



HCI: STUDY DESIGN

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First, the news...

- <https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/visual-representation>

No Class on Thursday

We have been learning about discount usability because these are easy to do with a small amount of time and budget.

**Today: designing studies and
evaluating the results**

- Step 1: Define what “usable” means**
- Step 2: Identify your variables**
- Step 3: Setup your study**
- Step 4: Evaluate the outcome**

The problem:
**You just built a new widget and now
you need to evaluate it**

Step 1: Define what “usable” means

A system which is undefined can never be wrong, it can only ever be surprising

Define your usability goal

- This step is very similar to specifying tasks for a think-aloud type study
- Identify what you think your users need to be able to do using your system
- The goals need to be specific and easy to identify if they have or have not been completed
- Examples:
 - Find a stool on a shopping page and purchase it
 - Locate the nearest bus stop that the 8 bus stops at
- Bad examples:
 - Have fun using the site
 - Find a bus to go somewhere

Step 2: Identify your variables

What are you going to measure?

- In statistics there are classically two types of measurements (variables): dependent and independent
- Dependent
 - Also known as the outcome variable
 - Measures the usability goal
- Independent
 - Anything you are directly manipulating
 - An element of the study which is under your control
 - A pre-existing feature of your participant

Lets use this study as an example

Button push required



Contacts

- modify your contacts
- read your contacts

Only when app is open



Calendar

- add or modify calendar events and send email to guests without owners' knowledge
- read calendar events plus confidential information

Anytime in the background



Identity (Ad software)

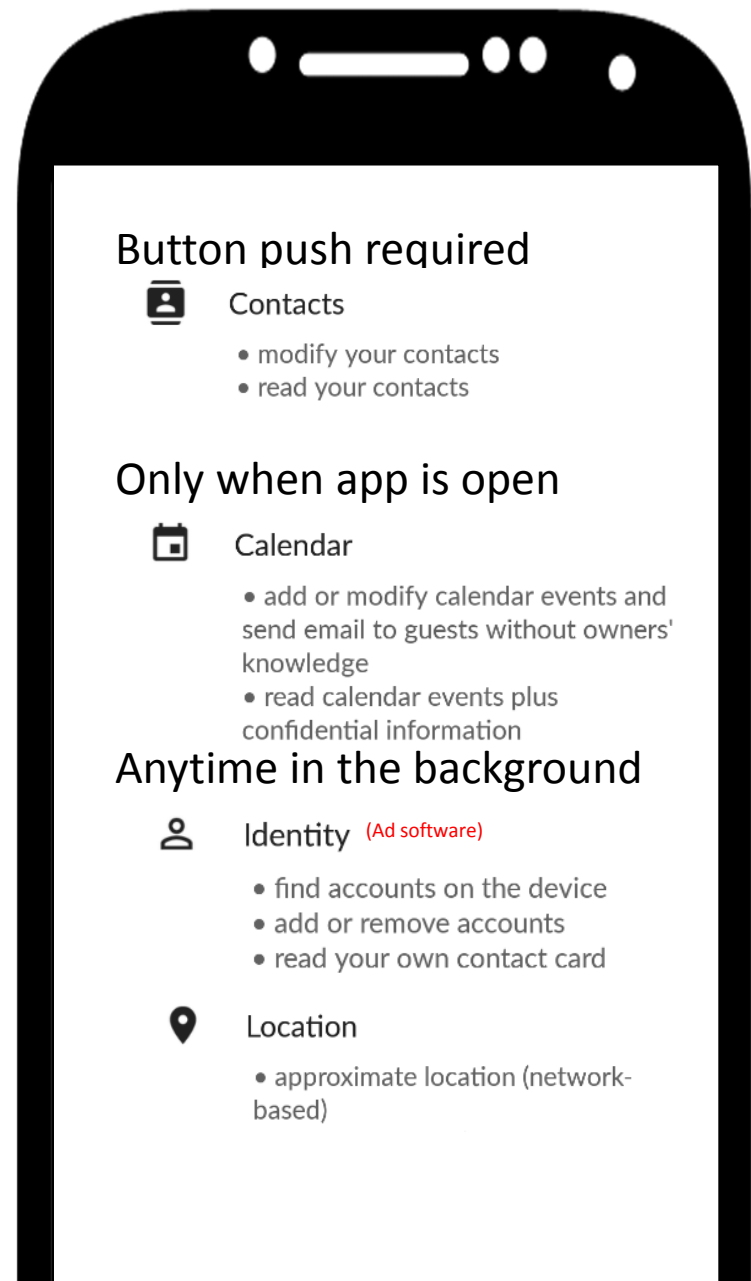
- find accounts on the device
- add or remove accounts
- read your own contact card



Location

- approximate location (network-based)

Goal:
User can identify if
an app can or
cannot perform an
action directly tied
to a permission.





Awesome App

can access

- Location
Uses the device's location
- Camera
Uses the device's camera(s)



Awesome App

can access

Without a button click

- Microphone
Record audio
- Camera
Uses the device's camera(s).
- Location
Uses the device's location. **Used by Ads**

Dependent variable:

Count of the number of questions the participant answered correctly

Can this app do?

Independent variable:

Which of the two interfaces the participant was shown

Absolutely Possible

Charge purchases to your credit card at any time.

Get your location.

Allow ads to know your location.

Load ads.

Write on the SD card

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Variables that would make sense

- Goal: User can identify if an app can or cannot perform an action directly tied to a permission.
- Dependent
 - Number of permissions correctly/incorrectly read
 - Time spent reading the permission screen
- Independent
 - Study group
 - Order of the permissions
 - Time of day
 - Type of device (laptop, mobile, PC)
 - Demographics of the participants

XKCD ran a study to see what men and women call different colors

- Dependent

- The color name they typed in

- Independent

- Sex (man or woman)
- Color they were shown

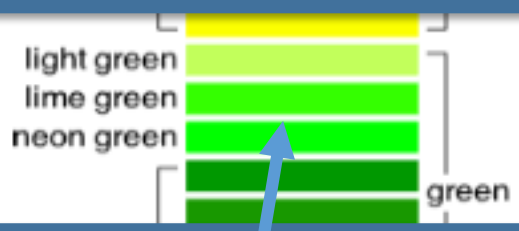
Actual color names if you're a girl ... *Actual color names if you're a guy ...*



Independent variable:
Sex of the participant



Dependent variable:
Color name they chose

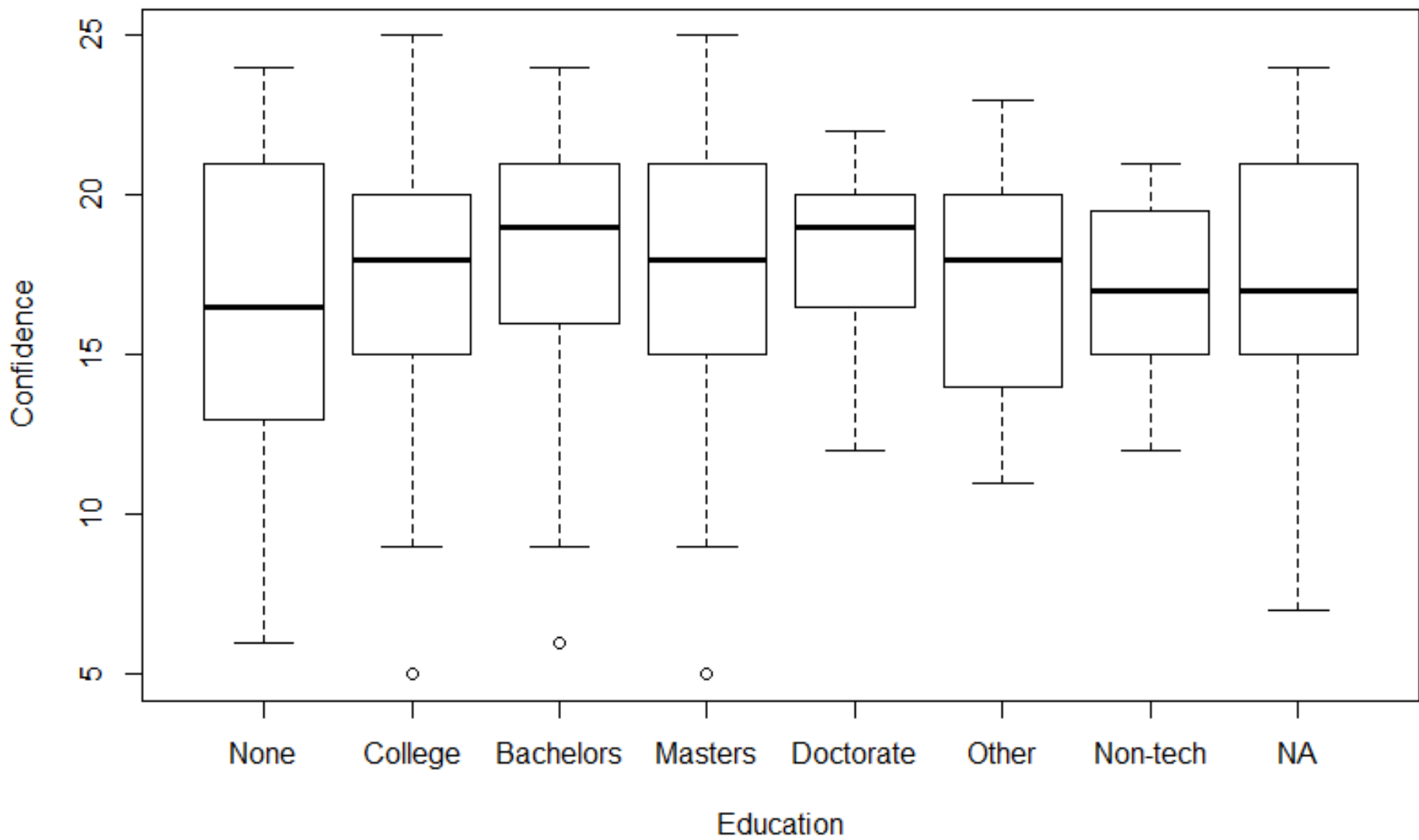


Independent variable:
Which color they were shown



MSc Project on reading config files

- Goal: Does the order of lines in a configuration file impact the way people interpret the file?
- Dependent
 - True/False – did the participant consider order
 - 1-7 – How confident were they in their answer
- Independent
 - Education level for technical professions only
 - Self-efficacy statements around programming and configuration file modification
 - Prior experience with configuration files
 - Other demographics



What I really want you to learn:

Think about what variables you are interested in and what graph / plot / table you want **before** you conduct the study

Common dependent things to measure

- Time to complete task
- Percent of task completed
- Percent of task completed per unit of time
- Ratio of successes to failures
- Time spent in errors
- Percent or number of errors
- Percent or number of competitors better than it
- Number of commands used
- Frequency of help and documentation use
- Percent of favorable/unfavorable user commands

Common dependent things to measure

- Number of:
 - Repetitions of failed commands
 - Runs of successes and failures
 - Times interface misleads the user
 - Good and bad features recalled by users
 - Available commands not invoked
 - Regressive behaviors
 - Users preferring your system
 - Times users need to work around a problem
 - Times the user is disrupted from a work task
 - Times the user loses control of the system
 - Times user expresses frustration or satisfaction

System Usability Scale

- Have the participants interact with the system
 - Have them answer the questions on the right
 - Follow the scale instructions
 - Use the resulting number as a dependent variable
1. I think that I would like to use this system frequently.
 2. I found the system unnecessarily complex.
 3. I thought the system was easy to use.
 4. I think that I would need the support of a technical person to be able to use this system.
 5. I found the various functions in this system were well integrated.
 6. I thought there was too much inconsistency in this system.
 7. I would imagine that most people would learn to use this system very quickly.
 8. I found the system very cumbersome to use.
 9. I felt very confident using the system.
 10. I needed to learn a lot of things before I could get going with this system.

Step 3: Setup your study

What do you want to be able to say after the evaluation is done?

- X interface is better than Y interface
 - Run an A/B study
 - Randomly assign users to groups
 - Have all users complete the same tasks
- My new interface is better than my old interface
 - Same as above
 - Or use rapid usability approach
- Users can use interface X to accomplish Y
 - Have users accomplish a set of tasks using X
 - Measure the usability (see step 2)
- Using my interface makes people better/smarter
 - Pre/post test – give them the same test before and after using your system

Between vs. Within subjects

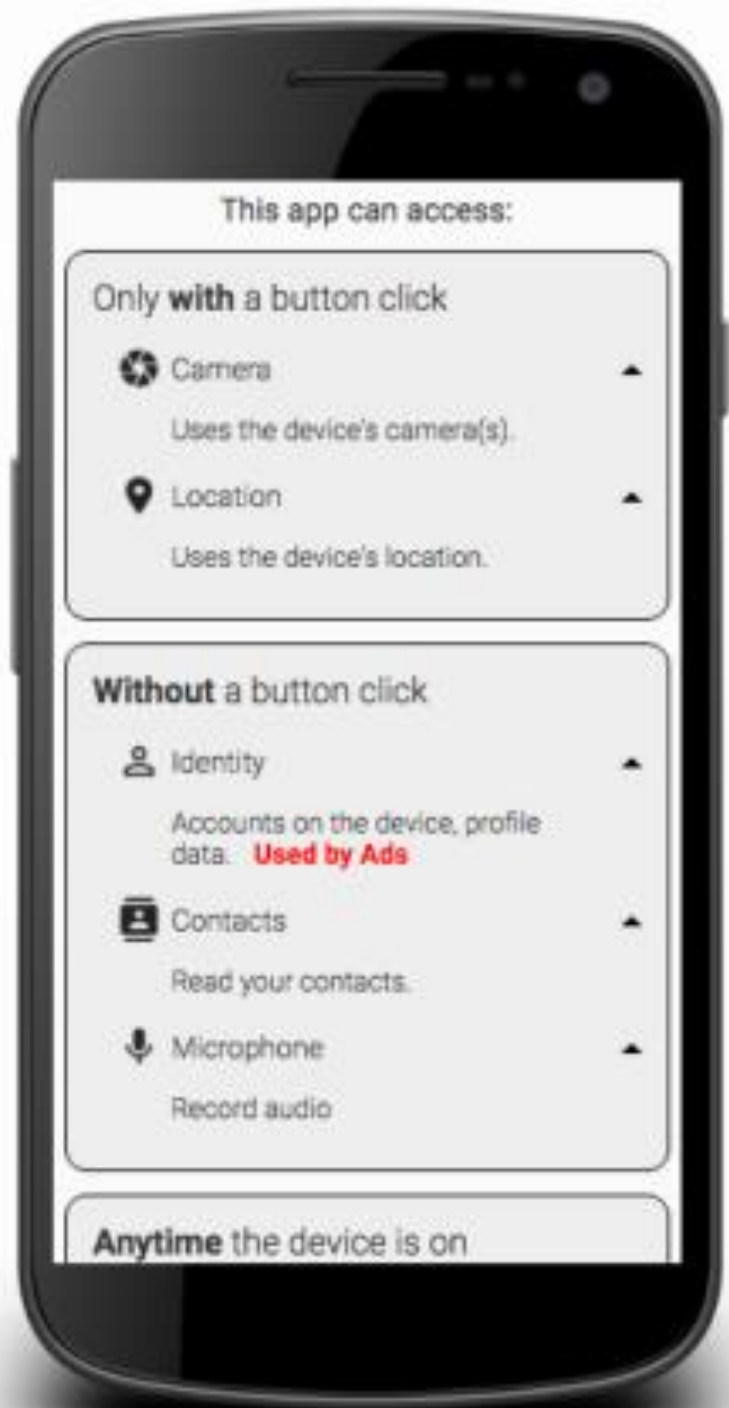
- Between subjects
 - Your study only shows one interface to one person
 - You are measuring how well the people randomly assigned to the A interface did compared to the people randomly assigned to the B interface
 - Lots of variability with this method
- Within subjects
 - Your study shows all interfaces to all people
 - You are measuring the difference in how they do on the two interfaces
 - Less variability (same person) but more learning effects and priming

Scripted vs observational

- Scripted studies are planned in advance
 - Tasks are prepared in advance
 - Participants are in a controlled environment such as a lab
 - Nearly all lab based studies are scripted
 - Think-aloud is scripted
- Observational studies are not planned and simply observe users doing their own tasks
 - Participants may not even be notified that they are part of a study
 - Participants are in their natural environment doing what they would normally do
 - Hard/impossible to prove what task the user was trying to accomplish

Study design

- A/B test between the existing and new interface
- Between subjects
- 10 Tasks shown in the same order to all participants
- Dependent variables
 - Accuracy on task
- Independent variables
 - Which interface



Study design

- Between subjects
- Multiple tasks
- Dependent
 - The color name they typed in
- Independent
 - Sex (man or woman)
 - Color they were shown

Actual color names
if you're a girl ...

Actual color names
if you're a guy ...



Step 4: Evaluate the outcome

Evaluation options

- Basic
 - Counts of effectiveness on tasks
- Academically sound
 - Statistics

Basic version

- Count the number of tasks where the participant was able to accomplish your goal
- If most participants were able to accomplish the goal then Yay! The interface is usable.

	Current Interface	New Interface
Task 1	15	12
Task 2	12	14
Task 3	11	10
Task 4	7	4

We are about to learn about some of the basic statistics used in HCI

These are only needed if you want to prove that a statement is true

Common statistical tests

- Regression
- T-Test
- ANOVA
- χ^2 (Chi Squared)

Chi Squared

- $\chi^2 = \sum \frac{(\text{Observed Value} - \text{Expected Value})^2}{(\text{Expected Value})}$
- Answers the question:
 - Does the observed data have the same ratio as expectedOR
 - Do two counts come from the same distribution

Questions?