

Research – Definition #1

- Research is...
Careful or diligent search
- Examples
 - Searching one's garden for weeds
 - Searching a computer to find all files modified on a certain date

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Chapter 4: Scientific Foundation

Next week should have a research question and a hypothesis, and show the TA on Wednesday

Research – Definition #2

- Research is...
Collecting information about a particular subject
- Examples
 - Survey voters to collect information on political opinions in advance of an election
 - Observe people using computers and collect information, such as the number of times they
 - Consulted the manual
 - Clicked the wrong button
 - Retried an operation
 - Uttered an expletive

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If you want to publish the paper, you have to get Ethics Board approval: <http://www.research.utoronto.ca/about/boards-and-committees/research-ethics-boards-reb/>

Could use this course as a "trial run"/pilot study and then redo the data when you get EB approval

Example risks for participants in HCI: eye strain, wrist strain

For testing, normally use about 15 people per condition

How to collect information? Read the Interaction Design online book for Chapter 7 – Data Gathering

Research – Definition #3

- Research is...
Investigation or experimentation aimed at the discovery and interpretation of facts, the revision of accepted theories or laws in light of new facts.
- Example
 - Design and conduct a user study to test whether a new interaction technique improves on an existing interaction technique (that's what this course is all about)

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At the end of the paper, there should be a conclusion saying whether the hypothesis was met or not met. You do this through collecting data and then running it through the stats model, and figuring out whether you have statistical significance. If the data is not statistically significant, then what you have predicted in your hypothesis is not true.

Does our hypothesis need to be right? No
Collect the data properly and let the statistics show what the truth is
You will not lose marks if you don't get SS results.

Experimentation

- A central activity in HCI research
- An experiment is sometimes called a user study, **not a usability test**
- Formal, standardized methodology preferred
 - Brings consistency to a body of work
 - Facilitates reviews and comparisons between different user studies

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Measure: time, number of errors, number of mouse clicks etc

You can use questionnaires and interviews – like a debriefing interview at the end. It's just not the core of the data

Research Must Be Published

- Publication is the final step
- Also an essential step
- Publish or perish!
 - Edict for researchers in all fields, and particularly in academia
- Until it is published, research cannot achieve its critical goal:
 - Extend, refine, or revise the existing body of knowledge in the field

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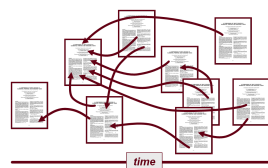
Peer Review

- Research submitted for publication is reviewed by peers – other researchers doing similar research
- Only research meeting a high standard of scrutiny is accepted for publication
 - Are the results novel and useful?
 - Does the evidence support the conclusions?
 - Does the methodology meet the expected standards for the field?
- Accepted research is published and archived
- The final step is complete

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Citations, References, Impact

- Citations, like hyperlinks, connect research to other research
- Through citations, a body of research takes shape
- The number of citations to a research paper is an indication of the paper's impact
- Can you spot the high-impact paper below? (arrows are citations)



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Research Must Be Reproducible

- A high standard of reproducibility is essential
- The research write-up must be sufficiently detailed to allow a skilled researcher to replicate the research if he/she desired
- The easiest way to ensure reproducibility is to follow a standardized methodology

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Research vs. Engineering vs. Design

- Researchers often work closely with engineers and designers, but the skills each brings are different
- Engineers and designers are in the business of building things, bringing together the best in form (design emphasis) and function (engineering emphasis)

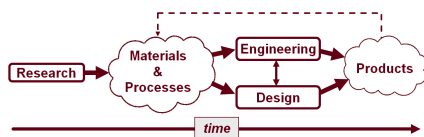
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Research Milieu

- Engineering and design are about products
- Research is not about products
- Research is narrowly focused
- Research questions are small in scope
- Research is incremental
- Research ideas build on previous research ideas
- Good ideas are refined, advanced (into new ideas)
- Bad ideas are discarded, modified
- Products come later, much later

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Schematic



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“Empirical” Research

- Empirical:
 - Originating in or based on observation or experience
 - Relying on experience or observation alone without due regard for system or theory (i.e., don’t be blinded by pre-conceptions)
- Example: Nicolas Copernicus (1473-1543)
 - Prevailing system or theory: celestial bodies revolved around the earth
 - Copernicus made astronomical observations that cut against this view
 - Result: heliocentric cosmology (the earth and planets revolve around the sun)

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“Empirical” Research

- Empirical: (by another definition)
 - Capable of being verified or disproved by observation or experiment
- HCI research
 - Framed by hypotheses
 - Methodology to test hypotheses
 - Experiments are the vehicle
 - Hypotheses must be sufficiently narrow and clear to allow for verification or disproval (see Research Questions)

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Observational Method

- Example methods:
 - Interviews, field investigations, contextual inquiries, case studies, field studies, focus groups, think aloud protocols, story telling, walkthroughs, cultural probes, etc.
- Focus on qualitative assessments (cf. quantitative)
- Relevance vs. precision
 - High in relevance (behaviours studied in a natural setting)
 - Low in precision (lacks control available in a laboratory)
- Goal: discover and explain reasons underlying human behaviour

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Experimental Method

- Aka scientific method
- Controlled experiments conducted in lab setting
- Relevance vs. precision
 - Low in relevance (artificial environment)
 - High in precision (extraneous behaviours easy to control)
- At least two variables:
 - Manipulated variable (aka independent variable)
 - Response variable (aka dependent variable)
- Cause-and-effect conclusions possible (changes in the manipulated variable caused changes in the response variable)

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Mouse, keyboard and joystick are all one independent variable with three levels.

If you add Windows 10 and Mac OSX is another independent variable with two levels.

Then you have 6 groups: keyboard+OSX, keyboard+Windows, mouse+OSX, etc.

Don't do this

One independent variable is good enough: two or three levels is fine

Dependent variable — measure more things

Correlational Method

- Look for relationships between variables
- Observations made, data collected
 - Example: are user's privacy settings while social networking related to their age, gender, level of education, employment status, income, etc.
- Non-experimental
 - Interviews, on-line surveys, questionnaires, etc.
- Balance between relevance and precision (some quantification, observations not in lab)
- Cause-and-effect conclusions not possible

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Observe and Measure

- Foundation of empirical research
- Observation is the starting point; observations are made...
 - By the apparatus
 - By a human observer
- Manual observation
 - Log sheet, notebooks
 - Screen capture, photographs, videos, etc.
- Measurement
 - With measurement, anecdotes turn to empirical evidence

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Research Questions

- Consider the following questions:
 - Is it better than current practice?
 - Which design alternative is best?
 - What are the performance limits?
 - What are the weaknesses?
 - Does it work well for novices?
 - How much practice is required?

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Research Questions

- Very weak
 - Is the new technique any good?
- Weak
 - Is the new technique better than Qwerty Soft Keyboard
- Better
 - Is the new technique faster than QSK?
- Better still
 - Is the measured entry speed (in words per minute) higher for the new technique than for QSK after one hour of use?

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You have to think of your variables before you can ask your research question

For the last one, measured entry speed is your dependent variable
Independent variable is technique for entry with two levels: new and QSK

For next Wednesday, we should decide our independent and dependent variables

Then we can put our question together because we know what we are measuring

Question includes keyword: higher, lower, worse, increase, decrease
Normally you're making a prediction that one of the things you are testing is producing a better result overall

Make sure to show the TA the research question to verify that the question is formulated properly

Internal Validity

- Definition:
 - The extent to which the effects observed are due to the test conditions (e.g., multitap vs. new)
- Statistically, this means...
 - Differences (in the means) are due to inherent properties of the test conditions
 - Variances are due to participant differences ("pre-dispositions")
 - Other potential sources of variance are controlled or exist equally or randomly across the test conditions

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