Last Tuesday in Current Topics…

• Contrast between empirical science and ethnography approach
• Triangulation
• Three key attributes of good research using engineering & design approach
• How to treat “other variables”
• Internal validity vs. external validity
The 1Line Keyboard: A QWERTY Layout in a Single Line

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Figure 1: The 1Line Keyboard. It consists of only eight character keys, flick gestures, and a novel approach for integration.
HCI Research Literacy III
Results and Dissemination with Examples from Midair Input
Applications of Midair Input
A Handlebar Metaphor
Available at: http://dl.acm.org/citation.cfm?id=2208585

3D spatial interactions

Song et al., CHI ’12
Going beyond the surface
Available at: http://dl.acm.org/citation.cfm?id=2208583
Understanding Naturalness and Intuitiveness in Gesture Production

Available at: http://dl.acm.org/citation.cfm?id=1979061
Benefits and Drawbacks of Midair Input

+ High degree-of-freedom
+ Move beyond desk/mobile
+ Natural way for gestural communication
  - Noisy input and accidental activation
  - Exertion: The Gorilla Arm problem
  - Privacy and social acceptance
Midair Pointing

(Vogel & Balakrishnan, UIST '05)

(Banerjee et al., ITS '11)

(Winkler et al., ITS '12)
Characterizing Design Space of Midair Pointing

- **Interaction Dimensions**
  - Reference Frame
    - Absolute Location
    - Relative to Object
    - Relative to Body
    - Relative to Device
    - Position (X, Y, Z)
    - Rotation
    - Roll
  - Input Scale
  - Input Degrees of Freedom
    - Visual
    - Aural
    - Haptic
  - Feedback Modality
  - Feedback Content

(Cockburn et al, International Journal of Human-Computer Studies ’11)
User Study: Effect of DoF and Visual Feedback

• Degrees of freedom
  • Ray casting: pitch and yaw
  • 2D plane: high, left
  • 3D volume: high, left, back

(Cockburn et al, International Journal of Human-Computer Studies ’11)
User Study: Effect of DoF and Visual Feedback

- Gradually reducing feedback
  - Full visual feedback: target location, origin, cursor
  - Hide the cursor
  - Hide the origin location, target, and cursor
  - No visual feedback

(Cockburn et al, International Journal of Human-Computer Studies ’11)
User Study: Effect of DoF and Visual Feedback

• Degrees of freedom
  • Ray casting: pitch and yaw
  • 2D plane: high, left
  • 3D volume: high, left, back

• Gradually reducing feedback
  • Full visual feedback: target location, origin, cursor
  • Without cursor
  • Without origin location and cursor
  • No visual feedback

Speed, accuracy, …

In-class exercise: Sketch two graphs showing the result

(Cockburn et al, International Journal of Human-Computer Studies ’11)
5.1. Selection times (speed)

Fig. 4. Speed and accuracy results for the three interfaces across feedback type (error bars). Speed: selection time. Accuracy: mean distance from target.

5.2. Accuracy

To further characterise accuracy, participants were able to make accurate selections on the 2D plane and 3D volume movements. We use pixel distance measures need to be normalised to allow small distances to do so. All interfaces used visual feedback to train participants, displaying targets inside a 650 pixel boundary. The 650 pixels on either axis correspond to a 3D interface, displaying selection distributions on the (x, y, z) space. Achieving this, we followed by 2D (1116 ms, 501 ms), and 3D substantially slower (1922 ms, 1017 ms).

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Accuracy: distance from target

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(Cockburn et al, International Journal of Human-Computer Studies ’11)
Data: By the Numbers

Number of years to get data: 3
Number of years to interpret data: 2
Number of years to write about data: 1.5
Number of slides to present data: 1

Yes! Finally!

What does it all mean??

Blah blah blah blah...

Results... that's it?

"Piled Higher and Deeper" by Jorge Cham www.phdcomics.com
Reading the Results
Statistics in Experimental Research

- H₀, H₁: hypothesis
- α: wrong hit
- β: wrong miss
- {r, d}: effect size
- IV & Conditions
- Power
- N: Sample size
- DV & Level of measurement

The experiment

- Data
  - {t, F, χ²}: Test statistics
  - Test statistics' assumptions
  - (α): p-value
  - df: Degree of freedom
  - {accept, reject}
  - (β)

Analysis

Report

Previous lecture

This lecture

Test statistics' assumptions

{within, between}

Power

Descriptive statistics, Visualization

Statistics in Experimental Research Report

CTHCI — Jan Borchers

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ANOVA: Analysis of Variance

• Goal: partition the variance from different sources

• Method: fit different models and determine how good the models explain the data
  • Maximal model: one parameter per data point
  • Null model: all data points are represented by
  • Determine just adequate candidate model that fits the data
ANOVA: Analysis of Variance

- Assess goodness of fit
  - Candidate model fits better than null model $\Rightarrow$ The effect is statistically significant
  - Candidate model fits as well as null model $\Rightarrow$ The effect is not statistically significant
- Both mean and variance matter: Examples here are simplified

Statistically significant

E.g., $F_{2,28} = 73.07, p < .001$

Not statistically significant
Main Effect

- Effect that each independent variable has to the dependent variable
  - Shown by mean of each level of a variable

- Main effect of interface and feedback type to selection time
In-class Exercise: Main Effect

- Draw graphs comparing the main effects of interface and feedback to the accuracy and discuss your analysis with your neighbor.
Interaction Effect

• Effect of one independent variable depends on the particular level of another independent variable

• Visualized by non-parallel lines connecting the same level of a variable

• Distance increases in 3D more rapidly than in 2D and Raycasting
In-class Exercise

• Draw graphs comparing the interaction effects interface × feedback to the selection time and discuss your analysis with your neighbor.
Putting Them All Together

- Regardless of feedback, Raycasting and 2D plane are comparable in speed.
- Raycasting is slightly less accurate.
- 3D volume is much slower and less accurate across the board.

![Speed and Accuracy Graphs](chart.png)
“To call in the statistician after the experiment is done may be no more than asking him to perform a post-mortem examination: he may be able to say what the experiment died of.” — Ronald Fisher
Dissemination
**Peer Reviewing Process**

**Authors**
- Submit the paper (19 September)
- Rebuttal (12–19 November)
- Submit camera-ready version (February)
- Present at the conference (April)

**Conference**
- External researchers provide anonymous reviews (by late October)
- Meta reviewer summarizes the reviews, adds own opinion (early November)
- Program committee (PC) meeting (early December)

http://chi2013.acm.org/authors/call-for-participation/papers-notes/
Criteria for a Good Paper

- **Contribution:** What new insight does it bring to the field?
- **Benefits:** What can one learn from this / do with this?
- **Novelty:** Prior publications?
- **Validity:** Are the claims properly backed up?
- **Applicability:** How good does the paper match the likely audience?
- **Format:** Readability and clarity
Structure of a Review

• Overall rating: 1: definite reject – 5: definite accept

• Short summary of the contributions and benefits
  • “This paper presents… (who) will benefit from (what)

• Concerns
  • Originality
  • Validity
  • Clarity

• Suggestions for improvement

• Reviewer’s expertise: 1: no knowledge – 4 expert
**Reviewing Checklist**

- **Recommending accept**
  - Convince yourself that it has **no serious defects**
  - Convince the editor that it is of an acceptable standard, by explaining why it is **original, valid, and clear**
  - List the changes that should be made before it appears in print
    - Where possible: indicating not just **what to change** but **what to change it to**
  - Take reasonable care in checking details, e.g., mathematics, formulas, and bibliography

- **Recommending reject**
  - Clearly explain the faults and, where possible, discuss how they could be rectified
  - Indicate which parts of the work are of **value** and which should be discarded
  - Check the paper to a reasonable level of detail

*From Writing for Computer Science (Zobel, 2004)*
Reviewing Checklist

• Always do the following in either case
  • Provide good references with which the authors should be familiar
  • Ask yourself whether your comments are fair, specific, and polite
  • Be honest about your limitations as a referee of that paper
  • Check your review carefully as you would check one of your own paper prior to submission

From Writing for Computer Science (Zobel, 2004)
Assignment 1: Write a Review

• Reading assignments
  • Pointing at 3D Target Projections with One-Eyed and Stereo Cursors (Teather and Stuerzlinger, CHI ’13)
  • A Comparison of Ray Pointing Techniques for Very Large Displays (Jota et al., GI ’10)
Assignment 1: Write a Review

• In groups of six, write a review for
  • Pointing at 3D Target Projections with One-Eyed and Stereo Cursors
    (Teather and Stuerzlinger, CHI ’13)

• Submission: One page A4 (Helvetica or Arial 12pt)

• Timeline
  • First submission deadline: Friday, May 3rd, 2013 before 12:00 noon
  • Group feedback: Wednesday, May 8th, 2013 in the lab
  • Revise-and-resubmit deadline: Wednesday, May 14th, 2013 before 12:00 noon

• Graded assignment: 5% total score of the course
Coming Up Next…

- April 30th: No lecture

- Enjoy your CHI 2013 with video previews: http://chischedule.org/2013/

- May 7th: No lecture: Student Representative Council Meetings

- May 8th: Lab — Feedback of Assignment 1

- May 14th: Lecture — Human Computation by Leonhard Lichtschlag