

# Analysis - 2

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INFR11158/11230 Usable Security and Privacy

Dr. Jingjie Li

09/02/2024



THE UNIVERSITY  
*of* EDINBURGH

# Overview

- Stats test continued
- Qualitative analysis
- Take-home

# Statistical tests

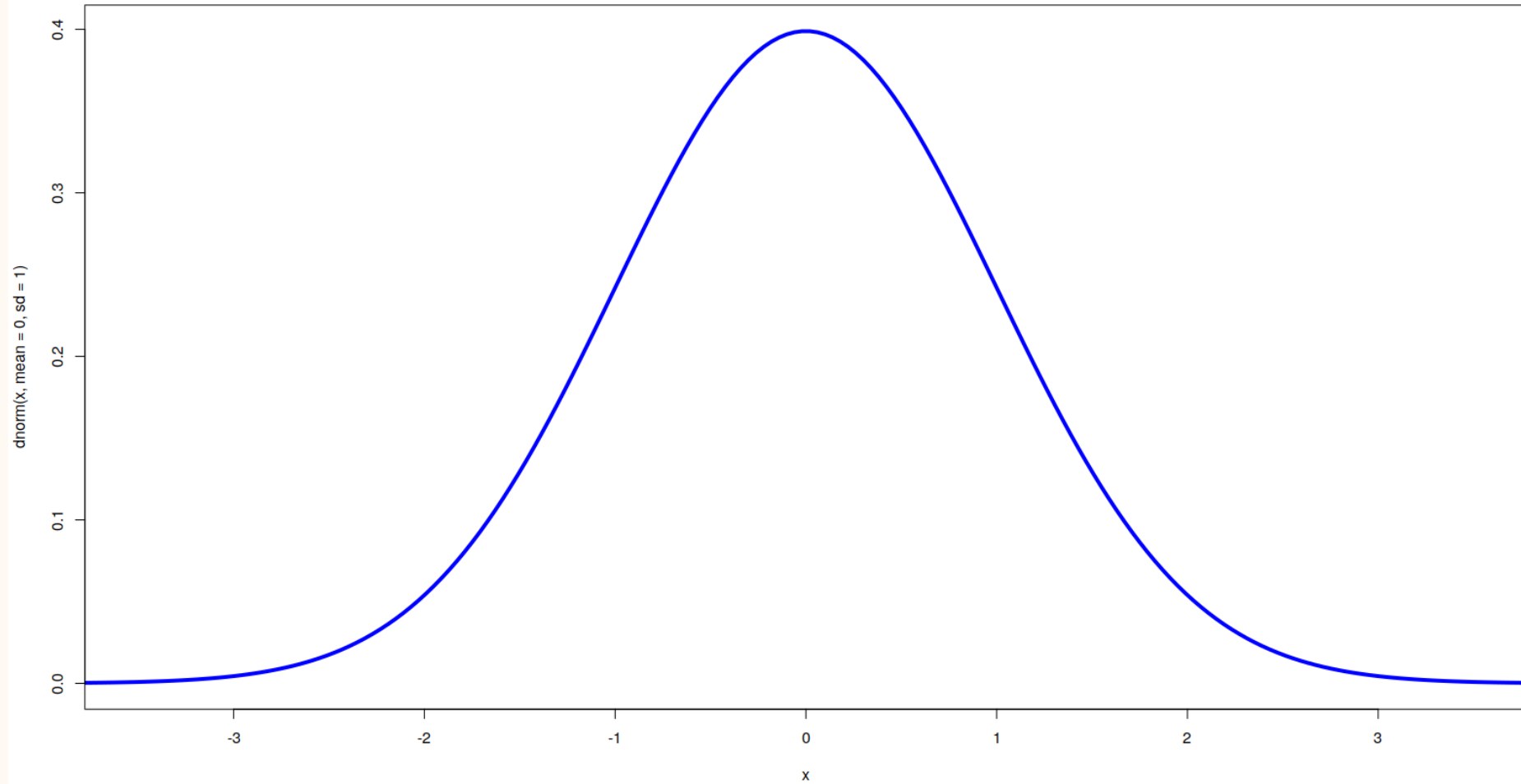
Comparing	Dependent	Independent	Parametric (Dependent variable is mostly normally distributed)	Non-parametric
The means of two independent groups	Continuous / scale	Categorical / nominal	Independent t-test	Mann-Whitney test
The means of 2 paired (matched) samples	Continuous / scale	Time variable (before/after)	Paired t-test	Wilcoxon signed rank test
The means of 3+ independent groups	Continuous / scale	Categorical / nominal	One-way ANOVA	Kruskal-Wallis test
3+ measurements on the same subject	Continuous / scale	Time variable	Repeated measures ANOVA	Friedman test
Relationship between 2 continuous variables	Continuous / scale	Continuous / scale	Pearson's Correlation Coefficient	Spearman's Correlation Coefficient
Predicting the	Continuous /	Any	Simple Linear	

**t-test: Test if two groups have the same mean  
(average)**

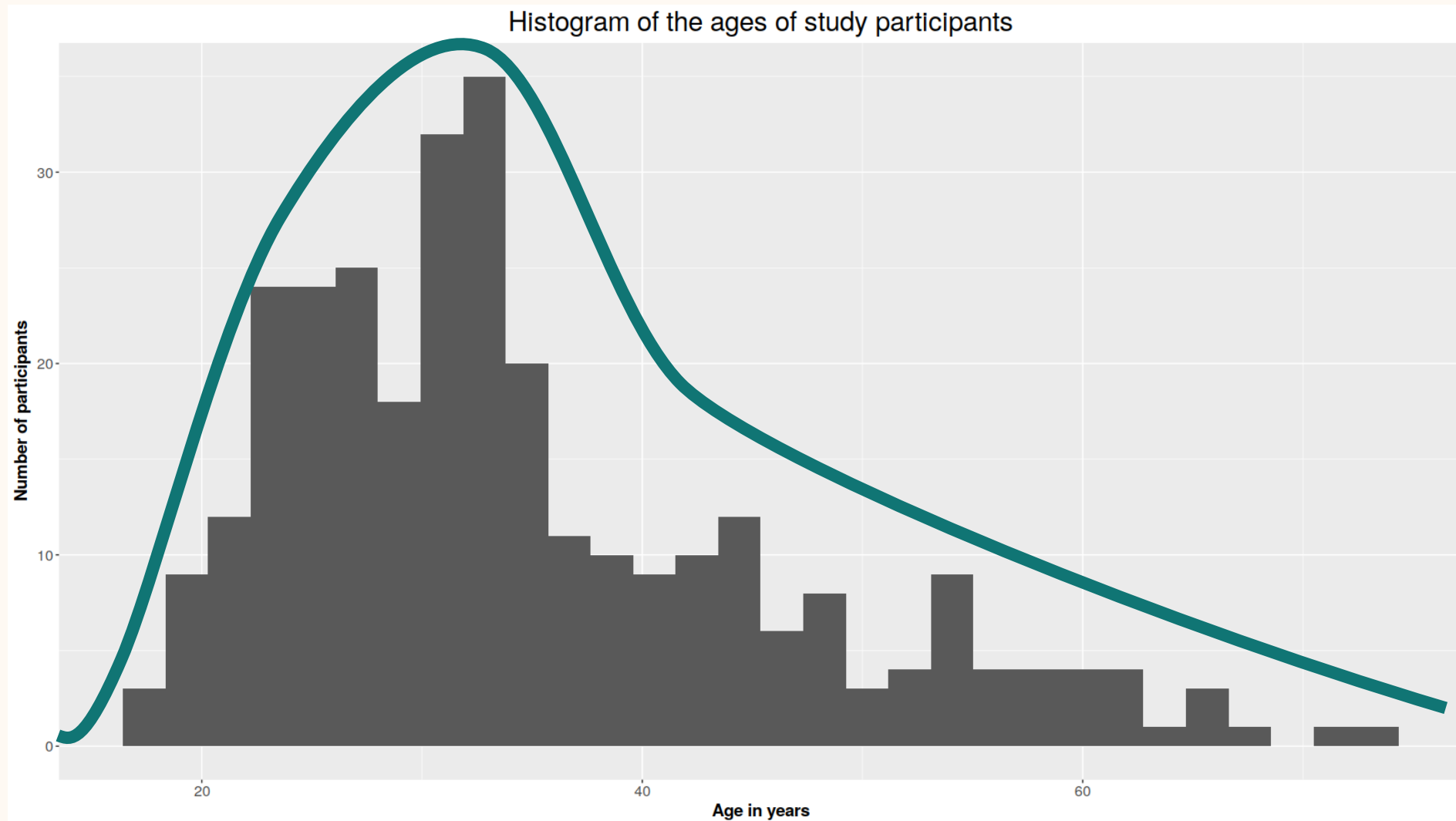
# T-test requires:

- Independent variable: categorical binary
- Dependent variable: numeric (continuous or discrete)
- Data must be **normally distributed**

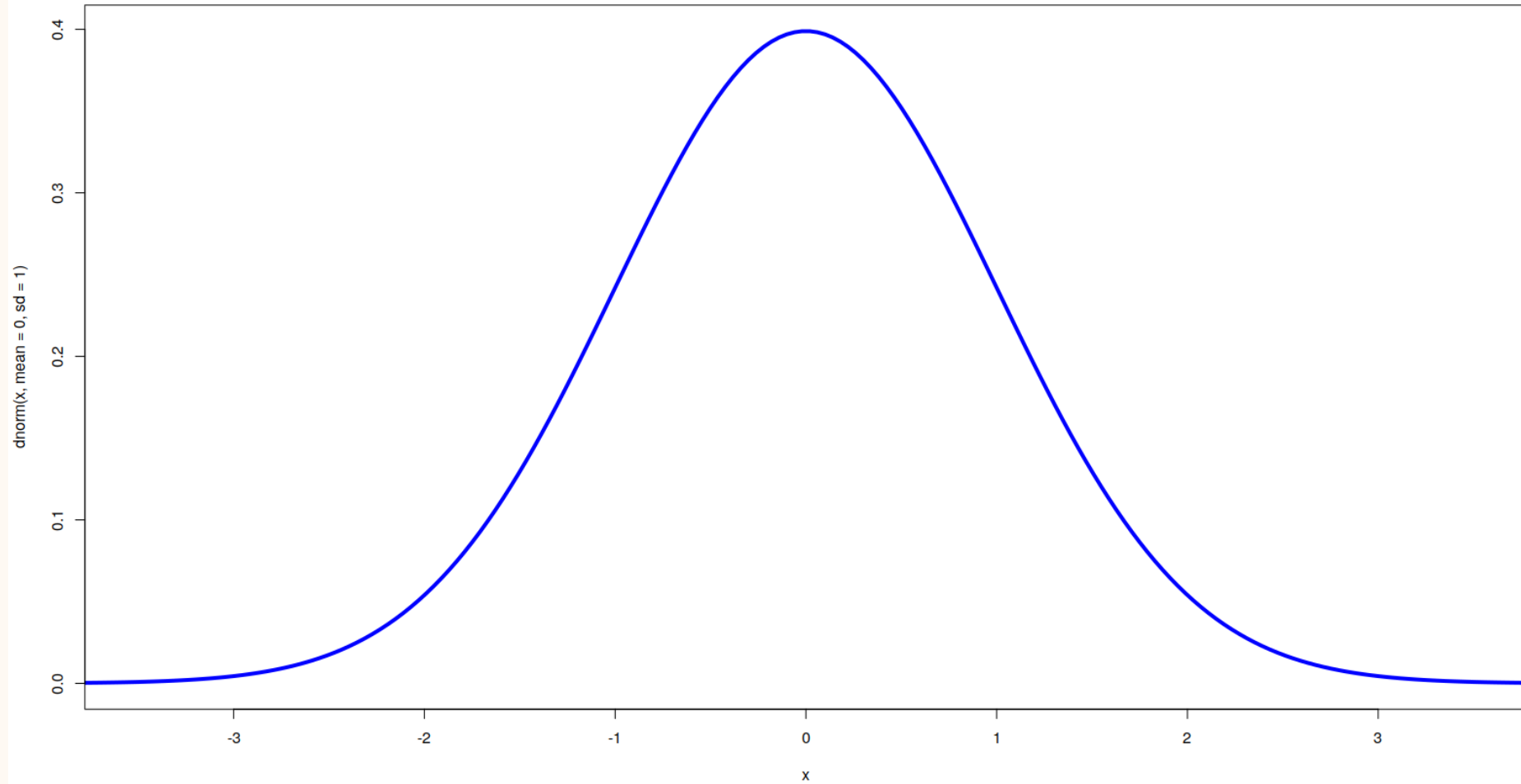
# Normal distribution



# Real data is messy

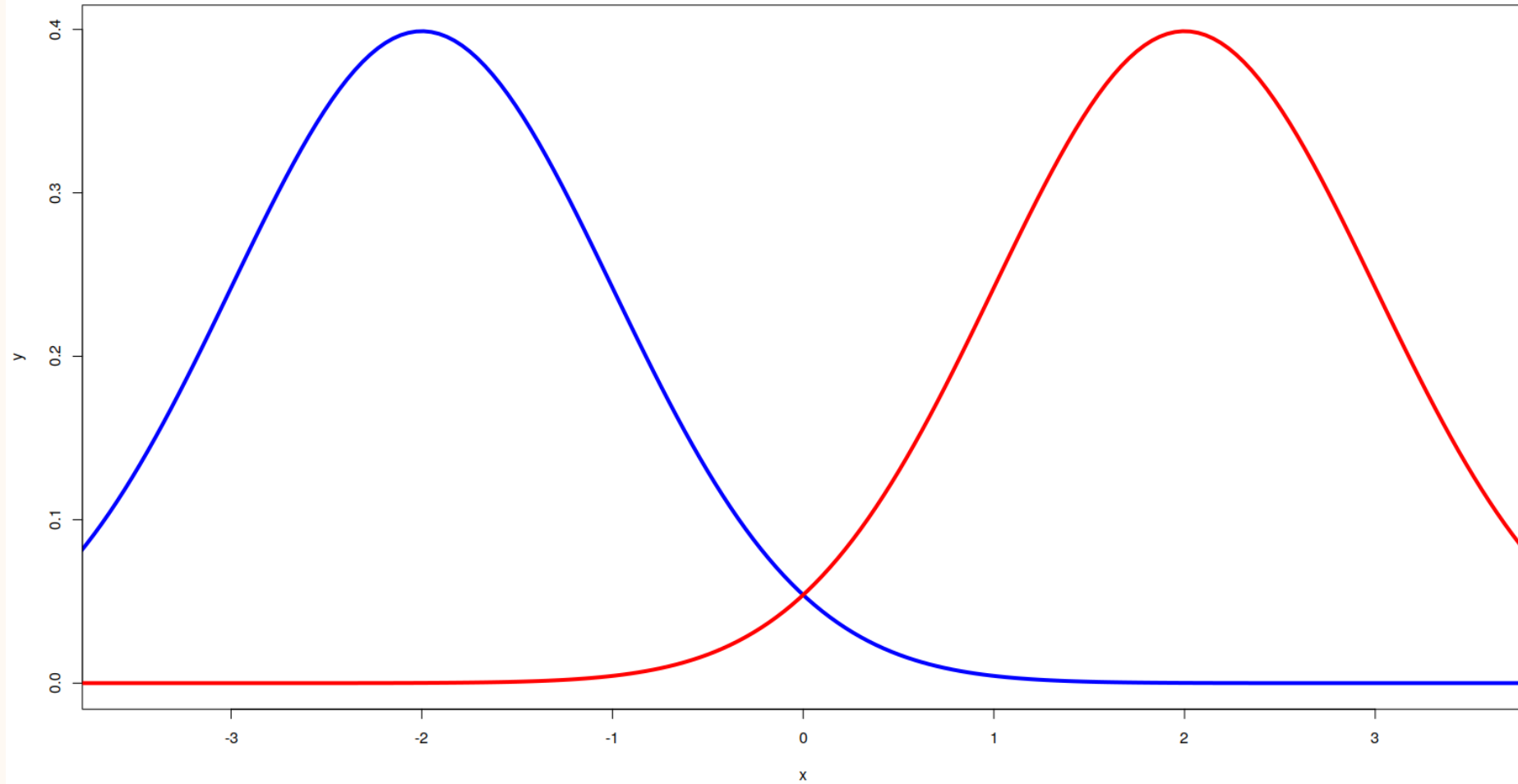


# Normal distribution

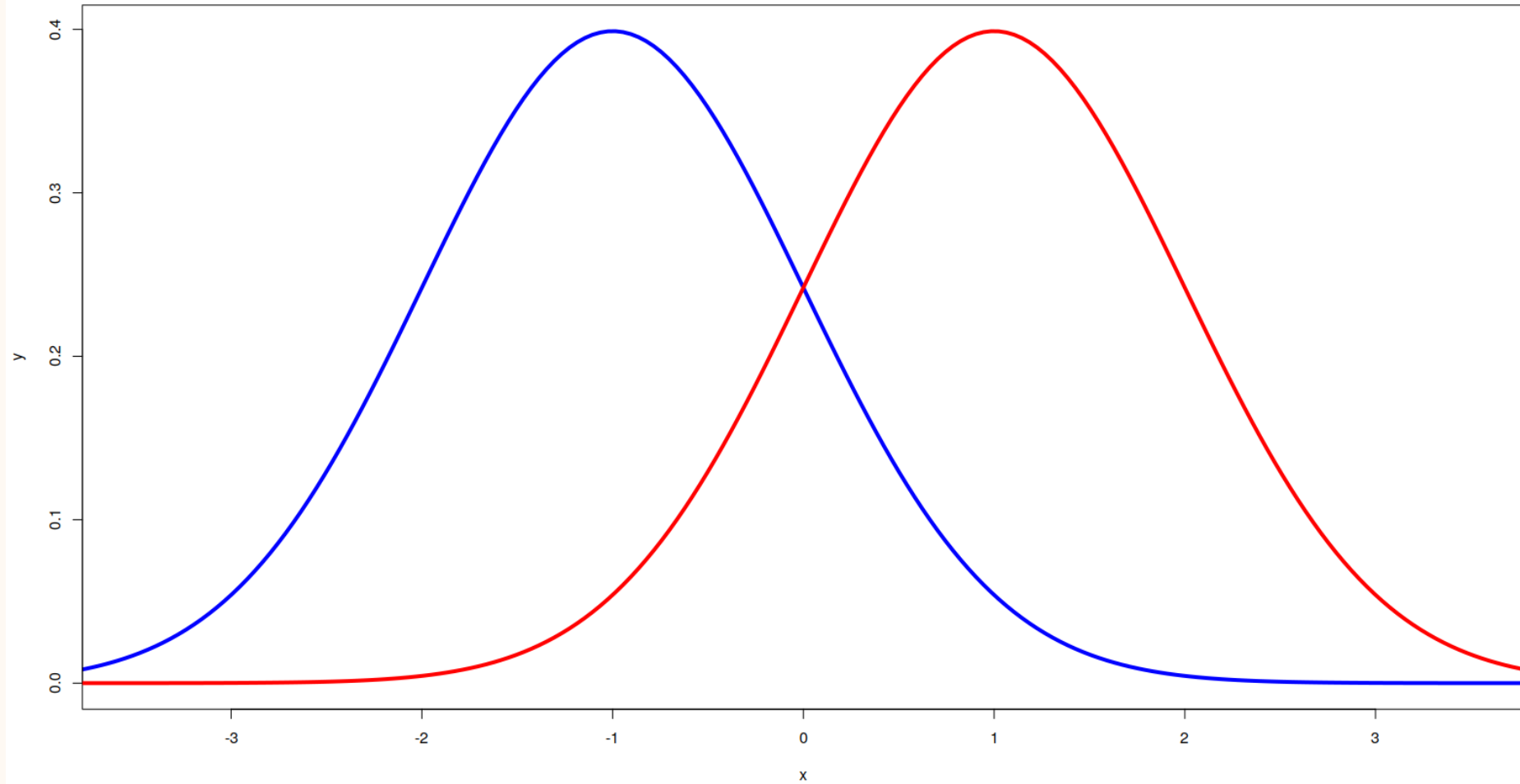


**T-test: Do two populations have the same mean?**

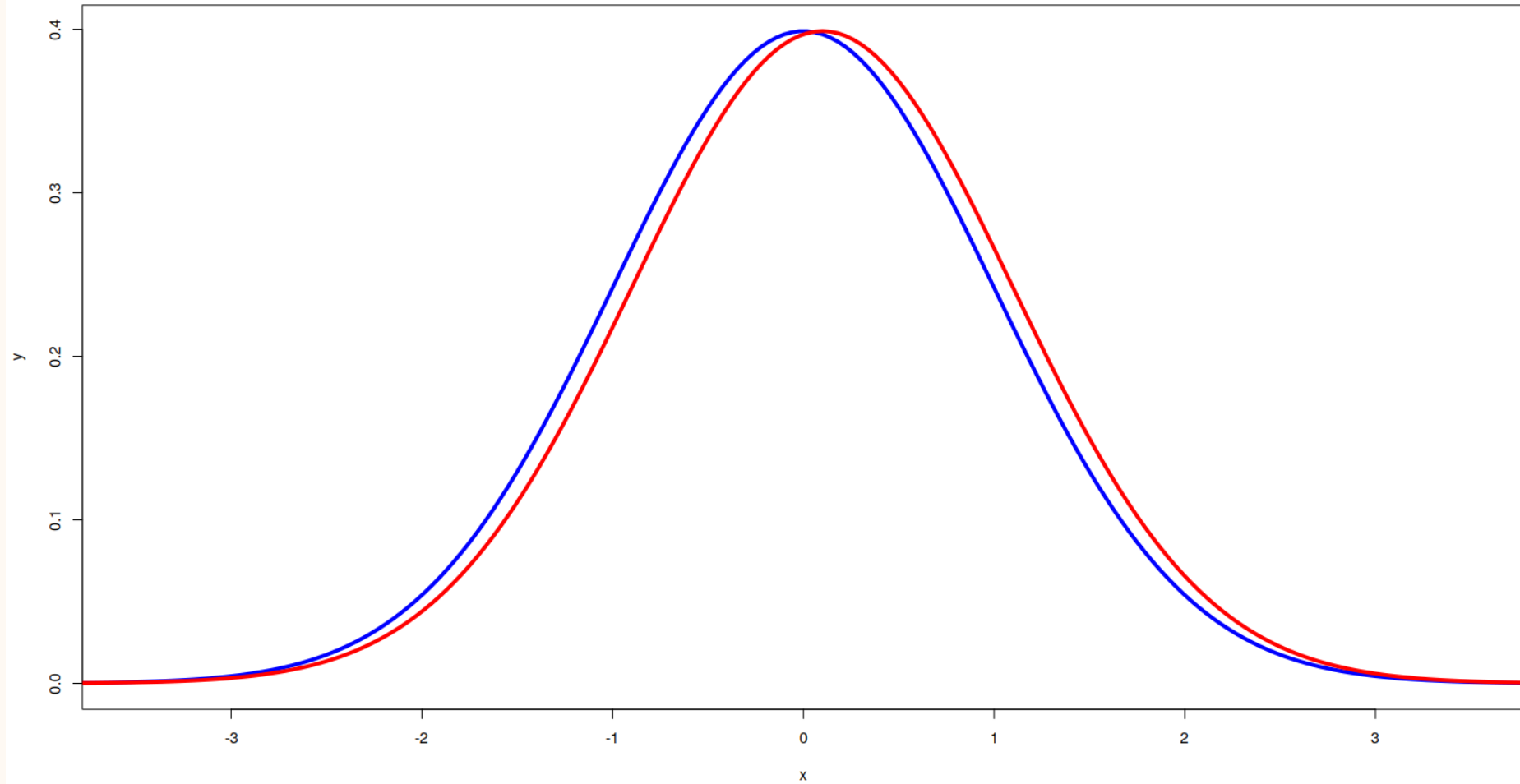
# Different means



# Maybe? different means



# Likely not different means



**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.**

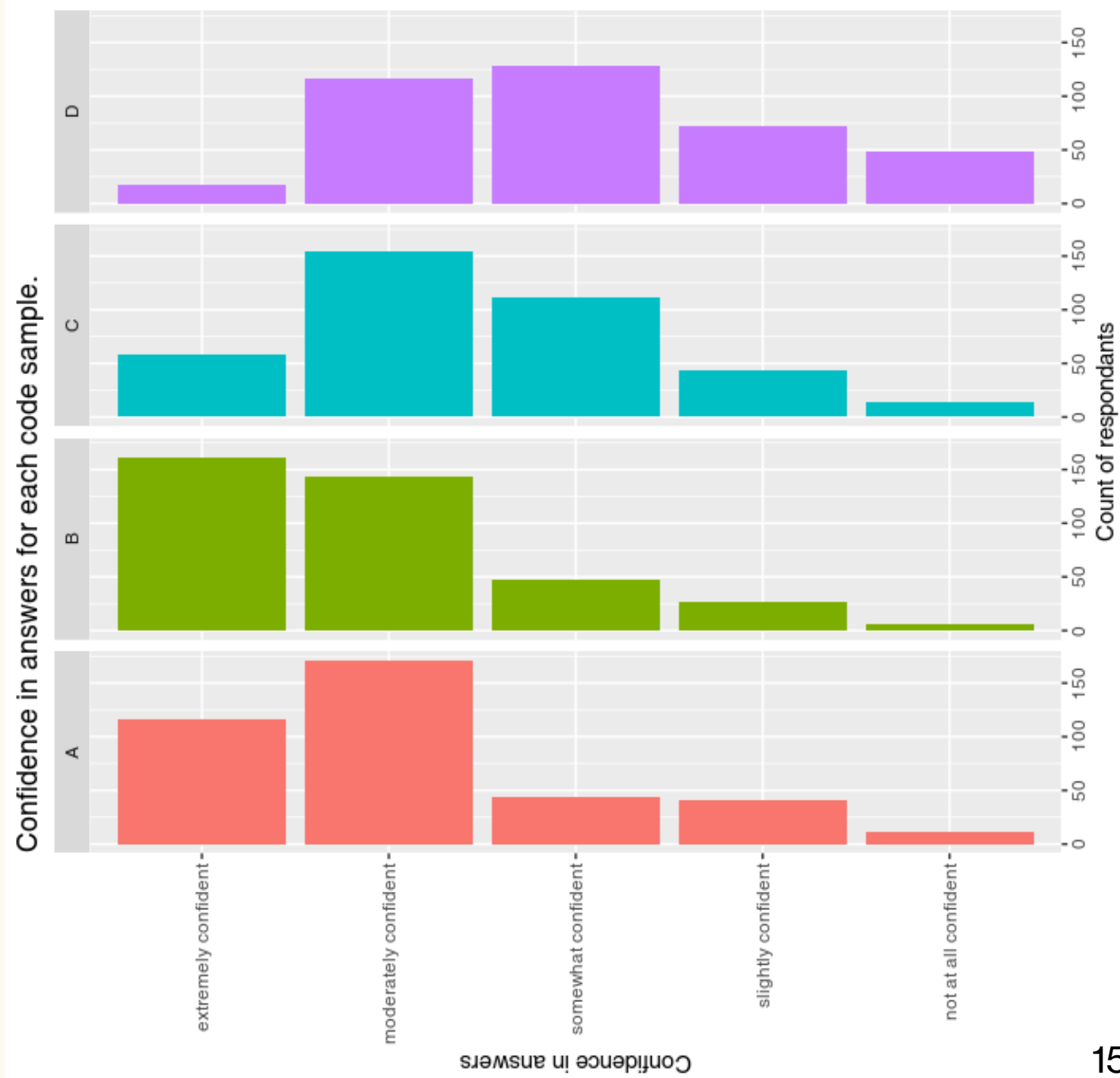
**Research Question: Does the code sample shown impact confidence in their answer?**

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

Within-subjects

**Independent:**  
Which code sample shown

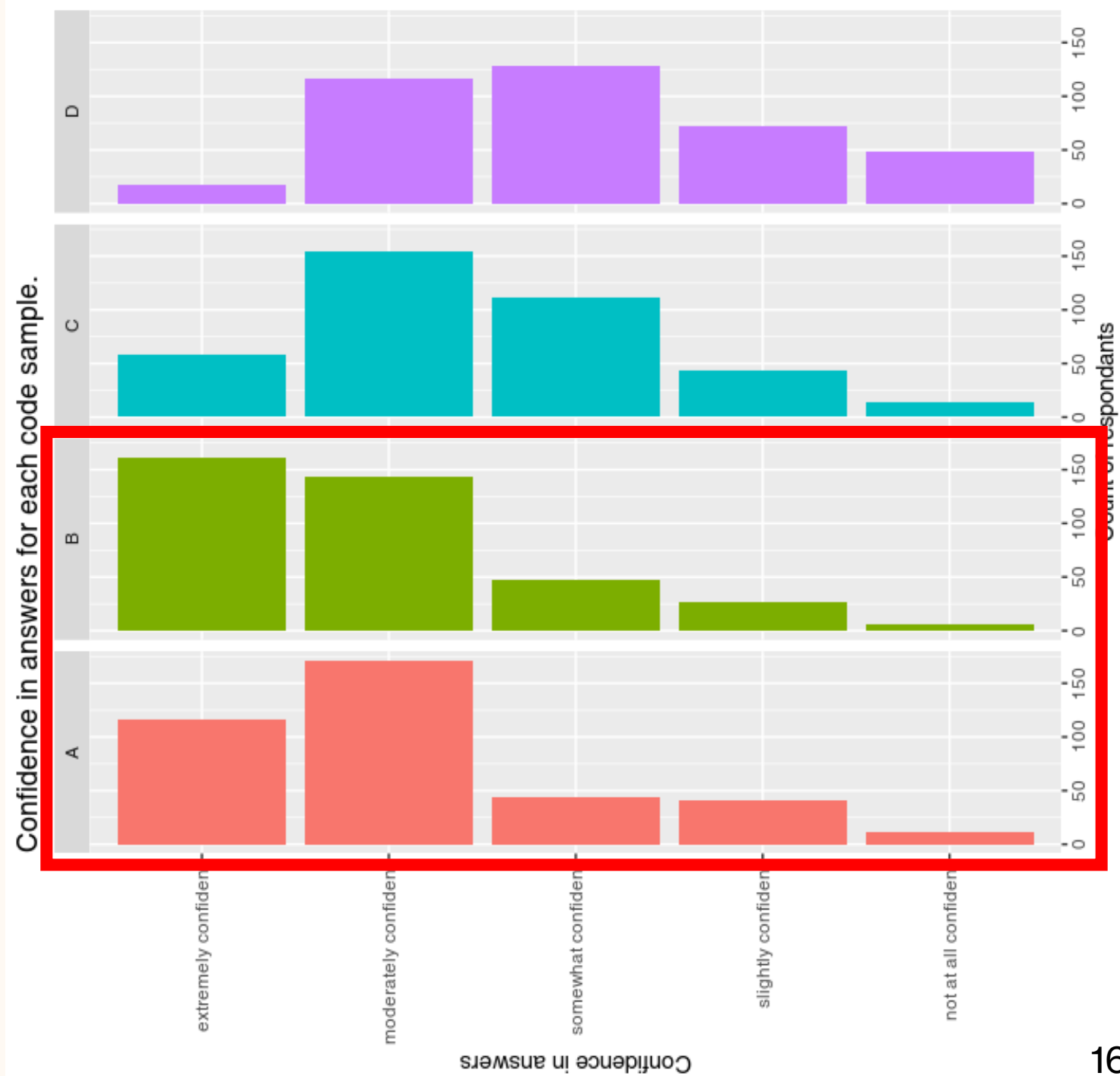
**Dependent:**  
Confidence



**Problem:** My categorical variable (code sample) is not binary, there are 4 levels.

**Solution:** Run the t-test on each pair. So test A vs B, A vs C, .... C vs D.

**Real solution:** Use an ANOVA (not covered in this class)



# Running the t-test

- This is a “**within** subjects” test where one person gave a confidence answer for **both** Code Sample A and Code Sample B
  - So we use a **Paired t-test**
- Create two arrays (or Excel columns) one with Code Sample A confidence, the other with Code Sample B confidence
- Two-sided (tailed)
  - For now, just do this. I don't have time to explain.
- Alpha of 0.05
  - p-value needs to be less than 0.05 to show that the two code samples produce different levels of confidence
  - Means that 5% of the time we will get the wrong answer from the statistical test

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

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

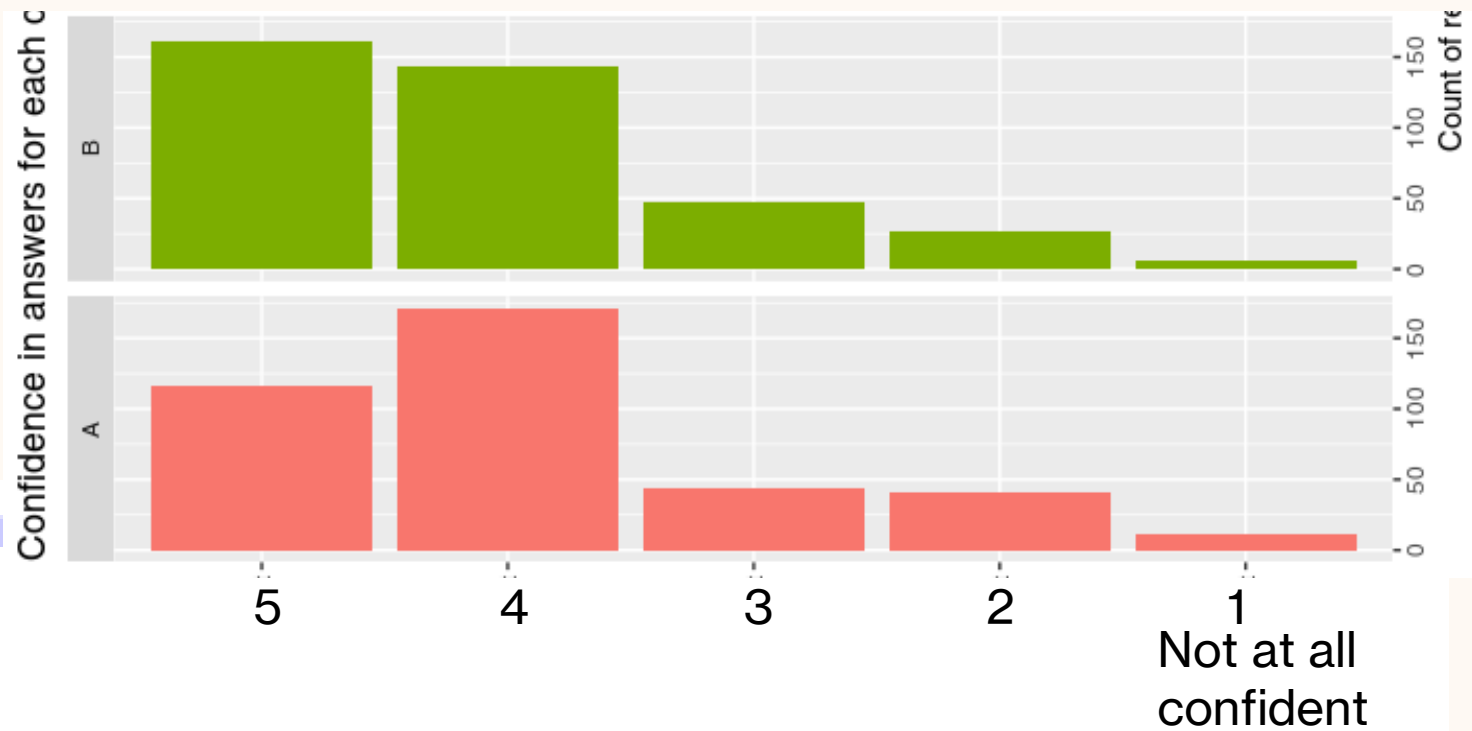
95 percent confidence interval:

-0.3218198 -0.1469302

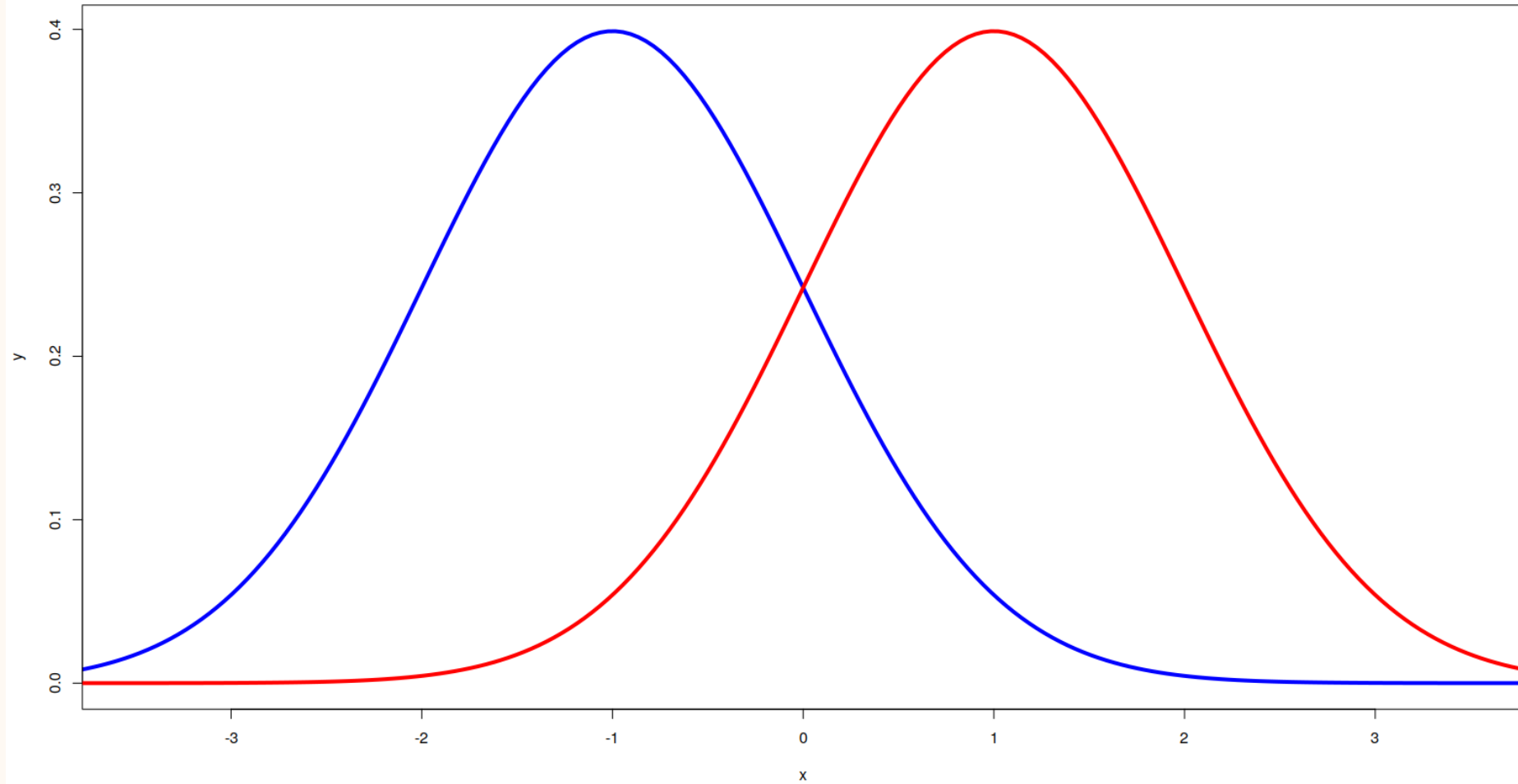
sample estimates:

mean of the differences

-0.234375



# Different means, small difference



**I ran a survey to learn about software update behaviors.**

**Research Question: Do women and men feel like they ask others for technical help with different frequency?**

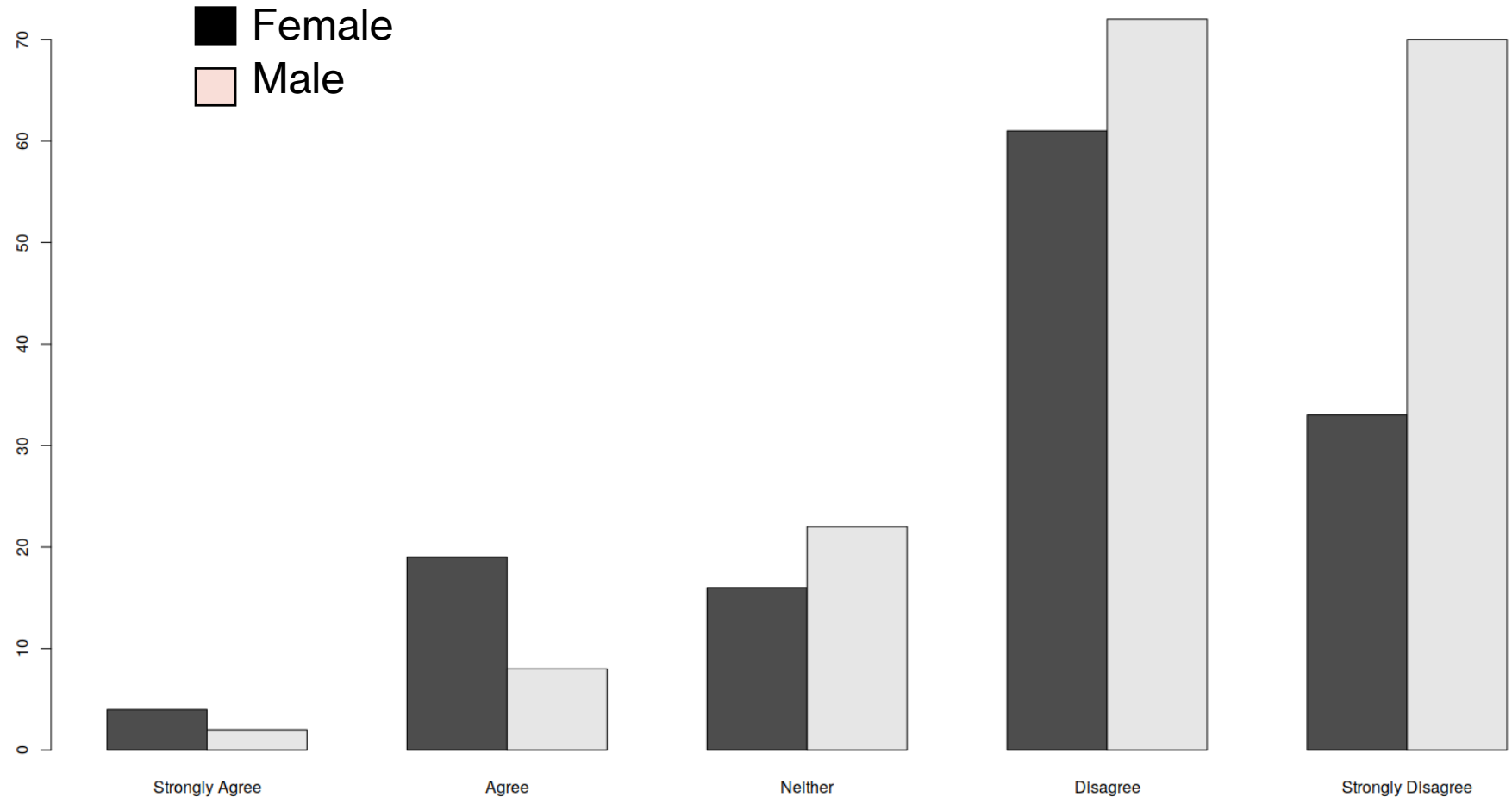
# Research

**Question:** Do women and men feel like they ask others for help with different frequency?

Between-subjects

**Independent:**  
Gender

**Dependent:**  
Agreement



I often ask others for help with technical questions

# Running the t-test

- This is a “**between** subjects” test where each person gave only one answer
  - So we use a **normal t-test** (not paired)
- Create two arrays one with women’s responses, one with men’s
- Two-sided (tailed)
  - For now, just do this. I don’t have time to explain.
- Alpha of 0.05
  - p-value needs to be less than 0.05 to show that the two genders produce different levels of confidence
  - This choice means that 5% of the time we will get the wrong answer from the statistical test

```
> t.test(as.numeric(d$i_ask_others_for_he
```

Welch Two Sample t-test

```
data: as.numeric(d$i_ask_others_for_help[d$gender == "Female"]) and [d$gender == "Male"]  
t = -3.4481, df = 253.99, p-value = 0.0006606
```

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

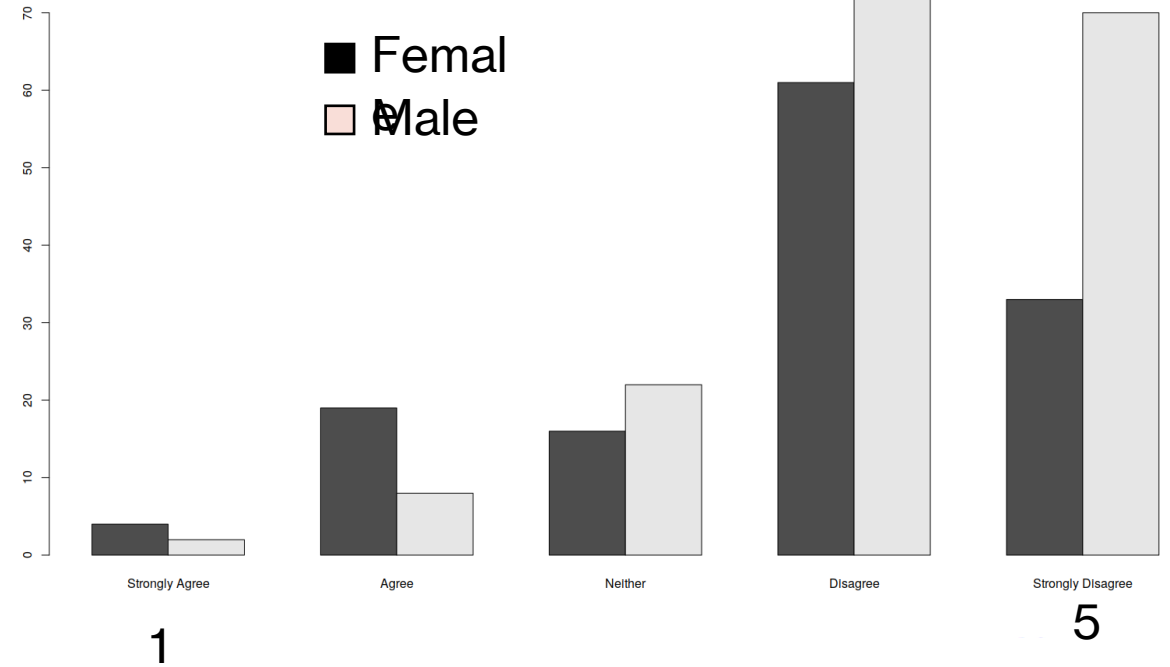
```
95 percent confidence interval:
```

```
-0.6245978 -0.1704934
```

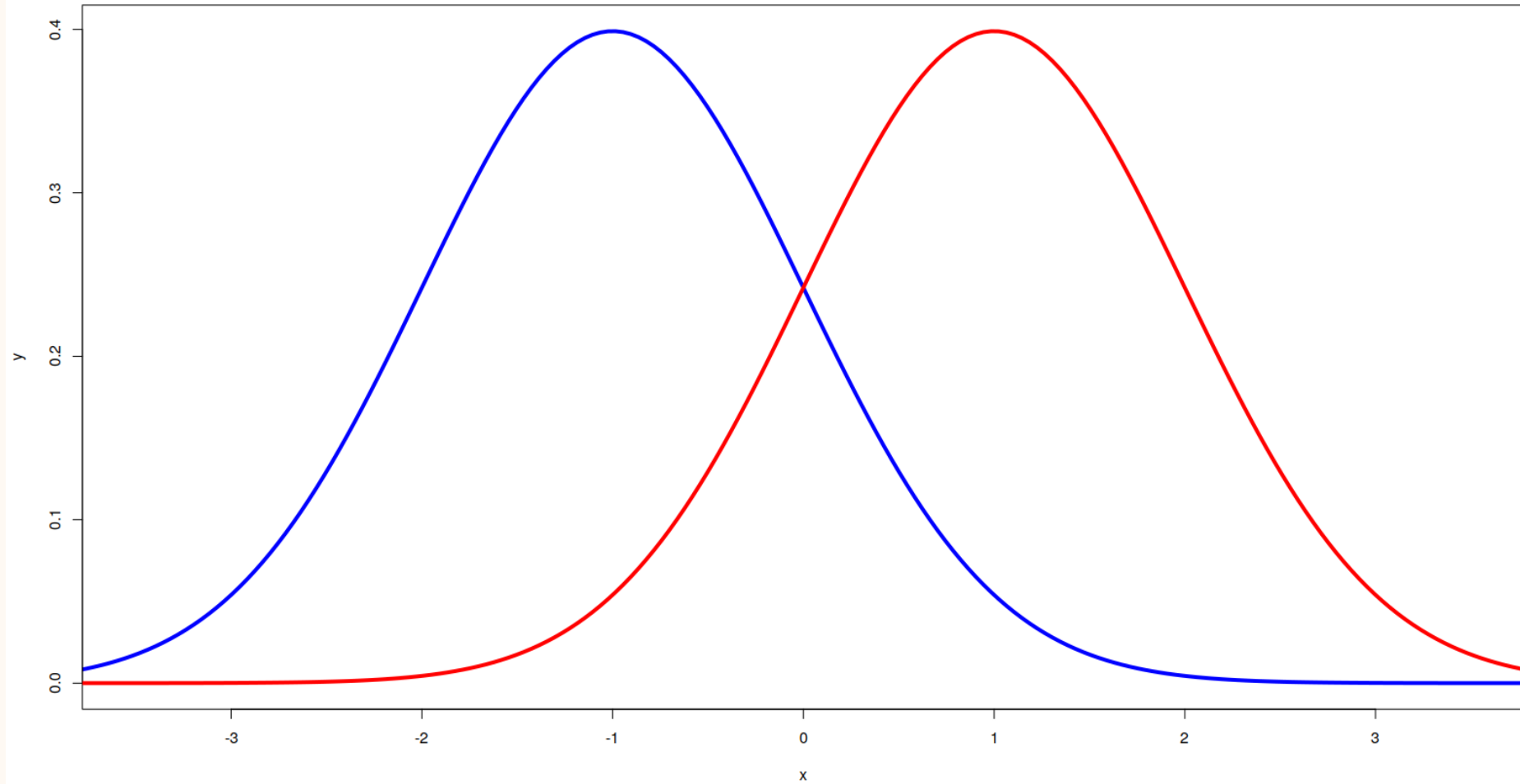
```
sample estimates:
```

```
mean of x mean of y
```

```
3.751880 4.149425
```



# Maybe? different means



**I asked participants to tell me a story about a prior software update.**

**Research Question:** Are people who relate positive stories older or younger?

## Research

**Question:** Are people who relate positive stories older or younger?

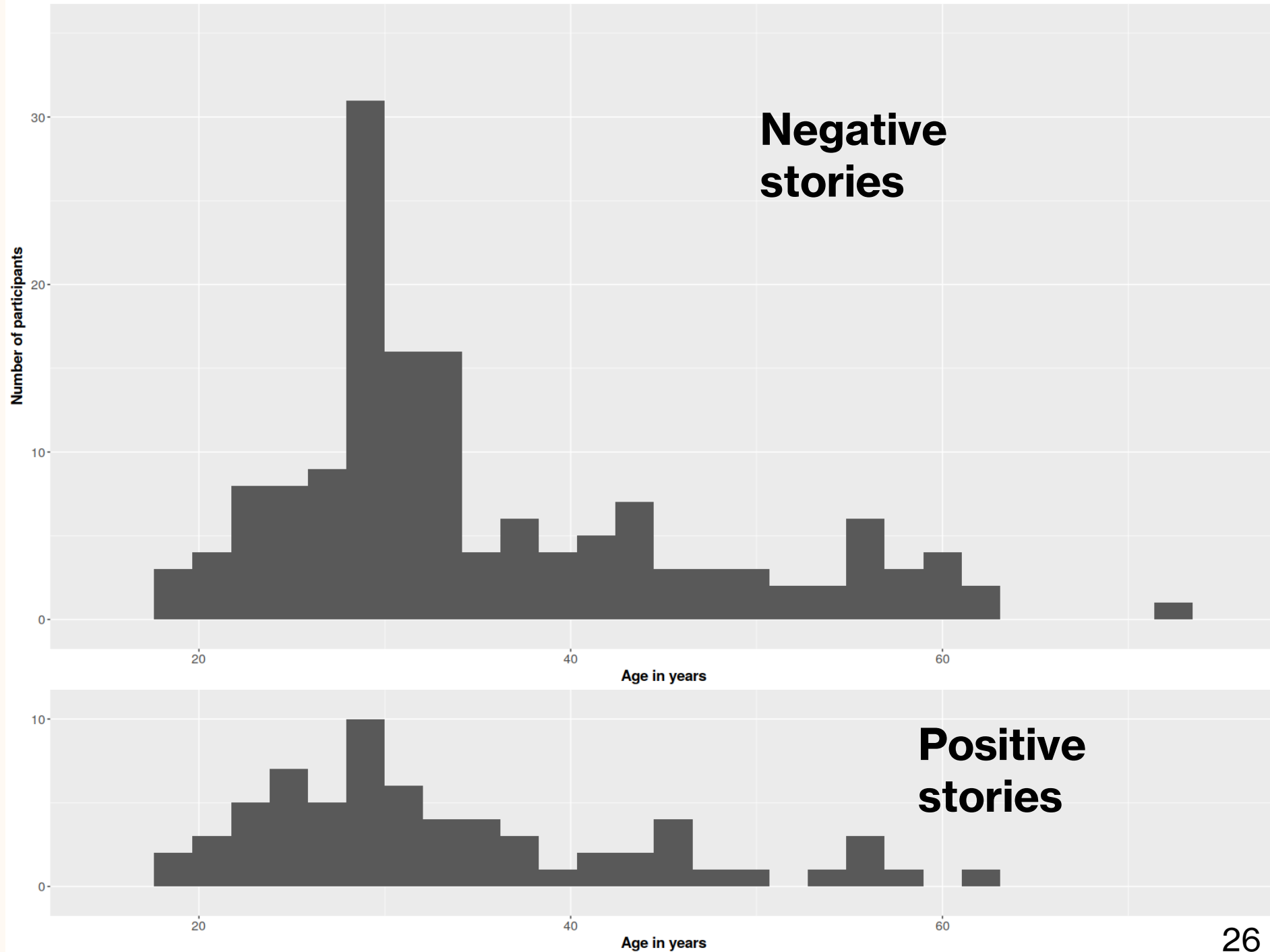
Between-subjects

**Dependent:**

- Age
- Numerical

**Independent:**

- Negative or Positive
- Binary



```
> t.test(s_neg$age, s_pos$age)
```

```
Welch Two Sample t-test
```

```
data: s_neg$age and s_pos$age
```

```
t = 0.75677, df = 123.07, p-value = 0.4506
```

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

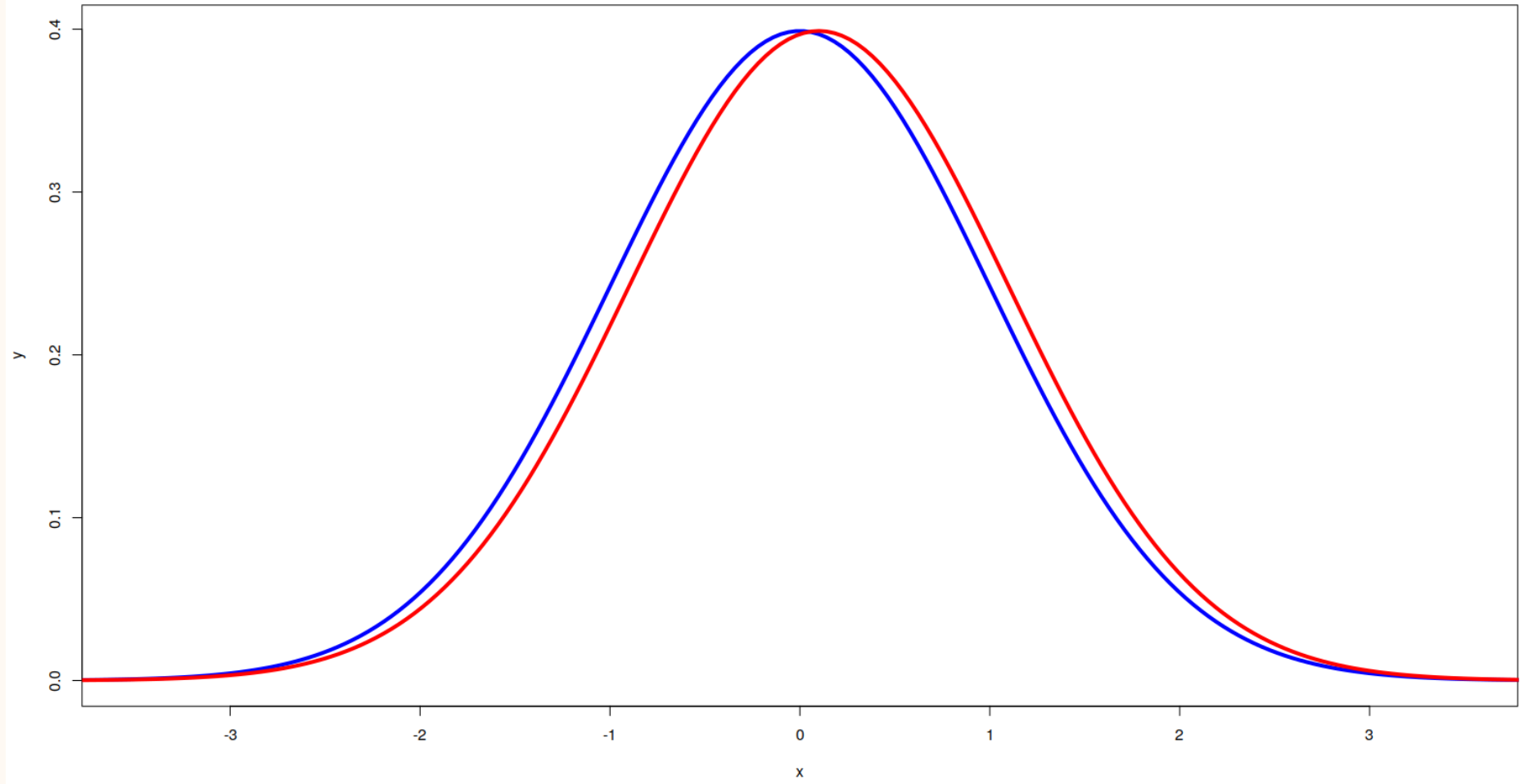
```
95 percent confidence interval:
```

```
-2.063833  4.618658
```

```
sample estimates:
```

```
mean of x mean of y
```

```
35.42667  34.14925
```



# Qualitative analysis

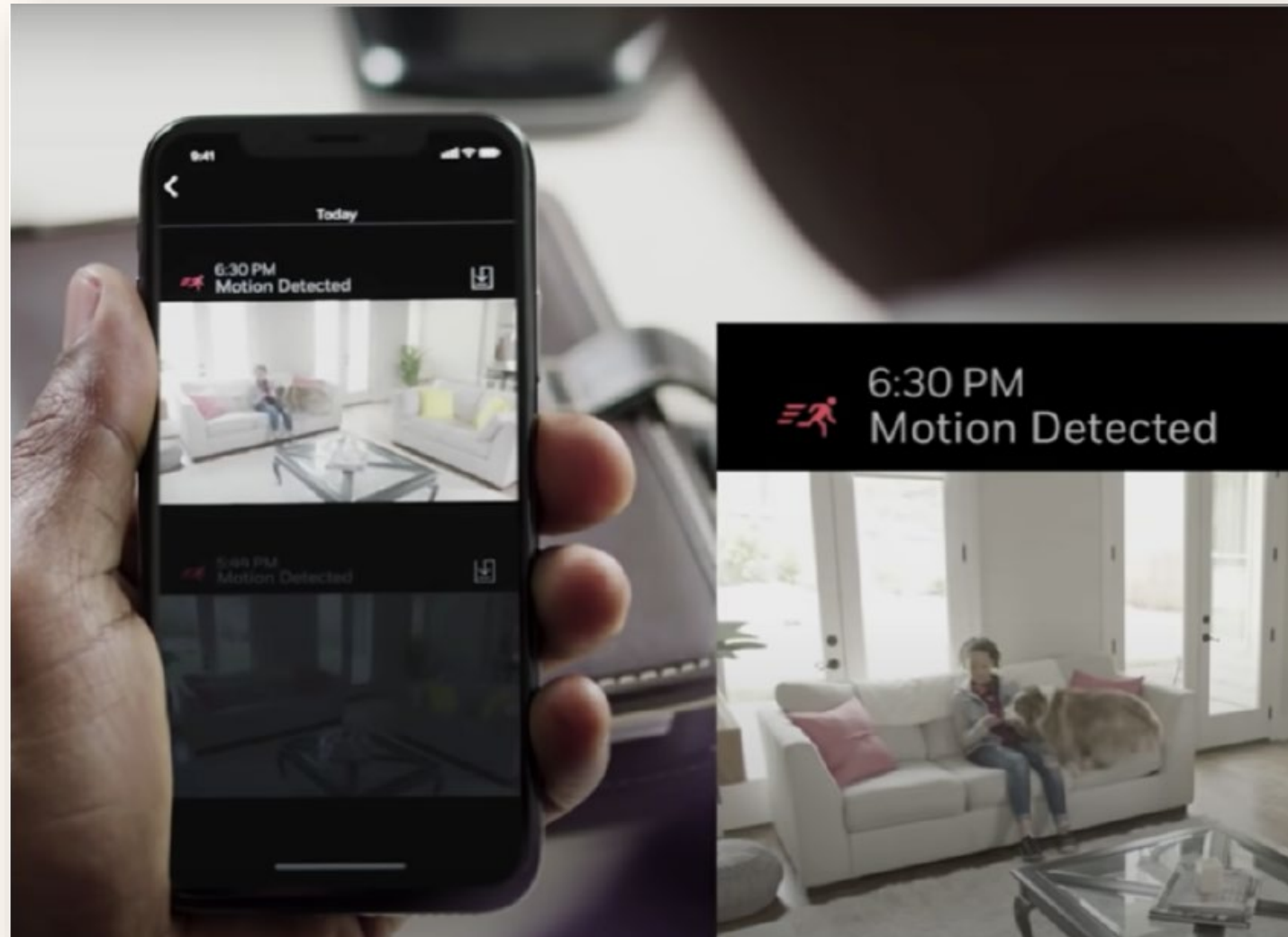
# When we need qualitative analysis

When we have unstructured data (text, image, video....)

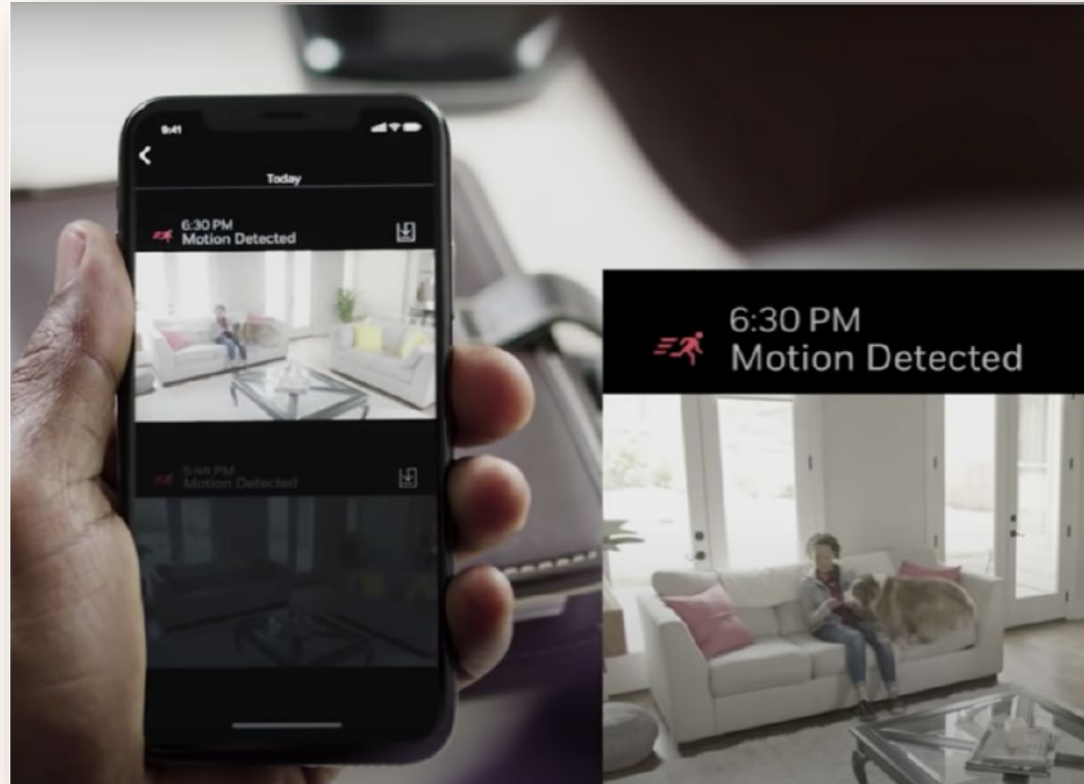
- Interview
- Open-ended entries
- Think aloud transcripts
- Short videos
- Photos
- Webpage
- Social media posts
- ....

Goal: form reliable interpretation of the data

# Give a try!



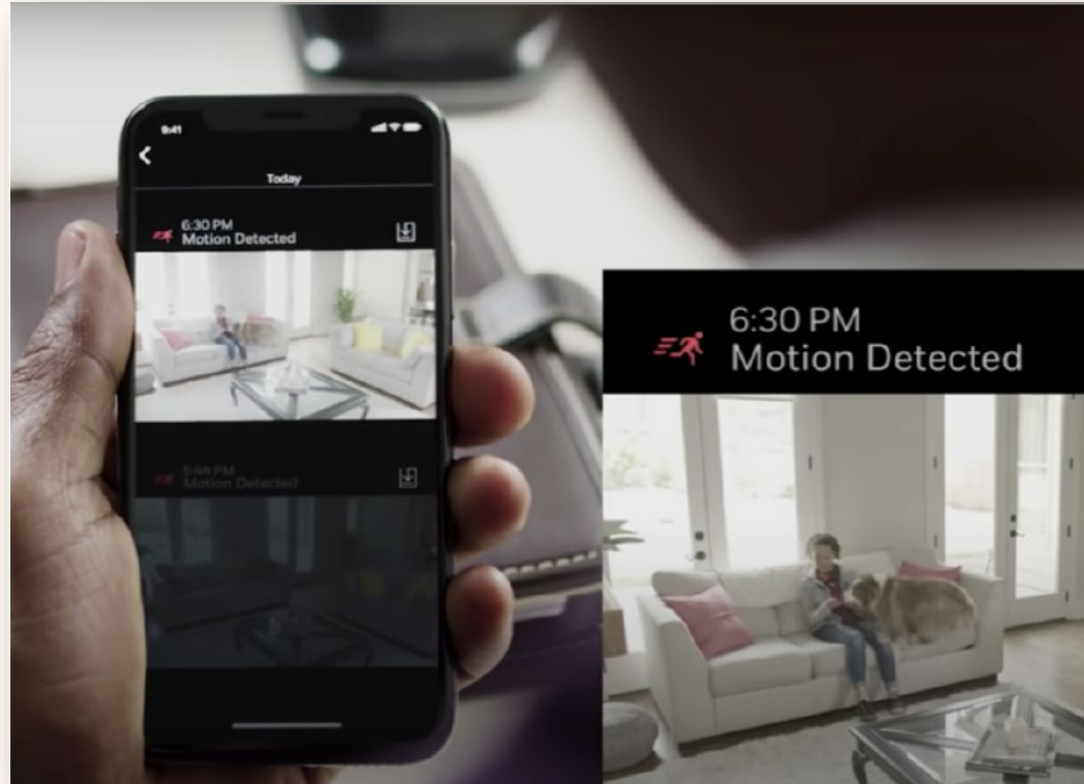
# Give a try!



- Snapshot of an app on a phone
- Child playing with dog
- Edited picture
- Motion detection enabled

....

# Give a try!



## What are the privacy concerns?

- Children being monitored
- Camera placed in the living room

....

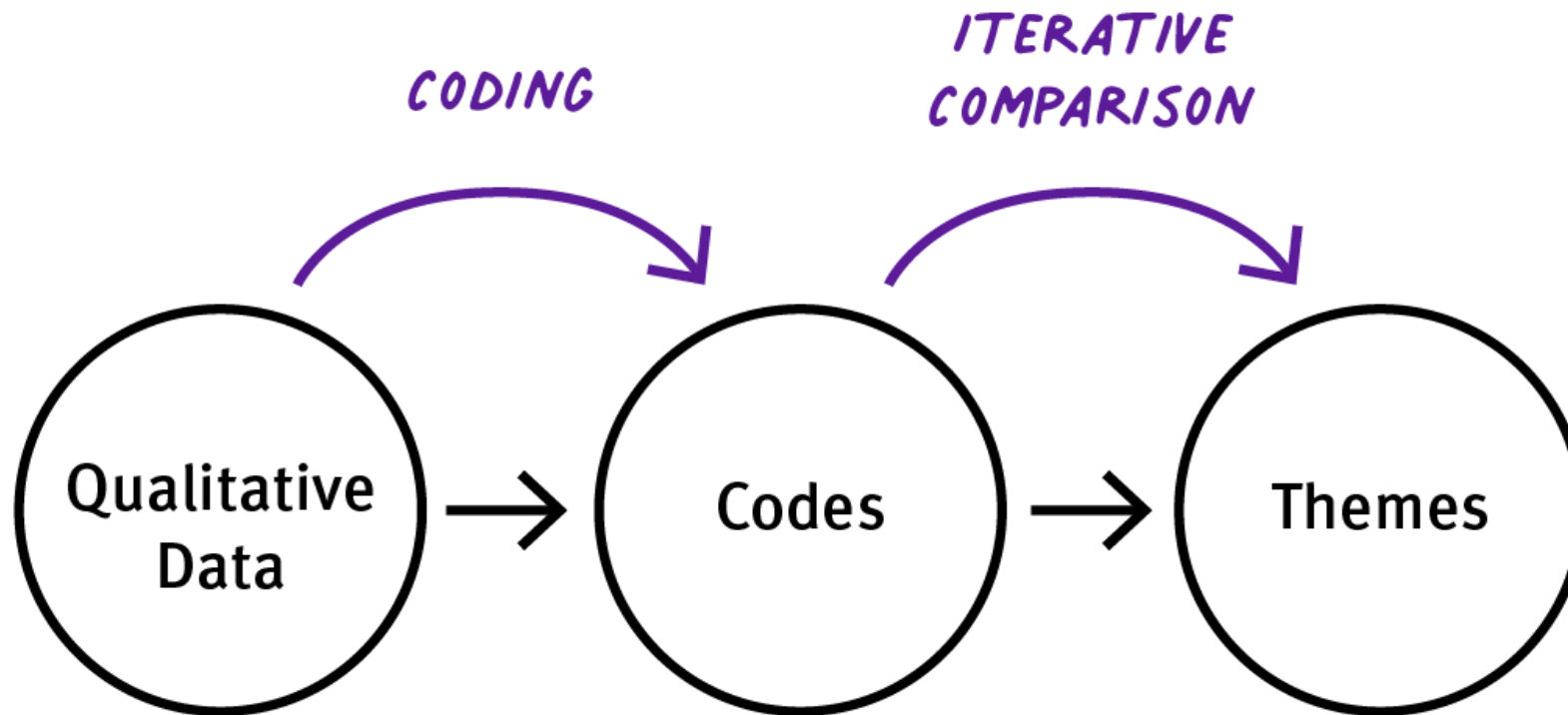
# Inductive coding vs deductive coding

- **Inductive:** look for any ideas that interest you from different aspects
  - Snapshot of an app on a phone
  - Child playing with dog
  - Edited picture
  - Motion detection enabled
  - ....

- **Deductive:** start with some hypothesis
  - Children being monitored by app (privacy concern)
  - Camera placed in the living room (place of the scene)

**We often use inductive and deductive coding together!**

# Thematic Analysis

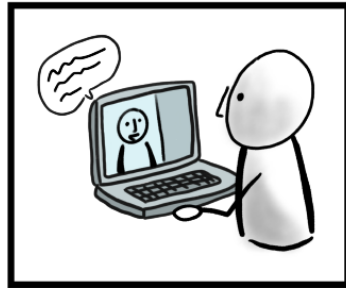


NNGROUP.COM **NN/g**

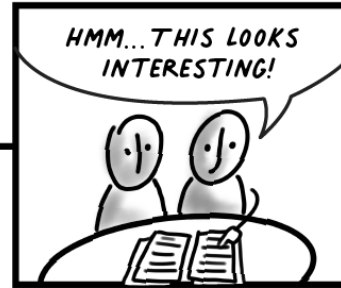
<https://www.nngroup.com/articles/thematic-analysis/>

# 6 Steps to Doing a Thematic Analysis

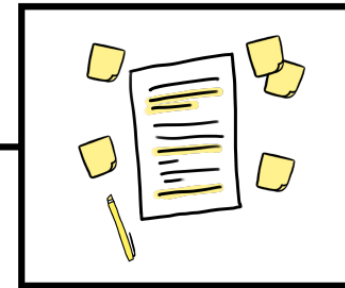
**STEP 1**  
Gather your data.



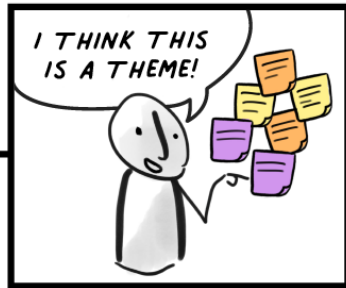
**STEP 2**  
Read all your data from beginning to end.



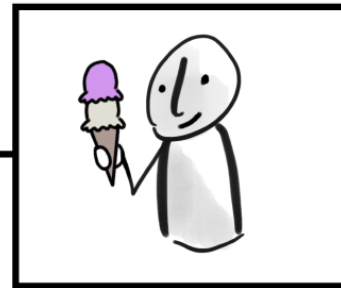
**STEP 3**  
Code the text based on what it's about.



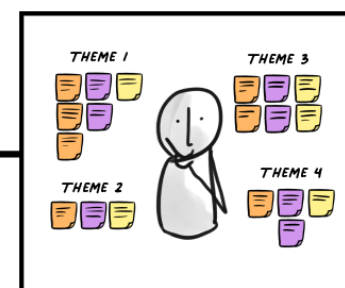
**STEP 4**  
Create new codes to encapsulate potential themes.



**STEP 5**  
Take a break for a day.



**STEP 6**  
Evaluate your themes for good fit.



REPEAT AS NEEDED

# Codebook

Analysis of child safety and privacy-related features and information		
Code/subcode		Explanation
If safety is mentioned (in text)	Webpage providing additional safety resources	The webpage provides extra links and resources for safety,
	Webpage not providing additional safety resources	The webpage provides no extra links or resources for safety, and it just mentions words about safety.
If privacy is mentioned (in text)	Webpage providing additional privacy resources	The webpage provides extra links and resources for privacy, and it just mentions words about privacy.
	Webpage not providing additional privacy resources	The webpage provides no extra links or resources for privacy, and it just mentions words about privacy.
Presence of product features addressing privacy or safety		The webpage shows features, such as child safety lock or privacy shutter buttons.
Presence of parental control-related information		The webpage shows how they offer parental control for the products, e.g., child-specific access control.
Presence of information for parents		The webpage shows information on what parents could do or not do with the children and the device, e.g., parents should supervise children when using the device.
Presence of child-specific content, features, functions, and profile		The webpage shows products offering child mode, content, and child profiles.
Presence of information/disclaimer of potential risks		The webpage shows potential safety risks or misuse, or explains what parents need to be aware of regarding the potential privacy or safety risks.
Presence of information on child data collection and use		The webpage shows how the company handles child-related data. Examples include data collection and use, sharing, and selling.
Indication of child existence (when child image is not presented)		The webpage shows no children, but the image shows child-related signals, including children's bedroom or toys/stuff around the smart home device or in the room.
Presence of smart home guide, e.g., teaching children about device use		The webpage shows instructions or materials directly addressing children, teaching children about device use.

- Read the data, iteratively refine the codes (in discussion with others), organize codes in a hierarchy...

# Reliability

- Stability (intra-rater reliability): whether the same coder codes the data in a consistent way throughout the process
- Reproducibility (inter-coder reliability): whether different coders code the same piece of data consistently (metric: Cohen's Kappa)

# Do we still need a human coder?

## CollabCoder: A Lower-barrier, Rigorous Workflow for Inductive Collaborative Qualitative Analysis with Large Language Models

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Simon Tangi Perrault

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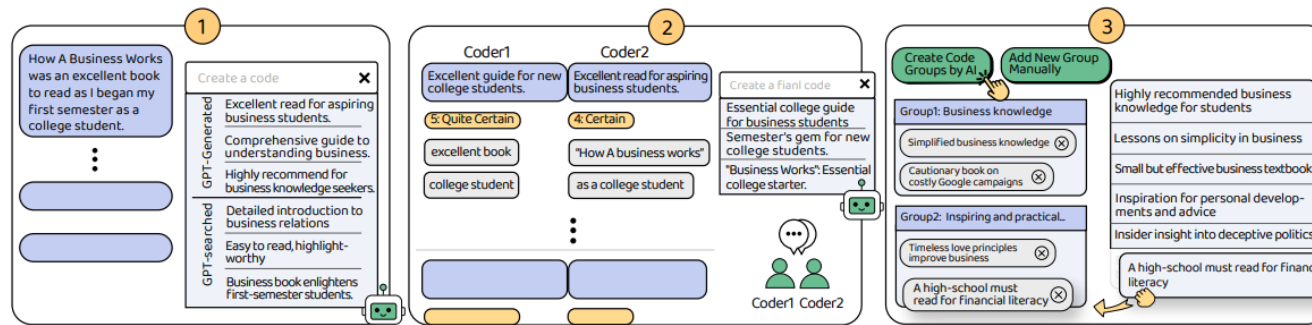
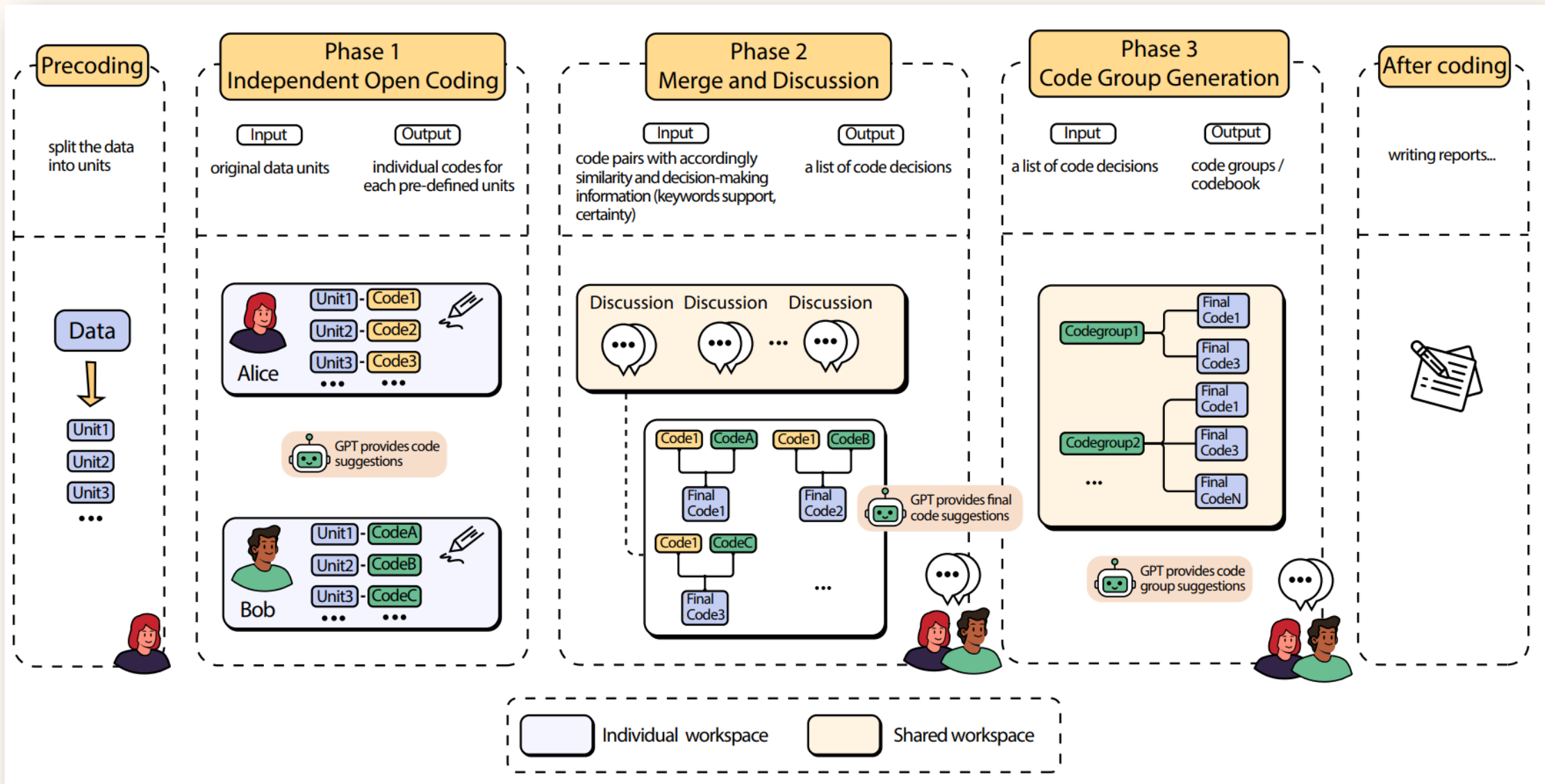


Figure 1: CollabCoder, An Integrated Workflow for Collaborative Qualitative Analysis. The workflow consists of three key stages: 1) Independent Open Coding, facilitated by on-demand code suggestions from LLMs, yielding initial codes; 2) Iterative Discussion, focusing on conflict mediation within the coding team, producing a list of agreed-upon code decisions; 3) Codebook Development, where code groups may be formed through LLM-generated suggestions, based on the list of decided codes.



Pre-coding: Create Consistent Data Units

### Create a new project

Project Name **1**

example\_project\_1

Add documents **2**

Only .csv and .txt files are allowed.

Choose files cleaned\_business.csv

Level of coding

Sentence **3**

Paragraph

Add collaborators

Email/Username

Bob **4**



Create new project **5**



Alice



Invitation



Bob

### Raw Data

How A Business Works was an excellent book to read as I began my first semester as a college student. Although my goal is to major in Business, I started my semester off with no idea of even the basic guidelines a Business undergrad should know. This book describes in detail every aspect dealing with business relations, and I enjoyed reading it. It felt great going to my additional business classes prepared and knowledgeable on the subject they were describing. Very well written, Professor Haeberle! I recommend this book to anyone and everyone who would like additional knowledge pertaining to business matters.

This is an inspirational and insightful book that is well written and contains some profound methods to improve your thinking and improve your life. The ideas and methods that Robbins suggests are not just theory but I can attest from personal experience that they really work as I have successfully used some of the concepts. Fried summarizes the best personal development strategies and combines it with brilliant business principles to help you become the entrepreneur of your own existence. I LOVED it.

Whether just starting out with a new business or being a seasoned owner pregnancy will throw some curve balls. This book helps you navigate through business and pregnancy and how they relate to one another. Must read for women who own their own businesses and want/are starting a family. Disclosure - I received a copy of this book for review purposes. However all opinions are my own.

I read a lot of motivational, business and self help books. This one is nothing like the others. There's a ton of great advice in this book, much of it is counter to conventional wisdom. I found it refreshing to read because the author is not afraid to say things that may be unpopular. My only real complaint is that it is such an easy book to read (feels like you are in the room listening to him speak)that you may end up flying through some of the great points without them registering fully. Read this one with a highlighter in hand.

Split the raw data into pre-defined data units, e.g., sentence, paragraph, etc.

Unit1

How A Business Works was an excellent book to read as I began my first semester as a college student. Although my goal is to major in Business, I started my semester off with no idea of even the basic guidelines a Business undergrad should know. This book describes in detail every aspect dealing with business relations, and I enjoyed reading it. It felt great going to my additional business classes prepared and knowledgeable on the subject they were describing. Very well written, Professor Haeberle! I recommend this book to anyone and everyone who would like additional knowledge pertaining to business matters.

**2a**

Unit2

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Unit3

Whether just starting out with a new business or being a seasoned owner pregnancy will throw some curve balls. This book helps you navigate through business and pregnancy and how they relate to one another. Must read for women who own their own businesses and want/are starting a family. Disclosure - I received a copy of this book for review purposes. However all opinions are my own.



## Phase 1: Open Coding

### Editor


Filters Export

ID	Raw Data	Add Code	Keywords support	Certainty
0	How A Business Works was an excellent book to read as I began my first semester as a college student. Although my goal is to major in Business, I started my semester off with no idea of even the basic guidelines a Business undergrad should know. This book describes in detail every aspect dealing with business relations, and I enjoyed reading it. It felt great going to my additional business classes prepared and knowledgeable on the subject they were describing. Very well written, Professor Haerberle! I recommend this book to anyone and everyone who would like additional knowledge pertaining to business matters.	Essential read for new college students	excellent book college students	5
1	This is an inspirational and insightful book that is well written and contains some profound methods to improve your thinking and improve your life. The ideas and methods that Robbins suggests are not just theory but I can attest from personal experience that they really work as I have successfully used some of the concepts. Fried summarizes the best personal development strategies and combines it with brilliant business principles to help you become the entrepreneur of your own existence. I LOVED it.	Comprehensive guide to understanding business.	improve attest from personal experience best personal development strategies	5
2	Easy read. A tale of burning and flying, acceptance and soaring. I applaud this book describing a successful businessman who decides to chuck it all in hopes of finding out the big WHY. An almost believable story that combines humanness with spirituality, ya know, super oneness and love. I appreciated the author's command of the written word. It is alerting us to become aware we are on a journey of light and love. It's about meditation and where it can lead us. A story built around seeking, Thank you Jacob for sharing this teaching with us.	Journey of light and love.	super oneness love	3

### Codebook

Filters Export

ID	Code	Time
0	Detailed introduction to busines...	28/08/2023, 11:01:09
1	Inspiring guide to improve life	21/03/2023, 10:00:49
2	Journey of light and love.	21/03/2023, 10:02:32
3	Essential for female entreprene...	21/03/2023, 10:03:16
4	Easy to read, highlight-worthy.	21/03/2023, 10:03:52
5	Well-written lesson on simplicity.	21/03/2023, 10:05:39
6	Corrupt auto insurance industry ...	21/03/2023, 10:06:55
7	Timeless principles boost botto...	21/03/2023, 10:07:45
8	Rodriguez tells truth, Pelosi lies.	21/03/2023, 10:09:31
9	Essential finance guide for stud...	21/03/2023, 10:10:15
10	Fun and informative graphic nov...	21/03/2023, 10:11:07
11	Guide for bringing faith to workp...	21/03/2023, 10:12:00



Alice      Individual workspace

### 2a Add Keywords Support:

Raw Data

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How A Business Works was an excellent book to read as I began my first semester as a college student. Although my goal is to major in Business, I started my semester off with no idea of even the basic guidelines a Business undergrad should know. This book describes in detail every aspect dealing with business relations, and I enjoyed reading it. It felt great going to my additional business classes prepared and knowledgeable on the subject they were describing. Very well written, Professor Haerberle! I recommend this book to anyone and everyone who would like additional knowledge pertaining to business matters.

keywords support

---

excellent book

college students

## Phase 1: Open Coding

### Editor


Filters Export

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1	This is an inspirational and insightful book that is well written and contains some profound methods to improve your thinking and improve your life. The ideas and methods that Robbins suggests are not just theory but I can attest from personal experience that they really work as I have successfully used some of the concepts. Fried summarizes the best personal development strategies and combines it with brilliant business principles to help you become the entrepreneur of your own existence. I LOVED it.	Comprehensive guide to understanding business.	improve attest from personal experience best personal development strategies	5
2	Easy read. A tale of burning and flying, acceptance and soaring. I applaud this book describing a successful businessman who decides to chuck it all in hopes of finding out the big WHY. An almost believable story that combines humanness with spirituality, ya know, super oneness and love. I appreciated the author's command of the written word. It is alerting us to become aware we are on a journey of light and love. It's about meditation and where it can lead us. A story built around seeking, Thank you Jacob for sharing this teaching with us.	Journey of light and love.	super oneness love.	3

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10	Fun and informative graphic nov...	21/03/2023, 10:11:07
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Alice  
Individual workspace

### 2a Add Keywords Support:

Raw Data

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keywords support

excellent book

college students

Phase2: Merge and discuss

Filters Export Calculate Replace All Undo All

ID	Raw Data	Alice	Bob	Similarity	Decision
0	How A Business Works was an excellent book to read as I began my first semester as a college student. Although my goal is to major in Business, I started my semester off with no idea of even the basic guidelines a Business undergrad should know. This book describes in detail every aspect dealing with business relations, and I enjoyed reading it. It felt great going to my additional business classes prepared and knowledgeable on the subject they were describing. Very well written, Professor Haeberle! I recommend this book to anyone and everyone who would like additional knowledge pertaining to business matters.	<p>5 Excellent guide for new college students.</p> <p>excellent book</p> <p>college students</p>	<p>4 Excellent read for aspiring business students.</p> <p>"How A business works"</p> <p>as a college student</p>	0.876	<p>4 Essential college guide for business students</p> <p>ChatGPT</p> <p>Version1: Essential college guide for business students</p> <p>Version2: Semester's gem for new college students</p> <p>Version3: Essential college starter</p>
1	This is an inspirational and insightful book that is well written and contains some profound methods to improve your thinking and improve your life. The ideas and methods that Robbins suggests are not just theory but I can attest from personal experience that they really work as I have successfully used some of the concepts. Fried summarizes the best personal development strategies and combines it with brilliant business principles to help you become the entrepreneur of your own existence. I LOVED it.	<p>5 Inspiring guide to improve life</p> <p>improve</p> <p>attest from personal experience</p> <p>best personal development strategies</p>	<p>4 Practical and insightful self-help guide.</p> <p>inspirational and insightful book</p>	0.845	<p>Inspiring and practical personal development book</p>
2	Easy read. A tale of burning and flying, acceptance and soaring. I applaud this book describing a successful businessman who decides to chuck it all in hopes of finding out the big WHY. An almost believable story that combines humanness with spirituality, ya know, super oneness and love. I appreciated the author's command of the written	<p>3 Journey of light and love.</p> <p>super oneness</p>	<p>5 Burning, flying, and acceptance</p> <p>burning and flying,</p>	0.699	<p>Spiritual journey of acceptance and discovery.</p>

1

1a

3a

Calculate

Statistics

Progress

Alice 100%

Bob 100%

Cohen's Kappa 0.11

Agreement Rate 0.2



Alice & Bob Shared workspace






2 For Alice, Bob's coding task can only be displayed after both of them finish coding task



## Phase3: Code Group Generation



### Code Groups







**2** + Add New Group    Create Code Groups By AI    **3** Update/Save code groups



**Group1: Business knowledge**  





- Simplified business knowledge 
- Cautionary book on costly Google campaigns. 
- Balancing business and motherhood **2b** 
- Effective lessons on simplicity 
- Straightforward, actionable advice for digital business 

**2a**  

**Group2: Inspiring and practical personal development book**  


- Timeless love principles improve business. 
- A high school must-read for financial literacy. 
- Practical guide for integrating faith in business 
- Inspiring and practical personal development book 
- Spiritual journey of acceptance and discovery. 
- Entertaining and educational graphic novel. 


**Group3: Unconventional, but valuable business insights**  

- Innovative leadership through Jugaad. 
- Unconventional, but valuable business insights. 
- Trial lawyer exposes insurance industry corruption 
- Politicians deceive for political gain. 


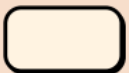
### Code Decision List

>> Double click to change the code. The codes in 'comparison' page will also be changed **1**

**Balancing business and motherhood** 

**1a** 

Straight to the point, it's cheap, it tastes **1a** is cheap. The good: price, location, dessert (recommended food items are: baked chicken, fried chicken, potatoes, Salad, meat and cheese, pizza) also our waitress was great. The normal: behind the counter meat slicing station, shrimp (not even deshelled), Mexican station. The bad: breakfast -worst eggs ever, actually worst, eggs. The chef can't even cut through ham or hard bread (tried on all 3 occasions), beef, shrimp again. As for decoration, it's the 1970 nightmare you can imagine.

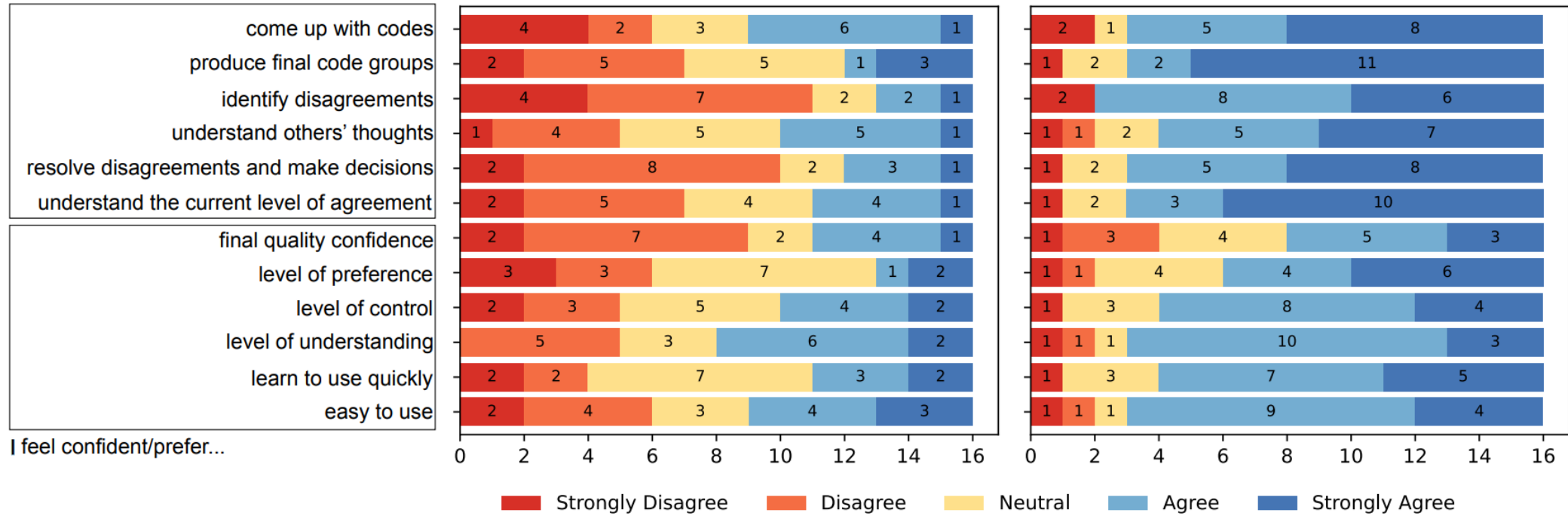
 

Alice & Bob    Shared workspace

I find it effective to...

Atlas.ti Web

CollabCoder



# Take-home

- **(Blog)** Li, J., Sun, K., Huff, B.S., Bierley, A.M., Kim, Y., Schaub, F. and Fawaz, K., 2023, January. [“It’s up to the Consumer to be Smart”: Understanding the Security and Privacy Attitudes of Smart Home Users on Reddit.](#) In *IEEE Symposium on Security and Privacy (SP)*
- **(Blog)** Forbes - [Is Apple’s New Vision Pro Going To Be A Privacy Nightmare?](#)