

Human-Computer Interaction: Study Design

Dr Kami Vaniea

Outline

- Lab studies
- Online studies
- Study design
 - Define what “usable” means
 - Select a study methodology
 - Identify the data to collect
 - Design the study structure
 - Plan the evaluation

Usability testing & research

Usability testing

- **Improve** products
- Few participants
- Results inform design
- Usually not completely replicable
- Conditions controlled as much as possible
- Procedure planned
- Results reported to developers

Experiments for research

- **Discover** knowledge
- Many participants
- Results validated statistically
- Must be replicable
- Strongly controlled conditions
- Experimental design
- Scientific report to scientific community

Lab Study

- Basic idea: Have a participant come to a physical place (lab) and interact with the interface there under observation.
- You setup the lab so it mimics the situation you want to test.
- Pros
 - Full control over the environment so limited confounds.
 - Detailed data from each subject .
 - Ability to ask them why they did something.
- Cons
 - Small sample sizes.
 - Being in the lab changes user behavior. They feel safer and their normal distractions are gone. They may also be more stressed.

Mixed-methods study

- Mix several HCI methods together in one study to get a better understanding of the topic.
- Most lab studies are a form of mixed-methods research. One of the more common is to do an experiment followed by a post-interview.
- Pros
 - You get more data.
 - One method will likely catch what another method missed.
- Cons
 - More methods take longer to plan and longer to run.
 - Data from different sources sometimes contradict each other and you must resolve the conflict.

Online Experiment

- Similar to a lab study, but remote.
- Basic idea: Have a participant interact with something via the internet and record aspects of their interactions.
- Pros
 - Larger and more diverse sample size.
 - More realistic (if the tested interface is meant to be used online).
 - Consistent structured data.
- Cons
 - Limited control over the environment so confounds likely.
 - No easy way to ask the user about observed behavior.
 - Careful design vital, users may not properly understand or ignore instructions.

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

~~Is [my tool] usable?~~

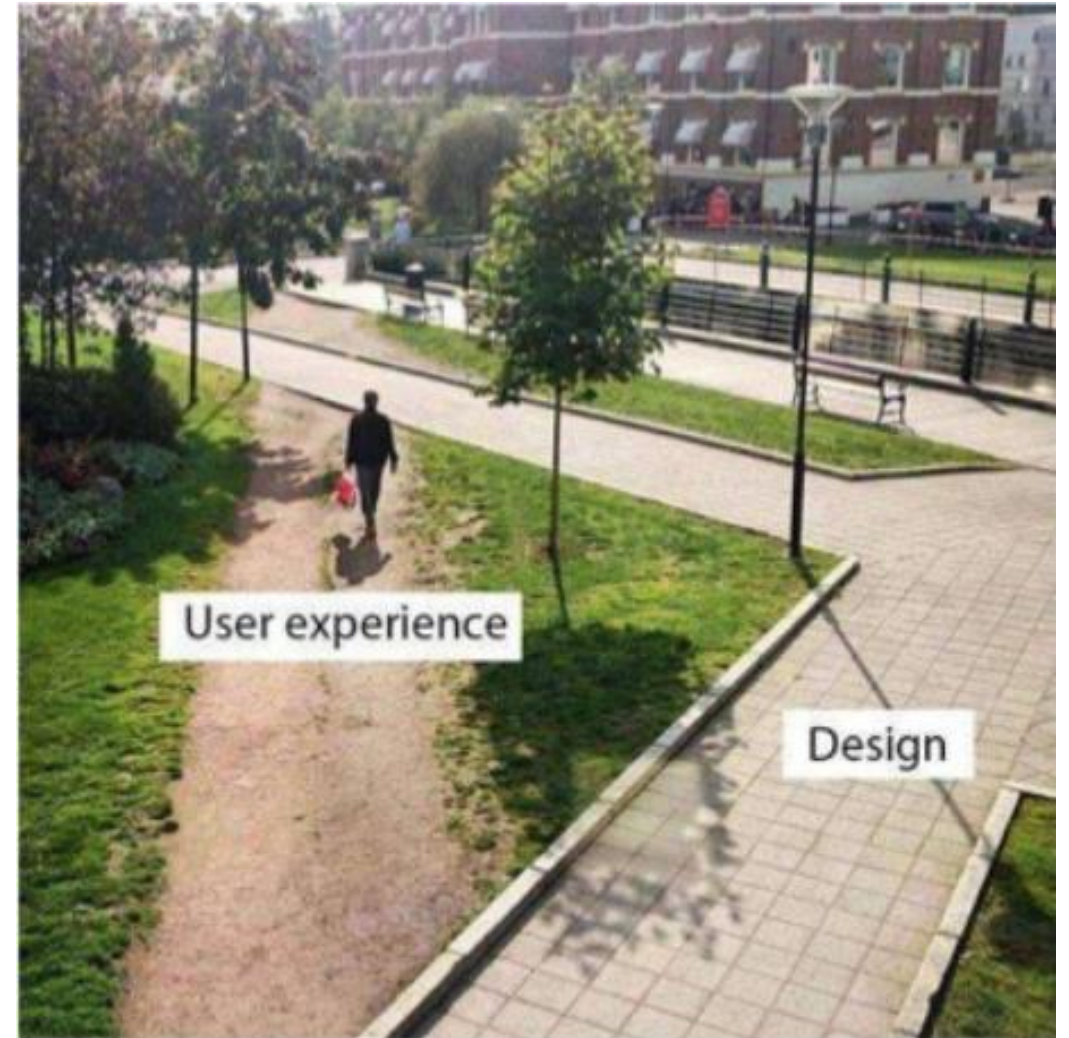


Needs to be more specific to be testable.

Usability

A design is not usable or unusable *per se*

- its **features**, together with the **users**, **what the users want** to do with it, and the **users' environment** in performing tasks, determine its level of usability



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Start by identifying requirements

Approaches:

- Interviews with users
- Interviews with experts
- Contextual inquiries
- Surveys
- Focus groups
- Reading background literature
- Diary studies
- Artifact analysis



Define your usability goals

- Identify what you think your users need to be able to do using your system or what kind of attitude you want them to have.
- 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.
 - Be willing to give the app 5 stars after interacting with it for the first time.
- Poor examples:
 - Have fun using the site.
 - Find a bus to go somewhere.

“Usable” could mean:

- User can accomplish a task in Y minutes.
- User can accomplish task with no major errors.
- User can learn to use the interface the first time they see it so that they can accomplish a task later.
- More users buy products on the site.
- Users buy more expensive products on the site.
- Expert users can navigate from A to B in less than X seconds.
- Users rate the app highly.
- Interface breaks no major HCI heuristics.
- Users can confidently send an encrypted and signed email to someone else who is able to open it.

Some of my recent research questions:

- Can people differentiate between a subdomain and a domain when reading a URL?
- Does [my new system] help people differentiate between malicious URLs and safe ones?
- Can users use [my new password manager] faster and with less errors than [the old password manager]?
- Does knowing how an app will use its permissions impact app installation decisions?
- What factors impact end-users' willingness to update software?
- Is the guidance given by some static analysis tools better at helping developers identify and fix security errors in their code?

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Many ways to test usability

- A/B Testing
- Affinity Diagraming
- Card Sorting
- Case Studies
- Cognitive Walkthrough
- Competitive Testing
- Critical Incident Technique
- Customer Experience Audit
- Desirability Testing
- Diary Studies
- Ergonomic Analysis
- Experience Sampling
- Experiments
- Eye tracking
- Fly-on-the-wall Observation
- Focus Groups
- Graffiti Walls
- Heuristic Evaluation
- Interviews
- KJ Technique
- Observation
- Participatory Action Research

What kind question are you asking?

- Attitudinal – User attitudes and opinions

vs.

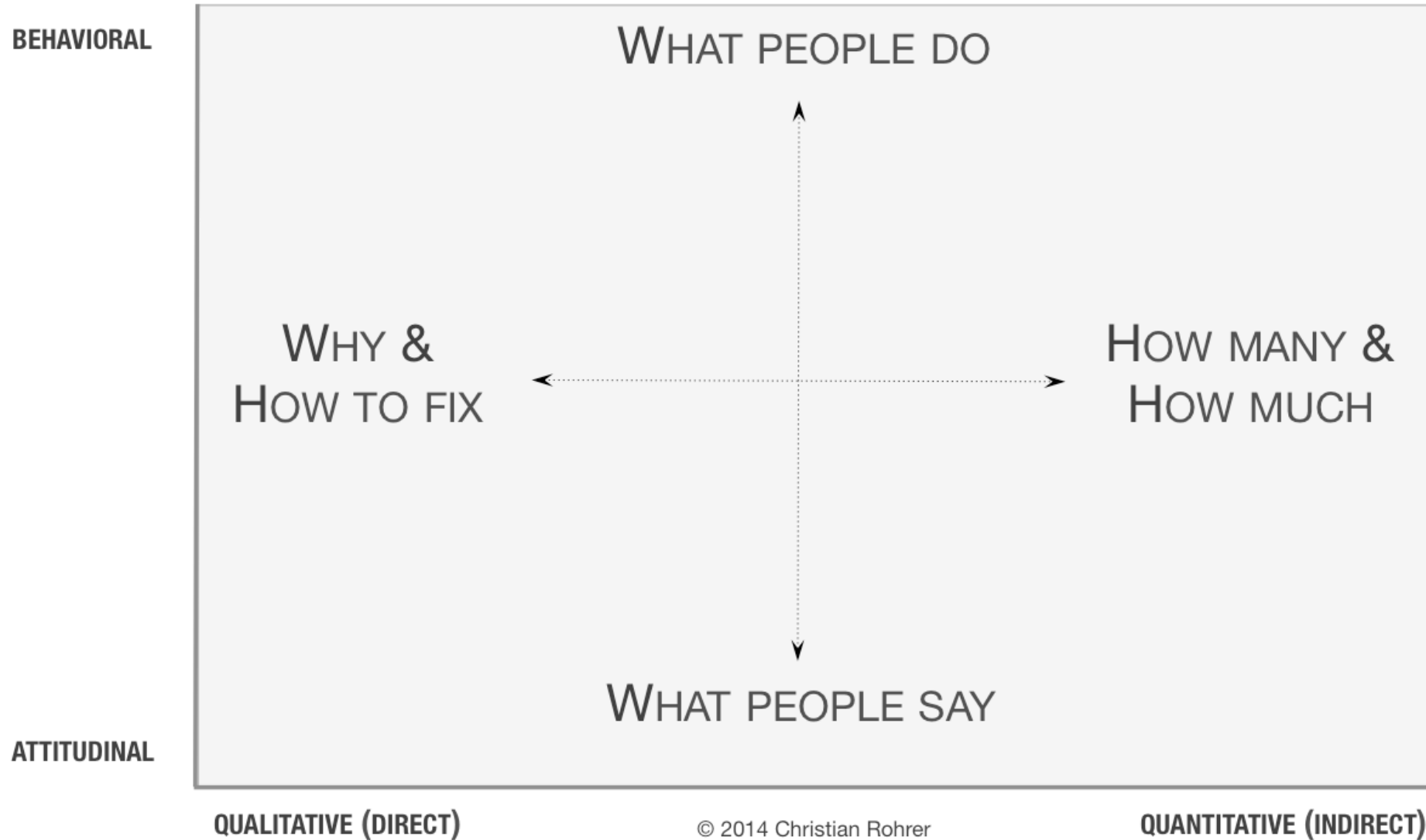
- Behavioral – What the user actually does or is capable of doing

- Qualitative – Unstructured data. Typically unstructured language data

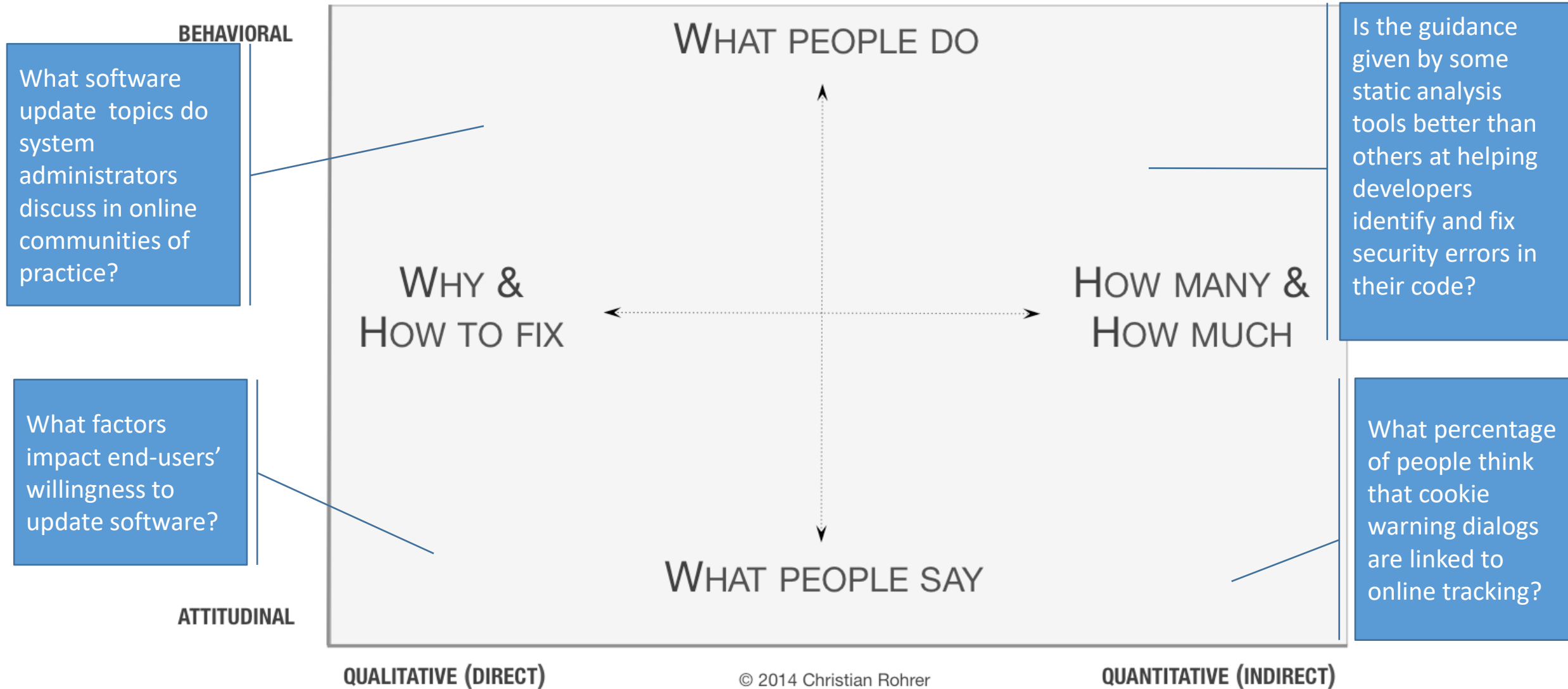
vs.

- Quantitative – Structured data. Typically numerical data that can be summed or counted

QUESTIONS ANSWERED BY RESEARCH METHODS ACROSS THE LANDSCAPE



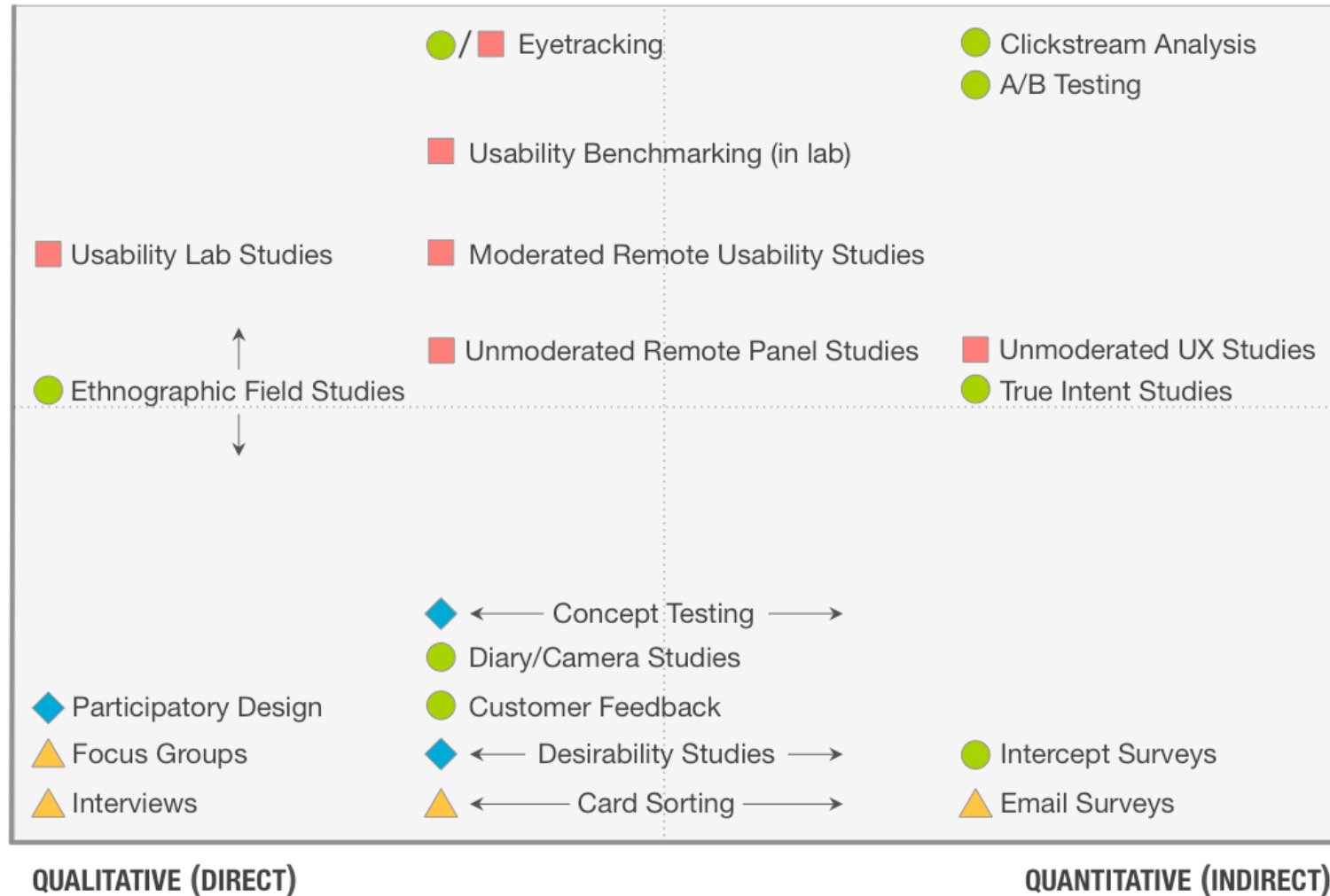
QUESTIONS ANSWERED BY RESEARCH METHODS ACROSS THE LANDSCAPE



A LANDSCAPE OF USER RESEARCH METHODS

BEHAVIORAL

ATTITUDINAL



KEY FOR CONTEXT OF PRODUCT USE DURING DATA COLLECTION

- Natural use of product
- Scripted (often lab-based) use of product
- ◆ Combination / hybrid
- ▲ De-contextualized / not using product

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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
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- Controlled
 - An element of the study that you ensure is the same for all participants

Common dependent things to measure

- Time to complete task
- Percent of task completed
- 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
- Qualitative data, like answers to interview questions

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

Common independent things to measure

- User demographics (age, gender, nationality, ...)
- Prior experience with the tool or similar tools
- Prior experience with technology
- Existing attitudes
- Answers to scale questions like privacy attitudes
- Aspects of the study
 - Which interface design they were assigned
 - What computer they were asked to use
 - Which recruitment platform they came from
 - Which condition they were assigned to
 - How hot or cold the room was
 - Order tasks were given to the user

Common things to control for

- Computing equipment – laptops can have different types of mice and screens.
- Researcher script – users can be impacted by what the researcher says, saying the same thing to all participants helps.
- Require specific browser – online studies can look different on different browsers, so one option is to require users to take the study on a desktop using a specific browser.
- Task order – users will behave differently on the first task than they will on the last. Also they will be influenced by earlier tasks.
- Pre-define hints – if a user gets stuck on a task you don't want them too frustrated, but giving unscripted answers can result in variations. So pre-creating hint cards can control for variation.

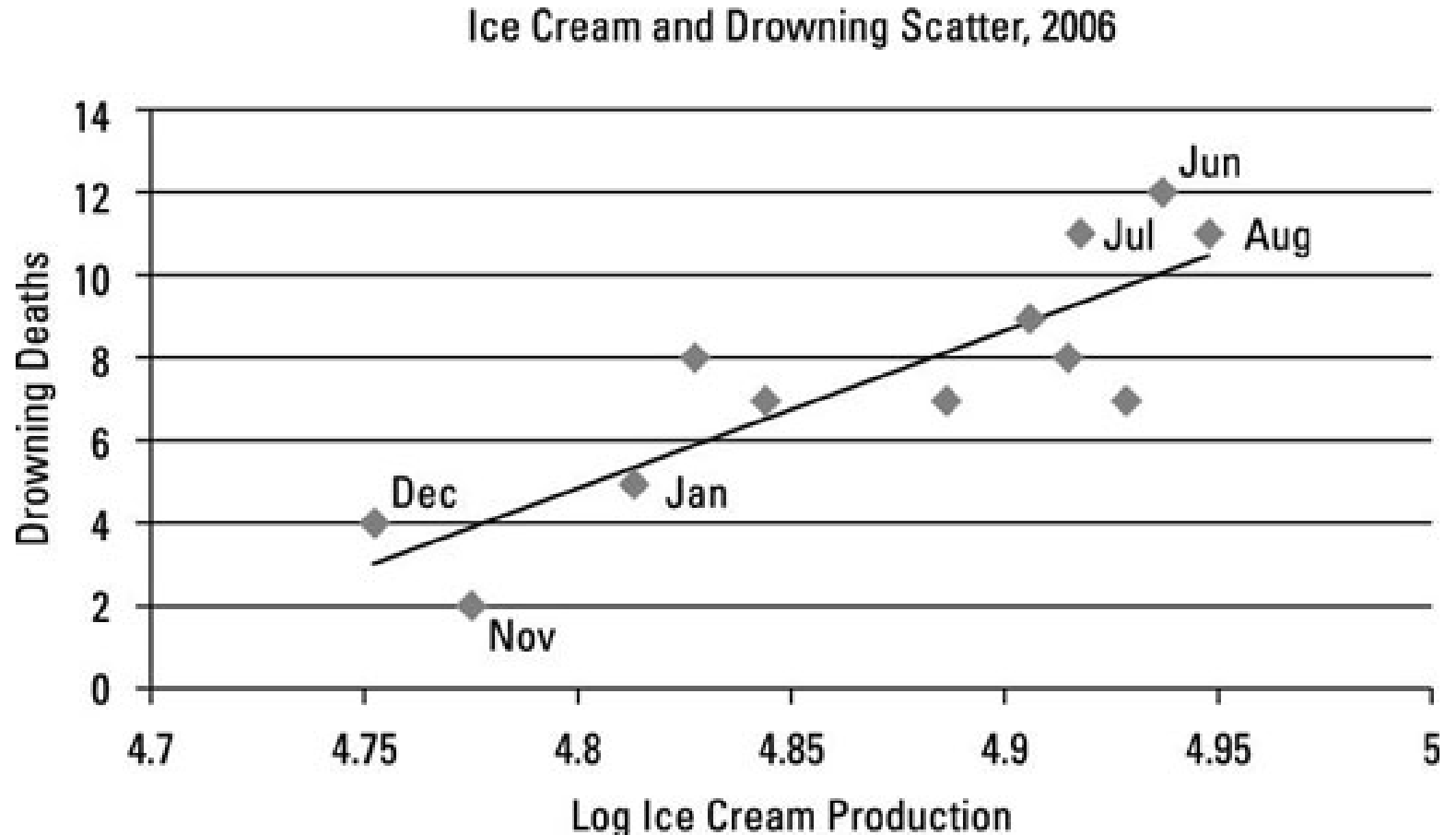
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Confounding Variable

An unmeasured influence that may be the source of the observed effect.

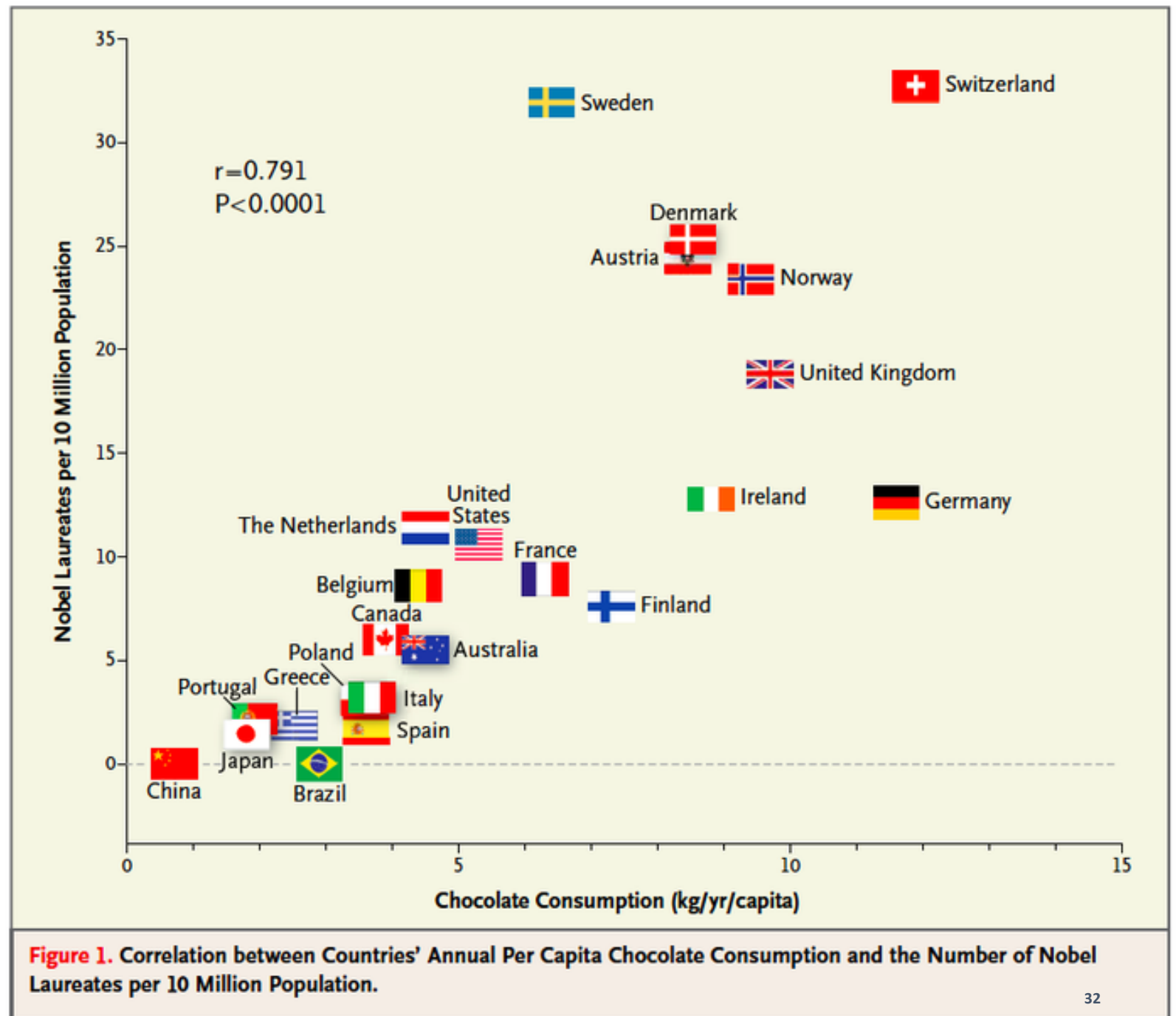
Think about what might impact your dependent variable in advance and measure it.



Confounding Variable

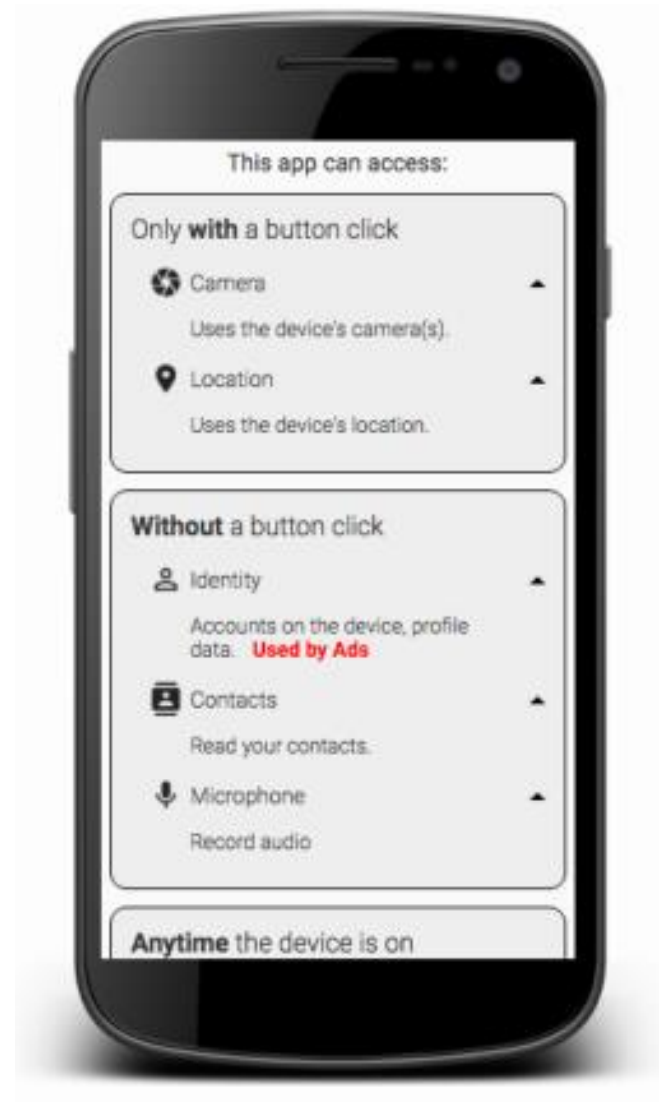
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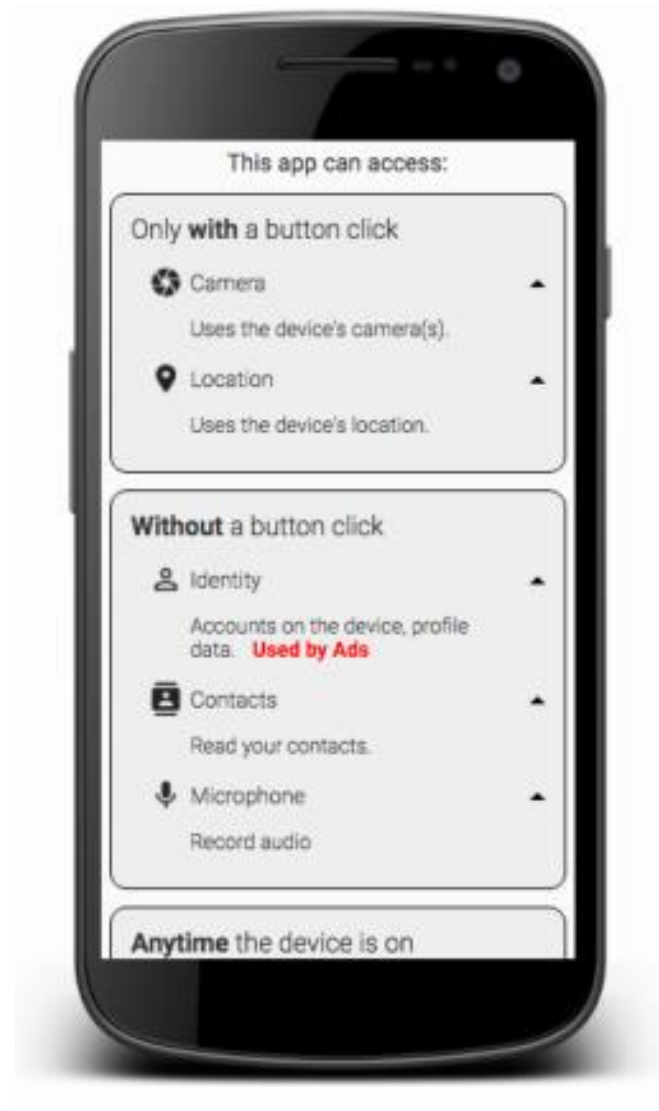


Example:

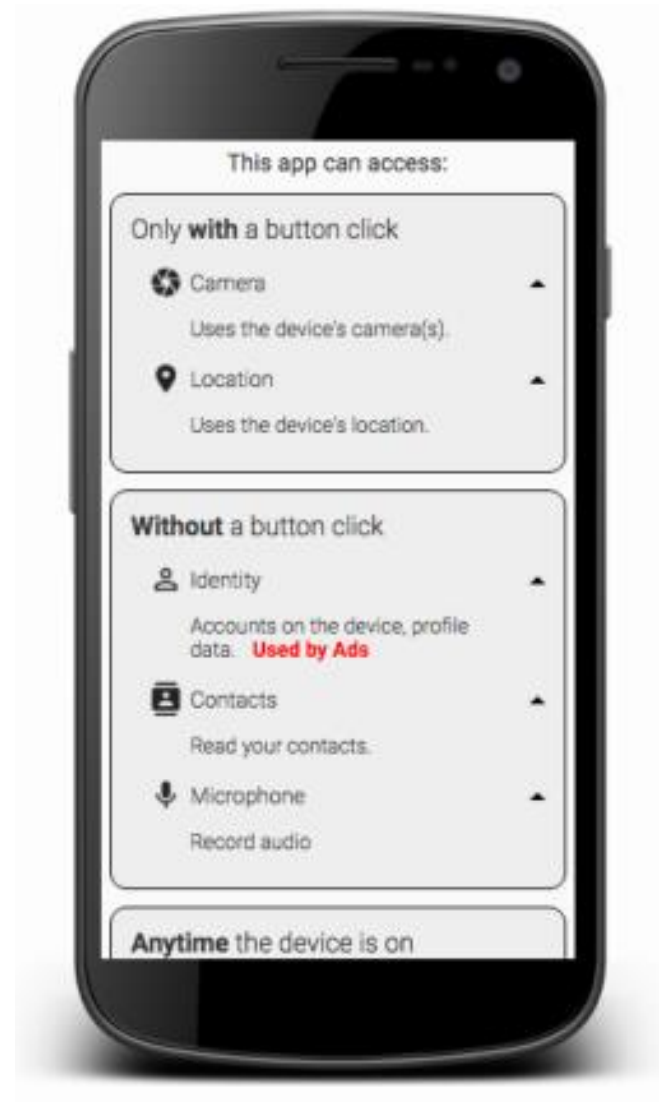
Project to
make app
permissions
easier for
people to
understand.



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



Method:
Online study
where users
are asked to
look at the
interface and
answer
questions
based on it.





Awesome App

can access

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

Which of the following can this app do?

Independent variable:

Which of the two interfaces the participant was shown

- 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

Absolutely
Possible

☐	☐	☐	☐	☐
☐	☐	☐	☐	☐
☐	☐	☐	☐	☐

Example 2

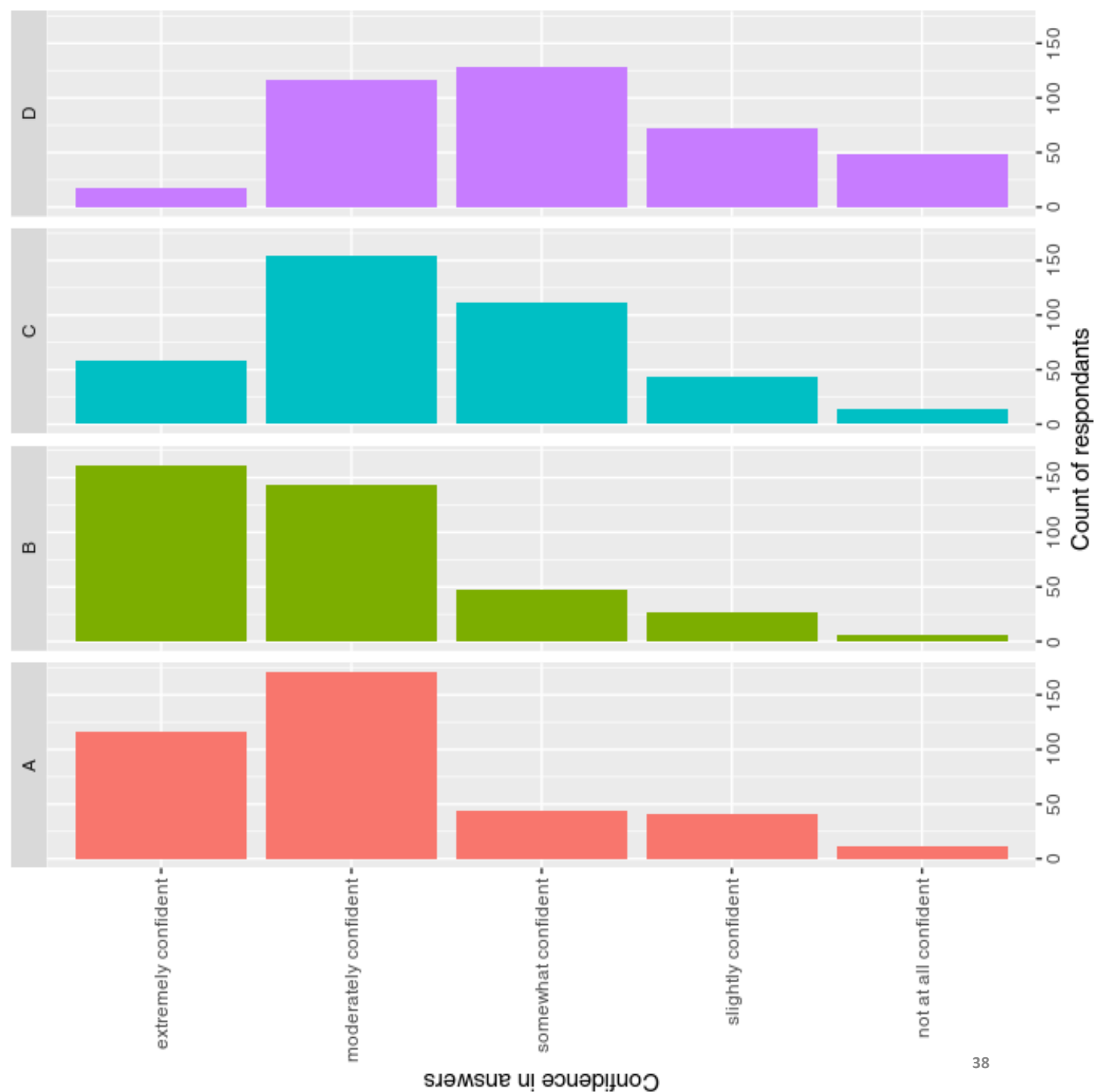
I showed participants 4 code samples and asked them what the code would do. I then asked them how confident they were in their answer.

Research Question: Does the code sample shown impact confidence in their answer?

Research Question:
Does the code sample
shown impact
confidence in their
answer?

Independent:
Which code sample
shown

Dependent:
Confidence



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.

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Scripted vs observational

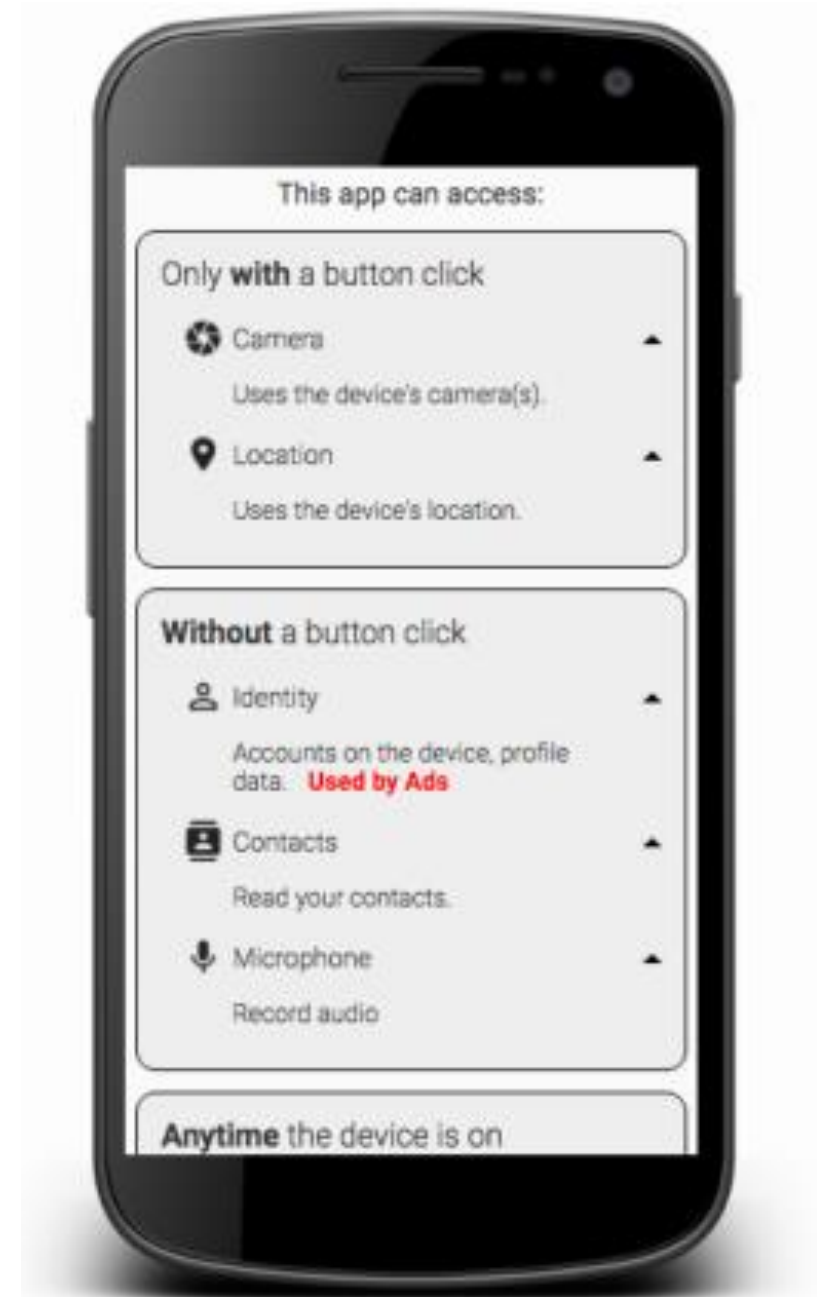
- Scripted studies are planned in detail in advance.
 - Tasks are prepared in advance.
 - Participants are in a controlled environment such as a lab.
 - Nearly all lab based studies are scripted.
 - Think-aloud is scripted.
- Observational studies are not planned and simply observe users doing their 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.
 - Some planning still needed around data collection.

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

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
 - User demographics

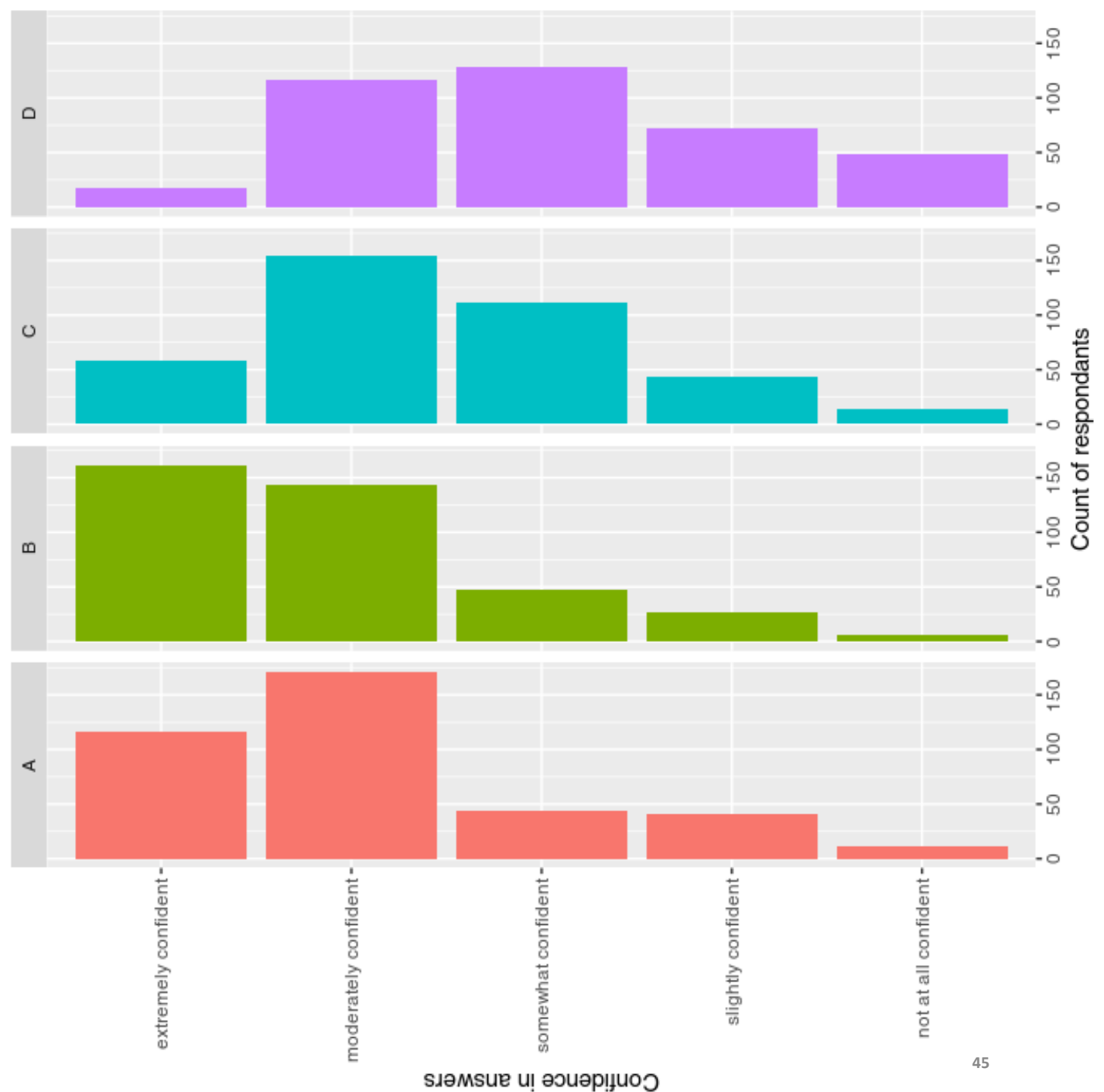


Online experiment

Within-subjects

Independent:
Which code sample
shown

Dependent:
Confidence



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Evaluation depends heavily on questions and data

- Goals
 - Usability testing
 - Evaluation for research
- Data type
 - Qualitative data
 - Quantitative data
- Research question
- Researcher skills
 - Statistics?

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Task accuracy

- 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

Content coding: Open coding

“I decided that I wasn't
going to install the
update because I have
heard all the reviews
online about how it
generally makes your
phone slower in every
respect.”

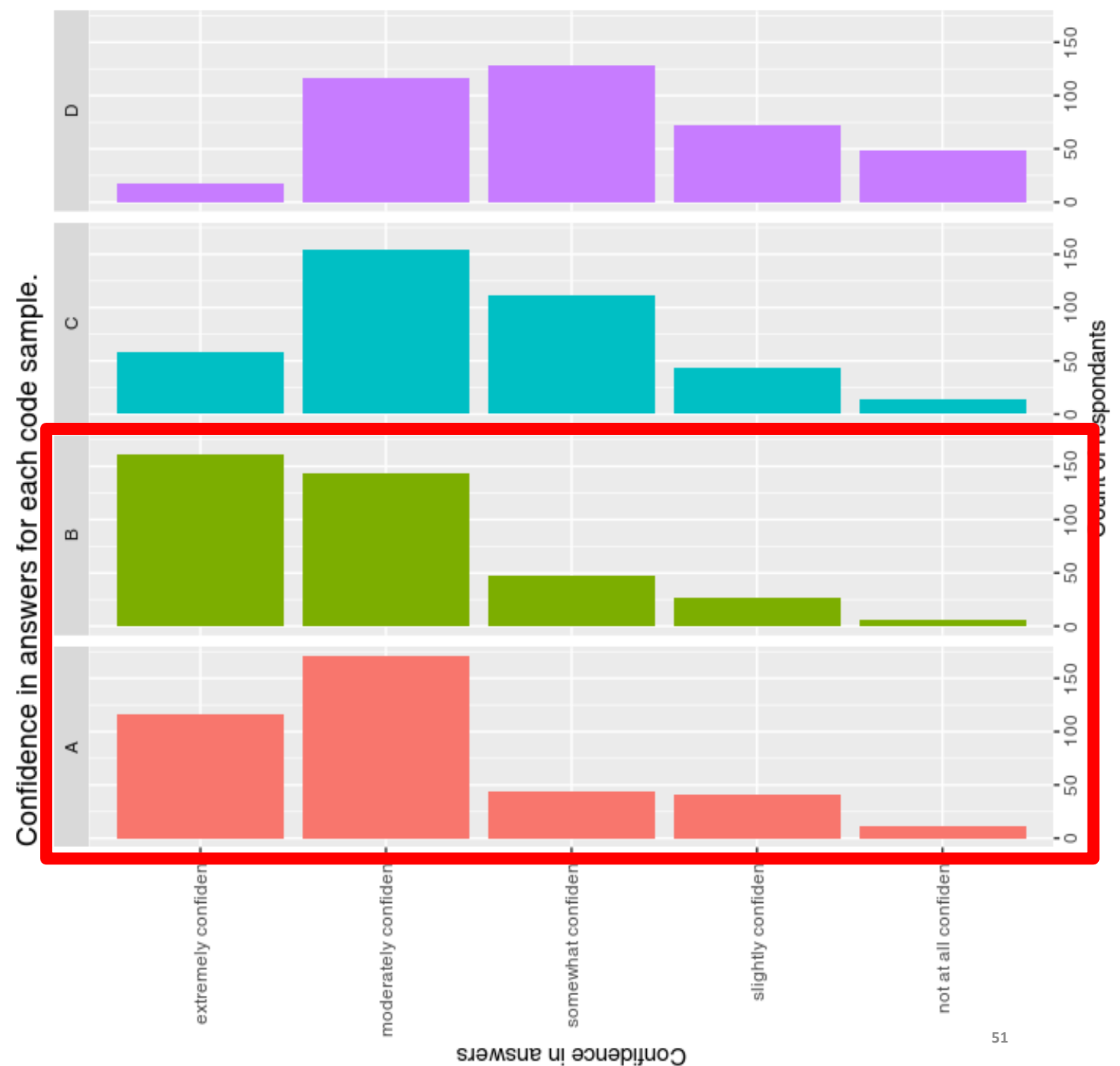
Not updating

Recommendations

Phone speed

Statistics

Question: Do people have a different level of confidence when reading code samples A vs B?



Yes, they have different confidence levels between A and B.

```
> t.test(a.confidence, b.confidence)
```

Paired t-test

data: a.confidence and b.confidence

t = -5.2699, df = 383, p-value = 2.285e-07

alternative hypothesis: true difference in means is not equal to 0

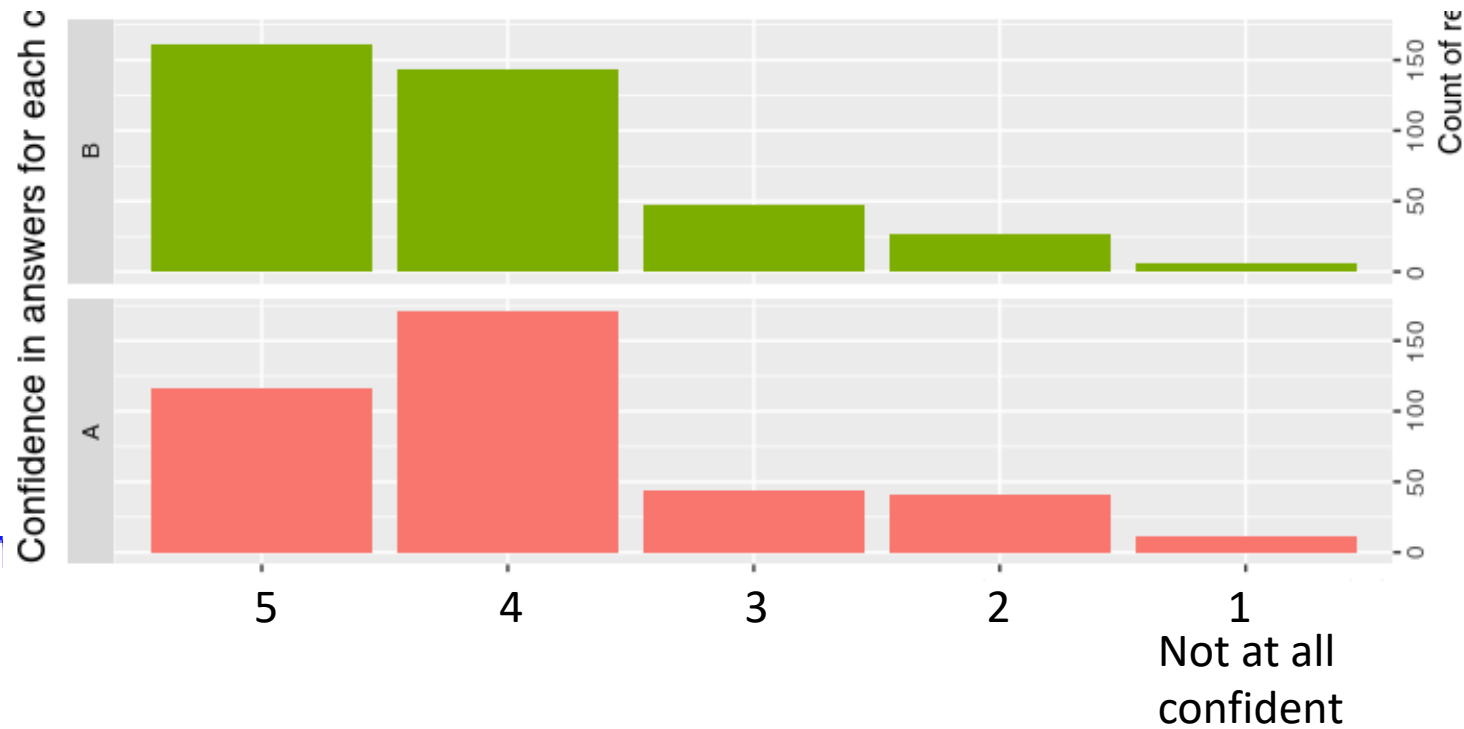
95 percent confidence interval:

-0.3218198 -0.1469302

sample estimates:

mean of the differences

-0.234375



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