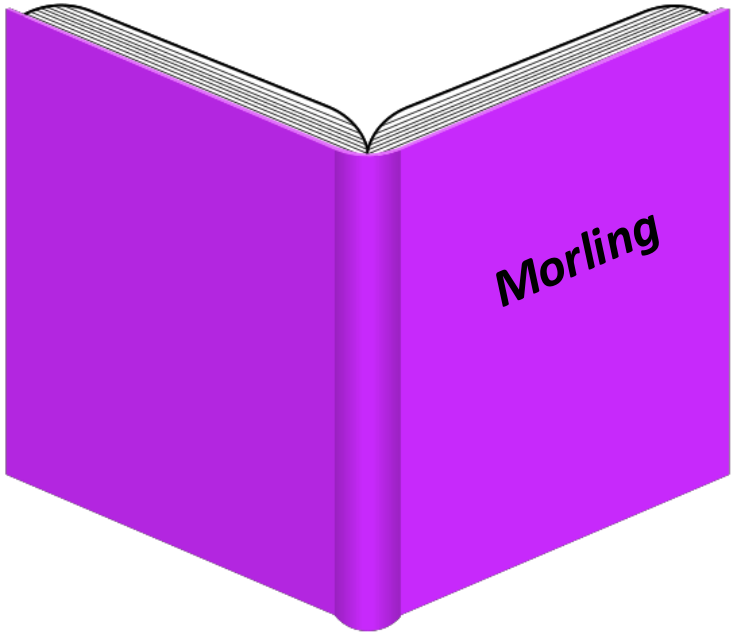
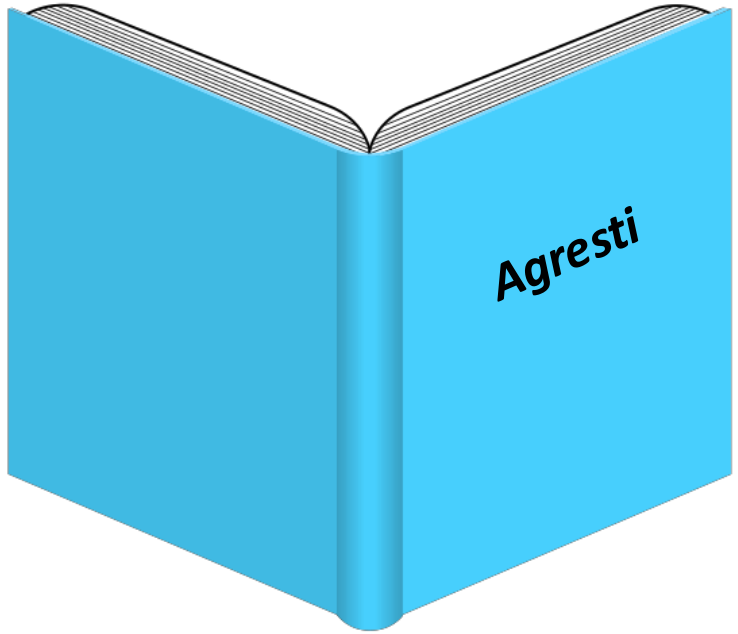


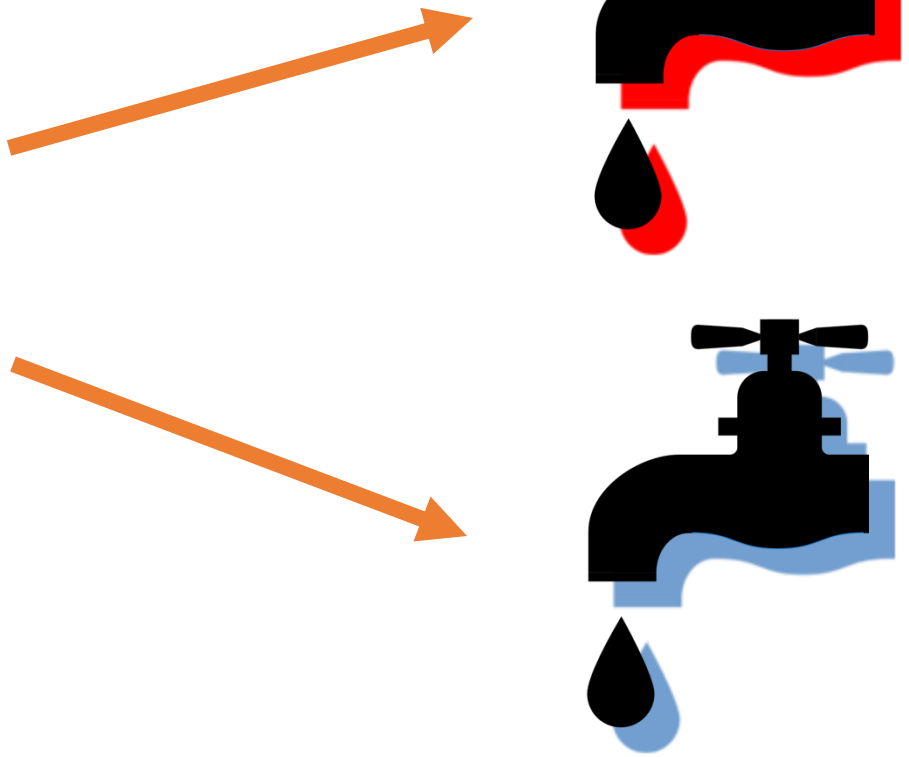


Research Methods and Statistics

Lecture 8: Experimental Research

Johnny van Doorn

Pictures source: pixabay



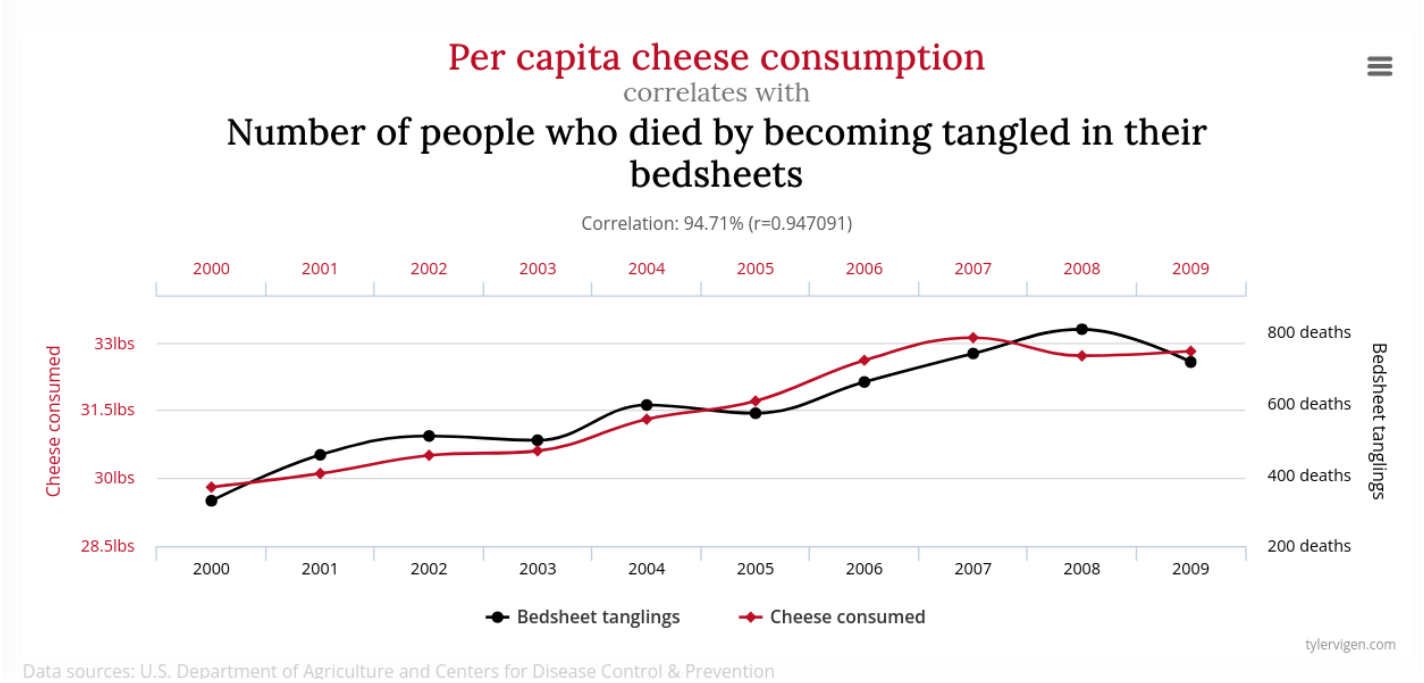
Do we take hot showers when we feel lonely?

How can we make proper, causal claims?

Source: https://pixabay.com/

Your Research Questions

- Think of two (psychological) variables you would like to investigate
- Need inspiration? → http://www.tylervigen.com/spurious-correlations



Today

1. **Experimental studies vs observational studies**

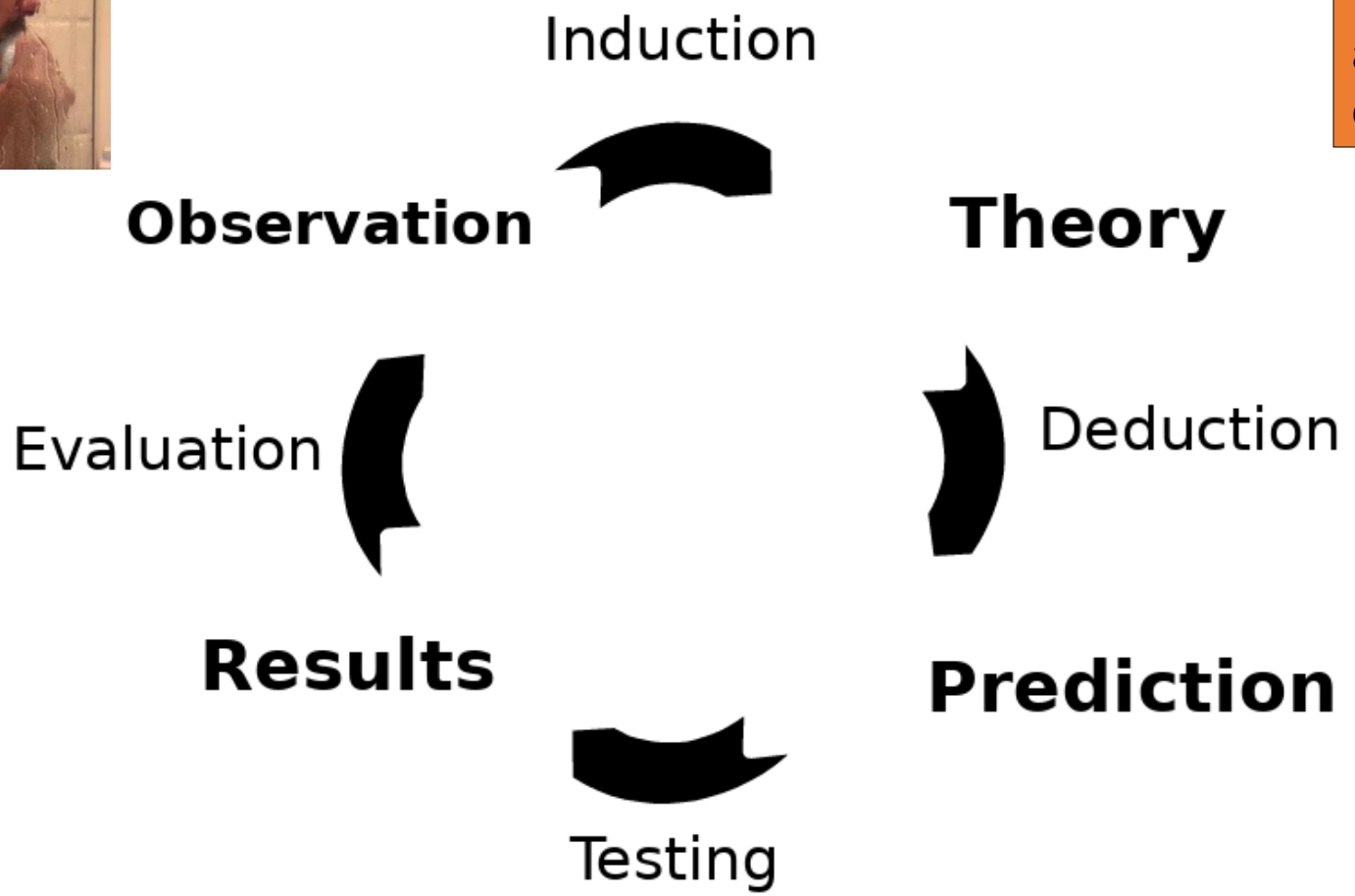
2. Pitfalls in experimental studies
    1. Pseudoreplication

3. Different experimental designs
    1. Pretest
    2. Within groups vs between groups

4. Order effects
    1. Counterbalancing

5. Recap
    1. Next time
    2. Example exam question

The empirical cycle



Theory: People use warm showers and baths to compensate for a lack of social warmth.

Hypothesis: Increased loneliness causes increased shower temperature

Parsimonious?
Falsifiable?

Observational study?

- What kind of observational study could you do?
- Bargh and Shalev (2012) hypothesized that people use warm showers and baths to compensate for a lack of social warmth

> *"Therefore, it seems that the "coldness" of loneliness or rejection could be treated somewhat successfully through the application of physical warmth—that is, physical and social warmth might be substitutable for each other at some level"*

Bargh, J. A., & Shalev, I. (2012). The substitutability of physical and social warmth in daily life. Emotion (Washington, D.C.), 12(1), 154–162. doi:10.1037/a0023527

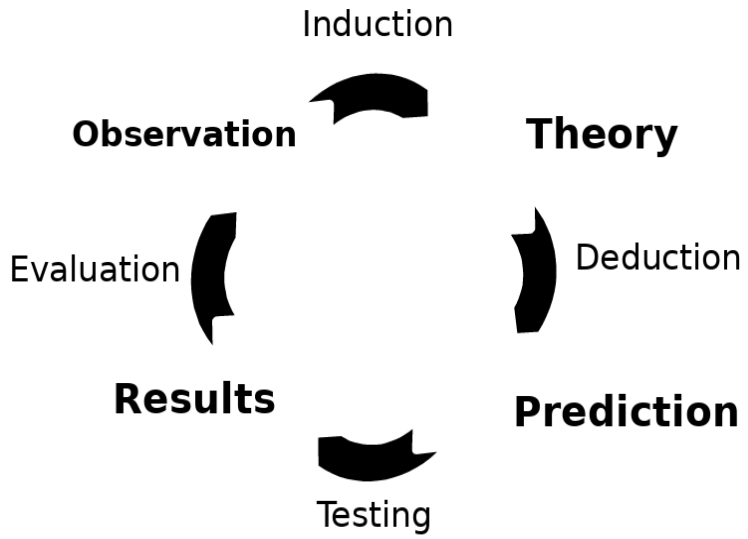
Hypothesis, Predictions, Operationalization

(in Bargh et. al)

- Hypothesis: Increased loneliness ***causes*** increased shower temperature

- Prediction: There is an ***association*** between loneliness and shower temperature

- Operationalization:
  - Dependent variable: Shower temperature
  - Independent variable: Loneliness



Operationalization of Shower Temperature

- *"How often do you usually take a bath?"* (on an 8-point scale ranging from more than 3 times a day to less than once a week)
- *"What temperature water do you use?"* (on a 6-point scale ranging from cold to very hot)
- *"About how much time do you spend in the bath?"* (on a 7-point scale ranging from less than 2 minutes to over 30 minutes)

Bargh, J. A., & Shalev, I. (2012). The substitutability of physical and social warmth in daily life. Emotion (Washington, D.C.), 12(1), 154–162. doi:10.1037/a0023527

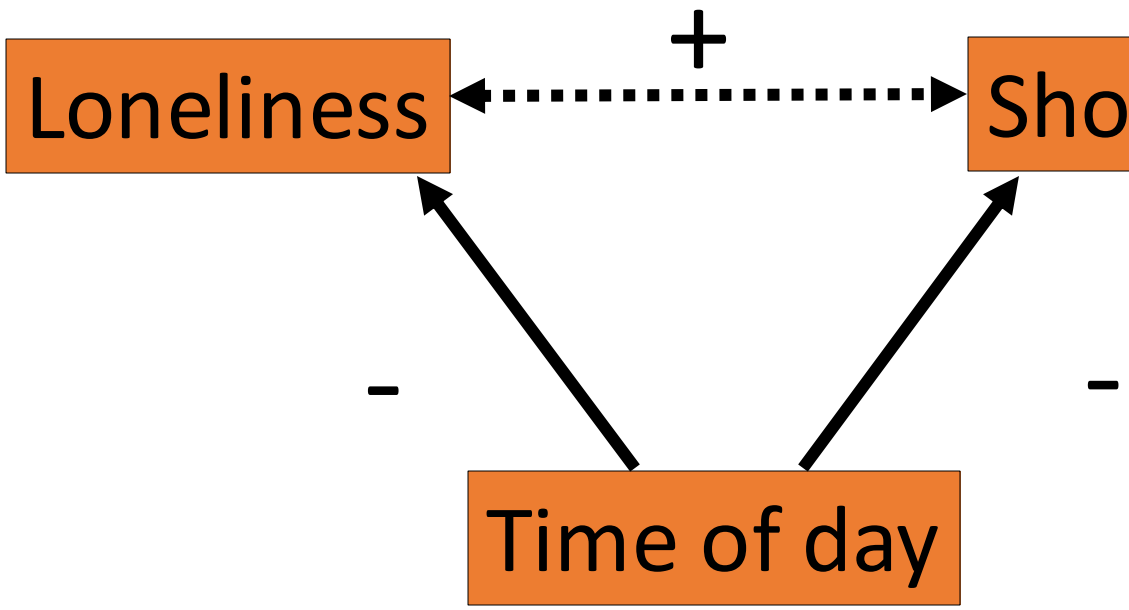
Operationalization of Loneliness

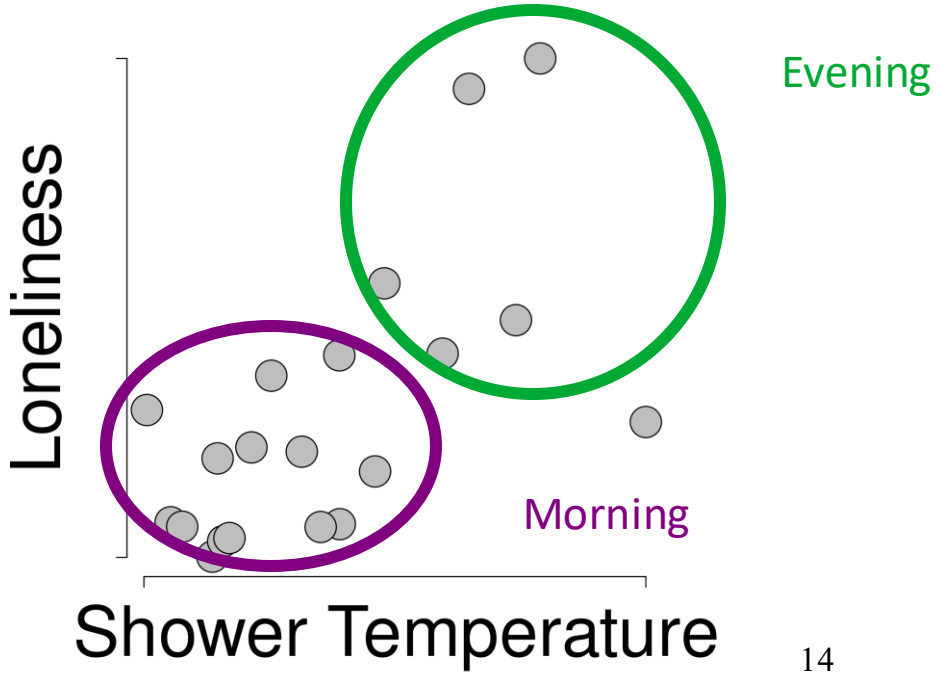
- "*I feel isolated from others*" (on a 4-point scale ranging from "never" to "often")
- "*There is no one I can turn to*"
- "*My interests and ideas are not shared by those around me*"

Russell, D., Peplau, L.A., & Cutrona, C.E. (1980). The revised UCLA Loneliness Scale: Concurrent and discriminant validity evidence. Journal of Personality and Social Psychology, 39, 472-480.

Take it yourself! https://artemciy.gitlab.io/loneliness-scale/#/

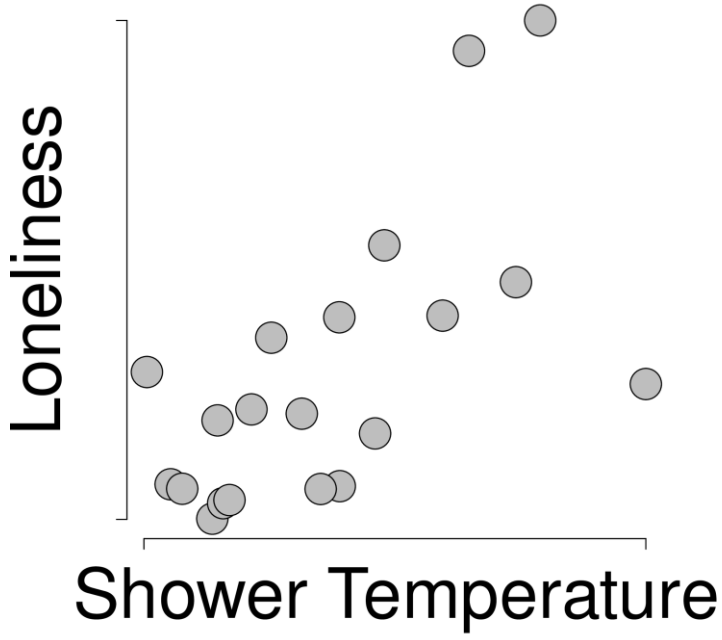
Confounding factors?





Directionality?

Loneliness ? Shower Temperature



Experimental study

- What kind of experimental study could you do?

Hypothesis, Predictions, Operationalization

- Hypothesis: Increased loneliness ***causes*** taking warmer showers

- Prediction: ***IF*** loneliness increases, ***THEN*** the shower temperature increases

- Operationalization:
  - Dependent variable: Shower temperature
  - Independent variable: *Two groups of participants, with different levels of loneliness*

Experimental Manipulation of Loneliness

- Participants take questionnaire about extraversion/introversion, then get feedback:

Lonely group
"… people who score high on extraversion have trouble keeping their relationships stable later in life."

Non-lonely group
"… being an extravert is a really good thing for relationships."

Baumeister RF, DeWall CN, Ciarocco NJ, Twenge JM. Social exclusion impairs self-regulation. Journal of Personality and Social Psychology. 2005;88(4):589–604.
Full manipulation text on p594

Experimental Manipulation of Loneliness

- Participants take questionnaire about extraversion/introversion, then get feedback:

Lonely group
"… being an introvert is not really a good thing for relationships. "

Non-lonely group
"… being an introvert is a really good thing for relationships."

Baumeister RF, DeWall CN, Ciarocco NJ, Twenge JM. Social exclusion impairs self-regulation. Journal of Personality and Social Psychology. 2005;88(4):589–604.
Full manipulation text on p594

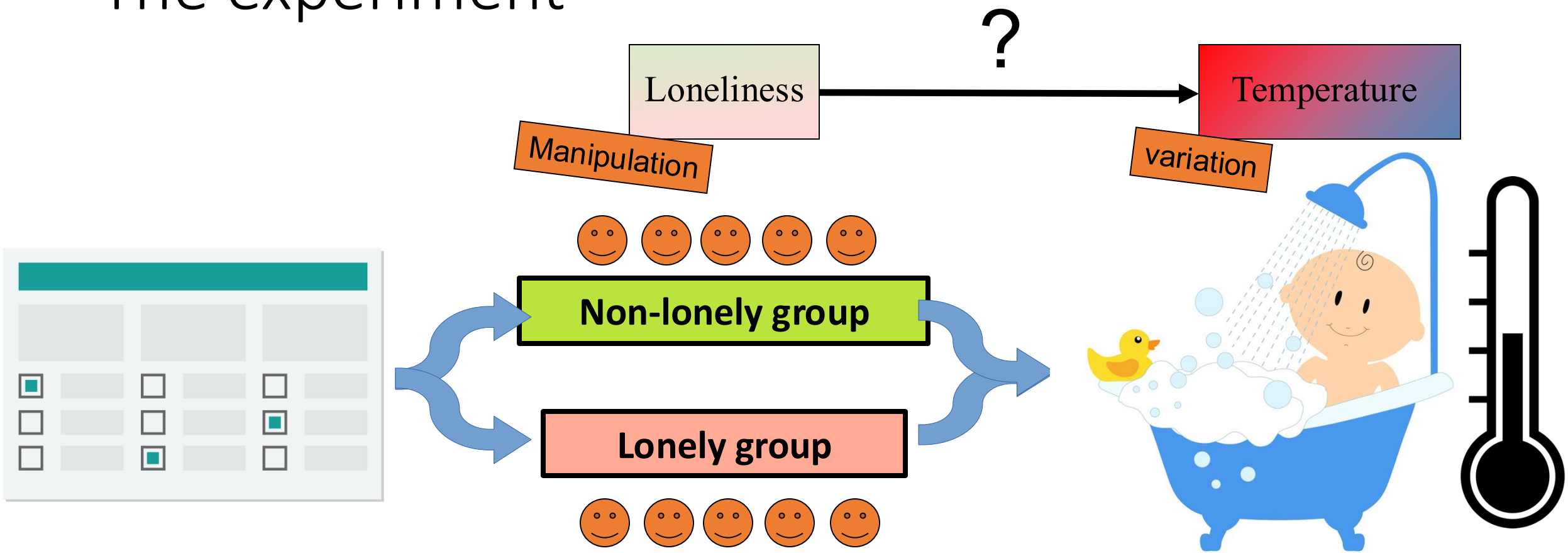
The experiment

Non-lonely group

Lonely group

Source: https://pixabay.com/

The experiment



Source: https://pixabay.com/

Question: What type of variables?

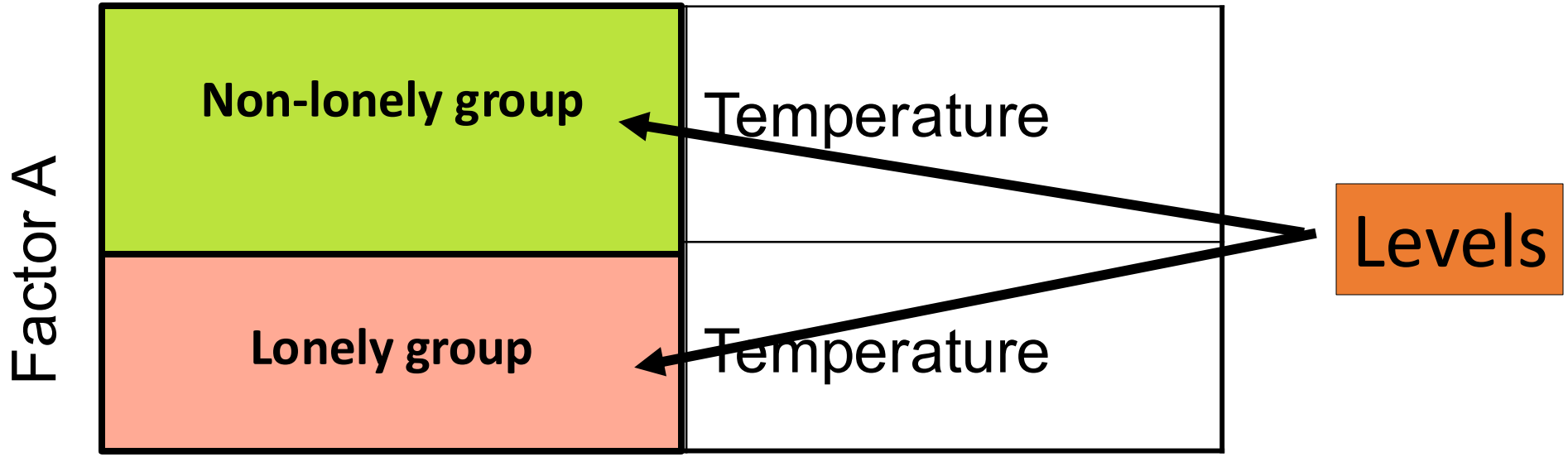
- Loneliness
  - Independent variable (IV, the book also uses “manipulated variable”)
  - Categorical (because two groups)
- Temperature
  - Dependent variable (DV, the book also uses “measured variable”)
  - Quantitative

IV

DV	Quantitative	Categorical
Quantitative	Correlation Regression	t-test ANOVA
Categorical	Logistic regression	Contingency table

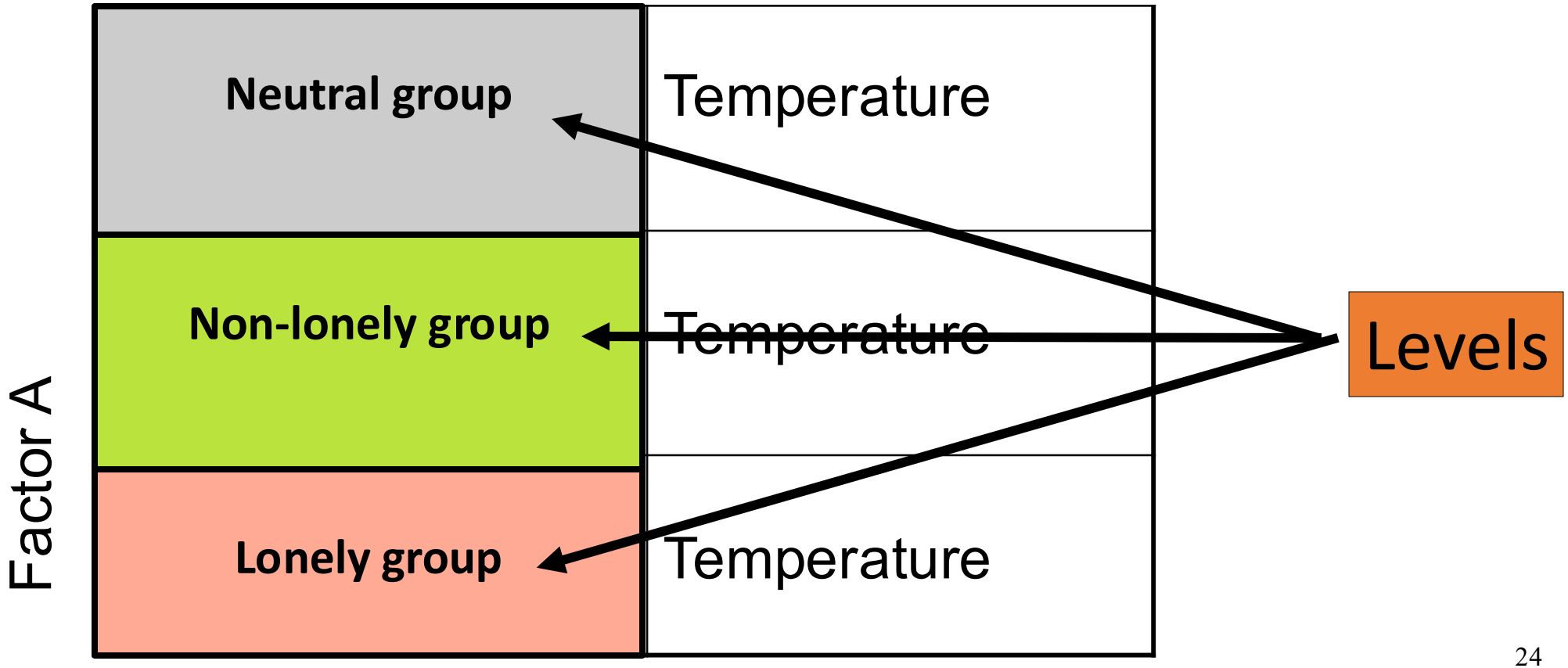
One-way experimental design

Design:



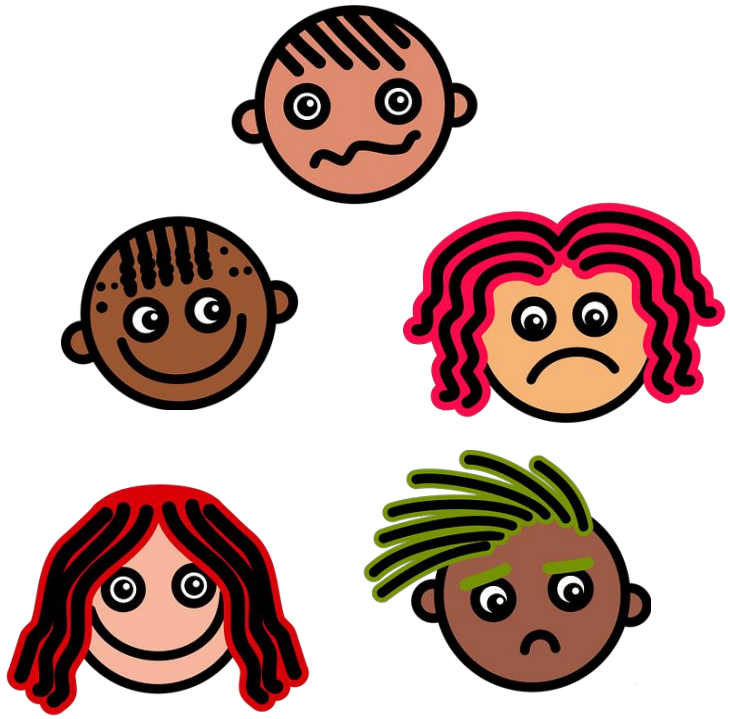
One-way experimental design

Design:

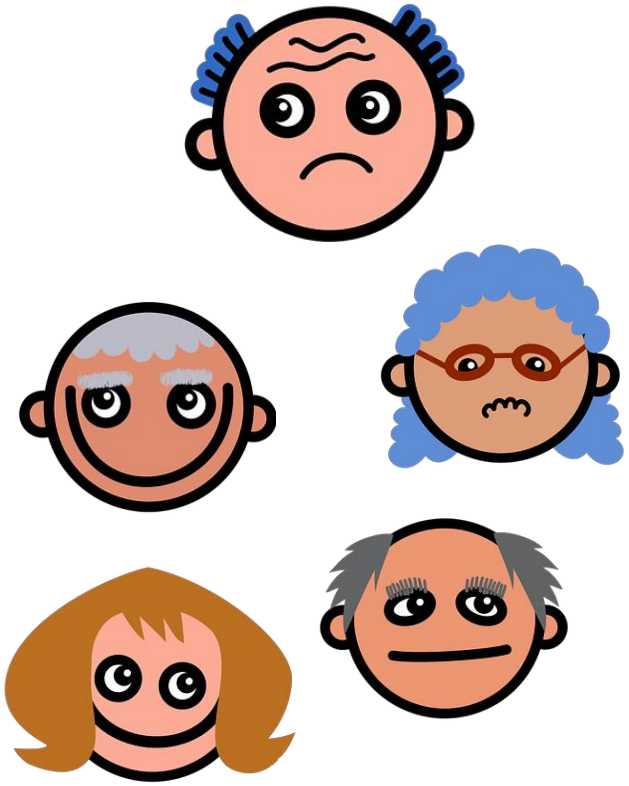


Collecting participants and assigning conditions

Non-lonely group

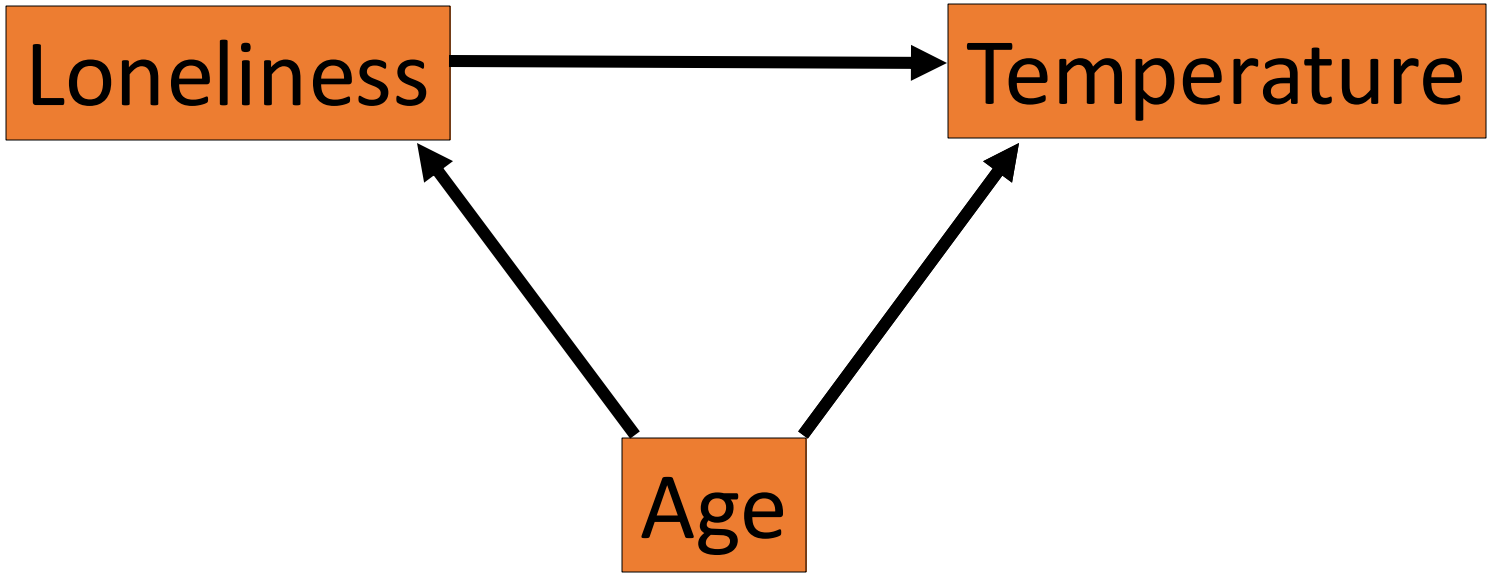


Lonely group



Source: https://pixabay.com/

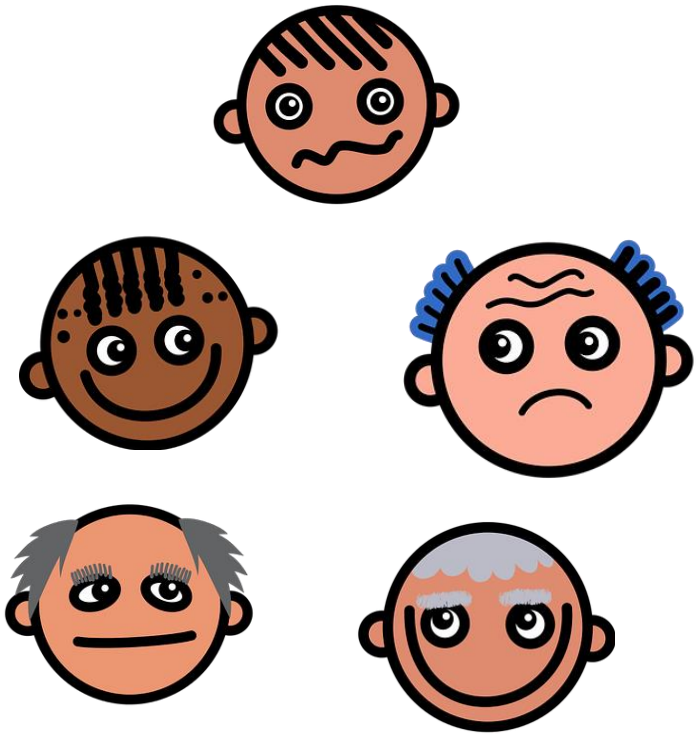
Systematic difference between group: potential confound



2) Internal validity: *Are there alternative explanations for the statistical effect?*

Collecting participants and assigning conditions

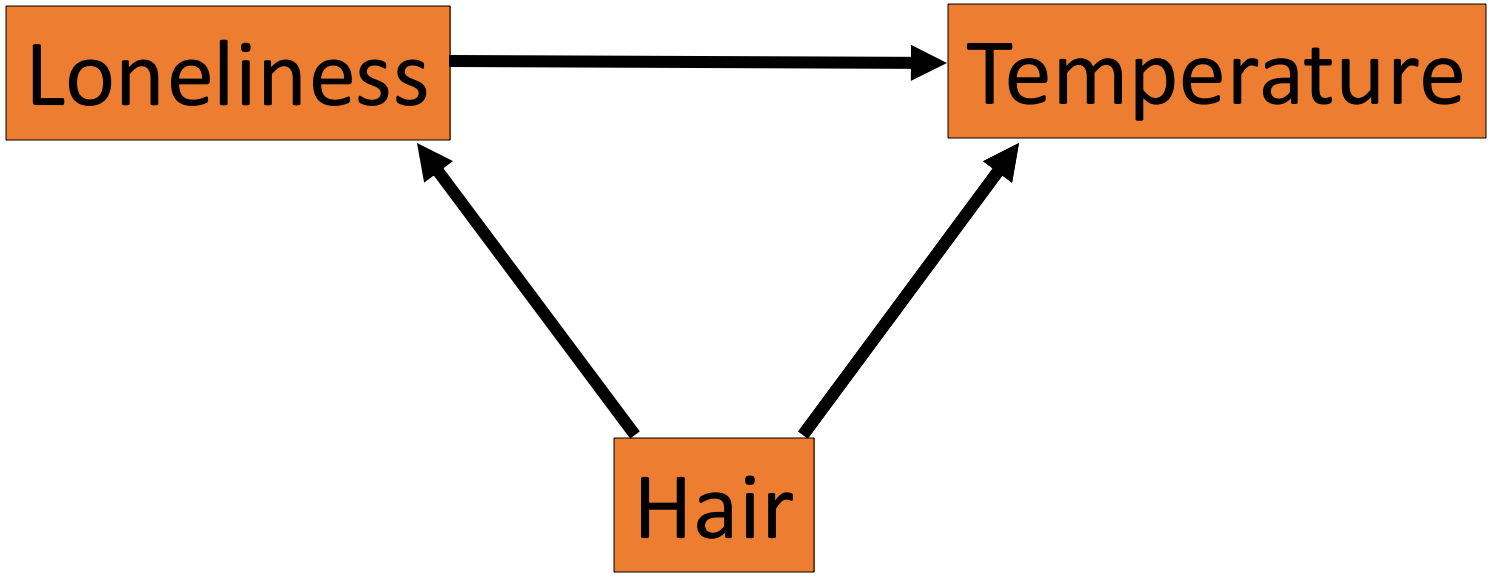
Non-lonely group



Lonely group

Source: https://pixabay.com/

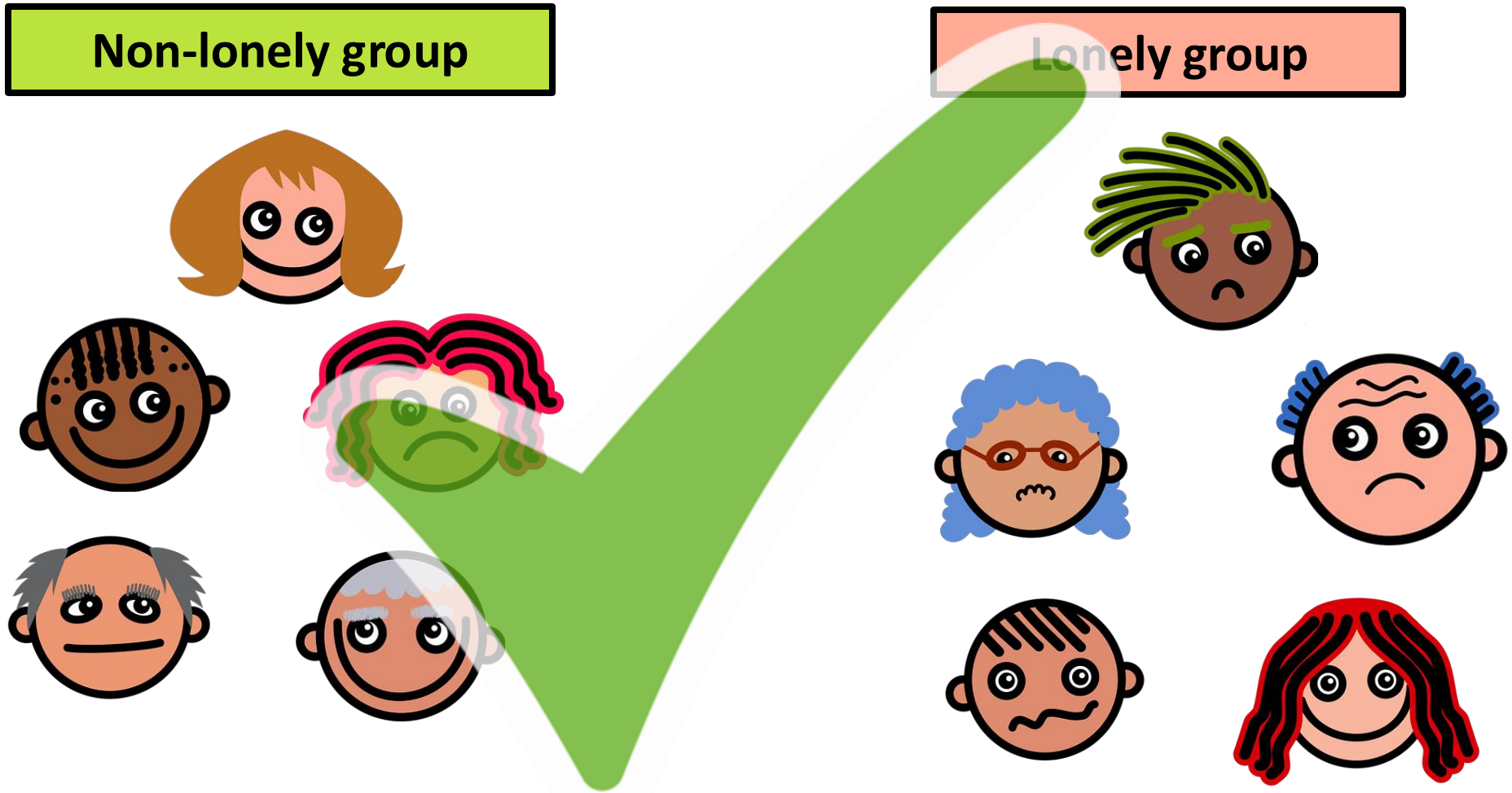
Systematic difference between group: potential confound



Solution: Experimental groups

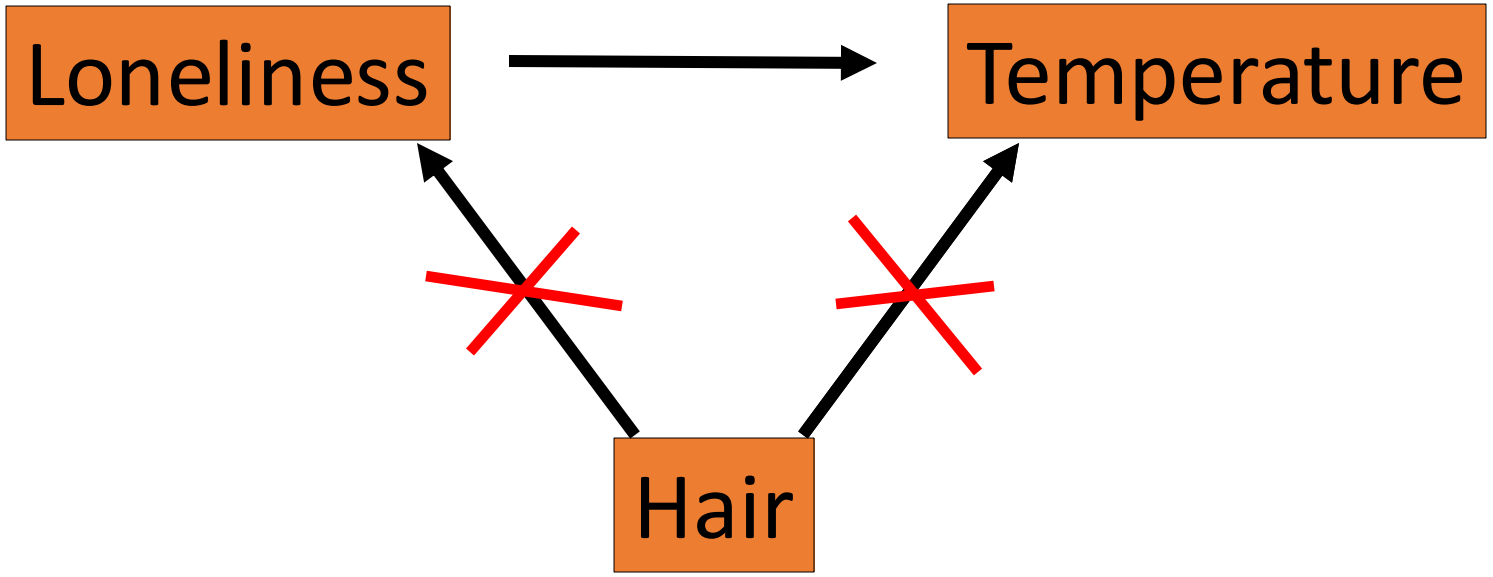
- Balanced groups: Only systematic difference between the group is the manipulation
- Method: **Random assignment**
  - Expected value of the difference between groups for all control variables should be roughly 0:
    - Age ≈ age
    - Hair ≈ hair

Collecting participants and assigning conditions

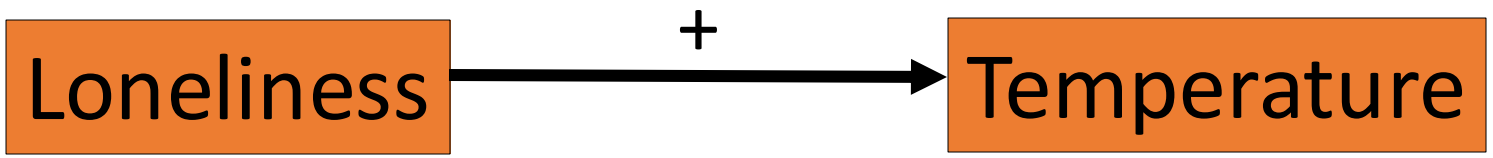


Source: https://pixabay.com/

Random assignment precludes confounds



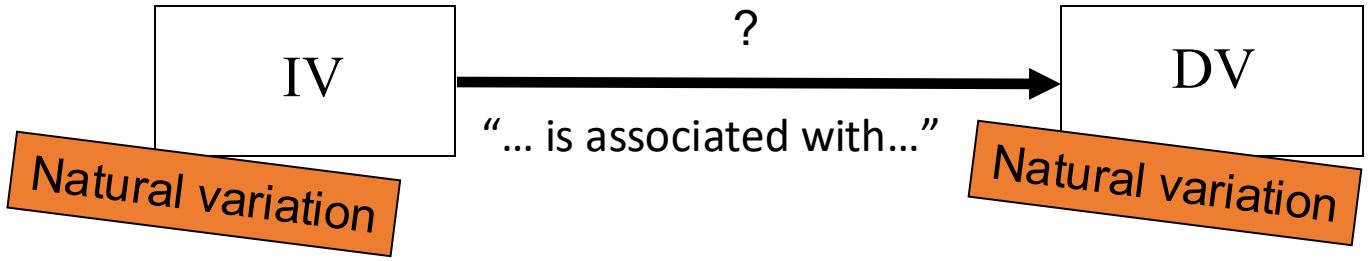
Temporal precedence establishes causality



- FIRST we manipulated loneliness
- THEN we measured water temperature

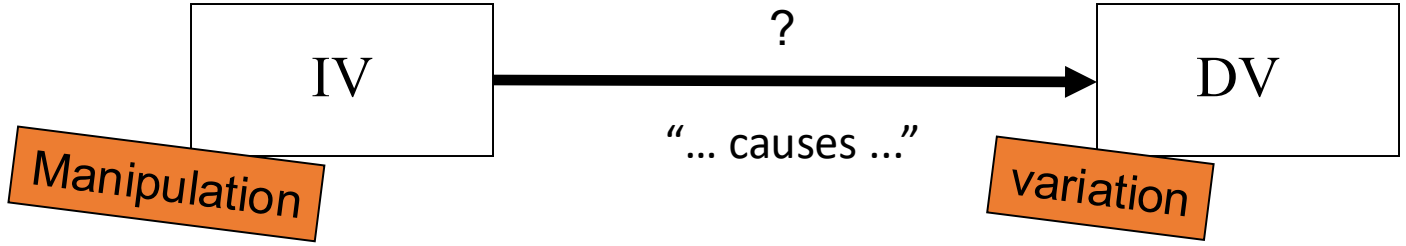
Differences between observational and experimental research

Observational research



Experimental research enables causal claims!

Experimental research



Differences between observational and experimental research

Cons

Experimental	Observational
* Impossible	
* Impractical	
* Unethical	
* Unnatural	

Source: https://pixabay.com/

Differences between observational and experimental research

Cons

Experimental	Observational
* Impossible	* Confounds
* Impractical	* No causality
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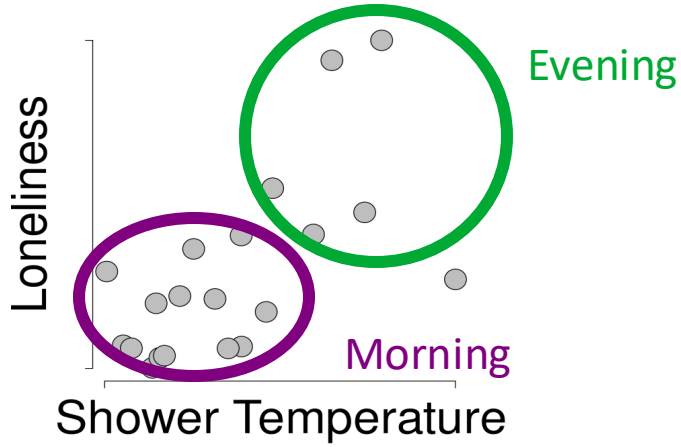

Differences between observational and experimental research

Cons

Experimental	Observational
* Impossible	* Confounds
* Impractical	* No causality
* Unethical	
* Unnatural	

Pros

Experimental	Observational
* Control	* Easier to do
* Causality	* Natural variation

Generalizability: When a theory is supported by both observational and experimental studies
→ Replication!

Today

1. Experimental studies vs observational studies

2. **Pitfalls in experimental studies**
    1. Pseudoreplication

3. Different experimental designs
    1. Pretest
    2. Within groups vs between groups

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    1. Counterbalancing

5. Recap
    1. Next time
    2. Example exam question

Pitfalls of experimental design

1. Manipulation changes multiple variables
   - Confound

1. There are other systematic differences between groups
   - Non-random assignment
     - Participants can choose which condition
     - First six in the Lonely group, last six in the Non-lonely group
     - First six in the morning, last six in the evening
     - …
   - Selection bias → Confound

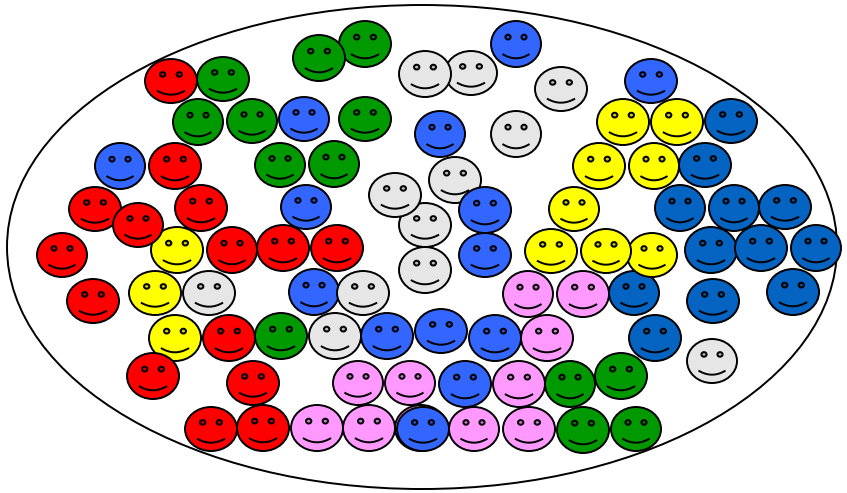
Pitfalls of experimental design

1. Manipulation changes multiple variables
   - Confound

2. There are other systematic differences between groups
   - Non-random assignment
   - Selection bias → Confound

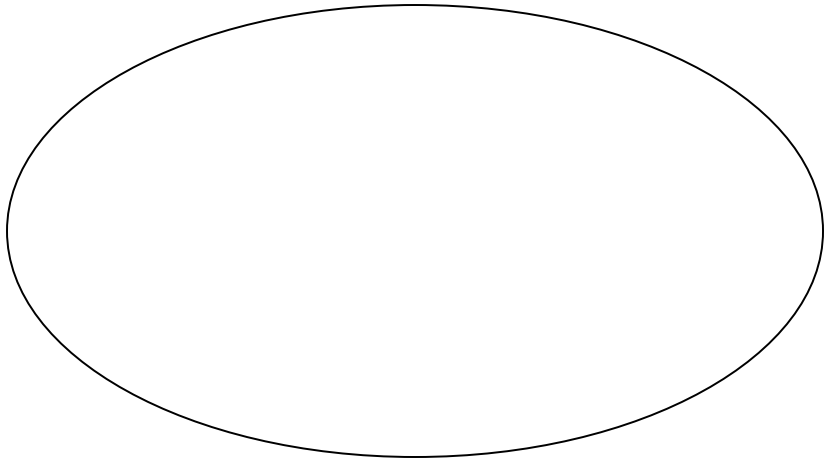
3. Pseudoreplication
   - Amplifies confounds

Population

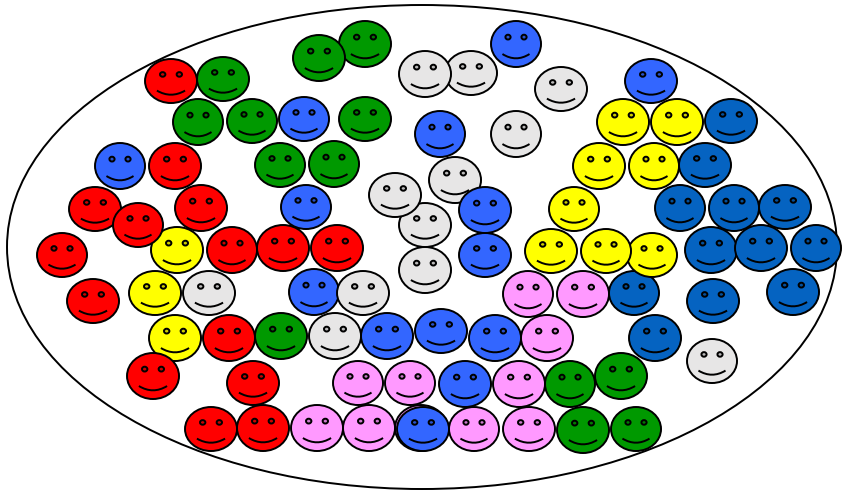


Replication: all observations are ***independent***

Sample

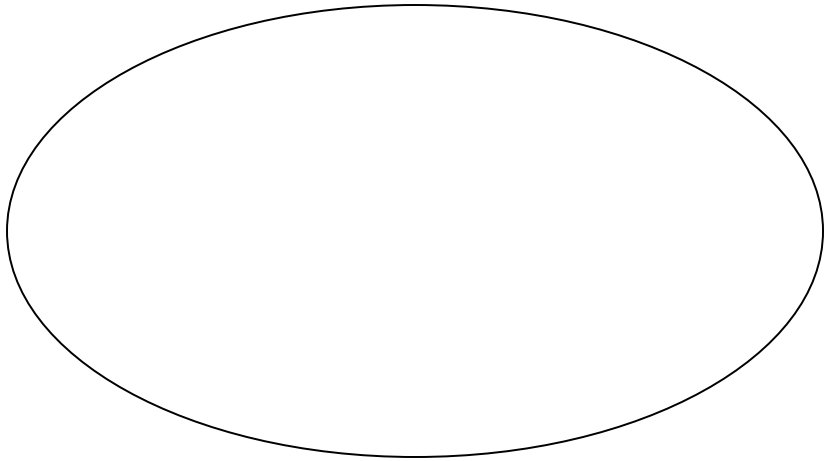


Population



Pseudoreplication: the observations are ***dependent***

Sample



What causes pseudoreplication?

- Observations are from the same environment
  - Children in one class
  - Students from one bachelor
  - Plants in one greenhouse
  - Trees in one forest

- Observations are genetically related
  - Siblings
  - Pups from one rat genetic straint

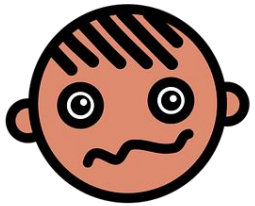
- Observations are related in time
  - Repeated measures

Further reading: https://www.statisticsdonewrong.com/pseudoreplication.html

Pseudoreplication

Non-lonely group

Lonely group



Source: https://pixabay.com/

Today

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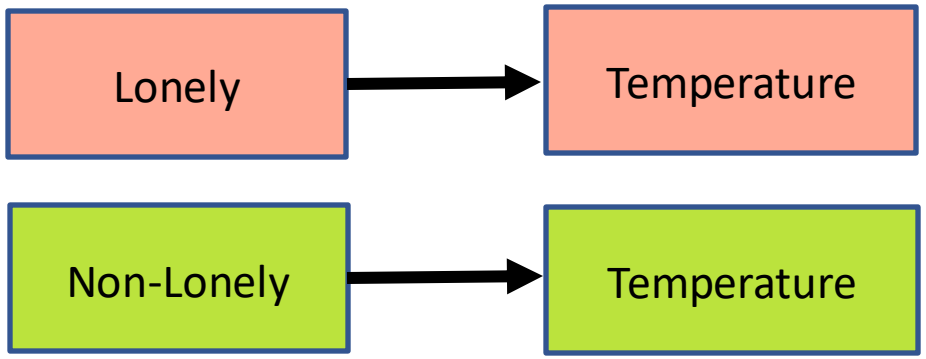
Different experimental designs

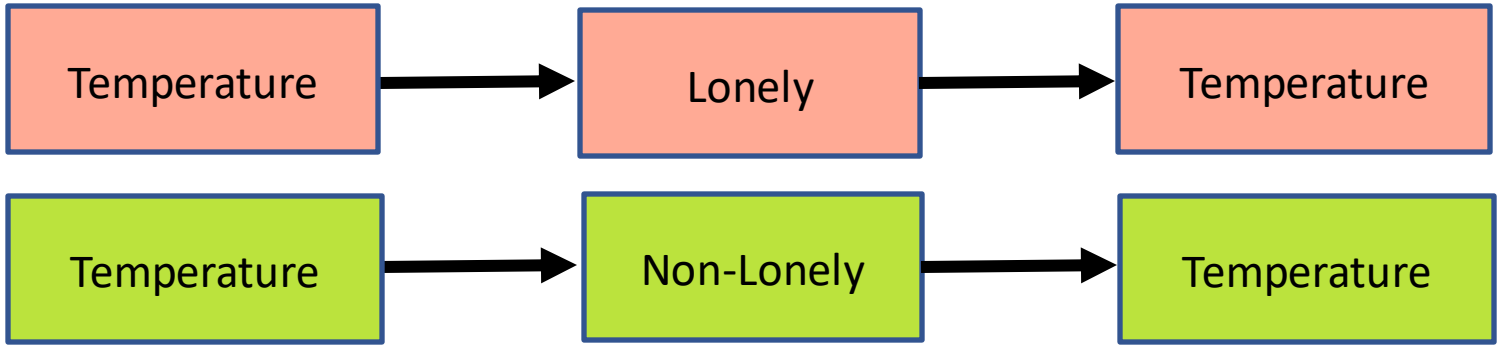
- So far: Post-test design
  - Random assignment in multiple groups
  - **Assume** no difference in DV prior to group assignment
  - Test the difference in DV after group assignment



Source: https://pixabay.com/

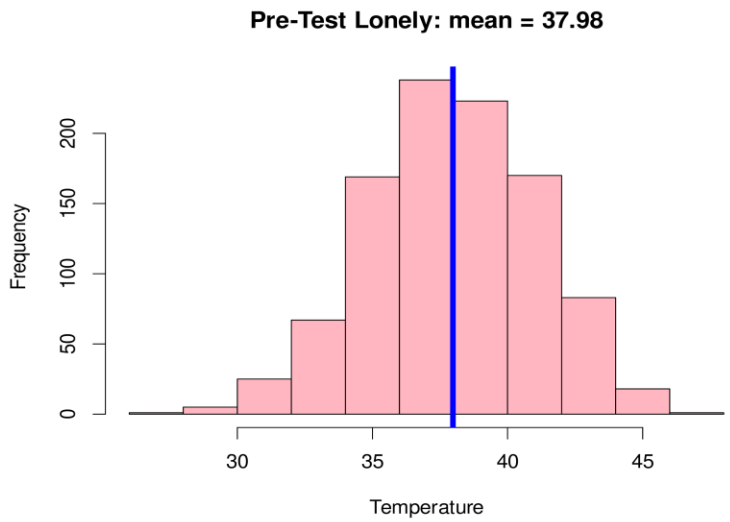
Different experimental designs

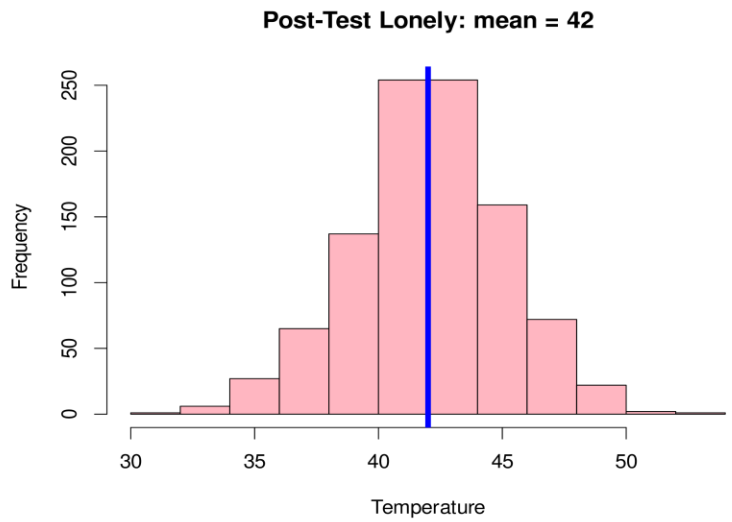
- Pretest/Posttest design
  - Random assignment in multiple groups
  - Measure DV prior to group assignment
  - Measure DV after group assignment
  - Test the “difference of the difference”



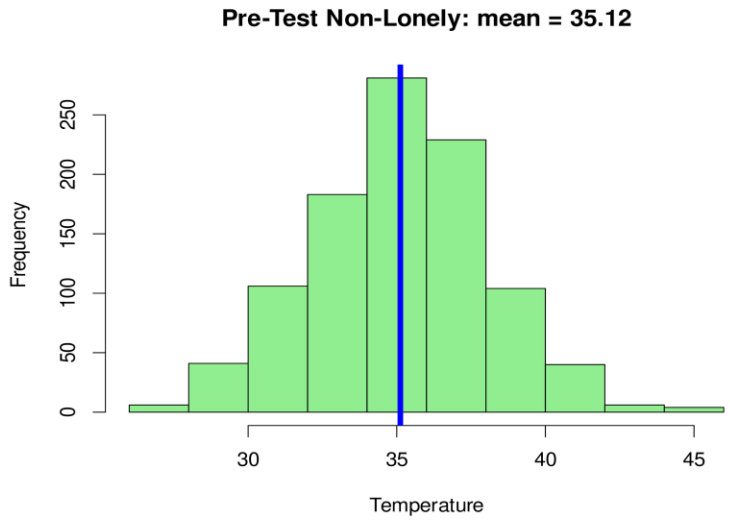
Source: https://pixabay.com/

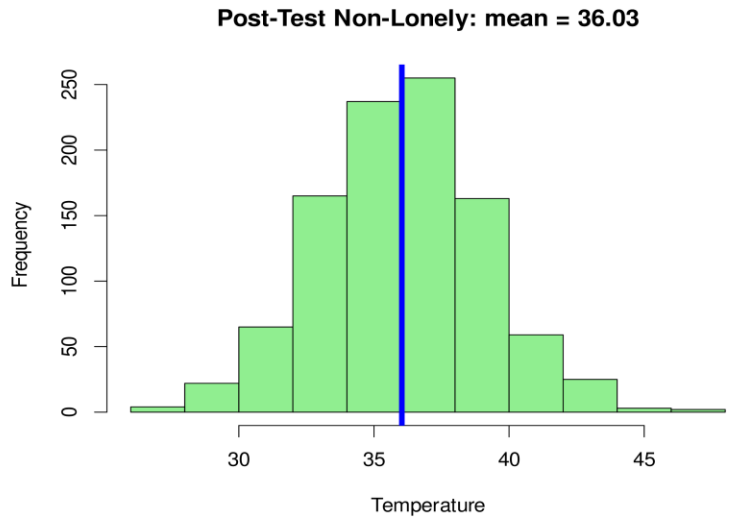
Pre-test/Post-test Design





Difference: 42 – 37.98 = 4.02

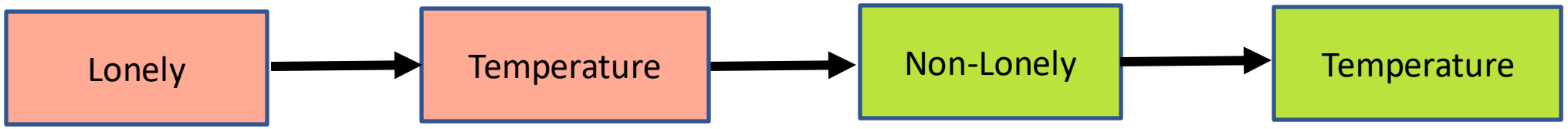




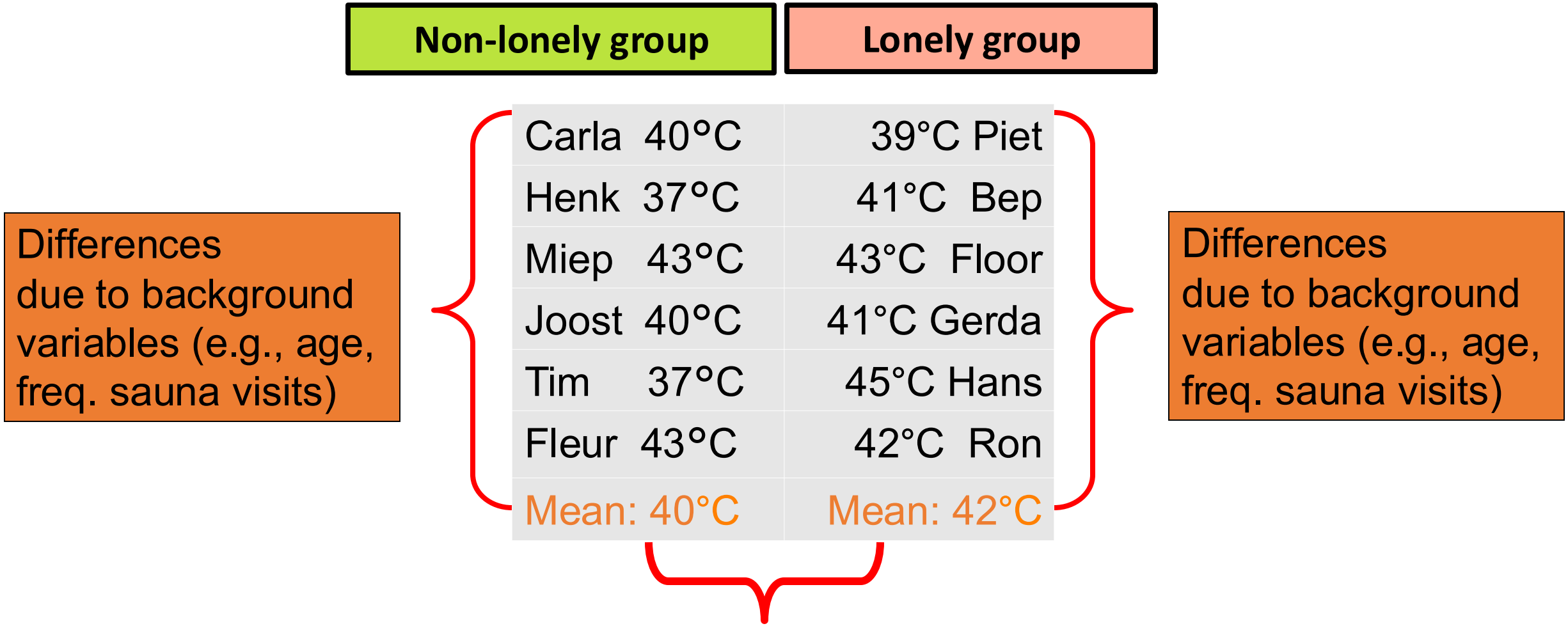
Difference: 36.03 – 35.12 = 0.91

Different experimental designs

- Repeated-measures design
  - Most important within-group design
  - Measure DV **twice in each participant**
  - Test the difference in DV



Between groups design



Within groups design

Non-lonely group	Lonely group
Carla 40°C	39°C Carla
Henk 37°C	41°C Henk
Miep 43°C	43°C Miep
Joost 40°C	41°C Joost
Tim 37°C	45°C Tim
Fleur 43°C	42°C Fleur
Mean: 40°C	Mean: 42°C

Differences due to background variables (e.g., age, freq. sauna visits)

But not between groups

Difference in mean driven by ~~background variables~~ AND manipulation

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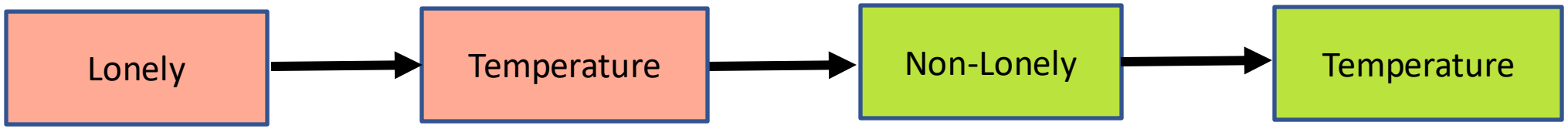
Order effects

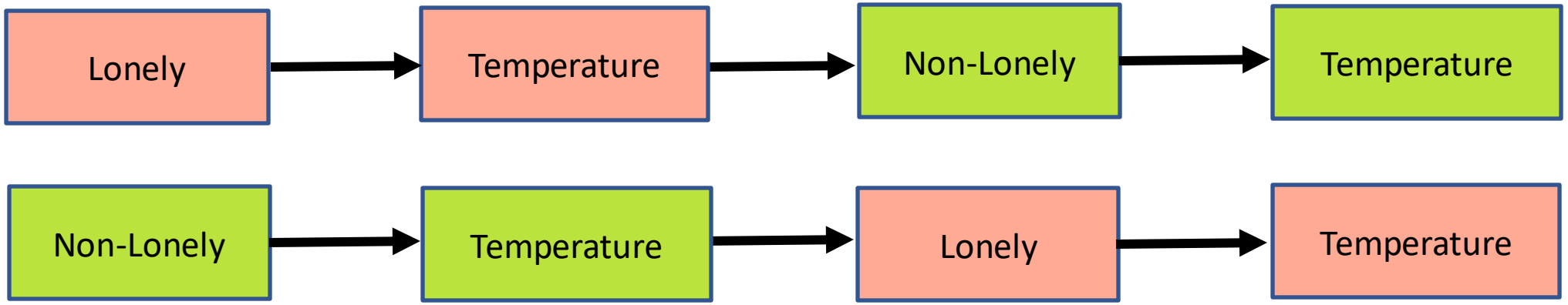
- Repeated-measures design



- Problems:
  - Carry-over effect
  - Training effects
  - Fatigue
  - …

Solution: counterbalancing

- Repeated-measures design



- Order effects remain for each individual, but ***not*** the group

Today

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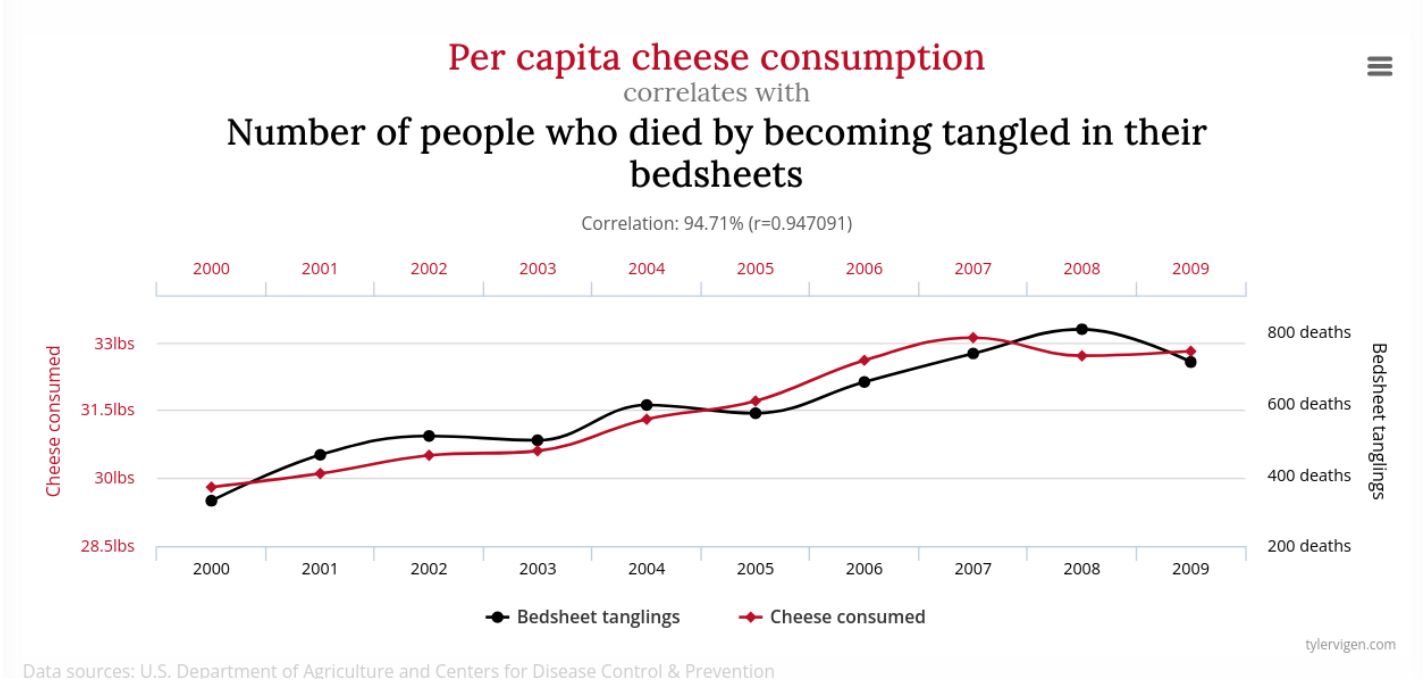
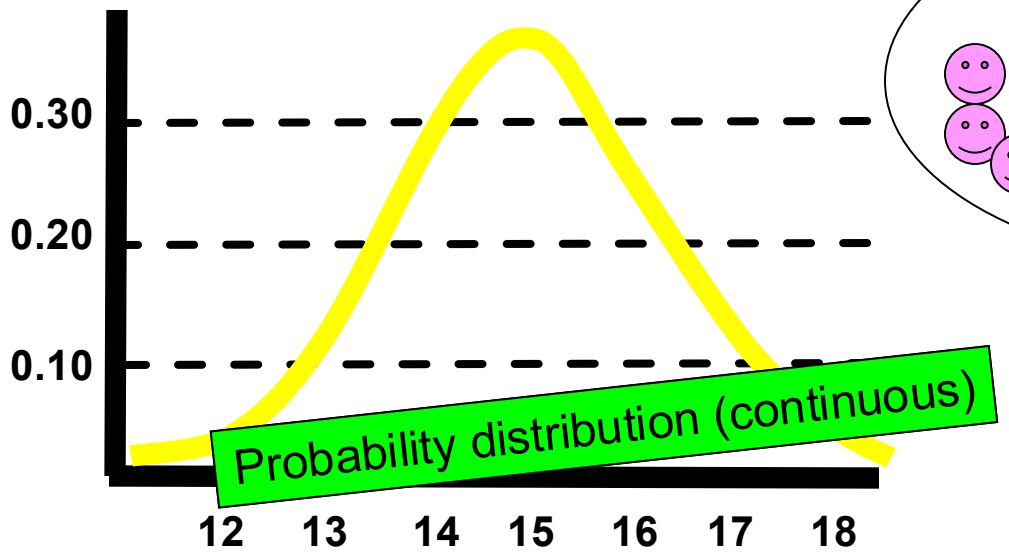
Your Research Questions

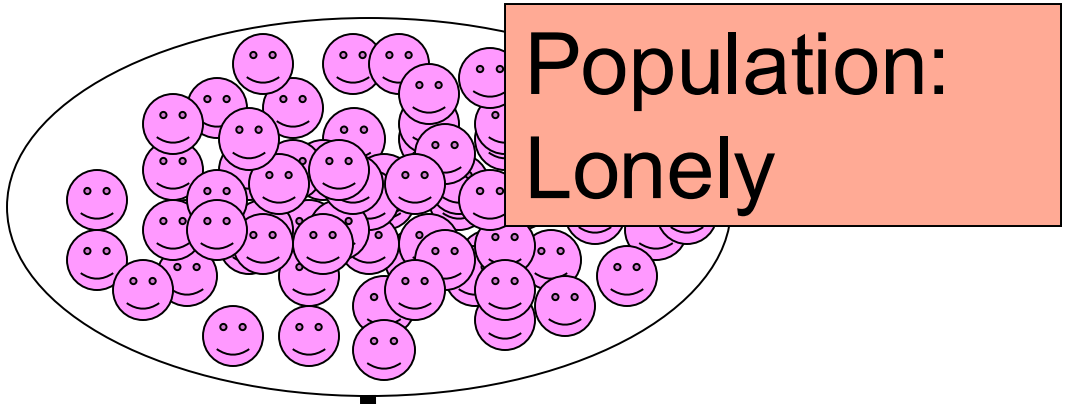
- Think of two (psychological) variables you would like to investigate
- How would you test a **causal** association?



Recap

- In order to make causal claims, we can do experimental studies
- Watch out for:
  - Confounds → random assignment, experimental control
  - Selection effects → random assignment
  - Different baseline levels → pre-test/post-test
  - Different backgrounds → repeated measures

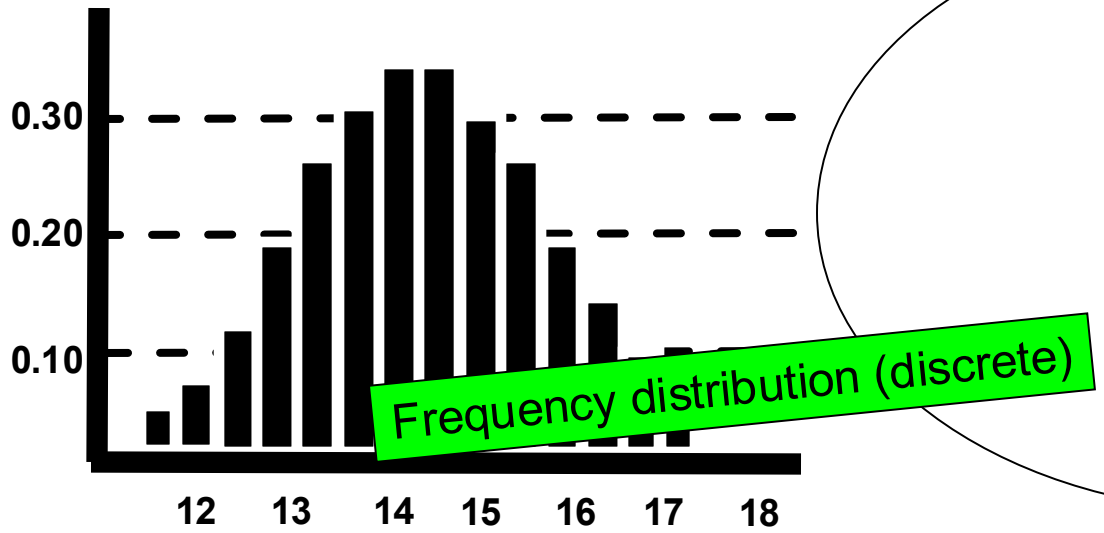


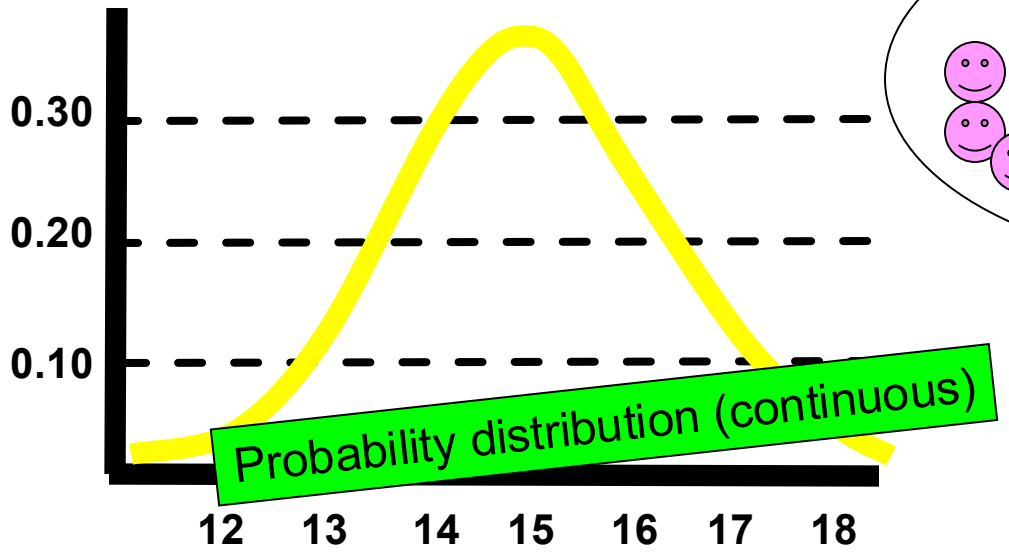


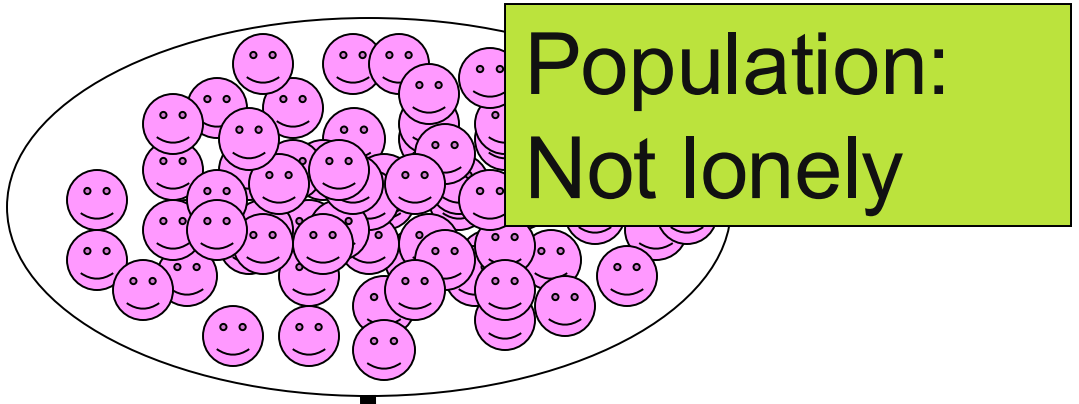
Population: Lonely

Sample

11
12
6
3
19



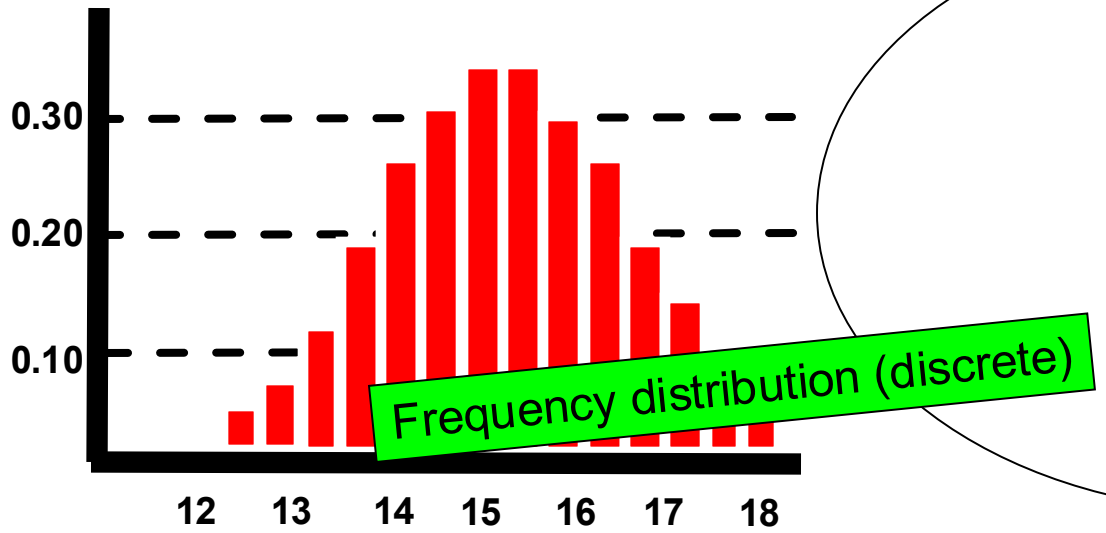




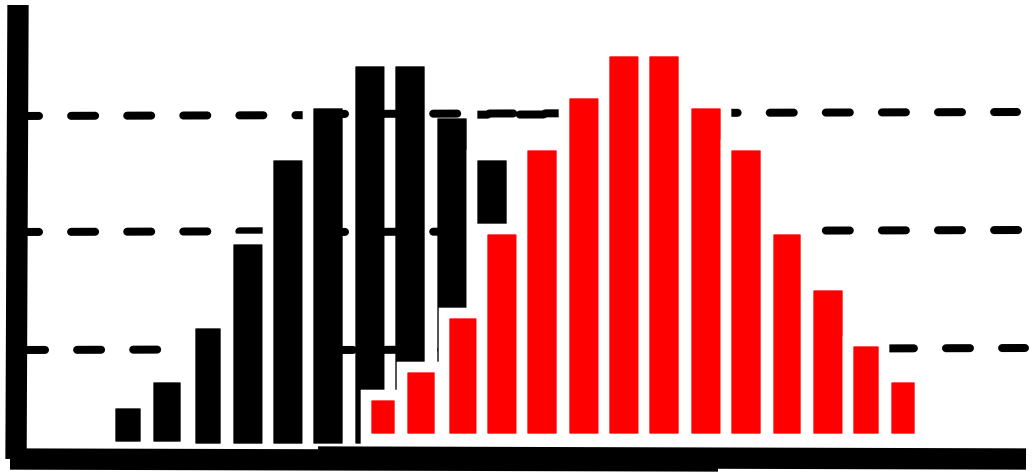
Population:
Not lonely

Sample

11
14
8
6
23



Next week



- → What evidence do we have that there is a difference between these two populations?

Next week

- → W ce betw

Today

1. Experimental studies vs observational studies

2. Pitfalls in experimental studies
    1. Pseudoreplication

3. Different experimental designs
    1. Pretest
    2. Within groups vs between groups

4. Order effects
    1. Counterbalancing

5. Closing
    1. Next time
    2. **Example exam question**

Example exam question

Imagine a researcher who is interested in the effect of meditation on people's ability to improve their golf swing. She sets up an experiment in which 30 novice golfers are tested. First, all of them are asked to drive a golf ball as far as possible (5 times). Next, 15 of the novice golfers are asked to meditate for 10 minutes, while the other 15 are given a newspaper to read. After 10 minutes, all golfers are again asked to drive a golf ball as far as possible (5 times).

What is the experimental design described here?

a) Posttest design
b) Pretest/posttest design
c) Repeated measures design

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What is the experimental design described here?

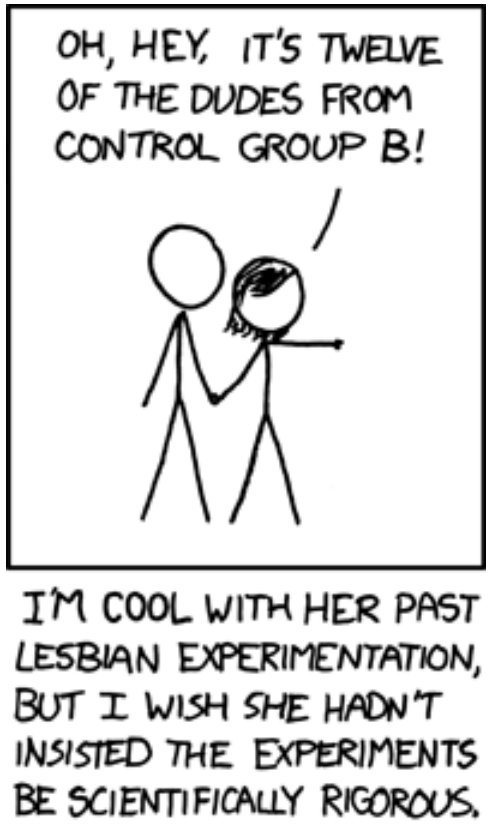
~~a) Posttest design~~

b) Pretest/posttest design

~~c) Repeated measures design~~

Questions?

Thank you for your attention



https://www.xkcd.com/507/

Bonus Movie

Back when people did not care about ethics in human experiments as much, in 1971 the famous Stanford prison experiment was conducted (Wikipedia link). Here, one group of people were assigned to be “prisoners”, while another group were assigned to be “guards” in a real prison. The goal was to see to what extent these people would start abusing their power. In 2001, a German movie, “Das Experiment”, was released that was based on the real events that transpired during the experiment.