



# 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)

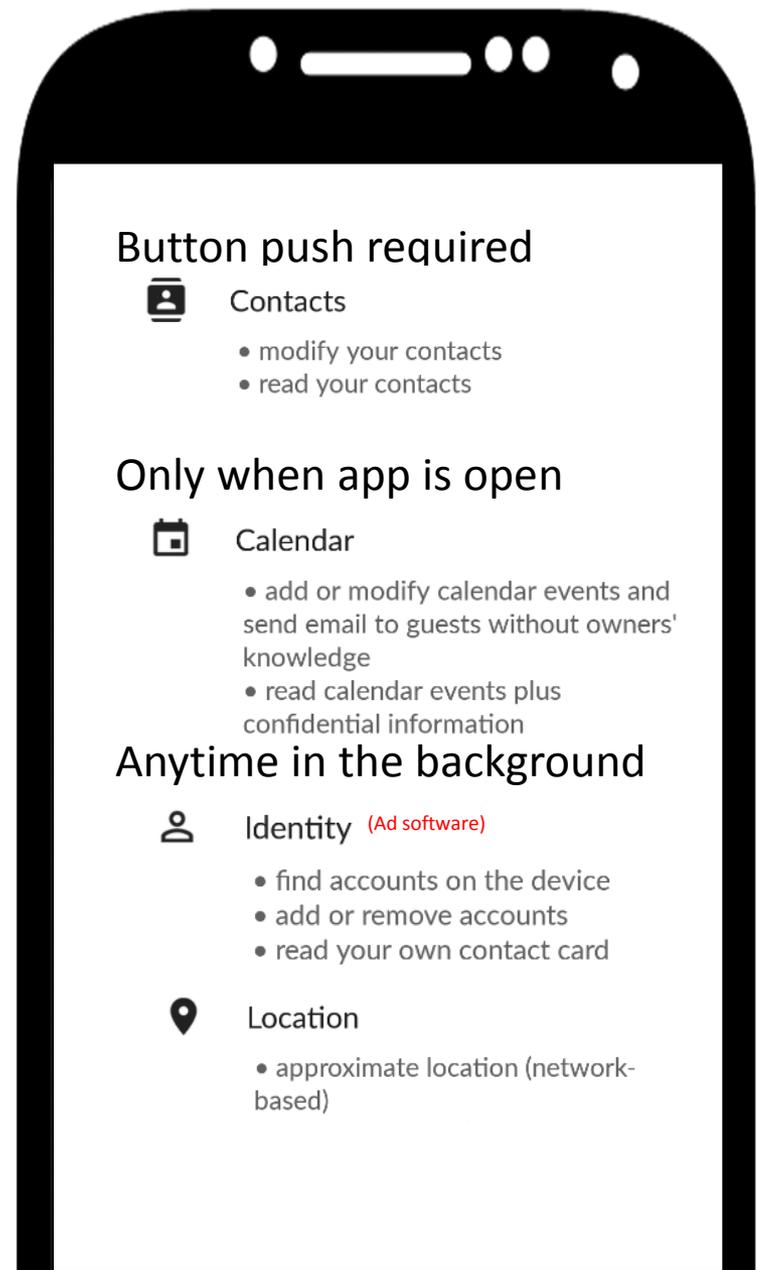
- find accounts on the device
- add or remove accounts
- read your own contact card



### 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

on 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.	<input type="radio"/>				
Get your location.	<input type="radio"/>				
Allow ads to know your location.	<input type="radio"/>				
Load ads.	<input type="radio"/>				
Write on the SD card	<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 ...*



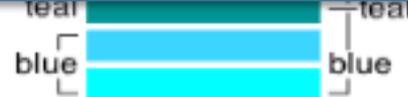
**Independent variable:**  
Sex of the participant



**Dependent variable:**  
Color name they chose

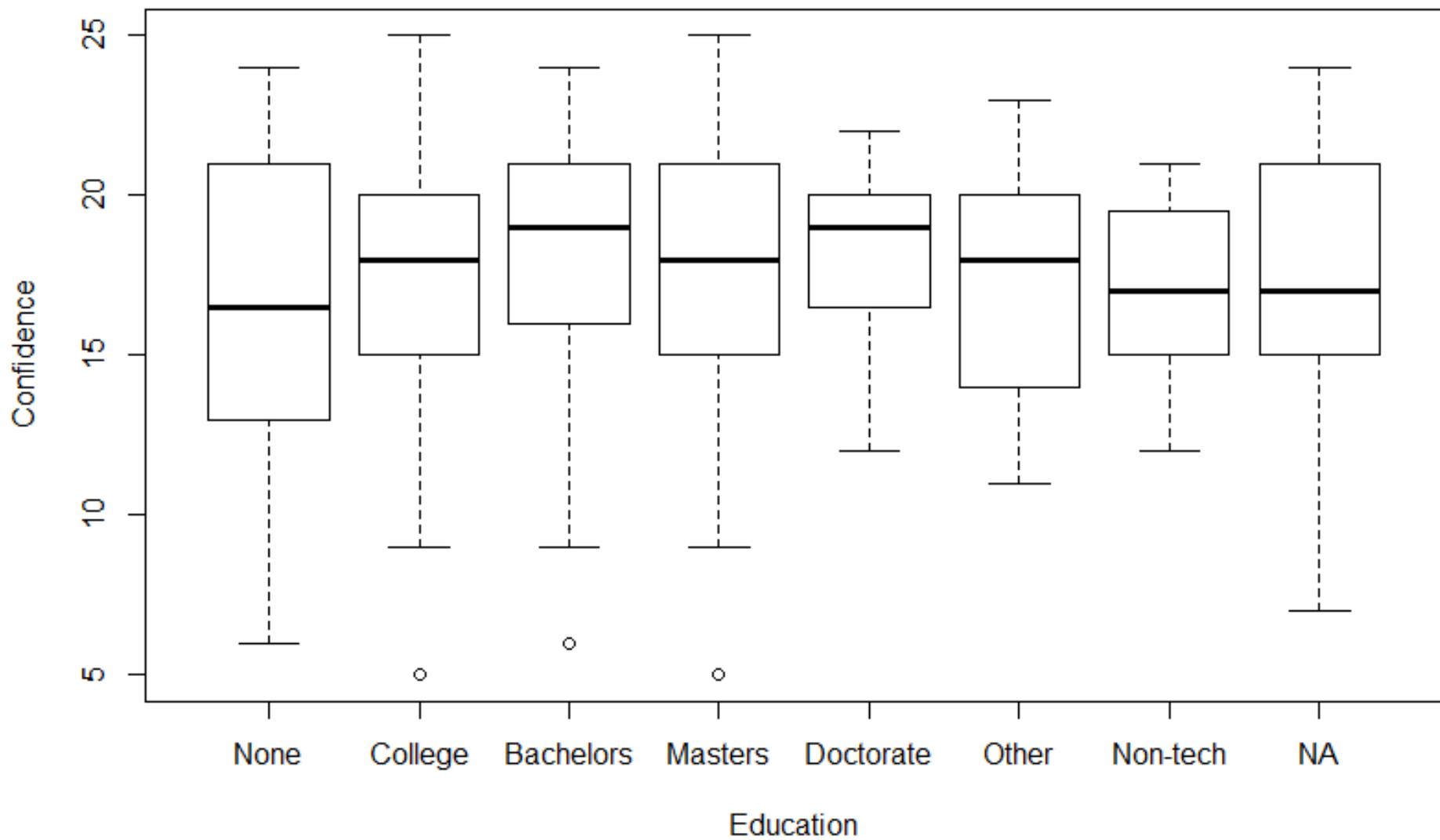


**Independent variable:**  
Which color they were shown



# 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

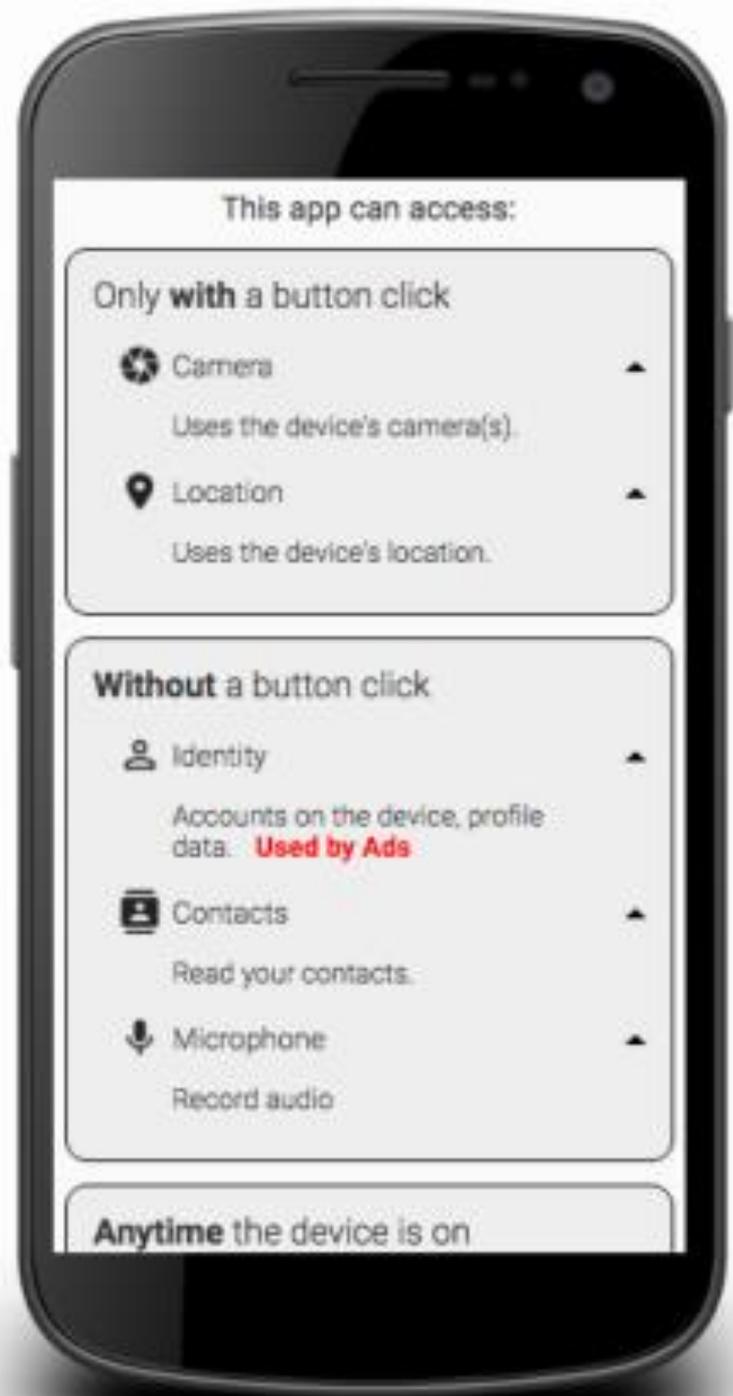
- Between subjects
  - Your study only shows one interface to one person
  - You are measuring how well the people randomly assigned to the A interface did compared to the people randomly assigned to the B interface
  - Lots of variability with this method
- Within subjects
  - Your study shows all interfaces 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
- $\chi^2$  (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?**