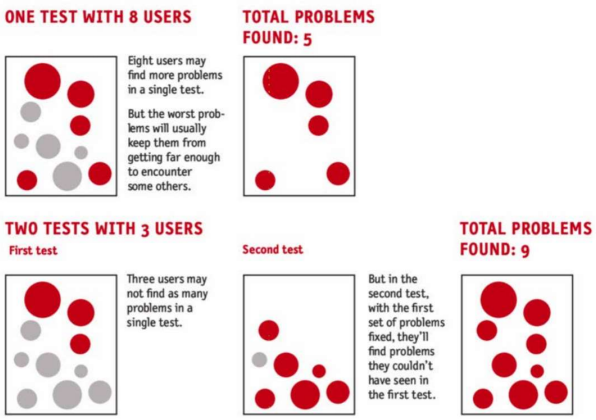
Quantitative vs. Qualitative:

- Quantity of phenomena and asks about the experience of many (average user)
- Methods: questionnaires, metrics
- Analysis: statistical data analysis (e.g. working with means and variance, inferential testing to understand data)
- Quantitative research = research based on data that can be quantified/counted
- Quantitative evaluation in HCI combines observation with mathematical analysis
- Quantitative – concerning quantity, qualitive – concerning quality

What is Qualitive Research?

- Understanding the quality of phenomena rather than simply their quantity
- Typically, less participants than quantitative analysis, but more in-depth data gathering and analysis
- Aimed at understanding why and how decisions are made, as well as what, when, where, etc.
- Methods such as ethnography, semi-structured & unstructured interviews, focus groups, diaries, etc.

E.g. Testing

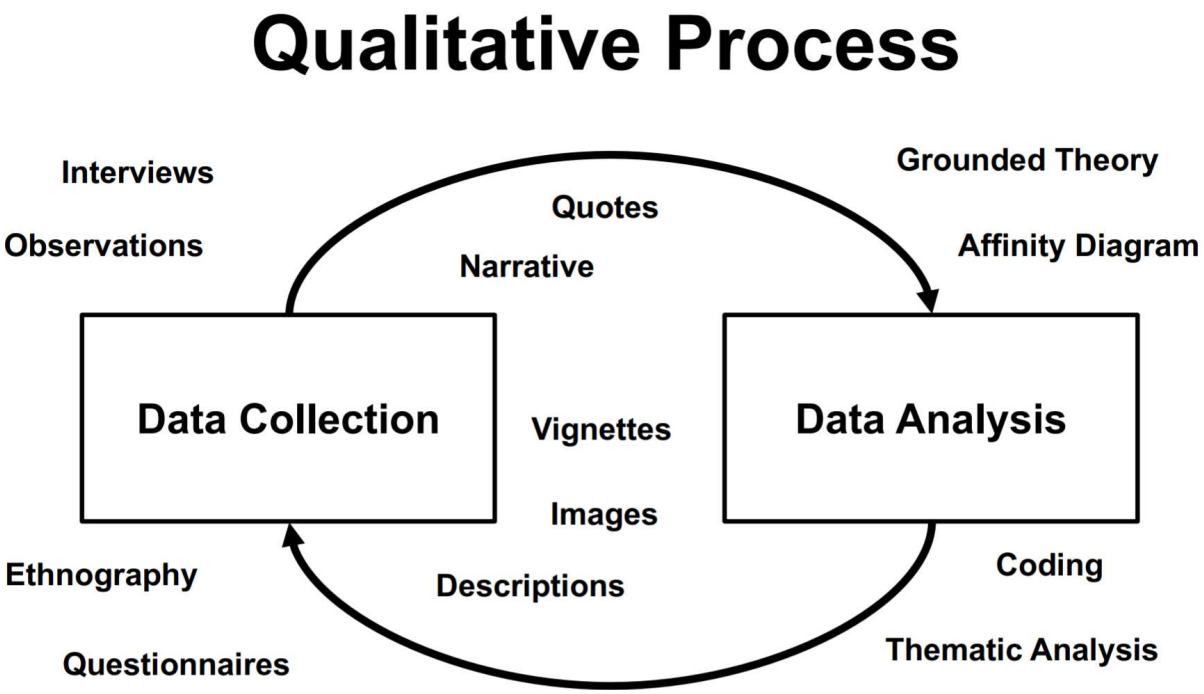


- Useful when the data you are interested in are…
    - Not easily observable, can't easily or meaningfully be reduced to numbers – feelings, values, abstract concepts
    - Can't be experimentally manipulated – ethics, feasibility
    - Complexity – more variables than you can measure, known variables interact in unpredictable ways

- Qualitive data can come in the form of: quotes from participants, in-depth descriptions of behaviours, images, narrative

Why use Qualitive methods in Computer Science?

- To determine what might be important to measure, why measured results are as they are, or if the subject of study cannot be measured easily
- To understand not only what happened, or what people are responding to, but also why
- To understand what people think or feel about something and why they think that way, what their perspectives and situations are and how those influence what is happening
- To understand and explore what a technology or practice means to people



Data Collection Methods:

- Methods: ethnographic observation, interview, focus group

Ethnography:

- Direct observations of how people actually live, work, etc, allows the designer to gain understanding of how technology will fit intuitively into their lives
- “Field work, then involves the disciplined study of what the world is like to people who have learned to see, hear, speak, think, and act in ways that are different. Rather than studying people, ethnography means learning from people”
- Ethnographic observation:
    - Identifying people and situations
    - Gaining access, consent, and trust
    - Watching, listening, and experiencing
    - Taking notes, remembering, and recording

    - Sorting, coding, and analysing
    - Searching for patterns and uniqueness
    - Finding the meaning in what is happening
- 4 key principles…
    1. Context – go where the activity is
    2. Partnership – talk about activity
    3. Interpretation – find/make meaning
    4. Investigate – look for surprises
- Data:
    - Handwritten notes
    - Drawings and sketches
    - Audio recordings
    - Video recordings (time consuming, set up and analysis)
    - Record everything you see in extreme data, the more data the better
- Field Notes:
    - Note rough times down the side of the page, numbering each line
    - Next to each number, write your descriptions, describe locations, people in the setting
    - Write down what everyone did
    - Write down what they said, in quotations
    - Describe informants and information sources such as documents
    - Write down your questions (Obs. Q: “xxx”) and how informants answered (Joe’s A: “xxx”)
    - Write down your interpretations (in parentheses)
- Strengths and weaknesses:
    - Useful both for design and evaluation
    - Often gives direct/indirect insights
    - Frequently augmented with other sources of information (interviews, diary studies, video data)
    - Very time consuming

Interview:

- Exploratory conversation around a particular topic, excellent for pursuing specific issues
    - Vary questions to suit context
    - Probe more deeply on interesting issues as they arise
    - Good for exploratory studies via open-ended questioning
    - Often leads to specific constructive suggestions
- Different types:
    - Unstructured: topic not set
    - Semi-structured: themes and examples of questions
    - Structured: specific list of questions
- Unstructured interviews:
    - Exploratory conversations around a particular topic

    - Questions are open: no expectation of the format, useful to explore the range of possible opinions
    - A plan still needed, so the right information is found out
    - Results in rich, unstructured data
- Semi-structured:
    - Use both open and closed questions
    - Basic script so the same topics are covered
    - Begin with pre-planned questions, then probe to expand further on points made
    - Don't lead people to conclusions
- Structured:
    - Interviewer asks pre-determined questions – similar to questionnaire
    - Exactly same questions used with every participant
    - Closed questions – require answer from pre-determined set of alternatives, works if range of possible answers is known and to save time
    - Only useful if goals are very well understood
- Structure of interview:
    1. Introduction – define settings and role
    2. Warm-up – start introducing the subject
    3. General issues – focus on general expectations, assumptions, and experiences
    4. Deep focus – introduce the product/idea and get attention to some details
    5. Retrospective – going back to general issues (any change?)
    6. Wrap-up – make it clear that it is over
- Indirectness…
    - Never ask direct questions with preconception built in them
    - Ask indirect questions
    - Let the user's feelings and true opinions emerge
    - Do not lead the user to please you
- Neutrality…
    - Forget about your opinion in the product/idea or its relevance to you
    - Be 'distant' from the product
    - Be a neutral observer of the user's answers
    - Phrase questions in such a way that they do not express your opinions
    - Do not react to 'wrong' answers
- Creating an interview…
    - Focus on the user's direct experience, not on fantasies, extrapolations, or 'would be' dreams
    - be matter fact

      "is X useful?": Wrong since the crietrion of evaluation is unclear

      "could you explain how X would help you in your work?": Correct
    - Keep each question focused on one topic
    - Keep questions non-judgemental
    - Keep questions open-ended

    - Avoid binary questions if they force the user to take a side

      "is X good or bad?": Wrong since it forces the user to a "black" or "white" position

      "rate from 1 to 5 (optimum) the quality of X": Correct

- Setting the interview:
    - Best in meaningful environment (contextual enquiry) e.g. work if about work
    - Explain what you are doing in their terms
    - Ask permission (ethics)
    - Record interview (additional permission required)
    - Opening questions e.g. what they do, how long they've done it, what their job involves, etc.
- Running the interview:
    - Don't ask leading questions (any question that suggests an answer is bad, wording, intonation, syntax)
    - Ask to clarify – when you don't understand something, when terms arise
    - Avoid interrupting – keep a notebook
    - Avoid generalizations
    - Indicate understanding rather than agreement
- Problems:
    - Close-ended questions instead of open-ended
    - Questions with complex answers made binary
    - Use of jargon or ambiguous terminology
    - Asking people to 'predict the future'
    - Invocation of authority (assuming that you know the answer and not paying enough attention to what the user says
    - Assuming that users can answer all your questions, sometimes people don't say what they believe
    - Sometimes people answer a different question to the one you asked
    - Videotaping is a good idea
- Wrap-up:
    - End the interview – summarise with them what you learned, thank and smile
    - Transcribe
- Strengths and weaknesses:
    - Interactive – researcher can drill deeper
    - Time efficient
    - Good interviewing is not easy
    - What they say vs what they do

Focus Groups:

- For IT applications, a series of tightly moderated group discussions
    - Preliminary phase – brainstorming, ideas, desires
    - Afterward – attitude, feelings, opinions
- Discussing ideas with target audience to elicit their feedback on developers'/designers' thoughts – not just observing, but also interacting

- Discussing their experience with specific user groups
- Steering discussion and probing but letting users explain their experience
- Commonly used...
    - Social, personal interaction
    - Public discussion
    - Highlights agreement, disagreement
    - People express their understanding
- Organisation:
    - Participants- choose the proper people, based on your target audience and the topic you want to discuss
    - Topic – choose the proper topic for the specific group of participants
    - Scope – determine in advance the number of groups and the purpose of each one of them
    - Discussion guide – prepare it carefully for each group
    - Moderator – neutral, non-judgemental, respectful, in control (not oppressive), getting to the end on time
    - Observers – they observe (take notes), it is better to videotape each focus group
- Participants…
    - People should be comfortable and free to speak
    - Choose homogenous people
    - Avoid experts on the topic
    - Avoid people likely to shut up for others
    - Avoid people 'aware' of focus groups
    - Avoid people who know each other
    - Avoid people who would feel evaluated
- Scope…
    - Don't trust a single focus group
    - About 4 groups is optimal – the first is like a general rehearsal, by the third there is a certain confidence, and the fourth is for confirmation
    - For detailed issues 6-8 participants is optimal, 8-12 for marketing research
    - Topics – 3-4 to be discussed, 10mins each
    - Not generic, not too focused
- Writing the guide…
    - Careful ordering of questions – from general to specific
    - Not directed, open-ended questions – get the people free to speak out
    - Focus on specifics
    - Unambiguous and personal
- Analysing…
    - Immediate debriefing
    - Use all material
    - Extract trends
    - Compare different opinions

    - Organise ideas: mental models, values, stories, problems, priorities, competitive values, terminology
- Weaknesses
    - Useless for usability information
    - Statistically irrelevant
    - They can be a basis for a survey, but not a substitute
    - They can reveal a phenomenon but not quantify it
    - The statements emerging should be interpreted (revealing attitudes more than facts), not taken at 'face value'

Data Analysis: Thematic Analysis:

- These methods result in lots of unstructured and messy data
- Audio must be transcribed – time consuming
- How do we make sense of this data?

Thematic Analysis:

- This allows us to draw together data based on abstract themes
- The themes are always emergent from the data
- This process is inductive
- First, we have to read and understand the data
- Then we break it down into chunks
- Then we code the data
- Reading and chunking…
    - Separate big blocks of text into smaller ones
    - Each block should be an idea
    - Read multiple times, read closely
    - Not interested in specific words used, but meaning of them
    - What are they telling us?
- Coding…
    - Many ways of doing this, depending on the philosophy behind the approach and what you are trying to find out – identifying recurring patterns of themes, categorising data, examining critical incidents
    - This is done independently by at least 2 researchers and results are compared for agreement

Simple Coding example

- **Interviewer**: Tell me about teens and drug use.
- **Respondent**: I think teens use drugs as a release from their parents ["**rebellious act**"]. Well, I don't know. I can only talk for myself. For me, it was an experience ["**experience**"] [in vivo code]. You hear a lot about drugs ["**drug talk**"]. You hear they are bad for you ["**negative connotation**" to the "**drug talk**"].

Naming Type	Description
In vivo codes	Wording that participants use in the interview
Constructed codes	Coded data from in vivo codes, Created by the researcher, Academic terms

- Identifying recurring themes…
  - This is the simplest type of analysis – often this is done first, then built upon with other methods
  - It is a high-level analysis
  - You are intending to get a broad picture
  - It should be completely inductive – you haven't decided in advance what the data may contain, allows yourself to be surprised/challenged
  - Read the text, noting on the transcript any patterns or themes that emerge – behaviour, places/contexts where important events happen, values
  - Identify themes and patterns from a sample of data (one participant, an excerpt of the transcript)
  - Try to apply those to the rest
  - At the end you should have a list of the most important themes from your data
  - But also, you will have easy to find raw data to back up your point – because they will be tagged with themes
  - This will help you report your data
- Memos…
  - Keep memos separate from data
  - Stop coding when an idea for memo occurs, so to not lose the thoughts
  - A memo can be brought to you by forcing it, by beginning to write about the code
  - When a lot of memos on different code appear similar, compare the codes for any differences that may have been missed. If the codes still seem the same, collapse two codes into one
  - When you have two ideas, add two separate memos to avoid confusion

Memos

Interviewer: Tell me about teens and drug use.
Respondent: I think teens use drugs as a release from their parents

Memo: The first thing that strikes me in this sentence is the word "use". This is a strange term because, when taken out of the context of drug taking, the word means that an object or a person is being employed for some purpose. It implies a willful and directed act. In making a comparison, when I think about a computer, I think about employing it to accomplish a task. I think of it as being at my disposal.

Respondent: I think teens use drugs as a release from their parents ["**rebellious act**"]. Well, I don't know. I can only talk for myself. For me, it was an experience ["**experience**"] [in vivo code]. You hear a lot about drugs ["drug talk"]. You hear they are bad for you ["**negative connotation**" to the "drug talk"]. There is a lot of them around ["**available supply**"]. You just get into them because they're accessible ["**easy access**"] and because it's kind of a new thing ["**novel experience**"]. It's cool! You know, it's something that is bad for you, taboo, a "no" ["**negative connection**"]. Everyone is against it ["**adult negative stance**"]. If you are a teenager, the first thing you are going to do is try them ["**challenge the adult negative stance**"].

Interviewer: Do teens experiment a lot with drugs?

Respondent: Most just try a few ["**limited experimenting**"]. It depends on where you are and how accessible they are ["**degree of accessibility**"]. Most don't really get into it hard-core [good in vivo concept] ["**hard-core use**" vs "**limited experimenting**"]. A lot of teens are into pot, hash, a little organic stuff ["**soft core drug types**"]. It depends on what phase of life you are at ["**personal developmental stage**"]. It's kind of progressive ["**progressive using**"]. You start off with the basic drugs like pot ["**basic drugs**"]. Then you go on to try more intense drugs like hallucinogens ["**intense drugs**"] [in vivo code].

- Categorising Data:
  - Much more detailed and technical analysis
  - Often (but not necessarily) there are categories in existence in advance – coding for usability issues etc.
  - Appropriate when you want the data in the form of structured categories – problems with menu navigation, frustration over interface features
- Reporting:
  - What you report depends on the analysis done
  - Generally, use evidence from the text to support your analysis
  - Thematic analysis – state a theme, an explanation of that theme, a quote illustrating that theme

Quantitative	Qualitative
Numbers	Words
Point of view of researcher	Point of view of participants
Research distance	Researcher close
Theory testing	Theory emergent
Static	Process
Structured	Unstructured
Generalisation	Contextual understanding
Hard, reliable data	Rich, deep data
Macro	Micro
Behaviour	Meaning
Artificial settings	Natural settings