

HUMAN-CENTERED
DESIGN



Assigning Participants to Conditions

Scott Klemmer
UC San Diego
The Design Lab

Should every participant use
every alternative?

Which vacuum cleaner is more effective?

Draw vacuum cleaner

What are the measures?

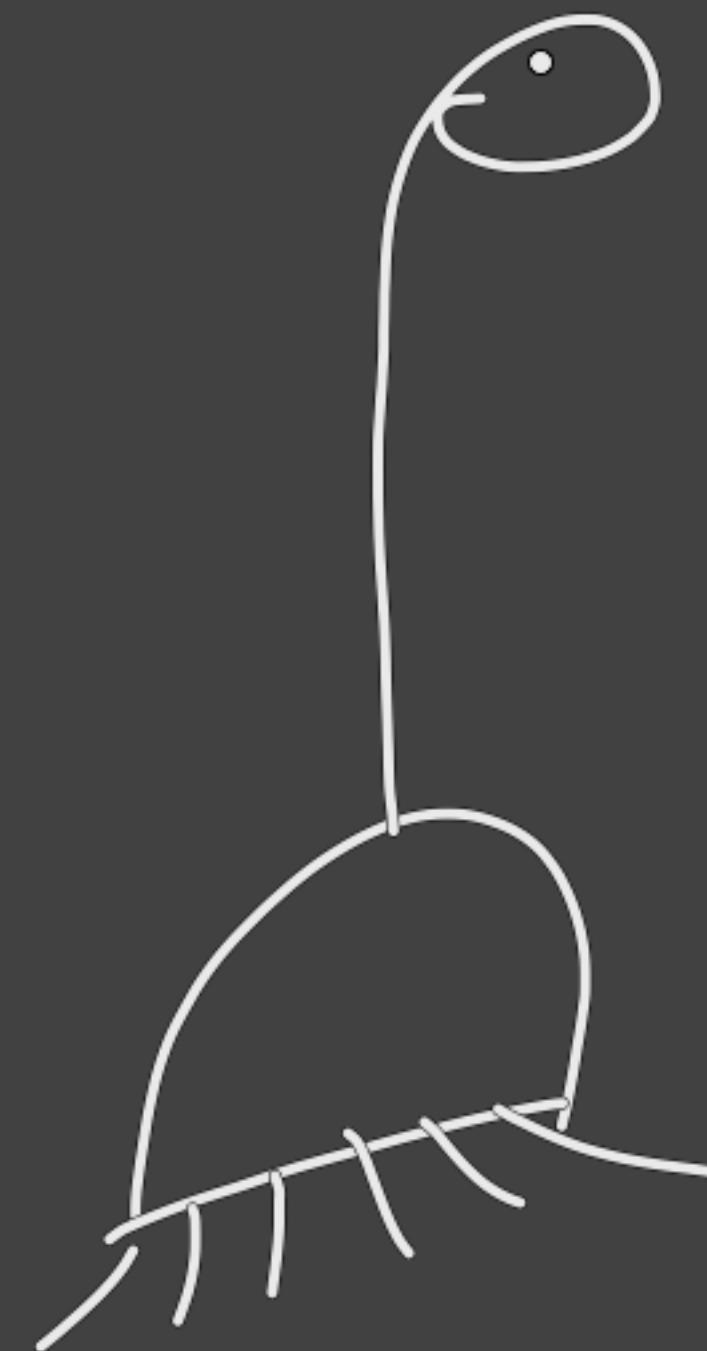
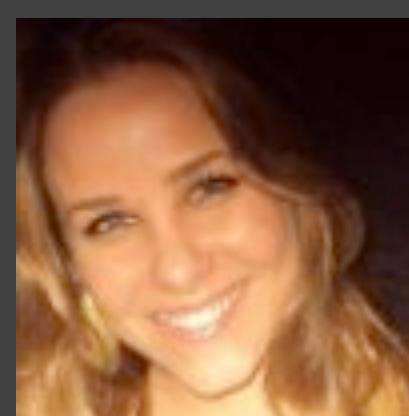
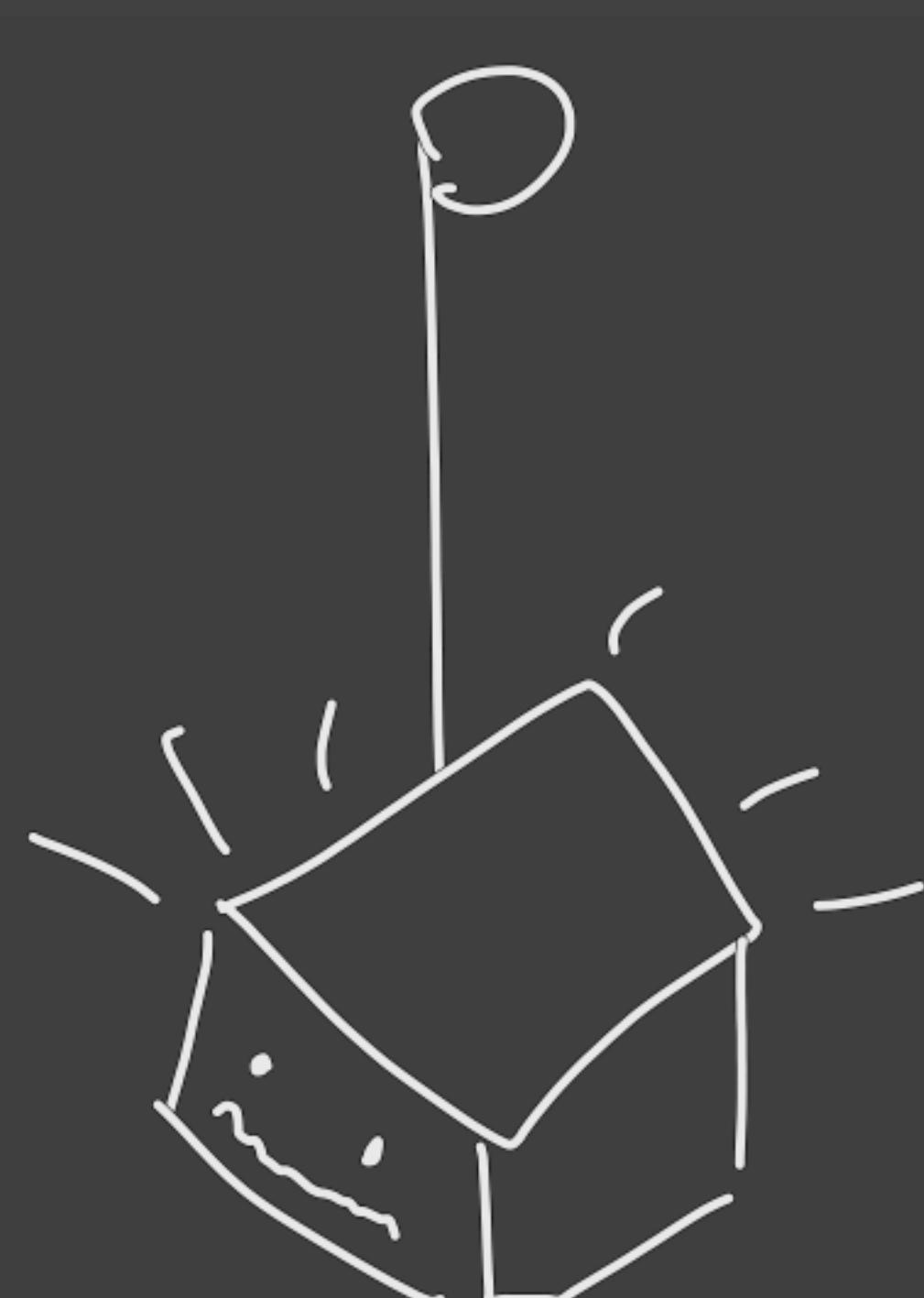
- Faster?
- Cleaner?
- Fatigue?
- Ergonomics?
- Environmental impact?
- Portability?
- Ease of use?
- Fewer errors?

- Manipulation: Vacuum type
- Measure: Speed, cleanliness

Between subjects design

Half the participants use one interface

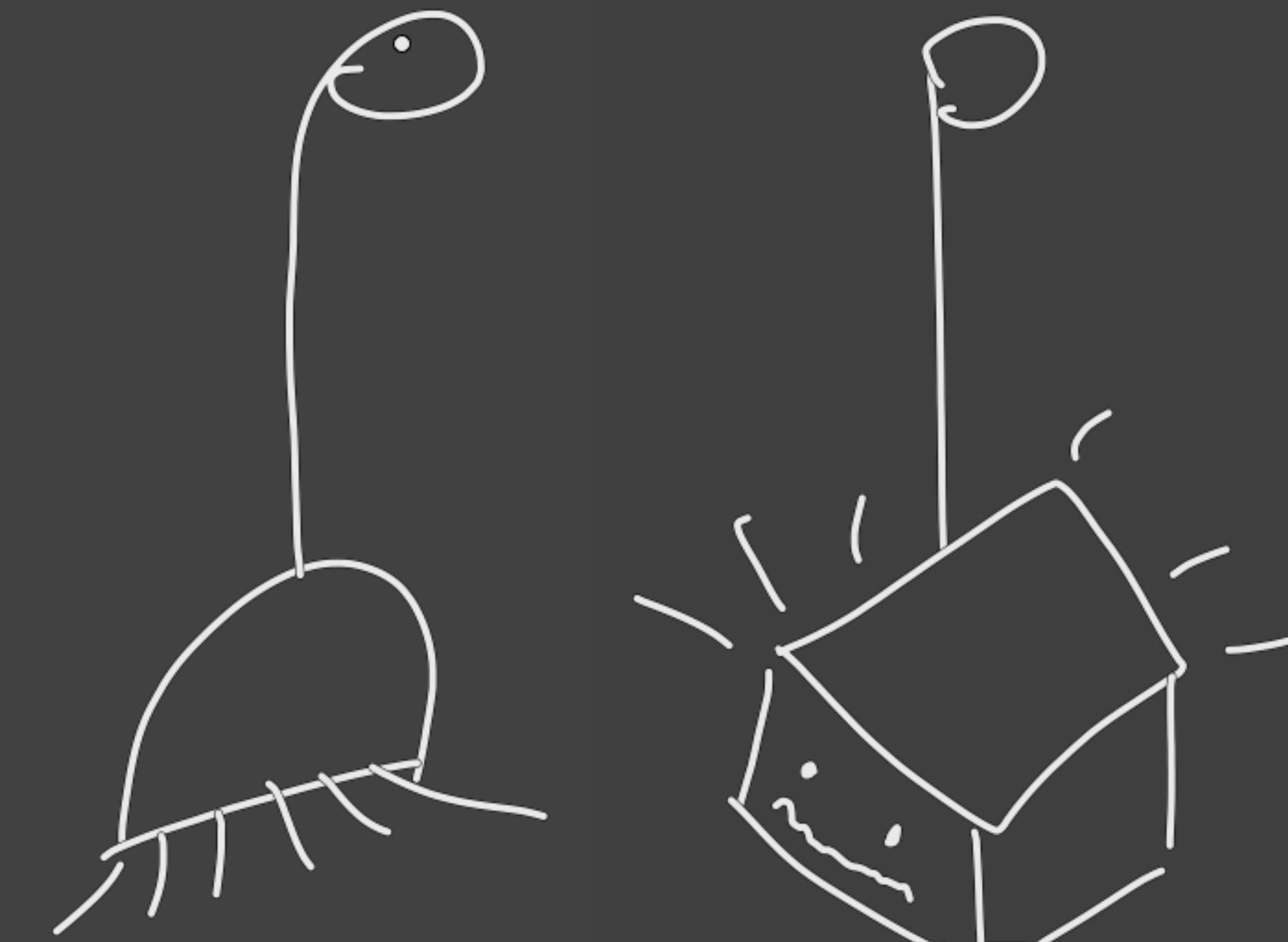
The other half use the other



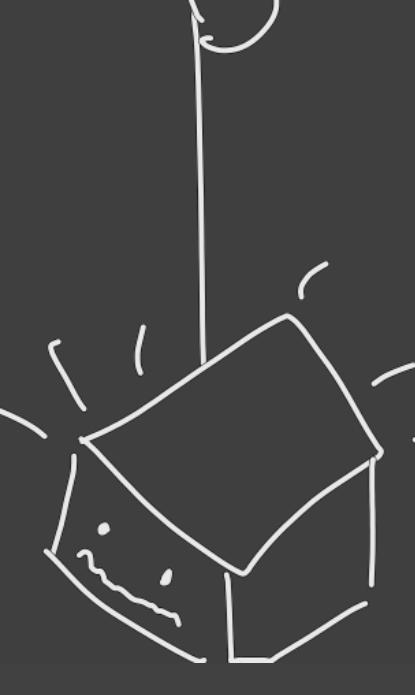
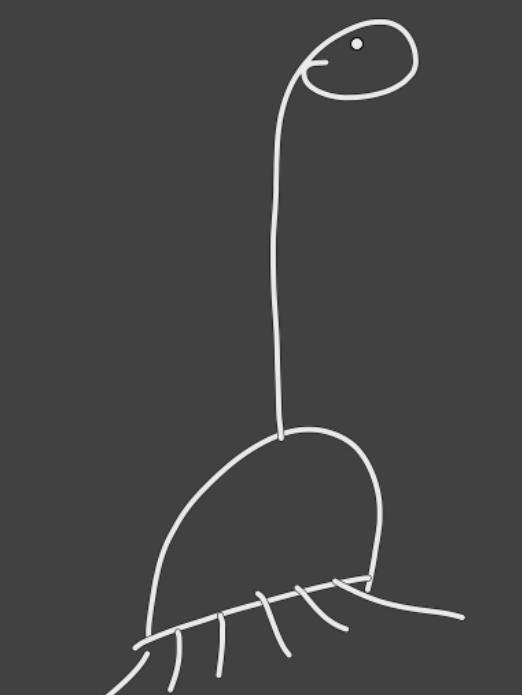
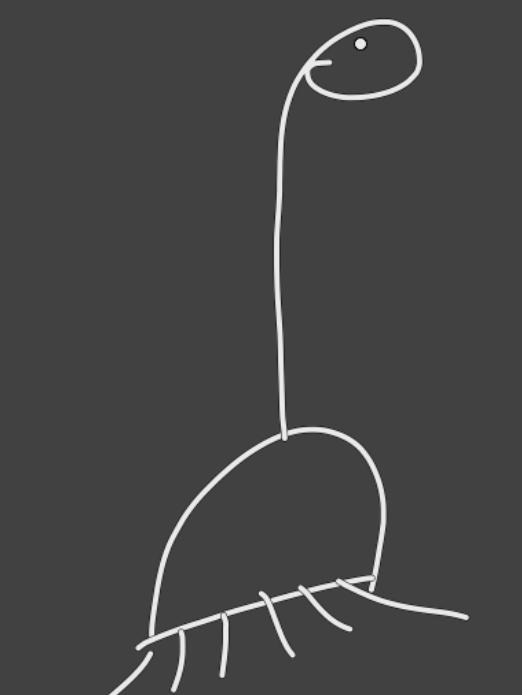
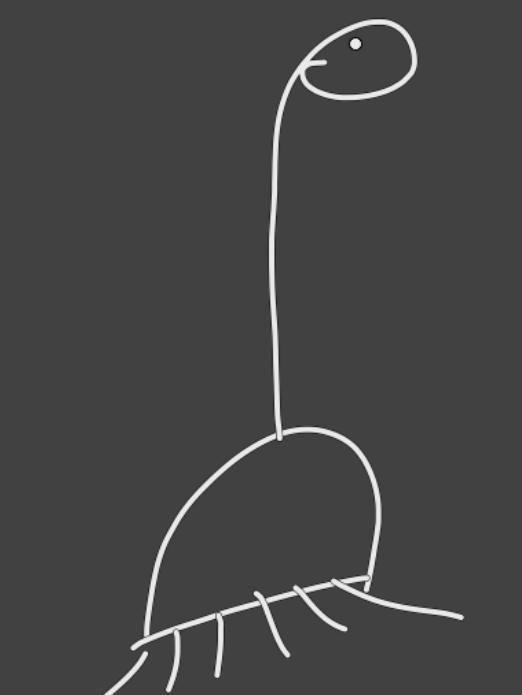
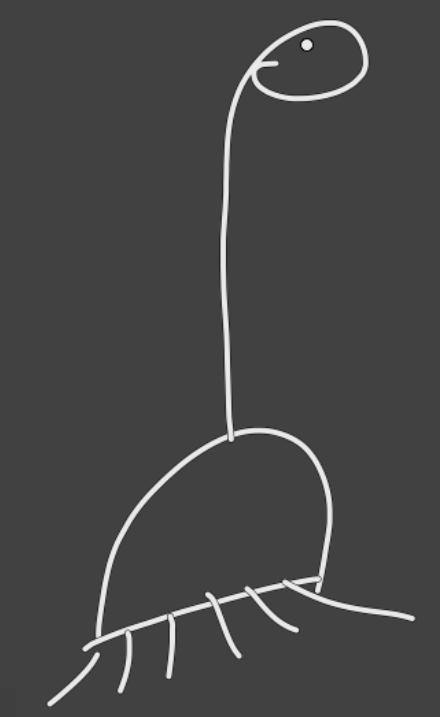
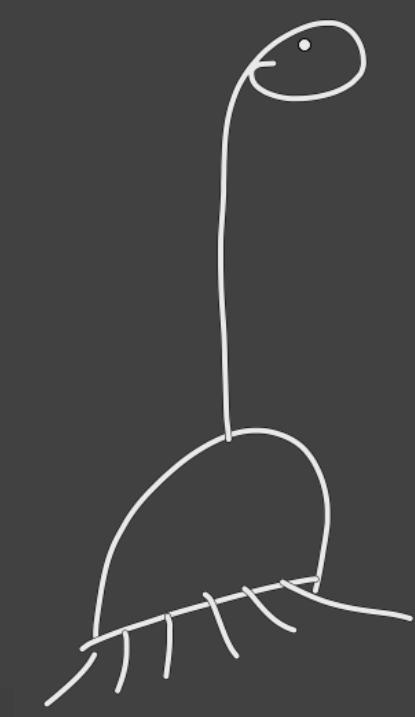
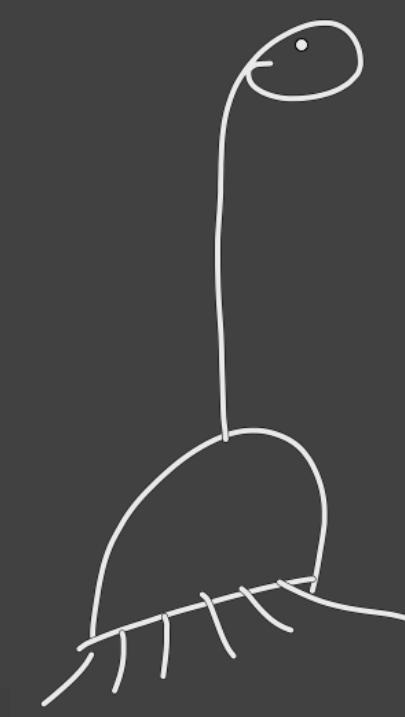
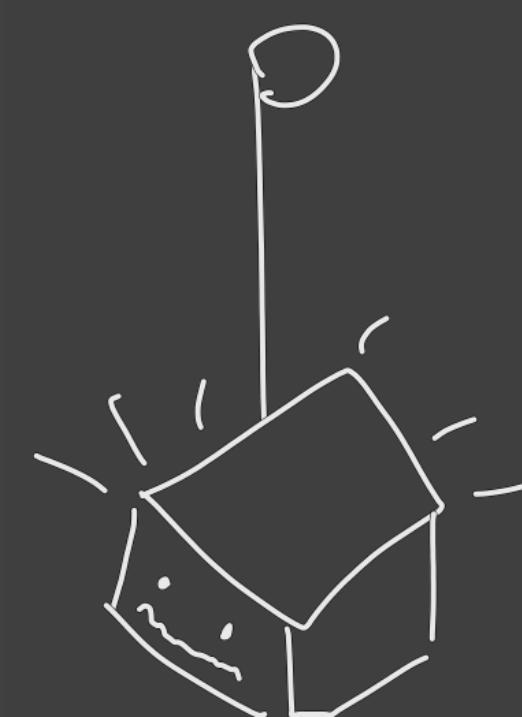
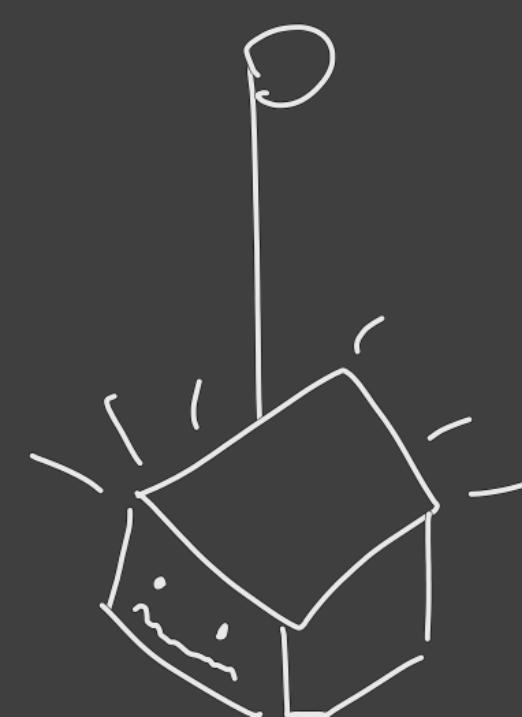
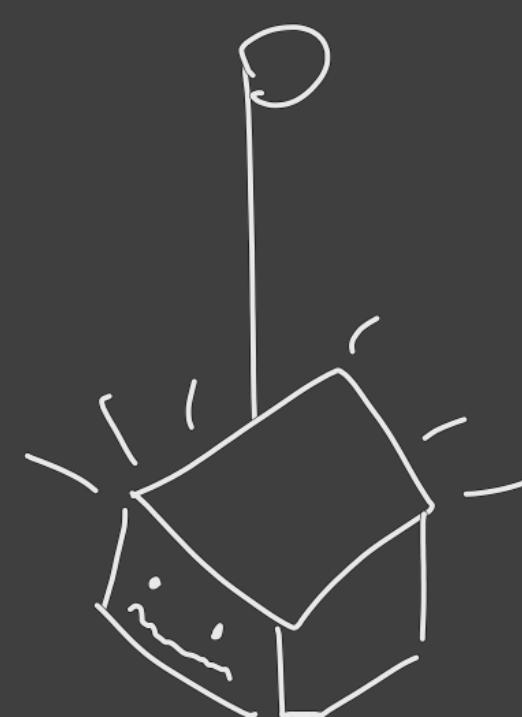
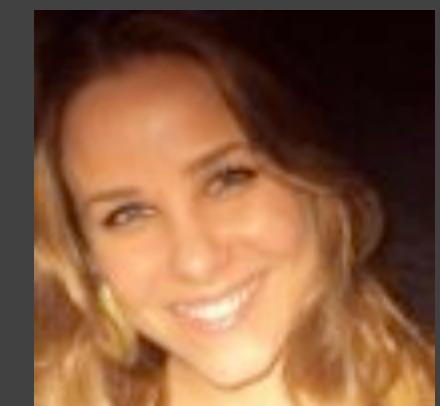
Within subjects design

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Everyone uses both interfaces



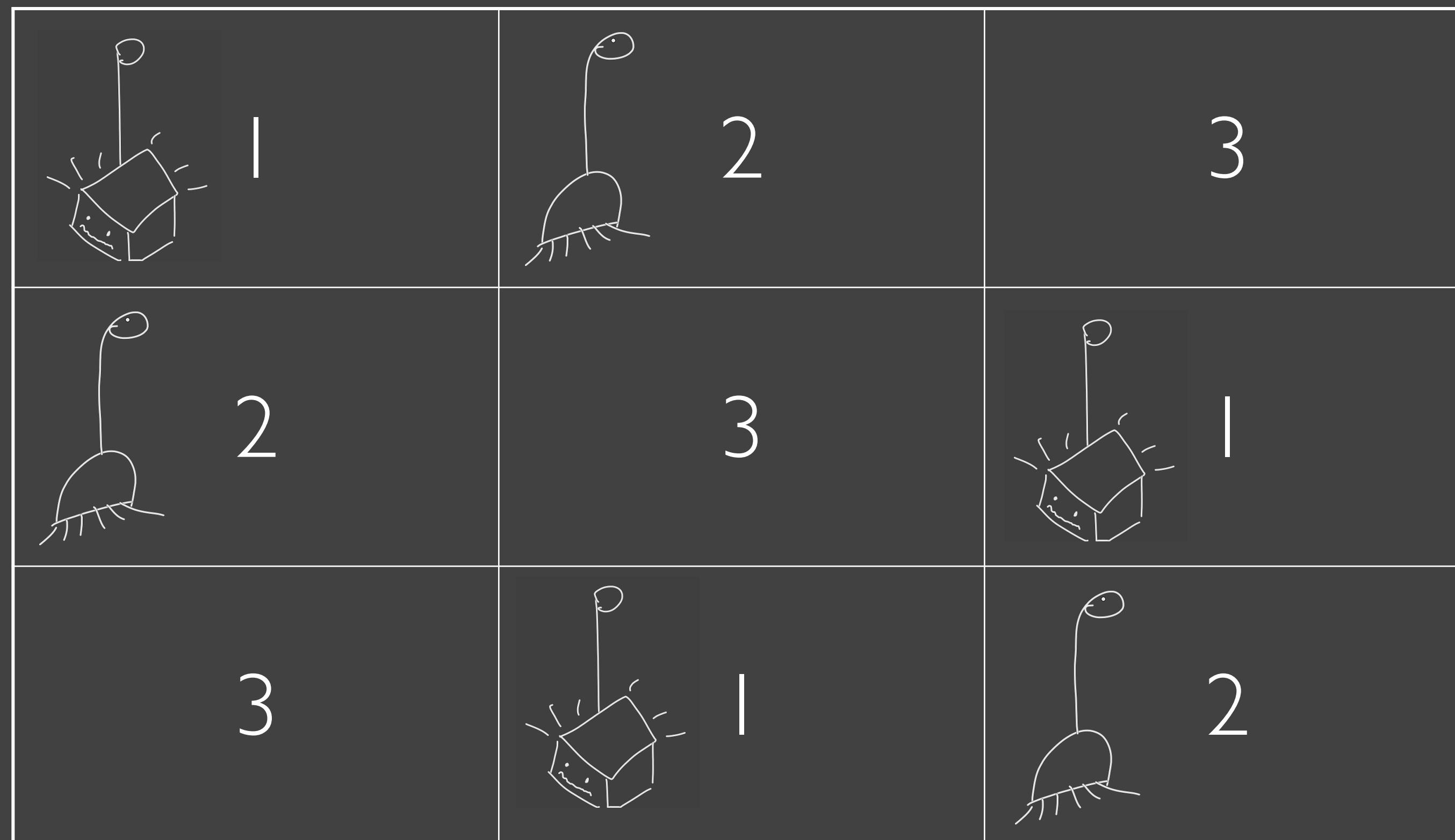
How Can We Address Ordering Effects?



How about individual
differences?

What about for Three or More Alternatives?

Latin Square



The Importance of Random Assignment

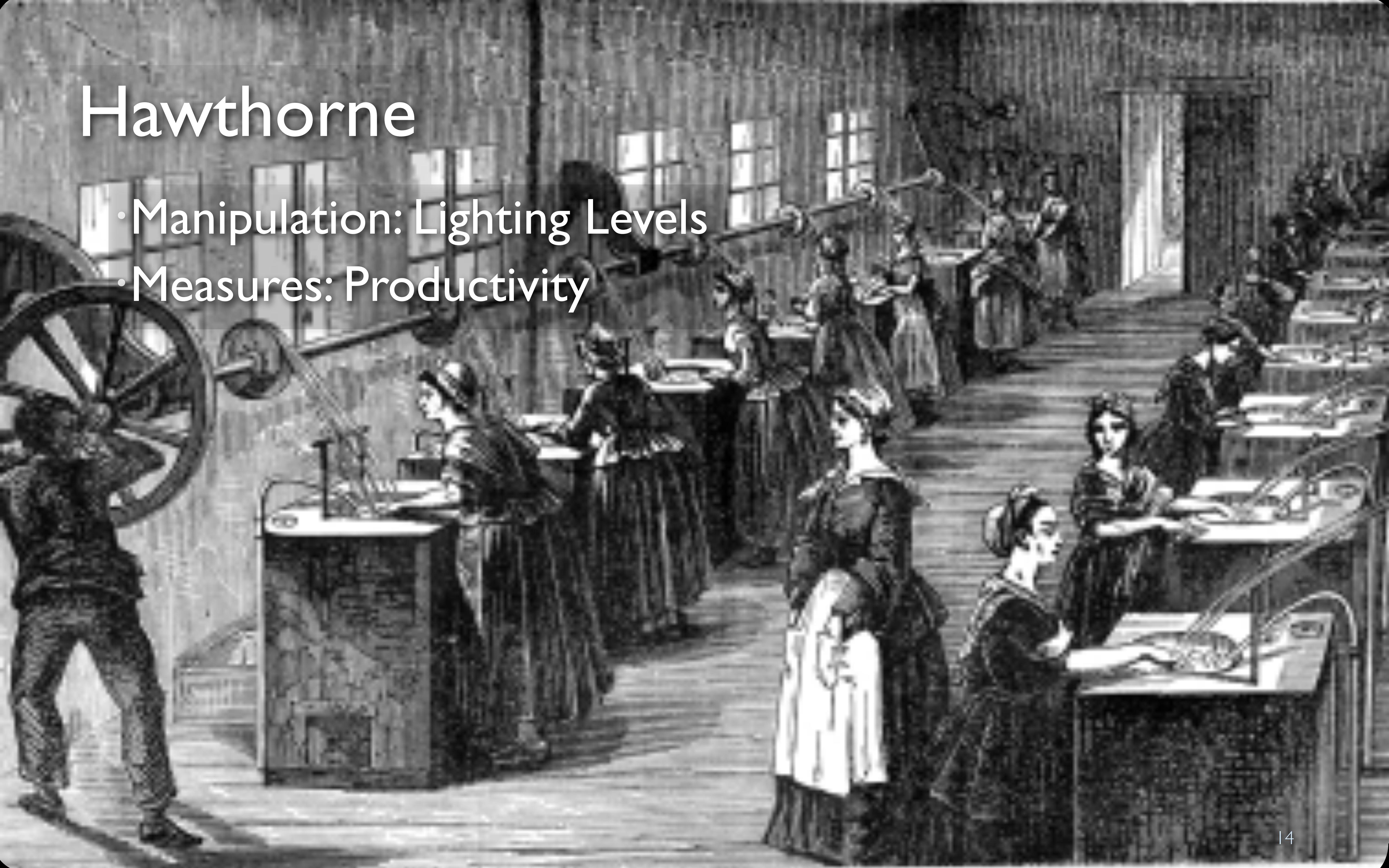
- Typing in the morning versus the afternoon

The Importance of Random Assignment

- Showing alternatives in sequence

Hawthorne

- Manipulation: Lighting Levels
- Measures: Productivity



Counterbalanced Assignment

- Say you worry that typing speed will differentially affect interface usage (if you're e.g., designing a new spreadsheet)
- You can use a pre-test to assign participants so that typing speed is roughly balanced across conditions
- There are many techniques; the key is that each participant has an equal chance of landing in either condition

“Offline” Counterbalancing

- If you can pre-test everyone ahead of time, you can form matched pairs
- The assignment of each pair is the result of a coin toss

TYPING SPEED	ORDERED
37	{ 35
68	{ 37
99	{ 57
59	{ 59
70	{ 61
35	{ 68
57	{ 70
61	{ 99

“Online” Counterbalancing

- If the pre-test happens online (i.e., you can't pre-test everyone before the experiment begins)
- Pick some threshold that's likely to be about the middle

TYPING SPEED

35

40

90

68

...

- I think of pre-test-like counterbalancing as helping the law of large numbers work a little bit faster

A danger: regression

- Let's find heady coins
- First, let's flip all the coins (our pre-test)
- If they land heads more than half, we'll call them heady
- Now let's feed them a snack
- Does snacking increase the natural tendency of coins?

15	10
15	14
15	8
14	8
14	15
13	12
13	12
12	8
12	10
12	12
12	10
12	13
12	8
11	9
11	11
10	8
10	5
10	11
10	15
10	10
9	7
9	9
9	9
8	10
8	7
8	8
7	10
6	12
6	14
5	9

Avoiding the Danger

- If the pre-test is used to counterbalance, and assignment is random, then the error goes away

Should every participant use
every alternative?

Three Major Strategies

- **Within-subjects:** everyone tries all the options. Good when you're not worried about learning/practice/exposure issues (that trying one version will 'pollute' the date from another version)
- **Between-participants:** each person tries one. Requires more people, and more attention to fair assignment. Has the benefit that each participant is uncorrupted (at least by the study...)
- **Counterbalancing** can help minimize variation in a between-subjects design

Further Reading

- Martin, Doing Psychology Experiments