



01: Interactive Systems & IxD, Usability & User Experience

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User-Centred System Design

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Session 1: Learning objectives



By completing this session, you should be able to:

- Identify contextual factors influencing design decisions and select appropriate interactive technologies for given situations.
- Describe what user-centred interaction design is, and where it can be applied.
- Explain the importance of usability and user experience, and the consequences of poor usability / a negative user experience.

Module foundation

Human-Computer Interaction (HCI)

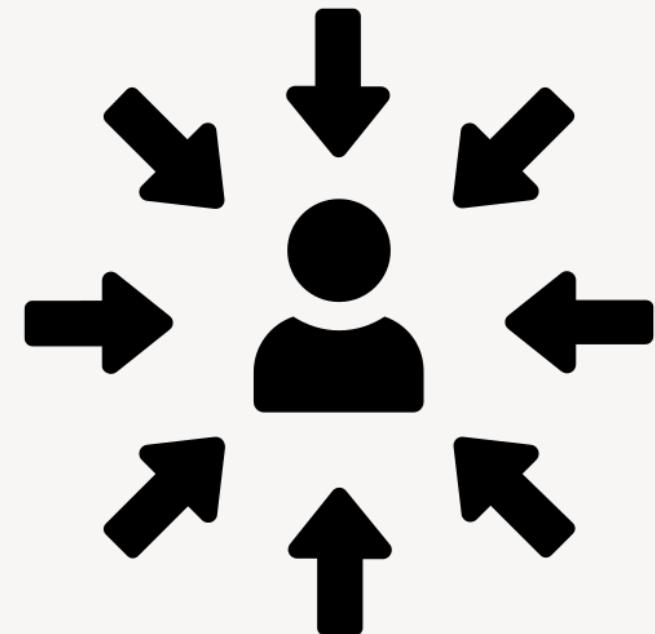
“Human-Computer Interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them”

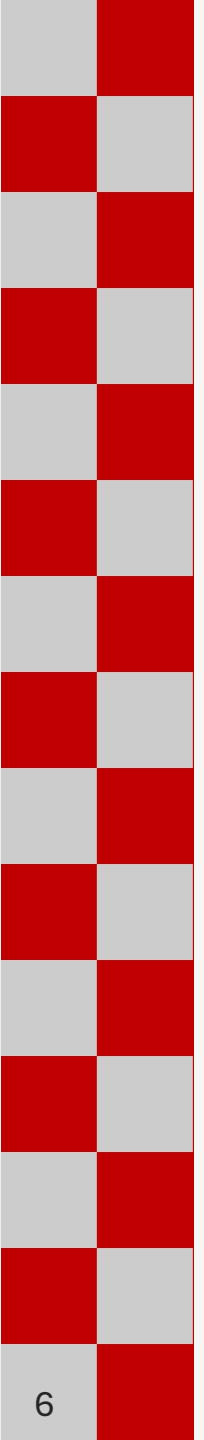
— ACM SIGCHI



User-Centred System Design **module ethos**

- Technology used by people should provide **good usability** and a **positive user experience**.
- When designing user-facing technology, it is crucial that we understand the **context of its use**, including the **people who will use it**.
- Successful user-facing technology is created by understanding the **goals, needs** and **behaviours** of current and potential **users**, and involving them in the design process, including through **user research**.
- It's rare to get design right first time, so it's important to **iterate**. We progressively improve our designs by **testing** them with users, and **learning** from these evaluations.





Interactive systems and technologies

Interactive systems and technologies

- Interactive systems deal with the transmission, display, storage or transformation of information.
- The technology of an interactive system ranges from components, devices, products and software systems that process information.
- Devices and systems that respond dynamically to people's actions. e.g. phones, websites, game controllers, but also clothes, buildings, cameras...
- Devices that:
 - allow users to input data and initiate actions—*input*
 - show the data that has been input and the actions that have been initiated (feedback); present the results of user actions—*output*

Interaction paradigms (non-exhaustive)

- Command line interfaces (CLI)
- WIMP / Desktop
- Hypertext / Web interfaces
- Graphical user interfaces (GUI)
- Voice interfaces (VUIs)
- Virtual/Augmented/Mixed reality (XR)
- Persuasive technologies.
- Ubiquitous / ambient computing.
- Tangible technologies.
- Affective technologies.
- Wearable interfaces.
- Brain–Computer Interfaces (BCIs)
- Multi-modal interfaces



Interaction types

Instructing : Users issue commands or select from options to make something happen.

Conversing : Interaction happens as a dialogue between the user and system.

Manipulating : Users interact with objects through direct action on them.

Exploring : User moves through an information space / environment to discover.

Responding : System initiates or invites actions based on context, data, or sensing.

Input devices

- Keyboard & keypads—digital or physical.
- Pointing devices—mouse, trackpad, joystick, stylus, game controllers...
- Touch & gesture devices—direct selection and touch gestures
- Voice input—recognize speech; mic + NLP
- Sensors, cameras, fingerprint scanners, barcode readers, wearables...



Output devices

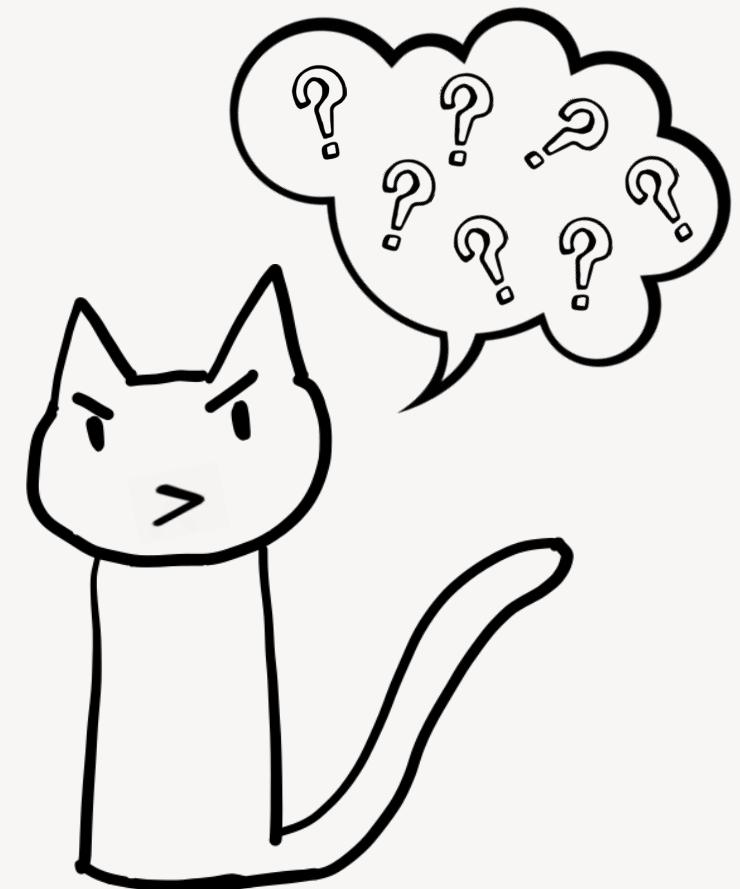
- Visual displays—screens; touchscreens, projectors, VR headsets, AR glasses
- Auditory output—for feedback, alerts, monitoring, visually intensive tasks; sounds or speech; speakers & headphones.
- Haptic & tactile output—force feedback / vibration from a phone, game controller, thimble, stylus, dataglove, wearable
- Olfactory & gustatory—digital scent or taste technology.
- Ambient & peripheral output—feedback in the environment; subtle changes or cues (colour, light, sound...)
- Print & tangible outputs—printers, 3D printers, Braille printers...



Touch X haptic device

Interaction technologies

What interactive technologies,
including input and output devices,
have you interacted with today?

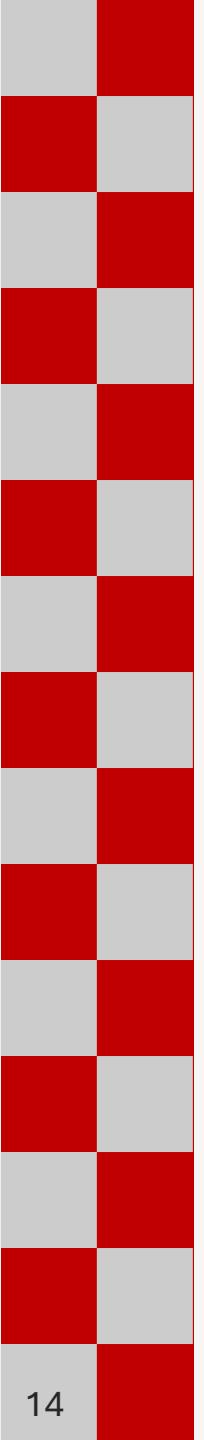


A user-centred approach to choosing or designing interaction technologies

Suitability is key. Think about:

- Task fit—e.g. drawing task requires an input device which readily supports continuous movement.
- User characteristics—e.g. experience, age, disabilities.
- Context of use—e.g. speech input not suitable for noisy environments, touch screen difficult if user cannot focus visual attention.
- Errors—Potential for error; consequence of error; cost to correct.
- Time to complete task.

Consider potential trade-offs between different options



Key concepts: **Interaction design (IxD)**

Interaction Design (IxD)

“is concerned with developing high quality interactive systems and products that fit with people and their ways of living”

From Designing Interactive Systems, by Benyon, Turner, and Turner, p5.

“designing interactive products to support the way people communicate and interact in their everyday and working lives”

From Interaction Design, by Preece, Sharp and Rogers, p8

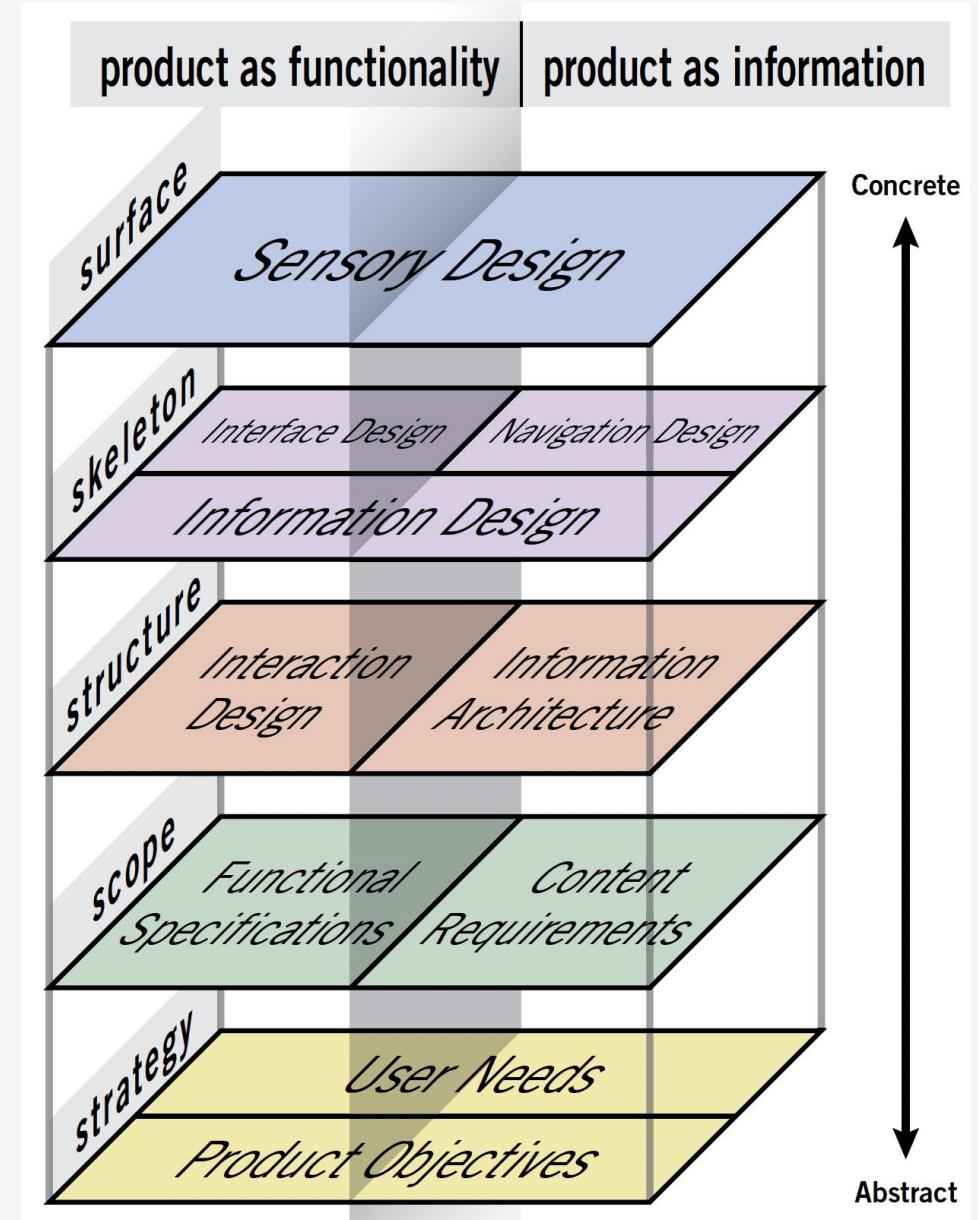
Interaction Design (**IxD**)

Designing the interactive aspects
of digital technologies, to deliver
successful, high-quality experiences

Interaction Design

- In the ‘5 Planes of User Experience’, Interaction Design is part of the ‘Structure’ plane.
- Interaction Design defines how the system behaves in response to the user.
- It’s about describing possible user behaviour and how the system will accommodate and respond to that behaviour.

From JJ Garrett (2011) The Elements of User Experience, Ch2 & Ch5



Where is interaction design applied?

Where might we want to take a user-centred approach to designing interactive systems?



Apps & websites

World Cuisine Guides

Our guides to world cuisine will help you learn about everything from culturally-specific equipment to the food history of dishes and traditions around the world.



WORLD CUISINES

The Drink of the Gods: An Introduction to Pulque

BY NAOMI TOMKY



THAI CUISINE
A Guide to Thai Paste
BY PAILIN CHAN

CHINESE CUISINE
The Sweet and Sour Guide
BY IDA YU



SOUTHEAST ASIAN CUISINES

Lao Food 101: Essential Dishes From Laos and Isaan



FOOD HISTORY
The History of Hibiscus Drinks in the African Diaspora



Explore World Cuisines

All

African Cuisines

Asian Cuisines

Caribbean Cuisines

Cen



AFRICAN CUISINES

The Joy of Eating Mutura,



AFRICAN CUISINES

A Beginner's Guide to South



FEATURES

A 'Typical' Breakfast in ... South

Smart TVs

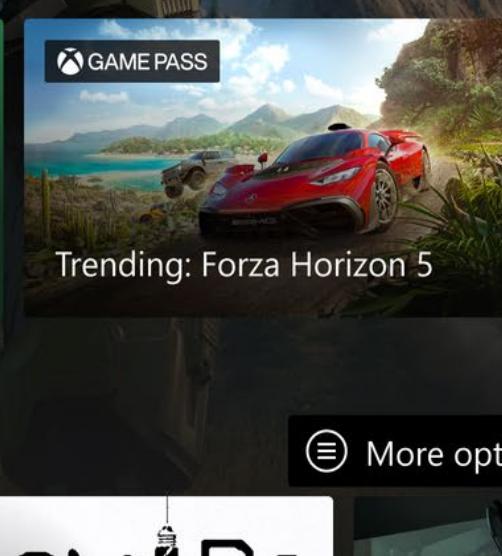
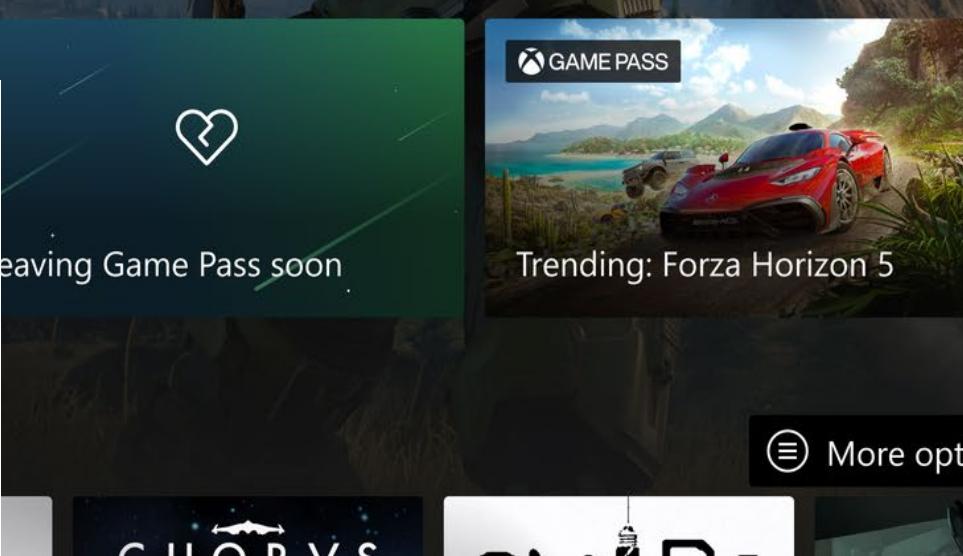


Smart Speakers / Connected Home



Games Consoles

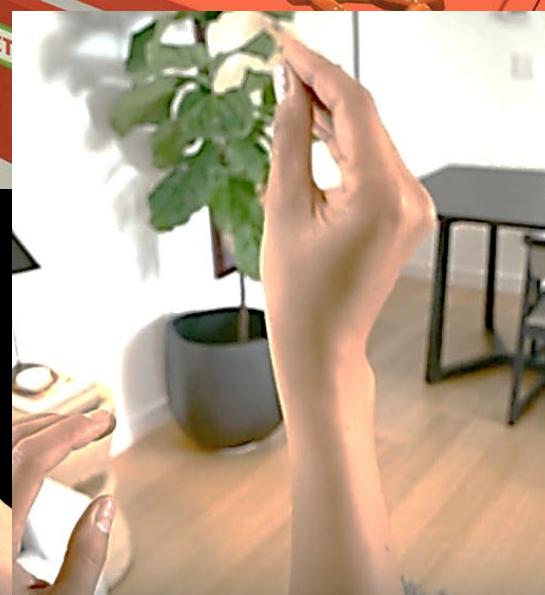
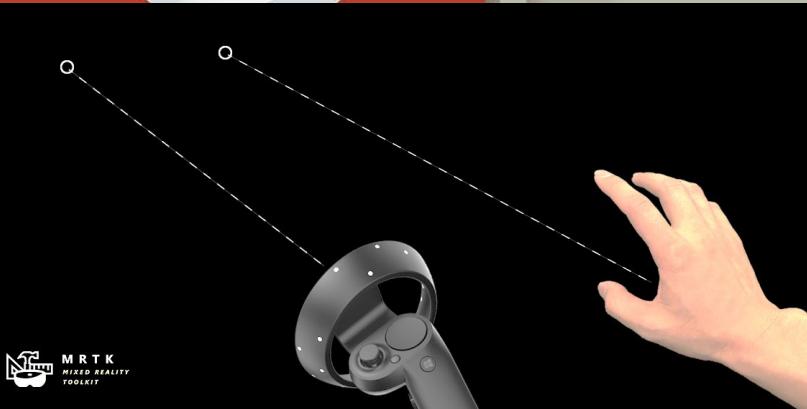
Jump back in



More options







EVA Park: City, University of London

A virtual world for people with communication impairments



Medical Systems



NASA's Shuttle flight control room



Spacecraft capsule



Connected cars

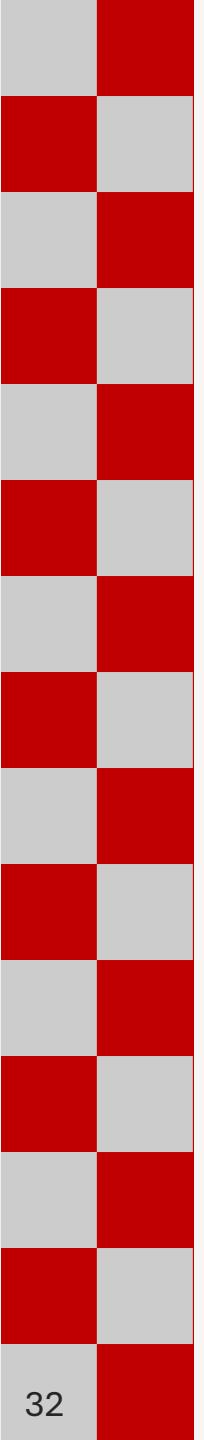


Wearable Tech



Questions?





Key concepts: **Usability & User Experience**

Two **key goals** of user-centred system design

- Good usability
- A positive user experience

Usability

“The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.”

International Organization for Standardization, ISO 9241

Ergonomics of human-system interaction

Part 210: Human-centred design for interactive systems

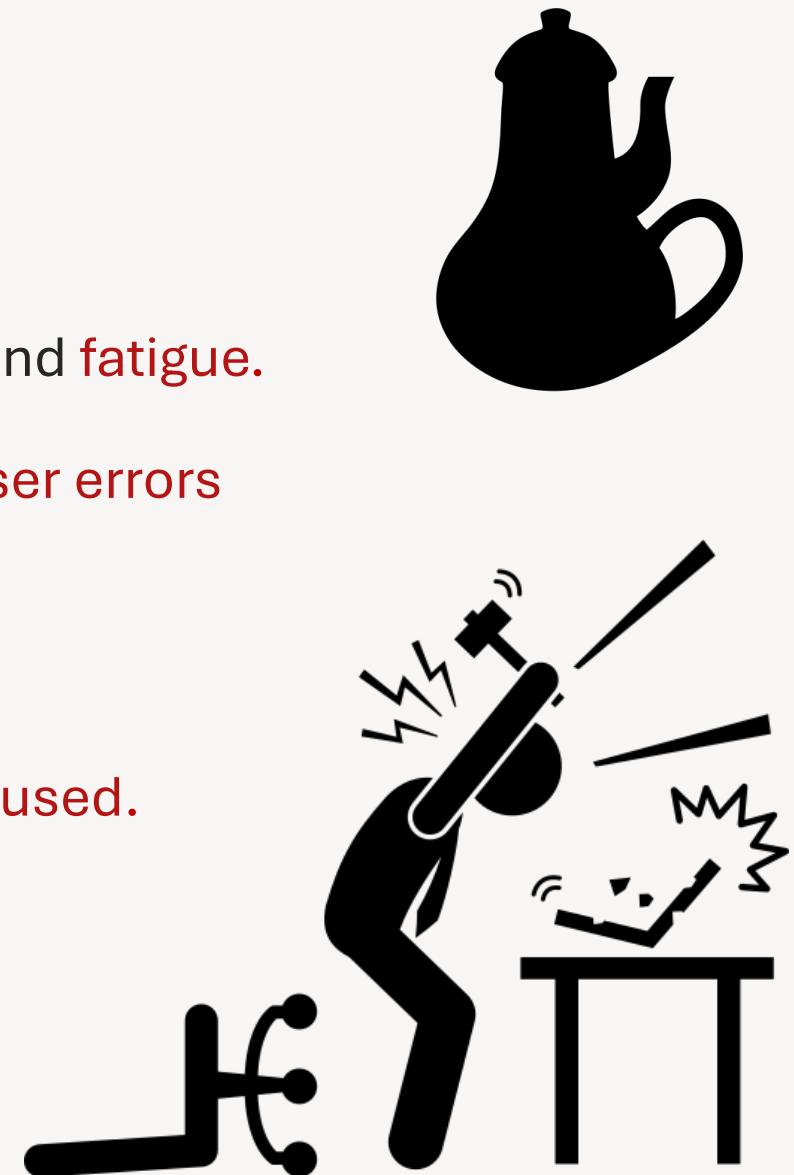
Usability unpacked

| | |
|----------------|--|
| User | A person who interacts with the system. Who they are, their attitudes, skills, abilities, motivations... |
| Goals | Users' <i>intended</i> outcomes. What do users want to do / achieve? |
| Context of use | Combination of users, goals and tasks, resources, and environment. What is the situation? |
| Effectiveness | How successful are users in achieving their goals? |
| Efficiency | Resources used in relation to the results. e.g. time, effort, cost... |
| Satisfaction | How users perceive the experience. To what extent do they feel their needs and expectations are met? |

Why worry about usability?

Poor usability leads to:

- Systems that cause users **frustration**, **stress** and **fatigue**.
- Systems that are **costly** to use, due to more **user errors** and **slower** operation speeds.
- **Unsafe** systems.
- Ultimately, systems that are **rejected** or **underused**.



Consequences of poor usability (example)

Fifth of rail passengers buy wrong ticket from machines, says regulator

Almost 20% of study's mystery passengers either paid too much for journey or paid too little, risking penalty fare



Almost three in five of those who took part said that the machines did not explain the times when off-peak tickets could be used. Photograph: Rick Findler/PA

*"About one in five train passengers using ticket machines could be either **paying too much** or be at risk of a penalty fare, the rail regulator has said.*

The Office of Rail and Road (ORR) carried out a study in which 13% of its mystery passengers chose more expensive tickets than required.

*A further 6% were at **risk of being fined** after underpaying by selecting inappropriate tickets for their journey.*

Britain's train operators should refund passengers who find they could have bought a cheaper ticket, the regulator concluded.

Two-thirds (65%) of the mystery passengers did not see any information on the type of tickets they could not buy on machines, while 57% reported that machines did not explain the times when off-peak tickets could be used."

Critical and deadly failures

Examples where poor usability has led to unsafe critical systems:

- *Therac-25*: A poorly designed radiotherapy interface let operators override safety checks, leading to fatal radiation overdoses.
- *Three Mile Island*: Confusing alarms and unclear indicators misled nuclear plant operators, worsening a reactor meltdown.
- *Air Inter Flight 148*: Ambiguous autopilot modes caused pilots to set the wrong descent rate, resulting in a fatal crash.
- *London Ambulance Dispatch*: An unreliable and hard-to-use dispatch system delayed emergency responses, contributing to patient deaths.

We cannot simply attribute problems to ‘human error’.

The error lies in the design of the systems that people are expected to use.

Blame the system, not the user

“The user is always right. If there is a problem with the use of the system, the system is the problem, not the user.”

— From The User’s Bill of Rights, (Karat 1998)

Summary list: <https://theomandel.com/resources/users-bill-of-rights>

Full article: <https://dl.acm.org/doi/10.1145/290133.290144>

Usability goals

- **Effective to use** (effectiveness)—how well users can achieve their goals
- **Efficient to use** (efficiency)—how quickly and with how little effort tasks can be performed
- **Safe to use** (safety)—protecting users from dangerous conditions, errors, or loss
- **Having good utility** (utility)—the range of functions that the system provides to meet user needs
- **Easy to learn** (learnability)—how quickly new users can begin effective interaction and reach proficiency
- **Easy to remember how to use** (memorability)—whether users can return to a system after time away and still use it effectively
- **Enjoyable to use** (satisfaction)—Goes beyond function to emotional response: whether interaction is pleasant and engaging

What is important for the system you are designing/evaluating?

Good usability (from Benyon, 2019)

A system with a high degree of usability will have the following characteristics:

- It will be **efficient** in that people will be able to do things using an appropriate amount of effort.
- It will be **effective** in that it contains the appropriate functions and information content, organized in an appropriate manner.
- It will be **easy to learn** how to do things and **remember** how to do them after a while.
- It will be **safe to operate** in the variety of contexts in which it will be used.
- It will have **high utility** in that it does the things that people want to get done.

From: Benyon, D. (2019) *Designing User Experience*. p108

User Experience

“A person’s perceptions and responses that result from the use or anticipated use of a product, system, or service”

International Organization for Standardization, ISO 9241
Ergonomics of human-system interaction
Part 210: Human-centred design for interactive systems

User Experience

“User experience encompasses all aspects of the end-user’s interaction...

The first requirement for an exemplary user experience is to meet the exact needs of the customer, without fuss or bother.

Next comes simplicity and elegance which produces products that are a joy to own, a joy to use.”

Nielsen Norman Group

[https://www.youtube.com
/watch?v=9BdtGjoIN4E](https://www.youtube.com/watch?v=9BdtGjoIN4E)



NN/g

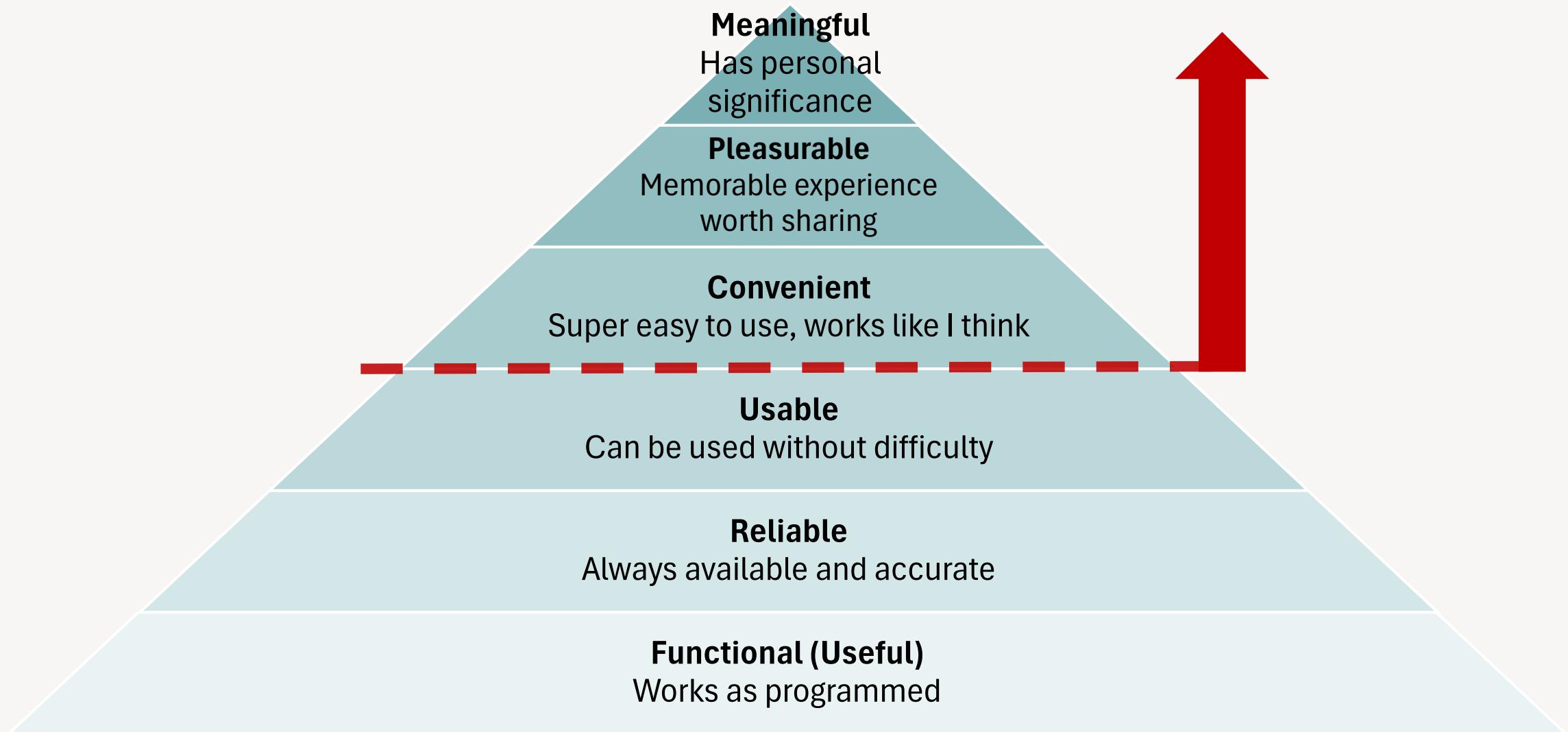
**Don Norman:
The Term UX**



Is it just about making attractive websites and apps?

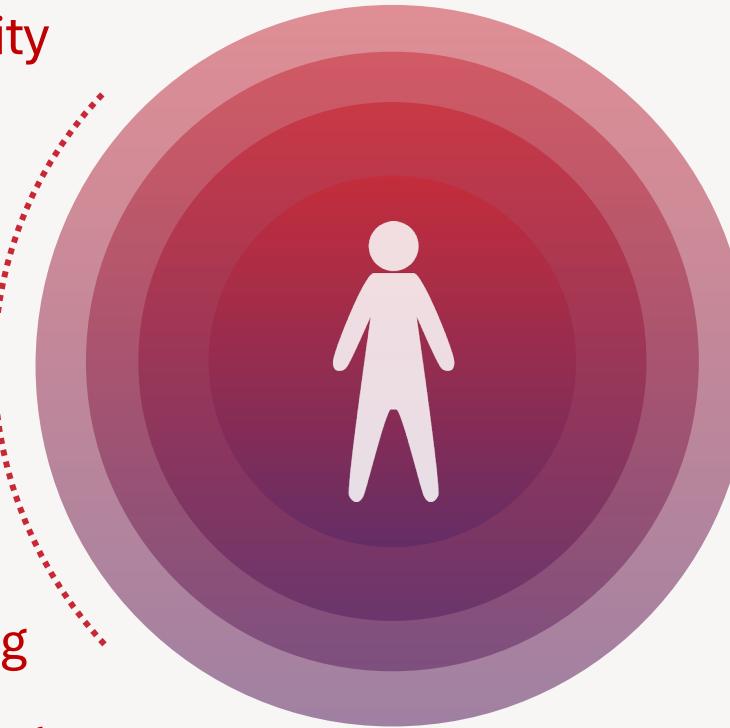
NO! You must consider a user's whole experience beyond just the interface!

More than just usable!



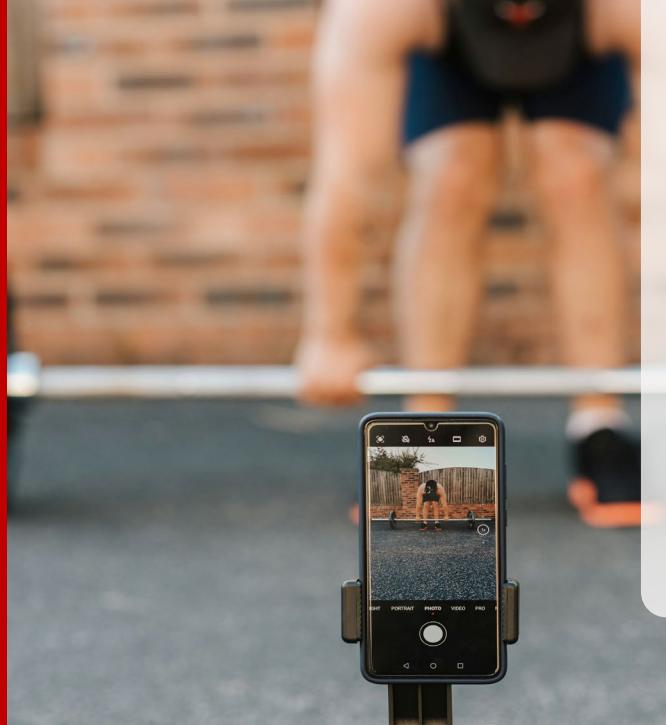
Elements of the User Experience

- Supportive of creativity
- Emotionally fulfilling
- Rewarding
- Fun
- Helpful
- Motivating
- Entertaining
- Aesthetically pleasing
- Cognitively stimulating
- ...

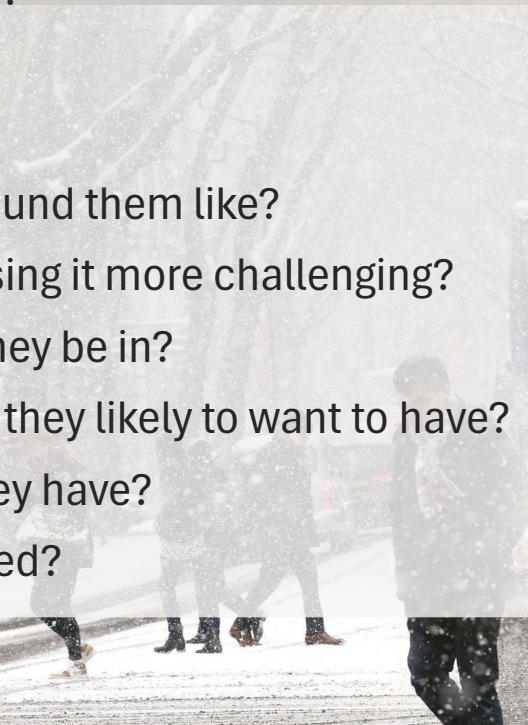


Being functional is no longer enough! – People expect a good user experience from every product they use.

UX can be what separates your system/product from those of your competitors.



- ## Context
- Who is using the technology?
 - What are they using it for?
 - Where are they using it?
 - What is the environment around them like?
 - Anything that might make using it more challenging?
 - What frame of mind might they be in?
 - What kind of experience are they likely to want to have?
 - What expectations might they have?
 - What support might they need?



Usability and user experience are both important

Successful interactive systems need

great usability

and an

awesome user experience...

How can we design for excellent usability and user experience?

- Understand users, what they do, their capabilities and limitations, desires, needs, motivations and contexts.
- Understand business, technical and domain opportunities, requirements and constraints.

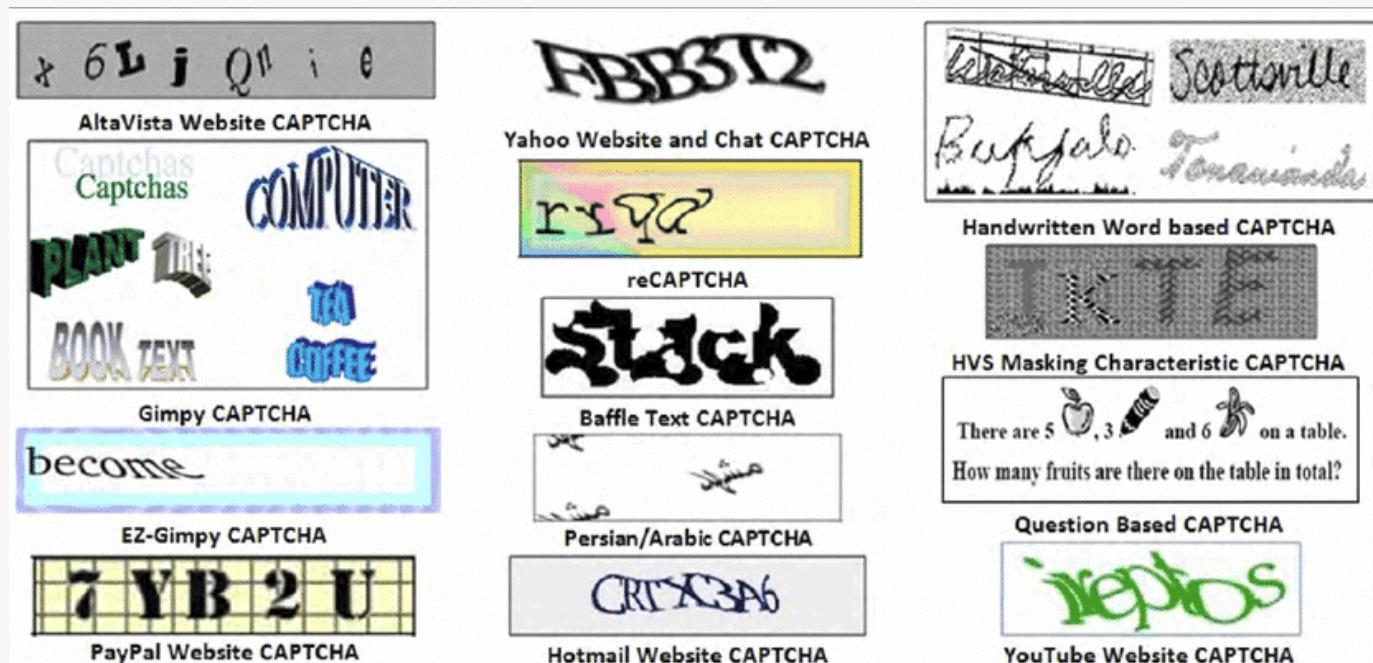
And then use this knowledge as a foundation to create interactive digital technologies whose form, content and behaviour is useful, usable and desirable, as well as economically viable and technically feasible.

(Adapted from: Cooper, A. et al (2014) About Face)

Bad design

Bad UX Examples (Interaction Design Foundation)

<https://www.interaction-design.org/literature/article/bad-ux-examples>



Session 1 Summary

- There are many, varied interaction systems and technologies.
- When designing interactive systems for people to use, understanding the context of use is important.
- Usability is critical for the effective, enjoyable and safe use of interactive systems.
- User experience goes beyond usability, to consider how people feel, and encompasses their whole experience.
- Bad or poor design can have adverse consequences—sometimes critical.

Questions?

