Lecture 7: Evaluating interactive systems

Approaches to evaluation in systems research and engineering
Overview of the course

• Theory driven approaches to HCI
• Design of visual displays
• Goal-oriented interaction
• Designing efficient systems
• Designing smart systems (guest lecturer)
  • Designing meaningful systems (guest lecturer)
• Evaluating interactive system designs
• Designing complex systems

Postponed for strike action
No lecture this Thursday
Now Monday 20th Feb at 3pm
Reminder: Controlled experiments from Lecture 5
Randomised Control Trial (RCT)

• Commonly used in medicine e.g. drugs trials
• What you need to run an RCT:  
  • A performance measure  
  • A representative population sample + informed consent  
  • A task
• Results  
  • Effect size, correlations, significance measures
• Difficulties  
  • Overcoming natural variation needs large samples  
  • Little understanding as to why a change occurred  
  • Does the effect generalise?  
  • Number of studies/orthogonality of variables
Commercial product evaluation

- RCTs are little used for design research in commercial products
- Performance measure is usually profit maximisation
  - Sales/Profit are often hard to measure with useful latency
- Typically use proxy measures instead
  - 1 day active, 7 day active, 28 day active

Often used as *summative* evaluation
Formative vs Summative

• Formative
  • Evaluates and refines design ideas

• Summative
  • Tests and evaluates systems
Internal vs External validity

• Internal Validity
  • Reproducibility, Scientific integrity, Refutability
  • “Was the study done right?”

• External Validity
  • Generalisability
  • “Does the study tell us useful things?”
Analytical (Theoretical)

Qualitative (words)
- Cognitive Walkthrough
- Cognitive Dimensions (Lecture 8)

Quantitative (numbers)
- KLM/GOMS

Empirical (Observed)

- Interviews (From Part 1A)
- Think Aloud

- Analytics/ Metrics
Analysing qualitative data

• Categorical coding (answers ‘closed’ questions)
  • Create a coding frame of expected categories of interest
  • Segment the text data
  • Assign each segment to a category

• Grounded theory (asks ‘open’ questions)
  • No prior expectation or theoretical assumption
  • Read data closely, looking for interesting stuff (‘open coding’)
  • Collect fragments, writing ‘memos’ to capture your own insights
  • Organise emerging themes using ‘axial coding’
  • Constantly compare memos, themes and findings to original data
Case study: Interpreting product feedback

Tinkercad Community Forum -> General Discussion

“Anything we didn't cover in other topics” (so could contain anything at all)

https://support.tinkercad.com/hc/en-us/community/topics/200160948-General-Discussion
Please I need of Help! How to round the sharp edges of a non-standard detail,...Apple logo?

I like making projects, but I can't figure out how to share my designs with others. It says there is a button, but I don't see one. Please help!

Hi, I'm trying to create a lock for my tripod camera, I started the design but I'm not sure if it will works, I'm asking any help to review my design please. the image show the lock, and the diameter of the tripod is 26mm so I have designed the lock as 27mm. I will appreciate your help thanks

I'm working on a file that I found on Thingiverse. I'm just trying to customize it the way I want to use. The final shape is as in the STL file I'm going to share. But I'm also sharing an image file where I'm showing 3 different sides and on these sides, marked some spots where I don't get rid of misalignment. No matter what I do here, It's never all right. Can anybody help me? Would it be difficult for you to just open the file on tinkercad and try if you can fix those sides? I'd be very appreciated.

How would I scale a few complicated interlocking objects up or down by 17% for example? A cube I would just add 17% to the 3 dimensions. I like making projects, but I can't figure out how to share my designs with others. It says there is a button, but I don't see one. Please help! I need of Help! How to round the sharp edges of a non-standard detail,...Apple logo?

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Categorical coding

• Create a coding frame of expected categories of interest
  • Bugs
  • Feature requests
  • Permission requests
  • Other

• Segment the text data
• Assign each segment to a category
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Inter-rater reliability

• Two or more people make the coding decisions independently to avoid systematic bias or misinterpretation
• Compare how many decisions agree, relative to chance
  • Calculate a statistical measure such as Cohen’s Kappa (for 2 people) or Fleiss’ Kappa (for more), comparing to typical levels (0.6-0.8 is considered ‘substantial agreement’)
• May take account of how many decisions still disagreed after discussion
  • Which may involve refining the coding frame to resolve decision criteria
  • Can ‘prototype’ by discussing a sample before coding the main corpus
Grounded theory

• For research where you don’t know in advance what you are looking for, but wanting to learn something from qualitative data

• Read data closely, looking for interesting stuff (‘open coding’)
• Collect fragments, writing ‘memos’ to capture your own insights
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Open Coding

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Memo: Nice community spirit
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Memo: Time for an educator's forum?
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Axial coding

Review the codes and memos, organising them according to themes that cut across the individual documents.

Community support ideas:
- Alumni
- Educators

Memo: Nice community spirit

Sometimes people don’t want help

Memo: Institutional Permissions

Parent assigning permissions to son

“Shard” as a feature name?

Bug: Firefox load
Reliability through constant comparison

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An example of applied mixed-methods (not examinable)

[Not in lecture notes online as it includes unpublished research]
How could bring user centered design to humanitarian interventions?

Need answers to questions such as:

- What are the barriers to your children going to school?
- What are the needs of Somali citizens who were recently displaced?

Classical surveys assume you know the list of possible answers, have power asymmetry problems etc.
Alternative socio-technical method:

- Ask an open question on a radio show
- People respond in local languages
- Using a custom tool (built with students from the CL)
  - Develop a coding scheme
  - Augmented labelling of dataset
  - Provenance tracing data structures to track how decisions were made
An example question

“What are two priorities that would improve your community’s welfare in the next three years?”

=> 7350 messages, of which 6709 were unique

(Followed by demographics questions)
### Messages

<table>
<thead>
<tr>
<th>Seq</th>
<th>Message</th>
<th>Gender</th>
<th>Scheme</th>
<th>WS - Correct Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>ping</td>
<td></td>
<td></td>
<td></td>
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<td>8</td>
<td>dumar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>dhadig</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Mayo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>18 sano</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Efficient interface for selecting labels**
- **Automatically suggest labels**
- ✓ Indicates human confirmed
## Confident Labelling

<table>
<thead>
<tr>
<th>Seq</th>
<th>Message</th>
<th>Gender</th>
<th>WS - Correct Data</th>
<th>Label Predictor</th>
</tr>
</thead>
<tbody>
<tr>
<td>537</td>
<td>DHDDIG</td>
<td>female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>538</td>
<td>DHADig</td>
<td>female</td>
<td></td>
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<td>539</td>
<td>coled</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>540</td>
<td>46sano</td>
<td>male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>541</td>
<td>RAJUL</td>
<td>male</td>
<td>Pipeline Auto-Coder</td>
<td></td>
</tr>
<tr>
<td>542</td>
<td>Rek</td>
<td>male</td>
<td>Pipeline Auto-Coder</td>
<td></td>
</tr>
<tr>
<td>543</td>
<td>Dheddigg</td>
<td>female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>544</td>
<td>L</td>
<td>female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>545</td>
<td>Waan majiina 1$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>546</td>
<td>WAA 23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>547</td>
<td>Holakoe su alahan Layga waydinooya yaana waydinooya</td>
<td>NC (not coded)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>548</td>
<td>waxan ahvy oday 60 jir ah</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>549</td>
<td>DA.deeyu wax 25sano jir</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>550</td>
<td>Saneeda 20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Low confidence => high salience**
- **Insufficient confidence to give any label**
- **Confident labelling**
HIGHLIGHTS

- Citizens identify improvements in the quality and inclusivity of social services, particularly health and education, as key priorities.
- Strong emphasis also placed on improving capacity, accountability and transparency of government institutions.

"Thank you first of all. I think that we need to have health centres that caters to the whole community. The Ministry of Health needs to organize and bring together all the doctors in the country so that they can be trained on how to help the community. Also private agencies in the country need to work on supporting people who are less fortunate."

"In my opinion, first of all we need to have a good government that respects its’ people and secondly we need to have free and fair elections of one person one vote” Female, 19 years, Dayniile.
Comparison of citizens' preferred decision making and problem solving mechanisms

**Decision making**
- 1. National government
- 2. Traditional leaders
- 3. The community
- 4. Experts and scholars
- 5. Local authority
- 6. Religious leaders
- 7. Everyone
- 8. The parents

**Problem solving**
- 1. Family and friends
- 2. The community
- 3. Experts and scholars
- 4. National government
- 5. God
- 6. Local government
- 7. Service delivers
- 8. Traditional leaders

**Distribution of themes**
- National government
- Traditional leaders
- The community
- Experts and scholars
- Local authority
- Religious leaders
- Everyone
- The parents
- Family and friends
- The community
- Experts and scholars
- National government
- God
- Local government
- Service delivers
- Traditional leaders
How to evaluate your Part II project
When HCI methods will be relevant

• Systems that a user will interact with
  • e.g. games, programming systems, VR
• Systems with perceptual goals
  • e.g. graphics, audio, affective computing
• Systems that you plan to deploy
  • e.g. apps, mobile sensing, software tools
• Systems that analyse social data
• In all these cases, you will be doing research with human participants - guidance is available & permission is necessary
  • https://www.tech.cam.ac.uk/Ethics_guidance
Thinking about evaluation (even if not HCI)

• Approach ‘testing’ as a scientific exercise, with intellectual outcomes
  – Define goals and hypotheses
  – Understand boundaries and performance limits by exploring them - failure is necessary!
• Should your evaluation be analytic (reasoning/argument) …
  – How consistent / well-structured is your analytic framework?
• … or empirical (measurement/observation)?
  – What are you measuring & why? Are the measurements compatible with your claims (validity)?
• Should your evaluation be formative or summative in nature?
  – If formative – couldn’t you finish your project?
  – If summative – are the criteria internal (from some theory) or external (from some problem)?
• Is your data quantitative or qualitative?
  – Descriptive aspects of the system, or engineering performance data?
  – If qualitative, how will you establish objectivity (i.e. that this is not simply your own opinion)?
Summary of analytic options (analysing your design)

• Cognitive Walkthrough
  – Normally used in formative contexts – if you do have a working system, then why aren’t you observing a real user (far more informative than simulating/imagining one)?
  – But Cognitive Walkthrough can be a valuable time-saving precaution before user studies start, to fix blatant usability bugs

• GOMS
  – unlikely you’ll have alternative detailed UI designs in advance
  – If you have a working system, a controlled observation is superior

• Cognitive Dimensions (lecture 8)
  – better suited to less structured tasks than CW & GOMS, which rely on predefined user goal & task structure
Summary of empirical options (collecting data)

• Interviews/ethnography
  – could be useful in formative/preparation phase

• Think-aloud / Wizard of Oz
  – valuable for both paper prototypes and working systems
  – can uncover usability bugs if analysed rigorously using qualitative methods
    • It would be wise to make this clear in your dissertation, to avoid reasonable suspicion of bad techniques

• Controlled experiments
  – numbers sometimes appear more ‘scientific’, but only:
    • If you can measure the important attributes in a meaningful way
    • If you test significance and report confidence interval of observed means

• Questionnaires
  – be clear what you are measuring – is self-report accurate?

• Field Testing
  – controlled release (and data collection?) may be possible

• See human participants guidance for empirical methods
Surveys and questionnaires

• Standardised *psychometric instruments* can be used
  – To evaluate mental states such as fatigue, stress, confusion - e.g. NASA TLX
  – To assess individual differences (IQ, introversion …) - e.g. five-factor personality

• Alternatively, questionnaires can be used to collect *subjective or self-report* evaluation from users
  – as in market research / opinion polls
  – ‘I like this system’ (and my friend who made it)
  – ‘I found it intuitive’ (and I like my friend)

• This kind of data can be of limited value
  – Can be biased, and self-report is often inaccurate anyway
  – It’s hard to design questionnaires to avoid these problems
Questionnaire design

• *Open* questions …
  – Capture richer qualitative information
  – But require a coding frame to structure & compare data (if hypotheses)
  – Or grounded theory methods (if you have broader questions)

• *Closed* questions …
  – Yes/No or *Likert* scale (opinion from 1 to 5)
  – Quantitative data is easier to compare, but limited insight

• Collecting survey data via interviews gives more insight but questionnaires are faster
  – Can collect data from a larger sample
  – Remember to test questionnaires with a pilot study, as it’s easier to get them wrong than with interviews
Product field testing

• Brings advantages of task analysis/ethnography to assessment and testing phases of product cycle.

• Case study: Intuit Inc.’s Quicken product
  – originally based on interviews and observation
  – follow-me-home programme after product release:
    • random selection of shrink-wrap buyers;
    • observation while reading manuals, installing, using.
  – Quicken success was attributed to the programme:
    • survived predatory competition from Microsoft Money
    • later valued at $15 billion.
Bad evaluation techniques - don’t use these!

• Purely affective reports: 20 subjects answered the question “Do you like this nice new user interface more than that ugly old one?”
  – Might apparently be empirical or quantitative (do you like it on a scale of 1 to 10)
  – But probably biased – if these are your friends, or trying to please (experimental demand)
• No testing at all: “It was deemed that more colours should be used in order to increase usability.”
  – Apparently formative/analytic
  – But subjective – the author is the subject, even though passive voice tries (dishonestly) to hide this
• Introspective reports made by a single subject (often the programmer, project manager or your project supervisor): “I find it far more intuitive to do it this way, and the users will too.”
  – Might be apparently analytic or qualitative, for example drawing on folk wisdom
  – But is often both biased and subjective
  – Unfortunately common in industry - the HiPPO evaluation method (Highest-Paid Person’s Opinion)
Research problem:
“How do you know if your evaluation is inline with user goals?”
The programming analogy challenge 2023: PowerPoint “View: Slide Master”
Click to edit Master title style

- Click to edit Master text styles
  - Second level
    - Third level
      - Fourth level
        - Fifth level
Prototype-based (vs instance-oriented) specification mode

Click to edit Master text style

- Second level
  - Third level
    - Fourth level
    - Fifth level
No Further HCI lecture on Thursday

- Theory driven approaches to HCI
- Design of visual displays
- Goal-oriented interaction
- Designing efficient systems
- Designing smart systems (guest lecturer)
- Designing meaningful systems (guest lecturer)
- Evaluating interactive system designs
- Designing complex systems

Postponed for strike action
Now Monday 20th Feb at 3pm