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
- Designing meaningful systems (guest lecturer)
- Evaluating interactive system designs
- Designing complex systems

Rescheduled to Tue 13 Feb
Reminder: Controlled experiments from Lecture 4

![Graph showing time taken to send tweet (faster) vs. number of observations (trials) for new and old methods. The new method is faster.](image-url)
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?”
Cognitive Walkthrough

Analytical (Theoretical)

Quantitative (numbers)
KLM/GOMS

Empirical (Observed)

Interviews (From Part 1A)
Think Aloud

Cognitive Dimensions (next Lecture)

Analytics/ Metrics / A/B tests

Controlled experiments / RCTs (Randomised Controlled Trial)
(Lecture 4)
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
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Can tinkercad be used to design simple 2D architecture style drafting for a remodel of my home? Hi. I have used the group option a lot to give shape to many of the objects of my design. I've noticed all these changes are stored, so every time I load the design or edit an object, it becomes slower and slower. Isn't there any way to make the program forget about all the objects used for cutting or adding shapes and forget the result as a definitive object?

I used tinkercad quite some time ago for a school project and some other stuff and haven't logged in since. I think it must be about 2 years (or more) since I last logged in. I had some projects that I worked on but now they're all gone? Does anyone know why this could be and how to get them back (if possible)? Thanks in advance.
Whenever we try to print our design on a 3D printer it keeps messing up at the corners when it overlaps and then the nozzle pulls it from the bed. We have square corners not round corners. Its frustrating and we don't know if its the corners or the bed or something to do with the slicer.

Hi, I'm trying to create a lock for my tripod camera, I started the design but I'm not sure if it will work, 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 thanks
I'm trying to make a cookie cutter, I succeeded in converting the outline to an svg file and then importing into Tinkercad, but I can't seem to figure out how to increase the width of the actual outline. I was able to adjust the height of the cookie cutter, length and width...but not the thickness of it. It doesn't even tell me what the thickness is currently if I had to guess it's probably defaulted at 1mm...and this is fine for the part of the cutter that actually cuts into the cookie dough. But 1 mm is flimsy and would be difficult to keep its shape (the shape of a cutter). I've been unable to pan around the screen. I could zoom to the center and click on my mouse button to pan to another area, but not actually move the view from the center. There were instructions for how to do it with a mouse but not for a trackpad. It turns out to be
on the trackpad you have to press and hold the shift key and then click and hold with two fingers and then scroll around. The instructions say to do that using the right mouse button. I've commonly used the two finger click but never two finger click, hold, scroll. I probably should have figured it out sooner. If anyone else is having the same problem, maybe this will help.
I've been gone from Tinkercad for a very long time. I was hoping to find all of my old designs. Are they gone or am I not looking in the right place?

I was able to log in yesterday. Today, I can login and see my projects but when I click TINKER NOW (or whatever it says) I get "Oops! 410 - The requested page has expired". When I try to log in again, I'm stuck in a loop and can't log in.

Hello all, I'm trying to make a pillar for a project, this pillar in real life gets slimmer from bottom to top (Base is thick and half way up it starts getting slimmer). Is there anyway that I can replicate this in Tinkercad?
We have a student who keeps getting a "Failed connecting. Please try again later" error when trying to log in. Using the same computer and browser, we are able to log in to Tinkercad with a different Google account. So the issue doesn't lock as 27mm. I will appreciate your help thanks
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 was interested in whether it was possible to animate the 3D creation on Thingiverse, and if it is possible if someone could explain to me it
We have a student who keeps getting a "Failed connecting. Please try again later" error when trying to log in. Using the same computer and browser, we are able to log in to Tinkercad with a different Google account. So the issue doesn't appear to be computer, browser, or filtering related. This is affecting this student's ability to continue with the lesson and is falling behind what the rest of the class is able to accomplish. We have tried logging in using this account on several different computers and browsers, all with the same error message. I have tried submitting a ticket to Support (four tickets actually), but now one has yet to respond after about two weeks. Despite having checked the 'stayed logged in' box, I keep getting logged out after a short period of inactivity. Very frustrating!
Hi, I would like to delete a Tinkercad project, but I can't find it there.
With the new beta client I have had nothing but trouble importing stl and obj files. Even though the files fit within the limitations, anything over only a megabyte or two will cause the workspace to lock up an infinite "import" process bar in the bottom corner. When I check task manager it says I am uploading, but after so long, I keep getting a error and the upload will cancel.
I create a shape in PS and it exports as an svg and goes right into Tinkercad. But when I have any kind of bitmap graphic and export it as an svg Tinkercad thinks about it for a minute or so and then just rejects the file. I'm trying to make this as simple as possible for my class, which means introducing Ai is not an option. We already use PS, so that's what I want.
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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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Segmentation (and relevance filtering)

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Coding

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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
- Organise emerging themes using ‘axial coding’
- *Constantly compare* memos, themes and findings to original data
Open Coding

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Memo: First time I've heard this term. Might be useful for future product documentation or features?
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Memo: Nice community spirit
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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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Help from community or self-sufficiency?
An example of applied mixed-methods
How to 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)
### Efficient interface for selecting labels

- **Messages:**
  - ping
  - Nin
  - lab
  - LAB
  - Dheedig
  - dhedig
  - 20
  - Lab
  - dumar
  - dhedig
  - Mayo
  - 18 sano

- **Automatically suggest labels**

- **✓ Indicates human confirmed**

- **Continuous sorting**
- **Jump to next uncoded**
- **Auto Code**

<table>
<thead>
<tr>
<th>Seq</th>
<th>Message</th>
<th>Gender</th>
<th>Scheme ID</th>
<th>WS - Correct Data</th>
</tr>
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<td>✓ NG (not coded)</td>
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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.

"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.

“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”
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 deliverers
8. Traditional leaders

Distribution of themes

- National government
- Traditional leaders
- The community
- Experts and scholars
- Local authority
- Religious leaders
- Everyone
- The parents
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

- **Keystroke-Level Model**
  - 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?
  - If doing qualitative analysis, ensure the process is rigorous and documented
- Field Testing
  - controlled release (and data collection?) *may* be possible, if you move very fast!
- 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, but this is relatively weak
  – resemble market research / opinion polls
  – ‘I like this system’ (i.e. I like my friend who made it?)
  – ‘I found it intuitive’ (i.e. and I like my friend?)

• This kind of data can be of limited value, even if scales are quantitative
  – 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 although 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 of commercial objectives is aligned with what users want or need?”
The programming analogy challenge 2024:

Note taking apps