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DECO2500 – Human Computer Interaction Design

Lecture Summary

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What is interaction design

1. Explain difference between good and poor interaction design
2. Describe what interaction design is and how it relates to human-computer interaction etc
3. Explain relationship between user experience and usability
4. Describe what and who is involved in interaction design
5. Outline different forms of guidance used in interaction design
6. 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

What are HCI and ID

Human-computer interaction (HCI)

Concerned with the design, evaluation, and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them

One set of usability principles (Norman 1998):

Visibility can you see your options for action? *Externalising cognition – Gulf of Execution*

Feedback can you see the effect of what you did? *Goal directed activity – Gulf of Evaluation*

Constraints is your activity usefully shaped towards successful paths? *Focusing attention – Gulf of Execution*

Mapping is there a natural relation between your actions and their effects on the world? *Mental model – Gulf of Execution*

Consistency are there similar operations and similar elements for similar tasks? *Learning and memory – Gulf of Execution*

Affordance do interface elements correctly “signal” how they are to be used? *Gulf of Execution*

Another set of usability principles (Nielsen 2001):

- Visibility of system status – *Externalising cognition*
- Match between system and real world – *Mental model*
- User control and freedom – *Goal-directed activity*
- Consistency and standards – *Learning and memory*
- Error prevention – *Focusing attention*
- Recognition rather than recall – *Learning and memory*
- Flexibility and efficiency of use – *Information processing*
- Aesthetic and minimalist design – *see Emotional design*
- Help users recognize, diagnose and recover from errors – *Goal-directed activity (7-stages)*
- Help and documentation

Interaction Design (ID)

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

Key Components of ID process

- Establishing user requirements
- Developing alternatives
- Prototyping
- Evaluating

Interaction Design Process

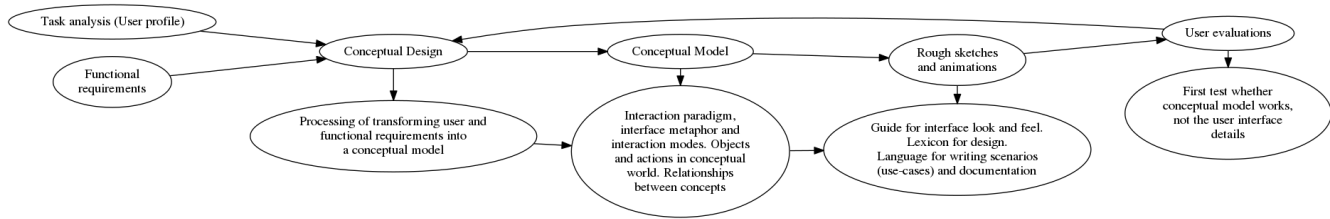


Figure 1: Interaction Design Process

Users should be involved throughout the project. Specific usability and user experience goals should be identified, clearly documented and agreed at start of project, and *tracked empirically throughout development*. Iteration is needed through the core activities

Help designers:

- Match what people want, need, and may desire
- Appreciate that one size does not fit all (e.g. teenagers very different from adults)
- Correct incorrect assumptions about user groups (e.g. not all old people want or need big fonts)
- Know people's sensitivities and capabilities

Architecture vs Engineering Analogy (ID vs soft engg)

Architects are specialists in how people will interact with spaces. Engineers are specialists in specifying and constructing the spaces

User Experience (UX)

How people feel about a product and their pleasure and satisfaction when using it, looking at it, holding it, and opening or closing it. It includes their overall impression of how good it is to use, right down to the sensual effect small details have on them, such as how smoothly a switch rotates or the sound of a click and the touch of a button when pressing it

Can't design user experience; can only design for it

Usability Goals

- Effective to use
- Efficient to use
- Safe to use
- Have good utility
- Easy to learn
- Easy to remember how to use

Understanding and Conceptualising Interaction

1. Explain what is meant by the problem space
2. Explain how to conceptualize interaction
3. Describe what a conceptual model is and how to formulate one
4. Discuss interface metaphors as part of a conceptual model
5. Outline core interaction types for informing development of a conceptual model

Conceptual Design

Processing of transforming user and functional requirements into a conceptual model before starting physical design.

“Designing what to design”

1. Problem space
2. Conceptual model
3. Interface metaphor
4. Design space

Initial Problem Space

“In the process of creating an interactive product, it can be tempting to begin at the nuts and bolts level of design...better to make these kinds of decisions after articulating the nature of the problem space; (that is, after) understanding and conceptualizing what is currently the user experience/product and how this is going to be improved or changed” Preece et al., p.37

- Question the assumptions
- Challenge the claims
 - Are there problems with 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 designing for a new user experience how do you think your proposed design ideas support, change, or extend current ways of doing things?
- Get others to challenge your ideas – hard to do it yourself

Conceptual Model

- **Will the user understand the underlying conceptual model?**

“A description of the proposed system in terms of a set of integrated ideas and concepts about what it should do, behave and look like, that will be understandable by the users in the manner intended.” (Preece, et al., 2002)

Three considerations when developing a conceptual model:

1. Interaction paradigm – ICT framework experienced
 - ICT framework within which interaction takes place (WIMP, mobile, ubiquitous computing, etc)
 - May be familiar or novel to user
 2. Interaction mode/type – what does the user have to DO?
 - How does the user interact with the system?
 - Helps user know what to do, in particular
 3. Interface metaphor – exploiting user experience
 - How is the user’s prior knowledge used?
 - Helps user know what to do and how to interpret feedback
- Not same as “user interface”
 - It’s the concepts people need to understand in order to *use* the interface
 - Not same as “user’s mental model”
 - It’s the conceptual basis for the user’s mental model
 - Not same as “use-cases”
 - It focuses on *system as a whole*, not individual tasks
 - Not same as “implementation architecture”
 - It involves *abstract* constructs, not technical or implementation-level constructs

Formulating a Conceptual Model

- **Will the user understand the underlying conceptual model?**
- What will users be doing when carrying out tasks?
- How will the system support those activities?
- What kind of *interface metaphor* is appropriate?
- What kinds of *interaction modes* and styles to use?

Interaction mode/interaction type

- Giving instructions
 - Issuing commands using keyboard and selecting options via menus
- Conversing
 - Interacting with the system as if having a conversation
- Manipulating and navigating
 - Acting on objects and interacting with virtual objects
- Exploring and browsing
 - Finding out and learning things

Interface metaphor

“This works like a ...”

Cognition

Cognition is operations involved with sensing and functioning mentally in the world

- Attention
- Perception and recognition
- Memory
- Cognition – internal or personal
 - Mental models
 - Gulfs of execution and evaluation
 - Information processing
- Cognition – external or shared
 - Distributed cognition
 - External cognition

Attention

- Processes by which we focus our minds and our senses on one thing/set of things from all possibilities around us
 - Visual attention (usually works serially)
 - Auditory attention (eyes-free, time-shared)
 - Focal/focused attention
 - Divided attention
 - Pre-attentive processes (not in full focal attention)
 - Peripheral awareness (background awareness)
- “Attention-aware computing”
- “Cocktail party effect”
- Possible to perform multiple tasks without one or more of them suffering?
- Depends on task and individual differences
- Heavy vs light multi-taskers
 - Heavy more distractible than light
 - Heavy find it difficult to filter irrelevant information
- “Distracted doctoring”/“Distracted driving”

Perception and recognition

How information is acquired from world through senses and transformed into experience

Memory

We encode and then retrieve knowledge. We remember what we have attended to. Context is an important cue to memory retrieval. We recognize things

Myth of 7 +/- 2 in design

- Miller’s (1956) theory of how much information people can remember
- Based on how many items you can remember from a spoken or briefly shown list (average = 7 +/- 2)
- But some designers say:

- “Present only 7 options on a menu”
- “Display only 7 icons on a tool bar”
- “Place only 7 tabs on the top of a website page”

This is wrong!

Information-processing Metaphor

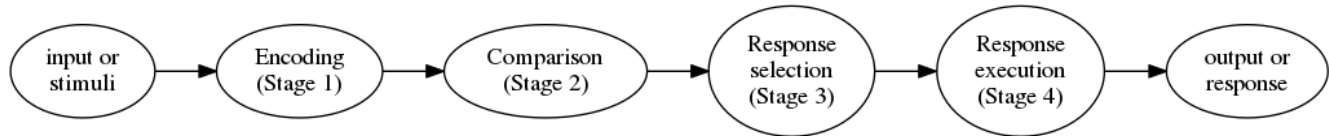


Figure 2: Information-processing metaphor

Stages of processing assumed:

- Stage 1 and Stage 4 – Modality of input and output affects performance
- Stage 2 and Stage 3 – Options to select amongst affect performance

Information Processing Models

“Model Human Processor”

- Based on mental activities only
- Models human interacting with computer
- Estimates time to do tasks
- Models highly constrained tasks – telephone operators
- Does not model how people interact with computers and other devices in less constrained contexts

GOMS – Card, Moran & Newell (1983) - Goals (what you’re trying to achieve) - Operators (actions you can do) - Methods (ways to assemble Operators) - Selection rules (ways to choose Methods)

Cognitive Frameworks For HCI

Cognitive frameworks for HCI are concepts and models that explain cognitive aspects of human-computer interaction and interaction design issues

Mental Models

- User develops understanding of system through learning about and using it
- User’s knowledge is sometimes described as “mental model”:
 - How to use the system
 - How to handle unfamiliar system or unexpected situations
- People make inferences using mental models
- Mental models often wrong or only partially right
- Refrigerator example

Seven Stages of action

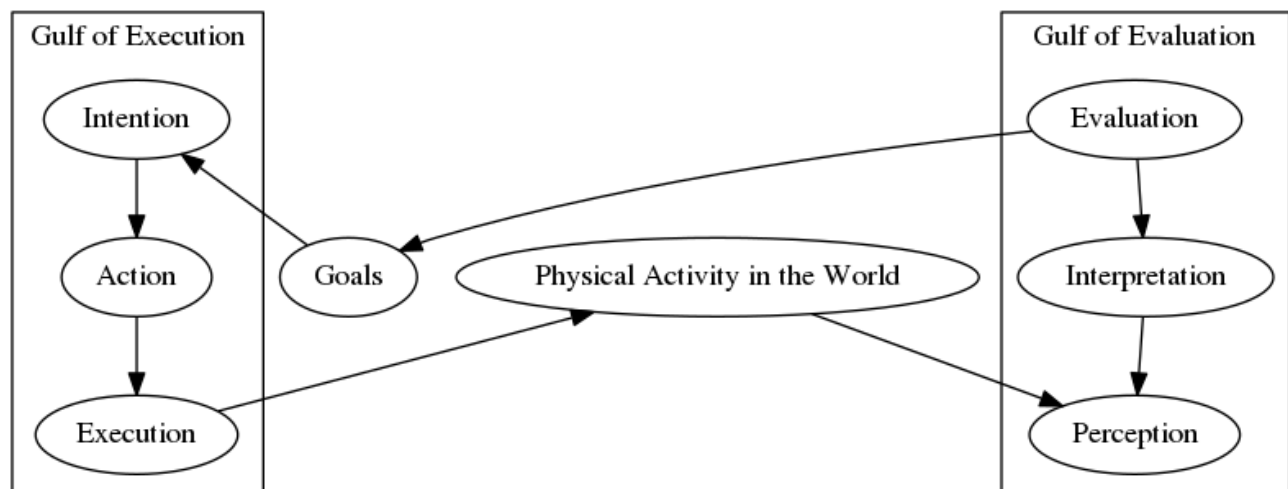


Figure 3: Seven stages of action

Norman's (1986) seven stages of action. "Seven stages" decompose interaction into steps. Each step may be well or poorly supported

Gulf of Execution

Difference between user's formulation of actions to reach a goal and actions allowed by system. If actions allowed by system match user's intention, then interaction will be effective.

Gulf of Evaluation

Distance between physical presentation of system state and expectation of user. If user can readily evaluate presentation in terms of goals, the gulf of evaluation is small

External Cognition

Explains how we interact with external representations (e.g. maps, notes, diagrams, tools, instruments, notations). How they extend our cognition. How they help us solve difficult problems

Distributed Cognition

- Shared/distributed problem-solving that takes place
- Role of verbal and *non-verbal* behaviour
- Coordinating mechanisms people use (e.g. rules, procedures)
- Communication that takes place as collaborative activity progresses
- How knowledge is shared and accessed
 - Taking bearings in narrow waterways
 - Micronesian navigation across the Pacific
- How cognitive phenomena work across individuals, artifacts, and internal and external representations (Hutchins, 1995)
- Propagation across representational states
- Information *transformed* through different media (computers, displays, paper, heads)
- Role of verbal and non-verbal behaviour

Conversation analysis

Fundamentals of conversations:

- Openings and greetings

- Personal space/distance
- Topic introduction
- Turntaking
- Making disclosures
- Admitting others
- Trouble and repair
- Closings and farewells

Rules

Sacks et al. (1978) describe three rules:

Rule 1 current speaker chooses next speaker by asking opinion, question, or request

Rule 2 another person decides to start speaking

Rule 3 the current speaker continues talking

Affordances of Media

- How does different media affect the fundamentals and pragmatics of conversation?
 - Compare how you finish a conversation on an audio-only channel (phone call) vs an audiovisual channel (Facetime, Skype, etc)
 - Compare how you correct a misunderstanding on email vs on a phone call vs on Facetime or Skype
- How do we select amongst different media for conversations of different kinds?
 - Number of other people
 - Familiarity with other people
 - Sensitivity of issue to be discussed
 - Simplicity/complexity of issue/purpose of communication

Telepresence

- Shared space
- 3 by 8 ft 'picture-window' between two sites with video and audio
- People interacted but strange things happened (Kraut, 1990)
 - Talked constantly about system
 - Spoke more to people in same room than in other room
 - When tried to get closer to someone in other place had opposite effect – went out of range of camera and microphone
- Technologies designed to allow a person to feel as if they were present in the other location
 - Projecting body movements, actions, voice and facial expressions to other location or person
- Superimpose images of other person on a workspace
 - Transparent board that shows other person's facial expression on your board as you draw
 - * Users did not feel comfortable "looking down" at the other person
- Most forms of videoconferencing lead to:
 - Longer conversational turns
 - Fewer interruptions of each other
 - Turn-taking more explicit
 - Greetings and farewells longer and more ritualised
- Video gives more intimacy than audio phone
- Low overhead to adopt
- Works in personal spaces
- Works well for already-acquainted people but also lets people get to know each other

Presence

Lifelogging

- Low cost audiovisual data collection and storage
- Can go beyond perpetual sharing and broadcasting of personal information to lifelogging

Google Glass

- Socially and cognitively problematic
- Distraction issues (display), privacy issues (forward camera)
- Banned in cars, cinemas, theatres, casinos, strip clubs, restaurants, cafes, etc
- “Glassholes”
- Current focus on enterprise applications only

Online Presence

- Rapid switching between media and applications to notify and be notified
- Selection of medium for message type, speed, cost, and urgency

Awareness Mechanisms

Involves knowing who is around, what is happening, and who it talking to whom

- 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
- Notification systems
 - User notify others as opposed to being constantly monitored
 - Provide information about shared objects and progress of collaborative tasks

Emotional Interaction

“Emotional interaction is about considering what makes us happy, sad, annoyed, anxious, frustrated, motivated, delirious, and so on, and using this knowledge to inform the design of different aspects of the user experience, from when we first want something to when we no longer interact with it or need to replace it.” Preece et al. (2015) p.133

Affect quick automatic reaction without reflection

Conscious emotion considered and conscious reaction

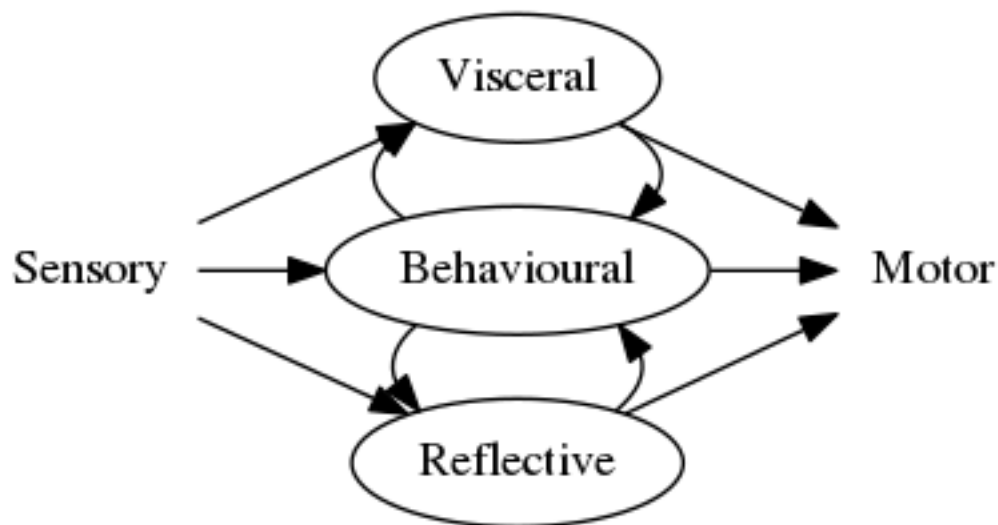


Figure 4: Norman, Ortony and Revelle (2004) model of emotion

Consequences of Emotions

Emotional state changes how people think

- When frightened or angry we focus narrowly; body tenses
 - More likely to be less tolerant
- When happy we are less focused; body relaxes
 - More likely to overlook minor problems and be more creative

Norman's (2004) views

- Designers "can get away with more" for leisure products than those designed for serious task
- Interfaces/devices to be used in stressful situations require extremely careful design

Visual Appeal – at visceral level

"Visual appeal can be assessed within 50ms, suggesting that web designers have about 50ms to make a good first impression."

Lindgaard et al., (2004) p.115

Frustrating Interfaces

- Application does not work properly or crashes
- System does not do what the user wants it to do
- The user's expectations are not met
- System does not provide sufficient information to let the user know what to do
- Error messages pop up that are vague or condemning
- Pop up advertisements that are difficult to dismiss
- Appearance of interface is garish, noisy, gimmicky or patronizing
- System requires users to carry out many steps, only to discover a mistake was made earlier and they need to start over
- Poorly laid out interface and/or over-use of graphics and sound
- They violate principles of user interface design that we studied earlier

Detecting Emotions

- Heart rate and heart rate variability
- Facial expressions
- Galvanic skin response
- Pupillometry
- Gestures, body motion
- Word use, speech pattern

Persuasive technologies

Novel forms of interactive technologies that monitor, nag, or send personalized messages intermittently to a person. Non-interactive methods, such as placement of warning signs, labels, or ads in prominent positions. Social norms vs affordances

Anthropomorphism

Attributing or inserting human-like qualities into inanimate objects (e.g. cars, computers)

Criticism

- Deceptive, makes people feel anxious, inferior or stupid
- People do not like screen characters who speak:
 - "Now Chris, that's no right. You can do better than that. Try again"
- Many prefer impersonal interaction:
 - "Incorrect. Try again"
- Personalized feedback is considered less honest and makes users feel less responsible for their actions (Quintanar, 1982)

Zoomorphism

Computers and robots in the form of an animal

- Use recreationally as pets
- Learning for children through play
- Use in clinical psychology situations

Summary

- Concerned with how interactive systems make people respond in emotional ways
 - Well-designed interfaces can elicit good feelings
 - Expressive interfaces provide reassuring feedback
 - Badly designed interfaces make people angry and frustrated
- Anthropomorphism is attribution of human qualities to objects

- Increasingly popular anthropomorphism is interface agents and robot pets
- Models of affect help us conceptualise emotional and pleasurable aspects of interaction design

Key Points

Chapter 1

- Interaction design is designing interactive products to support how people communicate and interact in their everyday and working lives
- Interaction design is multidisciplinary
- User Experience is central to interaction design
- “Optimizing” interaction requires taking into account context of use, types of activity, accessibility, cultural difference, and user groups
- Specifying usability and user experience goals helps design of good products
- Design principles are useful heuristic for analyzing and evaluating an interactive product

Chapter 3

- Social media change how we organise and conduct our lives
- Communications technology changes how we interact with each other:
 - We adjust to the new affordances or the removal of affordances in new forms of communication
- Social mechanisms have evolved to smooth out conversations, assist coordination of activities, and support mutual awareness of each others’ activities
- Focus on
 - Conversations
 - Telepresence
 - Awareness mechanisms