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 smart systems (guest lecturer)
• Designing efficient systems
• Designing meaningful systems (guest lecturer)
• **Evaluating interactive system designs**
• Designing complex systems
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)  |  Empirical (Observed)

Qualitative (words)  |  Quantitative (numbers)  |  Analytics/Metrics
<table>
<thead>
<tr>
<th>Qualitative (words)</th>
<th>Quantitative (numbers)</th>
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<tbody>
<tr>
<td>Cognitive Walkthrough</td>
<td>KLM/GOMS</td>
<td>Cognitive Dimensions (Lecture 8)</td>
<td>Interviews (From Part 1A) Think Aloud</td>
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<td>Analytics/ Metrics</td>
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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
Hi, I am trying to export a svg file for laser cutting, but it is blank, I have followed the advice given by Christian P on 11 April 2017 to a similar query, please your assistance is appreciated. Here is the link.
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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Can Tinkercad be used to design simple 2D architecture style drafting for a remodel of my home?
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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• Constantly compare memos, themes and findings to original data
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Memo: First time I've heard this term. Might be useful for future product documentation or features?
Open Coding

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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
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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](https://www.tech.cam.ac.uk/Ethics_guidance)
Thinking about evaluation (even if not HCl)

- 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
  - To assess individual differences (IQ, introversion …)

- 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 – since the author is the subject

• 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)