DES102: Introduction to Human Computer Interaction

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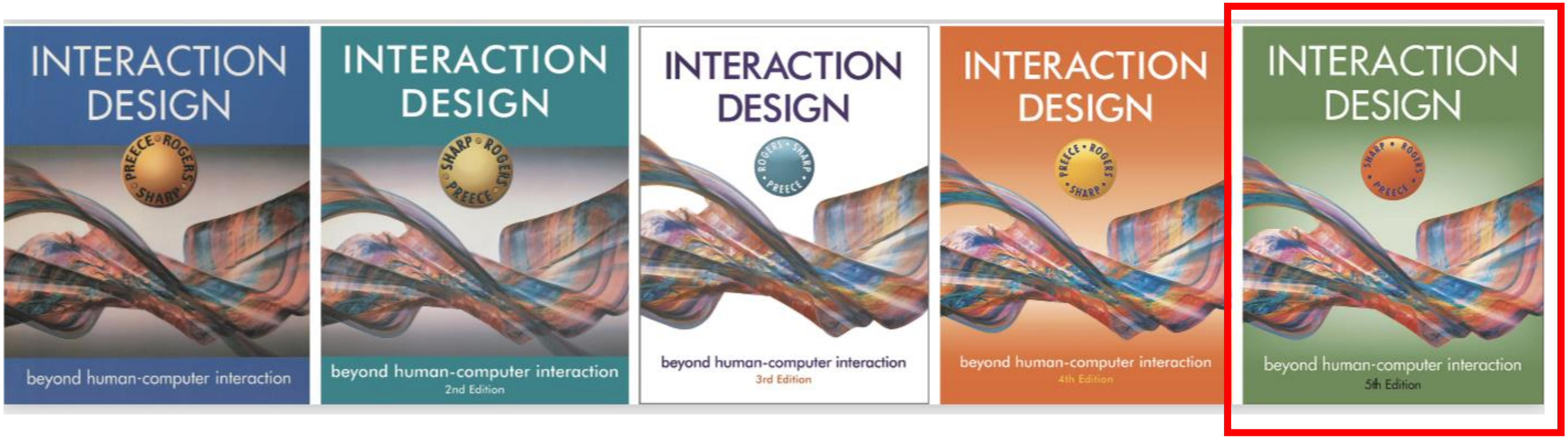
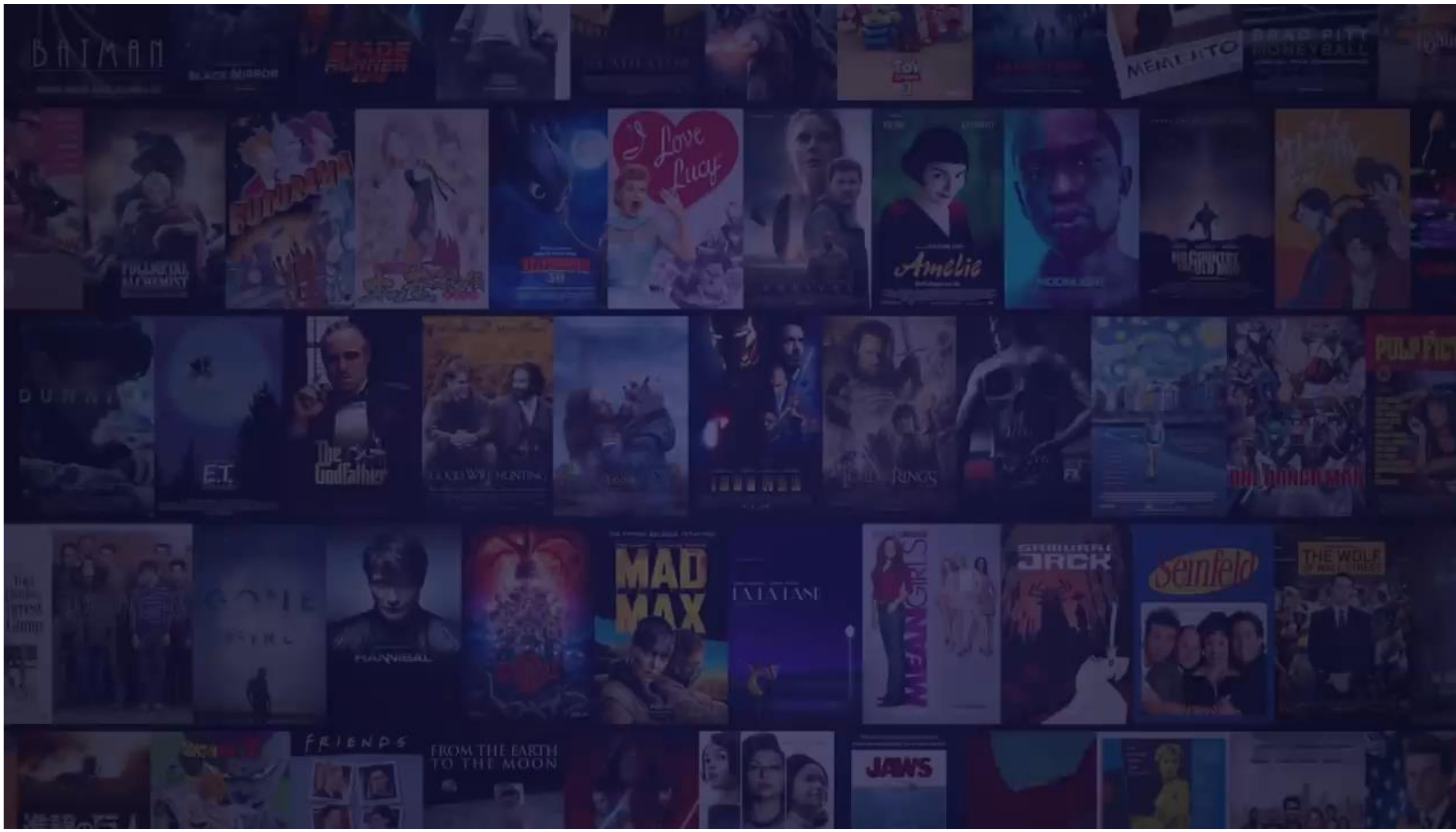


Interaction Design: Beyond Human-Computer Interaction. 2019. (5th Edition) by
Jenny Preece, Helen Sharp, Yvonne Rogers (Wiley)

Why do we need to study design?



https://www.youtube.com/watch?v=z8xh_AjPEEM

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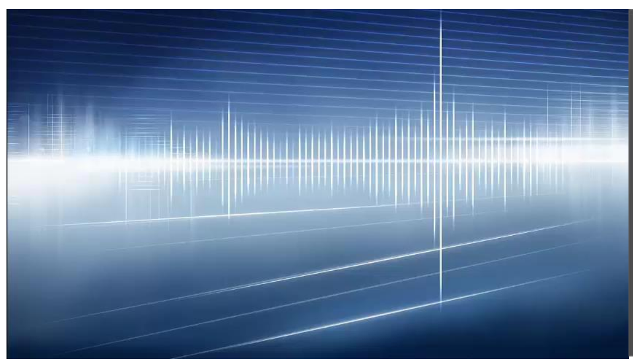

MIDAS@IIITD

Multimodal Digital Media Analysis Lab

https://midas.iiitd.edu.in/

https://instagram.com/midasiiitd https://facebook.com/midasiiitd
https://twitter.com/midasiiitd https://linkedin.com/company/midasiiitd

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    - **NSUT**: Ramit Sahwney, Puneet Mathur, Avinash Swaminathan, Rohit Jain, Hritwik, *etc.*
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    - **Academia**: CMU, Columbia University, University of Pennsylvania, University of Maryland, University of Southern California, Erasmus Mundus, University of Virginia, Georgia Tech, *etc.*

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- Dr. Mika Hama*, SLTI, USA, and many more...*

Good vs Bad Design (HCI)

https://www.youtube.com/watch?v=Il8TOCsoMK0

What is HCI?

https://www.youtube.com/watch?v=KtvwustmEDI

HCI

"The strength and tradition of HCI has been in its **human-centredness**, **usability and accessibility concerns**. HCI has evolved methods, guidelines, principles and standards to ensure that systems are easy to use and easy to learn."

Which **interactive product** do you use in daily life?

Aims and Objectives

- Students will be able to discuss and distinguish human computer interaction, user experience design, and design thinking.
- Students will be able to apply user centered design, and techniques for gathering data, rapid prototyping, as well as conveying design concepts.
- Students will be able to assess usefulness and usability of interaction designs.
- Students will be able to ideate, prototype, and evaluate new design concepts as part of group projects.

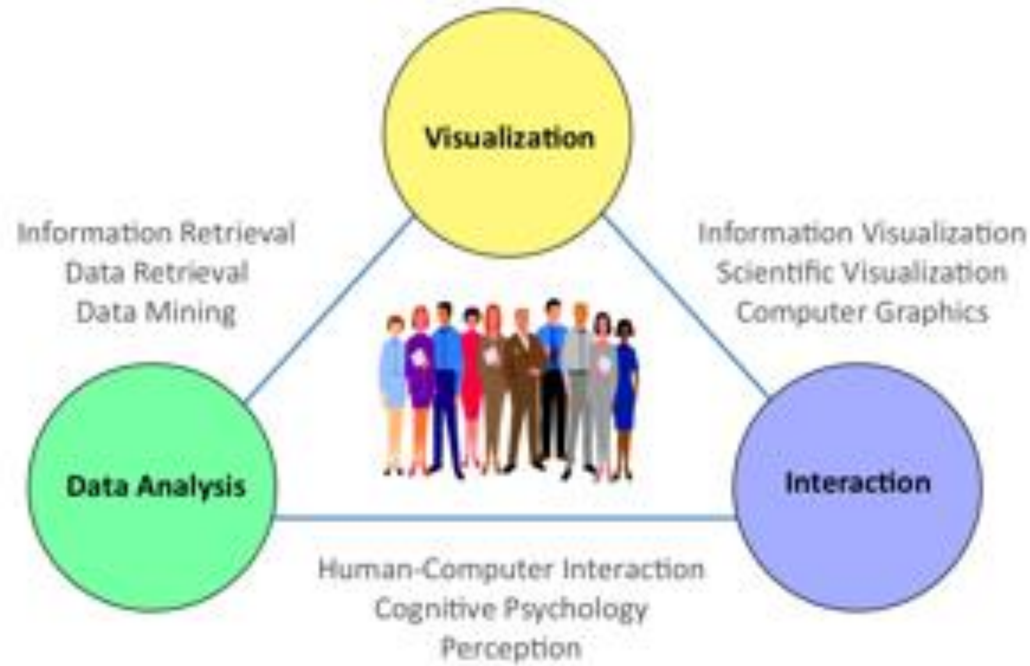
Schedule

Week#	Lecture Topic
1	Introduction to HCI / Chapter 1
2	What is Design (Pt. 1) / Chapter 1 & 2
3	What is Design (Pt. 2) / Chapter 1 & 2
4	What is Interaction (Pt. 1) / Chapter 3
5	What is Interaction (Pt. 2) / Chapter 3
6	What is the User Perspective (Pt. 1) / Chapters 4, 5, and 6
7	What is the User Perspective (Pt. 2) / Chapters 4, 5, and 6
	Mid-Term Exam - Multiple Choice Questions
	Mid Recess Break
8	What is an Interface (Pt. 1) / Chapter 7
9	What is Data Requirement, Gathering and Analysis / Chapters 8, 9,10, and 11
10	Iterative Design (Pt. 1) / Chapters 12 and 13
11	Iterative Design (Pt. 2) / Chapters 12 and 13
12	Iterative Design (Pt. 3) / Chapters 12 and 13
13	Evaluation / Chapters 14, 15, and 16

Evaluation

Type of Evaluation	% Contribution in Grade
Continuous Assignments	20%
Project	30% (10% Presentations upto Mid Sem + 10% Presentations upto End Sem + 10% End Term Compilation of the entire process woven into a Final Presentation)
Mid-sem	10%
End-sem	20%
Quizzes	20%

Designing Different Interactive Systems



- **Social interaction is increasingly important to UX and ID**
- **Hearing, haptics (touch) and other ways of perceiving the world are considered alongside the psychology**

What you can currently do using **digital technology**?

Can you comment on their design?

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What is Design

https://www.youtube.com/watch?v=MS8p-CgTJIg

Project Guideline from Google

https://www.youtube.com/watch?v=C_h4HnKVptk

Visual Speech Recognition

What is lipreading?

Lipreading is recognizing what is being spoken from video input only, without any audio. *i.e.,*

silent video -> text / audio/ video with audio

- Lipreading a text
- Lipreading as speech
- Lipreading for pathology
- Adding new classes in Lipreading

Let's put your lip reading abilities to test

(SHOW OF HANDS)

CONFIDENCE

CONFERENCE

CONCERNS

CONFLICT

CONFIDENCE

CONFERENCE

CONCERNS

CONFLICT

MOBIVSR Predictions:

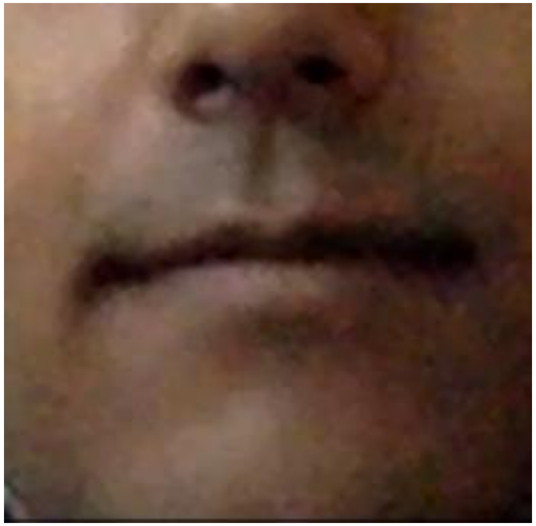
CONFERENCE	65%
CONFLICT	20%
OFFICERS	10%
OFFICE	5%

SPECIAL

SPONGE

DESPERATION

SPEECH



SPECIAL

SPONGE

DESPERATION

SPEECH

MOBIVSR Predictions:

SPEECH	85%
BRITISH	10%
PRESSURE	2%
INFLATION	1%

Let’s jump to MobiVSR difficulty level.
Your options:

ABOUT
ABSOLUTELY
ABUSE
ACCESS
ACCORDING
ACCUSED
ACROSS
ACTION
ACTUALLY
AFFAIRS
AFFECTED
AFRICA
AFTER
AFTERNOON
AGAIN
AGAINST
AGREE
AGREEMENT
AHEAD
ALLEGATION
S
ALLOW
ALLOWED
ALMOST
ALREADY
ALWAYS
AMERICA
AMERICAN
AMONG
AMOUNT
ANNOUNCED
ANOTHER
ANSWER
ANYTHING
AREAS
AROUND
ARRESTED
ASKED
ASKING
ATTACK
ATTACKS
AUTHORITIE
S
BANKS

BECAUSE
BECOME
BEFORE
BEHIND
BEING
BELIEVE
BENEFIT
BENEFITS
BETTER
BETWEEN
BIGGEST
BILLION
BLACK
BORDER
BRING
BRITAIN
BRITISH
BROUGHT
BUDGET
BUILD
BUILDING
BUSINESS
BUSINESSES
CALLED
CAMERON
CAMPAIGN
CANCER
CANNOT
CAPITAL
CASES
CENTRAL
CERTAINLY
CHALLENGE
CHANCE
CHANGE
CHANGES
CHARGE
CHARGES
CHIEF
CHILD
CHILDREN
CHINA

CLAIMS
CLEAR
CLOSE
CLOUD
COMES
COMING
COMMUNITY
COMPANIES
COMPANY
CONCERNS
CONFERENCE
CONFLICT
CONSERVATIV
E
CONTINUE
CONTROL
COULD
COUNCIL
COUNTRIES
COUNTRY
COUPLE
COURSE
COURT
CRIME
CRISIS
CURRENT
CUSTOMERS
DAVID
DEATH
DEBATE
DECIDED
DECISION
DEFICIT
DEGREES
DESCRIBED
DESPITE
DETAILS
DIFFERENCE
DIFFERENT
DIFFICULT
DOING
DURING
EARLY

EARLY
EASTERN
ECONOMIC
ECONOMY
EDITOR
EDUCATION
ELECTION
EMERGENCY
ENERGY
ENGLAND
ENOUGH
EUROPE
EUROPEAN
EVENING
EVENTS
EVERY
EVERYBODY
EVERYONE
EVERYTHING
EVIDENCE
EXACTLY
EXAMPLE
EXPECT
EXPECTED
EXTRA
FACING
FAMILIES
FAMILY
FIGHT
FIGHTING
FIGURES
FINAL
FINANCIAL
FIRST
FOCUS
FOLLOWING
FOOTBALL
FORCE
FORCES
FOREIGN
FORMER
FORWARD

FOUND
FRANCE
FRENCH
FRIDAY
FRONT
FURTHER
FUTURE
GAMES
GENERAL
GEORGE
GERMANY
GETTING
GIVEN
GIVING
GLOBAL
GOING
GOVERNMENT
GREAT
GREECE
GROUND
GROUP
GROWING
GROWTH
GUILTY
HAPPEN
HAPPENED
HAPPENING
HAVING
HEALTH
HEARD
HEART
HEAVY
HIGHER
HISTORY
HOMES
HOSPITAL
HOURS
HOUSE
HOUSING
HUMAN
HUNDREDS
IMMIGRATION

IMPACT
IMPORTANT
INCREASE
INDEPENDENT
INDUSTRY
INFLATION
INFORMATION
INQUIRY
INSIDE
INTEREST
INVESTMENT
INVOLVED
IRELAND
ISLAMIC
ISSUE
ISSUES
ITSELF
JAMES
JUDGE
JUSTICE
KILLED
KNOWN
LABOUR
LARGE
LATER
LATEST
LEADER
LEADERS
LEADERSHIP
LEAST
LEAVE
LEGAL
LEVEL
LEVELS
LIKELY
LITTLE
LIVES
LIVING
LOCAL
LONDON
LONGER
LOOKING

MAJOR
MAJORITY
MAKES
MAKING
MANCHESTER
MARKET
MASSIVE
MATTER
MAYBE
MEANS
MEASURES
MEDIA
MEDICAL
MEETING
MEMBER
MEMBERS
MESSAGE
MIDDLE
MIGHT
MIGRANTS
MILITARY
MILLION
MILLIONS
MINISTER
MINISTERS
MINUTES
MISSING
MOMENT
MONEY
MONTH
MONTHS
MORNING
MOVING
MURDER
NATIONAL
NEEDS
NEVER
NIGHT
NORTH
NORTHERN
NOTHING
NUMBER
NUMBERS
OBAMA
OFFICE

OFFICERS
OFFICIALS
OFTEN
OPERATION
OPPOSITION
ORDER
OTHER
OTHERS
OUTSIDE
PARENTS
PARLIAMENT
PARTIES
PARTS
PARTY
PATIENTS
PAYING
PEOPLE
PERHAPS
PERIOD
PERSON
PERSONAL
PHONE
PLACE
PLACES
PLANS
POINT
POLICE
POLICY
POLITICAL
POLITICIANS
POLITICS
POSITION
POSSIBLE
POTENTIAL
POWER
POWERS
PRESIDENT
PRESS
PRESSURE
PRETTY
PRICE
PRICES
PRIME
PRISON
PRIVATE

PROBABLY
PROBLEM
PROBLEMS
PROCESS
PROTECT
PROVIDE
PUBLIC
QUESTION
QUESTIONS
QUITE
RATES
RATHER
REALLY
REASON
RECENT
RECORD
REFERENDUM
REMEMBER
REPORT
REPORTS
RESPONSE
RESULT
RETURN
RIGHT
RIGHTS
RULES
RUNNING
RUSSIA
RUSSIAN
SAYING
SCHOOL
SCHOOLS
SCOTLAND
SCOTTISH
SECOND
SECRETARY
SECTOR
SECURITY
SEEMS
SENIOR
SENSE
SERIES
SERIOUS
SERVICE
SERVICES

SEVEN
SEVERAL
SHORT
SHOULD
SIDES
SIGNIFICANT
SIMPLY
SINCE
SINGLE
SITUATION
SMALL
SOCIAL
SOCIETY
SOMEONE
SOMETHING
SOUTH
SOUTHERN
SPEAKING
SPECIAL
SPEECH
SPEND
SPENDING
SPENT
STAFF
STAGE
STAND
START
STARTED
STATE
STATEMENT
STATES
STILL
STORY
STREET
STRONG
SUNDAY
SUNSHINE
SUPPORT
SYRIA
SYRIAN
SYSTEM
TAKEN
TAKING
TALKING
TALKS

TEMPERATURE
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THING
THINGS
THINK
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THOSE
THOUGHT
THOUSANDS
THREAT
THREE
THROUGH
TIMES
TODAY
TOGETHER
TOMORROW
TONIGHT
TOWARDS
TRADE
TRIAL
TRUST
TRYING
UNDER
UNDERSTAND
UNION
UNITED
UNTIL
USING
VICTIMS
VIOLENCE
VOTERS
WAITING
WALES
WANTED
WANTS
WARNING
WATCHING
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WEAPONS
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WEEKEND

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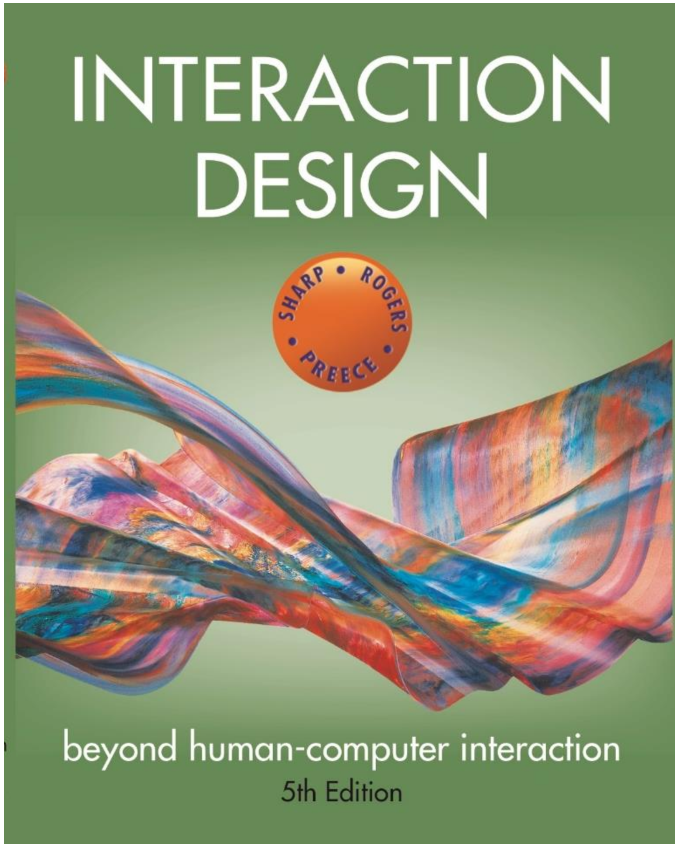
WITHIN
WITHOUT
WOMEN
WORDS
WORKERS
WORKING
WORLD
WORST
WOULD
WRONG
YEARS
YESTERDAY
YOUNG

MOBIVSR Predictions:

DIFFICULT	40%
GIVING	20%
GIVEN	10%
EVERYTHING	5%



Chapter 1

WHAT IS INTERACTION DESIGN?

Weeks 1-3

1 WHAT IS INTERACTION DESIGN?

1.1 Introduction
1.2 Good and Poor Design
1.3 What Is Interaction Design?
1.4 The User Experience
1.5 Understanding Users
1.6 Accessibility and Inclusiveness
1.7 Usability and User Experience Goals

Interview with Harry Brignull

2 THE PROCESS OF INTERACTION DESIGN

2.1 Introduction
2.2 What Is Involved in Interaction Design?
2.3 Some Practical Issues

Objectives

Objectives

The main goals of this chapter are to accomplish the following:

- Explain the difference between good and poor interaction design.
- Describe what interaction design is and how it relates to human-computer interaction and other fields.
- Explain the relationship between the user experience and usability.
- Introduce what is meant by accessibility and inclusiveness in relation to human-computer interaction.
- Describe what and who is involved in the process of interaction design.
- Outline the different forms of guidance used in interaction design.
- Enable you to evaluate an interactive product and explain what is good and bad about it in terms of the goals and core principles of interaction design.

Bad designs

Elevator controls and labels on the bottom row all look the same, so it is easy to push a label by mistake instead of a control button.

www.baddesigns.com

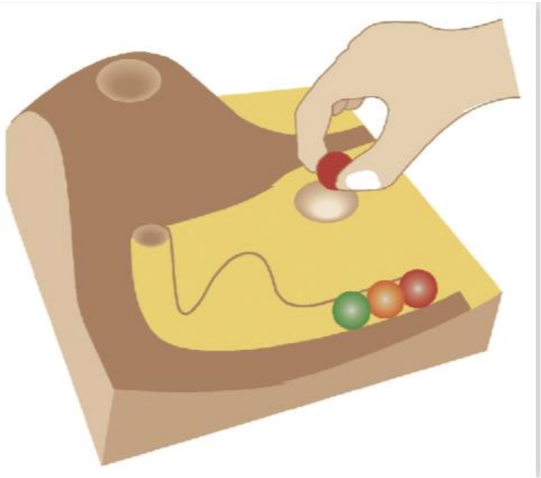
People do not make same mistake for the labels and buttons on the top row. Why not?

Why is this vending machine so bad?

www.baddesigns.com

- Need to push button first to activate reader
- Normally insert bill first before making selection
- Contravenes well known convention

Good design



- Marble answering machine (Bishop, 1995)
- Based on how everyday objects behave
- Easy, intuitive, and a pleasure to use
- Only requires one-step actions to perform core tasks

Good and bad design

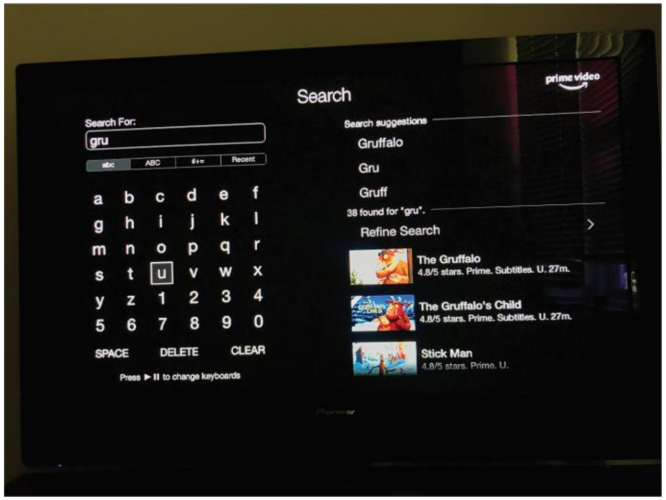
Why is the TiVo remote much better designed than standard remote controls?

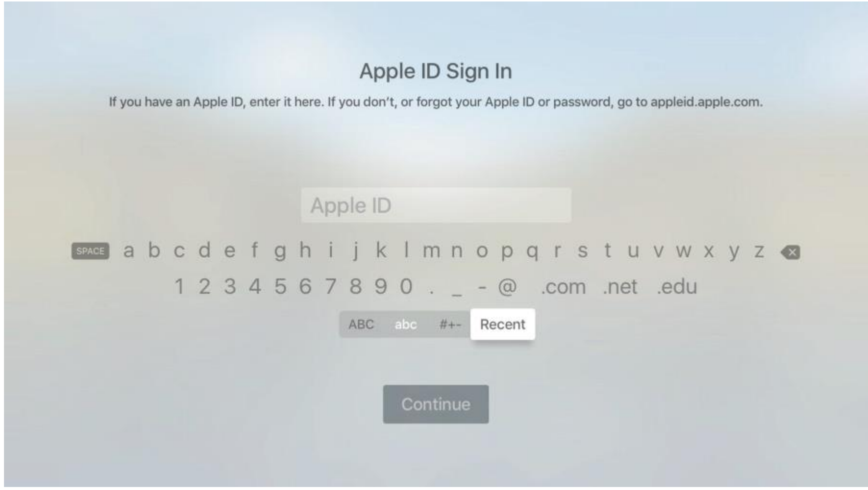
- Peanut shaped to fit in hand
- Logical layout and color-coded, distinctive buttons
- Easy-to-locate buttons

Dilemma

Which is the best way to interact with a smart TV? Why?

- Pecking using a grid keyboard via a remote control
- Swiping across two alphanumeric rows using a touchpad on a remote control
- Voice control using remote or smart speaker





Top 10 Web-Design Mistakes of 2021

https://www.youtube.com/watch?v=VGxze7xMYJs

What to design

Need to take into account:

- Who the users are
- What activities are being carried out
- Where interaction is taking place

Need to optimize the interactions users have with a product:

- So that they match the users' activities and needs

What is interaction design?

"Designing interactive products to support the way people **communicate** and **interact** in their everyday and working lives."

Sharp, Rogers, and Preece (2019)

"The design of spaces for human communication and interaction."

Winograd (1997)

Goals of interaction design

Develop usable products

- Usability means easy to learn, effective to use, and provides an enjoyable experience

Involve users in the design process

Which kind of design?

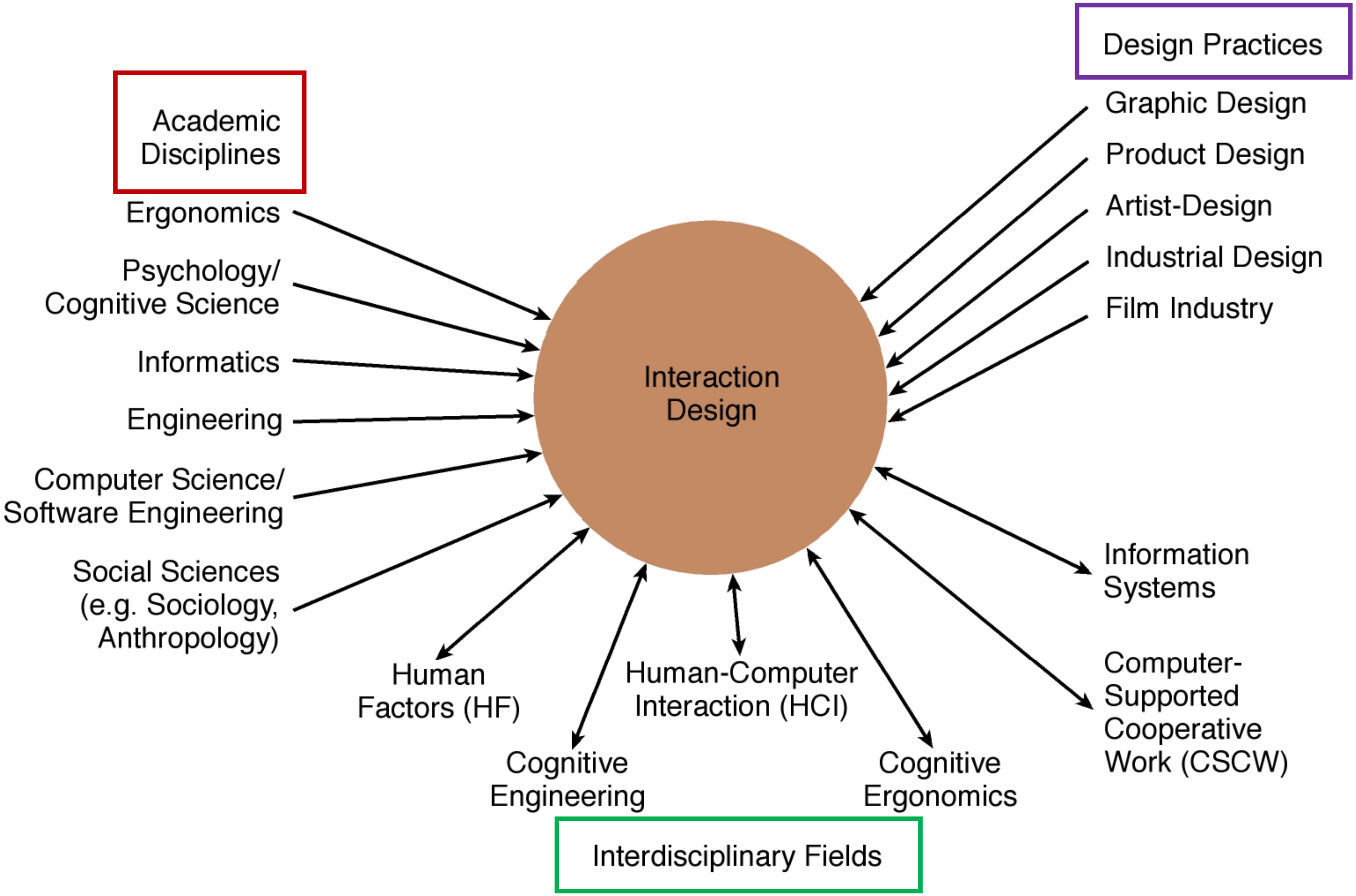
Number of other terms used emphasizing what is being designed, for example:

- User interface design, software design, user-centered design, product design, web design, experience design (UX)

Interaction design is the umbrella term covering all of these aspects:

- Fundamental to all disciplines, fields, and approaches concerned with researching and designing computer-based systems for people

Interaction design



Understanding of the Users

- Considering what people are good and bad at
- Considering what might help people with the way they currently do things
- Thinking through what might provide quality user experiences
- Listening to what people want and getting them involved in the design
- Using user-centered techniques during the design process

Relationship between ID, HCI, and other fields−academic disciplines

Academic disciplines contributing to ID:

- Psychology
- Social Sciences
- Computing Sciences
- Engineering
- Ergonomics
- Informatics

Relationship between ID, HCI and other fields−design practices

Design practices contributing to ID:

- Graphic design
- Product design
- Artist-design
- Industrial design
- Film industry

Relationship between ID, HCI and other fields−interdisciplinary fields

Interdisciplinary fields that ‘do’ interaction design:

- HCI
- Ubiquitous Computing
- Human Factors
- Cognitive Engineering
- Cognitive Ergonomics
- Computer Supported Co-operative Work
- Information Systems

Working in multidisciplinary teams

- Many people from different backgrounds involved
- Different perspectives and ways of seeing and talking about things

Benefits

- More ideas and designs generated

Disadvantages

- Difficult to communicate and progress forward the designs being create

ACTIVITY 1.1

In practice, the makeup of a given design team depends on the kind of interactive product being built. Who do you think should be involved in developing

- A public kiosk providing information about the exhibits available in a science museum?
- An interactive educational website to accompany a TV series?

Comment

Ideally, each team will have a number of different people with different skill sets. For example, the first interactive product would include the following individuals:

- Graphic and interaction designers, museum curators, educational advisers, software engineers, software designers, and ergonomists

The second project would include these types of individuals:

- TV producers, graphic and interaction designers, teachers, video experts, software engineers, and software designers

In addition, as both systems are being developed for use by the general public, representative users, such as school children and parents, should be involved.

In practice, design teams often end up being quite large, especially if they are working on a big project to meet a fixed deadline. For example, it is common to find teams of 15 or more people working on a new product like a health app. This means that a number of people from each area of expertise are likely to be working as part of the project team. ■

Interaction design in business

Large number of ID consultancies. Examples of well known ones include:

- **Nielsen Norman Group**: "help companies enter the age of the consumer, designing human-centered products and services"
- **Cooper:** "From research and product to goal-related design"
- **IDEO: "**creates products, services and environments for companies pioneering new ways to provide value to their customers"

The user experience

How a product behaves and is used by people in the real world

- The way people feel about it and their pleasure and satisfaction when using it, looking at it, holding it, and opening or closing it
- “Every product that is used by someone has a user experience: newspapers, ketchup bottles, reclining armchairs, cardigan sweaters.” (Garrett, 2010)
- “All aspects of the end-user's interaction with the company, its services, and its products. (Nielsen and Norman, 2014)

“Cannot design a user experience−only can design ***for*** a user experience”

Defining user experience

How users perceive a product, such as whether a smartwatch is seen as sleek or chunky, and their emotional reaction to it, such as whether people have a positive experience when using it.

(Hornbæk and Hertzum, 2017)

Hassenzahl's (2010) model of the user experience

- Pragmatic: how simple, practical, and obvious it is for the user to achieve their goals
- Hedonic: how evocative and stimulating the interaction is to users

User experience key

"It is not enough that we build products that function, that are understandable and usable, we also need to **build joy and excitement, pleasure and fun, and yes, beauty to people's lives**."

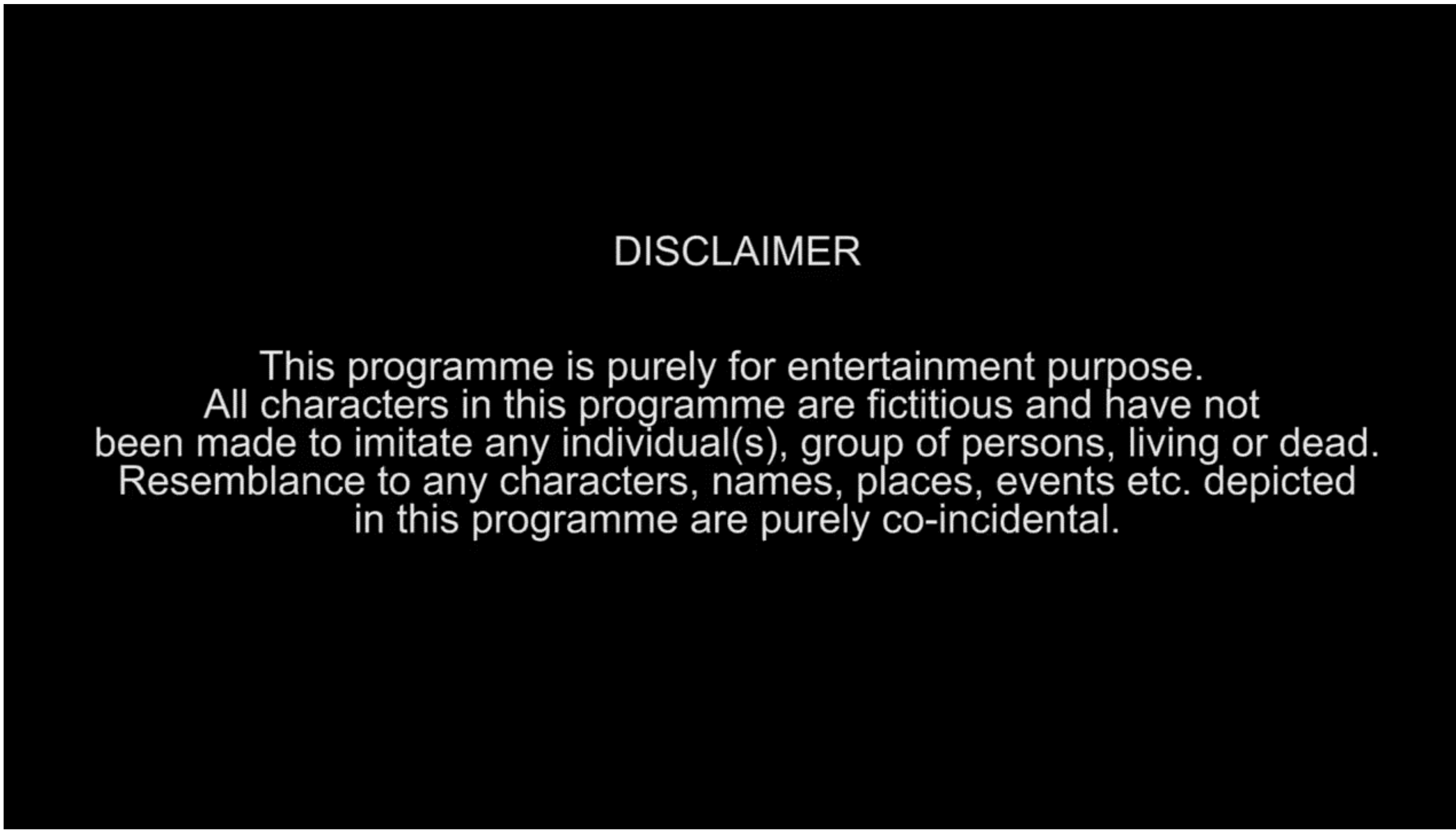
Why was the iPod user experience such a success?

Figure 1.6 The iPod Nano Touch
Source: ©Press Association, reproduced with permission.

- Quality user experience from the start
- Simple, elegant, distinct brand, pleasurable, must have fashion item, catchy names, cool...

Many aspects of the UX that can be considered and many ways of taking them into account when designing interactive products. **Of central importance are the usability, functionality, aesthetics, content, look and feel, and emotional appeal.**

Android vs iPhone



https://www.youtube.com/watch?v=IhOmtzLYPJ8

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Class Code: jyaylyn

https://classroom.google.com/c/NDUwNzQ4MjEyMzMy?cjc=jyaylyn

https://www.youtube.com/watch?v=yRf6wAR-eEY

Recap: Core characteristics of interaction design

- Users should be involved throughout the development of the project

- Specific usability and user experience goals need to be identified, clearly documented, and agreed to at the beginning of the project

- Iteration is needed through the core activities

Why?

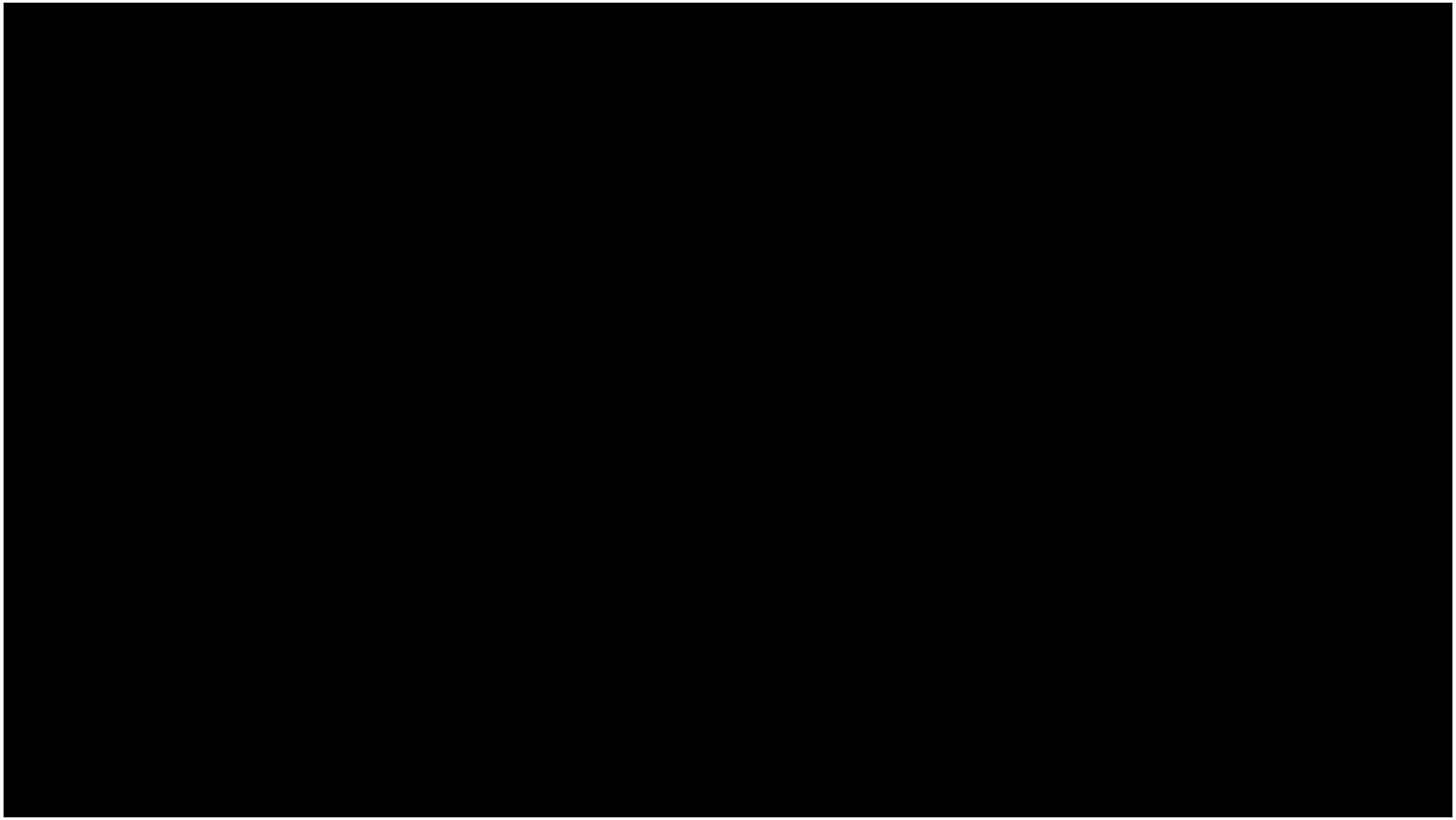
Help designers:

- Understand how to design interactive products that fit with what people want, need, and may desire
- Appreciate that one size does not fit all (for example, teenagers are very different to grown-ups)
- Identify any incorrect assumptions they may have about particular user groups. (for example, not all old people want or need big fonts)
- Be aware of both people's sensitivities and their capabilities

Accessibility

https://www.youtube.com/watch?v=XB4cjbYywqg

Inclusiveness



https://www.youtube.com/watch?v=QXY5TyCUTlo

Accessibility and inclusiveness

Accessibility*:* the extent to which an interactive product is accessible by as many people as possible

- Focus is on people with disabilities; for instance, those using android OS or apple voiceover

Inclusiveness: making products and services that accommodate the widest possible number of people

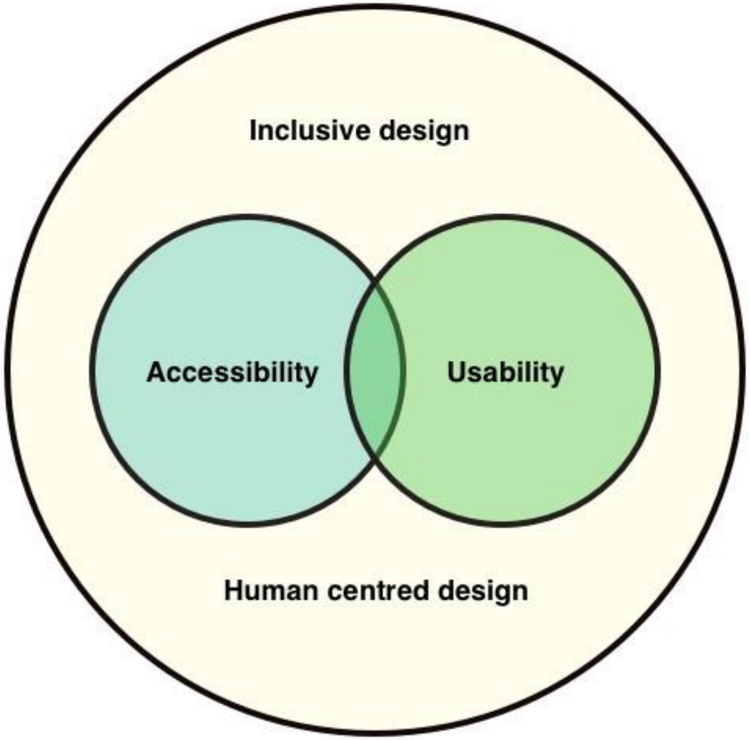
- Inclusiveness means being fair, open, and equal to everyone.
- For example, smartphones designed for all and made available to everyone regardless of their disability, education, age, or income

"Accessibility is an outcome. Inclusive design is a process."

Microsoft's definition of the two are:

Accessibility: *the qualities that make an experience open to all.*

Inclusive design: *a design methodology that enables and draws on the full range of human diversity.*



https://blog.prototypr.io/inclusive-design-and-accessibility-50718a3ac768

Accessibility can be achieved in two ways:

- first, through the inclusive design of technology, and
- second, through the design of assistive technology. When designing for accessibility, it is essential to understand the types of impairments that can lead to disability as they come in many forms.

Disabilities

- Whether someone is disabled changes over time with age, or recovery from an accident
- The severity and impact of an impairment can vary over the course of a day or in different environmental conditions
- Disabilities can result because technologies are designed to necessitate a certain type of interaction that is impossible for someone with an impairment
- Disability in this context is viewed as the result of poor interaction design between a user and the technology, not the impairment alone.

Understanding disability

Disabilities can be classified as:

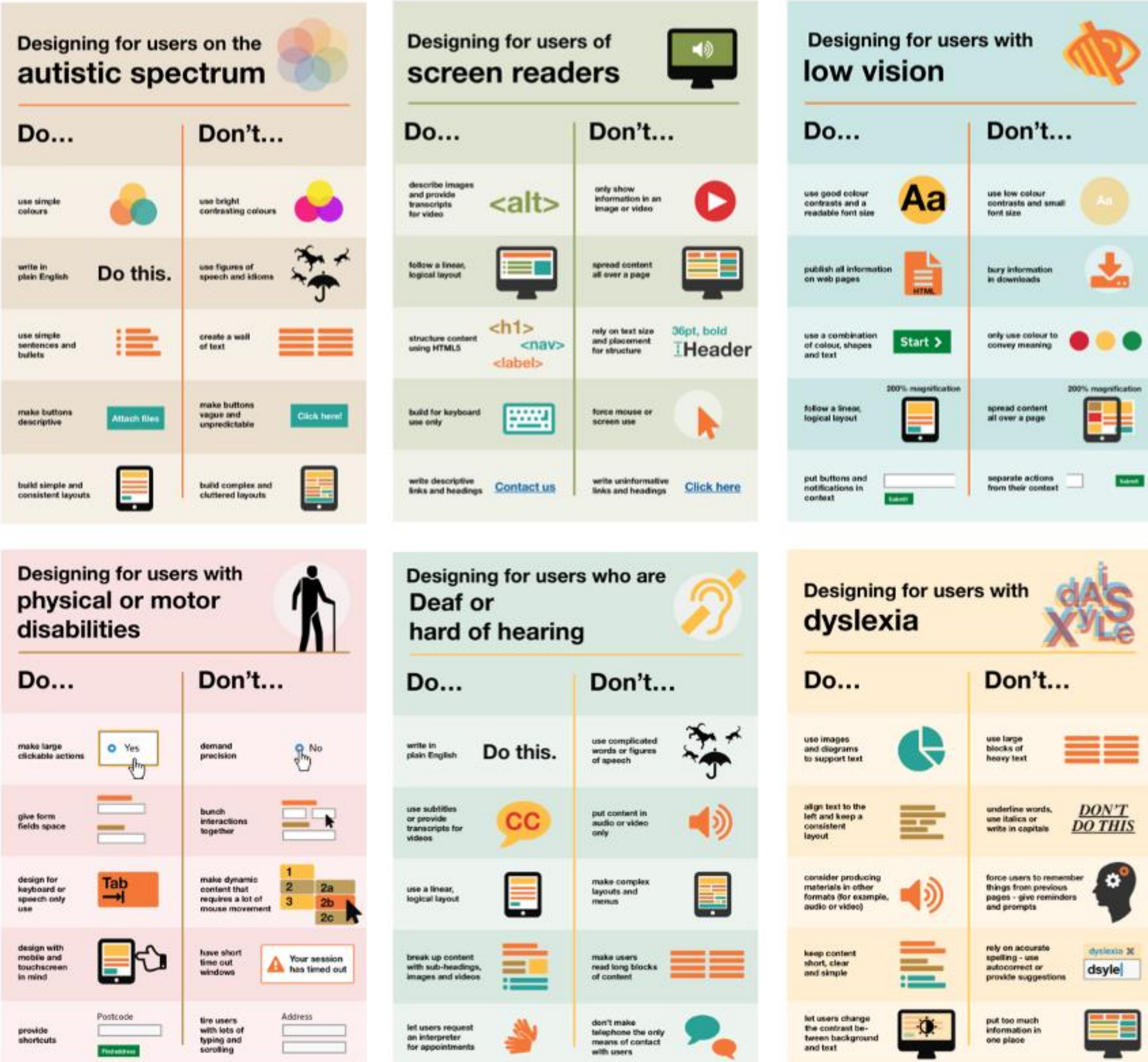
- Sensory impairment (such as loss of vision or hearing)
- Physical impairment (having loss of functions to one or more parts of the body after a stroke or spinal cord injury)
- Cognitive (including learning impairment or loss of memory/cognitive function due to old age)

Each type can be further defined in terms of capability:

- For example, someone might have only peripheral vision, be color blind, or have no light perception

Impairment can be categorized:

- Permanent (for instance, long-term wheelchair user)
- Temporary (that is, after an accident or illness)
- Situational (for example, a noisy environment means that a person can’t hear)



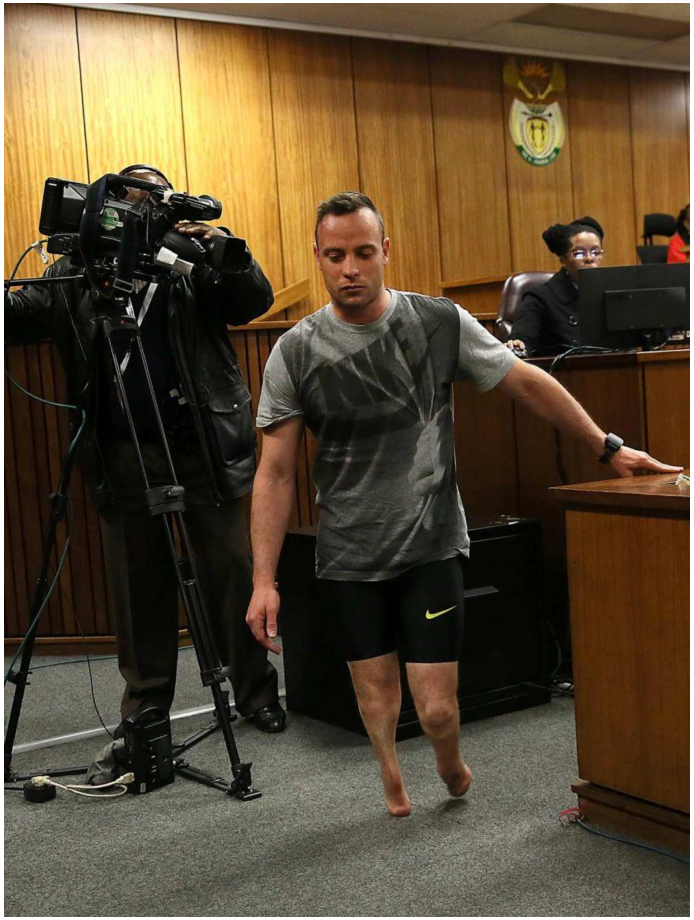
Designing for users on the autistic spectrum
Do...
Don't...
use simple colours
use bright contrasting colours
write in plain English
Do this.
use figures of speech and idioms
use simple sentences and bullets
create a wall of text
make buttons descriptive
Attach files
make buttons vague and unpredictable
Click here!
build simple and consistent layouts
build complex and cluttered layouts
Designing for users of screen readers
Do...
Don't...
describe images and provide transcripts for video
<alt>
only show information in an image or video
follow a linear, logical layout
spread content all over a page
structure content using HTML5
<h1>
<nav>
<label>
rely on text size and placement for structure
36pt, bold
Header
build for keyboard use only
force mouse or screen use
write descriptive links and headings
Contact us
write uninformative links and headings
Click here
Designing for users with low vision
Do...
Don't...
use good colour contrasts and a readable font size
Aa
use low colour contrasts and small font size
Aa
publish all information on web pages
HTML
bury information in downloads
use a combination of colour, shapes and text
Start >
only use colour to convey meaning
200% magnification
follow a linear, logical layout
200% magnification
spread content all over a page
put buttons and notifications in context
separate actions from their context
Designing for users with physical or motor disabilities
Do...
Don't...
make large clickable actions
Yes
demand precision
No
give form fields space
bunch interactions together
design for keyboard or speech only use
Tab
make dynamic content that requires a lot of mouse movement
1
2
3
2a
2b
2c
design with mobile and touchscreen in mind
have short time out windows
Your session has timed out
provide shortcuts
Postcode
tire users with lots of typing and scrolling
Address
Designing for users who are Deaf or hard of hearing
Do...
Don't...
write in plain English
Do this.
use complicated words or figures of speech
use subtitles or provide transcripts for videos
CC
put content in audio or video only
use a linear, logical layout
make complex layouts and menus
break up content with sub-headings, images and videos
make users read long blocks of content
let users request an interpreter for appointments
don't make telephone the only means of contact with users
Designing for users with dyslexia
Do...
Don't...
use images and diagrams to support text
use large blocks of heavy text
align text to the left and keep a consistent layout
underline words, use italics or write in capitals
DON'T DO THIS
consider producing materials in other formats (for example, audio or video)
force users to remember things from previous pages - give reminders and prompts
keep content short, clear and simple
rely on accurate spelling - use autocorrect or provide suggestions
dyslexia
dsyle
let users change the contrast between background and text
put too much information in one place

Being cool about disability

- Prosthetics can be designed to move beyond being functional (and often ugly) to being desirable and fashionable
- People now refer to “wearing their wheels,” rather than “using a wheelchair”

Fashionable leg cover designed by Alleles Design Studio

Being cool about disability



Oscar Pistorius
South African sprinter

Cultural differences

5/21/2015 versus 21/5/2015?

- Which should be used for international services and online forms?

- Why is it that certain products, like smartphones, are universally accepted by people from all parts of the world, whereas people from different cultures react to websites differently?

Usability and user experience goals

- Selecting terms to convey a person's feelings, emotions, and so forth can help designers understand the multifaceted nature of the user experience
- How do usability goals differ from user experience goals?
- Are there trade-offs between the two kinds of goals? (for example, can a product be both fun and safe?)
- How easy is it to measure usability versus user experience goals?

Usability goals

- How good a product is at doing what it is supposed to do (*Effectiveness*)
- Supports users in carrying out their tasks (*Efficiency*)
- Protect users from dangerous conditions and undesirable situations (*Safety*)
- Have right kind of functionality (*Utility*)
- Easy to learn (*Learnability*)
- Easy to remember how to use (*Memorability*)

User experience goals

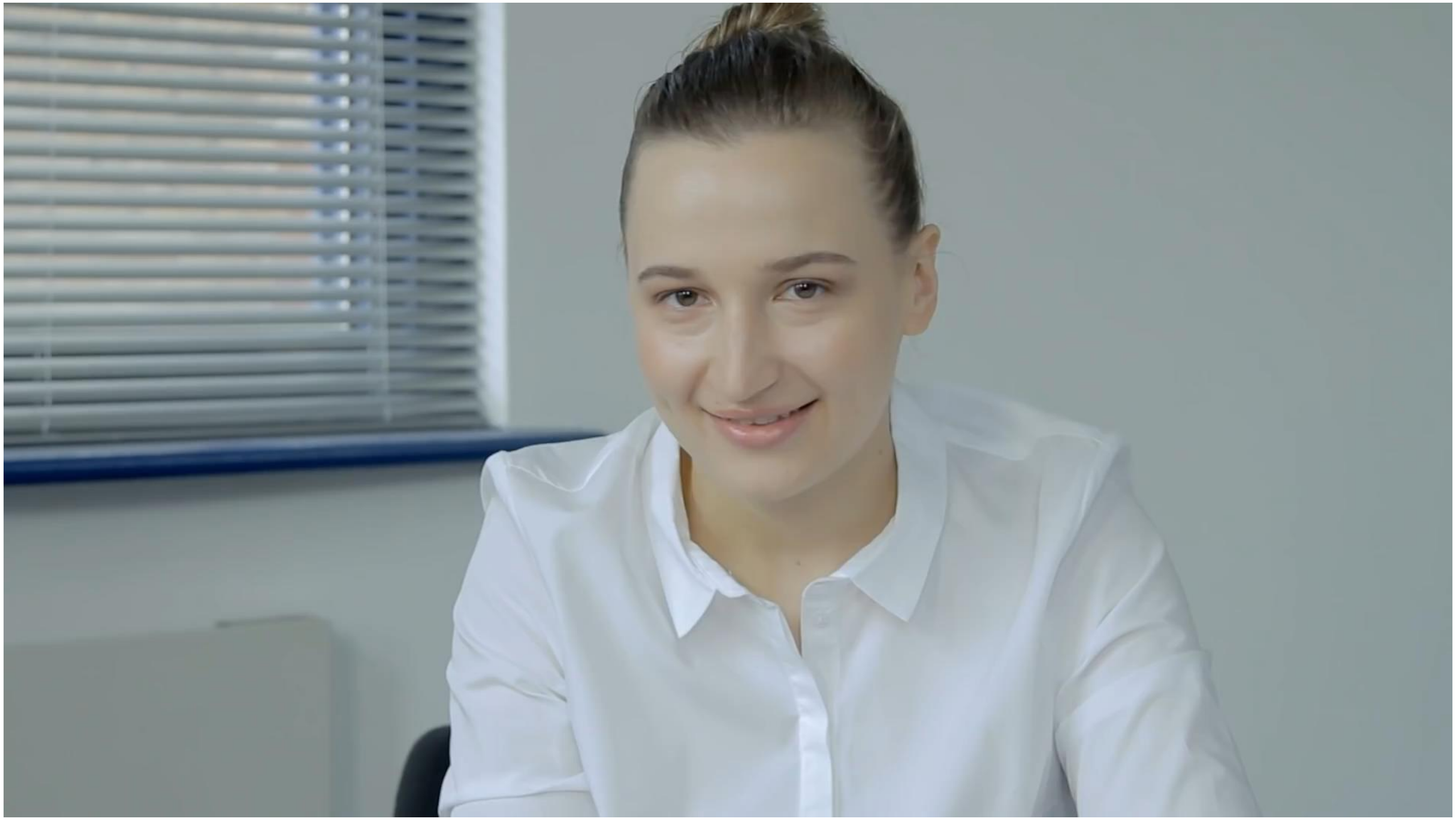
Desirable aspects

Satisfying	Helpful	Fun
Enjoyable	Motivating	Provocative
Engaging	Challenging	Surprising
Pleasurable	Enhancing sociability	Rewarding
Exciting	Supporting creativity	Emotionally fulfilling
Entertaining	Cognitively stimulating	Experiencing flow

Undesirable aspects

Boring	Unpleasant
Frustrating	Patronizing
Making one feel guilty	Making one feel stupid
Annoying	Cutesy
Childish	Gimmicky

Why do we need DP?



https://www.youtube.com/watch?v=u8Kt7fRa2Wc

Design principles

- Generalizable abstractions for thinking about different aspects of design
- The do’s and don'ts of interaction design
- What to provide and what not to provide at the interface
- Derived from a mix of theory-based knowledge, experience, and common-sense

Design principles

- *Visibility (findability)*
- *Feedback*
- *Constraints (navigability)*
- *Consistency*
- *Affordance*

Applying Design Principles in Practice

Design principles are used by interaction designers to aid their thinking when designing for the user experience.

Visibility - poor interface

www.baddesigns.com

- This is a control panel for an elevator
- How does it work?
- Push a button for the floor you want?
- Nothing happens. Push any other button? Still nothing. What do you need to do?
- It is not visible as to what to do!

Visibility - Improving on a poor interface

www.baddesigns.com

…with this elevator, you need to insert your room card in the slot by the buttons to get the elevator to work!

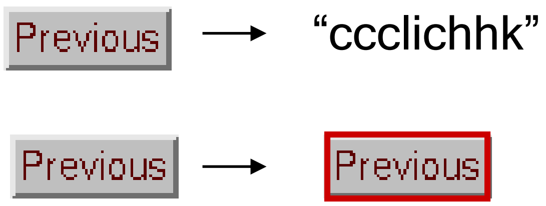
How would you make this action more visible?

- Make the card reader more obvious
- Provide an auditory message that says what to do (which language?)
- Provide a big label next to the card reader that flashes when someone enters
- Make relevant parts visible
- Make what has to be done obvious

Feedback

- Sending information back to the user about what has been done
- Includes sound, highlighting, animation, and combinations of these

  - For example, when screen button is clicked, it provides sound or red highlight feedback:



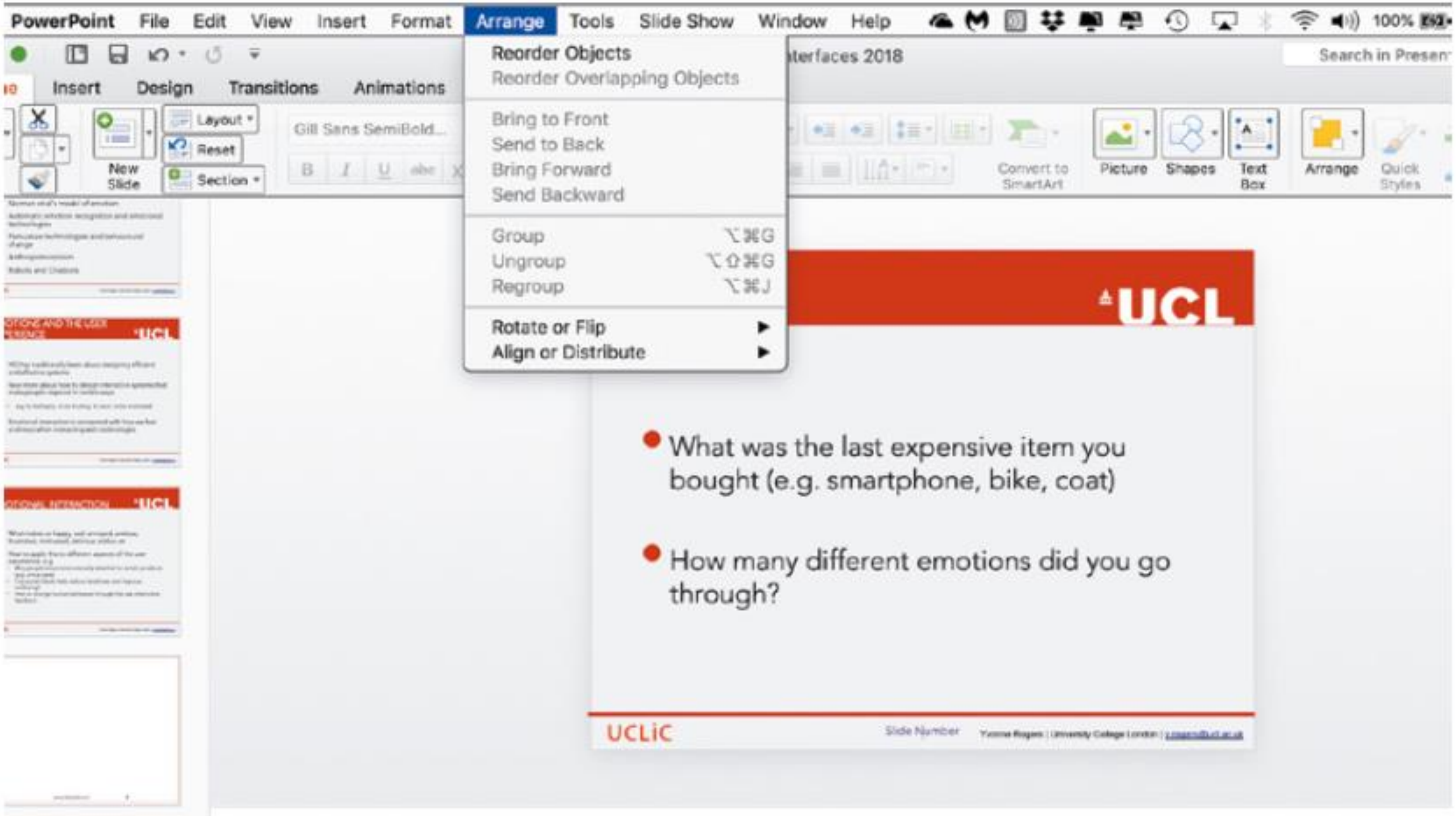


Figure 1.12 A menu showing restricted availability of options as an example of logical constraining. Gray text indicates deactivated options.

Source: https://www.ucl.ac.uk

Logical or ambiguous design?

www.baddesigns.com

- Where do you plug the mouse?
- Where do you plug the keyboard, in the top or bottom connector?
- Do the color-coded icons help?

How to design them more logically

www.baddesigns.com

(A) provides direct adjacent mapping between icon and connector

(B) provides color coding that associates the connectors with the labels

www.baddesigns.com

Consistency

- Design interfaces to have similar operations and use similar elements for similar tasks. (for example, always use Ctrl key plus first initial of the command for an operation: Ctrl+c, Ctrl+s, Ctrl+o)

- The main benefit is that consistent interfaces are easier to learn and use

When consistency breaks down

- What happens if there is more than one command starting with the same letter? (for example, save, spelling, select, style)

- You have to find other initials or combinations of keys, thereby breaking the consistency rule (for example, Ctrl+s, Ctrl+Sp, Ctrl+shift+l)

- Increases learning burden on user, making them more prone to errors

Internal and external consistency

- Internal consistency refers to designing operations to behave the same within an application
  - Difficult to achieve with complex interfaces
- External consistency refers to designing operations, interfaces, and so on to be the same across applications and devices
  - Very rarely the case, based on different designer's preference

Keypad numbers layout

A case of external inconsistency

(a) phones, remote controls

1	2	3
4	5	6
7	8	9
	0	

(b) calculators, computer keypads

7	8	9
4	5	6
1	2	3
0		

DES102: Introduction to Human Computer Interaction

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https://classroom.google.com/c/NDUwNzQ4MjEyMzMy?cjc=jyaylyn

Summary

https://www.youtube.com/watch?v=6TtUKz0KLBQ

Affordance

https://www.youtube.com/watch?v=2q1TFVMoySs

Affordances: to give a clue

- Refers to an attribute of an object that allows people to know how to use it. (For example, a mouse button invites pushing, a door handle affords pulling)

- Norman (1988) used the term to discuss the design of everyday objects

- Has since been popularized in interaction design to discuss how to design interface objects (for example, scrollbars to enable moving up and down; icons to click on)

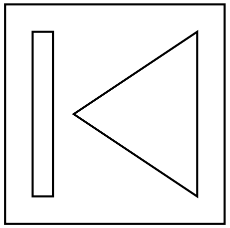
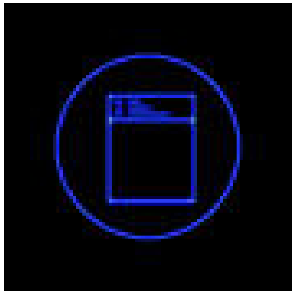
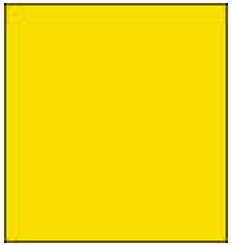
What does “affordance” have to offer interaction design?

- Interfaces are virtual and do not have affordances like physical objects
- Norman argues that it does not make sense to talk about interfaces in terms of ‘real’ affordances
- Instead, interfaces are better conceptualized as ‘perceived’ affordances:
    - Learned conventions of arbitrary mappings between action and effect at the interface
    - Some mappings are better than others

Activity

Virtual affordances

- How do these screen objects afford?
- What if you were a novice user?
- Would you know what to do with them?


Activity

https://www.youtube.com/watch?v=JKmBUsW3jPg

Key points

- Interaction design is concerned with designing interactive products to support how people communicate and interact in their everyday and working lives
- It is concerned with how to create quality user experiences for services, devices, and interactive products
- It is multidisciplinary, involving many inputs from wide-reaching disciplines and fields
- Optimizing the interaction between users and interactive products requires consideration of a number of interdependent factors, including context of use, types of activity, UX goals, accessibility, cultural differences, and user groups.
- Design principles, such as feedback and simplicity, are useful heuristics for informing, analyzing, and evaluating aspects of an interactive product.

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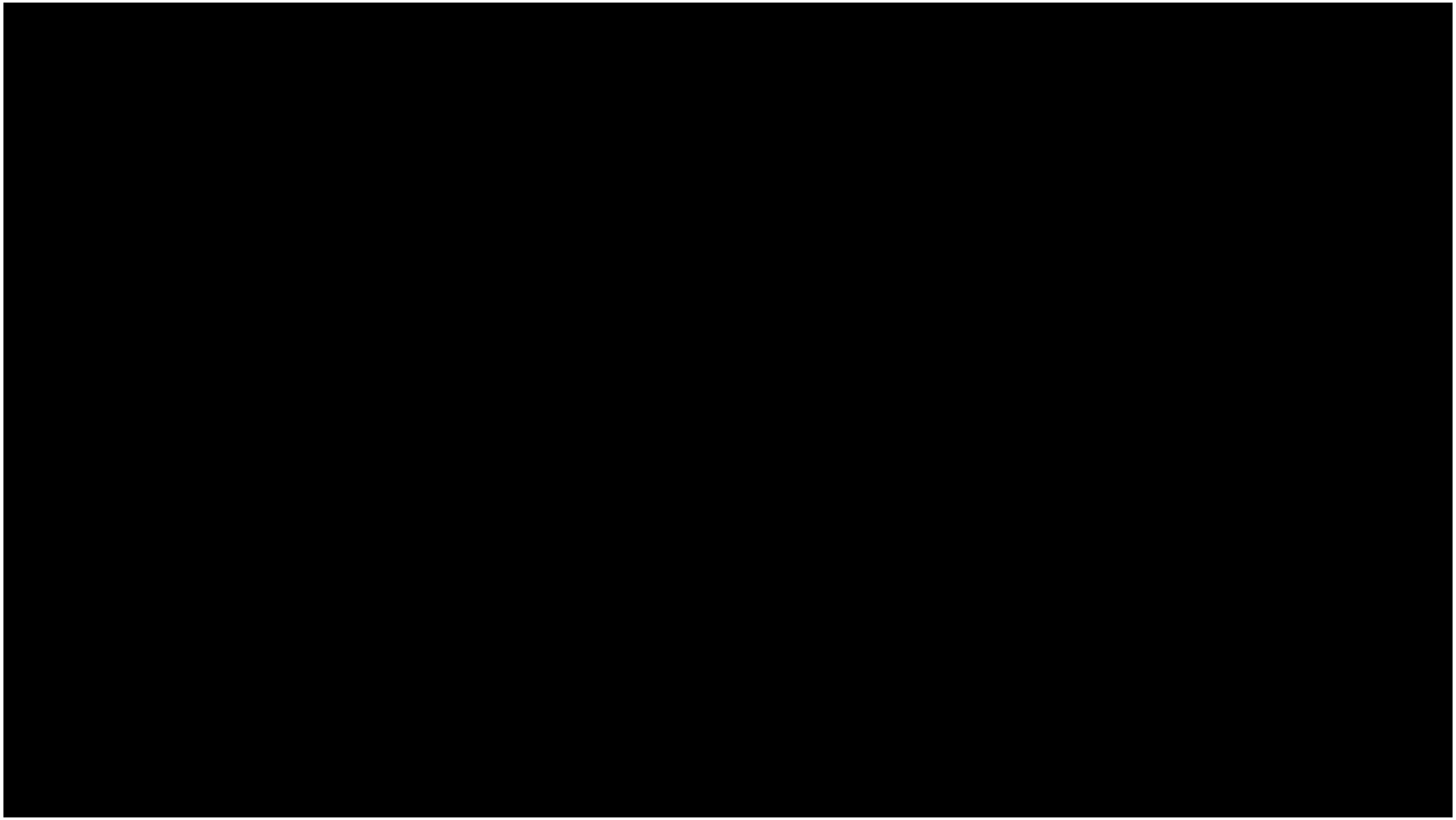
Topic?



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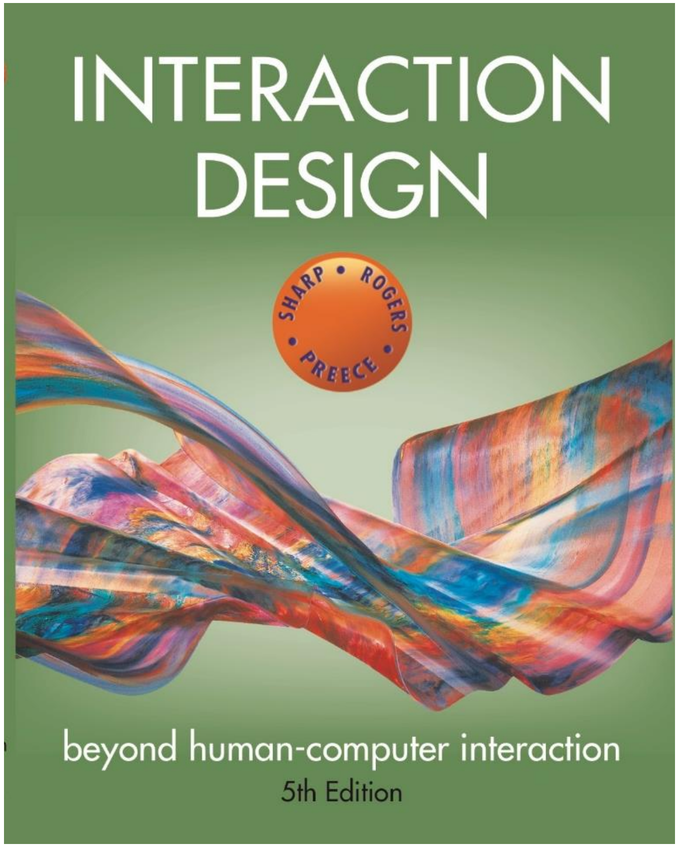


Chapter 2

THE PROCESS OF INTERACTION DESIGN

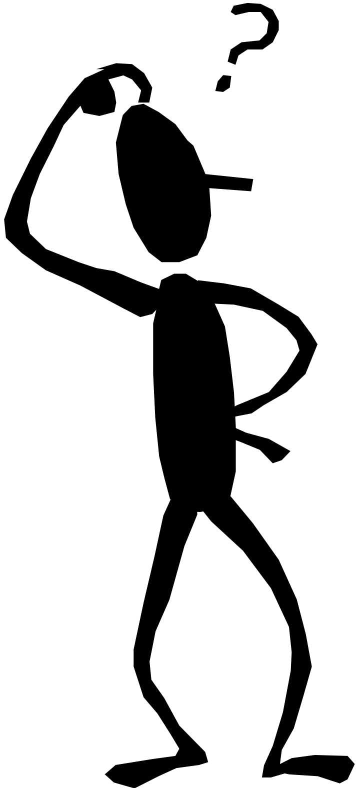
Overview

What is involved in Interaction Design?

- Understanding the problem space
- Importance of involving users
- Degrees of user involvement
- What is a user-centered approach?
- Four basic activities of interaction design
- A simple lifecycle model for interaction design

Some practical issues

- Who are the users?
- What are the users' needs?
- How to generate alternative designs
- How to choose among alternative designs
- How to integrate interaction design activities within other lifecycle models

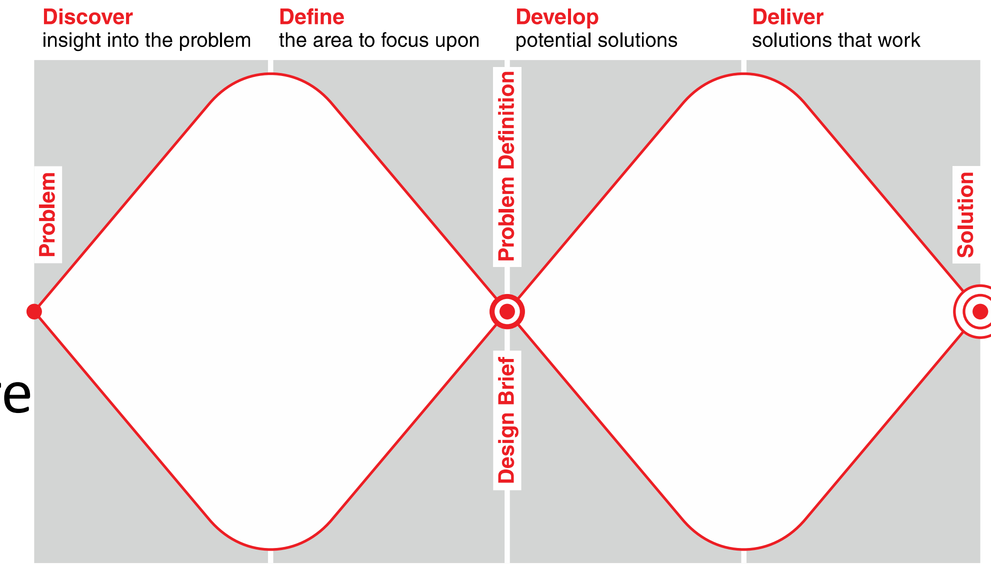


What is involved in Interaction Design?

- It is a process:
  - Focused on discovering requirements, designing to fulfil requirements, producing prototypes and evaluating them
  - Focused on users and their goals
  - Involves trade-offs to balance conflicting requirements
- Generating alternatives and choosing between them is key
- Four approaches: user-centered design, activity-centered design, systems design, and genius design

The double diamond of design

Discover: Designers try to gather insights about the problem.
Define: Designers develop a clear brief that frames the design challenge.
Develop: Solutions or concepts are created, prototyped, tested, and iterated.
Deliver: The resulting project is finalized, produced, and launched.



Source: Adapted from [The Design Process: What is the Double Diamond?]

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Recap: What is involved in Interaction Design?

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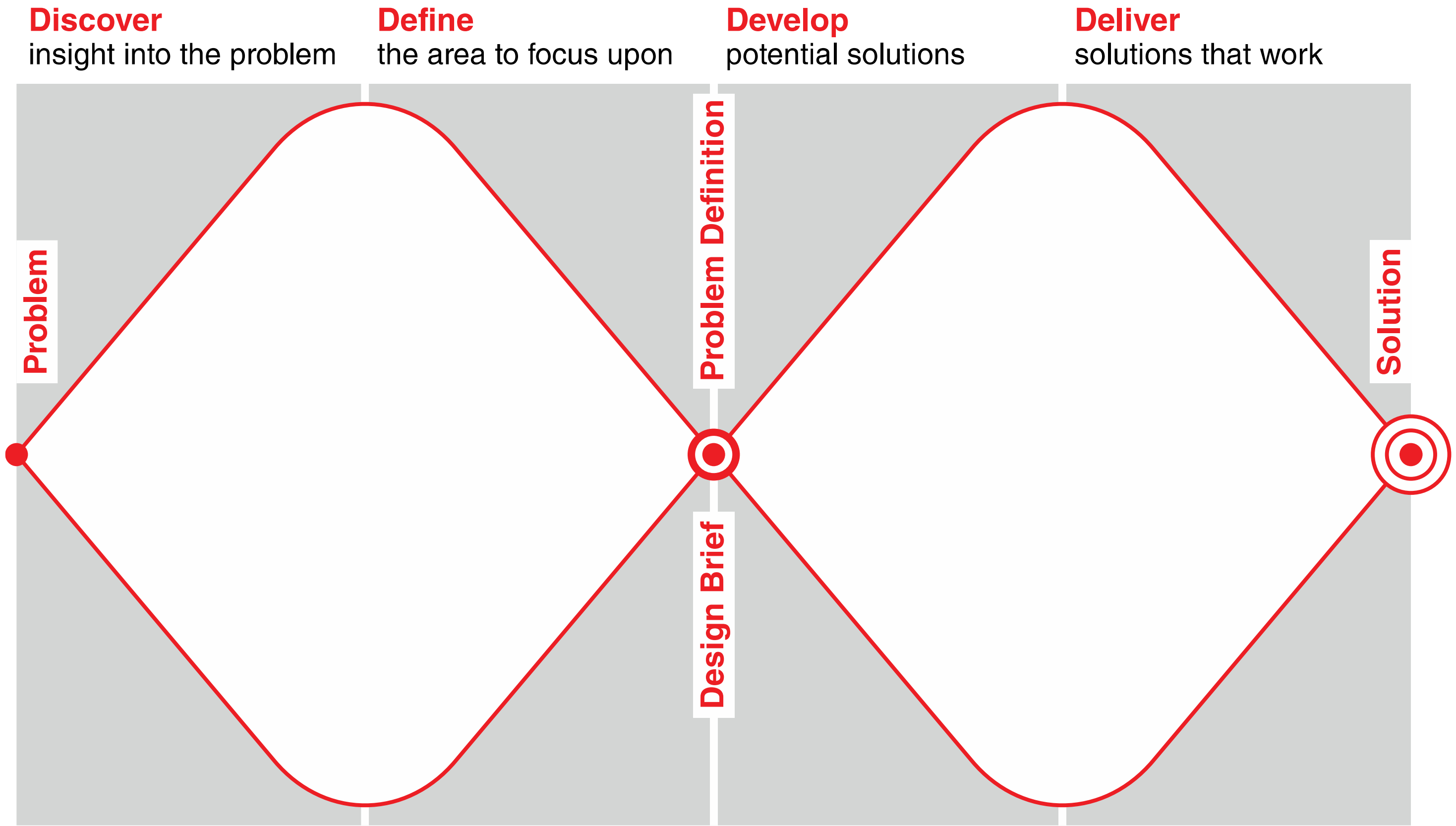
Recap: The double diamond of design



Source: Adapted from [The Design Process: What is the Double Diamond?]

More together

Understanding the problem space

Explore

- What is the current user experience?
- Why is a change needed?
- How will this change improve the situation?

Articulating the problem space

- Team effort
- Explore different perspectives
- Avoid incorrect assumptions and unsupported claims

Importance of involving users

Expectation management

- Realistic expectations
- No surprises, no disappointments
- Timely training
- Communication, but no hype

Ownership

- Make the users active stakeholders
- More likely to forgive or accept problems
- Can make a big difference in acceptance and success of product

Degrees of user involvement

- Member of the design team
  - Full time: constant input, but lose touch with users
  - Part time: patchy input, and very stressful
  - Short term: inconsistent across project life
  - Long term: consistent, but lose touch with users
- Face-to-face group or individual activities
- Online contributions from thousands of users
  - Online Feedback Exchange (OFE) systems
  - Crowdsourcing design ideas
  - Citizen science
- User involvement after product release

What is a user-centered approach?

User-centered approach is based on:

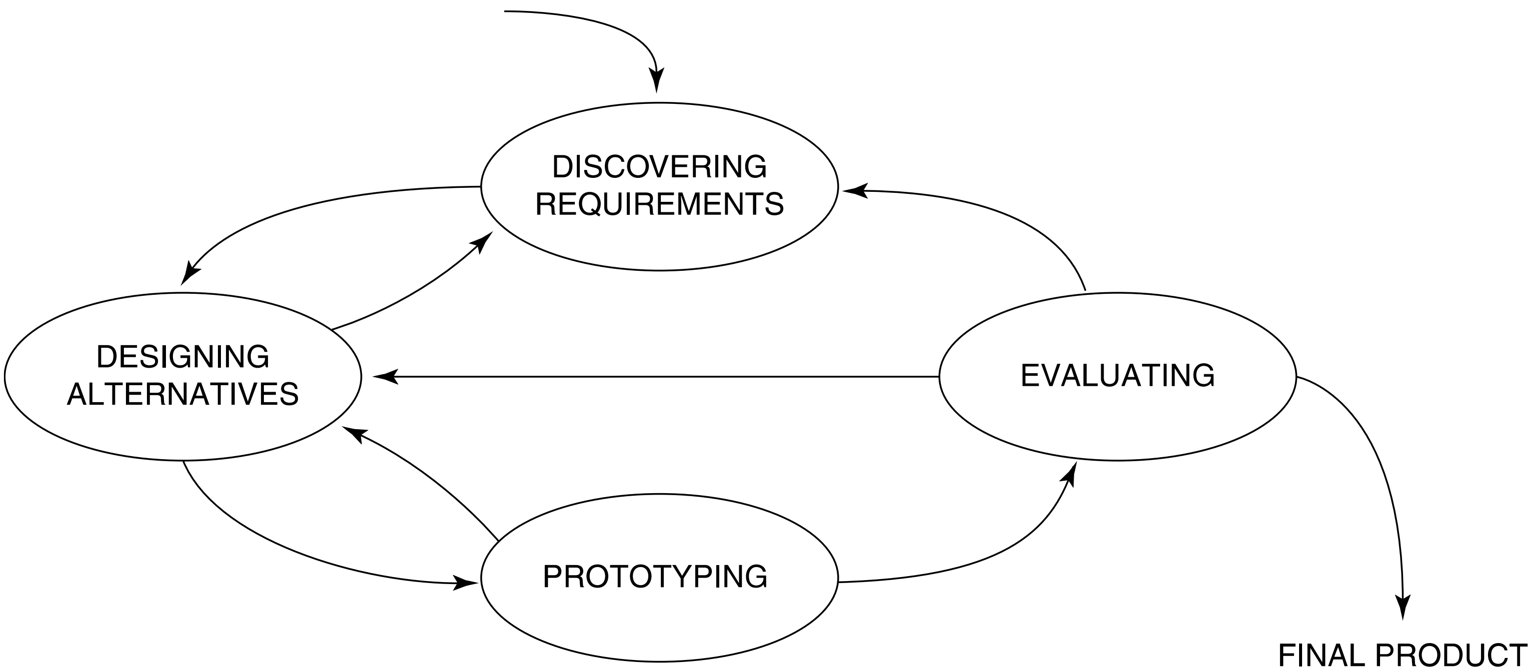
- Early focus on users and tasks: directly studying cognitive, behavioral, anthropomorphic, and attitudinal characteristics
- Empirical measurement: users' reactions and performance to scenarios, manuals, simulations, and prototypes are observed, recorded, and analyzed
- Iterative design: when problems are found in user testing, fix them and carry out more tests

Four basic activities of Interaction Design

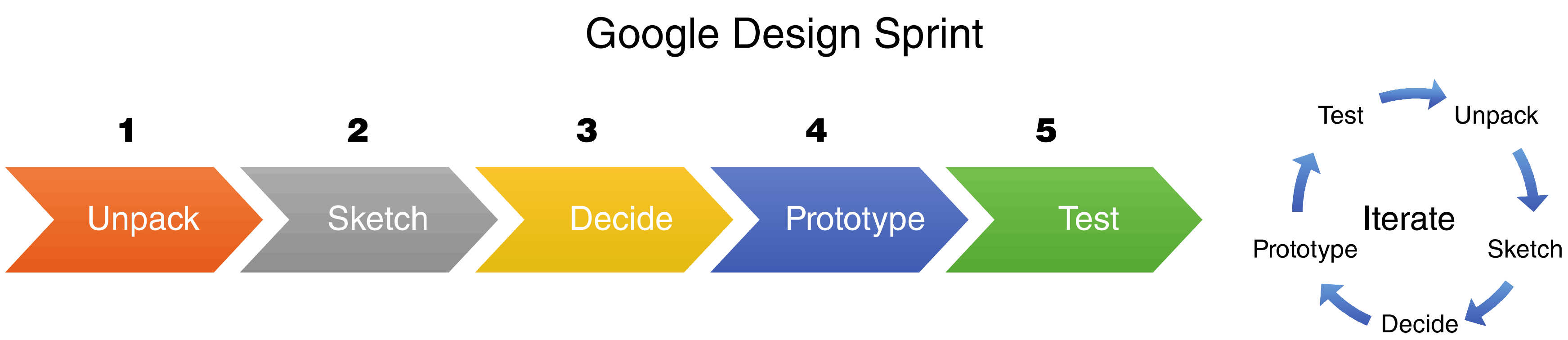
1. Discovering requirements
2. Designing alternatives
3. Prototyping alternative designs
4. Evaluating product and its user experience throughout

A simple interaction design lifecycle model

Exemplifies a user-centered design approach

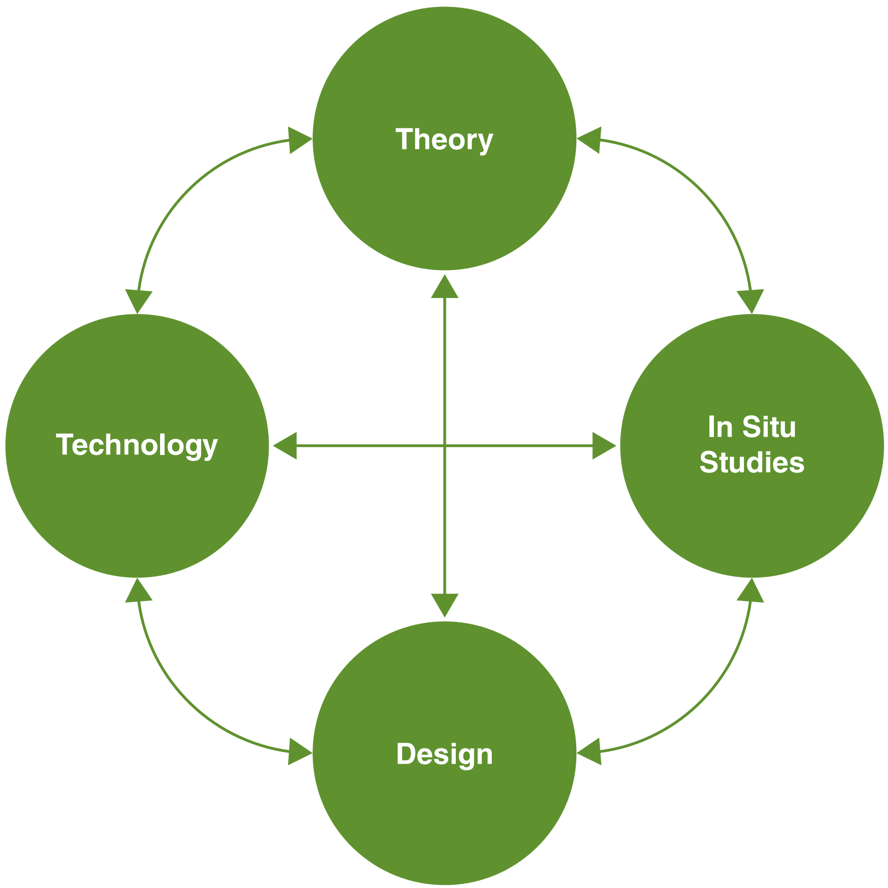


Another lifecycle model: Google Design Sprints (Knapp et al., 2016)



Source: *[Google Design Sprints]()* (used courtesy of Agile Marketing)

Another lifecycle model: Research in the Wild (Rogers and Marshall, 2017)



A framework for research in the wild studies

Source: Rogers and Marshall, 2017, p6. (used courtesy of Morgan and Claypool)

Some practical issues

- Who are the users?
- What are the users' needs?
- How to generate alternative designs?
- How to choose among alternatives?
- How to integrate interaction design activities with other lifecycle models?

Who are the users/stakeholders?

Not obvious

- 382 distinct types of users for smartphone apps (Sha Zhao et al, 2016)
- Many products are intended for use by large sections of the population, so user is “everybody”
- More targeted products are associated with specific roles

Stakeholders

- Larger than the group of direct users
- Identifying stakeholders helps identify groups to include in interaction design activities

What are the users' needs?

- Users rarely know what is possible
- Instead:
  - Explore the problem space
  - Investigate who are the users
  - Investigate user activities to see what can be improved
  - Try out ideas with potential users
- Focus on peoples' goals, usability, and user experience goals, rather than expect stakeholders to articulate requirements

How to generate alternatives

- Humans tend to stick with something that works
- Considering alternatives helps identify better designs
- Where do alternative designs come from?
  - ‘Flair and creativity’: research and synthesis
  - Cross-fertilization of ideas from different perspectives
  - Users can generate different designs
  - Product evolution based on changing use
  - Seek inspiration: similar products and domain, or different products and domain
- Balancing constraints and trade-offs

How to choose among alternatives

- Interaction design focuses on externally-visible and measurable behavior
- Technical feasibility
- Evaluation with users or peers
  - Prototypes not static documentation because behavior is key
- A/B Testing
  - Online method to inform choice between alternatives
  - Nontrivial to set appropriate metrics and choose user group sets
- Quality thresholds
  - Different stakeholder groups have different quality thresholds
  - Usability and user experience goals lead to relevant criteria

How to integrate interaction design activities within other models

- Integrating interaction design activities in lifecycle models from other disciplines requires careful planning
- Software development lifecycle models are prominent
- Integrating with agile software development is promising because:
  - It incorporates tight iterations
  - It champions early and regular feedback
  - It handles emergent requirements
  - It aims to strike a balance between flexibility and structure

Some key points

Four basic activities in interaction design process

- Discovering requirements
- Designing alternatives
- Prototyping
- Evaluating

User-centered design rests on three principles

- Early focus on users and tasks
- Empirical measurement using quantifiable and measurable usability criteria
- Iterative design

Guess, next topic…

https://www.youtube.com/watch?v=IhR9iRS9LcY

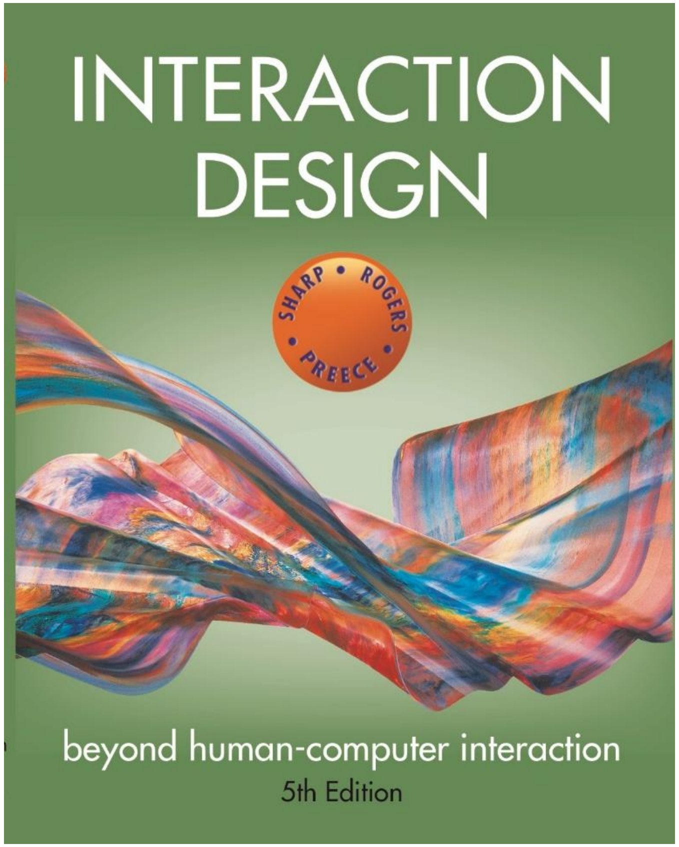
INTERACTION DESIGN

SHARP • ROGERS • PREECE

beyond human-computer interaction

5th Edition

From Twitter



Chapter 3

CONCEPTUALIZING INTERACTION DESIGN?

History of Mouse

History of Mouse

Conceptualizing design

Proof of concept

- Conceptualize what the proposed product will do

Why the need to conceptualizing design?

- To scrutinize vague ideas and assumptions about the benefits of the proposed product in terms of their feasibility
- How realistic is it to develop?
- How desirable and useful?

Xerox Star UI

https://www.youtube.com/watch?v=Cn4vC80Pv6Q

How Steve Jobs got the ideas of GUI from XEROX?

https://www.youtube.com/watch?v=J33pVRdxWbw

Assumptions and claims

- Write down your **assumptions** and **claims** when coming up with a new design
- Try to defend and support them by what they will provide
- Those that are difficult to articulate
  - Can highlight what ideas are vague or unrealistic
  - Identify human activities and interactivities that are problematic
- Iteratively work out how the design ideas might be improved

What is an assumption?

- Taking something for granted when it needs further investigation
  - For example, people will want to watch TV while driving

[Technotopic Narratives and Networked Subjects: Preparations for Everyday Life in Cooltown]

Kiki Kills

What is a claim?

- A claim is stating something to be true when it is still open to question
  - For example, “a multimodal style of interaction for controlling GPS — one that involves speaking while driving — is safe.”
  - “Participate in #KikiChallenge from car is safe”

Activity: How will enabling robot waiters to speak to customers enhance their experience?

Source: Xinhua, Guo Cheng

What is the problem being addressed?

- The benefits:
  - The robot could take orders and entertain customers by having a conversation with them
  - The robot could make recommendations for different customers, such as restless children or fussy eaters
- But just assumptions
- The real problem being addressed:

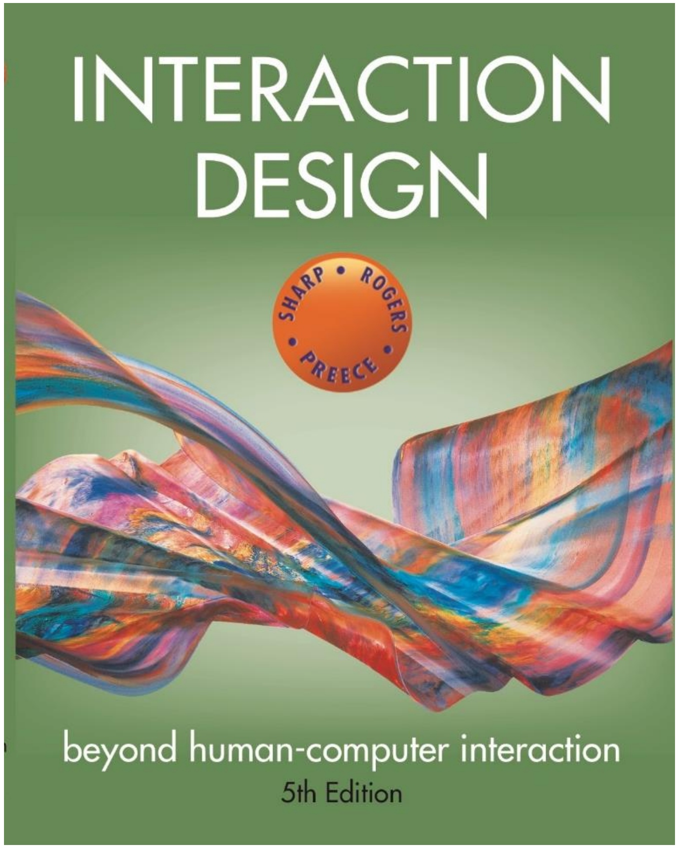
  "It is difficult to recruit good wait staff who provide the level of customer service to which we have become accustomed."

Working through assumptions

- Many unknowns need to be considered in the initial stages of a design project
  - Where do your ideas come from?
  - What sources of inspiration were used?
  - Is there any theory or research that can be used to inform them?
- During the early ideation process
  - Ask questions, reconsider assumptions, and articulate concerns

A framework for analyzing the problem space

- Are there problems with an existing product or user experience? If so, what are they?
- Why do you think there are problems?
- How do you think your proposed design ideas might overcome these?
- If you are designing for a new user experience, how do you think your proposed design ideas support, change, or extend current ways of doing things?



Chapter 3

CONCEPTUALIZING INTERACTION DESIGN?

Working through assumptions

- Many unknowns need to be considered in the initial stages of a design project
  - Where do your ideas come from?
  - What sources of inspiration were used?
  - Is there any theory or research that can be used to inform them?
- During the early ideation process
  - Ask questions, reconsider assumptions, and articulate (clearly expressed and easily understood) concerns

Critical Thinking

https://www.youtube.com/watch?v=pV-vf-7LbC8

A framework for analyzing the problem space

- Are there problems with an existing product or user experience? If so, what are they?
- Why do you think there are problems?
- How do you think your proposed design ideas might overcome these?
- If you are designing for a new user experience, how do you think your proposed design ideas support, change, or extend current ways of doing things?

Activity

- What were the assumptions and claims made about watching 3D TV?

Figure 3.2 A family watching 3D TV

Source: Andrey Popov, Shutterstock

Assumptions and claims: how realistic?

- There was no existing problem to overcome
  - What was being proposed was a new way of experiencing TV
- An assumption
  - People would really enjoy the enhanced clarity and color detail provided by 3D
- A claim
  - People would not mind paying a lot more for a new 3D-enabled TV screen because of the new experience

Benefits of conceptualizing

Orientation

- Enables design teams to ask specific questions about how the conceptual model will be understood by the target users

Open-minded

- Prevents design teams from becoming narrowly focused early on

Common ground

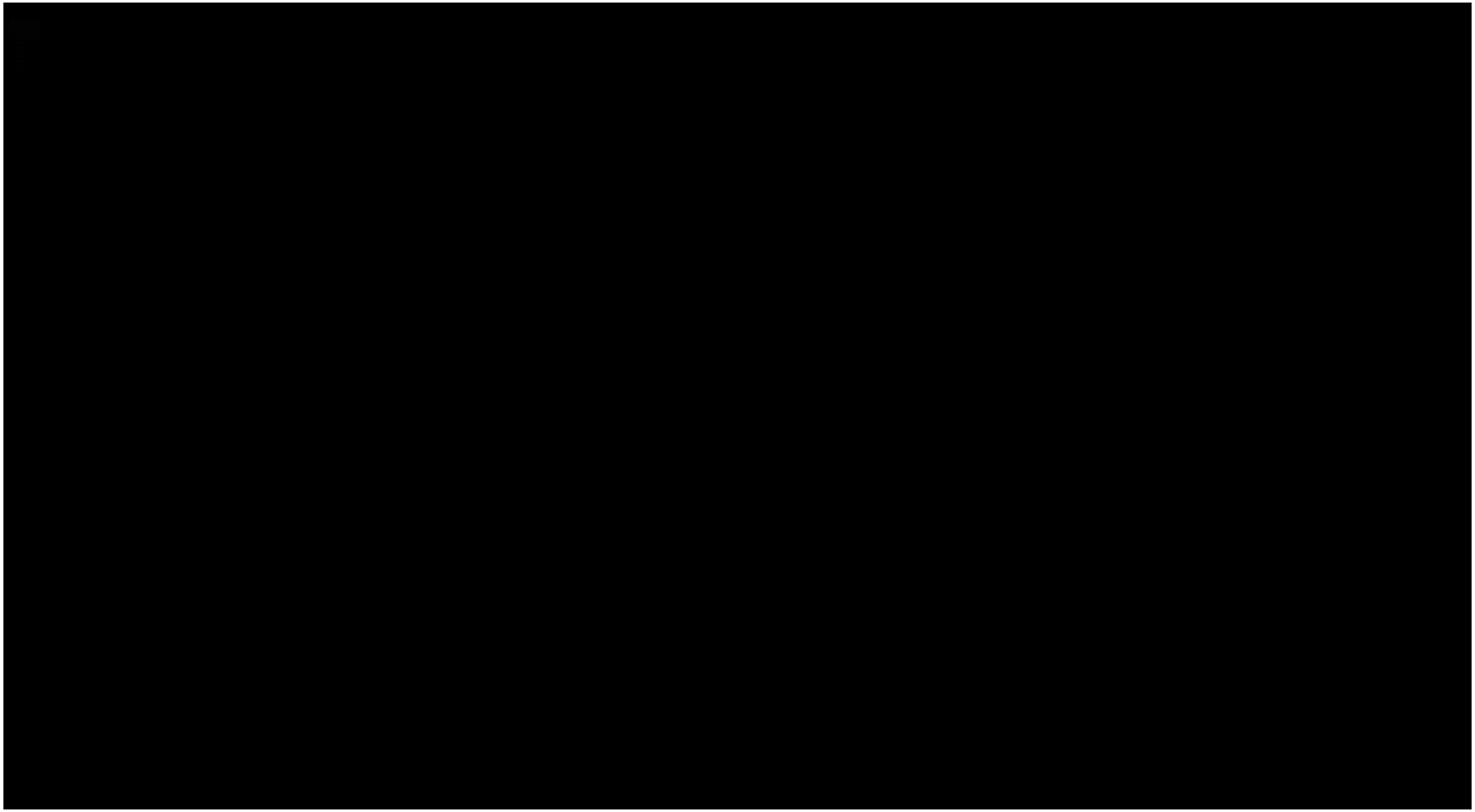
- Allows design teams to establish a set of commonly agreed terms

From problem space to design space

- Having a good understanding of the problem space can help inform the design space
  - For example, what kind of interface, behavior, functionality to provide

- Before deciding upon these, it is important to develop a conceptual model

From problem space to design space



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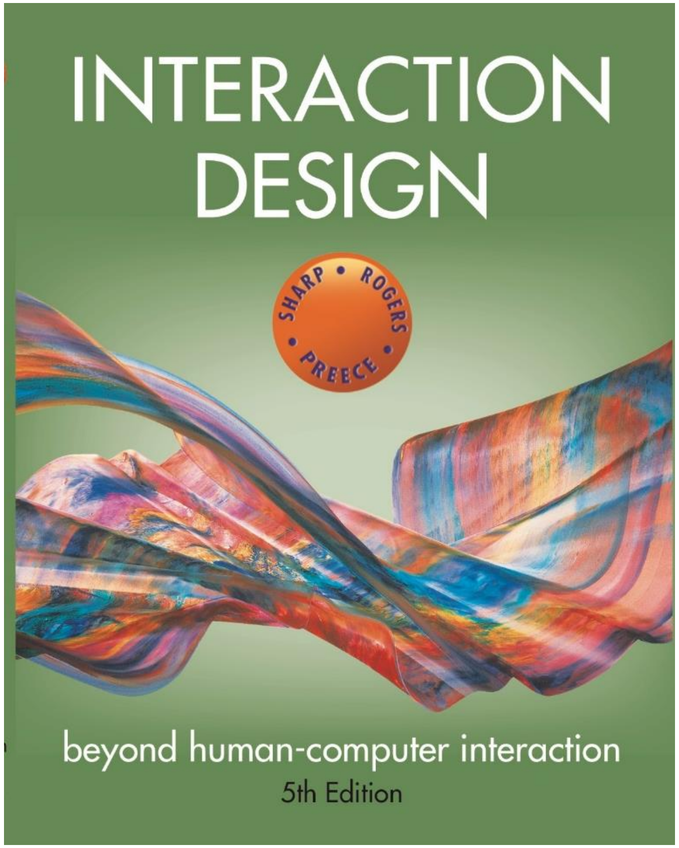


Chapter 3

CONCEPTUALIZING INTERACTION DESIGN?

Conceptual model

- A conceptual model is:

  "…a high-level description of how a system is organized and operates" (Johnson and Henderson, 2002, p26)

- A conceptual model enables:

  "…designers to straighten out their thinking before they start laying out their widgets" (Johnson and Henderson, 2002, p28)

- Provides a working strategy and framework of general concepts and their interrelations

Components

- The core components are:
- Metaphors and analogies
  - Understand what a product is for and how to use it for an activity (for example browsing and bookmarking)
- Concepts that people are exposed to through the product
  - Task–Domain objects they create and manipulate, their attributes, and operations that can be performed on them (for example, saving, revisiting, organizing)
- Relationship and mappings between these concepts
  - for instance, whether one object contains another

First steps in formulating a conceptual model

- What will the users be doing when carrying out their tasks?
- How will the system support these?
- What kind of interface metaphor, if any, will be appropriate?
- What kinds of interaction modes and styles to use?
    - Always keep in mind when making design decisions how the user will understand the underlying conceptual model

Conceptual models

- Many kinds and ways of classifying them
- The best conceptual models are often those that appear:
  - Obvious and simple
  - The operations they support are intuitive to use
- For example, a conceptual model based on the core aspects of the customer experience when at a shopping mall underlies most online shopping websites.

https://www.youtube.com/watch?v=-MlkASchodc

Interface metaphors

- Interface designed to be similar to a physical entity but also has own properties
  - For example, desktop metaphor, and web portals
- Can be based on activity, object, or a combination of both
- Exploit user's familiar knowledge, helping them to understand 'the unfamiliar'
- Conjures up the essence of the unfamiliar activity, enabling users to leverage this to understand more aspects of the unfamiliar functionality

Examples of interface metaphors

- Conceptualizing what users are doing
  - For instance, surfing the Web
- A conceptual model instantiated at the interface
  - For example, the desktop metaphor
- Visualizing an operation
  - For instance, an icon of a shopping cart into which the user places items

The card metaphor

- The card is a very popular UI. Why?
  - It has familiar form factor
  - It can easily be flicked through, sorted, and themed
  - It structures content into meaningful chunks (similar to how paragraphs are used to chunk a set of related sentences into distinct sections)
  - Its material properties give the appearance of the surface of paper

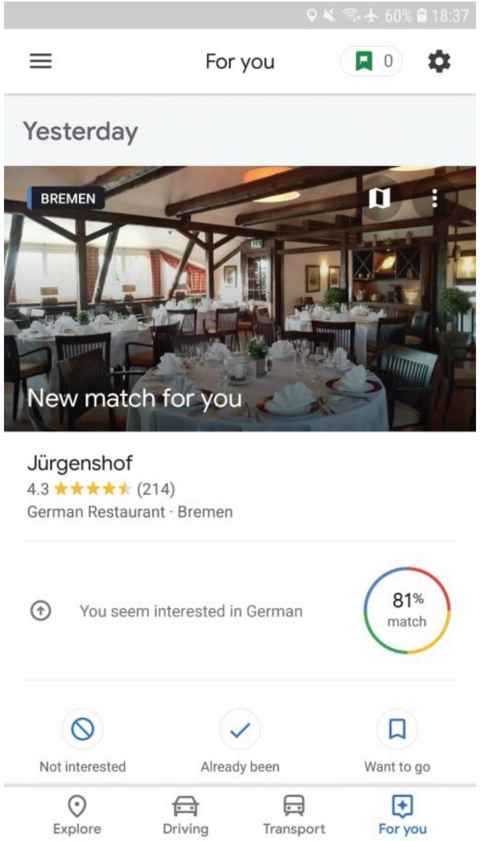


Figure 3.5 Google Now card for restaurant recommendation in Germany

Source: [Johannes Shonning]

Benefits of interface metaphors

- Makes learning new systems easier
- Helps users understand the underlying conceptual model
- Can be very innovative and enable the realm of computers and their applications to be made more accessible to a greater diversity of users

Problems with interface metaphors

- Break conventional and cultural rules
  - For instance, recycle bin placed on desktop
- Can constrain designers in the way that they conceptualize a problem space
- Conflicts with design principles
- Forces users to understand only the system in terms of the metaphor
- Designers can inadvertently use bad existing designs and transfer the bad parts over
- Limits designers' imagination in coming up with new conceptual models

Activity

- Describe the components of the conceptual model underlying most online shopping websites, for example:
  - Shopping cart
  - Proceeding to check-out
  - 1-click
  - Gift wrapping
  - Cash register

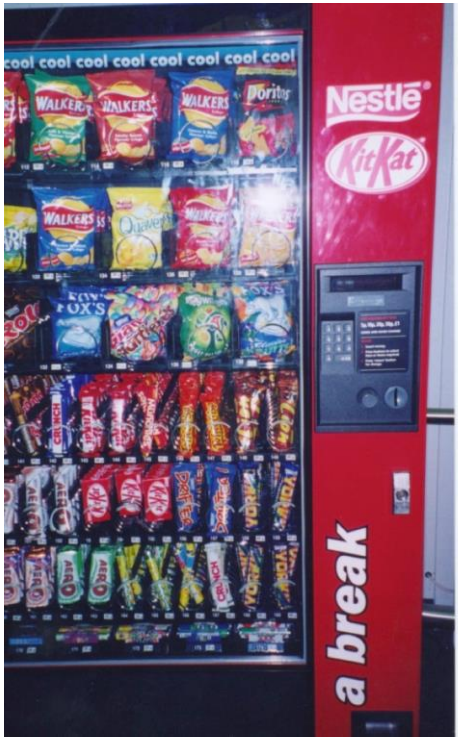
Interaction types

- Instructing
  - Issuing commands and selecting options
- Conversing
  - Interacting with a system as if having a conversation
- Manipulating
  - Interacting with objects in a virtual or physical space by manipulating them
- Exploring
  - Moving through a virtual environment or a physical space
- Responding
  - The system initiates the interaction and the user chooses whether to respond

1. Instructing

- Where users instruct a system and tell it what to do
  - For example: Tell the time, print a file, or save a file
- Very common conceptual model underlying a diversity of devices and systems
  - For instance: Word processors, VCRs, and vending machines
- The main benefit is that instructing supports quick and efficient interaction
  - Good for repetitive kinds of actions performed on multiple objects

Which is easiest and why?



2. Conversing

- Underlying model of having a conversation with another human
- Ranges from simple voice recognition menu-driven systems to more complex ‘natural language’ dialogs
- Examples include timetables, search engines, advice-giving systems, and help systems
- Also virtual agents, chatbots, toys, and pet robots designed to converse with you

https://www.youtube.com/watch?v=OayNySORAY0

Pros and cons of conversational model

- Allows users, especially novices, to interact with a system in a way that is familiar to them
  - Can make them feel comfortable, at ease, and less scared
- Misunderstandings can arise when the system does not know how to parse what the user says
  - For example, voice assistants can misunderstand what children say

"If you'd like to press 1, press 3.
If you'd like to press 3, press 8.
If you'd like to press 8, press 5..."

3. Manipulating

- Involves dragging, selecting, opening, closing and zooming actions on virtual objects
- Exploit’s users’ knowledge of how they move and manipulate in the physical world
- Can involve actions using physical controllers (for example, Nintendo Wii) or air gestures (such as, Microsoft Kinect) to control the movements of an on-screen avatar
- Tagged physical objects (for instance, balls) that are manipulated in a physical world result in physical/digital events (such as animation)

Direct Manipulation (DM)

- Ben Shneiderman (1983) coined the term DM
- Three core properties:
  - Continuous representation of objects and actions of interest
  - Physical actions and button pressing instead of issuing commands with complex syntax
  - Rapid reversible actions with immediate feedback on object of interest

Benefits of direct manipulation

- Novices can learn the basic functionality quickly
- Experienced users can work extremely rapidly to carry out a wide range of tasks−even defining new functions
- Intermittent users can retain operational concepts over time
- Error messages rarely needed
- Users can immediately see if their actions are furthering their goals, and if not, do something else
- Users experience less anxiety
- Users gain confidence and mastery and feel in control

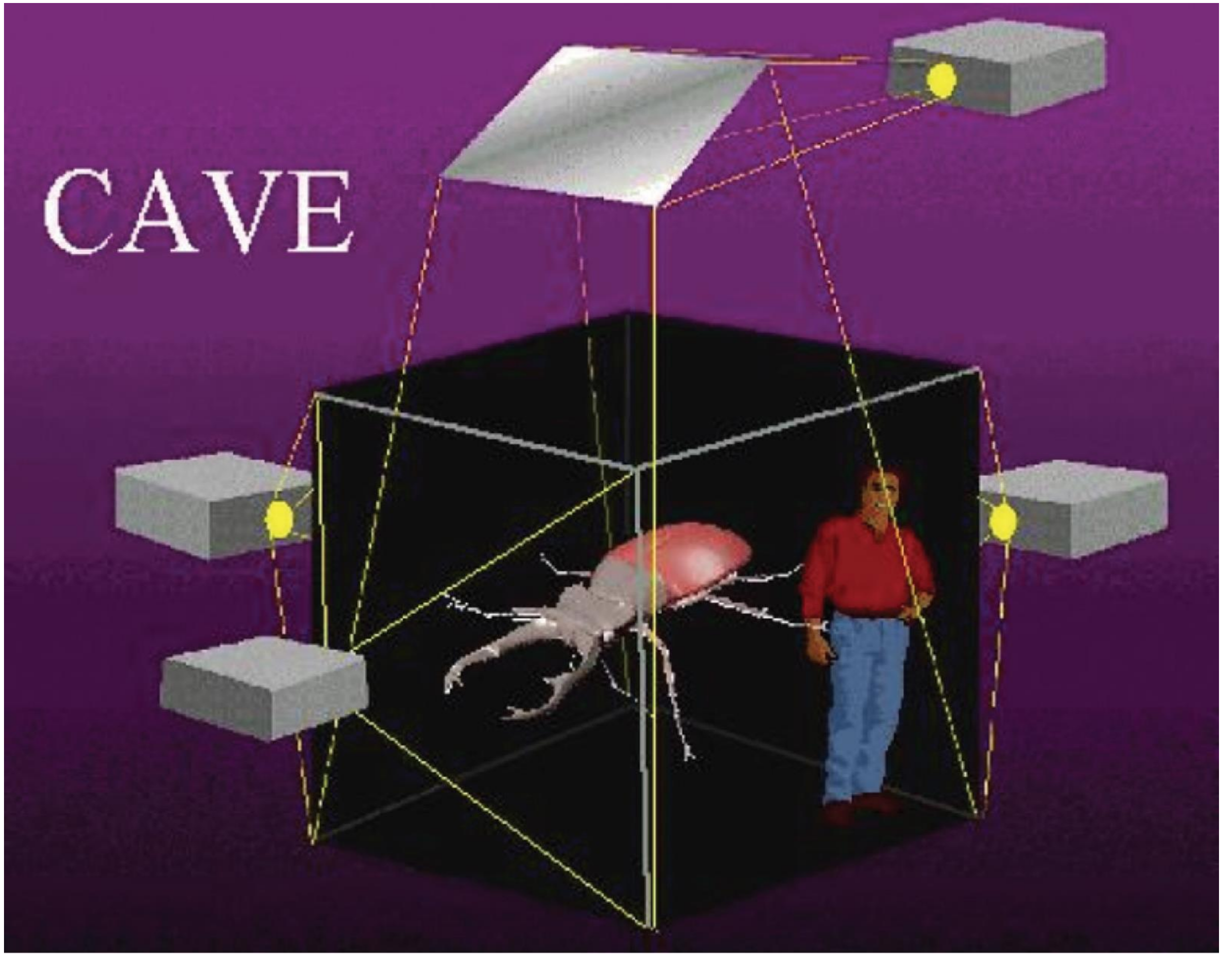
Disadvantages of DM

- Some people take the metaphor of direct manipulation too literally
- Not all tasks can be described by objects, and not all actions can be done directly
- Some tasks are better achieved through delegating, for example, spell checking
- Can become screen space 'gobblers'
- Moving a cursor using a mouse or touchpad can be slower than pressing function keys to do the same actions

4. Exploring

- Involves moving through virtual or physical environments
  - Users can explore aspects of a virtual 3D environment
  - Physical environments can also be embedded with sensors that when detect the presence of someone will trigger digital or physical events to happen
- Many examples of virtual environments, including cities, parks, buildings, rooms, and datasets
  - Enable users to fly over them and zoom in and out of different parts

Seeing things larger than life in VR



Cyber-Insects in the CAVE *Source*: Alexei A. Sharov

Exploring data in VR

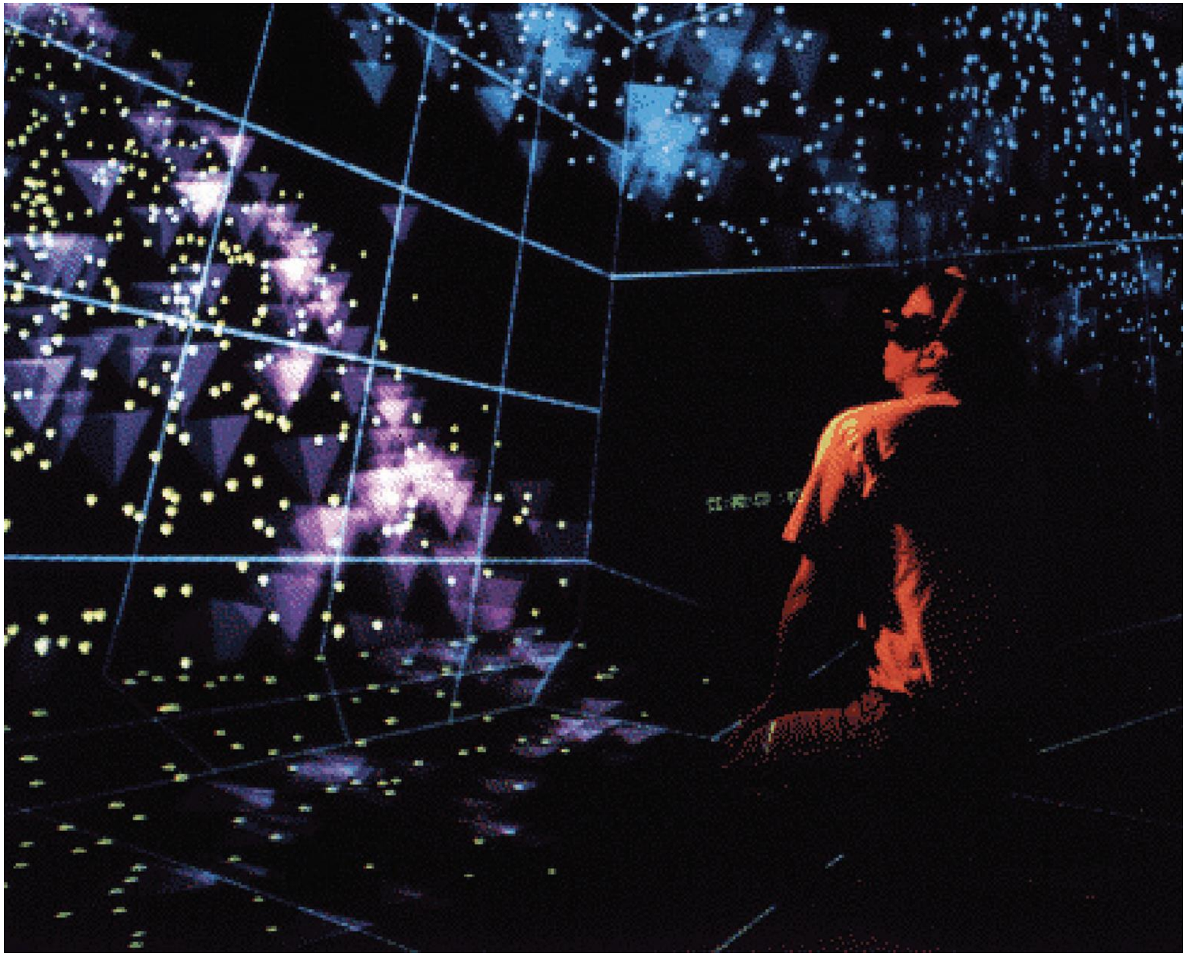


Image courtesy of Kalev Leetaru, National Center for Supercomputing Applications, University of Illinois.

Responding

- System takes the initiative to alert user to something that it “thinks” is of interest
- System does this by:
  - Detecting the location and-or presence of someone in a vicinity and notifies them on their phone or watch,
  - What it has learned from their repeated behaviors
- Examples:
  - Alerts the user of a nearby coffee bar where some friends are meeting
  - User’s fitness tracker notifies them of a milestone reached
- Automatic system response without any requests made by the user

This type suggested by Christopher Lueg et al. (2018)

Potential cons of system-initiated notifications

- Can get tiresome or frustrating if too many notifications or the system gets it wrong
- What does it do when it gets something wrong?
  - Does it apologize?
  - Does it allow the user to correct the advise or information?

Choosing an interaction type

- Direct manipulation is good for ‘doing’ types of tasks, for example, designing, drawing, flying, driving, or sizing windows
- Issuing instructions is good for repetitive tasks, for example, spell-checking and file management
- Having a conversation is good for certain services, for instance, finding information or requesting music
- Hybrid conceptual models are good for supporting multiple ways of carrying out the same actions

Difference between interaction types and interface styles

Interaction type:

- A description of what the user is doing when interacting with a system, for example, instructing, talking, browsing, or responding

Interface style:

- The kind of interface used to support the interaction, for instance, command, menu-based, gesture, or voice

Many kinds of interface styles available (see Chapter 7)…

- Command
- Speech
- Data-entry
- Form fill-in
- Query
- Graphical
- Web
- Pen
- Augmented reality
- Gesture

Other sources

Conceptual knowledge that is used to inform design and guide research include:

- Paradigms
- Visions
- Theories
- Models
- Frameworks

Paradigm

- Inspiration for a conceptual model
- General approach adopted by a community for carrying out research
  - Shared assumptions, concepts, values, and practices
  - For example, desktop, ubiquitous computing, in the wild

"a typical example or pattern of something
आदर्श प्रतिमान; नमूना"

Examples of new paradigms in HCI

- Ubiquitous / Pervasive computing
- Wearable computing
- Internet of Things (IoT)

Visions

- A driving force that frames research and development
- Invites people to imagine what life will be like in 10, 15, or 20 years' time
  - For example, Apple's 1987 knowledge navigator
  - Smart cities, smart health
  - Human-centered AI
- Provide concrete scenarios of how society can use the next generation of imagined technologies
- Also raise ethical questions such as, privacy and trust

a picture in your imagination

कल्पना में बना चित्र, मानसिक प्रतिबिंब, आकृति या मनोरूप

Questions raised by tech visions

- How to enable people to access and interact with information in their everyday lives
- How to design user experiences where there is no obvious user control
- How and in what form to provide contextually-relevant information to people
- How to ensure that information passed around interconnected devices and objects is secure

Theory

- Explanation of a phenomenon
  - For example, information processing that explains how the mind, or some aspect of it, is assumed to work
- Can help identify factors relevant to the design and evaluation of interactive products
  - Such as cognitive, social, and affective
- Can be used to predict what users will do with different interfaces

the general idea or principles of a particular subject
विषय-विशेष के आधारभूत सिद्घांत

Models

A simplification of an HCI phenomenon

- Enables designers to predict and evaluate alternative designs
- Abstracted from a theory coming from a contributing discipline, for example:
  - Don Norman's (1996) model of the Seven Stages of Action
  - Marc Hassenzahl's (2010) model of the user experience

a copy of something that is usually smaller than the real thing
किसी वस्तु का नमूना, प्रतिरूप (प्रायः मूल वस्तु से छोटा); मॉडल

Frameworks (ढांचा)

- Set of interrelated concepts and-or specific questions for ‘what to look for’
- Provide advice on how to design user experiences
  - Helping designers think about how to conceptualize learning, working, socializing, fun, and emotion
- Focus on how to design particular kinds of interfaces to evoke certain responses
- Come in various forms:
  - Such as steps, questions, concepts, challenges, principles, tactics, and dimensions

A classic HCI framework

Don Norman's (1988) framework of the relationship between the design of a conceptual model and a user's understanding of it

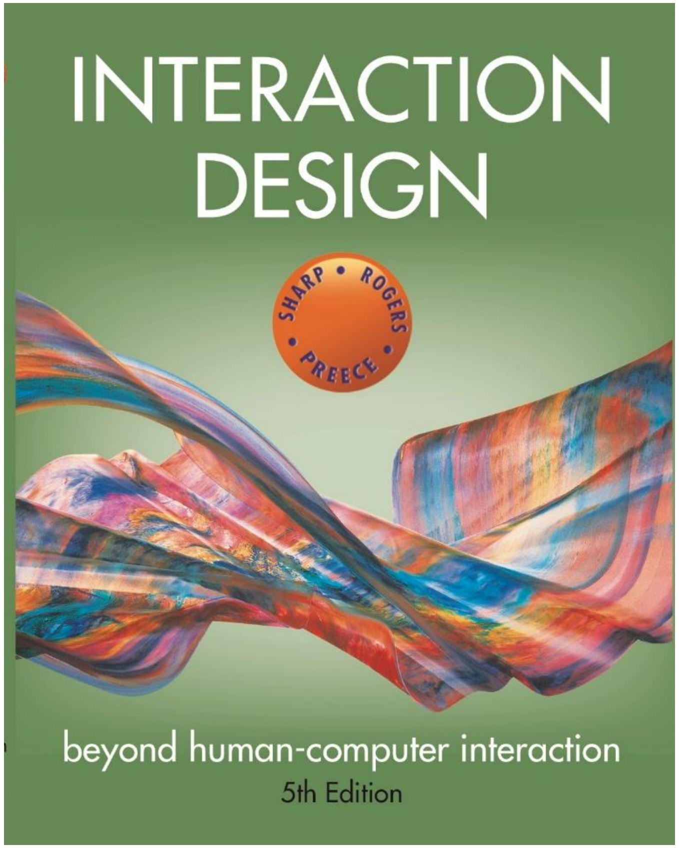
Consists of three interacting components:

- *The Designer's Model*
  - The model the designer has of how the system should work
- *System Image*
  - How the system actually works, which is portrayed to the user through the interface, manuals, help facilities, and so on
- *The User's Model*
  - How the user understands how the system works

Summary

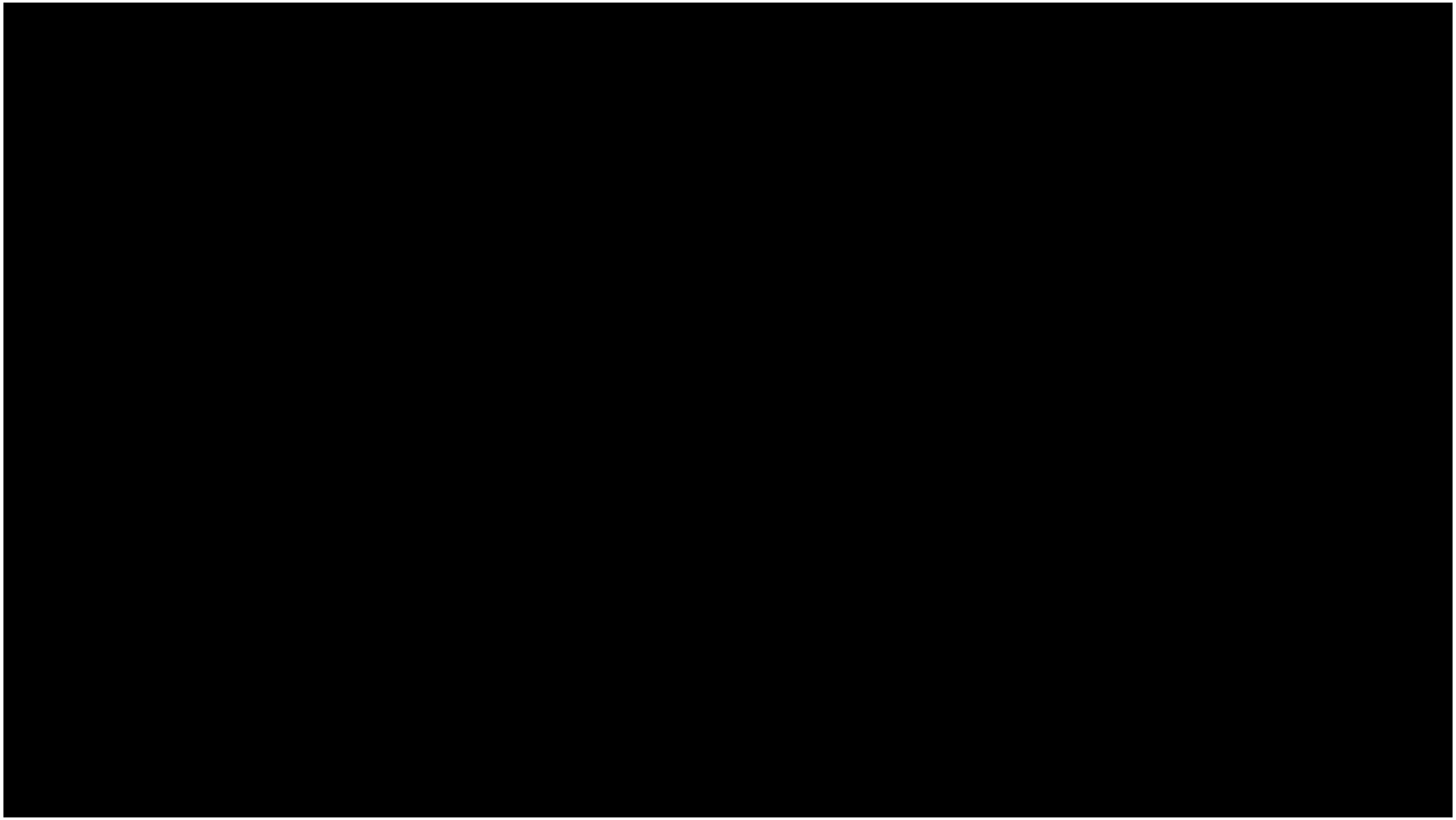
- Developing a conceptual model involves:
  - Understanding the problem space
  - Being clear about your assumptions and claims
  - Specifying how the proposed design will support users
- A conceptual model is a high-level description of a product in terms of:
  - What users can do with it and the concepts they need to understand how to interact with it
- Interaction types provide a way of thinking about how to support user’s activities
- Paradigms, visions, theories, models, and frameworks
  - Provide ways of framing design and research

https://www.youtube.com/watch?v=jgEOjQCRZBg



Chapter 4

COGNITIVE ASPECTS



https://www.youtube.com/watch?v=2jKKZYaPHGU

Overview

- What is cognition (अनुभूति, feeling, realization, perception, sensibility)?
- Why it is important to understand in HCI
- Describe how cognition has been applied to interaction design
- Explain what are mental models and how to elicit them
- Cover relevant theories of cognition

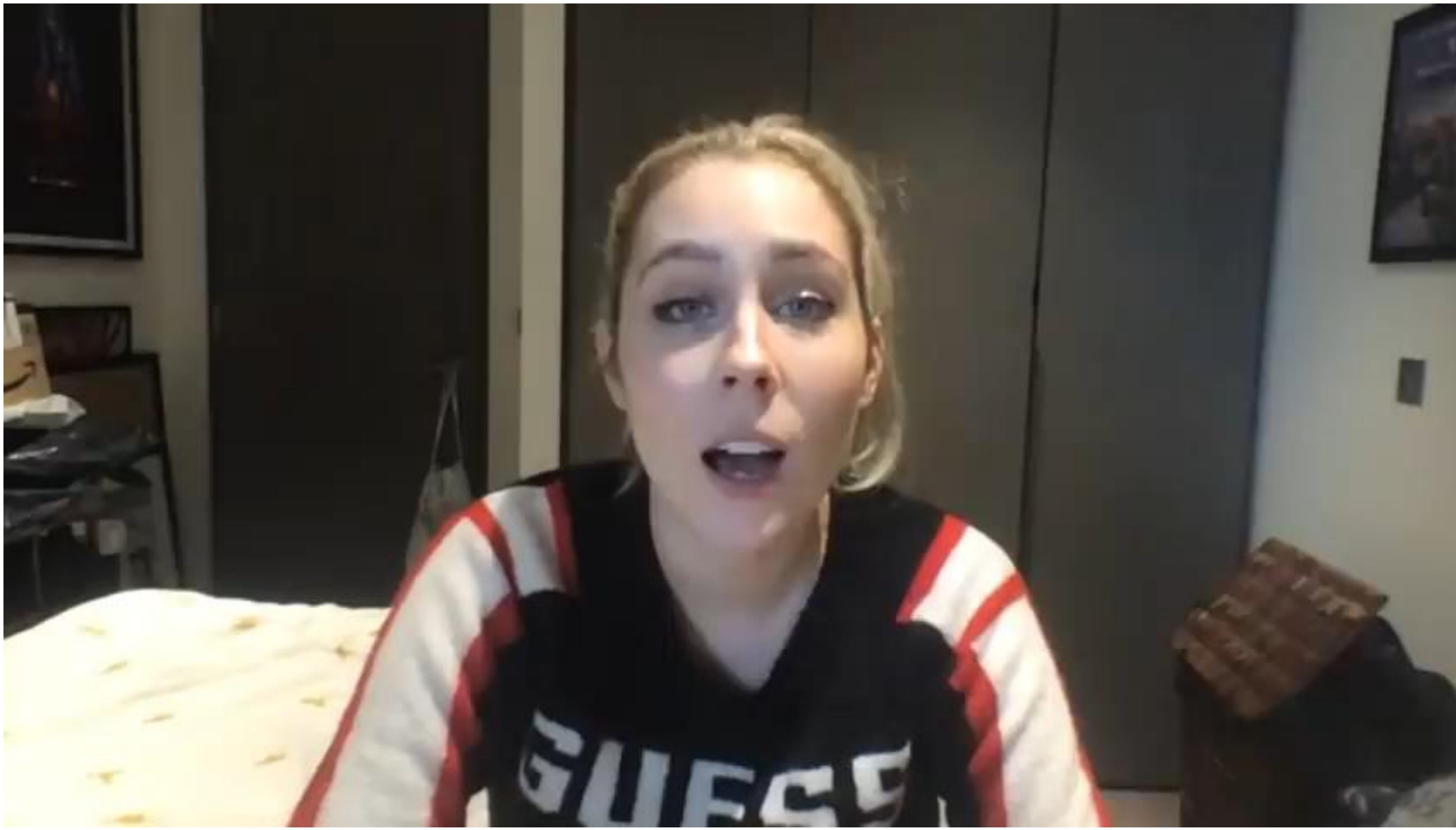
What is cognition?

- Thinking, remembering, learning, daydreaming, decision-making, seeing, reading, talking, writing…

- Ways of classifying cognition at a higher level:
  - Experiential cognition (Norman, 1993)
    - a state of mind where people perceive, act, and react to events around them intuitively and effortlessly.
  - Reflective cognition
    - involves mental effort, attention, judgment, and decision-making, which can lead to new ideas and creativity
  - Fast vs slow thinking (Kahneman, 2011)

Which involves fast vs slow thinking?

- 2 + 2 =
- 21 × 29 =
- What color eyes do you have?
- How many colors are there in the rainbow?
- How many months in the year have 31 days?
- What is the name of the first school you attended?



https://www.youtube.com/watch?v=LButXcZ57pc

How can understanding cognition help?

- Provides knowledge about what users can and cannot be expected to do
- Identifies and explains the nature and causes of problems that users encounter
- Provides theories, modeling tools, guidance, and methods that can lead to the design of better interactive products

Cognitive processes

- Attention (ध्यान)
- Perception (समझना)
- Memory (स्मृति)
- Learning (सीखना)
- Reading, speaking and listening
- Problem-solving, planning, reasoning and decision-making


KORG

Attention

- Selecting things on which to concentrate at a point in time from the mass of stimuli around us
- Allows us to focus on information that is relevant to what we are doing
- Involves audio and/or visual senses
- Focused and divided attention
  - Enables us to be selective in terms of the mass of competing stimuli, but limits our ability to keep track of all events
- Design recommendation
  - Information at the interface should be structured to capture users' attention, for example, use perceptual boundaries (windows), color, reverse video, sound, and flashing lights

Activity: Find the price for a double room at the Quality Inn in Pennsylvania

Pennsylvania
Bedford Motel/Hotel: Crinaline Courts
(814) 623-9511 S: $118 D: $120
Bedford Motel/Hotel: Holiday Inn
(814) 623-9006 S: $129 D: $136
Bedford Motel/Hotel: Midway
(814) 623-8107 S: $121 D: $126
Bedford Motel/Hotel: Penn Manor
(814) 623-8177 S: $119 D: $125
Bedford Motel/Hotel: Quality Inn
(814) 623-5189 S: $123 D: $128
Bedford Motel/Hotel: Terrace
(814) 623-5111 S: $122 D: $124
Bradley Motel/Hotel: De Soto
(814) 362-3567 S: $120 D: $124
Bradley Motel/Hotel: Holiday House
(814) 362-4511 S: $122 D: $125
Bradley Motel/Hotel: Holiday Inn
(814) 362-4501 S: $132 D: $140
Breezewood Motel/Hotel: Best Western Plaza
(814) 735-4352 S: $120 D: $127
Breezewood Motel/Hotel: Motel 70
(814) 735-4385 S: $116 D: $118

Activity: Find the price of a double room at the Holiday Inn in Columbia

South Carolina

City	Motel/Hotel	Area code	Phone	Rates Single	Rates Double
Charleston	Best Western	803	747-0961	$126	$130
Charleston	Days Inn	803	881-1000	$118	$124
Charleston	Holiday Inn N	803	744-1621	$136	$146
Charleston	Holiday Inn SW	803	556-7100	$133	$147
Charleston	Howard Johnsons	803	524-4148	$131	$136
Charleston	Ramada Inn	803	774-8281	$133	$140
Charleston	Sheraton Inn	803	744-2401	$134	$142
Columbia	Best Western	803	796-9400	$129	$134
Columbia	Carolina Inn	803	799-8200	$142	$148
Columbia	Days Inn	803	736-0000	$123	$127
Columbia	Holiday Inn NW	803	794-9440	$132	$139
Columbia	Howard Johnsons	803	772-7200	$125	$127
Columbia	Quality Inn	803	772-0270	$134	$141
Columbia	Ramada Inn	803	796-2700	$136	$144
Columbia	Vagabond Inn	803	796-6240	$127	$130

Activity

- Tullis (1987) found that the two screens produced quite different results
  - 1st screen: Took an average of 5.5 seconds to search
  - 2nd screen: Took 3.2 seconds to search
- Why, since both displays have the same density of information (31percent)?
- Spacing
  - In the 1st screen, the information is bunched up together, making it hard to search
  - In the 2nd screen, the characters are grouped into vertical categories of information making it easier

https://www.youtube.com/watch?v=bcChH8YzKjs

Multitasking and attention

- Is it possible to perform multiple tasks without one or more of them being detrimentally affected?
- Multitasking can cause people to lose their train of thought, make errors, and need to start over
- Ophir et al. (2009) compared heavy vs light multitaskers
  - Heavy multitaskers were more prone to being distracted than those who infrequently multitask
  - Heavy multitaskers are easily distracted and find it difficult to filter irrelevant information

Multitasking experiment

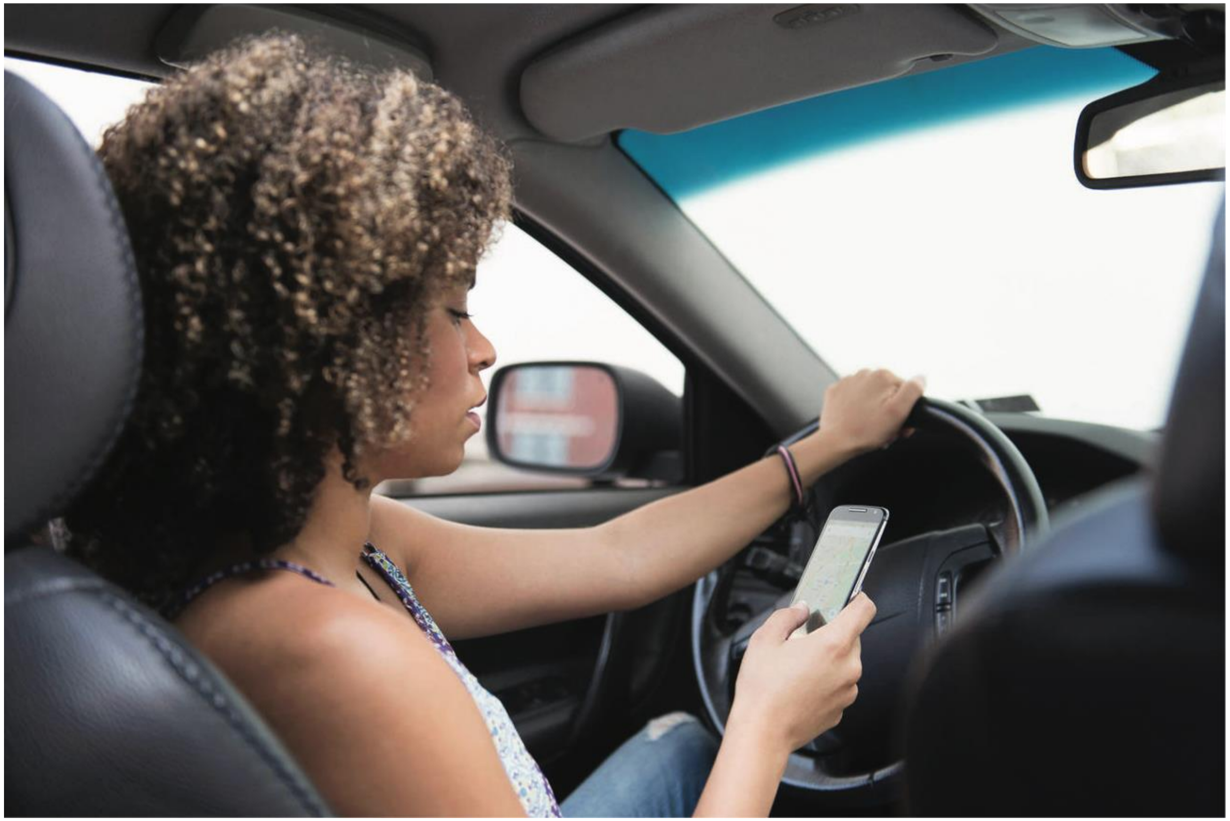
- Lotteridge et al. (2015) conducted another study involving writing an essay under two conditions: relevant or irrelevant information
  - Heavy multitaskers were easily distracted but able to put this to good use if the distracting sources were relevant to the task in hand
  - Irrelevant information was found to impact task performance negatively

Multitasking at work

It is increasingly common for workers to multitask

- For example, hospital workers have to attend to multiple screens in an operating room that provide new kinds of real-time information
- This requires clinician’s constant attention to check if any data is unusual or anomalous
- Need to develop new attention and scanning strategies

Is it OK to use a phone when driving?



No!

- Driving is very demanding
- Drivers are prone to being distracted
- There is a significant chance of causing accidents
- Drivers' reaction times are longer to external events when talking on the phone in a car (Caird et al., 2018)
- Drivers using their phones rely more on their expectations about what is likely to happen next as conducting a conversation takes up their attention
- Response time is slower to unexpected events (Briggs et al., 2018)
- Drivers often try to imagine what the other person's face is like− the person to whom they are speaking
  - Doing so competes with the processing resources needed to enable them to notice and react to what is in front of them

Are hands-free phones safer to use when driving?

- No, as same type of cognitive processing is happening when talking
- The same thing happens when talking with front seat passenger
  - But both can stop in mid-sentence if a hazard is spotted allowing the driver to switch immediately to the road
  - So, it's less dangerous talking to a front seat passenger than a remote person
  - A remote person on the end of a phone is not privy to what the driver is seeing and will carry on the conversation when there is a hazard
  - This makes it difficult for the driver to switch all their attention to the road

Design implications for attention

- Context: Make information salient when it needs to be attended to at a given stage of a task
- Use techniques to achieve this:
  - For example, color, ordering, spacing, underlining, sequencing, and animation
- Avoid cluttering visual interfaces with too much information
- Consider designing different ways to support effective switching and returning to an interface

Perception

Perception

- How information is acquired from the world and transformed into experiences
- Obvious implication is to design representations that are readily perceivable, for instance:
  - Text should be legible
  - Icons should be easy to distinguish and read

Is color contrast good? Find Italian

Black Hills Forest	Peters Landing	Jefferson Farms	Devlin Hall
Cheyenne River	Public Health	Psychophysics	Positions
Social Science	San Bernardino	Political Science	Hubard Hall
South San Jose	Moreno Valley	Game Schedule	Fernadino Beach
Badlands Park	Altamonte Springs	South Addision	Council Bluffs
Juvenile Justice	Peach Tree City	Cherry Hills Village	Classical Lit
Results and Stats	Highland Park	Creative Writing	Sociology
Thousand Oaks	Manchesney Park	Lake Havasu City	Greek
Promotions	Vallecito Mts.	Engineering Bldg	Wallace Hall
North Palermo	Rock Falls	Sports Studies	Concert Tickets
Credit Union	Freeport	Lakewood Village	Public Radio FM
Wilner Hall	Slaughter Beach	Rock Island	Children's Museum
Performing Arts	Rocky Mountains	Deerfield Beach	Writing Center
Italian	Latin	Arlington Hill	Theater Auditions
Coaches	Pleasant Hills	Preview Game	Delaware City
McKees Rocks	Observatory	Richland Hills	Scholarships
Glenwood Springs	Public Affairs	Experts Guide	Hendricksville
Urban Affairs	Heskett Center	Neff Hall	Knights Landing
McLeansboro	Brunswick	Grand Wash Cliffs	Modern Literature
Experimental Links	East Millinocket	Indian Well Valley	Studio Arts
Graduation	Women's Studies	Online Courses	Hughes Complex
Emory Lindquist	Vacant	Lindquist Hall	Cumberland Flats
Clinton Hall	News Theatre	Fisk Hall	Central Village
San Luis Obispo	Candlewood Isle	Los Padres Forest	Hoffman Estates

Are borders and white space better?

Find French

Webmaster
Russian
Athletics
Go Shockers
Degree Options
Newsletter

Curriculum
Emergency (EMS)
Statistics
Award Documents
Language Center
Future Shockers

Student Life
Accountancy
McKnight Center
Council of Women
Commute
Small Business

Dance
Gerontology
Marketing
College Bylaws
Why Wichita?
Tickets

Geology
Manufacturing
Management
UCATS
Alumni News
Saso

Intercollegiate
Bowling
Wichita Gateway
Transfer Day
Job Openings
Live Radio

Thinker & Movers
Alumni
Foundations
Corbin Center
Jardine Hall
Hugo Wall School

Career Services
Doers & Shockers
Core Values
Grace Wilkie Hall
Strategic Plan
Medical Tech

Educational Map
Physical Plant
Graphic Design
Non Credit Class
Media Relations
Advertising

Beta Alpha Psi
Liberal Arts
Counseling
Biological Science
Duerksen Fine Art
EMT Program

Staff
Aerospace
Choral Dept.
Alberg Hall
French
Spanish

Softball, Men's
McKinley Hall
Email
Dental Hygiene
Tenure
Personnel Policies

English
Graduate Complex
Music Education
Advising Center
Medical School
Levitt Arena

Religion
Art Composition
Physics
Entrepreneurship
Koch Arena
Roster

Parents
Wrestling
Philosophy
Wichita Lyceum
Fairmount Center
Women's Museum

Instrumental
Nursing
Opera
Sports History
Athletic Dept.
Health Plan

Find Hindi?

Activity

- Weller (2004) found people took less time to locate items for information that was grouped
  - Using a border (2nd screen) compared with using color contrast (1st screen)
- Some argue that too much white space on web pages is detrimental to search process
  - Makes it hard to find information
- Do you agree?

Activity: Which is the easiest to read and why?

What is the time?

What is the time?

What is the time?

What is the time?

What is the time?

Design implications

- Icons should enable users to *distinguish* their meaning readily
- Bordering and spacing are effective visual ways of grouping information
- Sounds should be audible and distinguishable
- Research proper color contrast techniques when designing an interface:
  - Yellow on black or blue is fine
  - Yellow on green or white is a no-no
- Haptic feedback should be used judiciously

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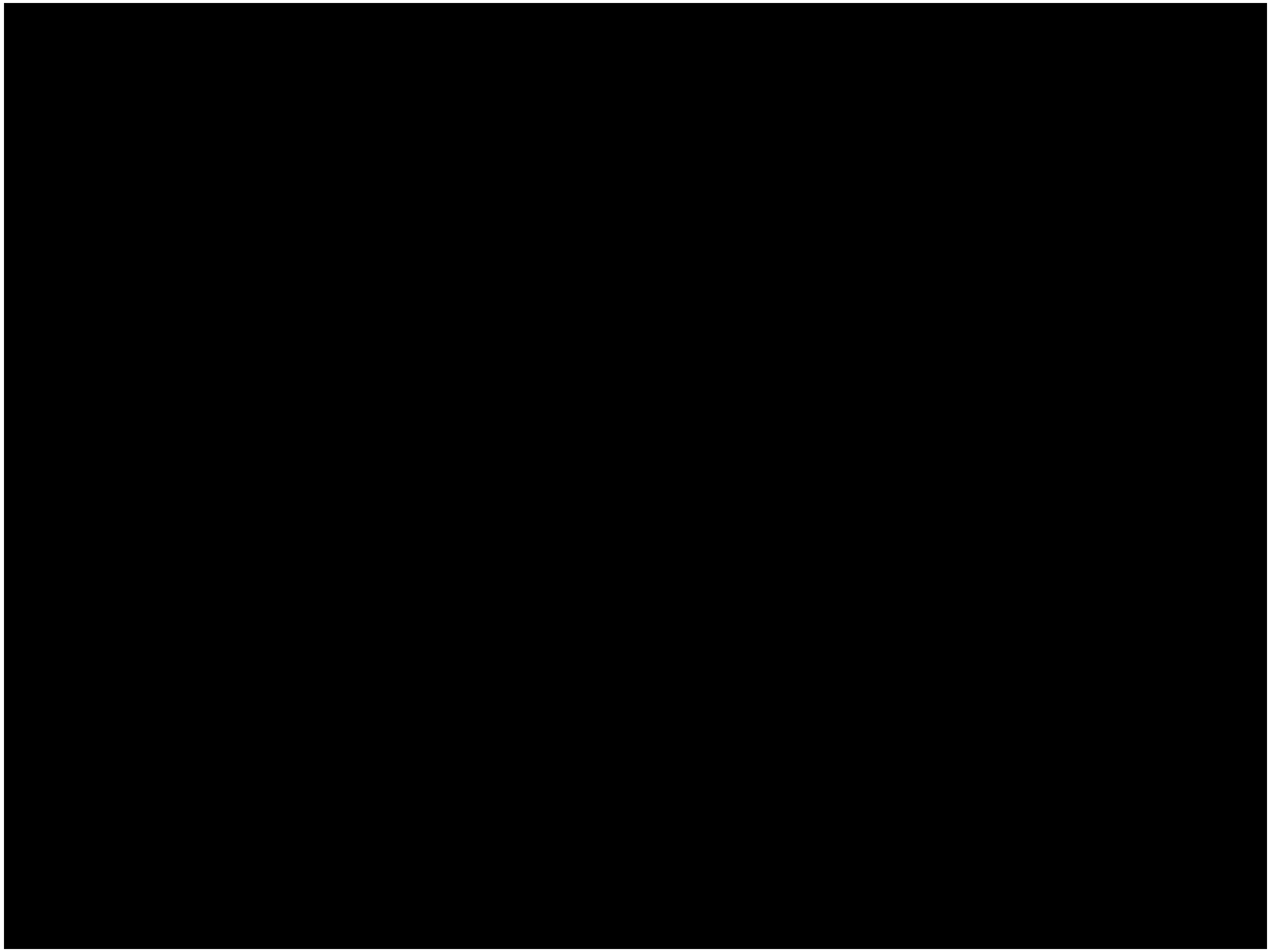
3.141592653589793238….

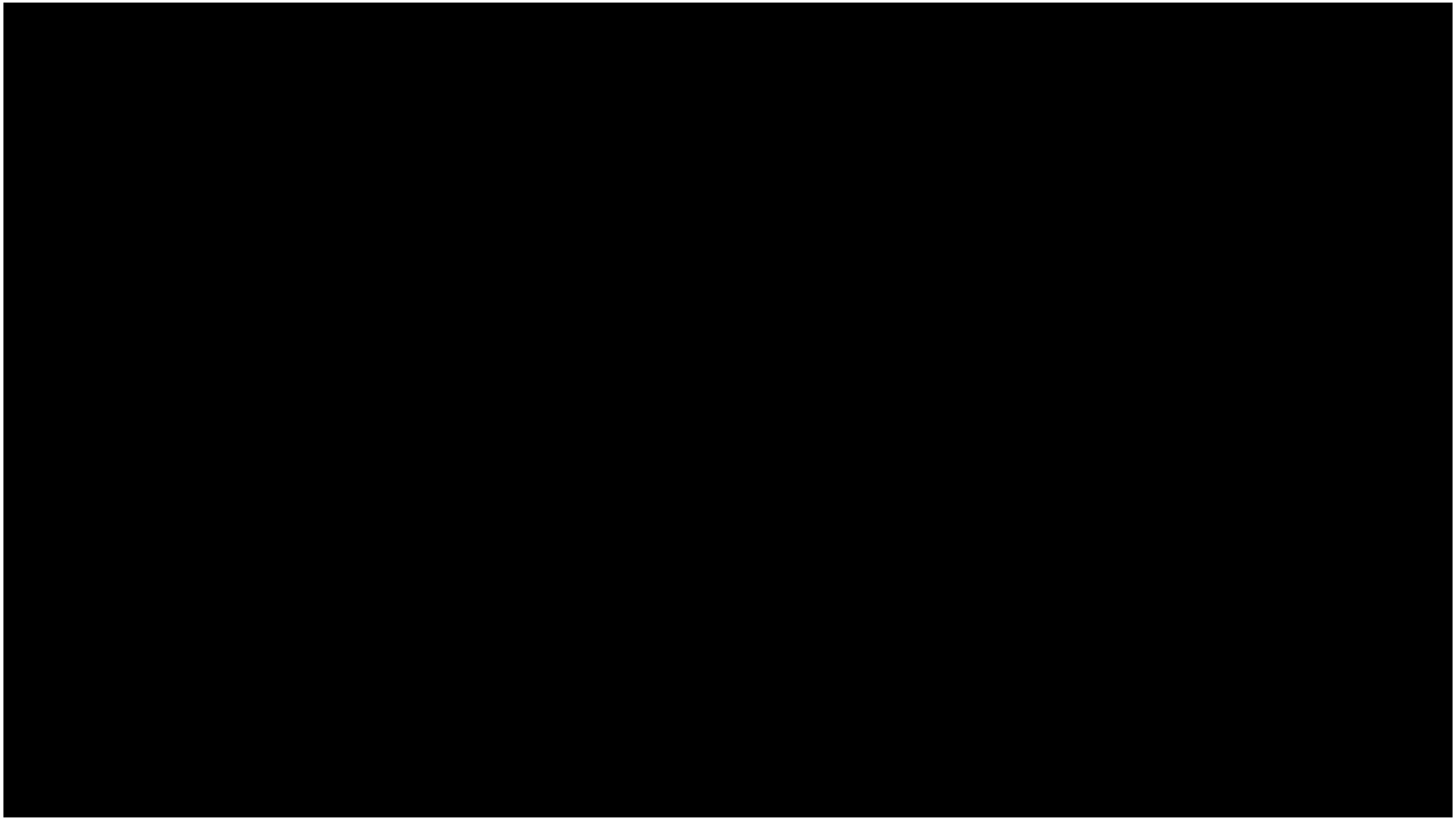
Memory



Memory

https://www.youtube.com/watch?v=hXsjwq1Q6HE

Learning



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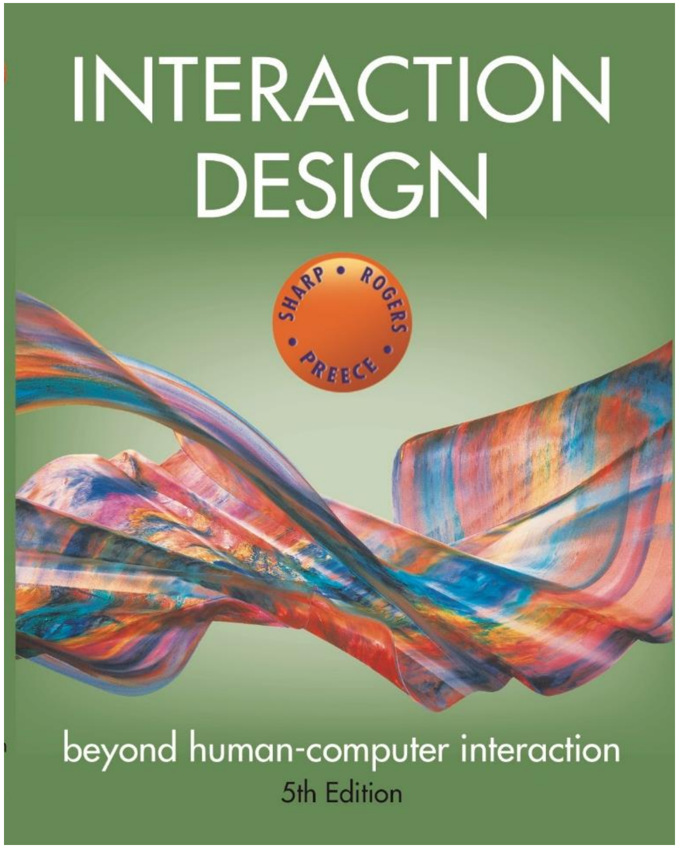


Chapter 4

COGNITIVE ASPECTS

Memory

https://www.youtube.com/watch?v=hXsjwq1Q6HE

Overview

- What is cognition (अनुभूति, feeling, realization, perception, sensibility)?
- Why it is important to understand in HCI
- Describe how cognition has been applied to interaction design
- Explain what are mental models and how to elicit them
- Cover relevant theories of cognition

Memory

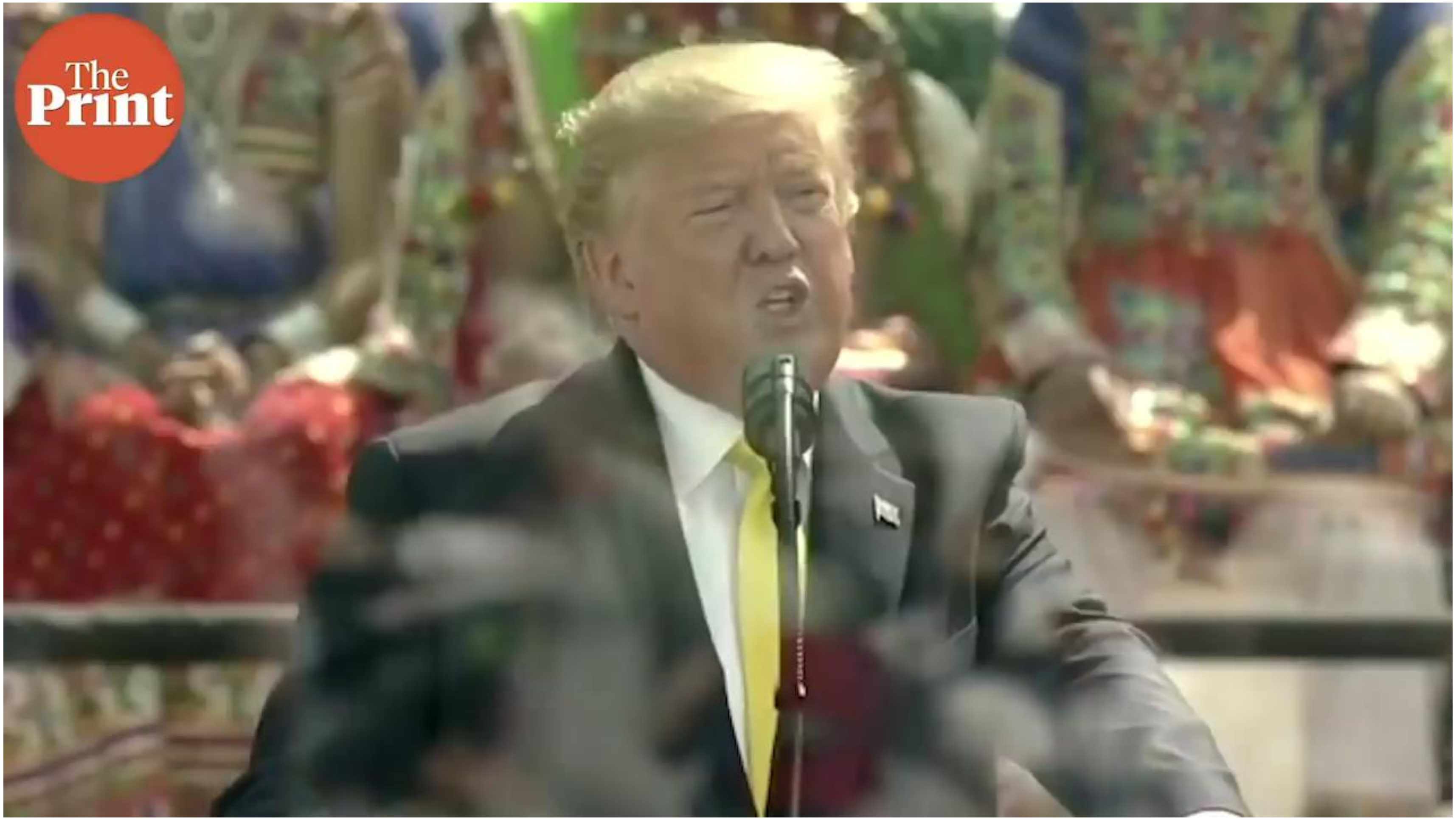
- Involves recalling various kinds of knowledge that allow people to act appropriately
  - For example, recognizing someone's face or remembering someone's name
- First encode and then retrieve knowledge
- We don't remember everything−it involves filtering and processing what is attended to
- Context is important as to how we remember (that is, where, when, how, and so on)
- We recognize things much better than being able to recall things
- We remember less about objects that we have photographed than when we observe them with the naked eye (Henkel, 2014)

Processing in memory

- Encoding is first stage of memory
  - Determines which information is attended to in the environment and how it is interpreted
- The more attention paid to something…
- The more it is processed in terms of thinking about it and comparing it with other knowledge…
- The more likely it is to be remembered
  - For example, when learning about HCI, it is much better to reflect upon it, carry out exercises, have discussions with others about it, and write notes than just passively read a book, listen to a lecture or watch a video about it

Context is important

- Context affects the extent to which information can be subsequently retrieved
- Sometimes it can be difficult for people to recall information that was encoded in a different context:
  - "You are on a train and someone comes up to you and says hello. You don't recognize him for a few moments, but then realize it is one of your neighbors. You are only used to seeing your neighbor in the hallway of your apartment building, and seeing him out of context makes him difficult to recognize initially"



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Activity

- Try to remember the dates of your grandparents' birthday
- Try to remember the cover of the last two books you read
- Which was easiest? Why?
- People are very good at remembering visual cues about things
  - For instance, the color of items, the location of objects and marks on an object
- They find it more difficult to learn and remember arbitrary material
  - For example, birthdays and phone numbers

Recognition versus recall

- Command-based interfaces require users to recall from memory a name from a possible set of 100s of names
- Graphical interfaces provide visually-based options (menus, icons) that users need only browse through until they recognize one
- Web browsers provide tabs and history lists of visited URLs that support recognition memory

The problem with the classic '7,+ or − 2'

- George Miller's (1956) theory of how much information people can remember
- People's immediate memory capacity is very limited to 7, + or − 2
- Has been applied in interaction design when considering how many options to display
- But is it a good use of a theory in HCI?
- Is it helpful?

When creating an interface, should the designer…

- Present only 7 options on a menu
- Display only 7 icons on a tool bar
- Have no more than 7 bullets in a list
- Place only 7 items on a pull down menu
- Place only 7 tabs on the top of a website page?
- Not necessarily…

The reason is…

- People can scan lists of bullets, tabs, and menu items for the one they want
- They don’t have to recall them from memory, having only briefly heard or seen them
- So you can have more than nine at the interface
  - For instance, history lists of websites visited
- Sometimes a small number of items is good
  - For example, smart watch displays
- Depends on task and available screen estate

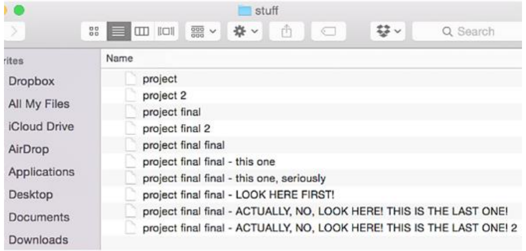
Personal Information management

Is a growing problem for many users:

- They accumulate a vast numbers of documents, images, music files, video clips, emails, attachments, bookmarks, and so forth
- Where and how to save them all; then remembering what they were called and where to find them again
- Naming most common means of encoding them
- But can be difficult to remember, especially when you have 10,000s
- How might such a process be facilitated taking into account people's memory abilities?

Personal Information management

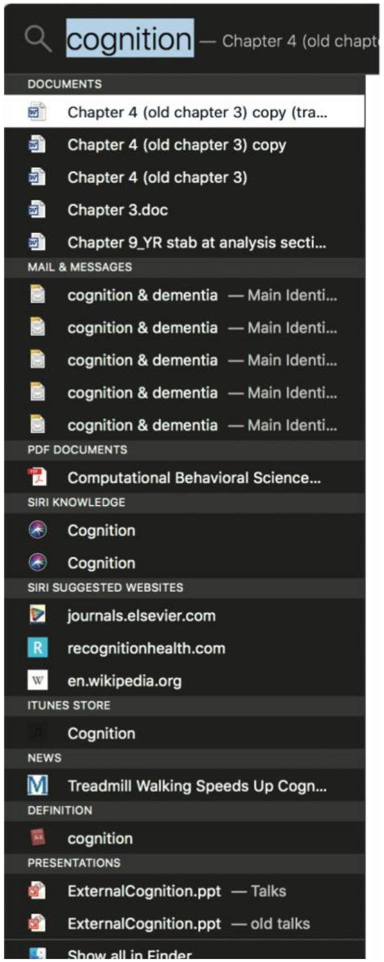
- Bergman and Whittaker, three interdependent processes model (2016) to help people manage their stuff:
  I. How to decide what stuff to keep
  II. How to organize it when storing
  III. Which strategies to use to retrieve it later



DOGHOUSEDIAR

- Most common approach is to use folders and naming
- Strong preference for scanning across and within folders when looking for something
- Search engines only helpful if you know the name of the file
- Smart search engines help with listing relevant files for partial name or when type in first letter

Apple's Spotlight search tool



Memory load

- Online/mobile and phone banking now require users to provide multiple pieces of information to access their account
  - For instance, ZIP code, birthplace, a memorable date, first school attended
  - Known as multifactor authentication (MFA)
- Why?
  - Increased security concerns
- Password managers, such as LastPass, have been developed that require only one master password
  - Reduces stress and memory load on users
- Passwords could become extinct with the widespread use of biometrics and computer vision algorithms

Digital Forgetting

- When might you wish to forget something that is online?
  - When you break up with a partner
  - Emotionally painful to be reminded of them through shared photos, social media, and so on.
- Sas and Whittaker (2013) suggest ways of harvesting and deleting digital content
  - For example, making photos of ex into an abstract collage
  - Helps with closure

Memory aids

https://www.youtube.com/watch?v=5AGeR6xjS14

Memory aids

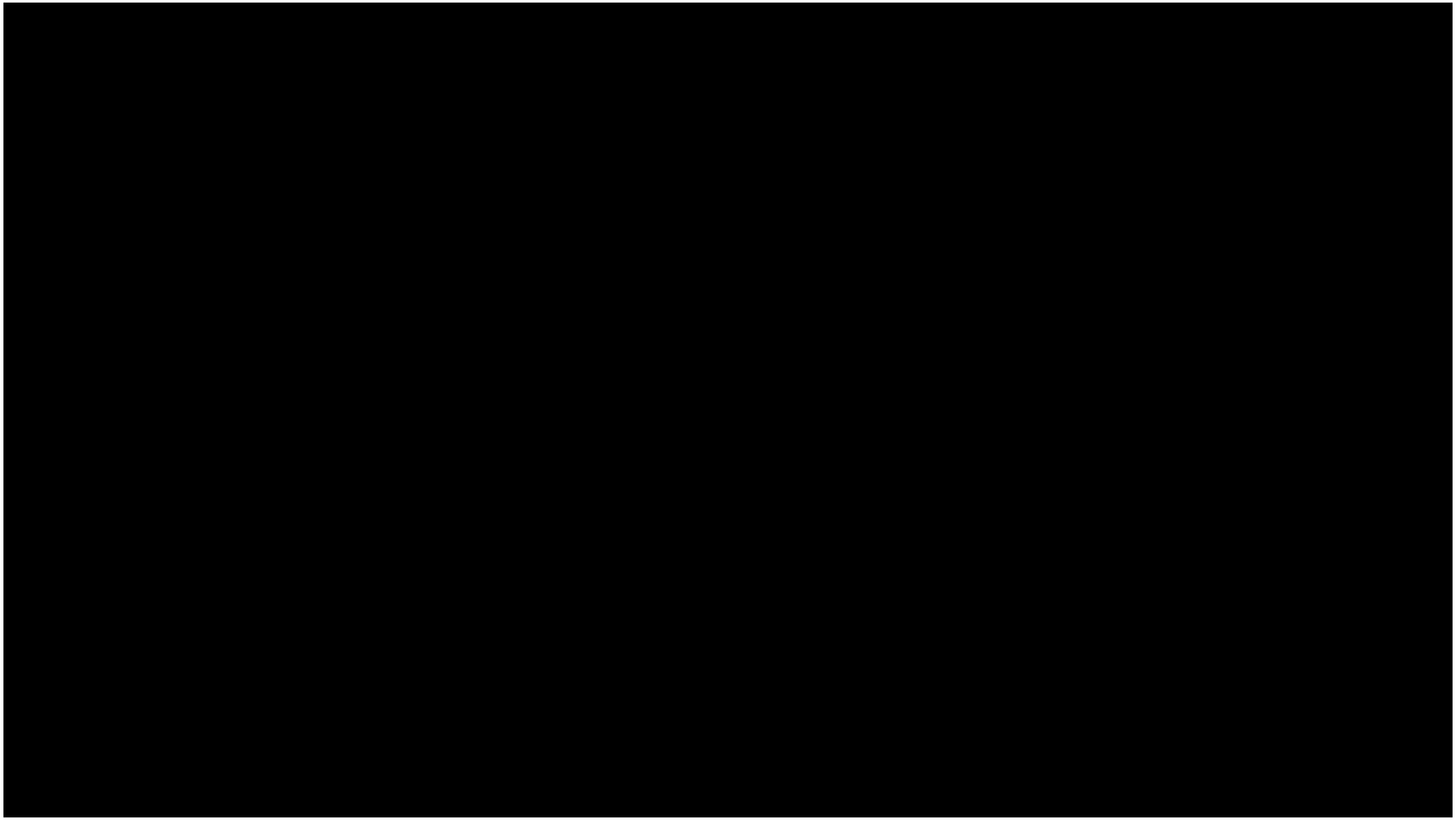
- SenseCam, developed by Microsoft Research Labs (now Autographer)
  - A wearable device that intermittently takes photos without any user intervention while worn
  - Digital images taken are stored and revisited using special software
  - Has been found to improve people's memory, especially those suffering from dementia
- Other aids include RemArc, which triggers long-term memory using old BBC materials

SenseCam

Design implications

- Reduce cognitive load by avoiding long and complicated procedures for carrying out tasks
- Design interfaces that promote recognition rather than recall
- Provide users with various ways of labelling digital information to help them easily identify it again
    - For example, folders, categories, color, flagging, and time stamping

Learning



Learning

- Involves the accumulation of skills and knowledge involving memory
- Two main types:
  - Incidental learning (for example, recognizing people's faces, what you did today)
  - Intentional learning (for instance, studying for an exam, learning to cook)
  - Intentional learning is much harder!
  - Many technologies have been developed to help (for example, multimedia, animations, VR)
- People find it hard to learn by following instructions in a manual
- People prefer to learn by doing

Design implications

- Design interfaces that encourage exploration
- Design interfaces that constrain and guide learners
- Dynamically linking concepts and representations can facilitate the learning of complex material

Reading, speaking, and listening

The ease with which people can read, listen, or speak differs:

- Many prefer listening to reading
- Reading can be quicker than speaking or listening
- Listening requires less cognitive effort than reading or speaking
- Dyslexics have difficulties understanding and recognizing written words

Applications

- Voice user interfaces allow users to interact with them by asking questions
  - For example, Google Voice, Siri, and Alexa
- Speech-output systems use artificially-generated speech
  - For instance, written text-to-speech systems for the visually impaired
- Natural-language systems enable users to type in questions and give text-based responses
  - Such as, chatbots

Design implications

- Speech-based menus and instructions should be short
- Accentuate the intonation of artificially generated speech voices
  - They are harder to understand than human voices
- Provide opportunities for making text large on a screen

Problem-solving, planning, reasoning, and decision-making

- All these processes involve *reflective* cognition
  - For example, thinking about what to do, what the options are, and the consequences
- Often involves conscious processes, discussion with others (or oneself), and the use of artifacts
  - Such as maps, books, pen and paper
- May involve working through different scenarios and deciding which is best option
- Weighing up alternatives

Design implications

- Provide information and help pages that are easy to access for people who wish to understand more about how to carry out an activity more effectively (for example, web searching)
- Use simple and memorable functions to support rapid decision-making and planning

Dilemma

- The app mentality is making it worse for people to make their own decisions because they are becoming risk averse (Gardner and Davis, 2013)
  - Instead, they now rely on a multitude of apps
  - This makes them increasingly anxious
  - They are unable to make decisions by themselves
  - They need to resort to looking up info, getting other’s opinions on social media, and comparing notes
- Do you agree?
- Did it happen to you when deciding which university/school to attend?

Cognitive frameworks

- These are used to explain and predict user behavior at the interface
  - Based on theories of behavior
  - Focus is on mental processes that take place
  - Also use of artifacts and representations
- Most well known are:
  - Mental models
  - Gulfs of execution and evaluation
  - Distributed cognition
  - External and embodied cognition

Mental models

- Users develop an understanding of a system through learning about and using it
- Knowledge is sometimes described as a mental model:
  - How to use the system (what to do next)
  - What to do with unfamiliar systems or unexpected situations (how the system works)
- People make inferences using mental models of how to carry out tasks

More mental models

- Craik (1943) described mental models as:
  - Internal constructions of some aspect of the external world enabling predictions to be made
- Involves unconscious and conscious processes
  - Imagery and analogies are activated
- Deep versus shallow models
  - For example, how to drive a car and how it works

Everyday reasoning and mental models

(a) You arrive home on a cold winter's night to a cold house. How do you get the house to warm up as quickly as possible? Set the thermostat to be at its highest or to the desired temperature?

(b) You arrive home starving hungry. You look in the fridge and find all that is left is an uncooked pizza. You have an electric oven. Do you warm it up to 375 degrees first and then put it in (as specified by the instructions) or turn the oven up higher to try to warm it up quicker?

Heating up a room or oven that is thermostat-controlled

- Many people when asked (a) choose the first option
- Why?
  - They think it will heat the room up quicker
  - General valve theory, where 'more is more' principle is generalized to different settings (for instance, gas pedal, gas cooker, tap, radio volume)
  - But it is a wrong mental model for thermostats based on on-off switch model
- Many people when asked (b) choose the first option
  - Electric ovens work on the same principle as thermostats
- Most of us have erroneous mental models (Kempton, 1996)

Erroneous mental models

- Lots of people hit the button for elevators and pedestrian crossings at least twice
  - Why? Think it will make the lights change faster or ensure that the elevator arrives!
- What kinds of mental models do users have for understanding how interactive devices work?
  - Poor, often incomplete, easily confusable, based on inappropriate analogies and superstition (Norman, 1983)

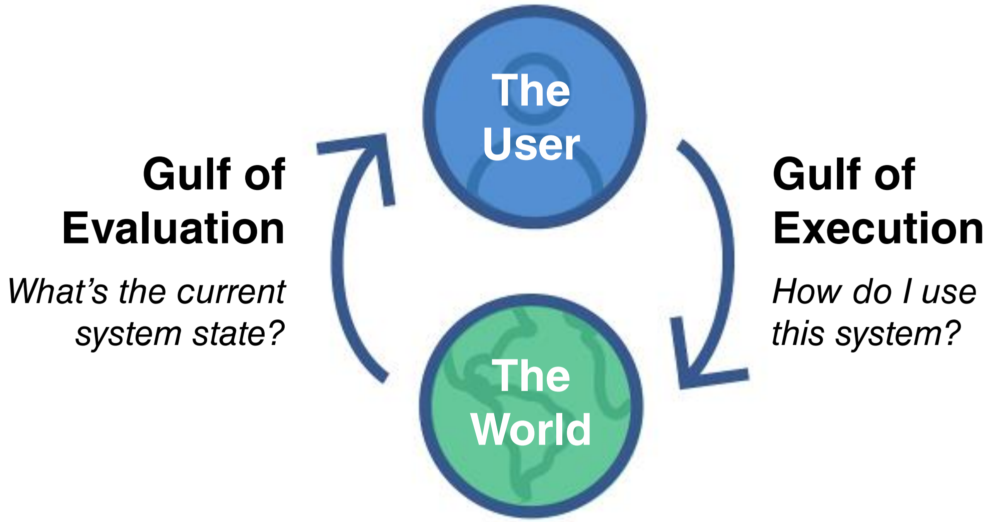
How can UX be designed to help people build better mental models?

- Clear and easy to use instructions
- Appropriate tutorials and contextual sensitive guidance
- Provide online videos and chatbot windows when needing help
- Transparency: to make interfaces intuitive to use
- Affordances of what actions an interface allows
  - For example, swiping, clicking, or selecting

Gulfs of execution and evaluation

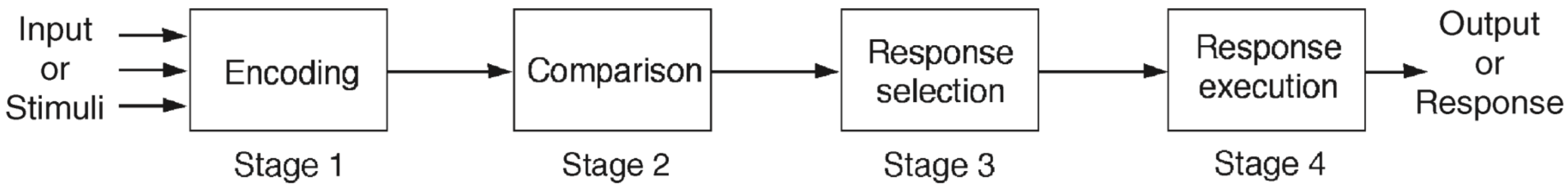
- The ‘gulfs’ explicate the gaps that exist between the user and the interface
- The gulf of execution
  - The distance from the user to the physical system
- The gulf of evaluation
  - The distance from the physical system to the user
- Bridging the gulfs can reduce cognitive effort required to perform tasks
- Can reveal whether interface increases or decreases cognitive load and whether it is obvious what to do next (Norman, 1986; Hutchins et al, 1986)

Bridging the gulfs



Information processing

- Conceptualizes human performance in metaphorical terms of information processing stages



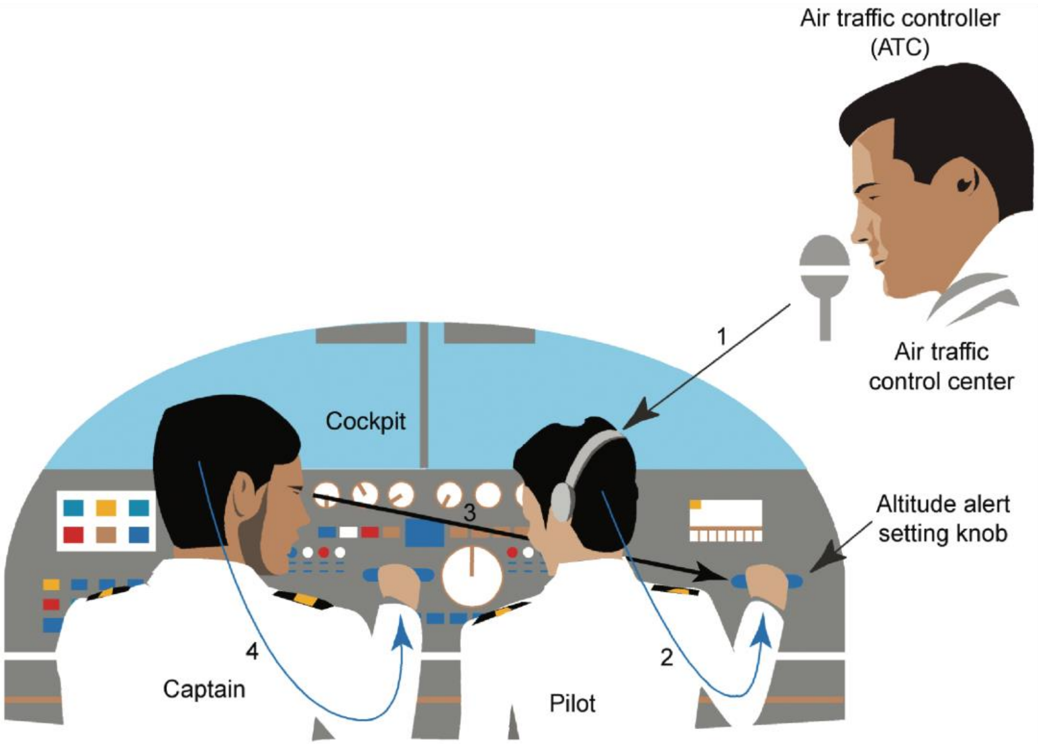
Limitations

- Based on modeling mental activities that happen exclusively inside the head
- Do not adequately account for how people interact with computers and other devices in real world

Distributed cognition

- Concerned with the nature of cognitive phenomena across individuals, artifacts, and internal and external representations (Hutchins, 1995)
- Describes these in terms of propagation across representational state
- Information is transformed through different media (computers, displays, paper, heads)

A cognitive system for ATC



Propagation of representational states:

1 ATC gives clearance to pilot to fly to higher altitude (verbal)

2 Pilot changes altitude meter (mental and physical)

3 Captain observes pilot (visual)

4 Captain flies to higher altitude (mental and physical)

What’s involved

- The distributed problem-solving that takes place
- The role of verbal and non-verbal behavior
- The various coordinating mechanisms that are used (for example, rules and procedures)
- The communication that takes place as the collaborative activity progresses
- How knowledge is shared and accessed

External cognition

- Concerned with explaining how we interact with external representations (such as maps, notes, and diagrams)
- What are the cognitive benefits and what processes involved
- How they extend cognition
- What technologies can we develop to help people carry out complex tasks (for example, learning, problem solving, and decision-making)?

Externalizing to reduce memory load

- Examples include the use of diaries, reminders, calendars, notes, shopping lists, to-do lists
  - Written to remind us of what to do
- Post-its, piles, marked emails are used to:
  - Where placed indicates priority of what to do
- External representations:
  - Remind us that we need to do something (for example, to buy something for mother’s day)
  - Remind us of what to do (for instance, buy a card)
  - Remind us when to do something (for example, send a card by a certain date)

Computational offloading

- When a tool is used in conjunction with an external representation to carry out a computation (for instance, pen and paper)
- Try doing the two sums below (a) in your head, (b) on a piece of paper, and (c) with a calculator.

$$234 \times 456 = ??$$

$$\text{CCXXXIIII} \times \text{CCCCXXXXXVI} = ???$$

- Which is easiest and why? Both are identical sums

Annotation and cognitive tracing

- Annotation involves modifying existing representations through making marks
  - For example, crossing off, ticking, and underlining
- Cognitive tracing involves externally manipulating items into different orders or structures
  - For instance, playing Scrabble or cards

Design implication

- Provide external representations at the interface that can reduce memory load and facilitate computational offloading
  - For example, information visualizations have been designed to allow people to make sense and rapid decisions about masses of data

Embodied Interaction

- The practical engagement with the social and physical environment (Dourish, 2001)
- Creating, manipulating and making meaning through our interaction with things
- How our bodies and active experiences shape how we perceive, feel, and think (Hornecker et al., 2017)
- They enable us to develop a sense of the world at both a concrete and abstract level
- Can provide new ideas about interaction and better design principles
  - For example, we think with our bodies not through them (Kirsh, 2013)

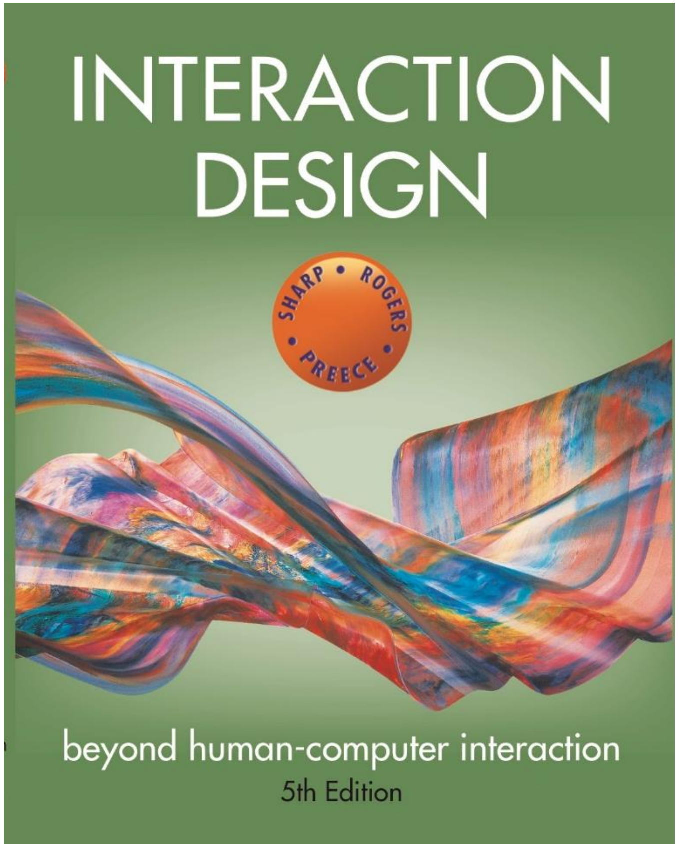
Summary

- Cognition involves many processes including attention, memory, perception, and learning
- The way an interface is designed can greatly affect how well users can perceive, attend, learn, and remember how to do their tasks
- Theoretical frameworks, such as mental models and external cognition, provide ways of understanding how and why people interact with products
- This can lead to thinking about how to design better products

In-depth activity

Write down how you think a contactless card or smartphone app like Apple Pay works

- What information is sent between the card/smartphone and the card reader when it is placed in front of it?
- What is the maximum amount you can pay for something using a contactless card, Apple Pay or Google Pay?
- Why is there an upper limit?
- How many times can you use a contactless card or Apple/Google Pay in a day?
- What happens if you have two contactless cards in the same wallet/purse?
- What happens when your contactless card is stolen and you report it to the bank? What does the bank do?



Chapter 5
SOCIAL INTERACTION

Overview

- What is meant by social interaction
- The social mechanisms used in conversations
- What is meant by social presence
- Overview of technologies for supporting social interaction
- How has social media changed how we keep in touch
- New social phenomenon arising from being able to connect online

Social interaction

- We live together, work together, play together, talk to each other, and socialize
- Social technologies developed to enable us to persist in being social when apart
  - They differ in how they support us
  - Some encourage social interactions (for example, family games with Alexa)
  - Others have a negative impact on everyday conversations (Turkle, 2015)…

Are we spending too much time in our own digital bubbles?

Questions raised by social tech

- Are F2F conversations being superseded by social media interactions?
- How many friends do you have on Facebook, LinkedIn, WhatsApp, and so on versus real life?
- How much do they overlap?
- How are the ways that we live and interact with one another changing?
- Are the established rules and etiquette still applicable to online and offline?

Conversational mechanisms

Various mechanisms and ‘rules’ are followed when holding a conversation face to face, such as mutual greetings

A: Hi there
B: Hi!
C: Hi
A: All right?
C: Good, how’s it going?
A: Fine, how are you?
C: OK
B: So-so. How’s life treating you?

Conversational rules

Sacks et al. (1978) conversation analysis of conversations propose three basic rules:

Rule 1: The current speaker chooses the next speaker by asking an opinion, question, or request

Rule 2: Another person decides to start speaking

Rule 3: The current speaker continues talking

More conversational rules

Turn-taking used to coordinate conversation

A: Shall we meet at 8:00?
B: Um, can we meet a bit later?

A: Shall we meet at 8:00?
B: Wow, look at him?

A: Yes what a funny hairdo!
B: Um, can we meet a bit later?

Back channeling to signal to continue and following

- Uh-uh, umm, ahh

Further conversational rules

Farewell rituals

- Bye then, see you, yeah bye, see you later….

Implicit and explicit cues

- For instance, looking at watch or fidgeting with coat and bags
- Explicitly saying, “Oh dear, look at the time, I must go, I’m running late…”

Breakdowns in conversation

When someone says something that is misunderstood:

- Speaker will repeat with emphasis:

  A: “This one?”

  B: “No, I meant that one!”

- Also use tokens:

  Eh? Quoi? Huh? What?

What happens in online conversations?

- Do the same conversational rules apply?
- Are there different kinds of breakdowns?
- How do people repair them for:
  - Email?
  - Instant messaging?
  - Texting?
  - Skype or other videoconferencing software?

Remote conversations

Remote conversations

- Much research on how to support conversations when people are ‘at a distance’ from each other
- Many applications have been developed
  - For example, email, videoconferencing, instant messaging, and chatrooms
- Do they mimic or move beyond existing ways of conversing?

Early videophone from the 1960s

VideoWindow system (Bellcore, 1989)

- Shared space that allowed people 50 miles apart to carry on a conversation as if in same room drinking coffee together
- 3 x 8 foot ‘picture-window’ between two sites with video and audio
- People did interact via the window, but strange things happened (Kraut, 1990)

Diagram of VideoWindow in use

Findings of how VideoWindow System was used

- Talked constantly about the system
- Spoke more to other people in the same room rather than in other room
- When trying to get closer to someone in the other place it had opposite effect—participants went out of range of the camera and microphone
- No way of monitoring this

Videoconferencing and telepresence rooms

- Many to choose from to connect multiple people (for instance, Zoom)
- Customized telepresence rooms for groups

Video-conferencing

https://www.youtube.com/watch?v=StzNtICeLqQ

Telepresence robots

Enable people to attend events who could not do so, such as by controlling their robot remotely

- In places such as schools, conferences, and museums
- Early example: Beam+
- Often dressed up to appear like the person to others at the event
- Positive experience of being there

Susan Lechelt at ACM CHI

Telepresence and social presence

- *Telepresence* refers to one party being present with another party, who is present in a physical space, such as a meeting room
- *Social presence* refers to the feeling of being there with a real person when in virtual reality

Facebook's vision of socializing in a 3D world using VR

- Two avatars talking at a virtual table
- Users experience each other through donning VR headsets

How much realism and immersion are necessary..?

- …in telepresence to make it compelling?
- *Telepresence rooms* try to make remote people appear to be life-like
  - Use multiple high definition cameras with eye-tracking features and directional microphones
- Does FaceTime have as much presence as more high definition settings?

What is co-presence?

- Co-located groups who want to collaborate
- Many technologies have been designed to:
  - Enable groups to work, learn and socialize more effectively together
  - For example, tabletops, whiteboards, and public displays

Coordination mechanisms

- When a group of people act or interact together, they need to coordinate themselves
  - For example, when playing football or navigating a ship

- To do so, they use:
  - Verbal and non-verbal communication
  - Schedules, rules, and conventions
  - Shared external representations

F2F coordinating mechanisms

- Talk is central
- Non-verbal also used to emphasize and as a substitute
  - For instance, nods, shakes, winks, glances, gestures, and hand-raising
- Formal meetings
  - Explicit structures such as agendas, memos, and minutes are employed to coordinate the activity

Awareness mechanisms

- Involves knowing who is around, what is happening, and who is talking with whom (Dourish and Bly, 1992)
- Peripheral awareness
  - Keeping an eye on things happening in the periphery of vision
  - Overhearing and overseeing—allows tracking of what others are doing without explicit cues
- Situational awareness
  - Being aware of what is happening around you in order to understand how information and your actions will affect ongoing and future events
    - For example, air traffic control or an operating theatre

Sharable interfaces

- Designed to capitalize on existing forms of coordination and awareness mechanisms
- Several studies investigating whether they help people to work together better, have found:
  - More equitable participation
  - More natural to work around
  - More comfortable sitting around a table than standing in front of a display

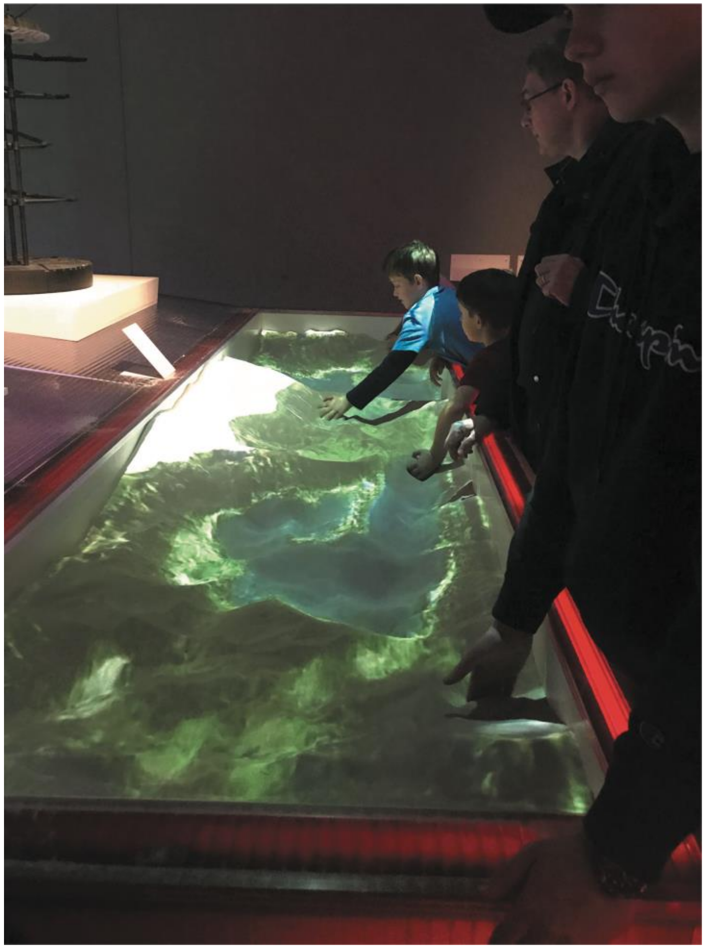
The Reflect Table

- LEDs lit up to reflect how much each member of the group spoke
- Used microphones in front of each individual to do this
- Study showed those who spoke the most changed their behavior the most
- Those who spoke the least did not change their behavior
- Why do you think this is?

Sococo floor plan of a virtual office: who is where and who meeting with whom

Playing together in same space

- Visitors using an AR sandbox at the V and A
- Visitors sculpt landscapes out of sand
- System reacts with changing superimposed digital colored landscape
- Enables creative forms of collaboration



Social engagement

- Refers to participation in activities of a social group
- Social exchange where people give or receive something from others
- Voluntary, unpaid and often altruistic (in the sense of sharing and doing good for others)
- Websites often used as hub to connect people
- Retweeting is a powerful way of connecting millions of people…

Retweeting goes viral

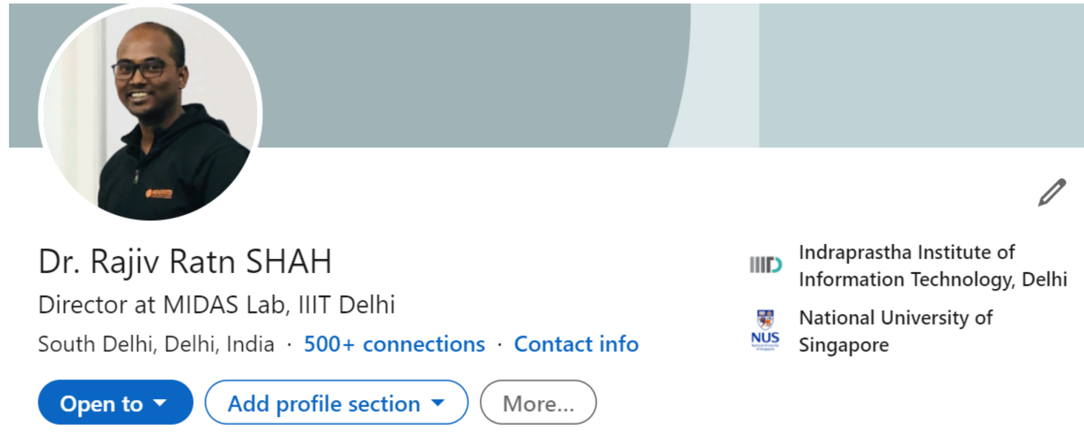
- The epic Twitter battle between Ellen DeGeneres and Carter Wilkerson
- Millions retweeted in the space of hours
- Connected millions of people for a fun cause
- Many people found it amusing to join in and watch the numbers grow

Dilemma: Is it OK to talk with a dead person using a chatbot?

- Eugenia Kuyda lost a close friend in a car accident who was only in his 20s
- She took all his texts sent over the course of his life and made a chatbot using them
- Chatbot responds to text messages so that Eugenia can talk to her friend as if he was alive
- Is this a creepy or comforting way to deal with grief?
  - Is it respectful of the dead person?

Summary

- Social interaction is central to our everyday lives
- Social mechanisms, like turn-taking, enable us to collaborate and coordinate our activities
- Keeping aware of what others are doing and letting others know what you are doing are important aspects of collaborative working and socializing
- Many technology systems have been built to support telepresence, social presence, and co-presence
- Social media has brought about significant changes in how people keep in touch and manage their social lives



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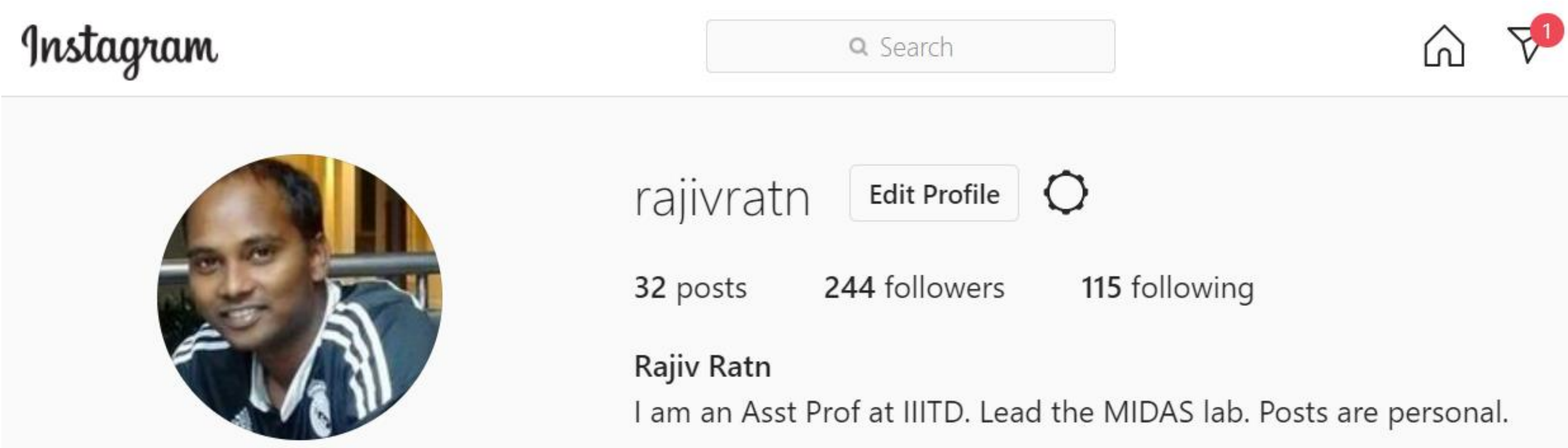
https://www.linkedin.com/in/rajivratn/



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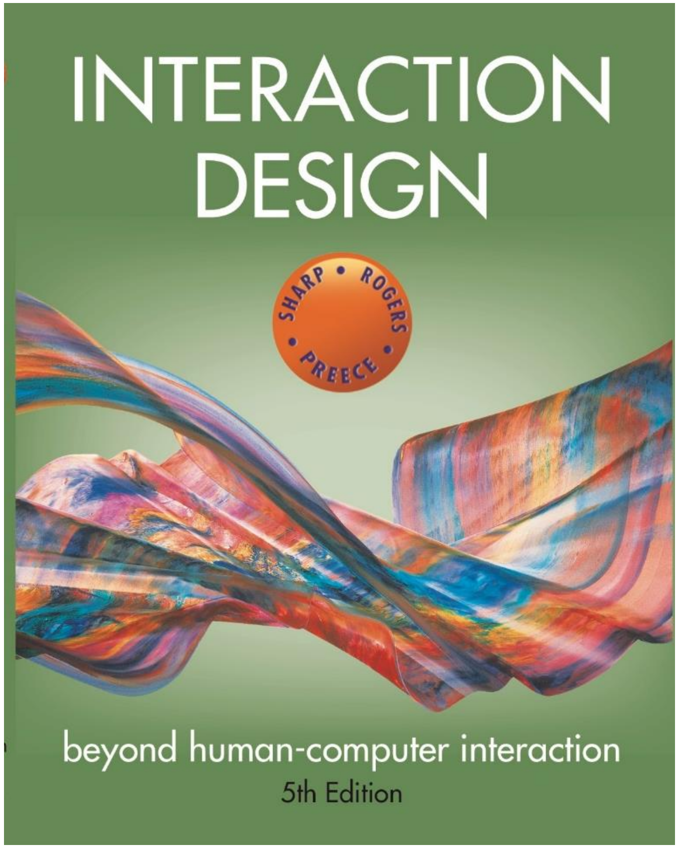


Chapter 6

EMOTIONAL INTERACTION

Overview

- Emotions and the user experience
- Expressive and emotional design
  - How the ‘appearance’ of an interface can affect users
- Affective computing and emotional AI
- Persuasive technologies and behavioral change
- Anthropomorphism
  - The pros and cons

Emotions and the user experience

- HCI has traditionally been about designing efficient and effective systems
- Now more about how to design interactive systems that make people respond in certain ways
  - For example, to be happy, to be trusting, to learn, or to be motivated
- Emotional interaction is concerned with how we feel and react when interacting with technologies
- Affective computing is improving with better recognition software and machine learning algorithms

Emotional interaction

- What makes us happy, sad, annoyed, anxious, frustrated, motivated, delirious, and so on
  - Translating this into different aspects of the user experience
- Why people become emotionally attached to certain products (for instance, virtual pets)
- Can social robots help reduce loneliness and improve well-being?
- How to change human behavior through the use of emotive feedback

Activity

- Try to remember the emotions you went through when buying a big ticket item online (for example, a refrigerator, a vacation, or a computer)
  - Need or want
  - Desire or anticipation
  - Joy or frustration
  - Afford or cannot afford
- How many different emotions did you go through?

  - rollercoaster set of emotions

Why has this simple way of obtaining visitor feedback been so effective?

Pulling at the heart strings with an emotive message

How easy is it to design an interface to match or change how we are feeling?

- Should an interface be designed to improve how we feel?
  - If so how?
- Our moods and feelings are continuously changing
  - How does the interface keep track and know when to do something?
- What moods match which kinds of interfaces?
- How would you design an interface for when someone is happy, angry, sad, bored, or focused?

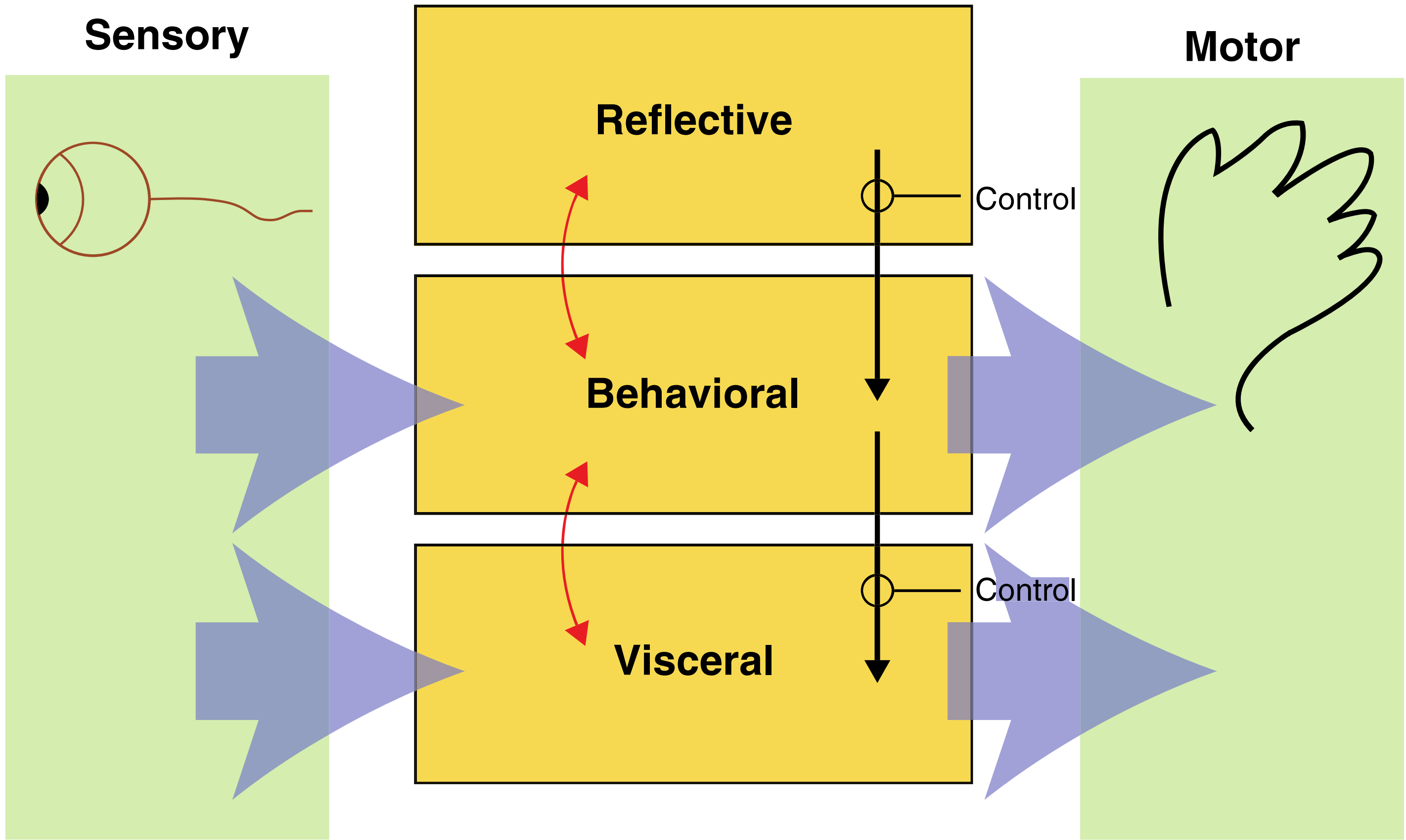
How do emotions affect behavior and behavior emotions?

- Examine how people express themselves and read each other (emotional intelligence)
  - For example, understand relationship between facial expressions, body language, gestures, and tone of voice.
  - When people are happy they laugh and relax body posture
  - When they are angry they screw up their face
- Does being angry make you concentrate better or more distracted?
- When you are happy do you take more risks such as spend more money or buy more?
- Baumeister et al (2007) argue the relationship is more complex than a single cause-and-effect model

Automatic (affect) versus conscious emotions

- Emotions can be short-lived (for instance, a fit of anger) or complex and long-lasting (for example, jealousy)
- Emotions have been categorized as automatic or conscious:
  - Automatic ones are rapid and dissipate quickly
  - Conscious ones develop slowly and take a long time to go (for instance, reflection)

Ortony et al. (2005) model of emotional design



Claims from model

- Our emotional state changes how we think
  - When frightened or angry, we focus narrowly and our bodies respond by tensing muscles and sweating
    - More likely to be less tolerant
  - When happy, we are less focused and our bodies relax
  - We are more likely to overlook minor problems and be more creative

Designing with the three levels in mind

- Visceral design refers to making products look, feel, and sound good
- Behavioral design is about use, and it equates with traditional values of usability
- Reflective design is about considering the meaning and personal value of a product

Analyzing a swatch watch design using the model

- Cultural images and graphical elements designed at the reflective level
- Affordances of use at the behavioral level
- Brilliant colors and wild design attract user's attention at the visceral level

Expressive interfaces

- Provide reassuring feedback that can be both informative and fun
- Can also be intrusive, however, causing people to become annoyed and even angry
- Color, icons, sounds, graphical elements, and animations are used to make the ‘look and feel’ of an interface appealing
  - Conveys an emotional state
- In turn, this can affect the usability of an interface
  - People are prepared to put up with certain aspects of an interface (for instance, slow download rate) if the end result is appealing and aesthetic

The appearance of an interface

(a) Emotional icons were used in the 1980s to indicate rebooting or crashed computer

- Smiling apple face

(b) Nowadays, computers use more impersonal but aesthetically-pleasing icons to indicate that the user needs to wait

- Beachball

(a)

(b)

The design of thermostats

(a) The Nest thermostat has a minimalist and aesthetically-pleasing design

- Round face and simple dial
- Large font and numbers

(b) It is very different from earlier thermostat designs

- Utilitarian and dull

(a)

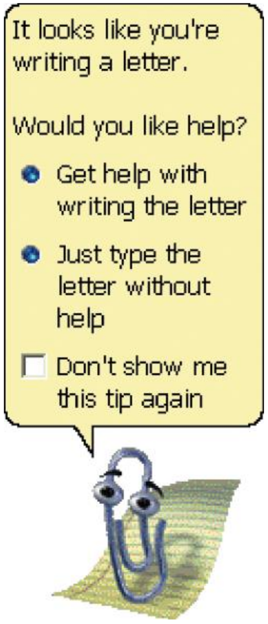
(b)

Annoying interfaces

- Microsoft pioneered friendly interfaces for technophobes
  - For example, 'At Home with Bob' software
  - 3D metaphors based on familiar places (for instance, living rooms)
- Agents in the guise of pets (such as a bunny or dog) were included to talk to the user
  - Made users feel more at ease and comfortable
  - But many people did not like the idea of Bob, so it never made it as a product

Microsoft's Clippy and IKEA's Anna

- Clippy did…
- But was disliked by so many?
  - Was it annoying, distracting, patronizing, or other?
- Anna appeared as a virtual agent
  - Blinked, moved her lips and head to suggest facial expressions



(a)

(b)

Frustrating interfaces

Many causes:

- When an application doesn't work properly or crashes
- When a system doesn't do what the user wants it to do
- When a user's expectations are not met
- When a system does not provide sufficient information to enable the user to know what to do
- When error messages pop up that are vague, obtuse, or condemning
- When the appearance of an interface is garish, noisy, gimmicky, or patronizing
- When a system requires users to carry out too many steps to perform a task, only to discover that a mistake was made earlier and that they need to start all over again

Error messages

“The application Word Wonder has unexpectedly quit due to a type 2 error.”

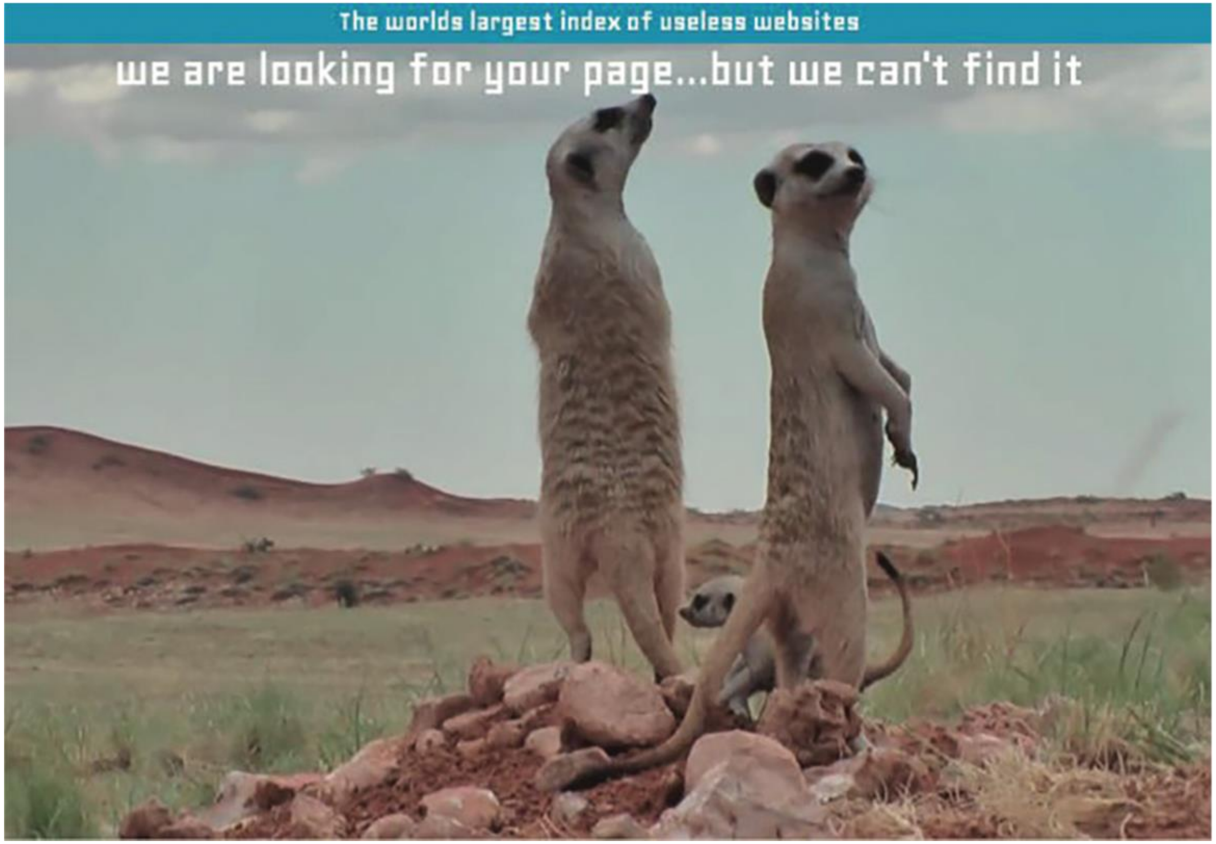
Why not instead?

“The application has expectedly quit due to poor coding in the operating system”

Shneiderman’s classic guidelines for error messages include:

- Avoid using terms like FATAL, INVALID, or BAD
- Audio warnings
- Avoid UPPERCASE and long code numbers
- Messages should be precise rather than vague
- Provide context-sensitive help

A friendly cute image instead of the impersonal 404 error message

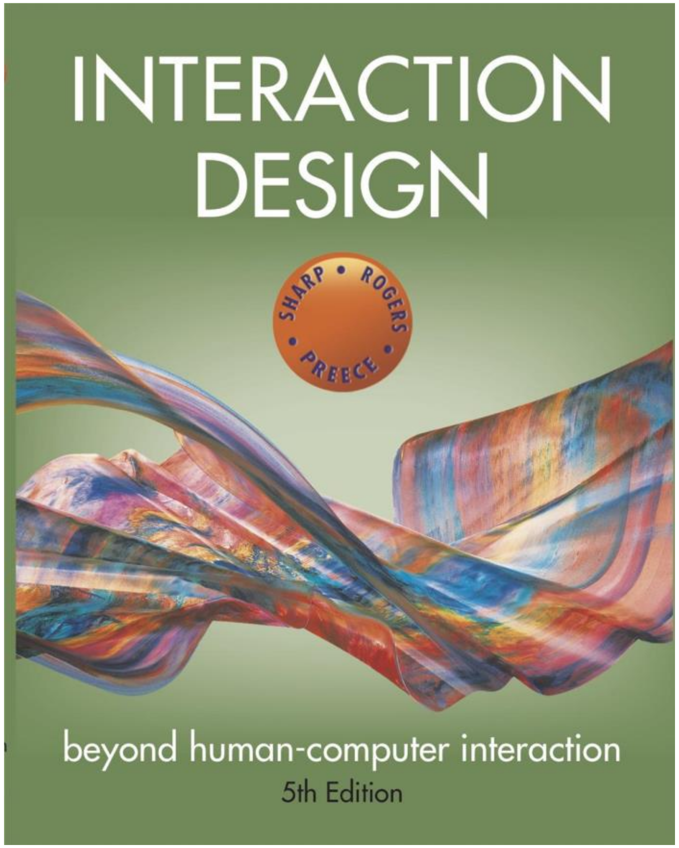


Dilemma: Should computers say they're sorry?

- Reeves and Naas (1996) argue that computers should be made to apologize
- Should emulate human etiquette
- Would users be as forgiving of computers saying they're sorry as people are of each other when saying they're sorry?
- How sincere would they think the computer was being? For example, after a system crash:
  - "I'm really sorry I crashed. I'll try not to do it again"
- How else should computers communicate with users?

Dilemma: Should voice assistants teach kids good manners?

- Many children talk to Alexa as if she was their friend
- They also learn that it is not necessary to say please and thank you to her when asking questions
- Is this lack of using etiquette a problem?
- Would it transfer over to real life situations?
  - For example, demanding “Auntie, get me my drink.”
- Parents should still teach their kids good manners
- Alexa can be configured to be polite as well
- How much parental control should voice assistants be given?
- Would children find it weird or creepy that their Alexa (who is their friend) nags them to clean their teeth?



Chapter 8

DATA GATHERING

Aims

- Discuss how to plan and run a successful data gathering program.
- Enables you to plan and run an interview.
- Empowers you to design a simple questionnaire.
- Enables you to plan and carry out an observation.

Five key issues

1. Setting goals
   - Decide how to analyze data once collected
1. Identifying participants
   - Decide from whom to gather data
   - How many participants are needed
1. Relationship with participants
   - Clear and professional
   - Informed consent when appropriate
1. Triangulation
   - Look at data from more than one perspective
   - Collect more than one type of data, for instance, qualitative data from experiments and qualitative data from interviews
1. Pilot studies
   - Small trial of main study

Data recording

- Notes, audio, video, and photographs can be used individually or in combination:
  - Notes plus photographs
  - Audio plus photographs
  - Video
- Different challenges and advantages with each type of data recording

Interviews

Unstructured: Not directed by a script. Rich but not replicable.

Structured: Tightly scripted, often like a questionnaire. Replicable but may lack richness.

Semi-structured: Guided by a script, but interesting issues can be explored in more depth. Can provide a good balance between richness and replicability.

Focus groups: A group interview

Interview questions

- Two types:
  - ‘Closed questions’ have a predetermined answer format, for example, ‘yes’ or ‘no’
  - ‘Open questions’ do not have a predetermined format
- Closed questions are easier to analyze
- Avoid:
  - Long questions
  - Compound sentences — split them into two
  - Jargon and language that the interviewee may not understand
  - Leading questions that make assumptions, for example, why do you like …?
  - Unconscious biases, for instance, gender stereotypes

Running the interview

Introduction: Introduce yourself, explain the goals of the interview, reassure about the ethical issues, ask to record, and present the informed consent form.

Warm-up: Make first questions easy and non-threatening.

Main body: Present questions in a logical order

A cool-off period: Include a few easy questions to defuse tension at the end

Closure: Thank interviewee, signal the end, for example, switch recorder off.

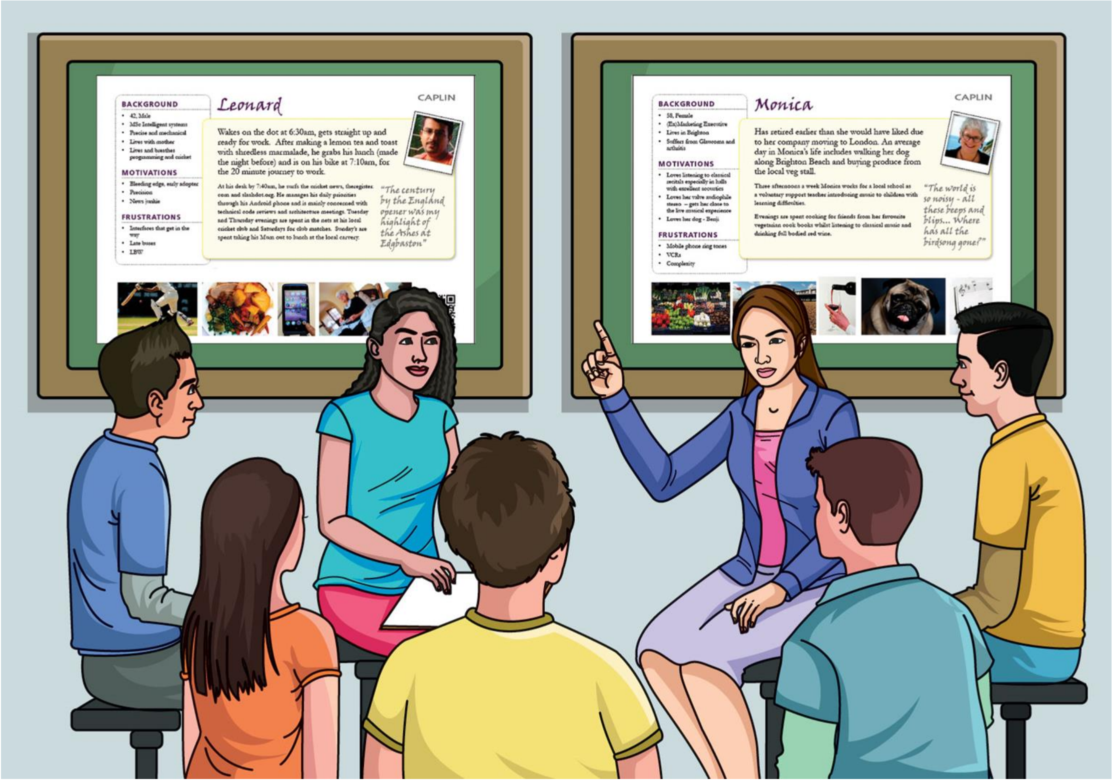
Other forms of interviews

Digital conferencing systems such as Skype, Zoom, email, and smartphones can be used to conduct interviews. Some advantages are:

- Participants are in their own environment so are more relaxed
- Participants don’t need to travel
- Participants don’t need to worry about what to wear
- For interviews involving sensitive issues, it is easier for interviewees to be anonymous

Enriching the interview process

Props: Devices for prompting interviewee, for example, use a prototype, scenario



Questionnaires

- Questions can be closed or open
- Closed questions are easier to analyze, and may be distributed and analyzed by computer
- They can be administered to large populations
- Disseminated by paper, email and the web
- Sampling can be a problem when the size of a population is unknown as is common online evaluation

Questionnaire design

- The impact of a question can be influenced by question order.
- You may need different versions of the questionnaire for different populations.
- Provide clear instructions on how to complete the questionnaire.
- Strike a balance between using white space and keeping the questionnaire compact.
- Avoid very long questions and questionnaires
- Decide on whether phrases will all be positive, all negative, or mixed.

Question and response format

- ‘Yes’ and ‘No’ checkboxes
- Checkboxes that offer many options
- Rating scales
  - Likert scales
  - Semantic scales
  - 3, 5, 7 or more points
- Open-ended responses

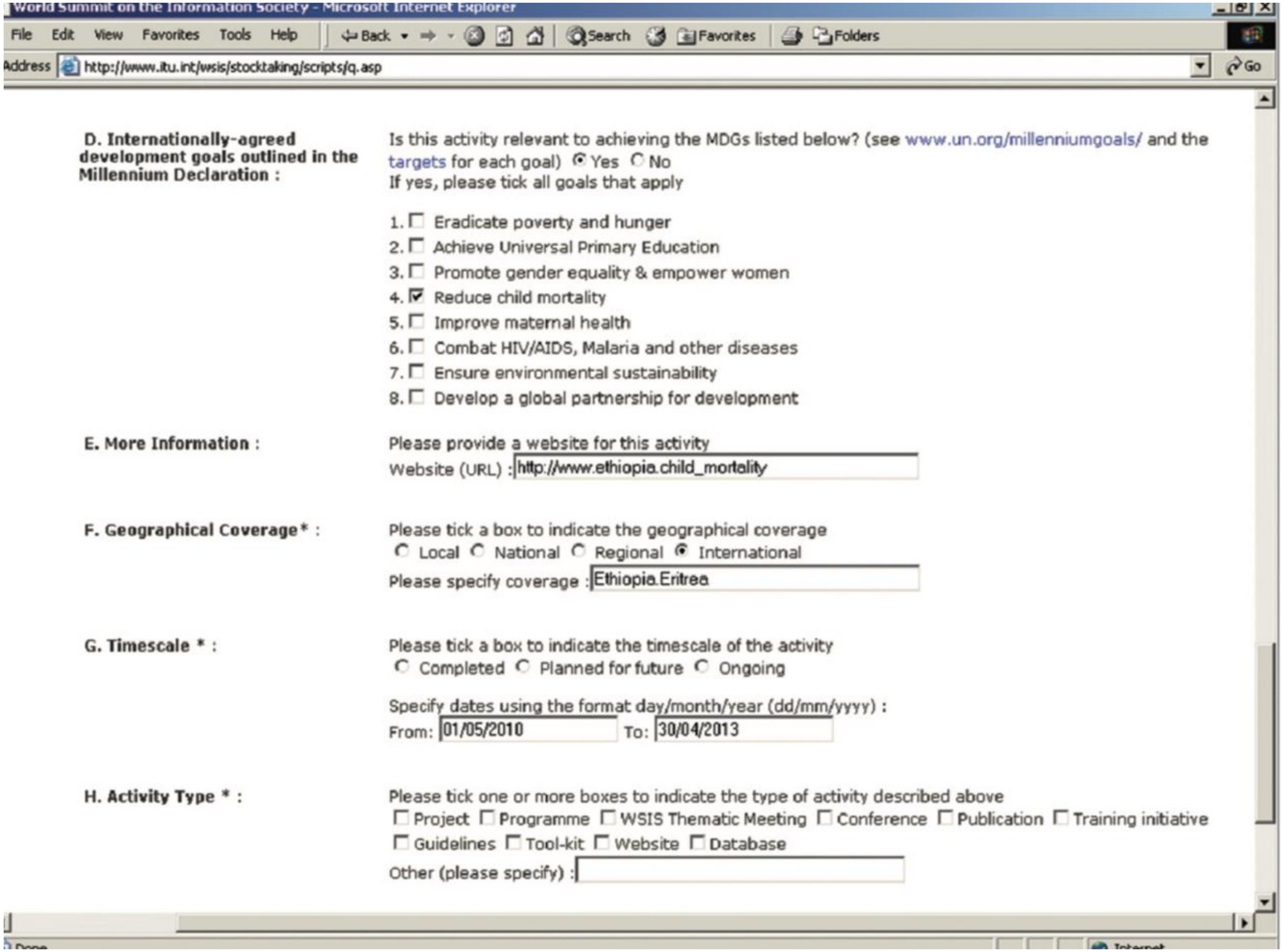
Encouraging a good response

- Make sure that the purpose of study is clear
- Promise anonymity
- Ensure that questionnaire is well designed
- Offer a short version for those who do not have time to complete a long questionnaire
- If mailed, include a stamped, addressed envelope
- Follow-up with emails, phone calls, or letters
- Provide an incentive
- 40 percent response rate is good, 20 percent is often acceptable

Advantages of online questionnaires

- Relatively easy and quick to distribute
- Responses are usually received quickly
- No copying and postage costs
- Data can be collected in database for analysis
- Time required for data analysis is reduced
- Errors can be corrected easily

Example of an online questionnaire



Questionnaire shows check boxes, radio boxes, and pull-down menus

Problems with online questionnaires

- Sampling is problematic if population size is unknown
- Preventing individuals from responding more than once can be a problem
- Individuals have also been known to change questions in email questionnaires

Deploying online questionnaires

- Plan the timeline
- Design offline
- Program/complete online template
- Test the survey to make sure that it behaves as you would expect
- Test it with a group that will not be part of the survey to check that the questions are clear
- Recruit participants

Observation

- Direct observation in the field
  - Structuring frameworks
  - Degree of participation (insider or outsider)
  - Ethnography
- Direct observation in controlled environments
- Indirect observation: tracking users' activities
  - Diaries
  - Interaction logging
  - Video and photographs collected remotely by drones or other equipment

Observation

Figure 8.8 Mars Exploration Rover
Source: Reproduced by permission of NASA Jet Propulsion Laboratory (NASA-JPL).

Structuring frameworks to guide observation

- Three easy-to-remember parts:

  The person: Who?

  The place: Where?

  The thing: What?

- A more detailed framework (Robson, 2014):

  Space: What is the physical space like and how is it laid out?

  Actors: What are the names and relevant details of the people involved?

  Activities: What are the actors doing and why?

  Objects: What physical objects are present, such as furniture

  Acts: What are specific individual actions?

  Events: Is what you observe part of a special event?

  Time: What is the sequence of events?

  Goals: What are the actors trying to accomplish?

  Feelings: What is the mood of the group and of individuals?

Planning and conducting observation in the field

- Decide on how involved you will be: from passive observer to active participant
- How to gain acceptance
- How to handle sensitive topics, for example, culture, private spaces, and so on
- How to collect the data:
    - What data to collect
    - What equipment to use
    - When to stop observing

Ethnography

- Ethnography is a philosophy with a set of techniques that include participant observation and interviews
- Debate about differences between participant observation and ethnography
- Ethnographers immerse themselves in the culture that they study
- A researcher’s degree of participation can vary
- Analyzing video and data logs can be time-consuming
- Collections of comments, incidents, and artifacts are made

More on Ethnography

- Co-operation of people being observed is required
- Informants are useful
- Data analysis is continuous
- Interpretivist technique
- Questions get refined as understanding grows
- Reports usually contain examples

More on Ethnography *(continued)*

(a) (b)

Figure 8.9 (a) The situation before MERboard; (b) a scientist using MERboard to present information

Source: J. Trimble, R. Wales and R. Gossweiler (2002): “NASA position paper for the CSCW 2002 workshop on Public, Community and Situated Displays MERBoard.

Online Ethnography

- Virtual, Online, Netnography
- Online and offline activity
- Interaction online differs from face-to-face
- Virtual worlds have a persistence that physical worlds do not have
- Ethical considerations and presentation of results are different

Observations and materials that might be collected (Crabtree, 2003)

- Activity or job descriptions
- Rules and procedures that govern particular activities
- Descriptions of activities observed
- Recordings of the talk taking place between parties
- Informal interviews with participants explaining the detail of observed activities
- Diagrams of the physical layout, including the position of artifacts
- Other information collected when observing activities:
  - Photographs of artifacts (documents, diagrams, forms, computers, and so forth)
  - Videos of artifacts
  - Descriptions of artifacts
  - Workflow diagrams showing the sequential order of tasks
  - Process maps showing connections between activities

Direct observation in a controlled environment

- Direct observation
  - Think aloud techniques
- Indirect observation – tracking users' activities
  - Diaries
  - Interaction logs
  - Web analytics
- Video, audio, photos, and notes are used to capture data in both types of observations

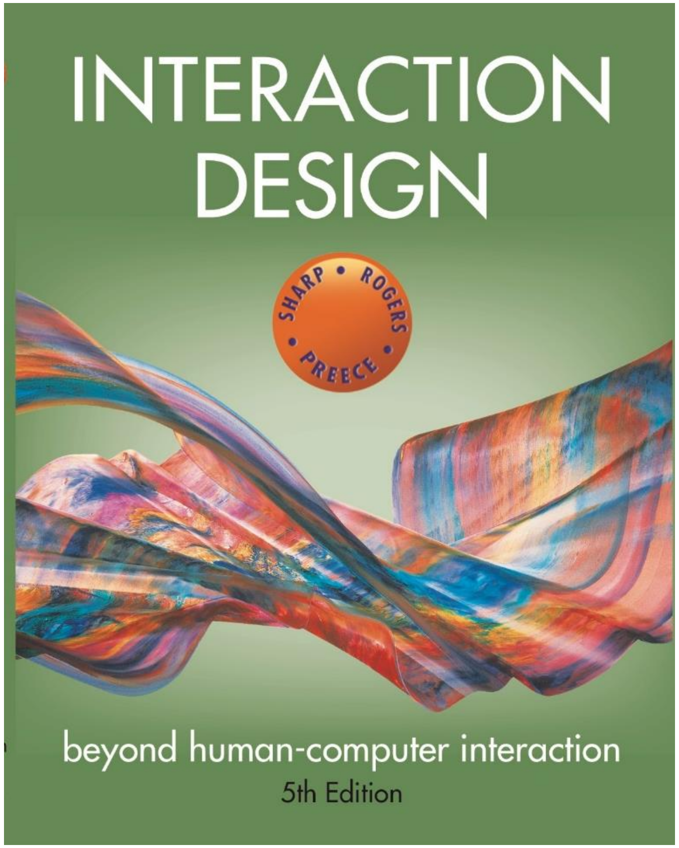
Choosing and combining techniques

Depends on the:

- Focus of the study
- Participants involved
- Nature of the technique(s)
- Resources available
- Time available

Summary

- Data gathering sessions should have clear goals
- An informed consent may be needed
- Five key issues of data gathering are: goals, choosing participants, triangulation, participant relationship, pilot
- Data may be recorded using handwritten notes, audio or video recording, a camera, or any combination of these
- Interviews may be structured, semi-structured, or unstructured
- Focus groups are group interviews
- Questionnaires may be on paper, online, or telephone
- Observation may be direct or indirect, in the field, or in controlled settings
- Techniques can be combined depending on the study focus, participants, nature of technique, and available resources and time



Chapter 9
Data Analysis, Interpretation, and Presentation

Goals

- Discuss the difference between qualitative and quantitative data and analysis
- Enable you to analyze data gathered from:
  - Questionnaires
  - Interviews
  - Observation studies
- Make you aware of software packages that are available to help your analysis
- Identify common pitfalls in data analysis, interpretation, and presentation
- Enable you to interpret and present your findings in appropriate ways

Quantitative and qualitative

Quantitative data: Expressed as numbers

Qualitative data: Difficult to measure sensibly as numbers, for example, count number of words to measure dissatisfaction

Quantitative analysis: Numerical methods to ascertain size, magnitude, and amount

Qualitative analysis: Expresses the nature of elements and is represented as themes, patterns, or stories

Be careful how you manipulate data and numbers!

Basic quantitative analysis

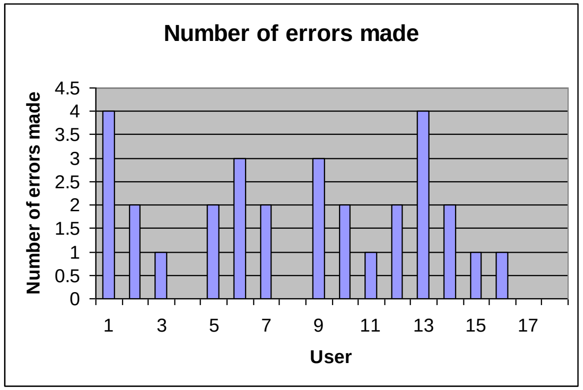
- Averages:

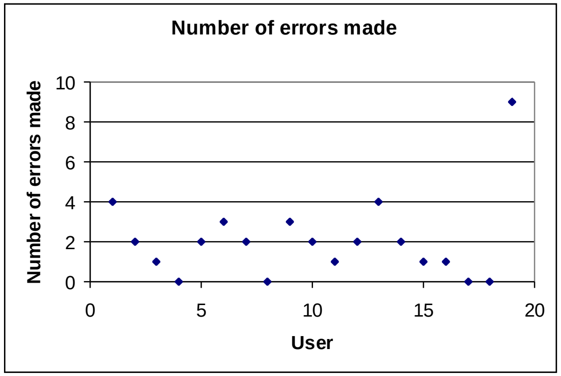
  Mean: Add up values and divide by number of data points

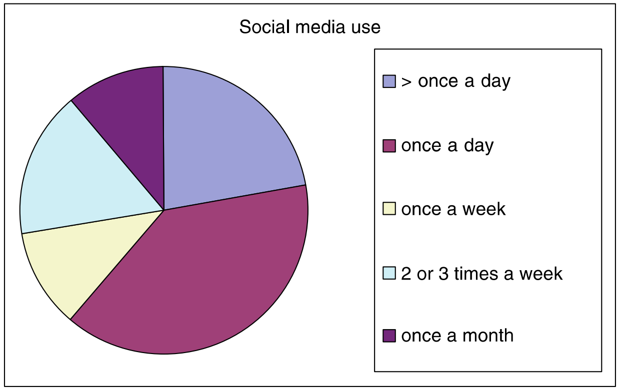
  Median: Middle value of data when ranked

  Mode: Figure that appears most often in the data

- Percentages
- Be careful not to mislead with numbers!
- Graphical representations give overview of data







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How question design affects data analysis

- Question design affects analysis

  Open question: Each answer analyzed separately

  Closed question: Analyzed quantitatively

- Fixed alternative answers restrict what can be said in findings

Basic qualitative analysis

- Looking for critical incidents
  - Helps to focus in on key events
  - Then analysis can proceed using specific techniques
- Identifying themes
  - Emergent from data, dependent on observation framework if used
  - Inductive analysis
- Categorizing data
  - Categorization scheme pre-specified
  - Deductive analysis
- In practice, combination of inductive (*reasoning aims at developing a theory*) and deductive (*reasoning aims at testing an existing theory*)

Which analytical framework?

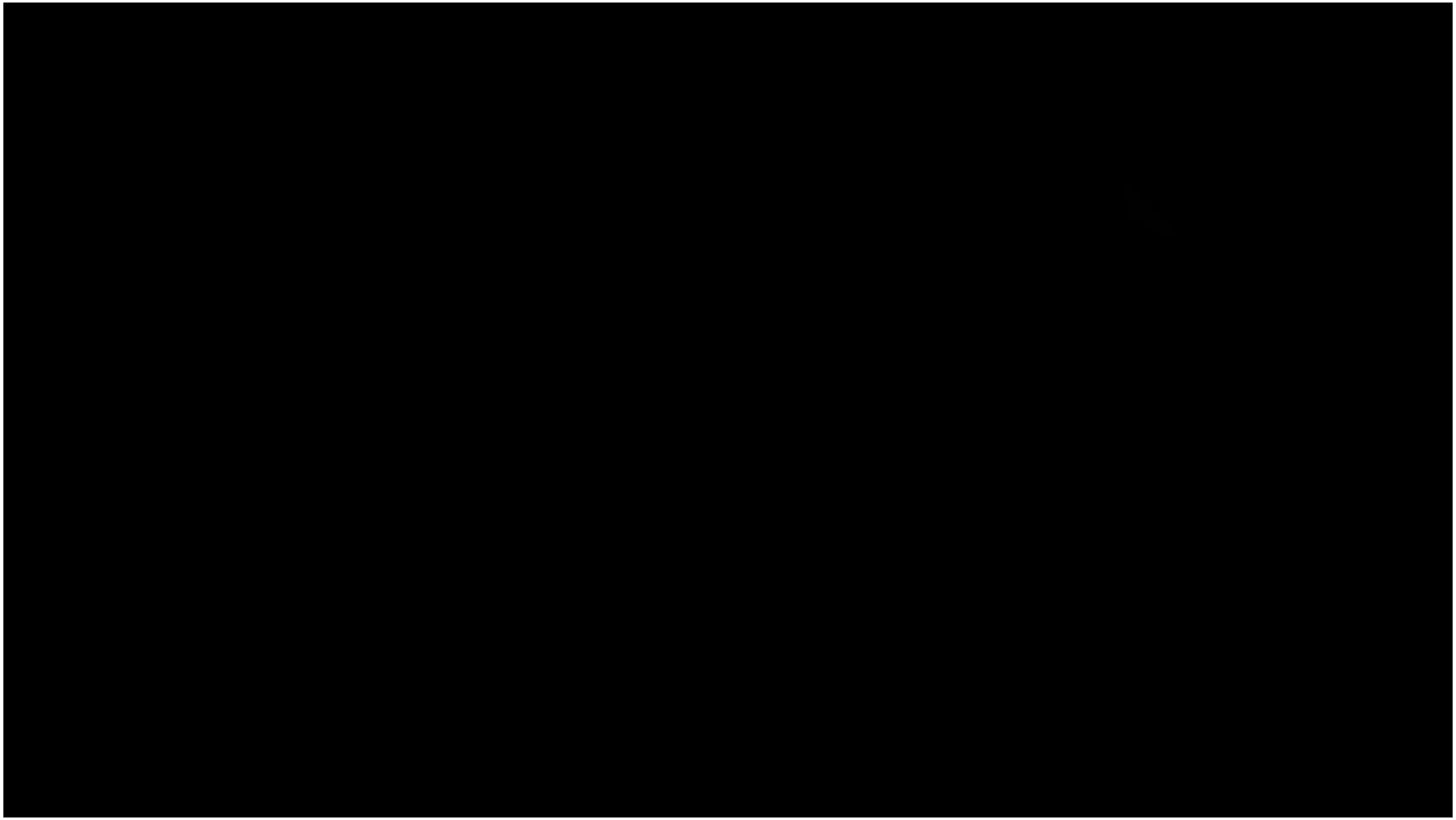
Framework	Data	Focus	Expected outcomes	Level of granularity
Conversation analysis	Recordings of spoken conversations	How conversations are conducted	Insights into how conversations are managed and how they progress	Word-level, or finer, for instance, pauses and inflection
Discourse analysis	Recordings of speech or writing from individuals or several participants	How words are used to convey meaning	Implicit or hidden meanings in texts	Word, phrase, or sentence-level
Content analysis	Any form of "text" including written pieces, video and audio recordings, or photographs	How often something is featured or is spoken about	Frequency of items appearing in a text	A wide range of levels from words, to feelings or attitudes, to artifacts or people
Interaction analysis	Video recordings of a naturally-occurring activity	Verbal and non-verbal interactions between people and artifacts	Insights about how knowledge and action are used within an activity	At the level of artifact, dialogue, and gesture
Grounded theory	Empirical data of any kind	Constructing a theory around the phenomenon of interest	A theory grounded in empirical data	Varying levels, depending on the phenomenon of interest
Systems-based frameworks	Large-scale and heterogeneous data	Large-scale involving people and technology, such as a hospital or airport	Insights about organizational effectiveness and efficiency	Macro-level, organizational level

Conversation Analysis

Examines the semantics of a conversation in fine detail

```
SUS  i'd like to play beat the intro in a minute
LIA  [ oh no:: ]
SUS  [ alexa    ][ (1.1)   ] beat the in[tro
CAR             [ °yeah° ]
LIA                                      [°no:::...°
CAR  (0.6) it's mother's day? (0.4)
SUS  it's (     ) yep (.) listen (.) you need to keep
     on eating your orange stuff (.) liam
     (0.7)
CAR  and your green stuff
SUS  alexa (1.3) alexa (0.5)=
CAR                         =°and your brown stuff°
SUS  play beat the intro
```

An extract of the conversation between a family and Alexa



Discourse Analysis

- Focuses on dialogue; that is, the meaning of what is said and how words convey meaning
- Assumption that there is no objective scientific “truth”
- Language is viewed as a constructive tool
- Discourse analysis is useful when trying to identify subtle meaning

Content Analysis

- Involves classifying data into themes or categories and studying their frequencies
- Can be used for any “text”: video, newspapers, advertisements, images, and sounds
- Often used in conjunction with other techniques

Interaction Analysis

- A way to investigate and understand interactions between people and artefacts
- Based on empirical observations such as videos
- Inductive process in teams, collaboratively
- Contents of the material is logged
- Materials are extracted, classified, or removed
- Instances of a salient event are assembled and played one after the other
- The team of researchers studies the assemblage together

Grounded Theory

- Seeks to develop theory from systematic analysis of empirical data
- Three levels of ‘coding’

  Open: Identify categories

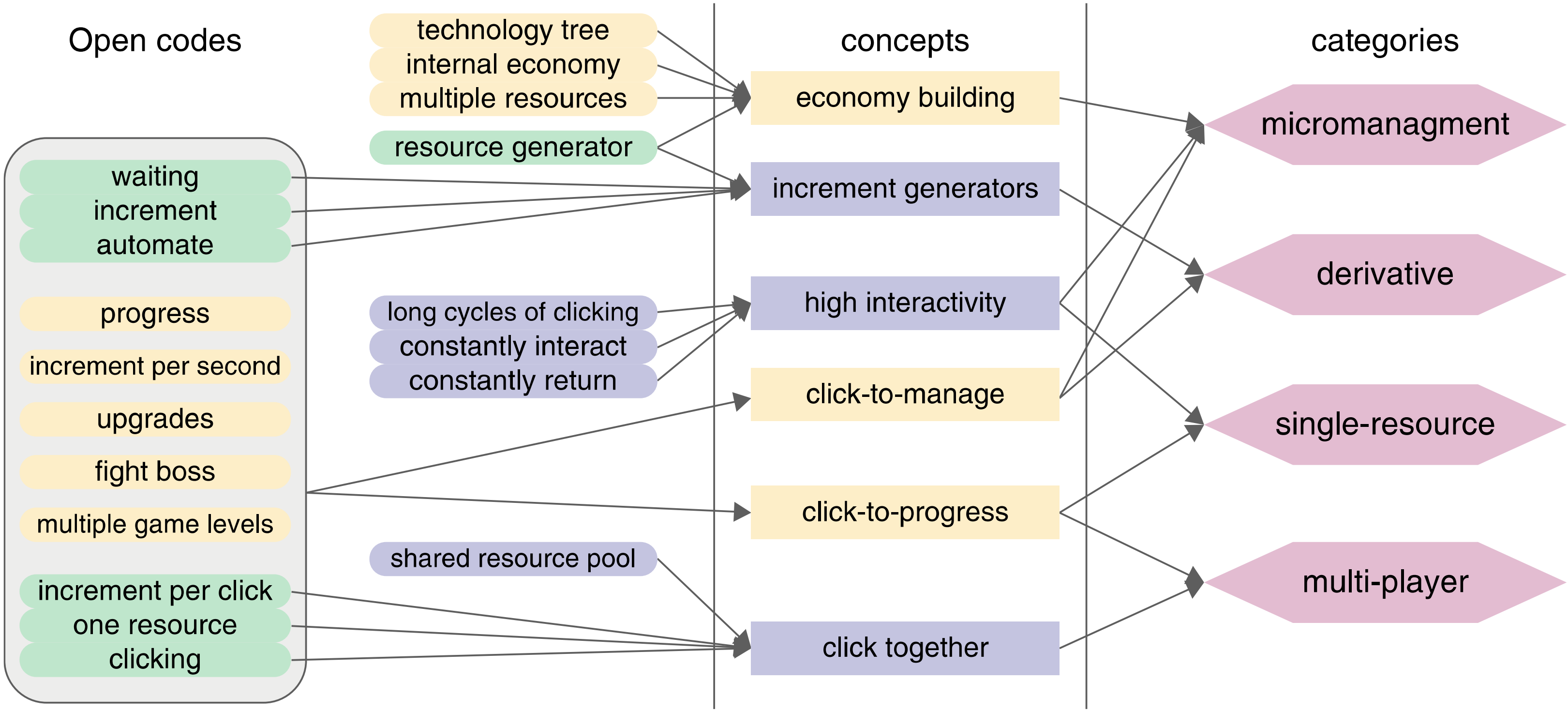
  Axial: Flesh out and link to subcategories

  Selective: Form theoretical scheme
- Researchers are encouraged to draw on own theoretical backgrounds to inform analysis
- Analytic tools to help stimulate:
  - Question the data
  - Analyze words, phrases or sentence
  - Comparisons between objects or abstract categories

Illustration of open coding

Game Feature	Observations
Game name	*AdVenture Capitalist* [G38]
Play description	You start CLICKING on a lemonade stand and collect money. Spend money to make upgrades, INCREASE PRODUCTION PER CLICK. Start hiring workers and INCREASE PRODUCTION PER SECOND. When you have enough money, you can buy new businesses, automate all your businesses to INCREMENT more money, and leave the game progress.
Game mechanics	Click to gain money, AUTOMATE production, make upgrades to DAMAGE/SEC.
Rewards	ONE CURRENCY, which is money, is rewarded in return.
Interface	GRAPHICAL
Interactivity level	7
Progress rate	9
Overview	This is a SINGLE-PLAYER game, which requires LONG CYCLES OK CLICKING at the start, and making a number of upgrades. Production rate reaches $390/sec in less that 10 minutes and you gain 1M in cash making the game progress faster.

Development of open coding



The analysis process that developed the incremental games super-category (each category above is part of incremental games). The process started with open coding of observations on idle games: multiple codes are created. Concepts are discovered through analyzing the open codes and identifying common features. This is an iterative process, where new codes are added, combined, or deleted. Each code is connected to one or more games and can be combined to form new concepts. Concepts are analyzed to find common relationships, and, thus, categories emerge. In the diagram, coloration is only to aid in reading. The left grouping is to show that all contained codes are part of click-to-manage and click-to-progress.

Source: Alharti et al (2018)

System-based frameworks

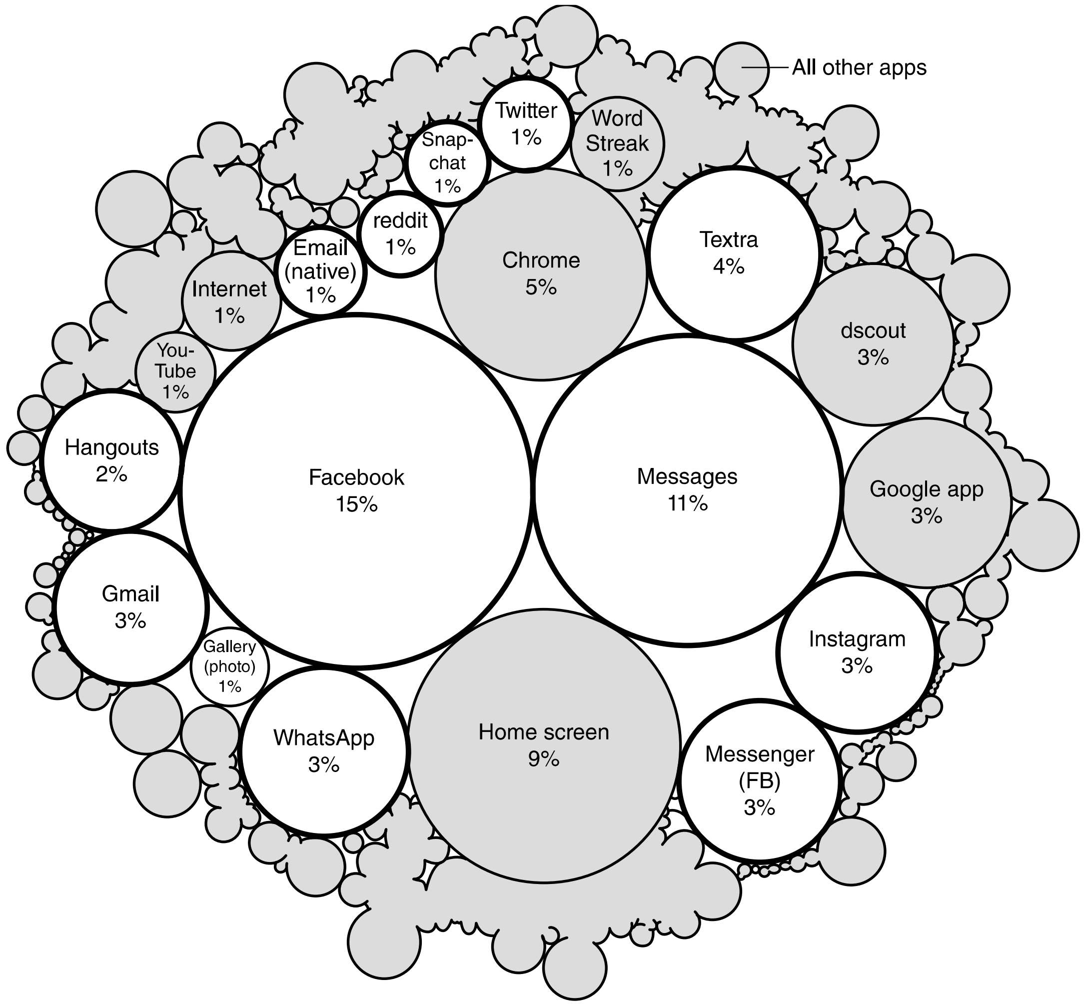
Understanding a whole socio-technical system requires different analytical framework

- Socio-technical systems theory
- Distributed Cognition of Teamwork

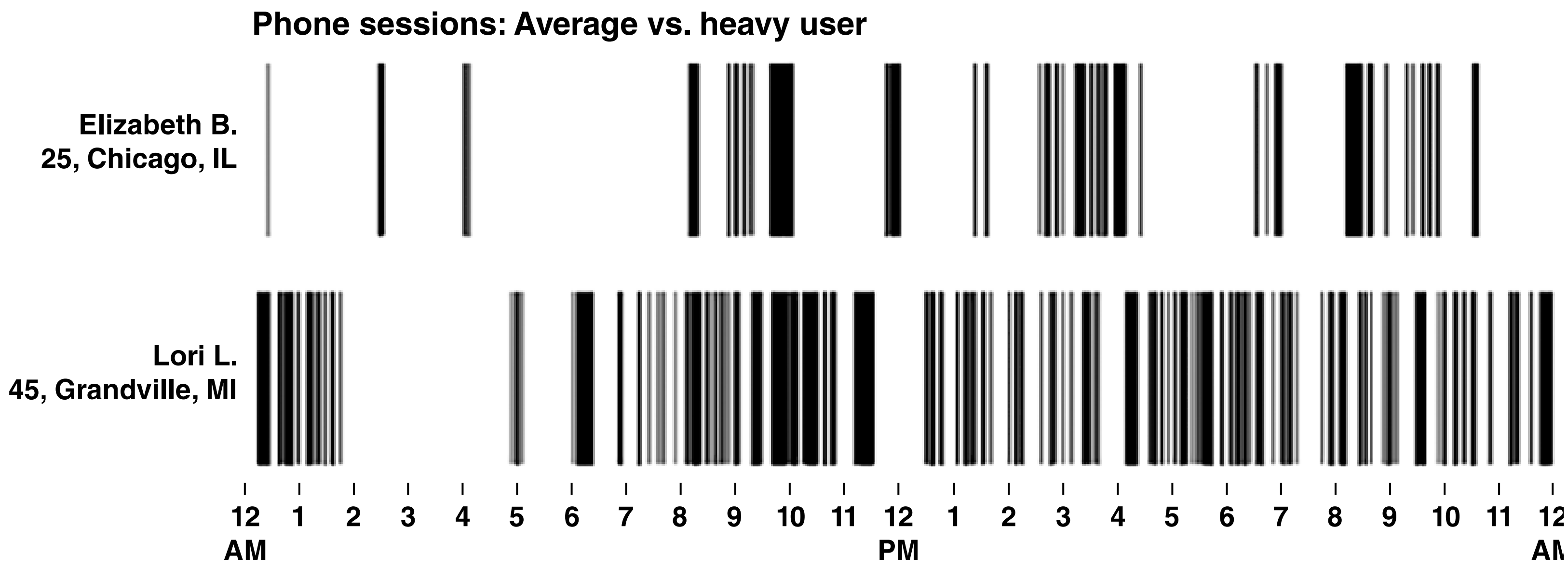
Tools to support data analysis

- Spreadsheet – Simple to use, basic graphs
- Statistical packages, for example, SAS and SPSS
- Qualitative data analysis tools
  - Categorization and theme-based analysis
  - Quantitative analysis of text-based data
- Nvivo and Dedoose support qualitative data analysis
- Computer Assisted Qualitative Data Analysis (CAQDAS) Networking Project, based at the University of Surrey

Interpreting and presenting the findings



Interpreting and presenting the findings

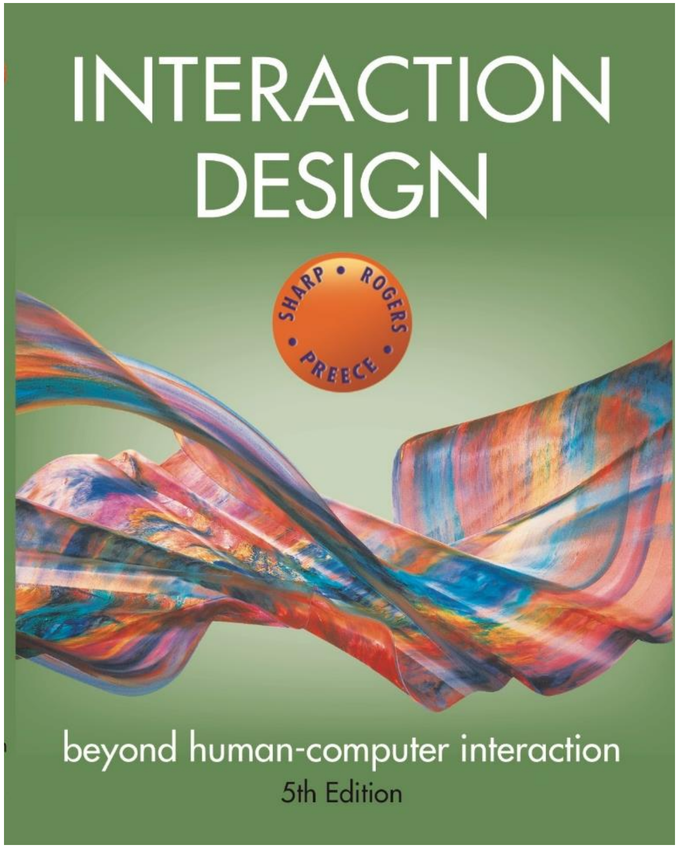


Presenting findings

- Structured notations have clear syntax and semantics to present particular viewpoint
- Stories are easy and intuitive approach to communicate ideas
- Summarize findings using a range of notations

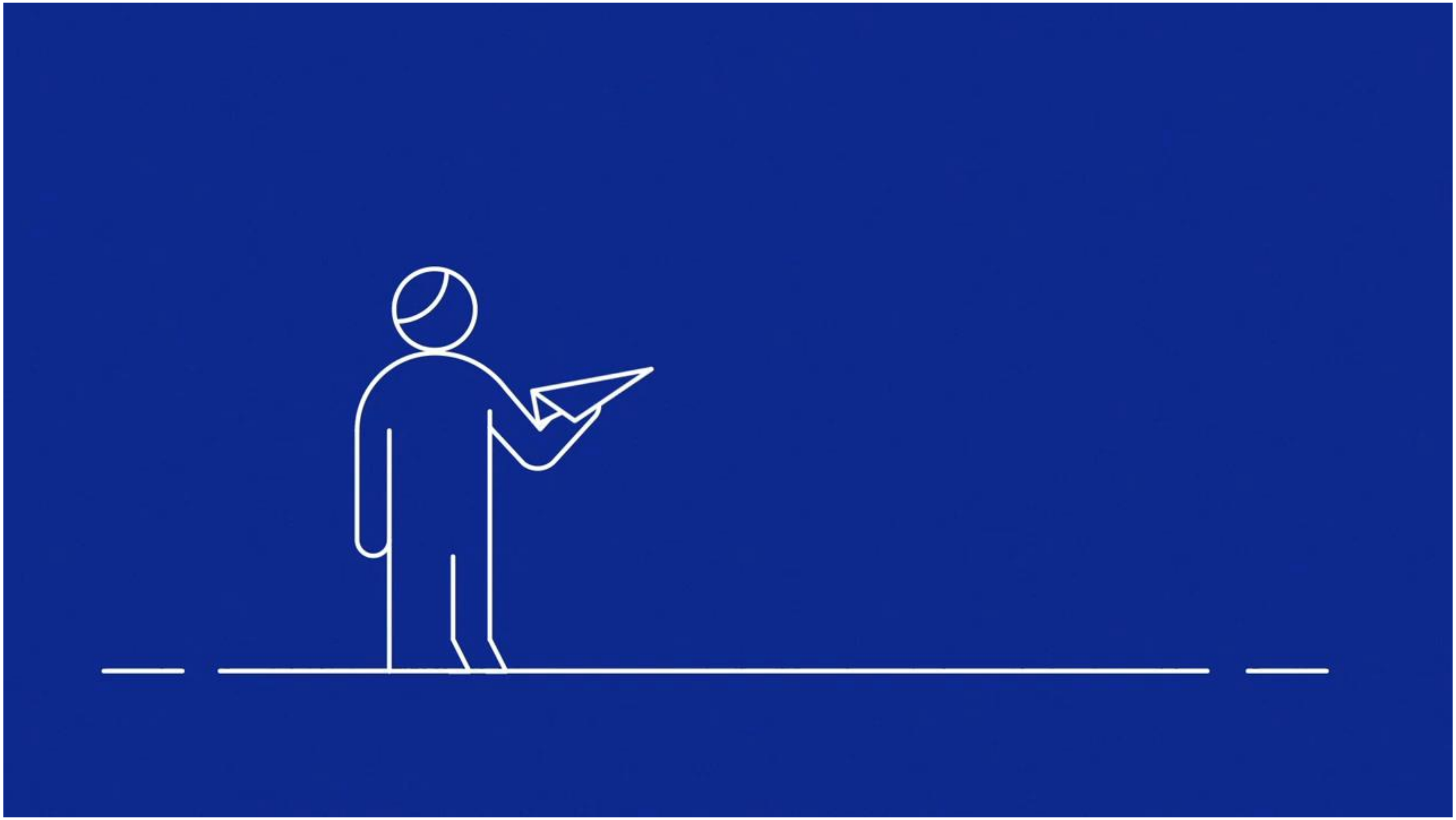
Summary

- The data analysis that can be done depends on the data gathering that was done
- Qualitative and quantitative data may be gathered from any of the three main data gathering approaches
- Percentages and averages are commonly used in Interaction Design
- Mean, median, and mode are different kinds of ‘average’ and can have very different answers for the same set of data
- Analysis of qualitative data analysis may be inductive (extracted from the data), or deductive (pre-existing concepts)
- Several analytical frameworks exist that focus on different levels of granularity with different purposes



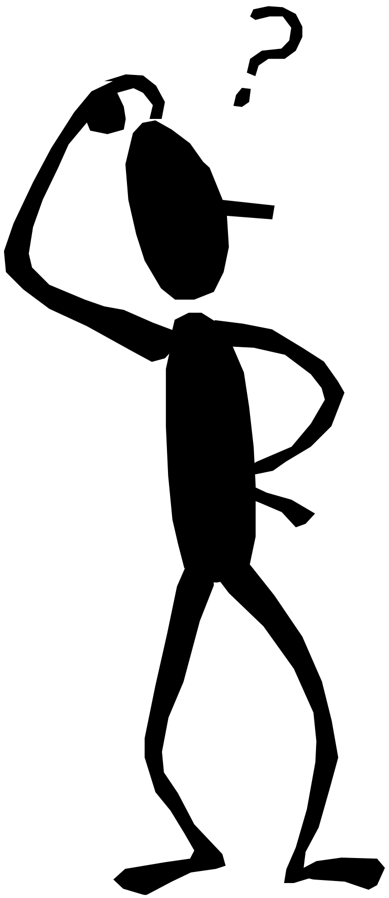
Chapter 12

DESIGN, PROTOTYPING and CONSTRUCTION



Overview

- Prototyping
- Conceptual design
- Concrete design
- Using scenarios
- Generating prototypes
- Construction



Conceptual design

- A conceptual model is an outline of what people can do with a product and what concepts are needed to understand and interact with it
- Understand problem space and current requirements; empathize with users
- Creativity and brainstorming techniques
- Mood board may capture desired feel
- Consider alternatives: scenarios and prototyping helps

Choosing an interface metaphor

- Interface metaphors combine familiar knowledge with new knowledge in a way that will help the user understand the product.
- Three steps: understand functionality, identify potential problem areas, and generate metaphors
- Evaluate metaphors:
  - How much structure does it provide?
  - How much is relevant to the problem?
  - Is it easy to represent?
  - Will the audience understand it?
  - How extensible is it?

Considering interaction and interface types

- Which interaction type?
  - How the user invokes actions
  - Instructing, conversing, manipulating, exploring, or responding
- Do different interface types provide insight?
  - Shareable, tangible, augmented reality, and so forth

Expanding the initial conceptual model

- What functions will the product perform?
  - What will the product do and what will the human do?
- How are the functions related to each other?
  - Sequential or parallel?
  - Categorizations, for example, all actions related to privacy on a smartphone
- What information is needed?
  - What data is needed to perform the task?
  - How is this data to be transformed by the system?

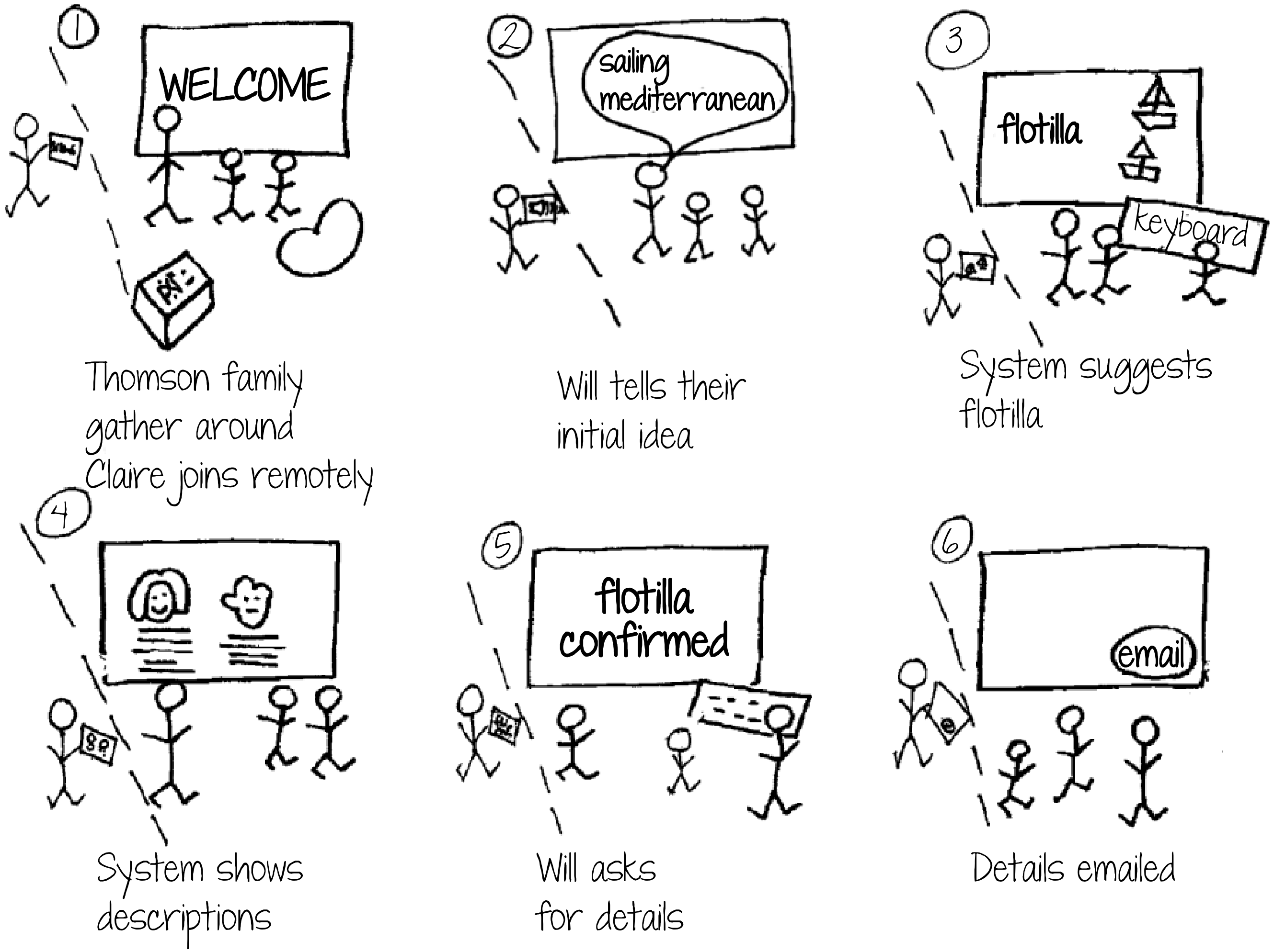
Concrete design

- Difference between conceptual and concrete is emphasis
- Many aspects to concrete design
  - Color, icons, buttons, interaction devices, and so on
- User characteristics and context
  - Inclusiveness, input, and output modes
- Accessibility
  - Web Content Accessibility Guidelines
- Cross-cultural design
  - Language, colors, icons, and information architecture
  - Indigenous knowledge and perspectives

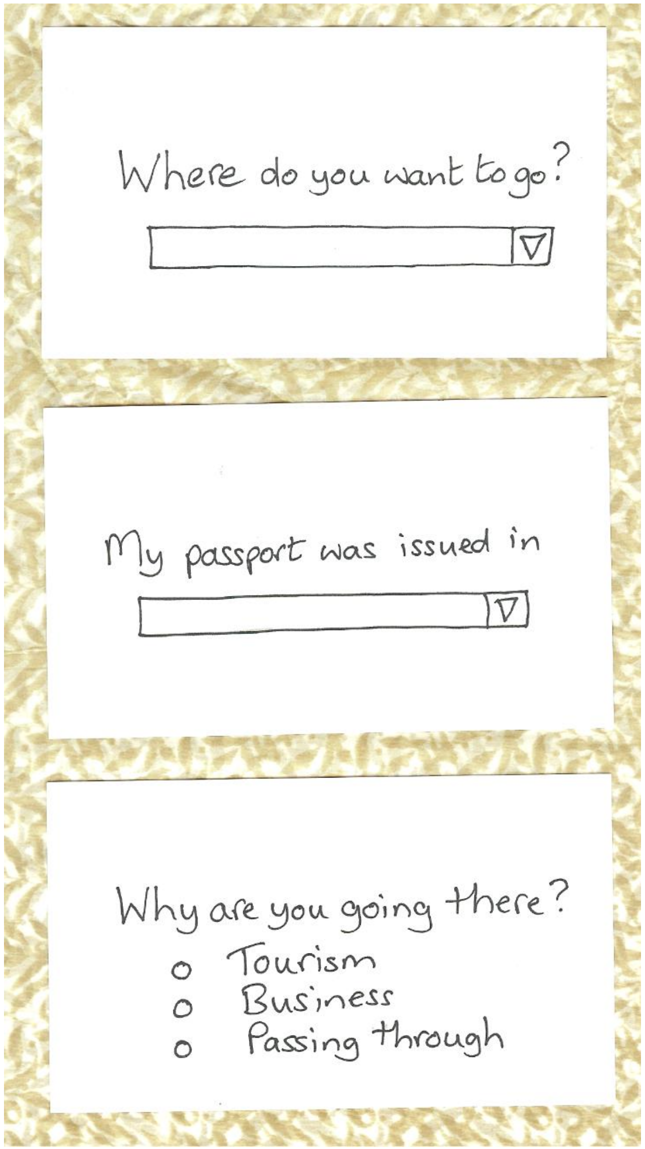
Generating prototypes

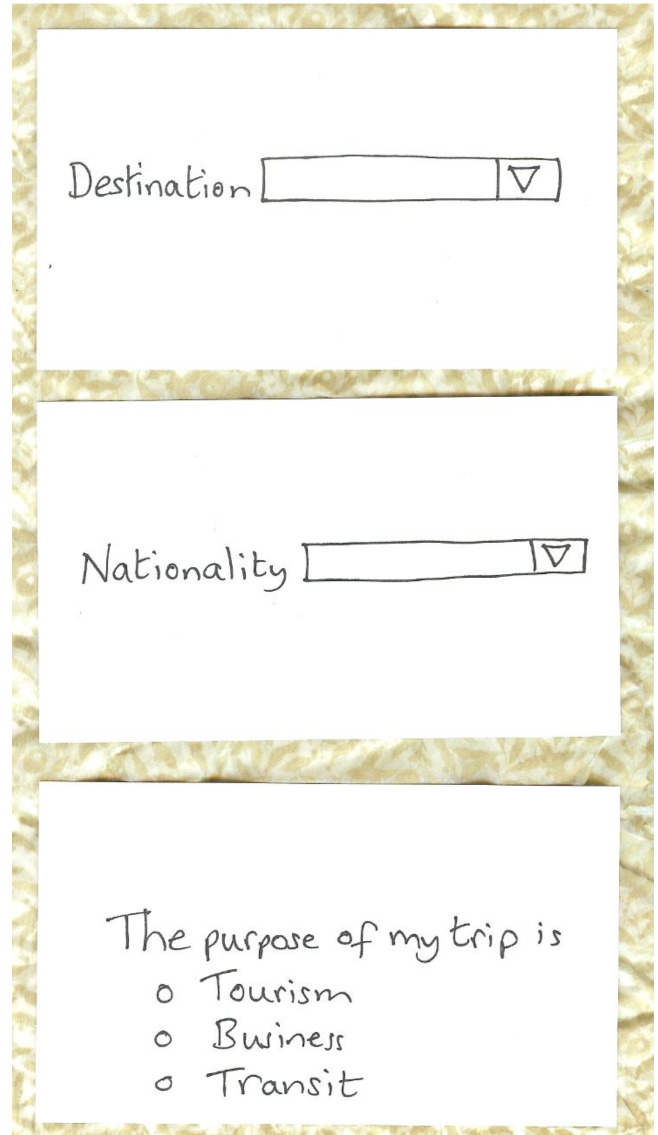
- Generate a storyboard from a scenario
  - Break down scenario into steps
  - Create a scene for each step
- Sketching out a storyboard prompts designers to think about design issues
- Generate a card-based prototype from a storyboard or from a use case
  - Consider each step in use case – what interaction element is needed
  - Draw a card that captures it

Generating storyboard



Generating card-based prototype

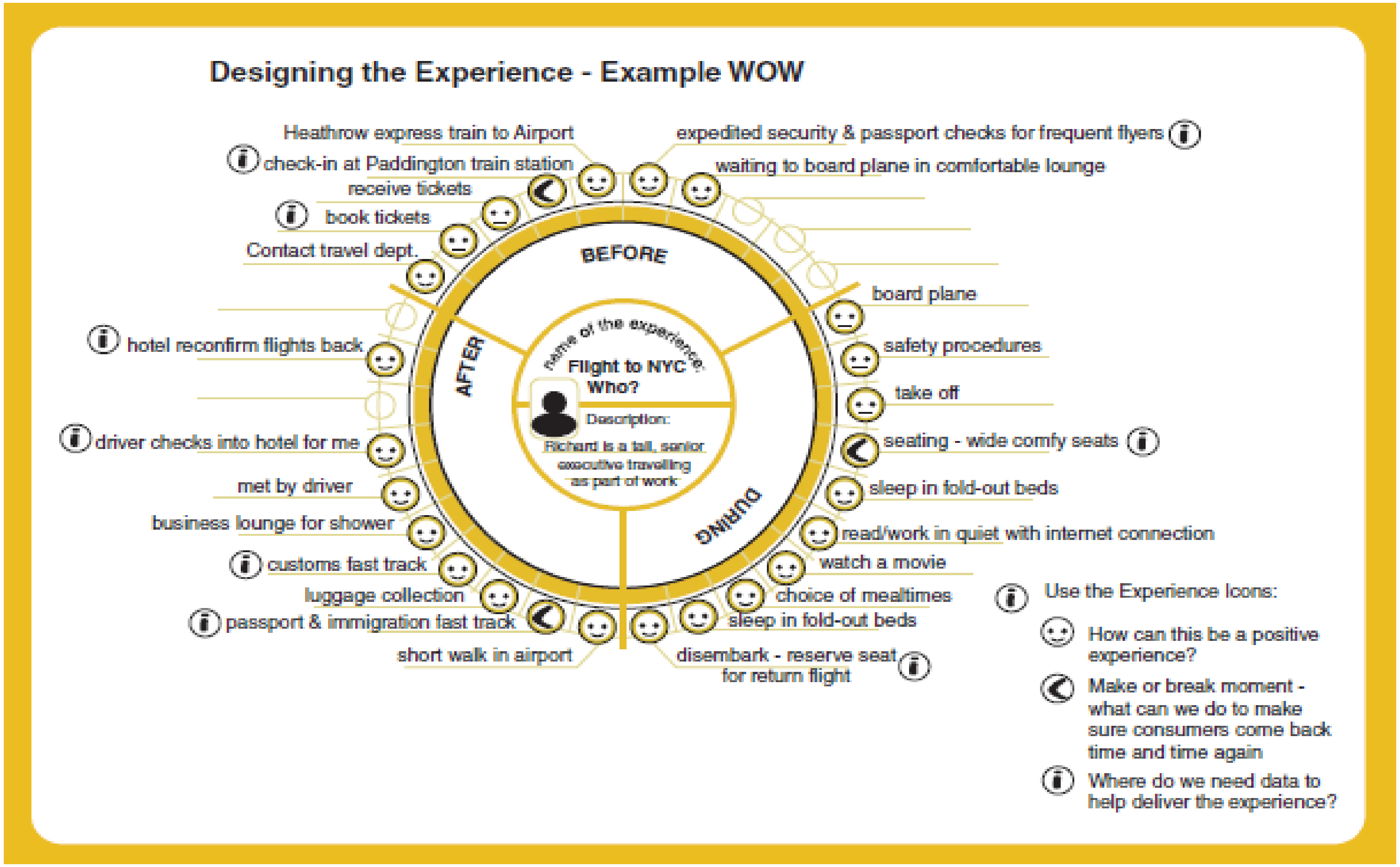




Explore the user's experience

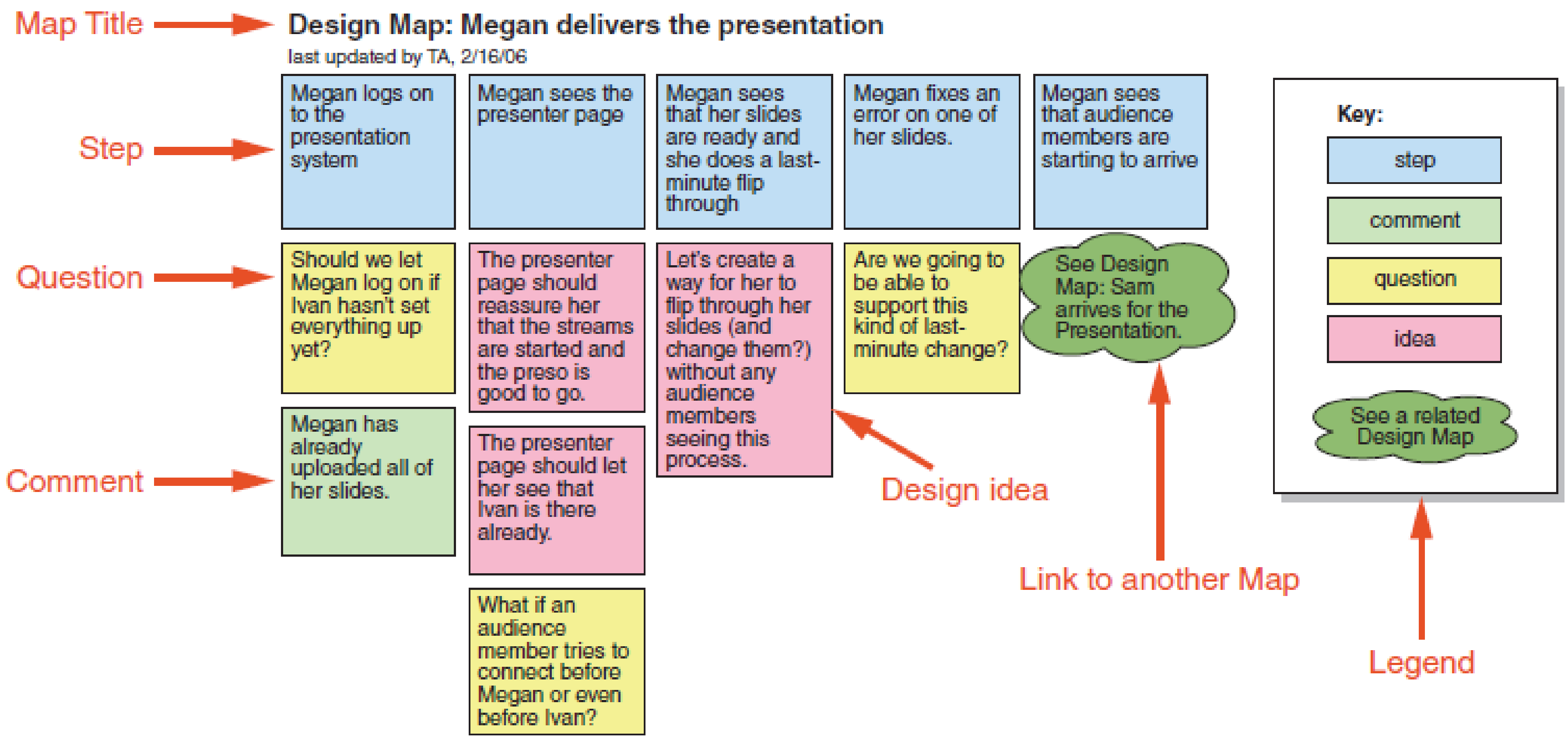
- Use personas, card-based prototypes, or stickies to model the user experience
- Visual representation called:
  - Design map
  - Customer or user journey map
  - Experience map
- Two common representations
  - Wheel
  - Timeline

An experience map drawn as a wheel



Source: LEGO

An experience map drawn as a timeline

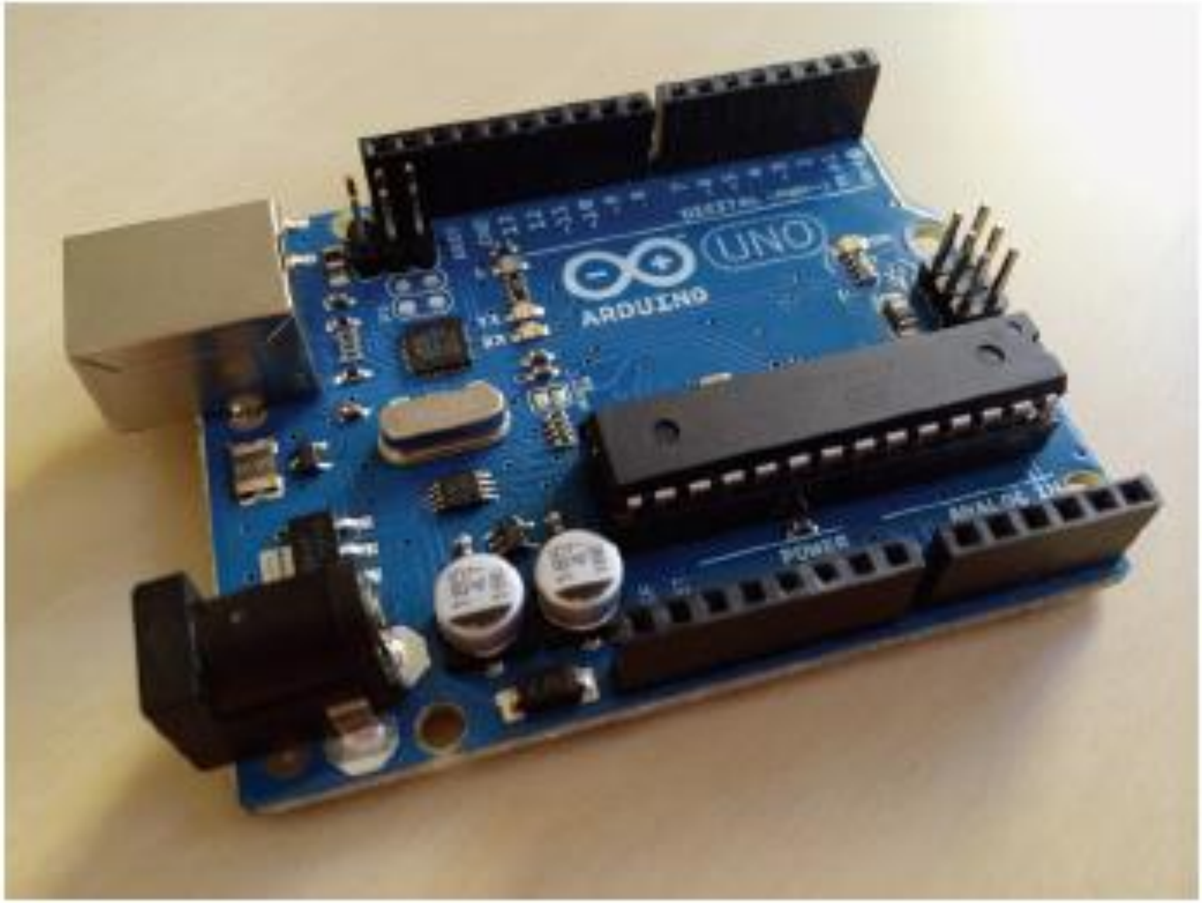


Source: Adlin and Pruitt (2010), p134. Used courtesy of Morgan Kaufmann.

Construction: Physical computing

- Build and code prototypes using electronics
- Toolkits available include
  - Arduino
  - LilyPad (for fabrics)
  - Senseboard
  - BBC micro:bit
  - MaKey MaKey
- Designed for use by wide range of people

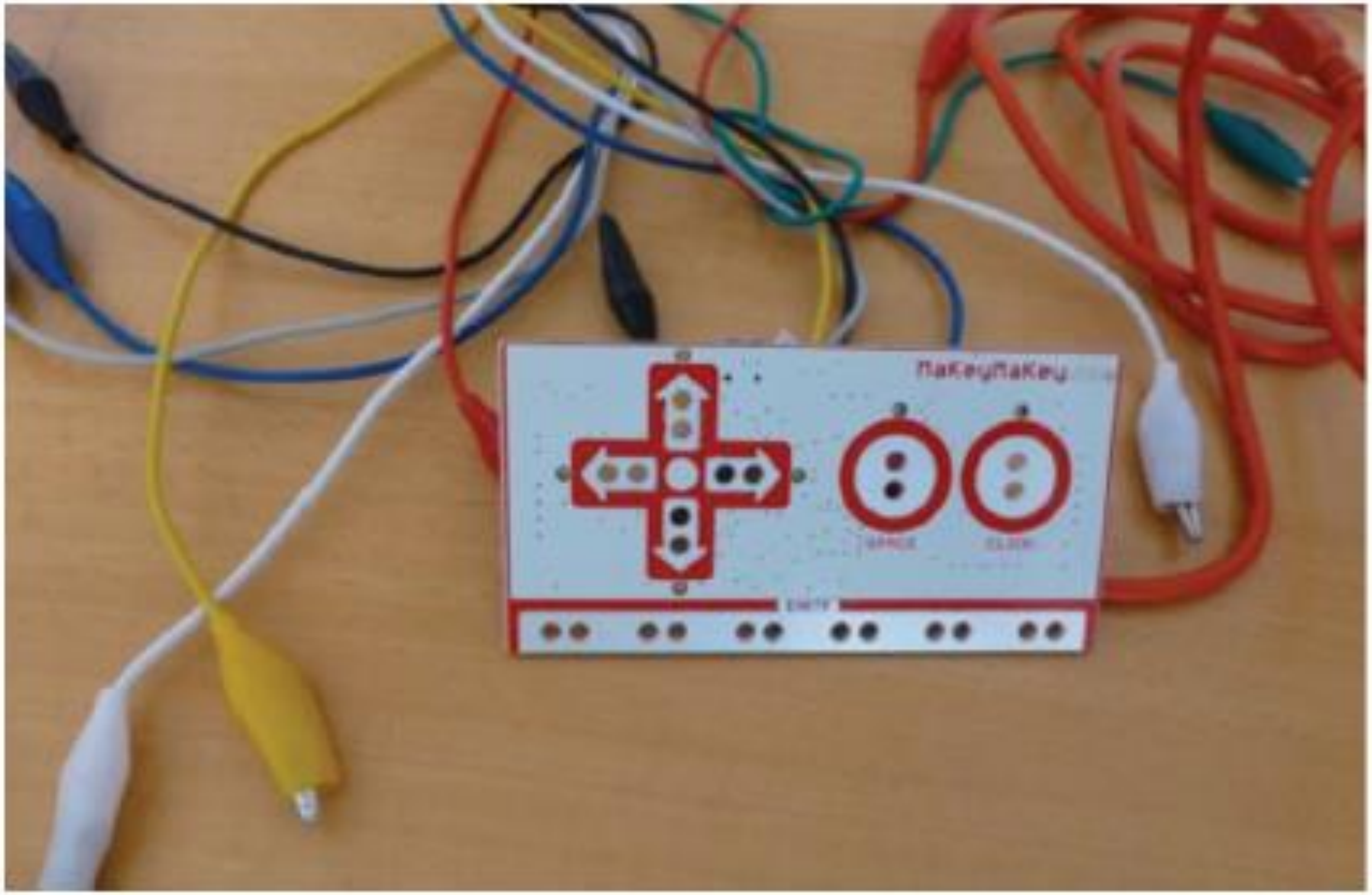
Physical computing kits



The Arduino board

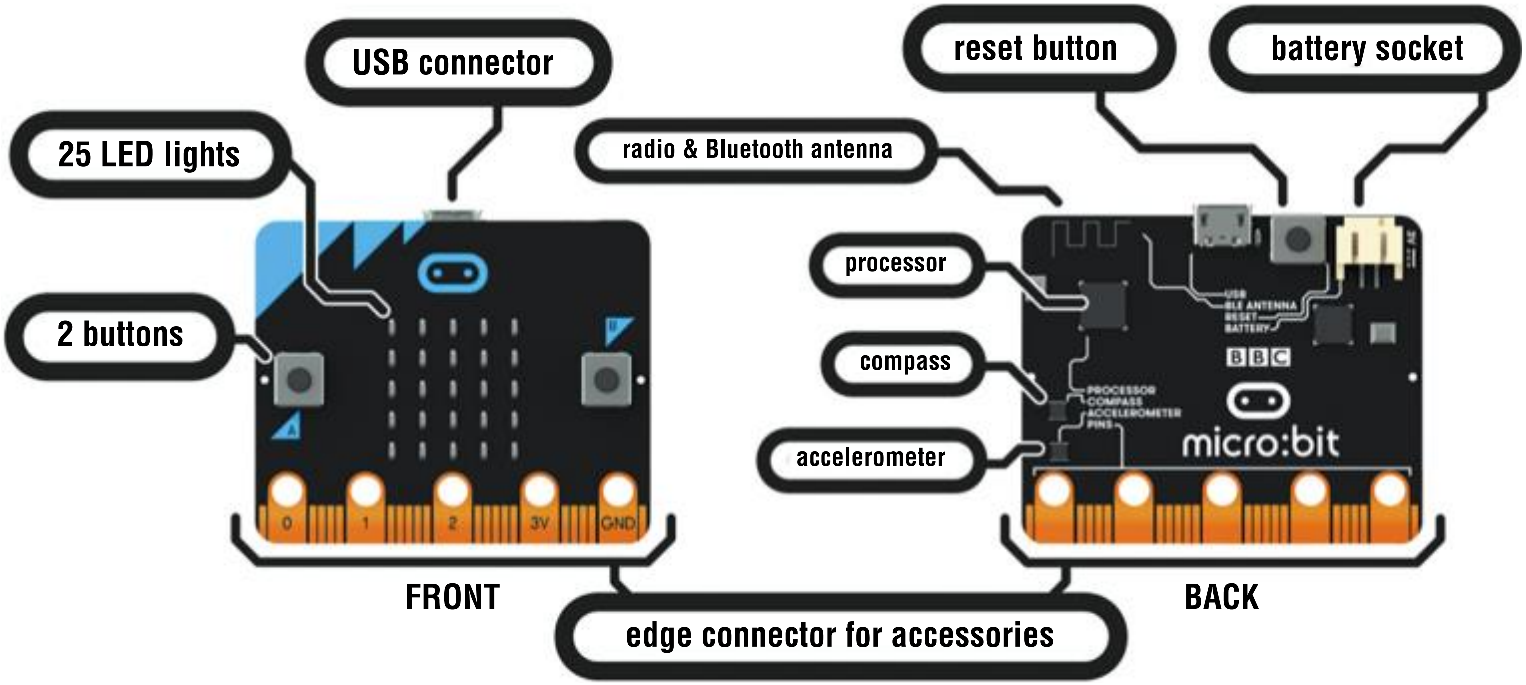
Source: Used courtesy of Dr. Nicolai Marquardt

Physical computing kits



The Makey Makey toolkit *Source*: Makey Makey

Physical computing kits



The BBC micro:bit

Source: micro:bit. Used courtesy of Micro:bit Foundation

Construction: SDKs

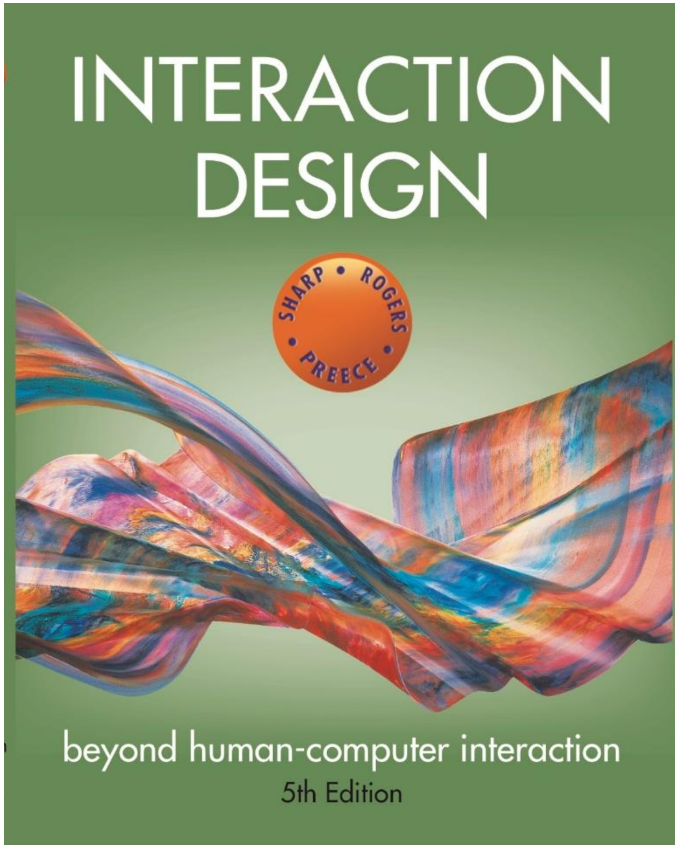
- Software Development Kits
  - Programming tools and components to develop for a specific platform, for example, iOS
- Includes: IDE, documentation, drivers, sample code, and application programming interfaces (APIs)
- Makes development much easier
- Examples:
  - Amazon’s Alexa Skills Kit for voice-based services
  - Apple’s ARKit for augmented reality
  - Microsoft’s Kinect SDK for motion tracking

Summary

- Prototyping may be low fidelity (such as paper-based) or high fidelity (such as software-based)
- Existing software and hardware helps create prototypes
- Two aspects to design: conceptual and concrete
- Conceptual design develops an outline of what users can do and what concepts are needed to understand the product.
- Concrete design specifies design details, for example, layout or navigation

Summary (*continued*)

- Three approaches to develop an initial conceptual model: interface metaphors, interaction styles, and interface styles.
- Expand an initial conceptual model by considering whether product or user performs each function, how those functions are related, and what information is required to support them
- Generate prototypes from scenarios and use cases
- Physical computing kits and software development kits facilitate the transition from design to construction



Chapter 14

INTRODUCING EVALUATION

Goals

- Explain the key concepts and terms used in evaluation
- Introduce range of different types of evaluation methods
- Show how different evaluation methods are used for different purposes at different stages of the design process and in different contexts of use
- Show how evaluators mixed and modified to meet the demands of evaluating novel systems

Goals *(continued)*

- Discuss some of the practical challenges of doing evaluation
- Through case studies, illustrate how methods discussed in Chapters 8, 9, and 10 are used in evaluation, and describe some methods that are specific to evaluation
- Provide an overview of methods that are discussed in detail in the next two chapters

Why, what, where, and when to evaluate

Iterative design and evaluation is a continuous process that examines:

Why: To check users' requirements and confirm that users can utilize the product and that they like it

What: A conceptual model, early and subsequent prototypes of a new system, more complete prototypes, and a prototype to compare with competitors' products

Where: In natural, in-the-wild, and laboratory settings

When: Throughout design; finished products can be evaluated to collect information to inform new products

Bruce Tognazzini tells you why you need to evaluate

“Iterative design, with its repeating cycle of design and testing, is the only validated methodology in existence that will consistently produce successful results. If you don’t have user-testing as an integral part of your design process you are going to throw buckets of money down the drain.”

See AskTog.com for topical discussions about design and evaluation

Types of evaluation

Controlled settings that directly involve users (for example, usability and research labs)

- Natural settings involving users (for instance, online communities and products that are used in public places)
    - Often there is little or no control over what users do, especially in in-the-wild settings
- Any setting that doesn't directly involve users (for example, consultants and researchers critique the prototypes, and may predict and model how successful they will be when used by users

Living labs

- People's use of technology in their everyday lives can be evaluated in living labs
- Such evaluations are too difficult to do in a usability lab
- An early example was the Aware Home that was embedded with a complex network of sensors and audio/video recording devices (Abowd et al., 2000)

Living labs *(continued)*

- More recent examples include whole blocks and cities that house hundreds of people, for example, Verma et al., research in Switzerland (2017)
- Many citizen science projects can also be thought of as living labs, for instance, iNaturalist.org
- These examples illustrate how the concept of a lab is changing to include other spaces where people’s use of technology can be studied in realistic environments

Evaluation case studies

- A classic experimental investigation into the physiological responses of players of a computer game
- An ethnographic study of visitors at the the Royal Highland show in which participants are directed and tracked using a mobile phone app
- Crowdsourcing in which the opinions and reactions of volunteers (for example, from the crowd) inform technology evaluation

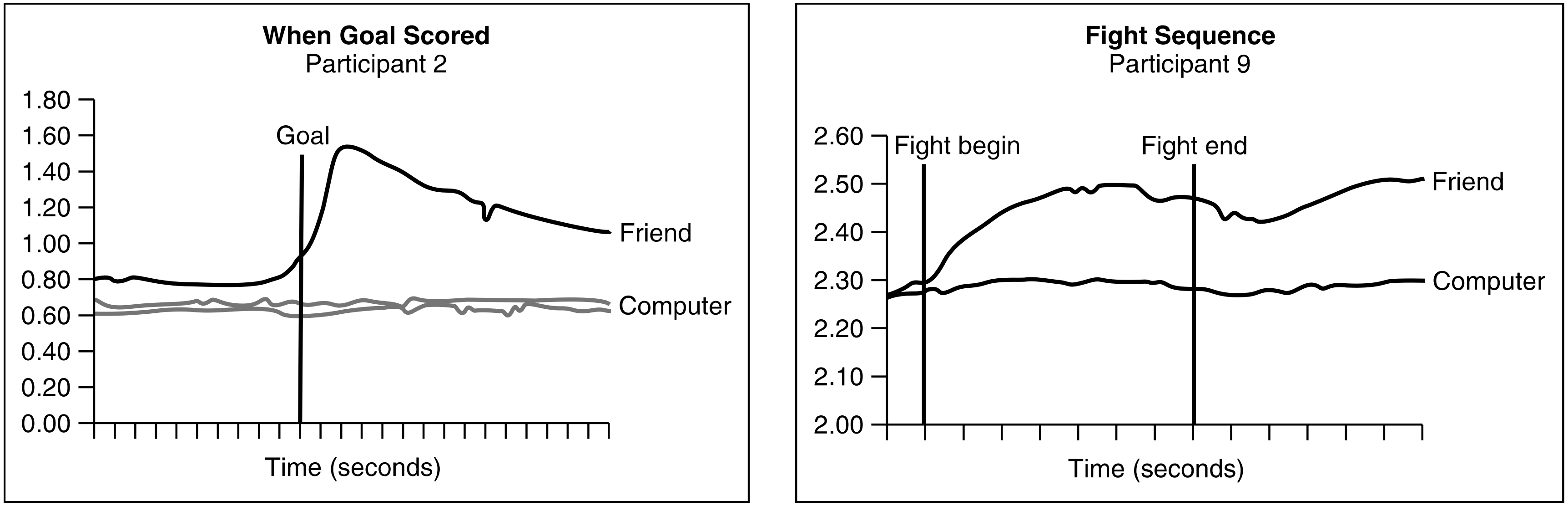
Challenge and engagement in a collaborative immersive game

- Physiological measures were used
- Players were more engaged when playing against another person than when playing against a computer
- Why was the physiological data collected normalized?

Physiological data of participants in a videogame

Source: Mandryk and Inkpen (2004), *"The Physiological Indicators for the Evaluation of Co-located Collaborative Play,"* CSCW'2004, pp 102-111. Reproduced with permission of [ACM Publications].

Example of physiological data



(a) (b)

A participants' skin response when scoring a goal against a friend (a), and another participants' response when when engaging in a hockey fight against a friend versus against the computer (b).

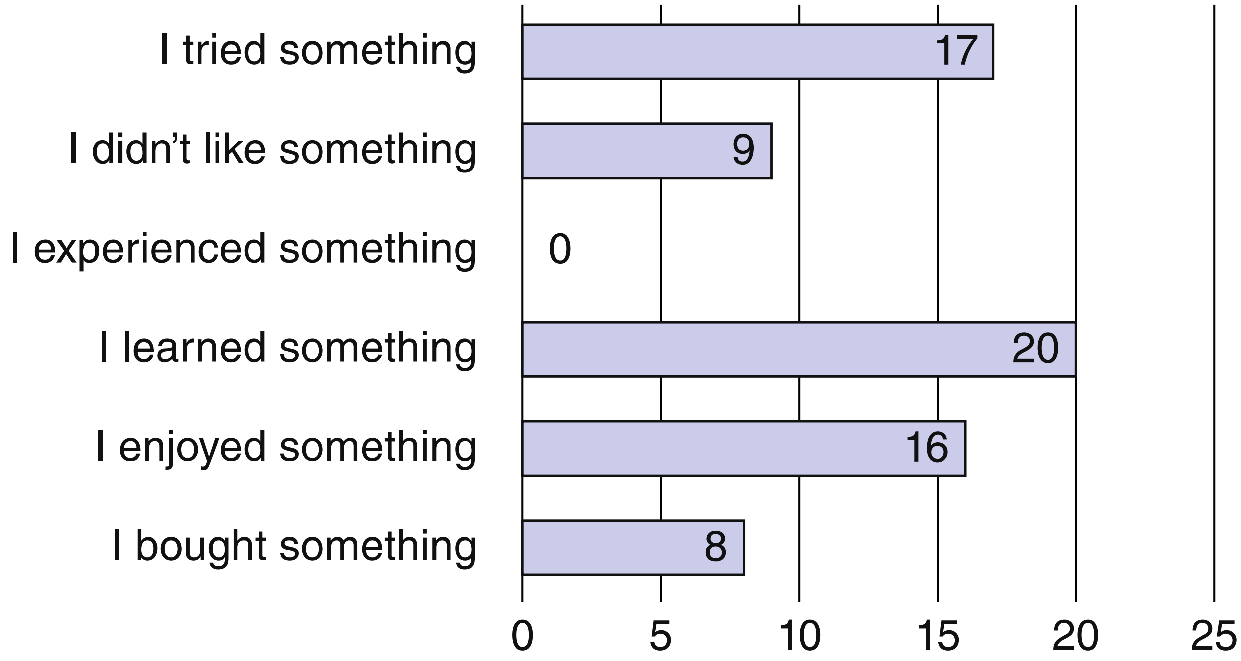
Source: Mandryk and Inkpen (2004), *"The Physiological Indicators for the Evaluation of Co-located Collaborative Play,"* CSCW'2004, pp 102-111. Reproduced with permission of ACM Publications.

Ethnobot app used at the Royal Highland Show

- The Ethnobat directed Billy to a particular place (Aberdeenshire Village)
- Next, Ethnobot asks "…what's going on?"
- The screen shows five of the experience buttons from which Billy needs to select a response

Source: Tallyn et al. (2018) Reproduced with permission of ACM Publications.

Experience responses submitted in Ethnobot



Number of prewritten experience responses submitted by participants to the pre-established questions that Ethnobot asked them about their experiences

Source: Tallyn et al. (2018) Reproduced with permission of ACM Publications.

What did we learn from the case studies?

- How to observe users in the lab and in natural settings
- How evaluators excerpt different levels of control in the lab and in natural settings and in crowdsourcing evaluation studies
- Use of different evaluation methods

What did we learn from the case studies? *(continued)*

- How to develop different data collection and analysis techniques to evaluate user experience goals such as challenge and engagement
- The ability to run experiments on the Internet that are quick and inexpensive using crowdsourcing
- How a large number of participants can be recruited using Mechanical Turk

Evaluation methods

Method	Controlled settings	Natural settings	Without users
Observing	x	x	
Asking users	x	x	
Asking experts		x	x
Testing	x		
Modeling			x

The language of evaluation

- Analytics
- Analytical evaluation
- Biases
- Controlled experiment
- Crowdsourcing
- Ecological validity
- Expert review or criticism
- Field study
- Formative evaluation
- Heuristic evaluation
- Informed consent form
- In the wild evaluation
- Living laboratory
- Predictive evaluation
- Reliability
- Scope
- Summative evaluation
- Usability laboratory
- User studies
- Usability testing
- Users or participants
- Validity

Participants' rights and getting their consent

- Participants need to be told why the evaluation is being done, what they will be asked to do and informed about their rights
- Informed consent forms provide this information and act as a contract between participants and researchers
- The design of the informed consent form, the evaluation process, data analysis, and data storage methods are typically approved by a high authority, such as the Institutional Review Board

Things to consider when interpreting data

Reliability: Does the method produce the same results on separate occasions?

Validity: Does the method measure what it is intended to measure?

Ecological validity: Does the environment of the evaluation distort the results?

Biases: Are there biases that distort the results?

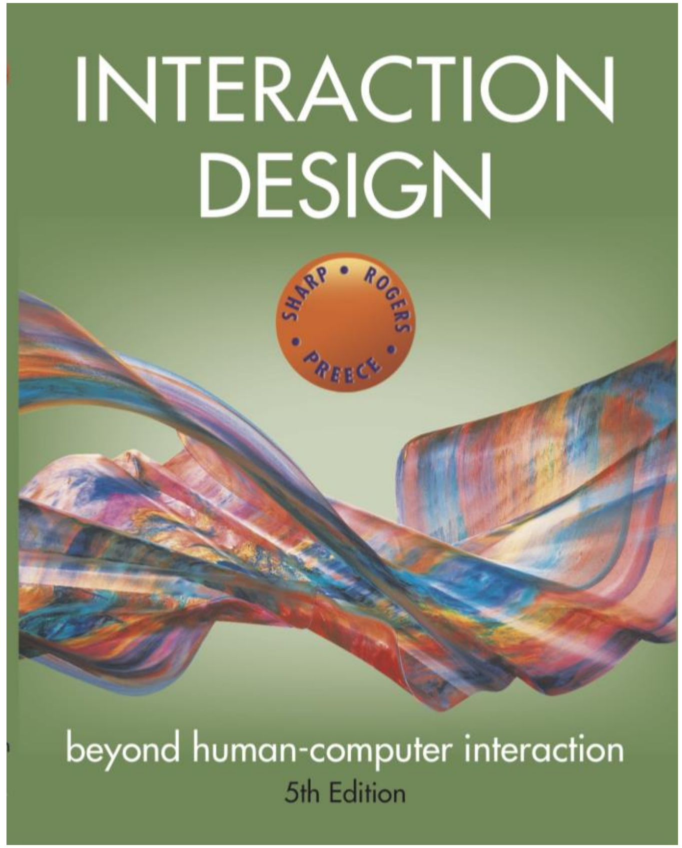
Scope: How generalizable are the results?

Summary

- Evaluation and design are very closely integrated
- Some of the same data gathering methods are used in evaluation as for establishing requirements and identifying users' needs, for example, observation, interviews, and questionnaires
- Evaluations can be done in controlled settings such as laboratories, less controlled field settings, or where users are not present

Summary *(continued)*

- Usability testing and experiments enable the evaluator to have a high level of control over what gets tested, whereas evaluators typically impose little or no control on participants in field studies
- Different methods can be combined to get different perspectives
- Participants need to be made aware of their rights
- It is important not to over-generalize findings from an evaluation



Chapter 15
Evaluation Studies:
From Controlled to Natural Settings

Goals

- Explain how to do usability testing
- Outline the basics of experimental design
- Describe how to do field studies

Usability testing

- Involves recording performance of typical users doing typical tasks
- Controlled settings
- Users are observed and timed
- Data is recorded on video, and key presses are logged
- The data is used to calculate performance times and to identify and explain errors
- User satisfaction is evaluated using questionnaires and interviews
- Field observations may be used to provide contextual understanding

Quantitative performance measures

- Number of users successfully completing the task
- Time to complete task
- Time to complete task after time away from task
- Number and type of errors per task
- Number of errors per unit of time
- Number of navigations to online help or manuals
- Number of users making a particular type of error

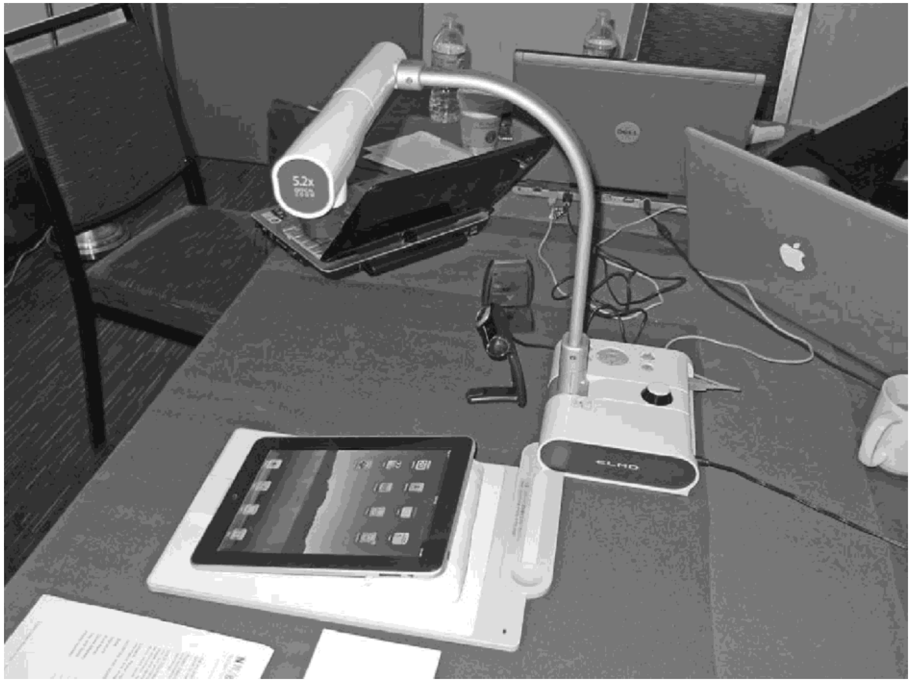
Source: Wixon and Wilson, 1997

Usability lab with observers watching a user and assistant

Tobii Glasses Mobile Eye-Tracking System

Source: Dalton et al., 2015, p.3891. Reproduced with permission of [ACM Publications].

Portable equipment for use in the field



Setup used in the Chicago usability testing sessions

Source: iPad App and Website Usability Study. Used courtesy of the [Neilsen Norman Group](#).

Testing the iPad usability

- First study was conducted quickly in two cities: Fremont, CA and Chicago, IL
- Tests had to be done quickly, as information was needed by third-party app developers
- Also needed to be done secretly so that the competition was not aware of the study before the iPad was launched
- Seven participants with over three months experience with iPhones

Testing the iPad usability *(continued)*

- Signed an informed consent form explaining:
  - What the participant would be asked to do
  - The length of time needed for the study
  - The compensation that would be offered for participating
  - Participants' right to withdraw from the study at any time
  - A promise that the person's identity would not be disclosed
  - An agreement that the data collected would be confidential and available to only the evaluators
- Participants were asked to explore the iPad
- Next, they were asked to perform randomly-assigned specified tasks

Examples of the tasks used in the iPad evaluation

App or website	Task
iBook	Download a free copy of *Alice's Adventures in Wonderland* and read through the first few pages.
Craigslist	Find some free mulch for your garden.
eBay	You want to buy a new iPad on eBay. Find one that you could buy from a reputable seller.
Time Magazine	Browse through the magazine and find the best pictures of the week.
Epicurious	You want to make an apple pie for tonight. Find a recipe and see what you need to buy in order to prepare it.
Kayak	You are planning a trip to Death Valley in May this year. Find a hotel located in the park or close to the park.

Adapted from Budiu and Nielsen, 2010
Source: iPad App and Website Usability Study. Used courtesy of the Neilsen Norman Group.

Problems and actions

- Examples of problems detected:
  - Accessing the Web was difficult
  - Lack of affordance and feedback
  - Getting lost in an application
  - Knowing where to tap
- Actions by evaluators:
  - Reported to developers
  - Made available to public on Neilsen Norman Group.

Problems and actions *(continued)*

- Accessibility for all users is important
- Study did not address how iPad would be used in people's everyday lives
- Another study was done a year later to examine this and other issues that there was insufficient time to address in the first study

Usability testing conditions

- Usability lab or other controlled space
- Emphasis on:
  - Selecting representative users
  - Developing representative tasks
- 5-10 users typically selected
- Tasks usually around 30 minutes
- Test conditions are the same for every participant
- Informed consent form explains procedures and deals with ethical issues

How many participants is enough for user testing?

- The number is a practical issue
- Depends on:
  - Schedule for testing
  - Availability of participants
  - Cost of running tests
- Typically 5-10 participants
- Some experts argue that testing should continue until no new insights are gained

Usability testing and Experiments

- Usability testing is applied experimentation
- Developers check that the system is usable by the intended user population by collecting data about participants' performance on prescribed tasks
- Experiments test hypotheses to discover new knowledge by investigating the relationship between two or more variables

Usability testing and research

Usability Testing	Experiments for Research
• Improve products	• Discover knowledge
• Few participants	• Many participants
• Results inform design	• Results validated statistically
• Usually not completely replicable	• Must be replicable
• Conditions controlled as much as possible	• Strongly controlled conditions
• Procedure planned	• Experimental design
• Results reported to developers	• Scientific report to scientific community

Experiments

- Test hypothesis
- Predict the relationship between two or more variables
- Independent variable is manipulated by the researcher
- Dependent variable influenced by the independent variable
- Typical experimental designs have one or two independent variables
- Validated statistically and replicable

Experimental designs

Different participants (between subjects):

Single group of participants is allocated randomly to the experimental conditions

Same participants (within subjects):

All participants appear in both conditions

Matched participants (pairwise):

Participants are matched in pairs, for example, based on expertise, gender, and so on

Different, same, matched participant design

Design	Advantages	Disadvantages
Different	No order effects	Many subjects and individual differences a problem
Same	Few individuals, no individual differences	Counter-balancing needed because of ordering effects
Matched	Same as different participants, but individual differences reduced	Cannot be sure of perfect matching on all differences

Field studies

- Field studies are done in natural settings
- “In the wild” is a term for prototypes being used freely in natural settings
- Seek to understand what users do naturally and how technology impacts them
- Field studies are used in product design to:
  - Identify opportunities for new technology
  - Determine design requirements
  - Decide how best to introduce new technology
  - Evaluate technology in use

A field study of a pain-monitoring device

- Monitoring patients' pain is a known challenge for physicians
- Goal of the study was to evaluate the use of a pain-monitoring device for use after ambulatory surgery
- Painpad is a keypad device
- It was usability tested extensively in the lab before brought into two hospitals
- Goal was to understand how Painpad was used in the natural environment and as part of routines in two UK hospitals.
- How pain-monitoring differed with Painpad

Painpad

A tangible device for inpatient self-logging of pain

Source: Price et al., 2018. Reproduced with permission of ACM Publications.

Data collection and participants

- Two studies in two hospitals involving 54 people
- 13 males, 41 females
- Privacy was a important concern
- Hospital stay ranged from 1-7 days, mean and median age 64.6, 64.5
- Patients given Painpad after surgery and prompted to report pain levels every two hours
- Nurses also collected scores
- All data entered into charts
- Patients in one hospital were given a user-satisfaction survey when they left
- Also rated Painpad on a 1-5 Likert scale

Data analysis and presentation

- Three types of data were collected:
  - Satisfaction with Painpad was based on questionnaire responses
  - Patients' compliance with the two-hour routine
  - How data collected from Painpad compared with data collected by nurses
- Data showed:
  - Satisfaction with Painpad 4.63 on Likert scale
  - Patience compliance was mixed: some liked it while others disliked or didn't notice the prompts
  - Patients recorded more scores with Painpad than through the nurses

Summary

- Usability testing takes place in controlled usability labs or temporary labs
- Usability testing focuses on performance measures, for example, how long and how many errors are made when completing a set of predefined tasks
- Indirect observation (video and keystroke logging), user satisfaction questionnaires, and interviews are also collected
- Affordable, remote testing systems are more portable than usability labs
- Many also contain mobile eye-tracking and other devices

Summary *(continued)*

- Experiments test a hypothesis by manipulating certain variables while keeping others constant
- The experimenter controls independent variable(s) in order to measure dependent variable(s)
- Field studies are evaluation studies that are carried out in natural settings to discover how people interact with technology in the real world
- Field studies that involve the deployment of prototypes or technologies in natural settings may also be referred to as ‘in-the-wild’ studies
- Sometimes the findings of a field study are unexpected, especially for in-the-wild studies that explore how novel technologies are used by participants in their own homes, places of work, or outside