



Principles & Practices of Open Research

An online module for
undergraduate and
Masters students

Module 4 – Reproducible Practices



What is
reproducibility?

A

What is research reproducibility?



1

It means that research is conducted and reported so that another researcher could reach the same results and conclusions using the same approaches

2

It does **not** mean enabling others to copy research

3

It is instead intended to allow people to confirm or correct findings through reproducing the methods

What is research reproducibility?

- If another researcher cannot reproduce the research, this does not necessarily mean the findings aren't valid
- This is because reproducibility does not equal truth
- But lack of reproducibility does raise questions about a study's validity and reliability



What is research reproducibility?

Reproducibility can also be understood as

1

Methods reproducibility: enough information is provided about the study methods for it to be repeated

2

Results reproducibility: An independent study obtains the same results using the original methods

3

Inferential reproducibility: Similar conclusions are reached from replicated findings

Reproducible Research Practices

Reproducible research involves:



Sharing data and research procedures

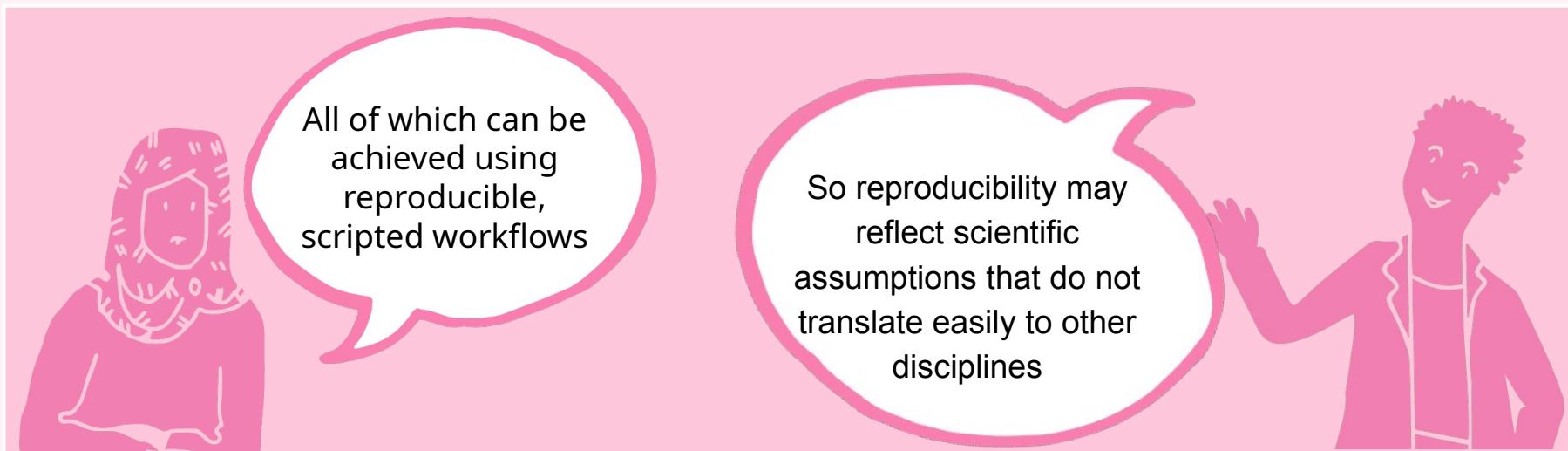
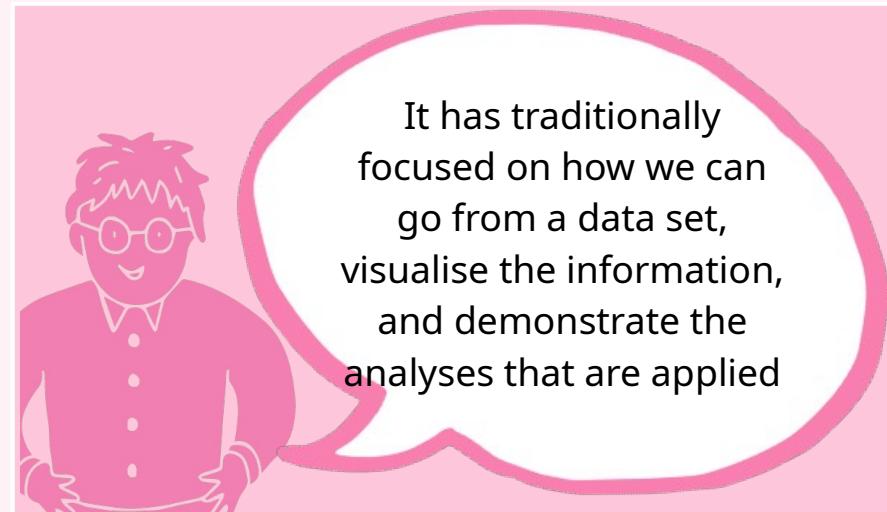
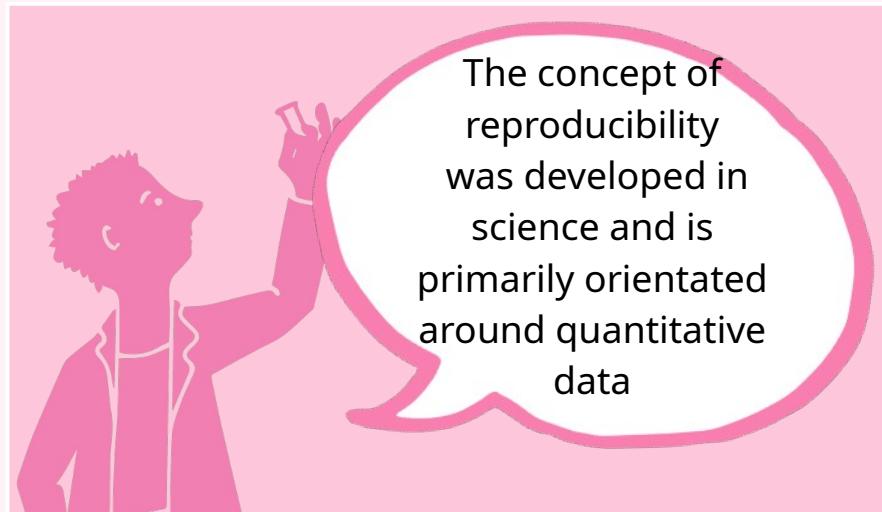


Making these available for public/peer evaluation



Taking steps in the study design process to minimize bias

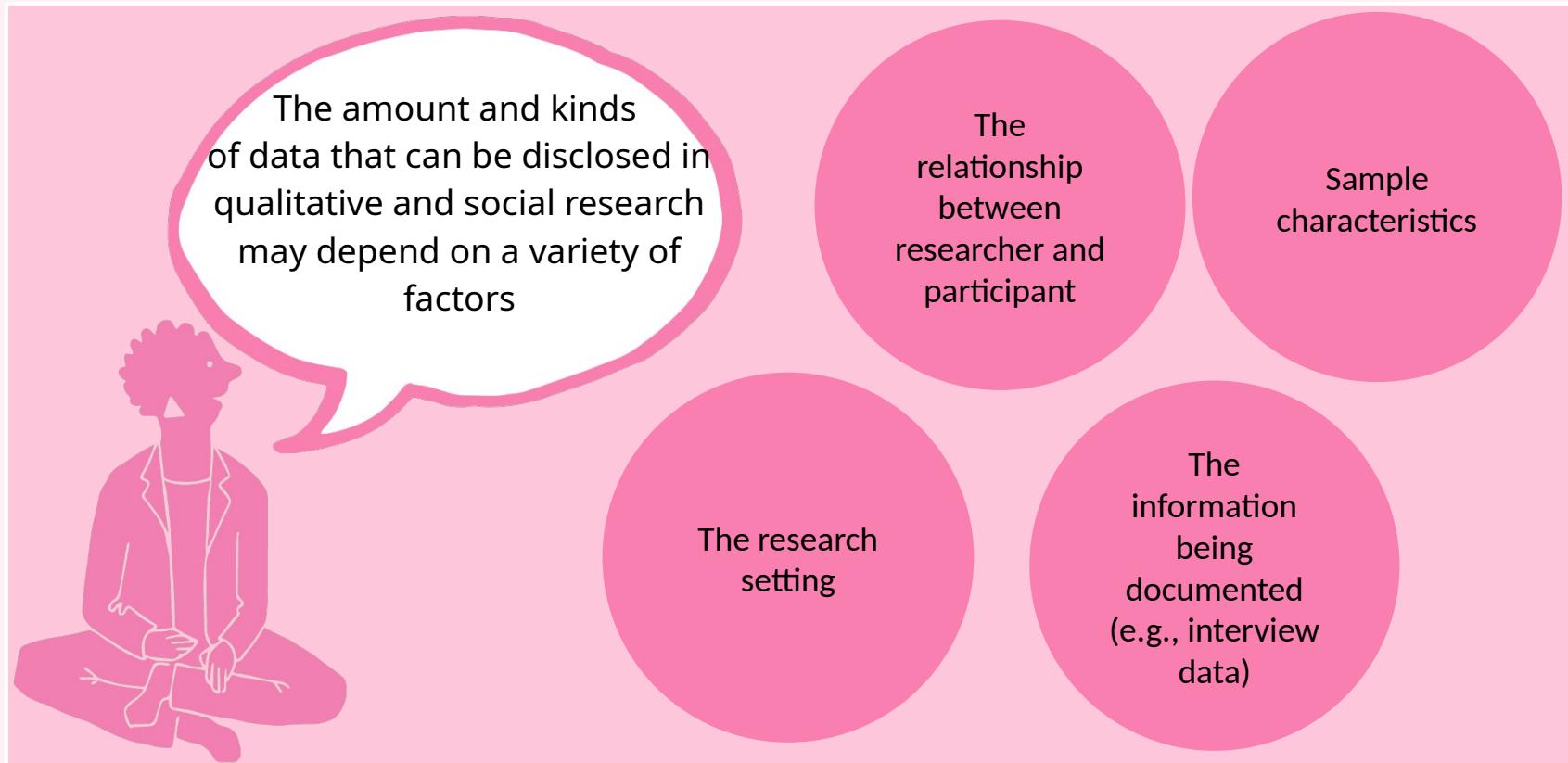
Reproducibility Across Disciplines



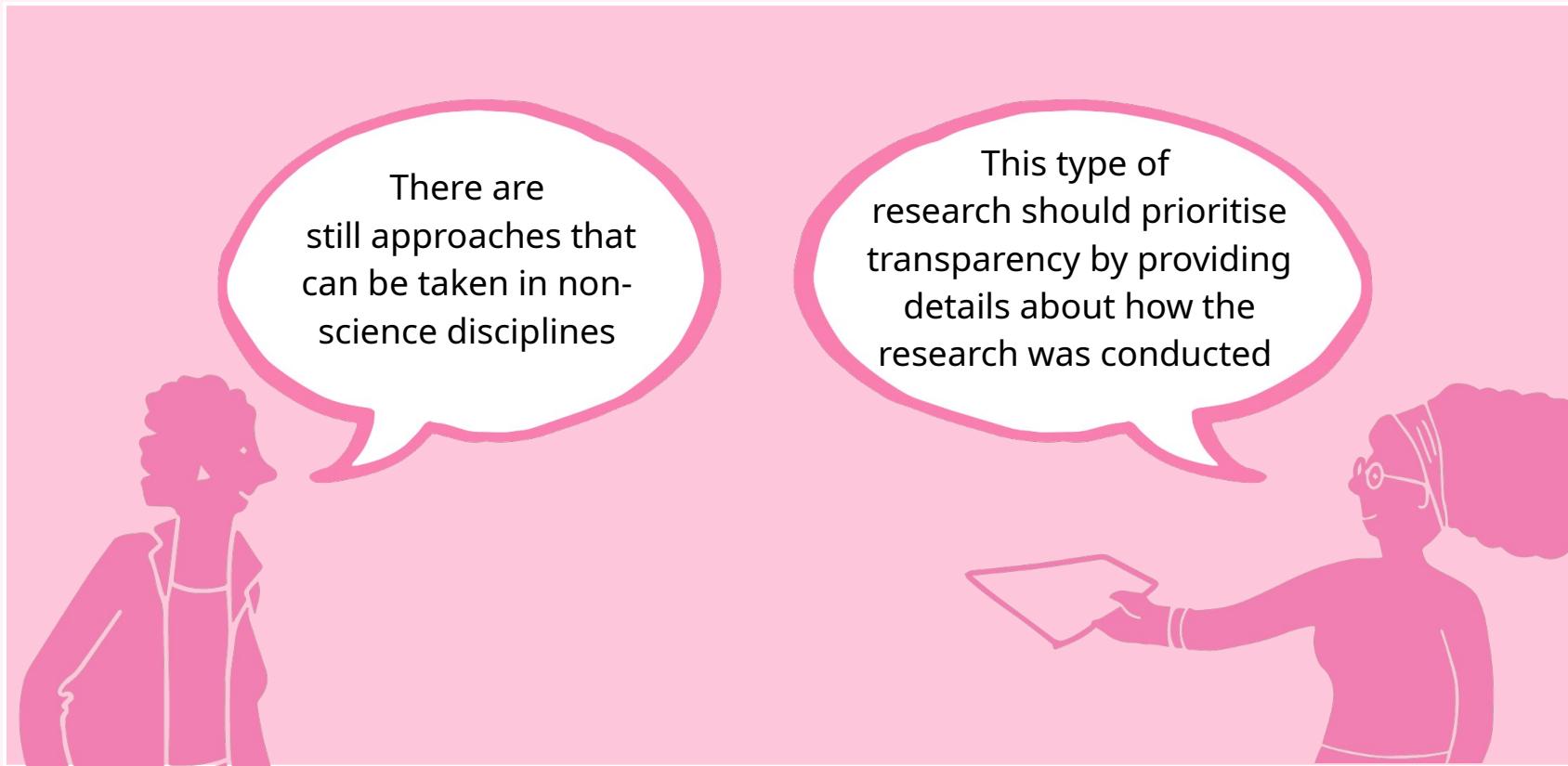
Reproducibility Across Disciplines



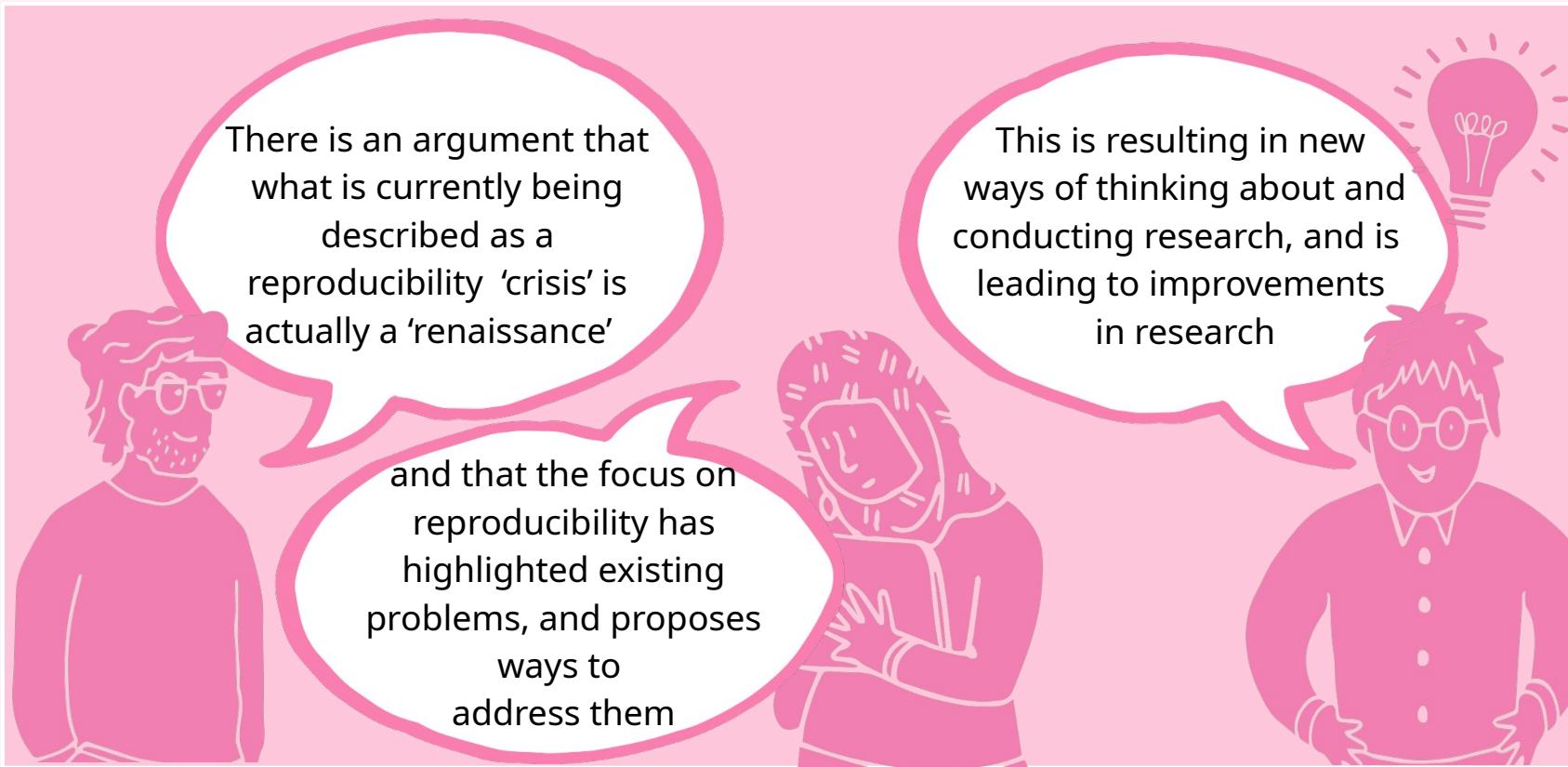
Reproducibility Across Disciplines



Reproducibility Across Disciplines



“Crisis” vs. “Renaissance”



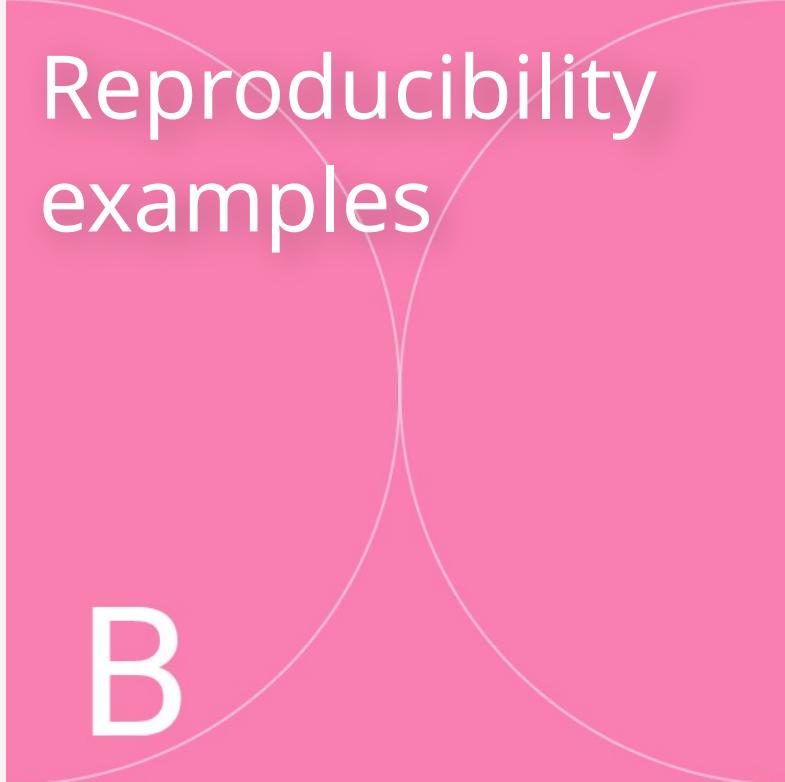




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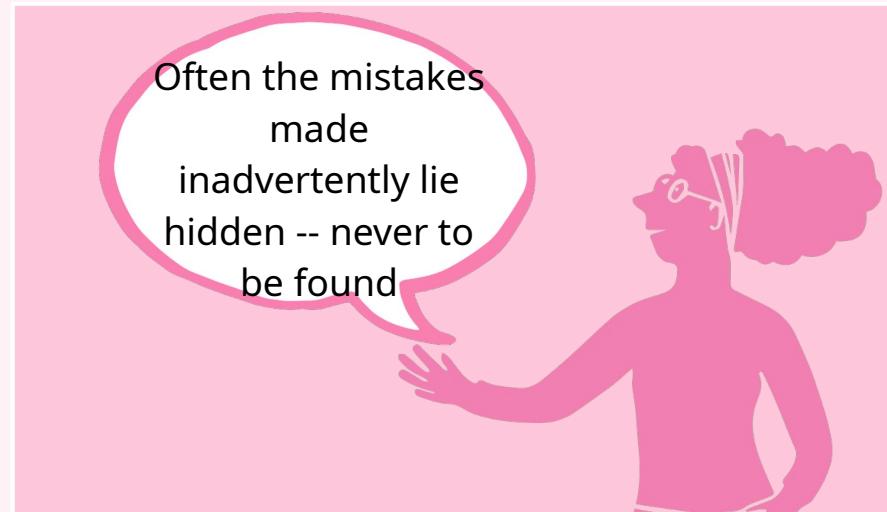
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Reproducibility
examples

Reproducibility Examples



Example 1: Identifying Reproducibility Issues in a Clinical Trial

- Clinical trials are studies that examine (typically) treatments on human health outcomes
- In 2018 a major medical journal retracted an important clinical trial after a serious error was detected in how the trial data was processed



Example 1: Identifying Reproducibility Issues in a Clinical Trial

- In this trial, the treatment and controls groups had their coding reversed
- This means that what researchers thought was data from the treatment group was actually data from the control group, and vice versa!



Example 1: Identifying Reproducibility Issues in a Clinical Trial

- This was an inadvertent mistake that invalidated the trial results
- The mistake was only found because the code underlying the results was published and so could be examined
 - Someone who examined the code spotted the mistake
- In this way, reproducible research practices saved the day!



Example 2: Power Posing

- In 2010, researchers published results from a psychological study suggesting that **power posing** (standing or adopting an assertive posture) can improve confidence
- These findings were disseminated widely, and the concept of power posing quickly found its way into popular culture



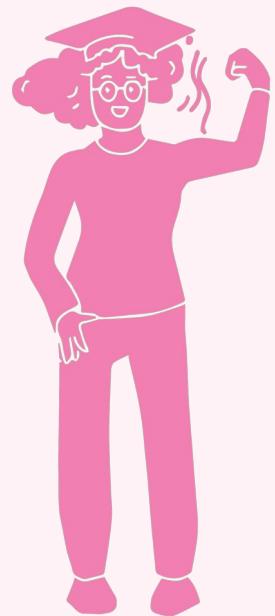
Example 2: Power Posing

- Two years later however, the results of the study were called into question when a replication study failed to find the same results
- This was particularly the case for changes that the original researchers had reported for certain hormones as a result of power posing
- In addition, increased scrutiny of the original research revealed that the statistical significance values associated with the work were barely significant



Example 2: Power Posing

- The research was, for a time, dismissed as pseudoscience
- However preregistered and robust replication studies have supported that power posing is linked to people's feeling of confidence now
- This reaffirms a link between posture and confidence
- It also demonstrates the importance of being able to reproduce studies to determine potentially erroneous and/or valid findings



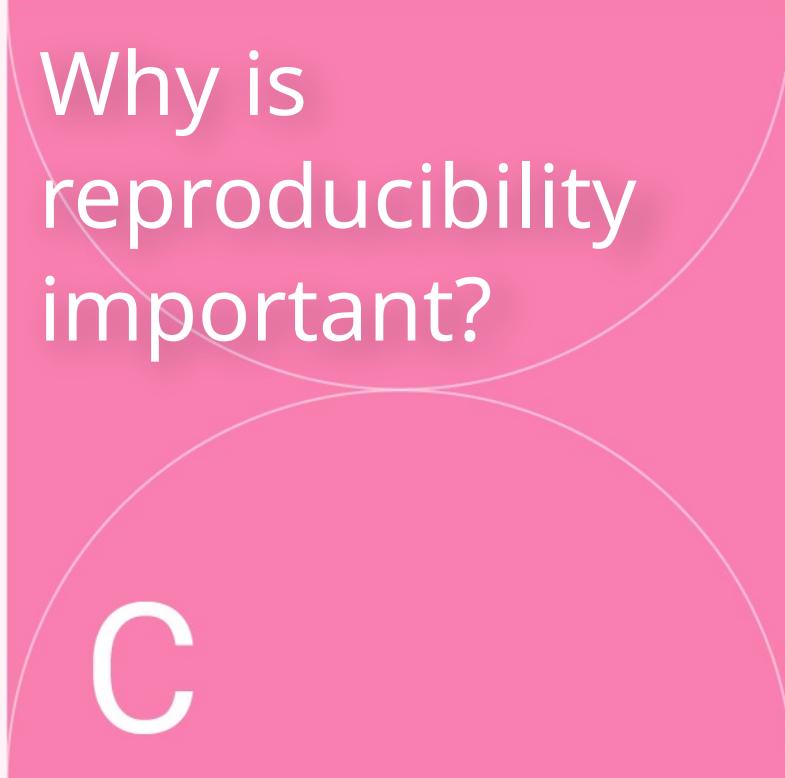




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Why is
reproducibility
important?

Why is reproducibility important?



Why is
reproducibility
important?

1

It ensures research can be assessed, verified, and confirmed by other researchers

2

It helps identify and correct situations where researchers have engaged in questionable research practices

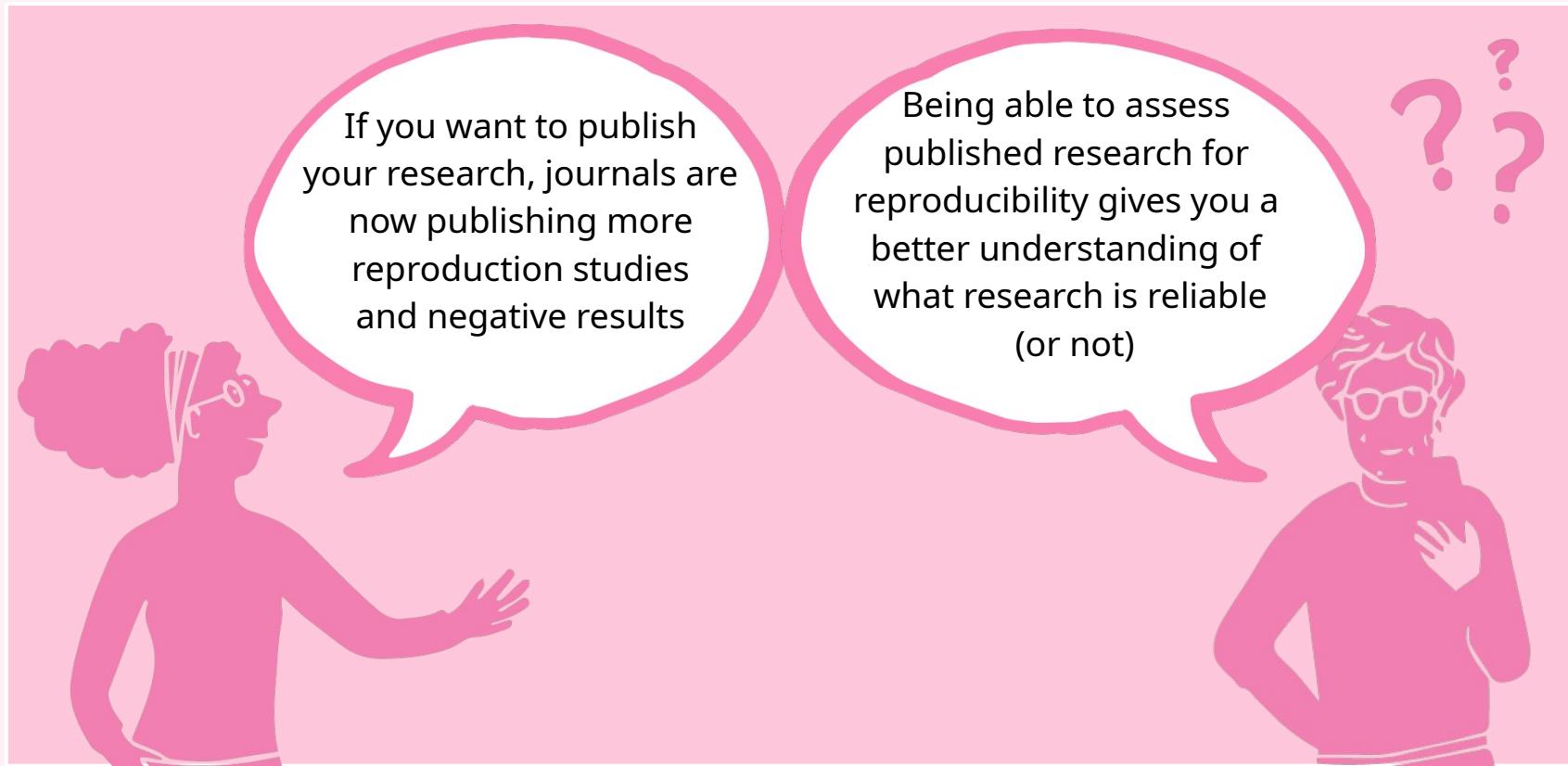
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Creating a culture of reproducibility can discourage researchers from reporting only those findings that are significant/exciting

How does this impact you?



How does this impact you?



How does this impact you?







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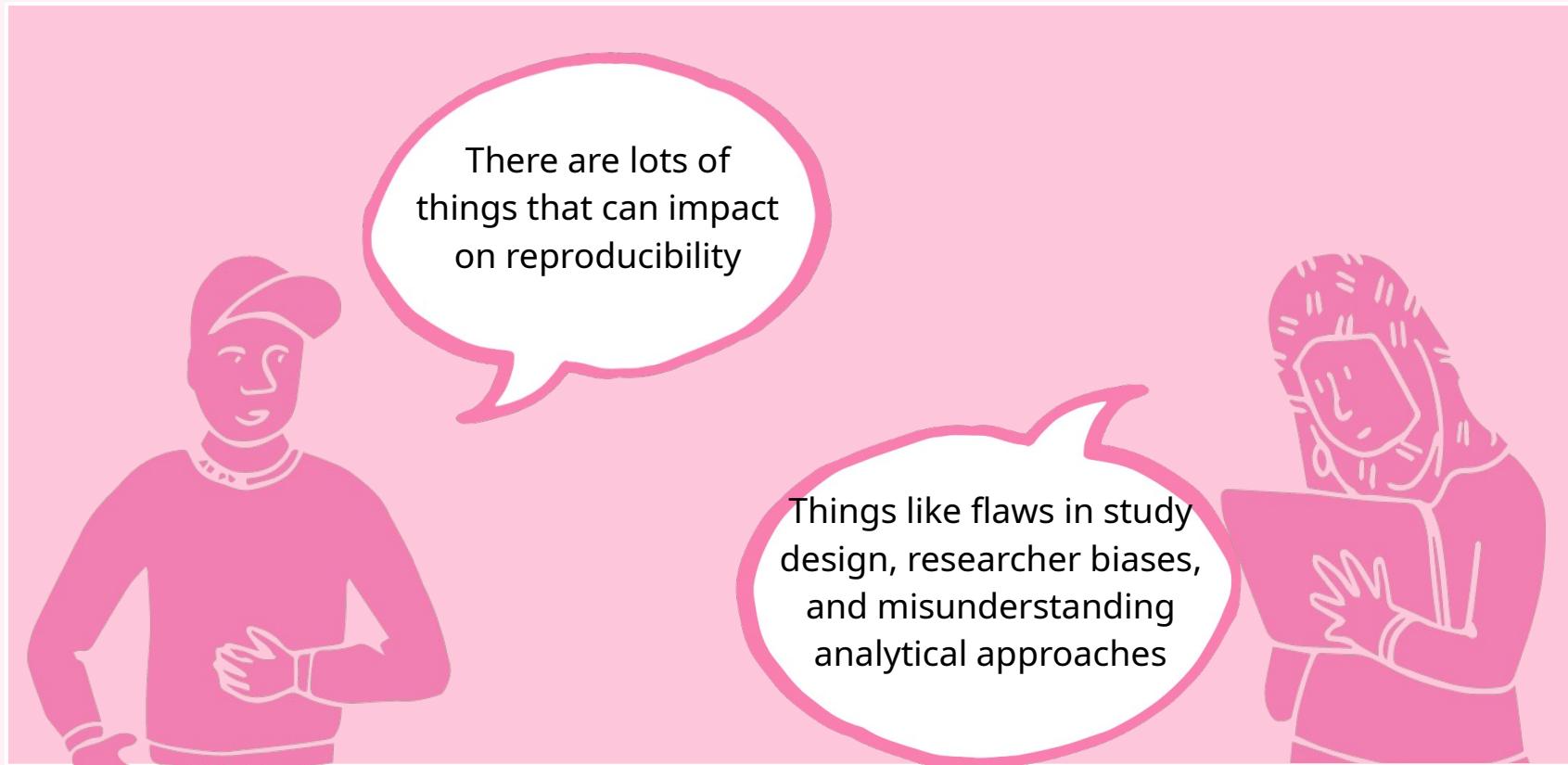
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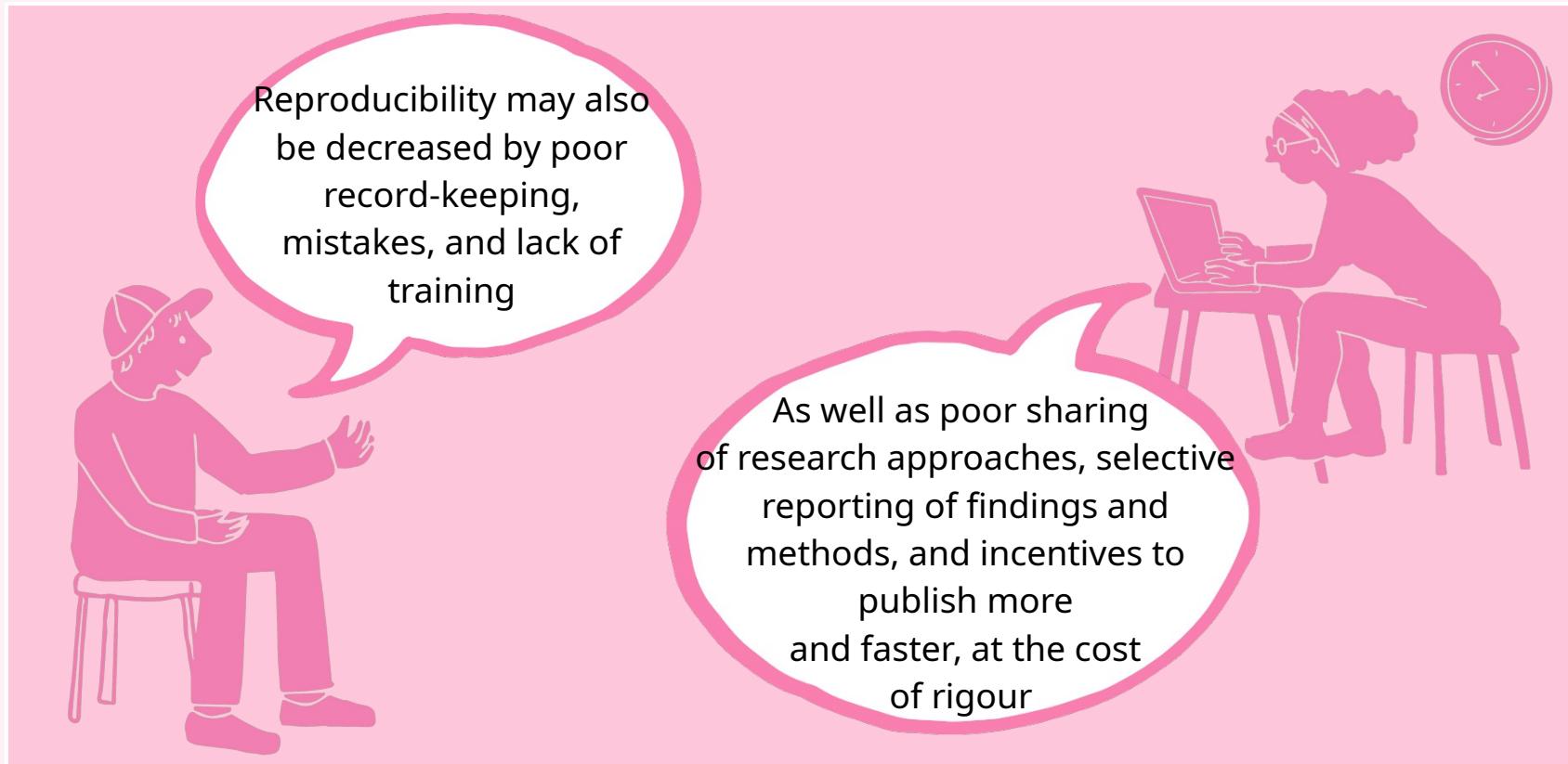


How do we make
research more
reproducible?

What kinds of things decrease reproducibility?



What kinds of things decrease reproducibility?



How can we make research more reliable and reproducible?



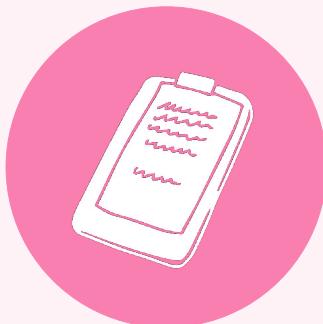
Carefully document your methods using a data management plan



Use a uniform filing system with clear folder and filing names



Store metadata alongside primary data (metadata is data about data)



Store all research materials in accordance with institutional guidelines



Consider keeping a digital notebook to share processes and steps used to generate the findings

How can we make research more reliable and reproducible?

- If you are working with data that can be more readily made available, make your data and details of methods freely available to other researchers by

Publishing the data in a repository

Always including a data dictionary to accompany your data

Using open-source software and providing information about...

Such as OSF, which you were introduced to in Module 2

A data dictionary gives clear information about your data

Statistical tests, or other analytical approaches employed, and the arguments used

How can we make research more reliable and reproducible?

- In some disciplines it is not as easy/possible to make data available
- If it is not possible, remember the importance of enhancing transparency by providing details about how the research was conducted
- These details can include:

The theoretical method adopted

The research setting

The relationship between researcher and participants

Anonymised participant characteristics

How can we make research more reliable and reproducible?



Strategies to make your research more reproducible are presented throughout the PaPOR TRaIL course

Research Integrity (Module 1)

Research Data Management (Module 4)

Open Reporting (Module 5)

Knowledge Dissemination (Module 6)

There are resources available to help

- Examples of resources in University College Cork include:
 - A [digital badge in the Responsible Conduct of Research](#) that includes training on research reproducibility
 - There are postgraduate modules on
 - [Reproducible Research Practices \(PG6030\)](#)
 - and an [Introduction to Research Integrity, Ethics and Open Science \(PG6015\)](#)
 - The [UCC Boole Library](#) also run a variety of [training sessions](#)
- Other universities may have supports, including training and workshops, to support you to develop reproducible research methods

There are resources available to help

- There are also online networks and communities you can follow and join. E.g.,

- The [UK Reproducibility Network \(UKRN\)](#)

The UKRN provides guidance and resources for methods and strategies for improving research reproducibility

- [Reproducibility for Everyone](#)

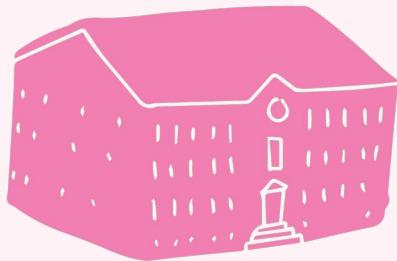
This provides resources and webinars on strategies for reproducible research

- [Reproducibilitea](#)

A community for early-stage researchers interested in open science and reproducibility

What efforts are universities and supervisors making to help us to make research more reproducible?

- Efforts are increasing by supervisors and universities to support students



What efforts are universities and supervisors making to help us to make research more reproducible?

- One example of this, being led by Dr Katherine Button (University of Bath) is a collaborative approach to open research projects
- In this model, students at a number of UK universities participate in a “consortium” to complete their final year theses
- The students receive extra support throughout the project to make their research reproducible

