Babraham Institute

Research Integrity

or *How to be a Good Scientist*

Jo Montgomery, Sarah Inglesfield,
Anne Segonds-Pichon, Laura Biggins and Simon Andrews

v2025-10

Babraham Bioinformatics

A

B

C

D


Maryland
200g
CHOC CHIP


McVitie's
Digestives
433g
Milk Chocolate


McVitie's
Fruit
Shortcake
200g

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An illustration

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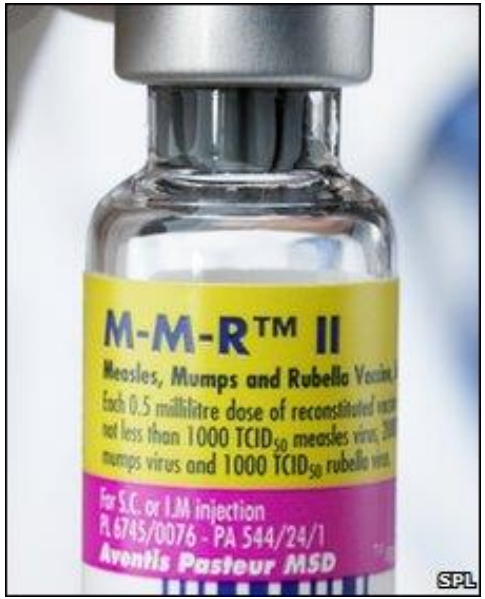
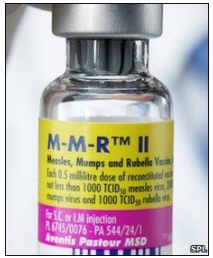
Research Integrity

MMR = Measles, Mumps and Rubella



⟺ **Autism**



1998 **Link** MMR autism

Wakefield *et al.*

n=12 children

https://pubmed.ncbi.nlm.nih.gov/9500320/

1999 **No link** MMR autism

Taylor *et al.*

n=498 children

https://pubmed.ncbi.nlm.nih.gov/10376617

2001: **No link** MMR autism

Dales *et al.*

n=600-1900 children each year over 14 years

https://pubmed.ncbi.nlm.nih.gov/11231748/

2002-2005: **No link** MMR autism

Many more studies

https://pubmed.ncbi.nlm.nih.gov/15366972/

https://pubmed.ncbi.nlm.nih.gov/15877763/

2010

Andrew Wakefield found guilty of serious professional **misconduct**

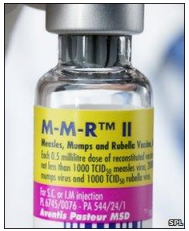
https://www.bmj.com/content/340/bmj.c593

2010

Retraction of the Wakefield *et al.* paper

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2831678/

Research Integrity



- Scientists and organisations across the world **spent a great deal of time and money** refuting the results of a minor paper in the *Lancet* .

- **MMR vaccination**: **1995: 95%** to **2002: 81 %**
- Measles outbreaks in the UK in 2008 and 2009
- **2020**: Uptake of MMR vaccine: **91%** (still below herd immunity)

Retracted article **2010** **12 years**
See the retraction notice

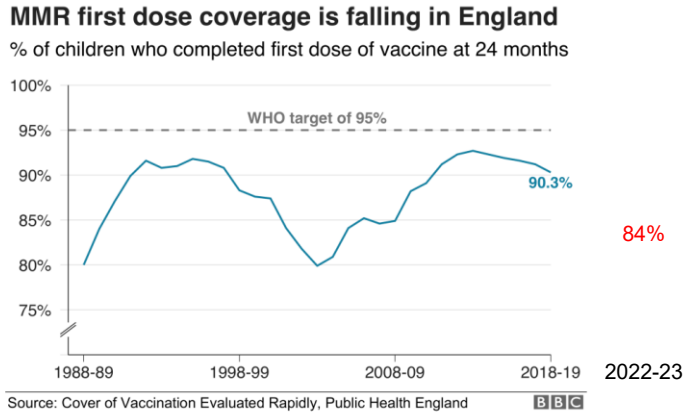
Lancet. 1998 Feb 28;351(9103):637-41. doi: 10.1016/s0140-6736(97)11096-0.

Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children

A J Wakefield [1], S H Murch, A Anthony, J Linnell, D M Casson, M Malik, M Berelowitz, A P Dhillon, M A Thomson, P Harvey, A Valentine, S E Davies, J A Walker-Smith

Affiliations + expand

PMID: 9500320 DOI: 10.1016/s0140-6736(97)11096-0



Research Integrity

The Guardian
Newspaper of the year

Rise in measles cases prompts vaccination campaign in England

UKHSA declares national incident as figures suggest more than 3.4 million children have not had MMR jab

Measles cases in the West Midlands have been at their highest level since the mid-1990s. Photograph: MedStockPhotos/Alamy

- **2016**: UK declared measles free
  Now lost this status

- Increases in number of measles cases
- **2022-23**: **: 84% children in England**
- **(74% in London, vs 90% South West)**
- Need vaccination rate of **95%**
- **Current decline due to:**
  - Vaccine misinformation
  - Not serious?
  - Difficulty accessing appointments
  - Impact of covid pandemic

Obvious examples are obvious, but…

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Outline of the course

Babraham Bioinformatics


Research Integrity
What does it mean?
Questioning
Definitions
In Practice
Ethics
Keeping Track
Responsibility
How can we apply it?
Publications
Misconduct
When is it tested?
Bottom line
Good Science

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What is Research Integrity?

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Research Integrity
a.k.a. Scientific Integrity

- **Scientific integrity** (From Wikipedia):

Scientific integrity deals with '**best practices**' or rules of professional practice of researchers.

- Organisation for Economic Co-operation and Development (OECD) report, 2007 **replication (or reproducibility) crisis** and the **fight against scientific misconduct**.

Research Integrity

a.k.a. Scientific Integrity

- The **replication crisis - scientific studies** are **difficult or impossible to replicate** or reproduce.

Psychology:
Open Science Collaboration
(100 papers from 2012)
36% of the replications yielded significant findings vs 97% in the original studies.

Cancer Research:
Reproducibility Project: Cancer Biology
(53 papers from 2010 to 2012)
25% experiments could be reproduced.
Replication effect sizes were 85% smaller on average than the original findings.

https://osf.io/82fth/
https://www.sciencenews.org/article/cancer-biology-studies-research-replication-reproducibility

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Which words are most important/synonymous with integrity?

Exercise

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Research Integrity

Many words

Responsibility

Accountability

Honesty

Fair

Objectivity

Respect

Scientific integrity

Rigor

Care

Reproducibility

Openness

Ethics

Transparency

Accurate

Reliability

Cooperation

Collegiality

Quality

Research Integrity

More than words

- Accountability
- Accurate
- Care
- Collegiality
- Cooperation
- Ethics
- Fair
- Honesty
- Objectivity
- Openness
- Quality
- Reliability
- Reproducibility
- Respect
- Responsibility
- Rigor
- Transparency

Scientific integrity

Research Integrity

Research Integrity means conducting, reviewing and reporting research in a responsible way that allows ourselves and others to have confidence that our research is trustworthy and of the highest quality.
It also sets the culture of the Institute as an inclusive, respectful, open and outstanding place to work.

BI-RES-005 RESEARCH INTEGRITY POLICY

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Research Integrity in practice

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Research Integrity: In Practice

- Accountability
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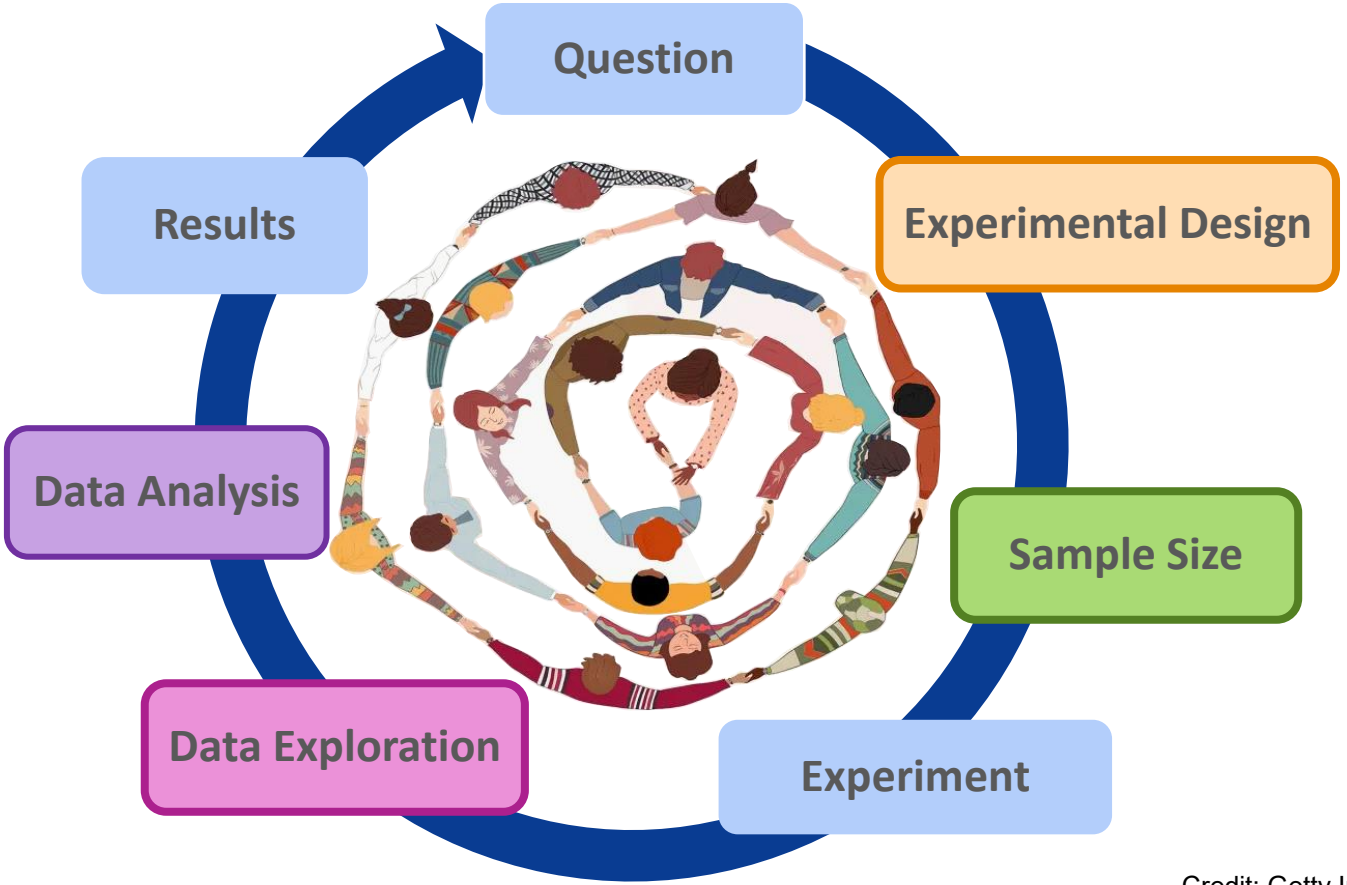

Credit: Getty Images/melitas

Research Integrity in practice

Experimental design

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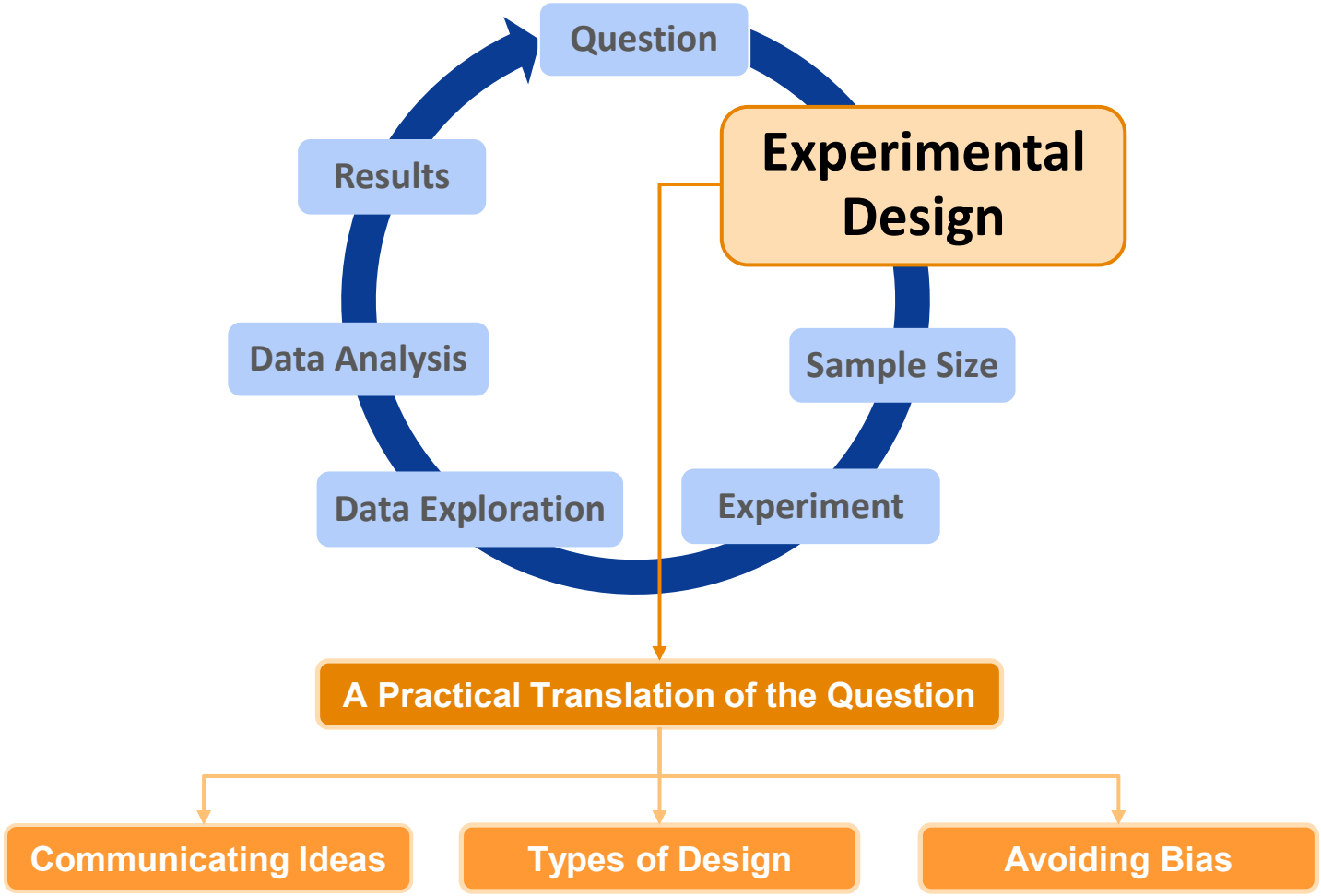

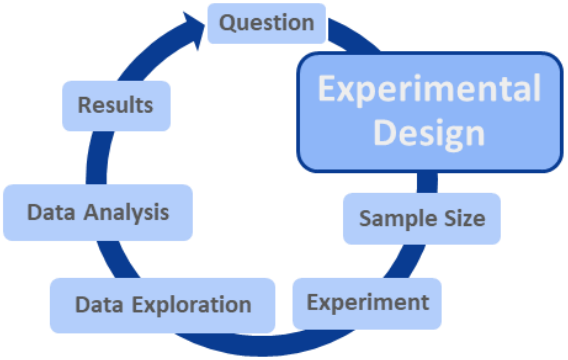

Clear Communication

- Accountability
- Accurate
- Care
- **Collegiality**
- **Cooperation**
- Ethics
- Fair
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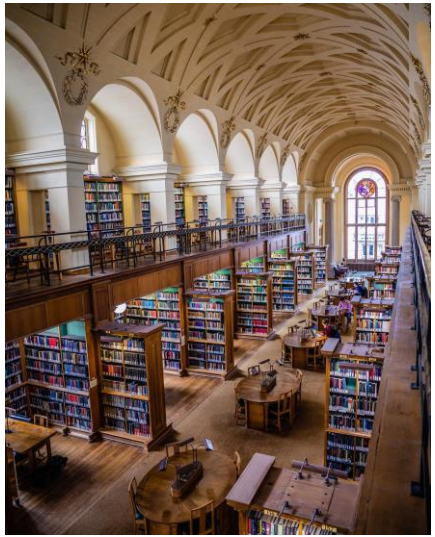
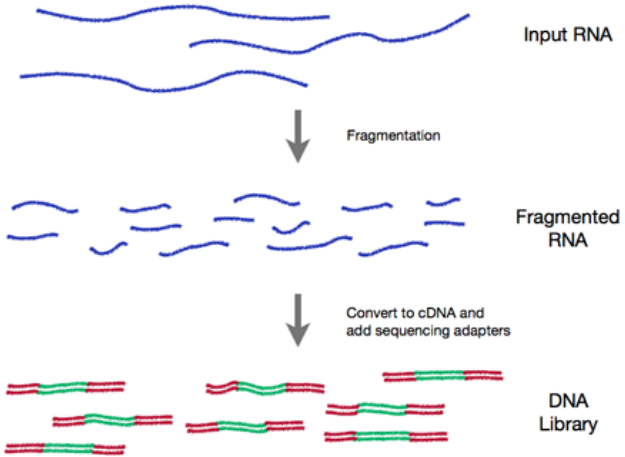
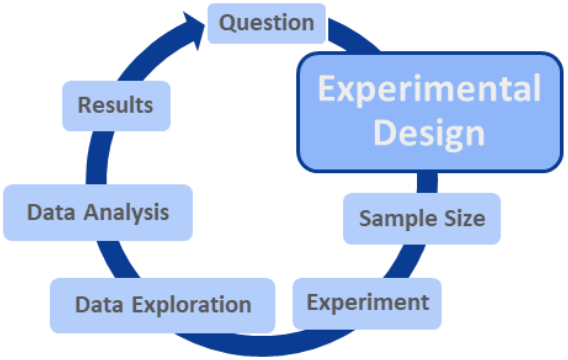
Library



Library, Cambridge



RNA seq Library



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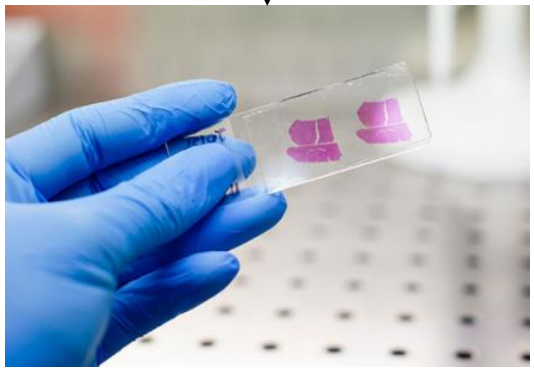
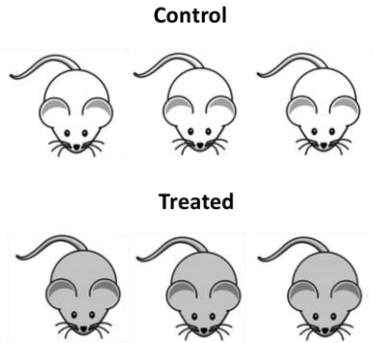
Clear Communication

Sample

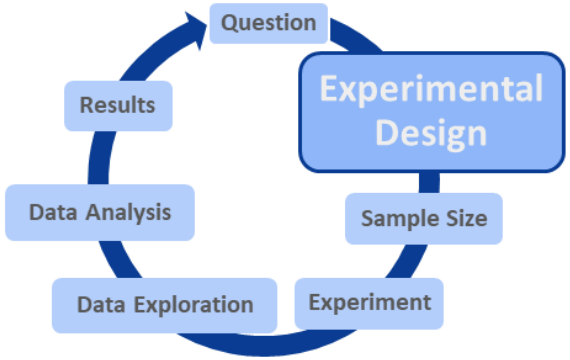


Tissue **Sample**



Sample of mice

- Different words to describe the same data/graphs
- Different traditions in different labs, areas of science



Appropriate Type of Design

Distinguish real differences from experimental artefacts…

…But experiments can be big and complicated

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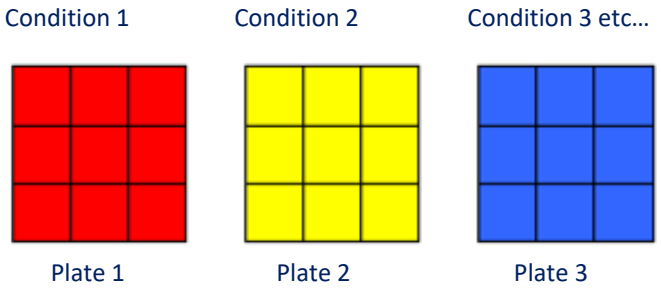
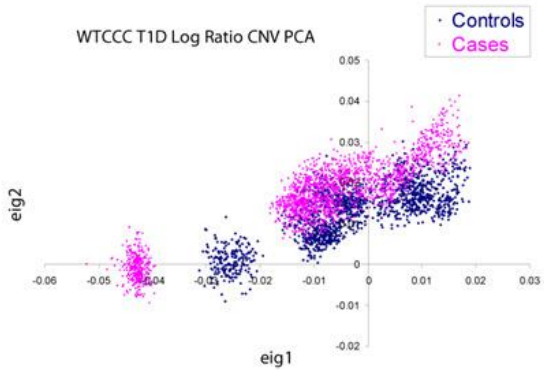
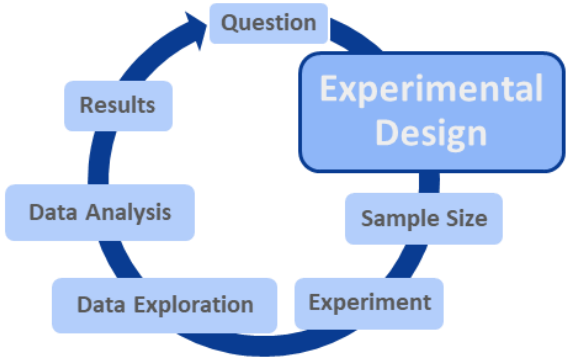
Seminal Wellcome Trust GWAS Study:

- 14000 cases of 7 diseases & 3000 shared controls
- Each processed at different sites and genotyped on distinct series of plates





Differences between control and cases are confounded by plate



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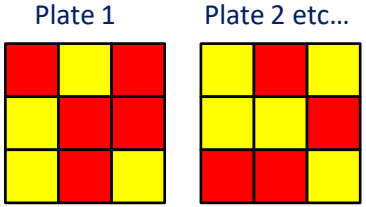
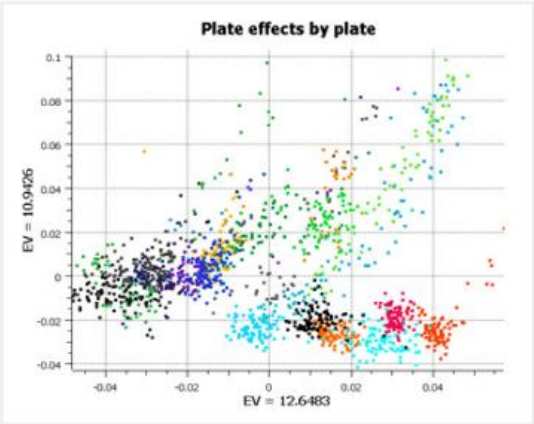
GenADA multi-site collaborative study:

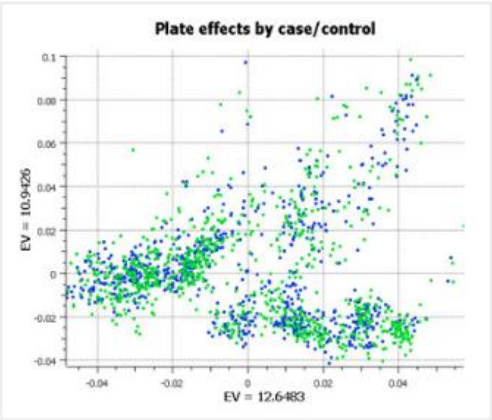
- 875 Alzheimers patients, 850 controls, 9 sites
- Randomised Block Design



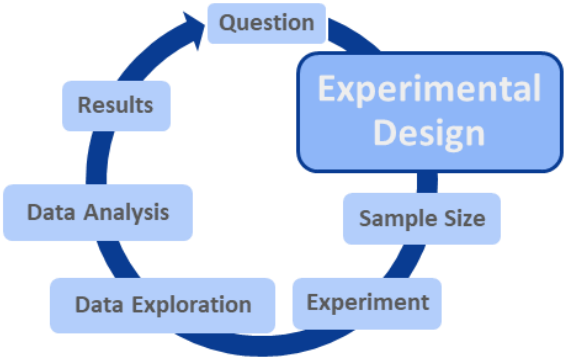
Still have differences between plates



Doesn't confound the experiment



https://blog.goldenhelix.com/stop-ignoring-experimental-design-or-my-head-will-explode/



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Avoiding Bias

Humans are not always good at remaining objective…

Cognitive Bias = Pareidolia

Biases can also impact our experiments

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Confirmation bias

Exercise

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A Quick Exercise on Confirmation Bias and Hypothesis Testing

You will be presented with 3 numbers in a sequence.

You need to guess the **rule** that governs the sequence.

You can suggest any 3 numbers you like, and we will tell you whether or not your sequence follows the rule.

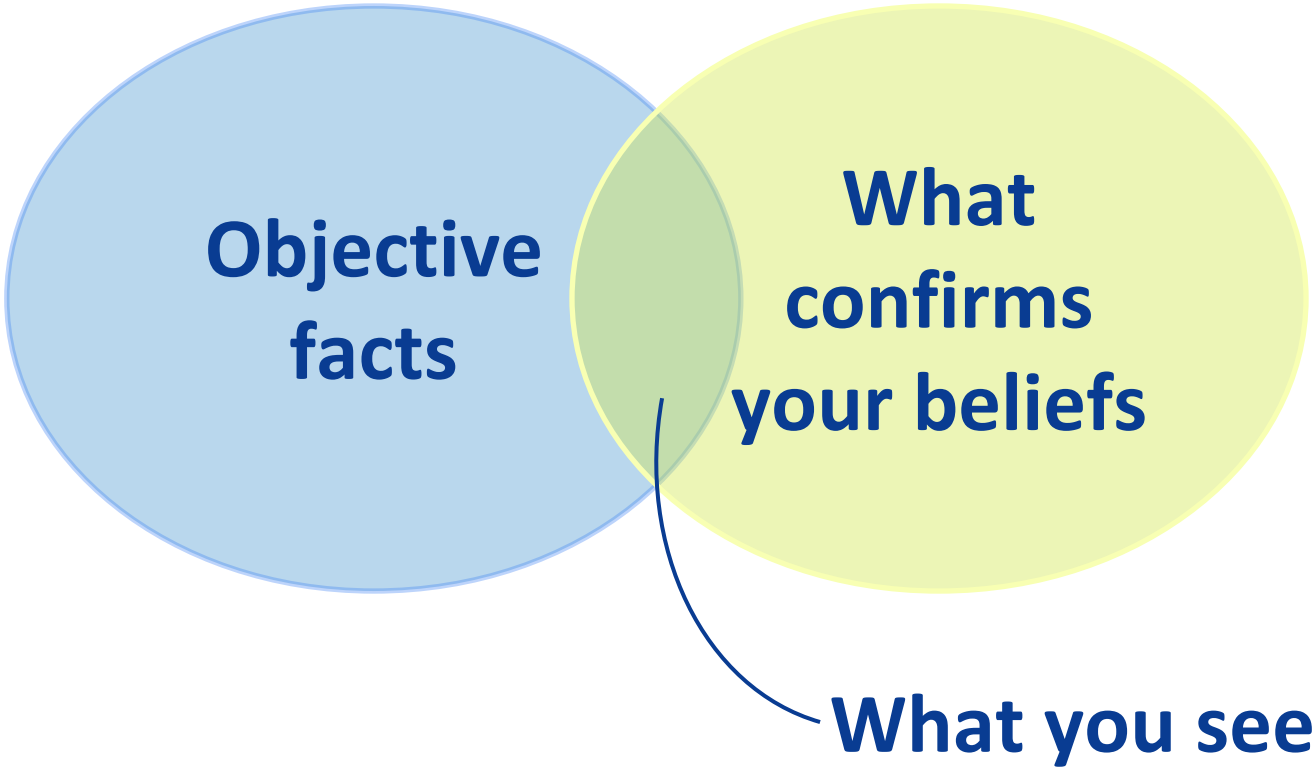
A Quick Exercise on Confirmation Bias and Hypothesis Testing

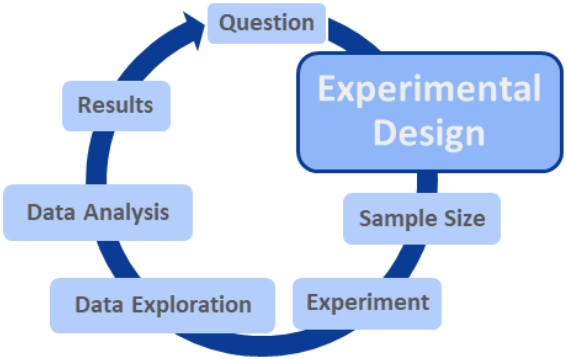
2 | 4 | 8

A Quick Exercise on Confirmation Bias and Hypothesis Testing

What's the rule?

Confirmation bias





Experimenter Bias

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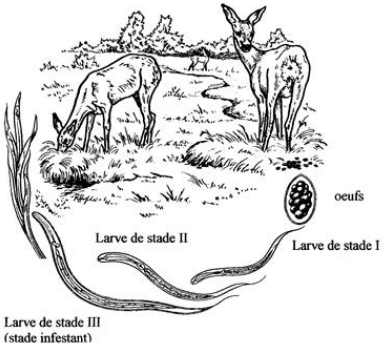
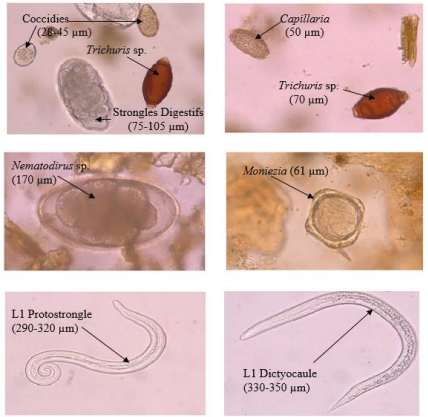
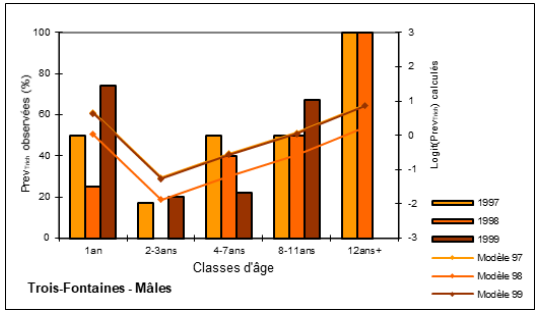
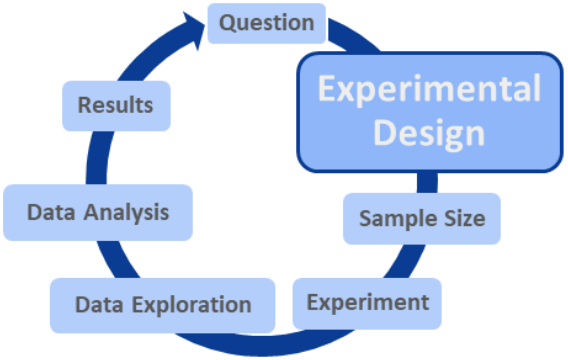






Scientists should be **blind** … if they want to be **objective**!

Wetzer and Rieck, 1960



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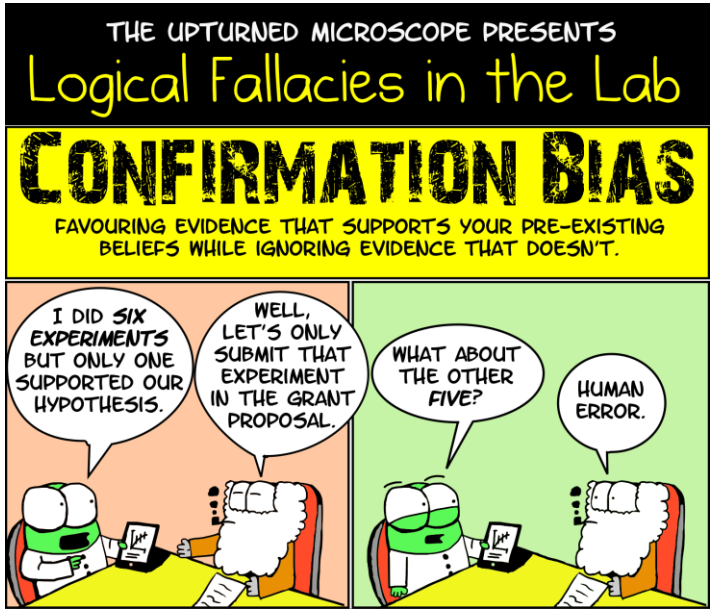
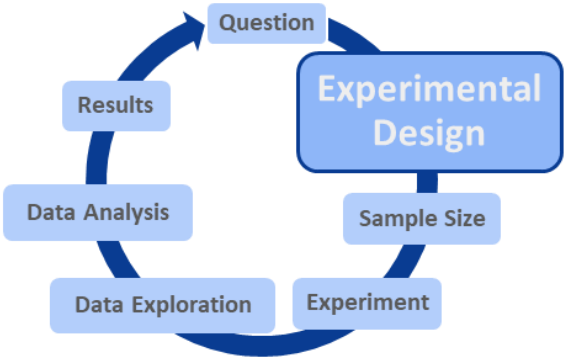
Blinding

is important to avoid

Confirmation bias





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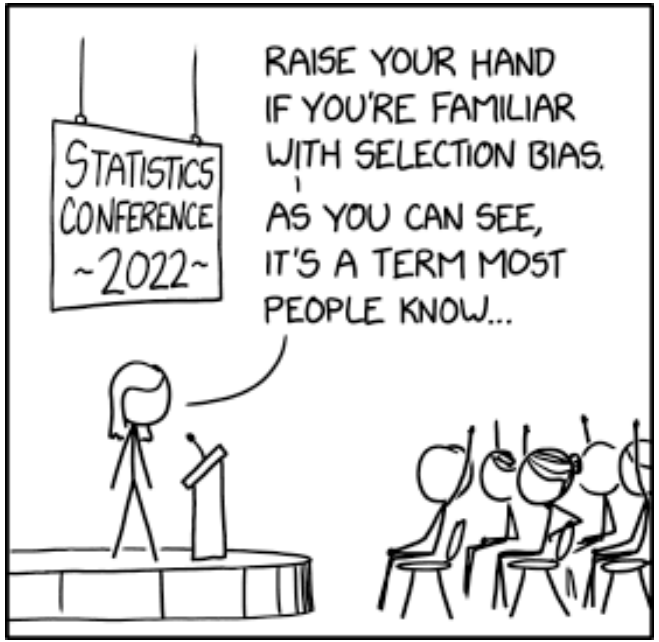
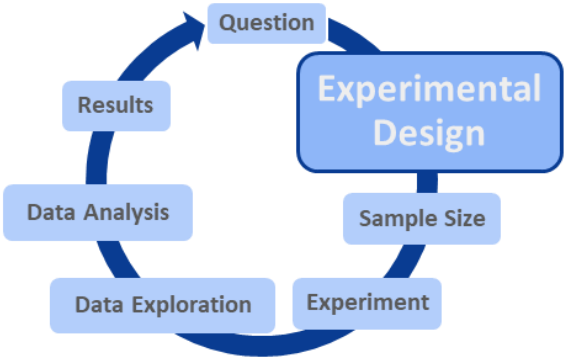
Selection Bias



Biases in our sample populations can impact on our conclusions too



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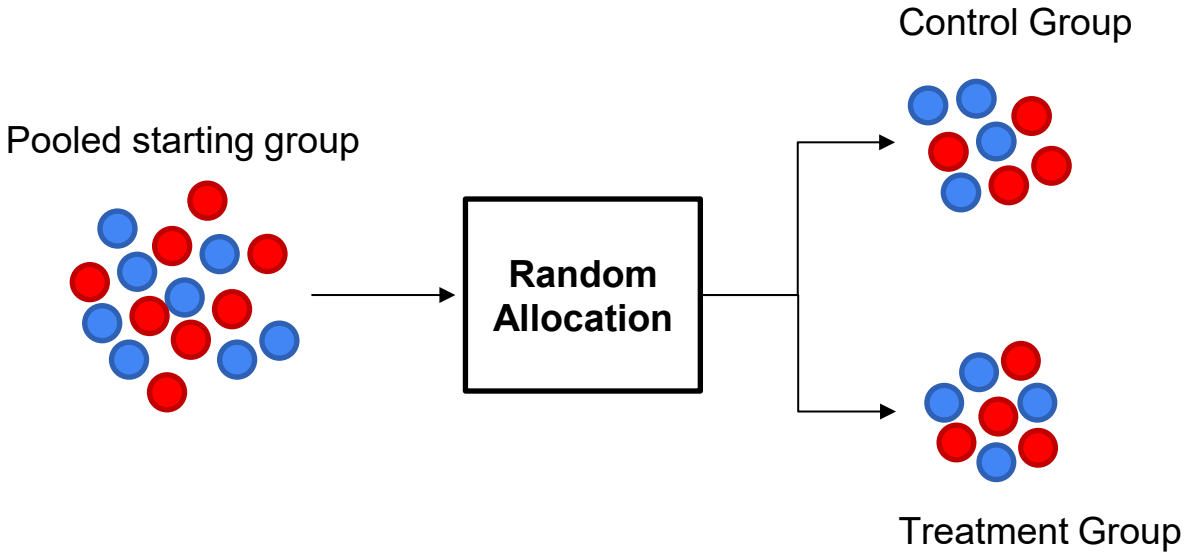
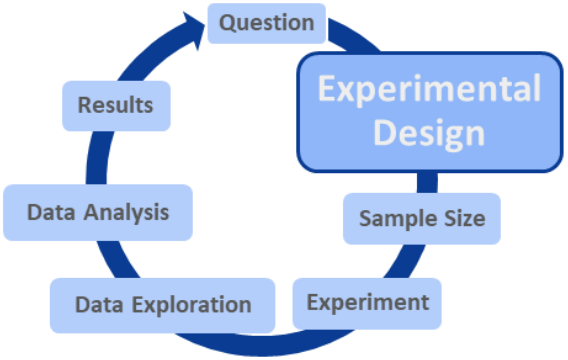
Randomisation



Each experimental unit has equal probability of receiving a treatment

- Minimises Selection Bias
- Reduces systematic differences between groups



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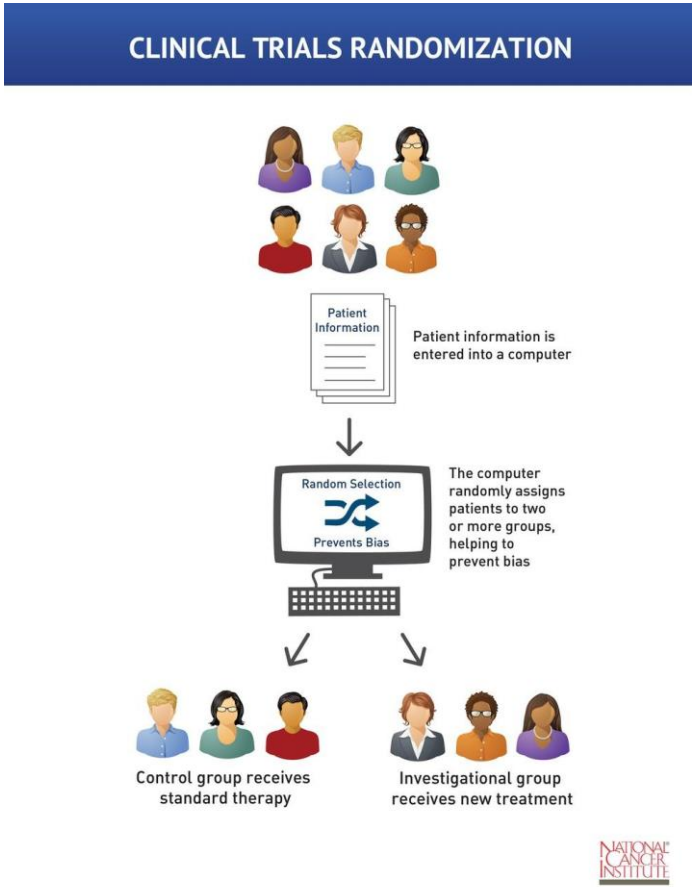
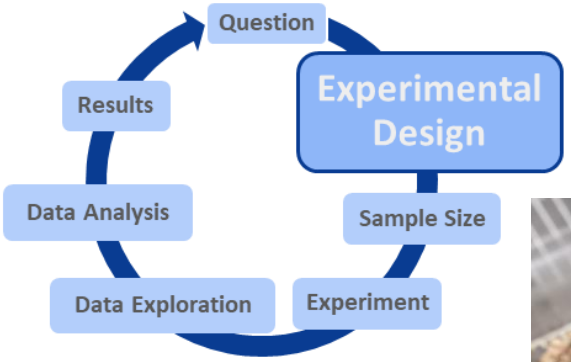
Random Allocation





Random Allocation

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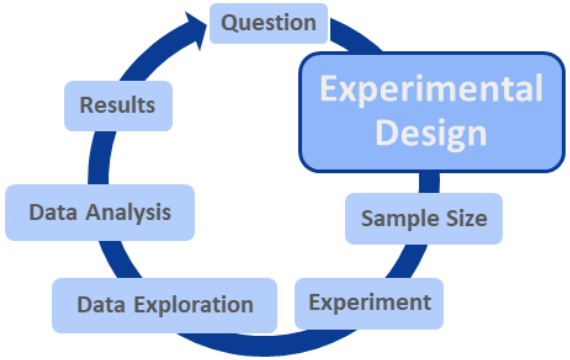
Pick out a mouse at random, first 3 get the treatment

Is this random?

Does it have the potential to introduce bias?

A Biased

B Not Biased



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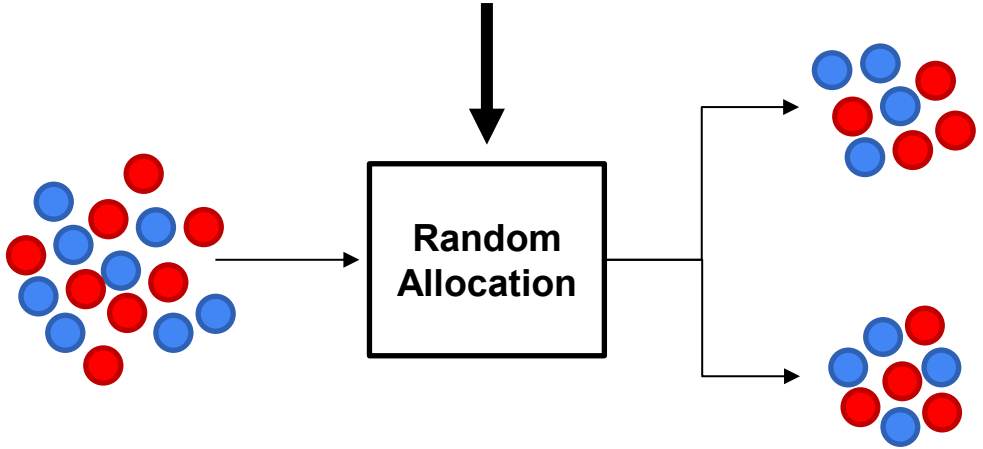
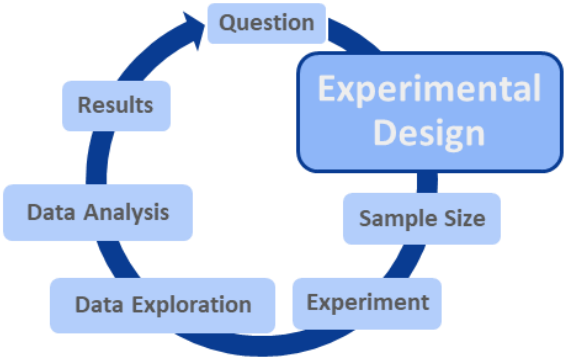
Randomisation More Broadly

Consider Nuisance Factors



Also consider randomisation **throughout** the experiment

https://eda.nc3rs.org.uk/experimental-design-allocation#randomisationstrategy



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Transparency

In a nutshell

Good experimental design…

- Translates the scientific question into lab work
- Prevents subjectivity
- Reduces effects of nuisance variables

…Is a fair way to do science

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Research Integrity in practice

Sample size

Babraham Bioinformatics

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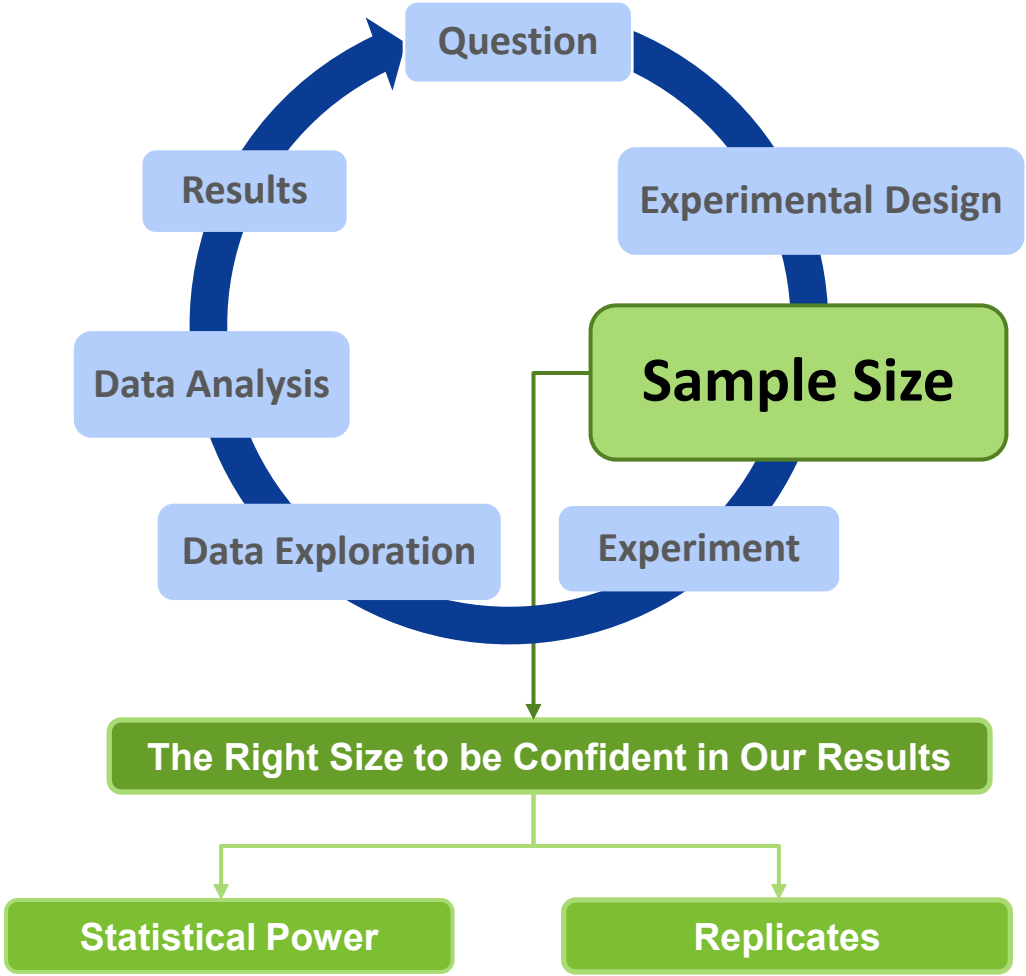
Cooperation
Ethics
Fair
Honesty
Objectivity
Openness
Quality
Reliability
Reproducibility
Respect
Responsibility
Rigor
Transparency



Statistical power: an analogy

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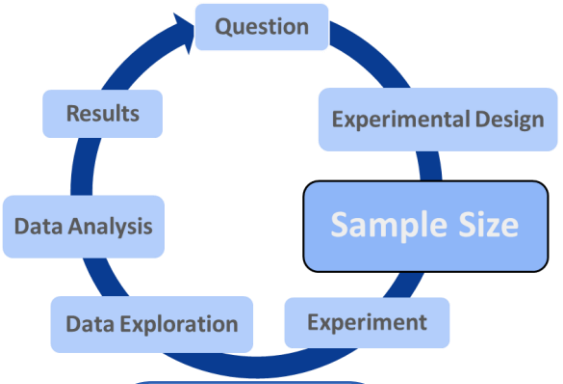
You send your child into the basement to find a tool. The child comes back and says "it isn't there".
What do you conclude?

In the house	**In the lab**
"If the tool really is in the basement, what are the chances that your child would have found it?"	"If there is a difference between 2 conditions, what are the chances that your experiment will pick it up ($p<0.05$)?"
How long did the child spend looking? 	How many mice do you look at? **Sample size** 
How big is the tool?  or 	How big is the difference? **The absolute effect** 
How messy is the basement?  or 	How messy the data are? **Variability** 



The Importance of Statistical Power

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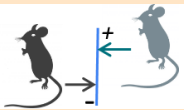
"If there is a difference between 2 conditions, what are the chances that your experiment will pick it up ($p<0.05$)?"

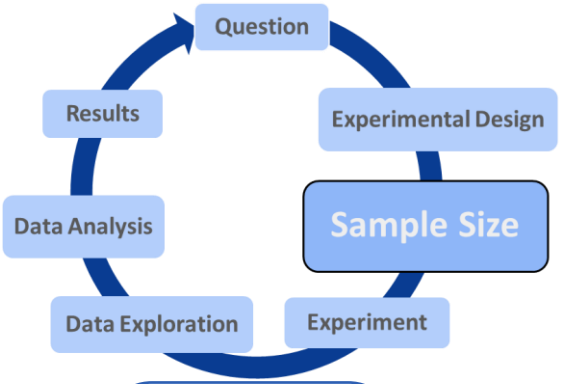
Increase **Sample size** to increase **Power** → How many mice do you look at? **Sample size**

Little to no control

How big is the difference? **The absolute effect**



How messy the data are? **Variability**



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The Importance of Statistical Power

Low Powered Studies have a greater chance of failing to detect a real effect

BUT that's all probability…

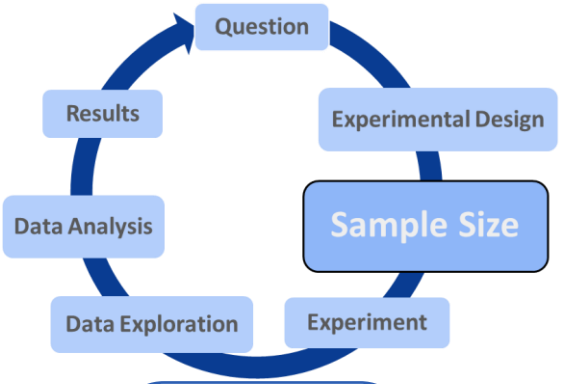
So some underpowered studies will detect a real effect

Are these results trustworthy?

A Yes

B No

https://www.taconic.com/taconic-insights/quality/animal-research-sample-size-calculation.html



The Importance of Statistical Power

The Problem of the "Inflation Effect"…

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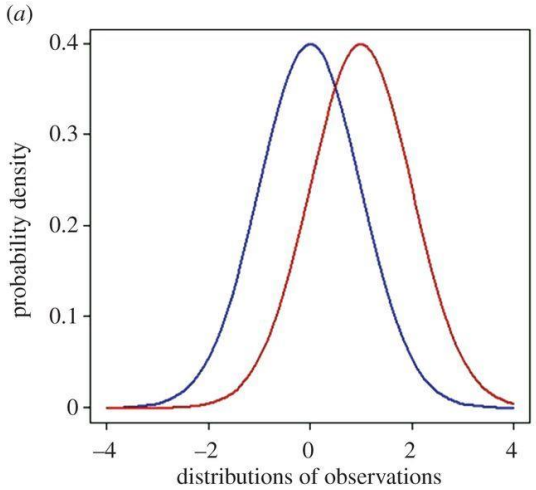
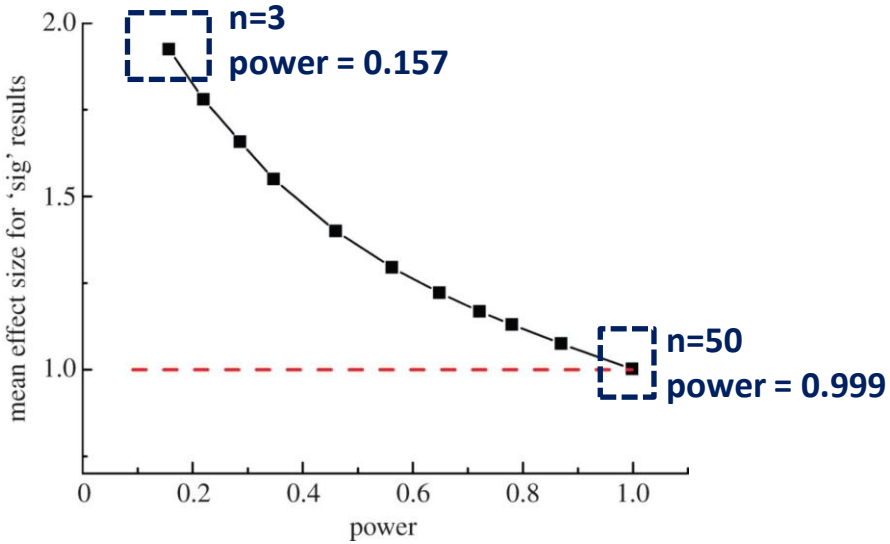
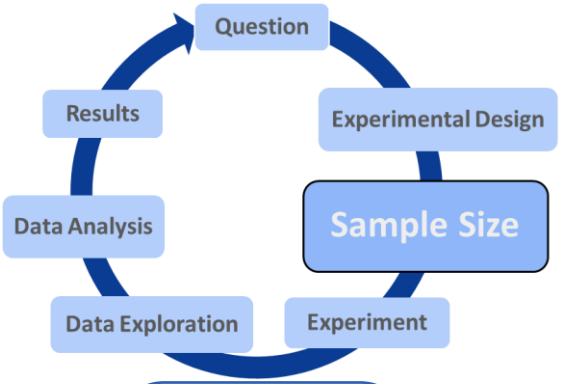
The TRUE effect size = 1





https://royalsocietypublishing.org/doi/10.1098/rsos.140216



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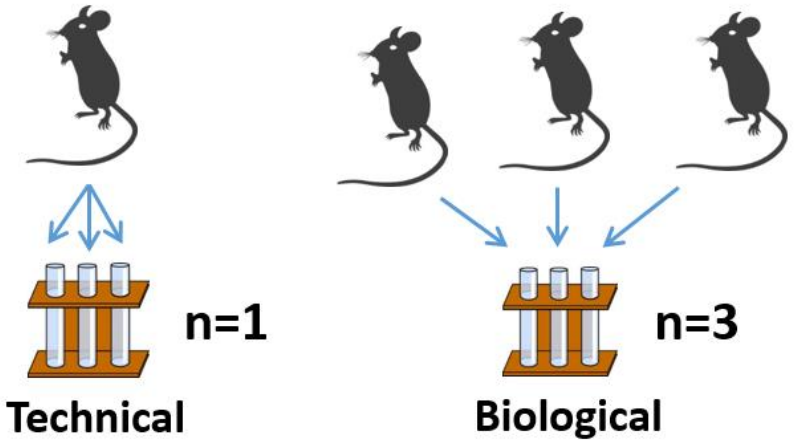
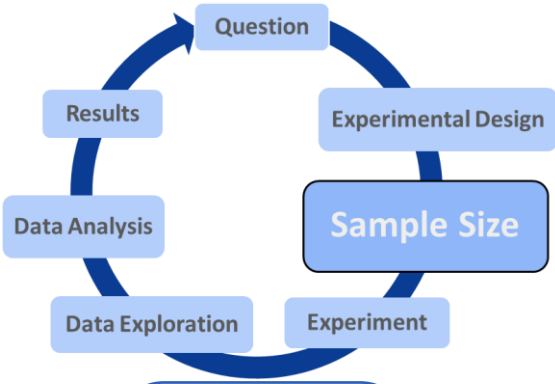
Defining Replicates

*By the way: **replicates** = repeat = sample = library*

Technical versus biological replicates





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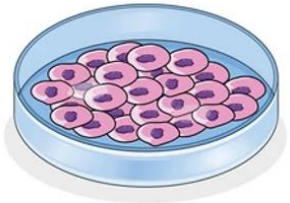
What is a Biological Replicate in Practice?

1 biological replicate:

A 1 mouse

B 1 cage



1 biological replicate:

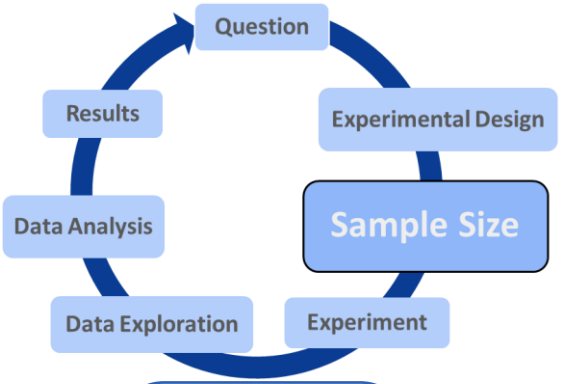
A 1 cell

B 1 petri dish

1 biological replicate:

A 1 worm

B 1 petri dish



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In a nutshell

Sample Size & Power are key to confident results

Underpowered Studies are more likely to:

- Fail to detect real effects
- Overestimate the effect size of detected effects

More biological replicates increase our evidence

How Many?
Formalise with power calculations….

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Research Integrity in practice

Data Exploration & Data Analysis

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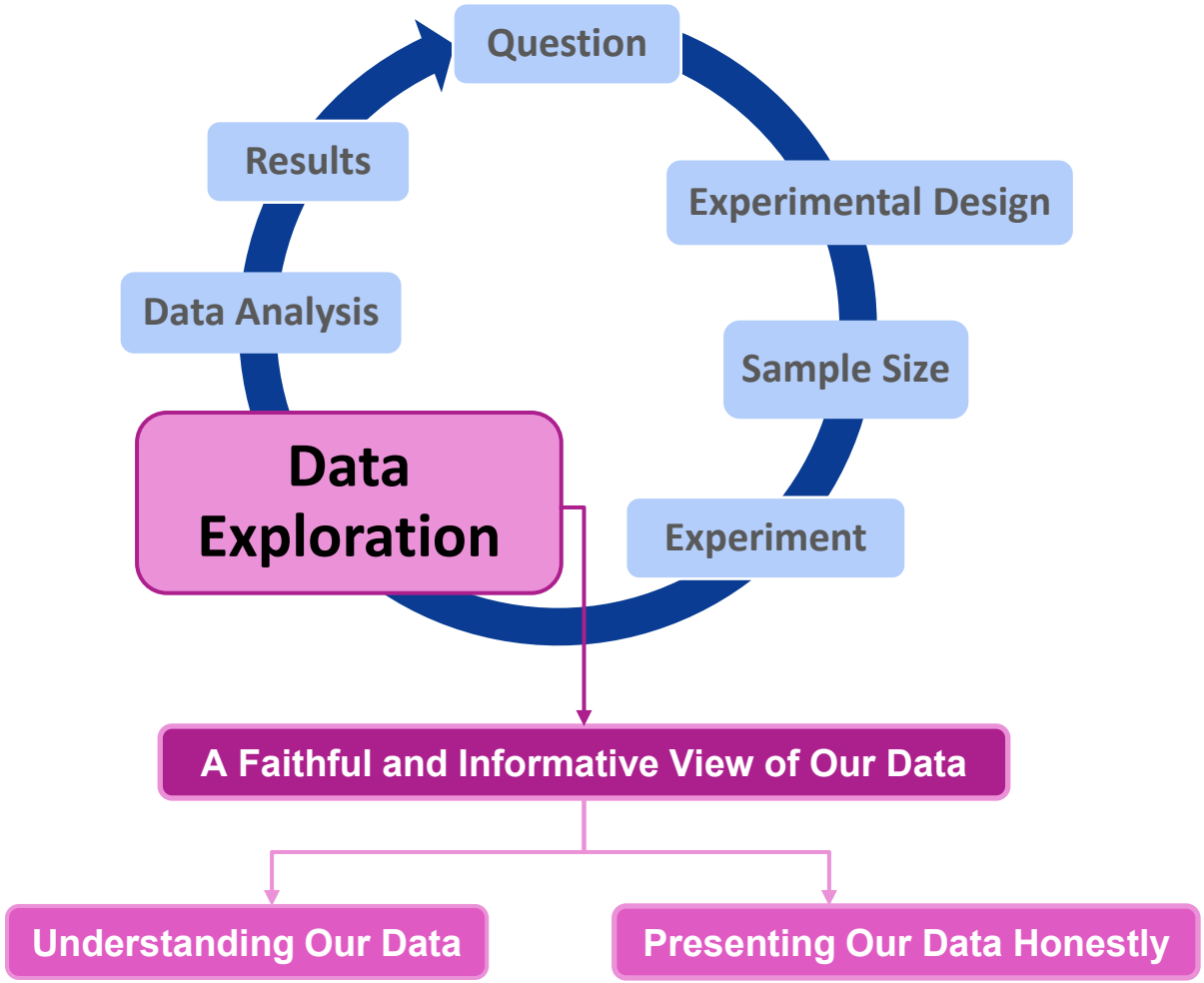

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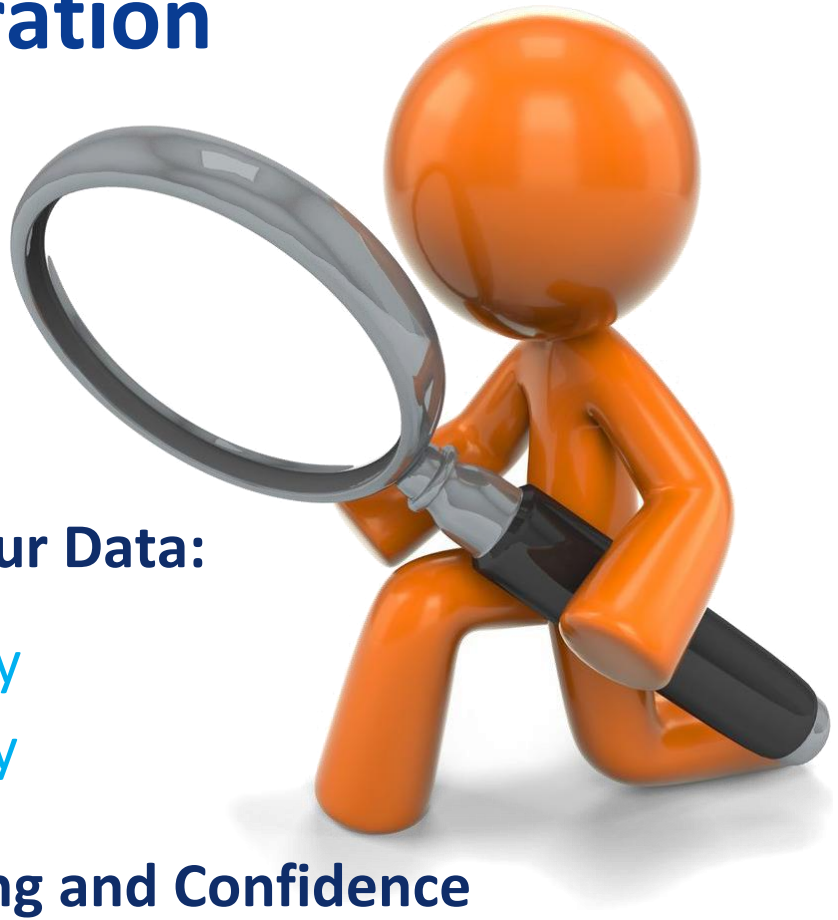
Data Exploration



Understanding Our Data:

- The Biology
- The Quality

Builds Our Understanding and Confidence

Data Exploration: Understanding Our Data

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Often we summarise our data to key values

N	182
X Mean	54.26
Y Mean	47.83
X SD	16.76
Y SD	26.93
Correlation	-0.06

Can be really useful…

…And also really not!

Data Exploration: Anscombe's Quartet

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"A computer should make both calculations *and* graphs"

Francis Anscombe

Dataset 1		Dataset 2		Dataset 3		Dataset 4	
X1	Y1	X2	Y2	X3	Y3	X4	Y4
10.00	8.04	10.00	9.14	10.00	7.46	8.00	6.58
8.00	6.95	8.00	8.14	8.00	6.77	8.00	5.76
13.00	7.58	13.00	8.74	13.00	12.74	8.00	7.71
9.00	8.81	9.00	8.77	9.00	7.11	8.00	8.84
11.00	8.33	11.00	9.26	11.00	7.81	8.00	8.47
14.00	9.96	14.00	8.10	14.00	8.84	8.00	7.04
6.00	7.24	6.00	6.13	6.00	6.08	8.00	5.25
4.00	4.26	4.00	3.10	4.00	5.39	19.00	12.50
12.00	10.84	12.00	9.13	12.00	8.15	8.00	5.56
7.00	4.82	7.00	7.26	7.00	6.42	8.00	7.91
5.00	5.68	5.00	4.74	5.00	5.73	8.00	6.89

4 datasets

Each consisting of X and Y variable

All 4 datasets have the same summary statistics...

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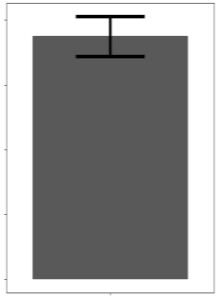
Data Exploration: Anscombe's Quartet

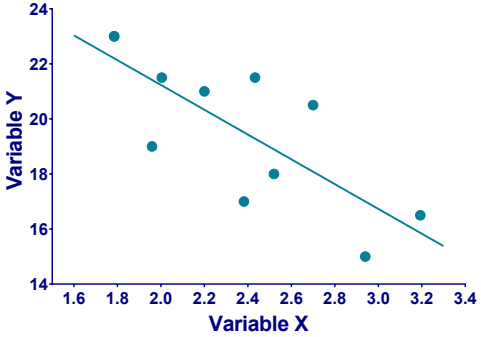
The average and spread of the conditions appears the same

	Dataset 1		Dataset 2		Dataset 3		Dataset 4	
	X1	Y1	X2	Y2	X3	Y3	X4	Y4
N	11	11	11	11	11	11	11	11
Mean	9.00	7.50	9.00	7.50	9.00	7.50	9.00	7.50
STD	3.31	2.03	3.31	2.03	3.31	2.03	3.31	2.03
SEM	1.00	0.612	1.00	0.612	1.00	0.612	1.00	0.612



The relationship between X & Y can be described the same

	Correlation (r)	Line of Best Fit
x1 vs. y1	r = 0.8164	Y = 0.5001*X + 3.000
x2 vs. y2	r = 0.8162	Y = 0.5000*X + 3.001
x3 vs. y3	r = 0.8163	Y = 0.4997*X + 3.002
x4 vs. y4	r = 0.8165	Y = 0.4999*X + 3.002



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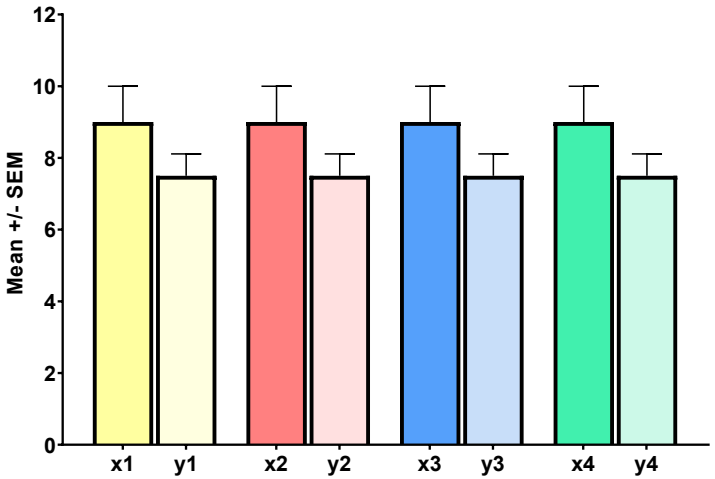
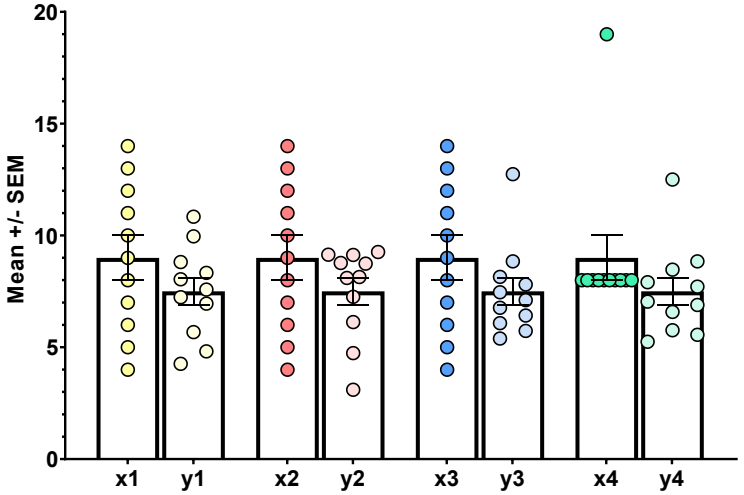
Data Exploration: Anscombe's Quartet

How does the data behave within the groups?





We're still not getting a complete view of the data
What about the relationship between X & Y?

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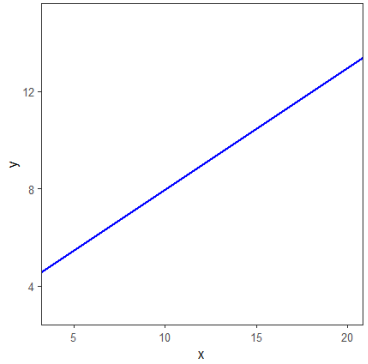
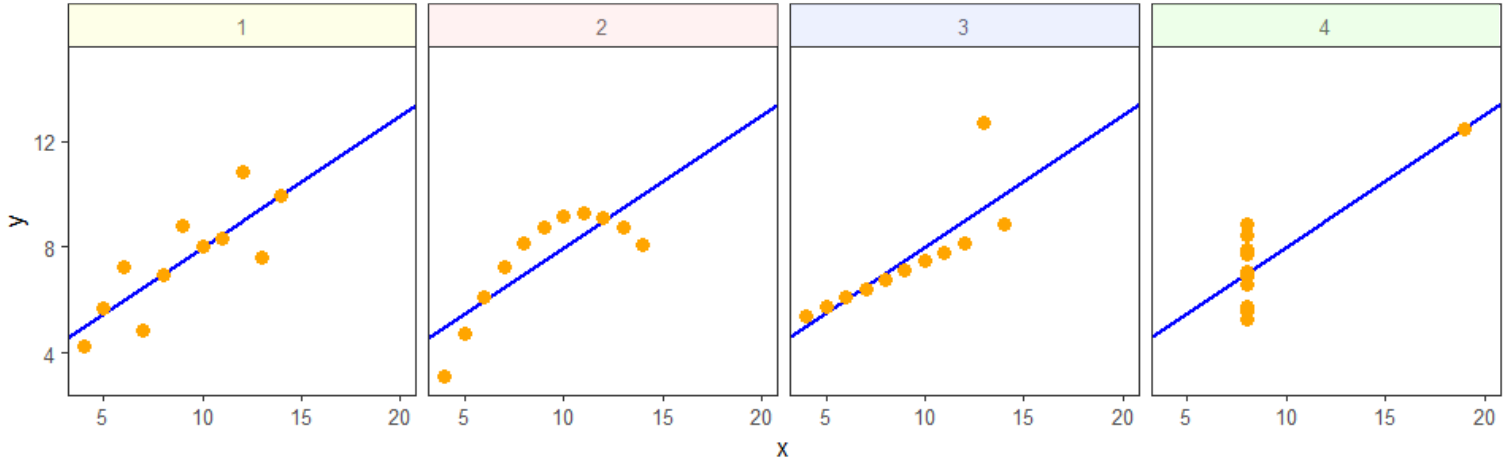
Data Exploration: Anscombe's Quartet

What about the relationship between X & Y?



r = 0.816 Y = 0.500*X + 3.00



Can You Predict The Data Structure?

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We already know what the data will look like…

Line A

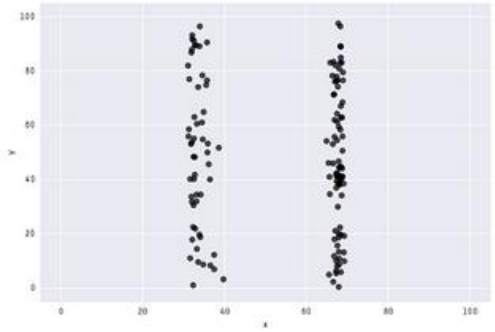
Circle B

N	182
X Mean	54.26
Y Mean	47.83
X SD	16.76
Y SD	26.93
Correlation	-0.06

C Unstructured

D I Don't Know…
A Dinosaur!

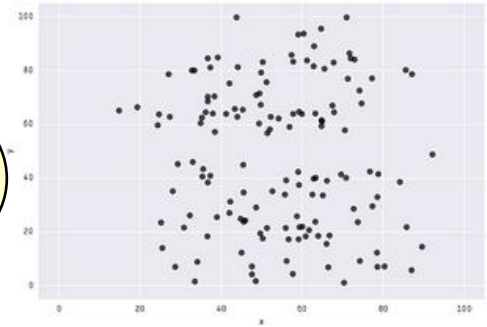
The Datasaurus Dozen



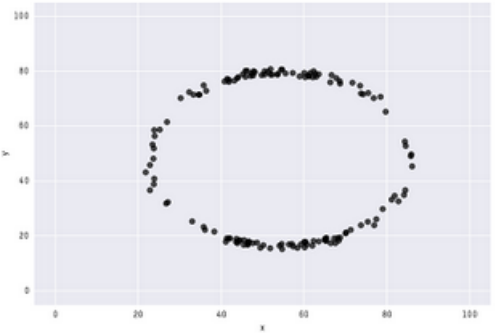
A

N	182
X Mean	54.26
Y Mean	47.83
X SD	16.76
Y SD	26.93
Correlation	-0.06

C



B



D

And More!

https://www.research.autodesk.com/publications/same-stats-different-graphs/

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Data Exploration: Seeing is Believing!

Beware of statistical or graphical summaries…

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x1 vs. y1	r = 0.8164	Y = 0.5001*X + 3.000
x2 vs. y2	r = 0.8162	Y = 0.5000*X + 3.001
x3 vs. y3	r = 0.8163	Y = 0.4997*X + 3.002
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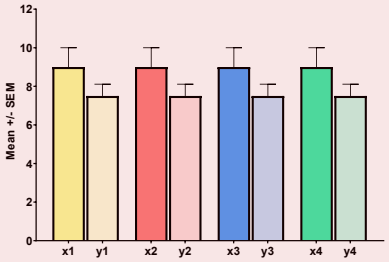

N	182
X Mean	54.26
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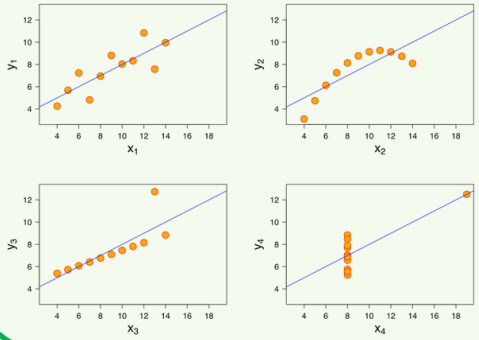
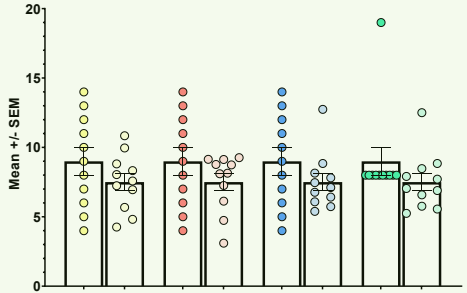
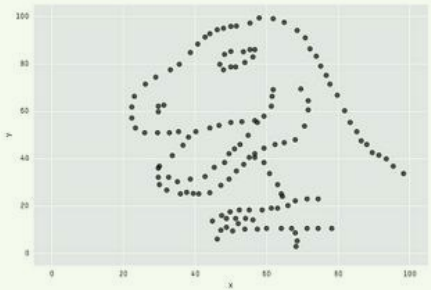
X SD	16.76
Y SD	26.93
Correlation	-0.06

…without proper exploration & visualisation!







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Data Exploration

Exercise

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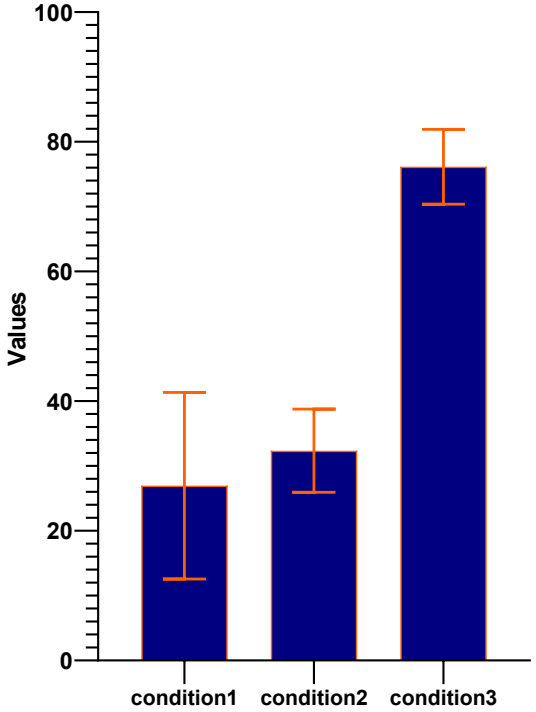
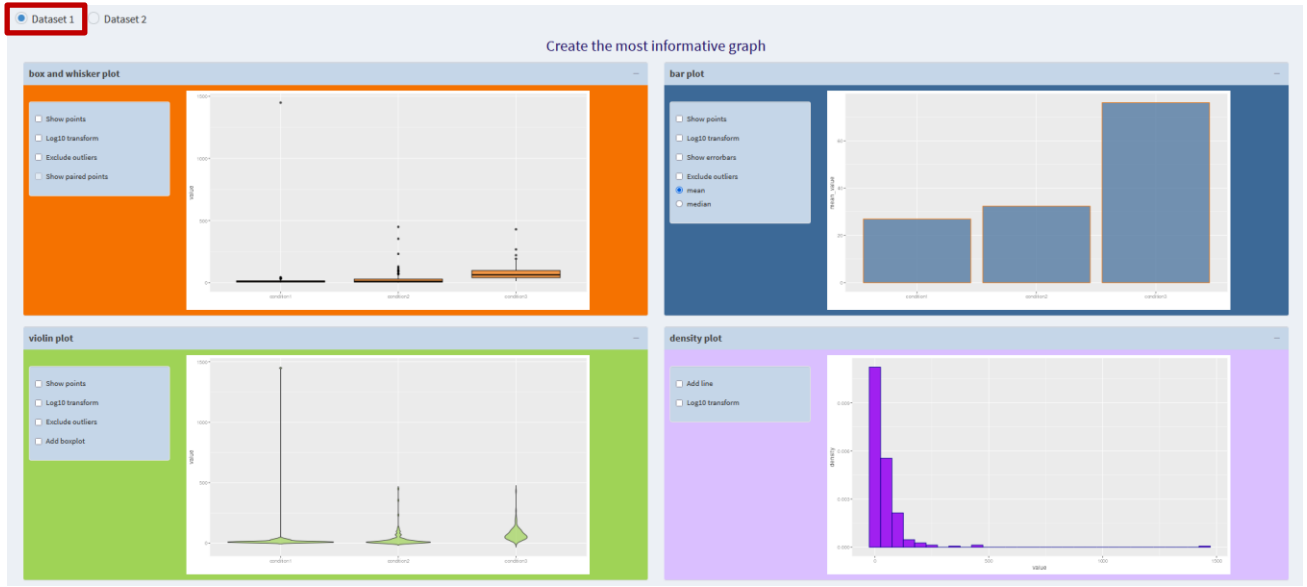
What do you think of this graph?



Values from 3 conditions from one experiment

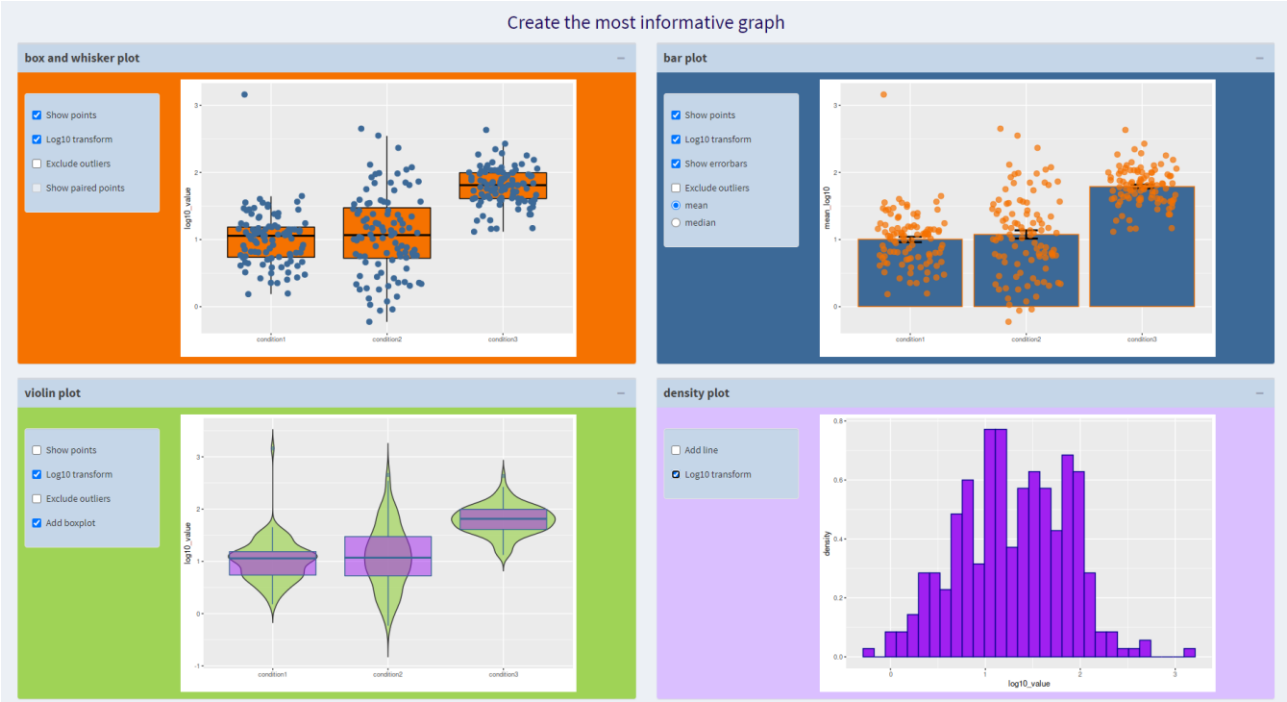
Representing Dataset 1:
Create the most informative graph

https://tinyurl.com/RIdataExp **Make sure you are looking at Dataset 1**



Plot for initial exploration of the data?
Plot for presentation/ publication?

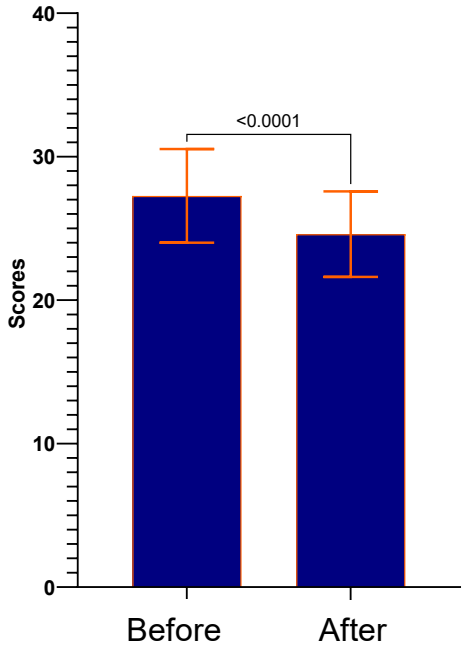
Representing Dataset 1:
Create the most informative graph



Which plots did we choose and why?

Any differences between initial exploration and presentation?

What do you think of this graph?

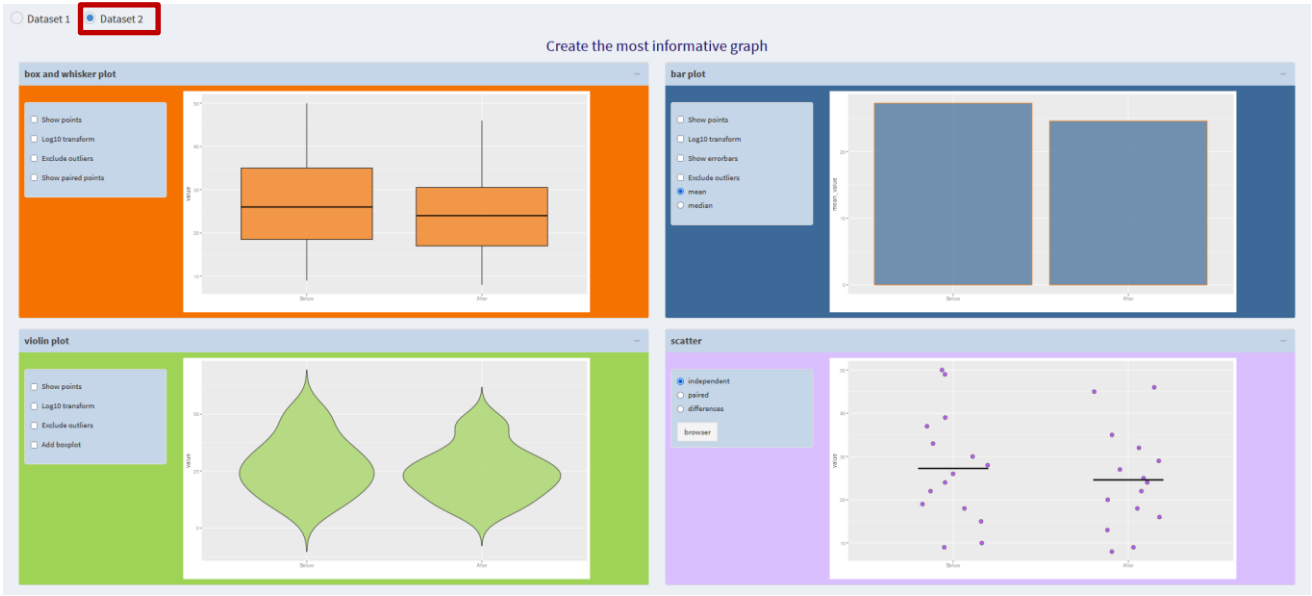


Values for before-after treatment from 4 experiments.

Representing Dataset 2:
Create the most informative graph

https://tinyurl.com/RIDataExp

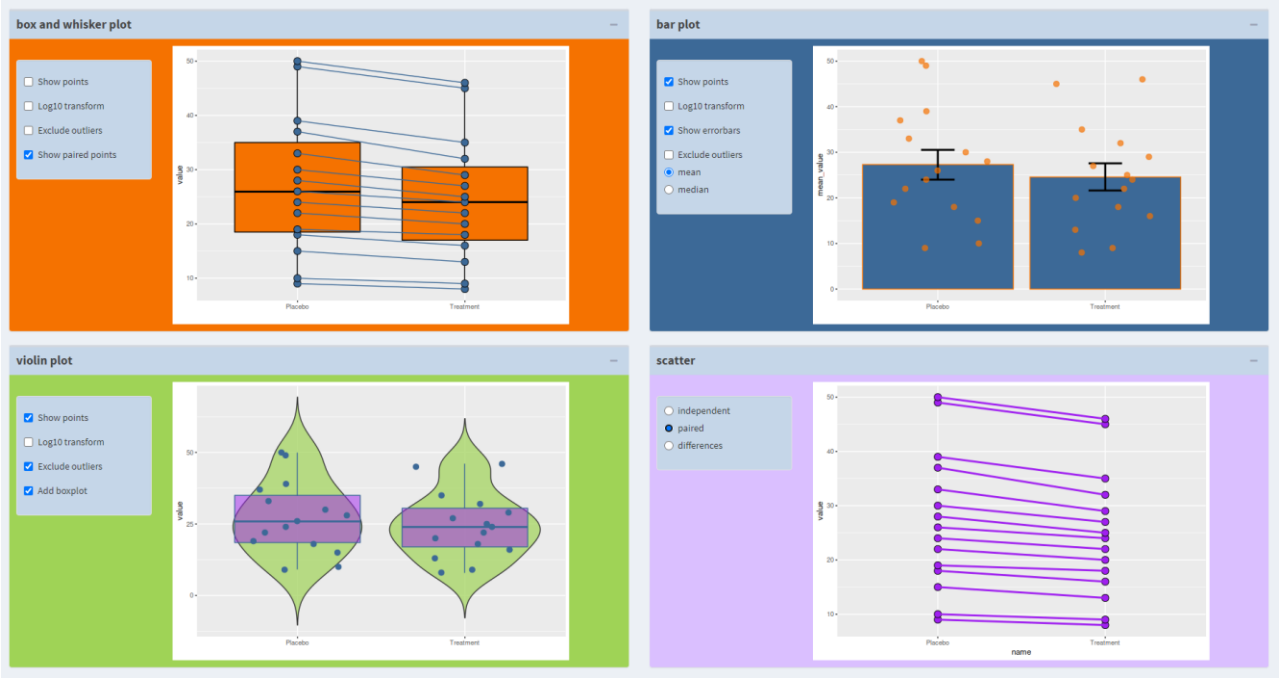
Make sure you are looking at Dataset 2



Create a plot to best represent dataset 2

Think about experimental design and statistics

Representing Dataset 2:
Create the most informative graph



Which plots did we choose and why?

What do you think about the stats now?

An Aside to Help with Better Figure Design…

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Scientific Figure Design

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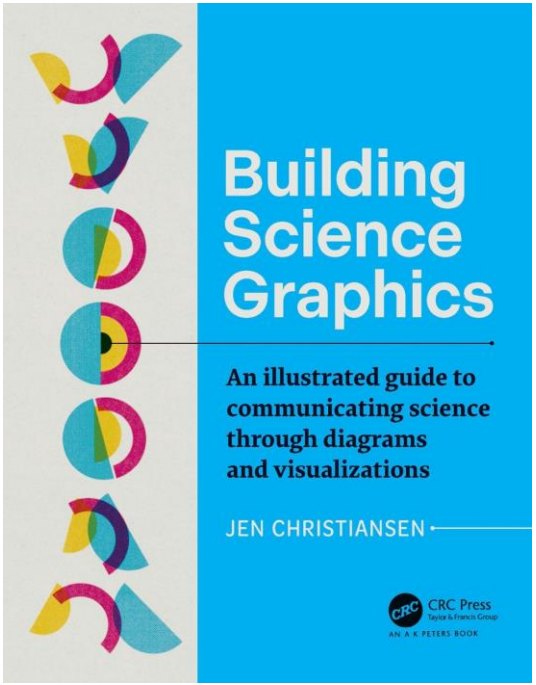
ReproducibiliTea

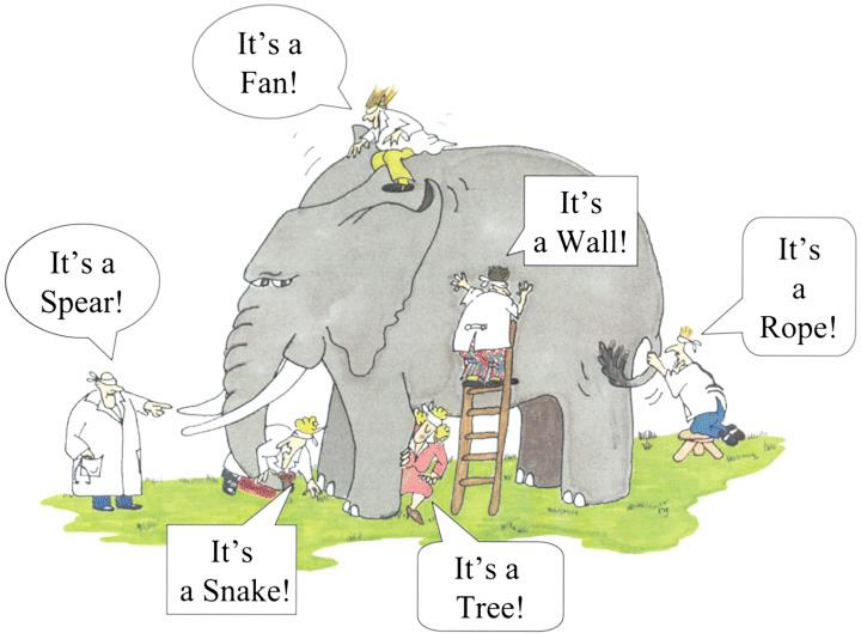


Data exploration

What can go wrong if we don’t do it?!

Data exploration

Less Exploring more Assuming!

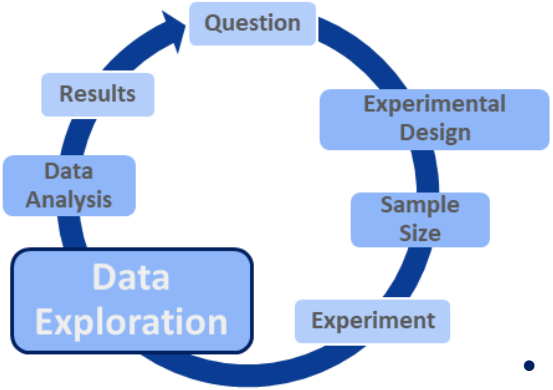


Risk missing the actual story the data is telling…

Image from https://link.springer.com/article/10.1007/s00246-017-1742-2

Data Exploration…

…Suspicious Summaries



Accountability
Accurate
Care
Collegiality
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Fair
Honesty
Objectivity
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Reliability
Reproducibility
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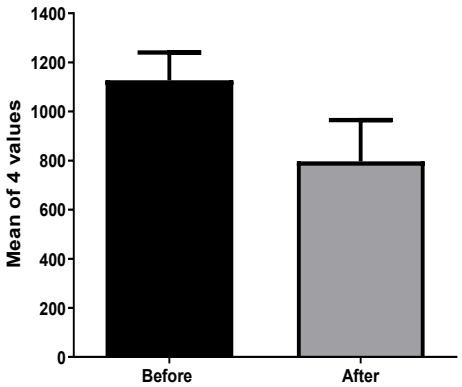
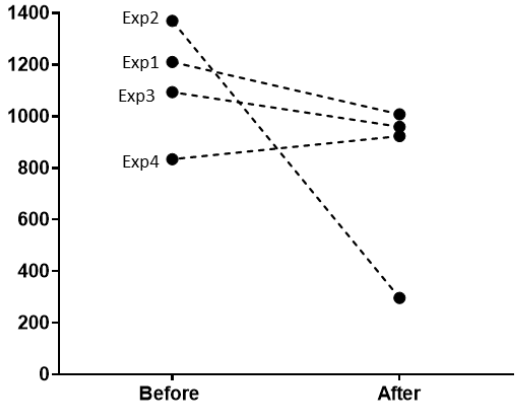
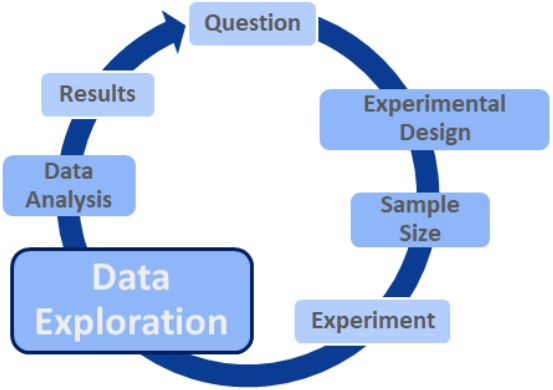
Responsibility
Rigor
Transparency

Example 1

- Four experiments: Before-After treatment effect on a variable of interest.
- Hypothesis: Treatment will decrease the levels of the variable of interest







Example 2

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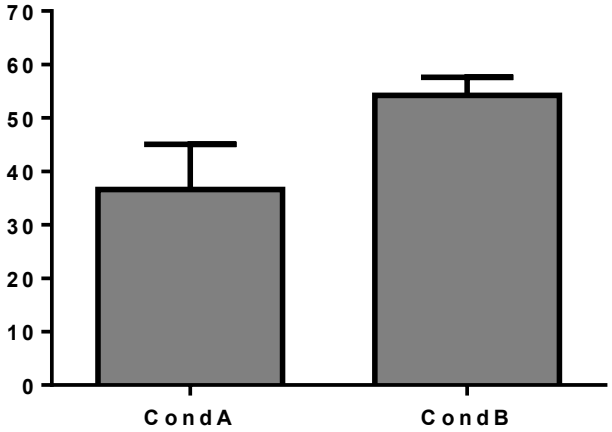

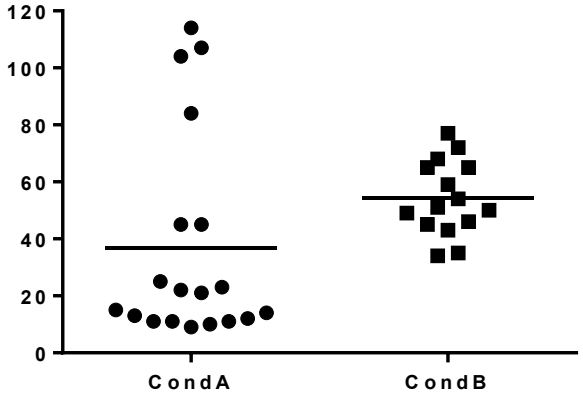

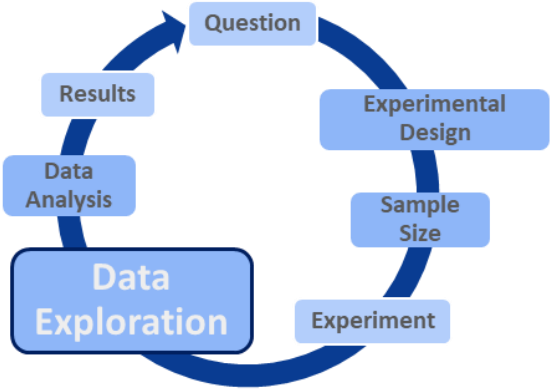

Example 3

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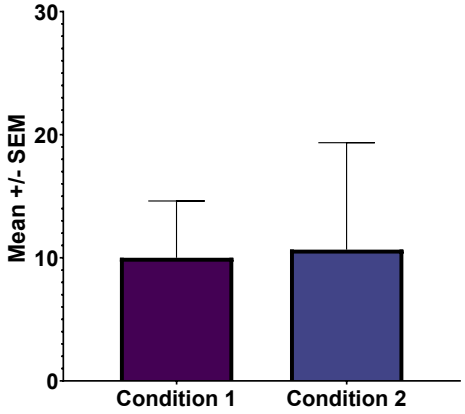
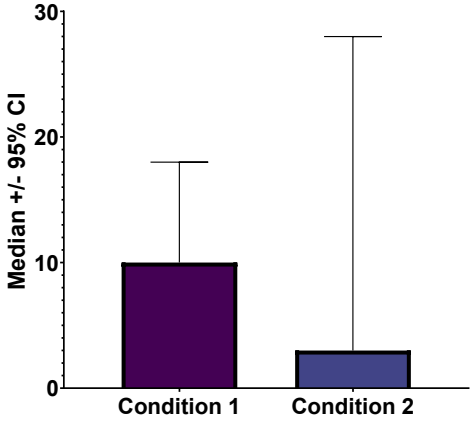
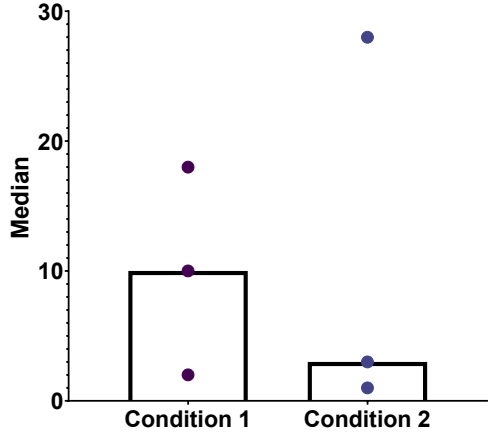
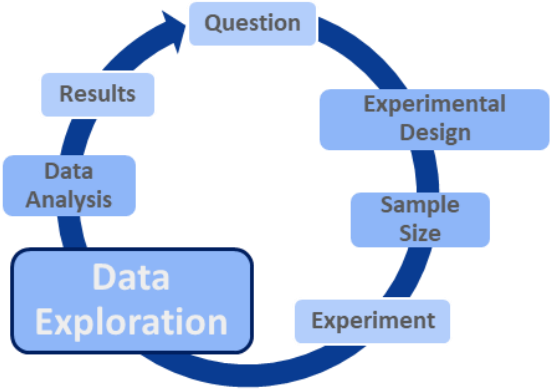






Data Exploration…

…Dubious Datasets



Example 1: A Knockout?

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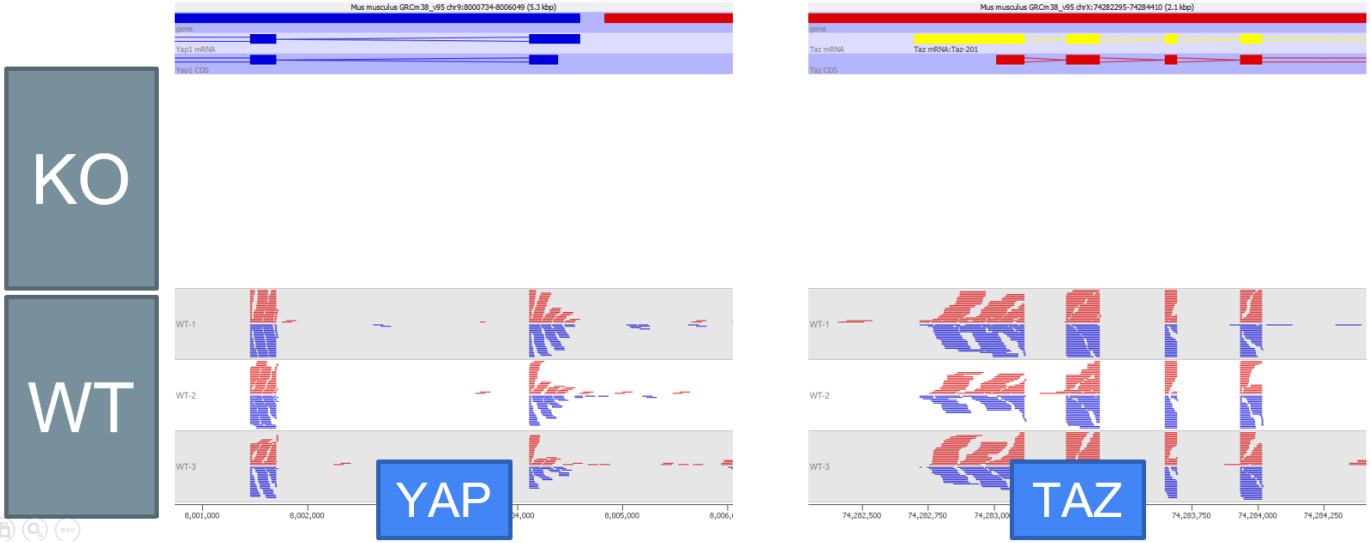
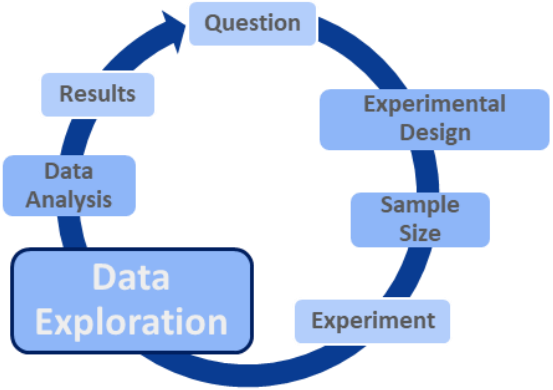
nature neuroscience

YAP and TAZ control peripheral myelination and the expression of laminin receptors in Schwann cells





Example 2: A Case of Mistaken Identity

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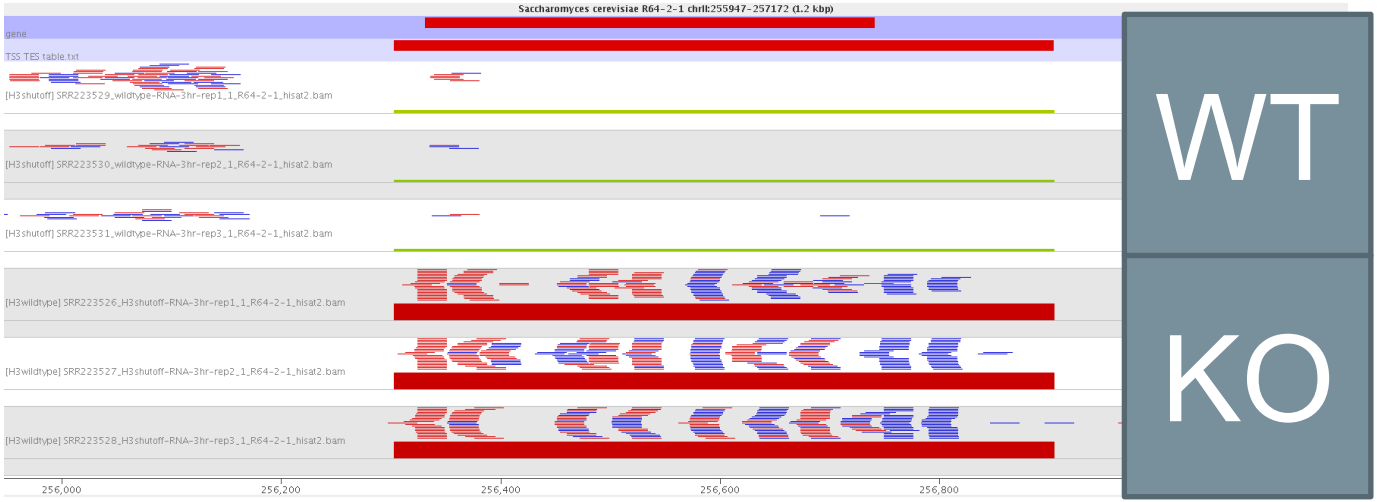
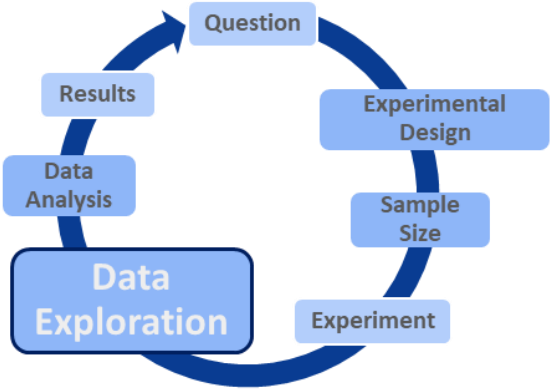
OPEN ACCESS Freely available online

PLoS GENETICS

In Vivo* Effects of Histone H3 Depletion on Nucleosome Occupancy and Position in *Saccharomyces cerevisiae





Example 3: Of Mice and Mycoplasma!

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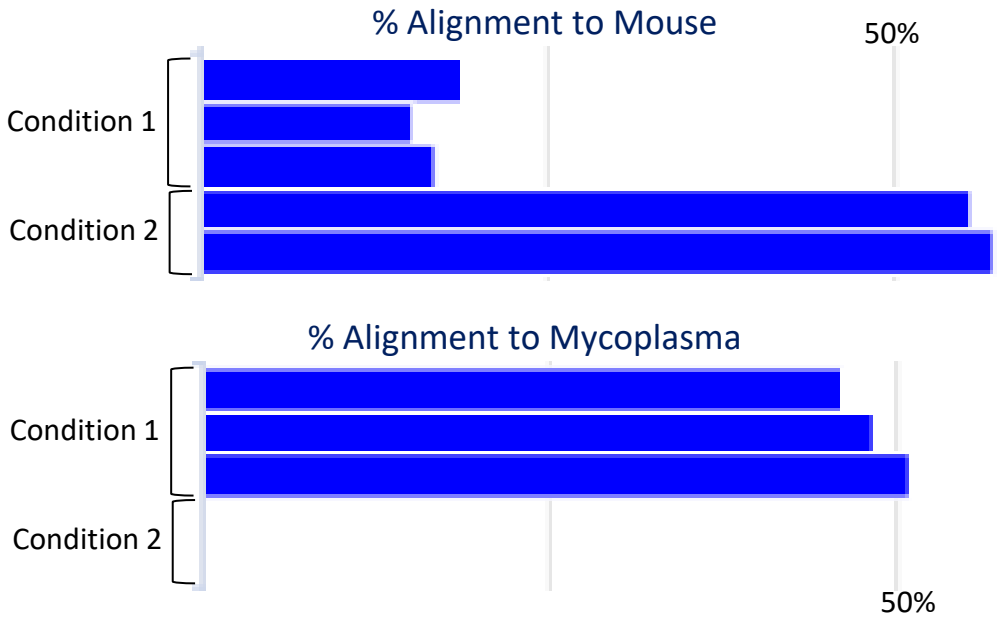
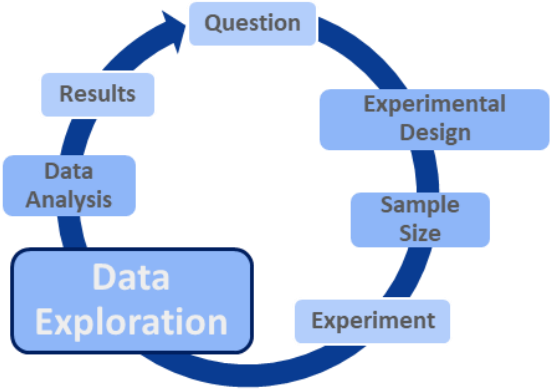
nature COMMUNICATIONS

DOT1L-mediated murine neuronal differentiation associates with H3K79me2 accumulation and preserves SOX2-enhancer accessibility





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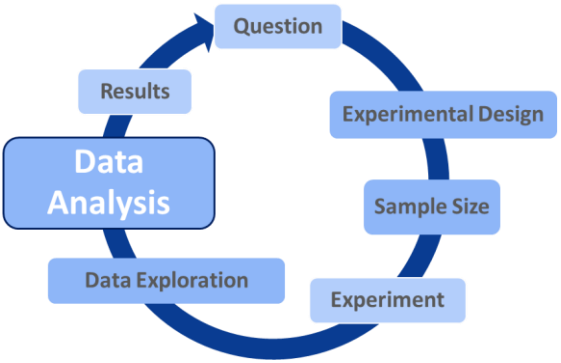
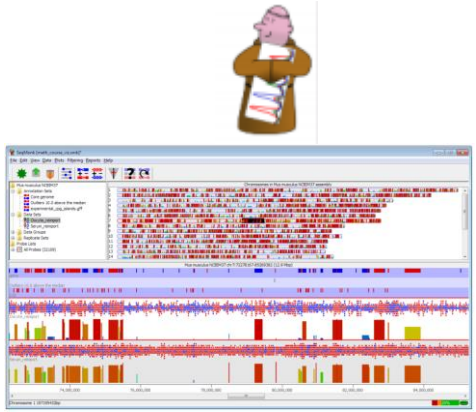
All highlight the perils of assuming and not exploring….

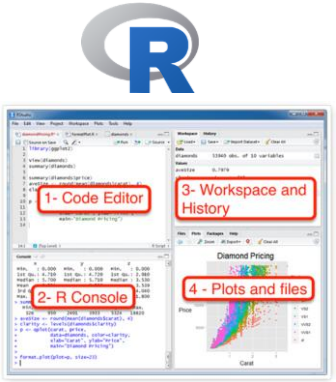
…Is it okay if you don’t know there’s a problem?

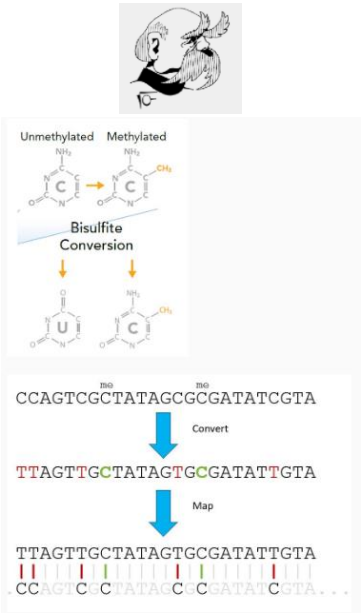


Analytical Tools

The right tools for the job!







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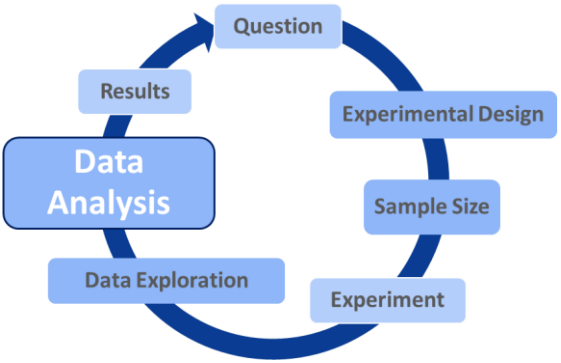
- Know what's out there
- Learn how to use it



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Help With Analytical Tools

Babraham Bioinformatics

Core Skills Courses

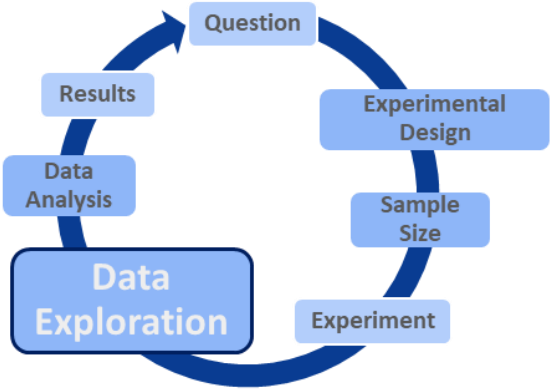
e.g. R Programming

Babraham Bioinformatics

Application Specific Courses

e.g. NGS Analysis

https://www.bioinformatics.babraham.ac.uk/training.html



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In a nutshell

Data exploration is CRITICAL to:

- Understand our data
- Be confident in our findings

Ensure our results are quality and reliable

… Good for everyone!

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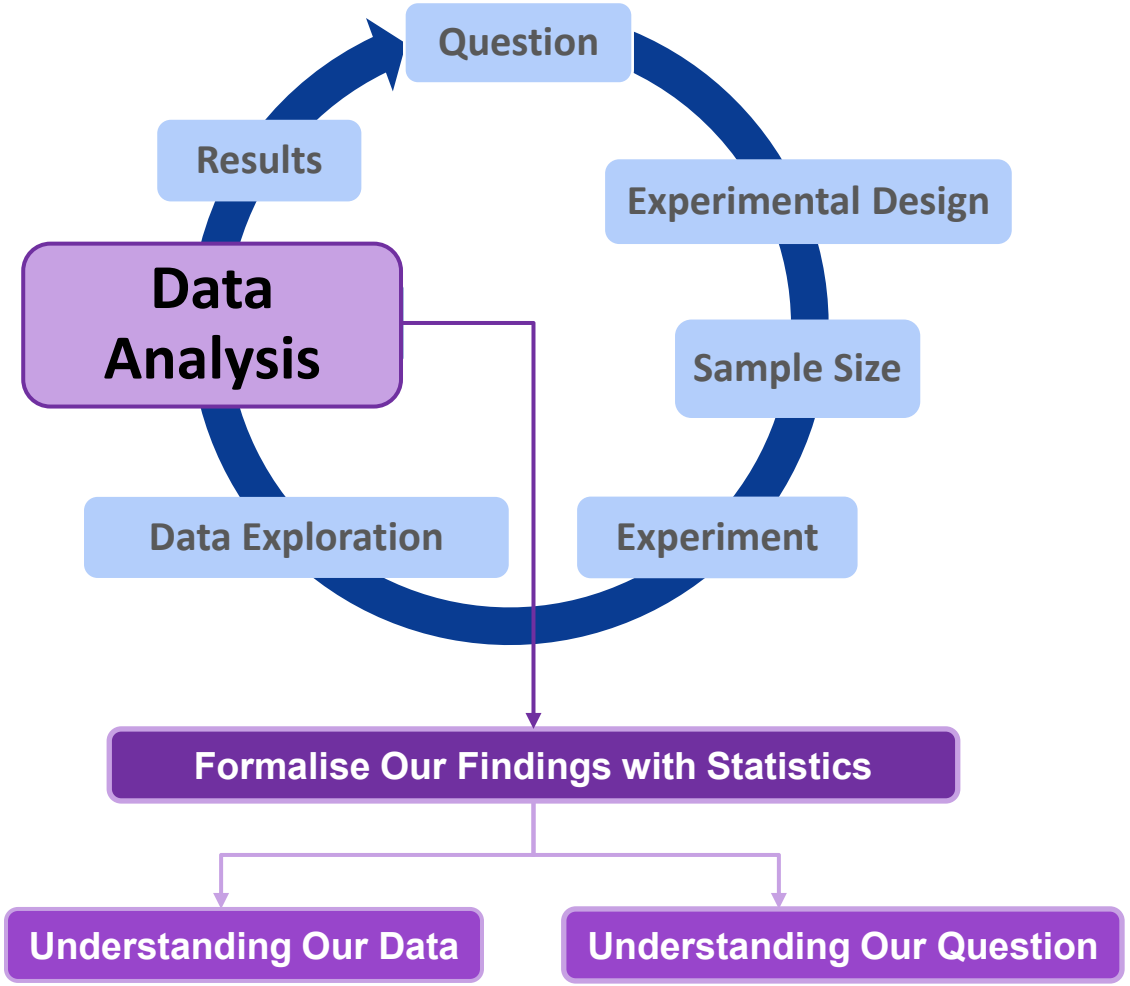

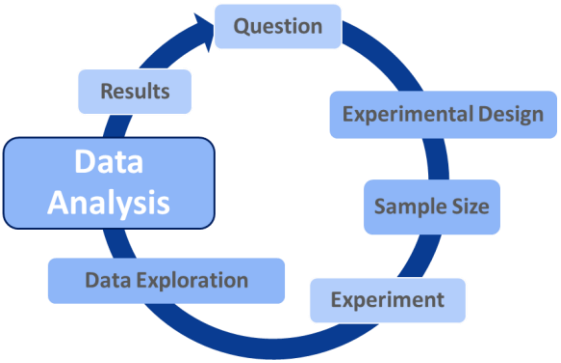

Statistical Analysis

Translate the hypothesis/question into statistical questions

By choosing the right test!

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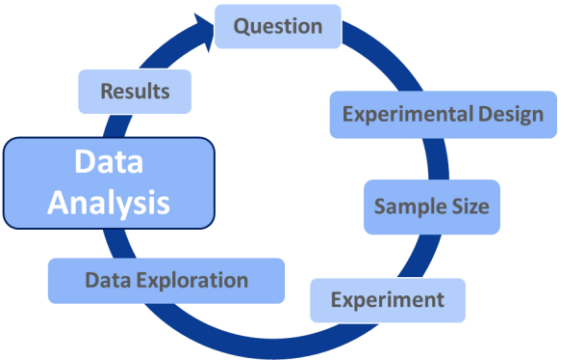
Healthy approach:

"It's not about knowing the name of the test…

…It's knowing what the test should do"

Anne Segonds-Pichon



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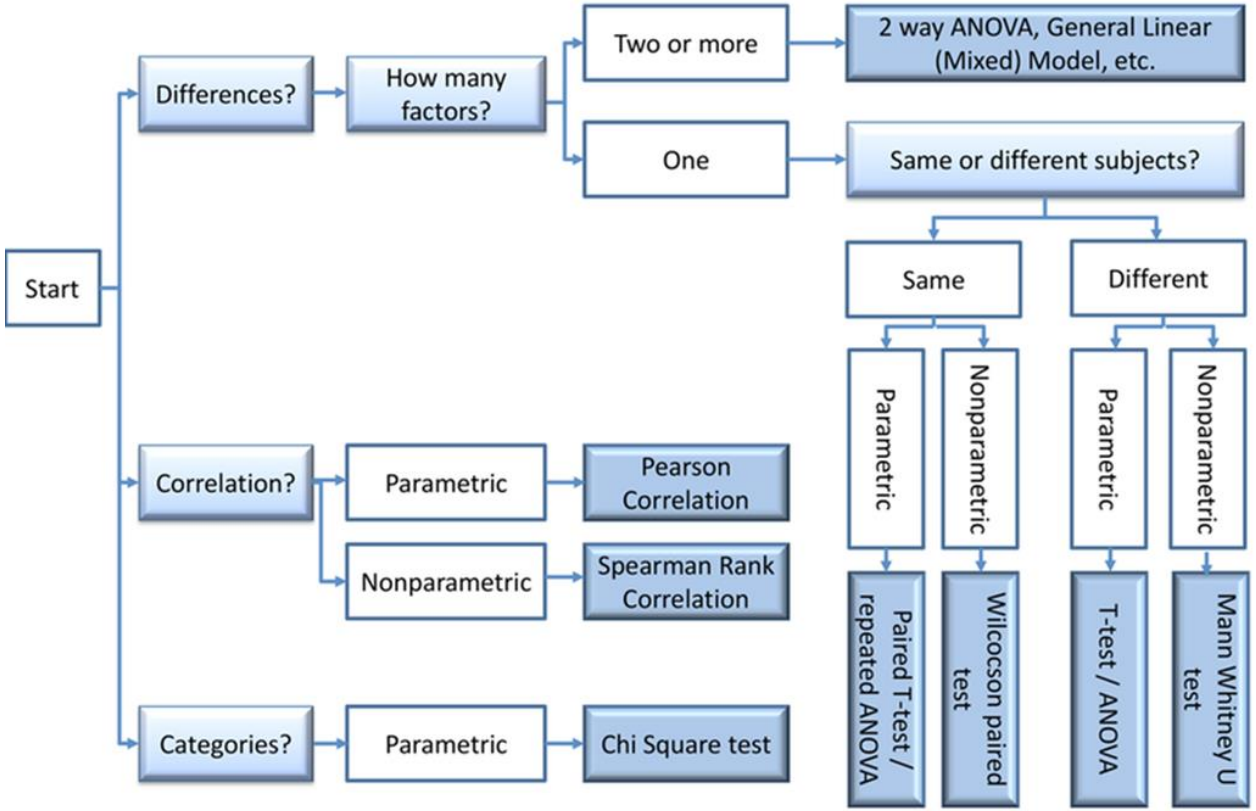
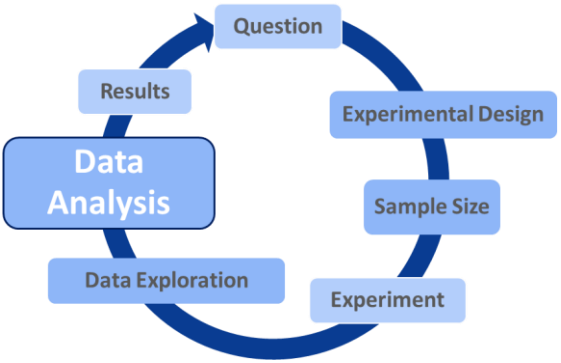
Knowing what the Test should do…

Statistics Decision tree





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Knowing what the Test should do…

Babraham Bioinformatics

Statistics Using R

Babraham Bioinformatics

Statistics Using GraphPad Prism

https://www.bioinformatics.babraham.ac.uk/training.html

Research Integrity

More than 1 way to Investigate!

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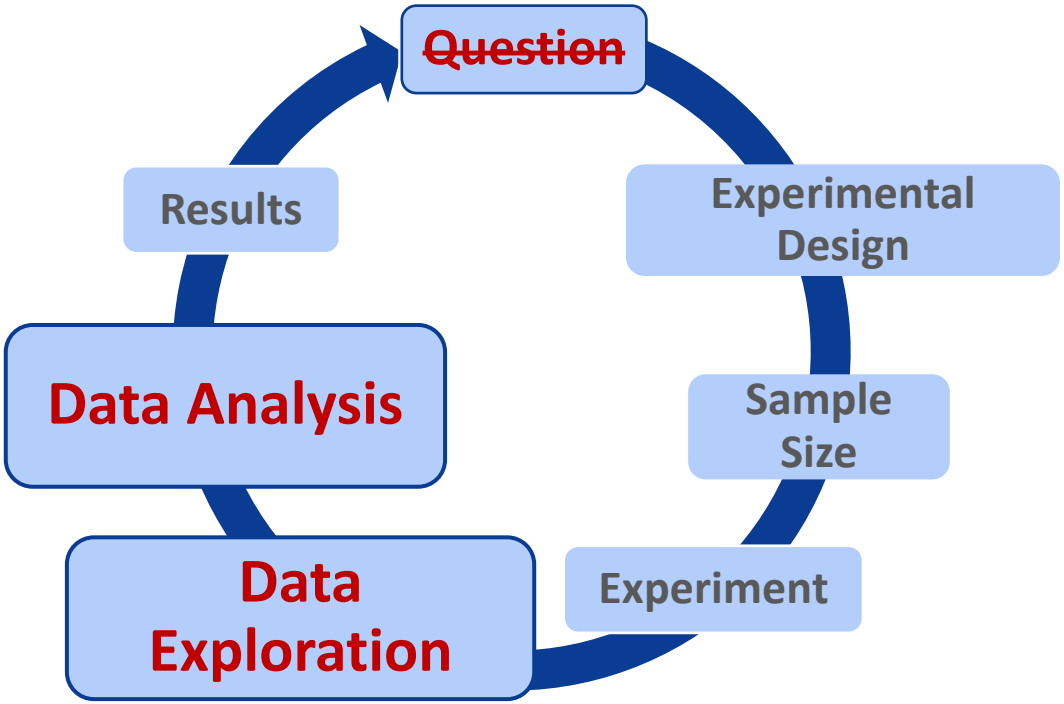

Exploratory data analysis

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In a nutshell

Data exploration should always be **a pivotal step of analysis**

Stats helps us **formalise our findings**

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Research Integrity

What does Ethics mean?

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Research Integrity

Ethics and Animal Welfare

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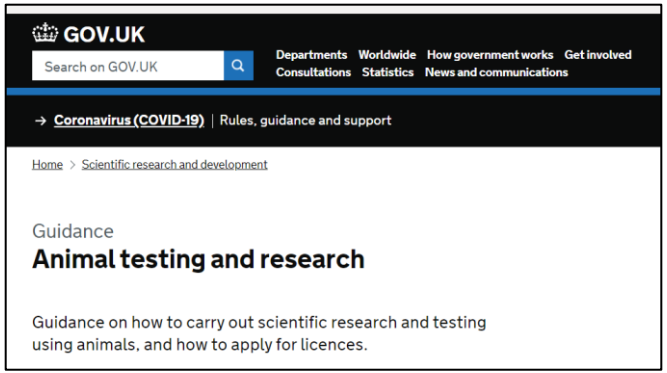
- If we need **biological replicates** to be confident in our results, why not have **as many as we can?**
- And what does it have to do with **integrity**?
- Time to talk about the **Home Office**, **ASPA** and the **3 Rs**

Research Integrity

Home Office

The Home Office (HO) is a ministerial department of the Government of the UK, responsible for immigration, security and law and order.

- But more importantly: **animal welfare**



Research Integrity

The 3 Rs

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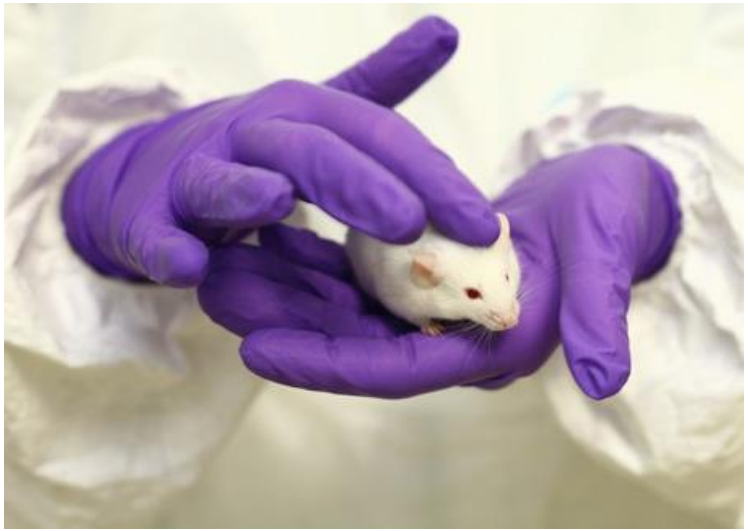
https://wellcome.org/sites/default/files/wtp057673_0.pdf

Research Integrity

The 3Rs: about animal welfare

Replace

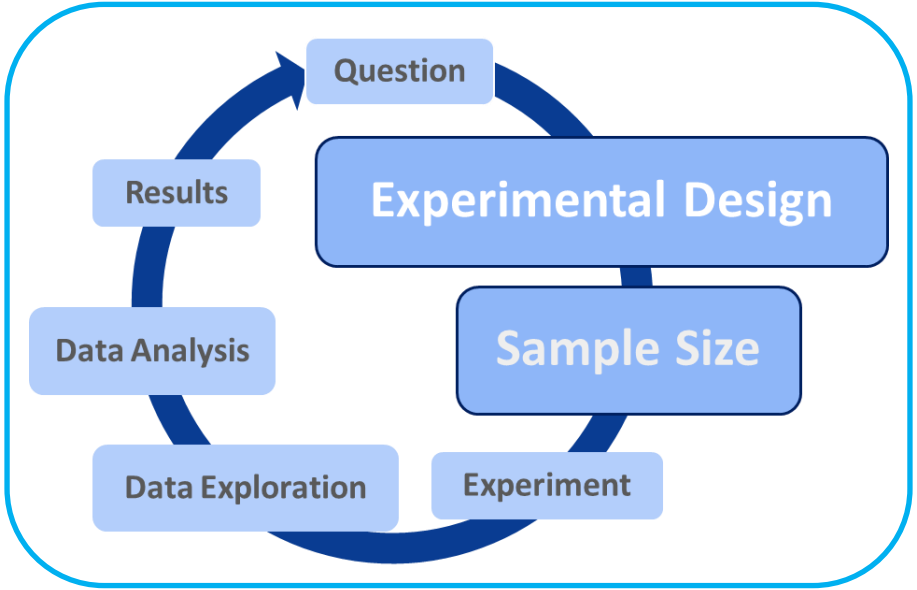


Avoiding or replacing the use of animals in areas where they otherwise would have been used.

Research Integrity

The 3Rs: about animal welfare

Reduce

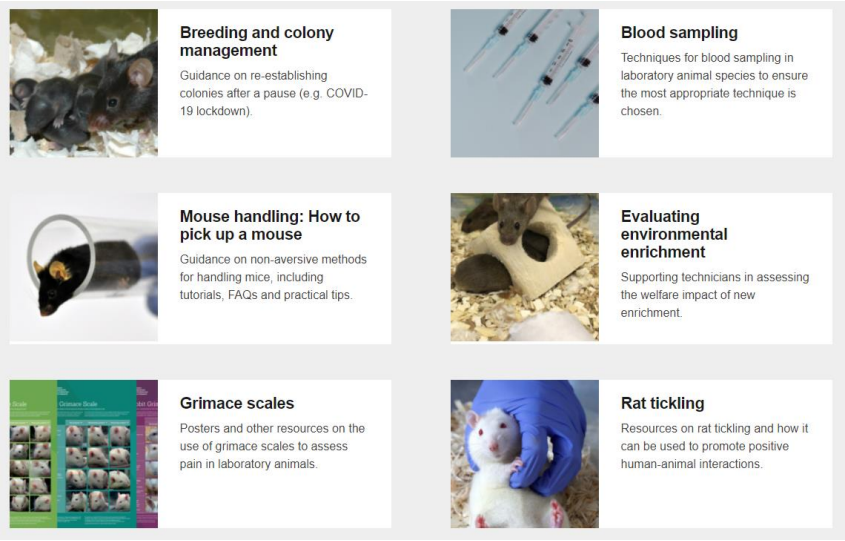


Minimising the number of animals used consistent with scientific aims.

Research Integrity

The 3Rs: about animal welfare

Refine



Minimising the pain, suffering, distress or lasting harm that research animals might experience.

3Rs resource library | NC3Rs

Research Integrity

The 3 Rs at Babraham: AWERB

The Hub People Committees Institute Science Facilities

Animal Welfare & Ethical Review Body

Remit

To provide the campus with independent ethical advice on the balance of harms to benefits within scientific projects using animals. To monitor standards of animal care and welfare, to support and advise named persons and licensees working under the Animals (Scientific Procedures) Act and to advise the Establishment Licence Holder on the suitability of Project Licence applications. To develop initiatives and guidelines leading to the widest possible application of the 3Rs (refinement, reduction and replacement) both on the campus and amongst the wider scientific community. In accordance with our commitments to the Concordat on Openness in animal research, any staff member with a concern that falls within the AWERB remit is encouraged to speak to the AWERB chair or any other committee member.

Good Research in Practice

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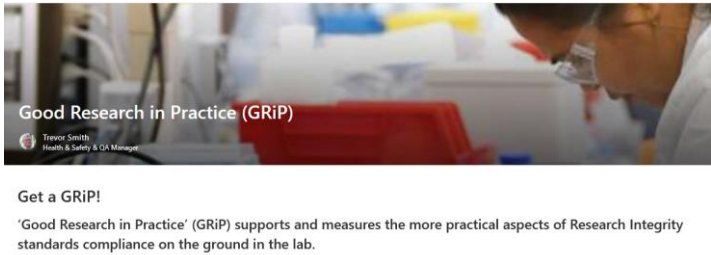
Good Research in Practice

The Research Process

- Responsibilities
- Competence
- Project planning
- Quality Control



Laboratory Practice

- Health and safety
- Handling of samples and materials
- Facilities and equipment
- Documentation of procedures and methods
- Research/work records

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Keeping track of the research

How?

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Research Integrity

Laboratory Notebooks

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Research Integrity

Laboratory Notebooks

Research Integrity

Laboratory Notebooks

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Research Data

Data Storage

Image: cleanpng.com

Legal Requirements

Practicalities

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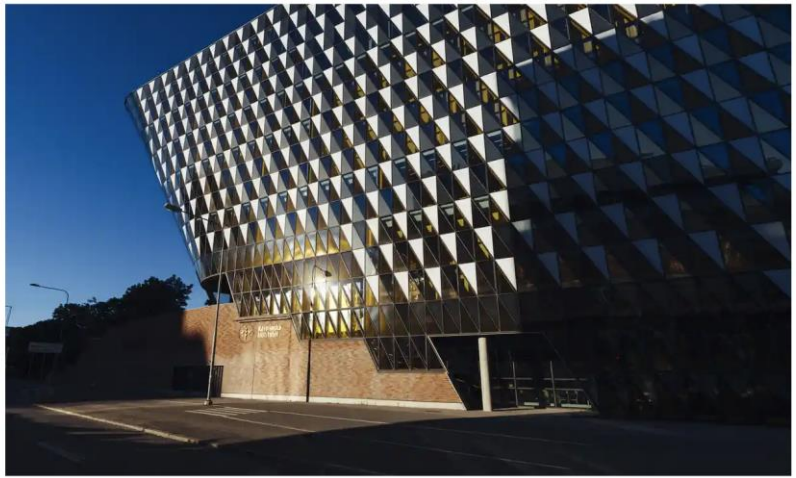
Research Data

Data Storage

Sweden

Decades of research destroyed after freezer fails at Swedish university

Estimated value of the samples thought to be in the millions as incident reported to police



An internal investigation has been launched at the Karolinska Institutet despite no indication of sabotage. Photograph: Bloomberg/Getty Images

The Guardian
Newspaper of the year

- Interruption in the supply of liquid nitrogen leading to the destruction of samples from multiple institutions.
- Valued in the millions.
- “Those worst affected are those researching leukaemia, they have gathered samples from patients over as much as 30 years,”

What should we be doing?

Expectations and Responsibilities

Created by Fajar Studio
from Noun Project

Created by Ribbla Team
from Noun Project

Created by Anggara Putra
from Noun Project

Created by shashank singh
from Noun Project

Created by Good Wife
from Noun Project

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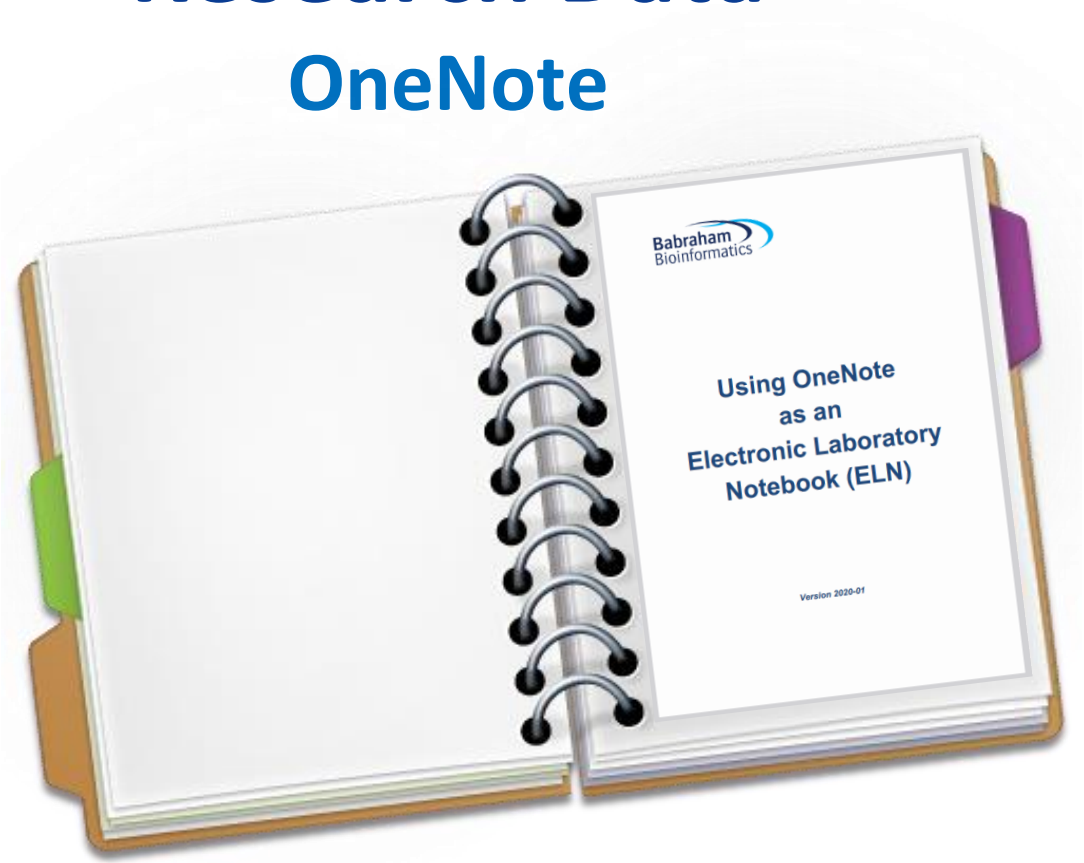
Research Data

OneNote



Responsibility

Research Integrity

Wider Responsibility

- Accountability
- Accurate
- Care
- Collegiality
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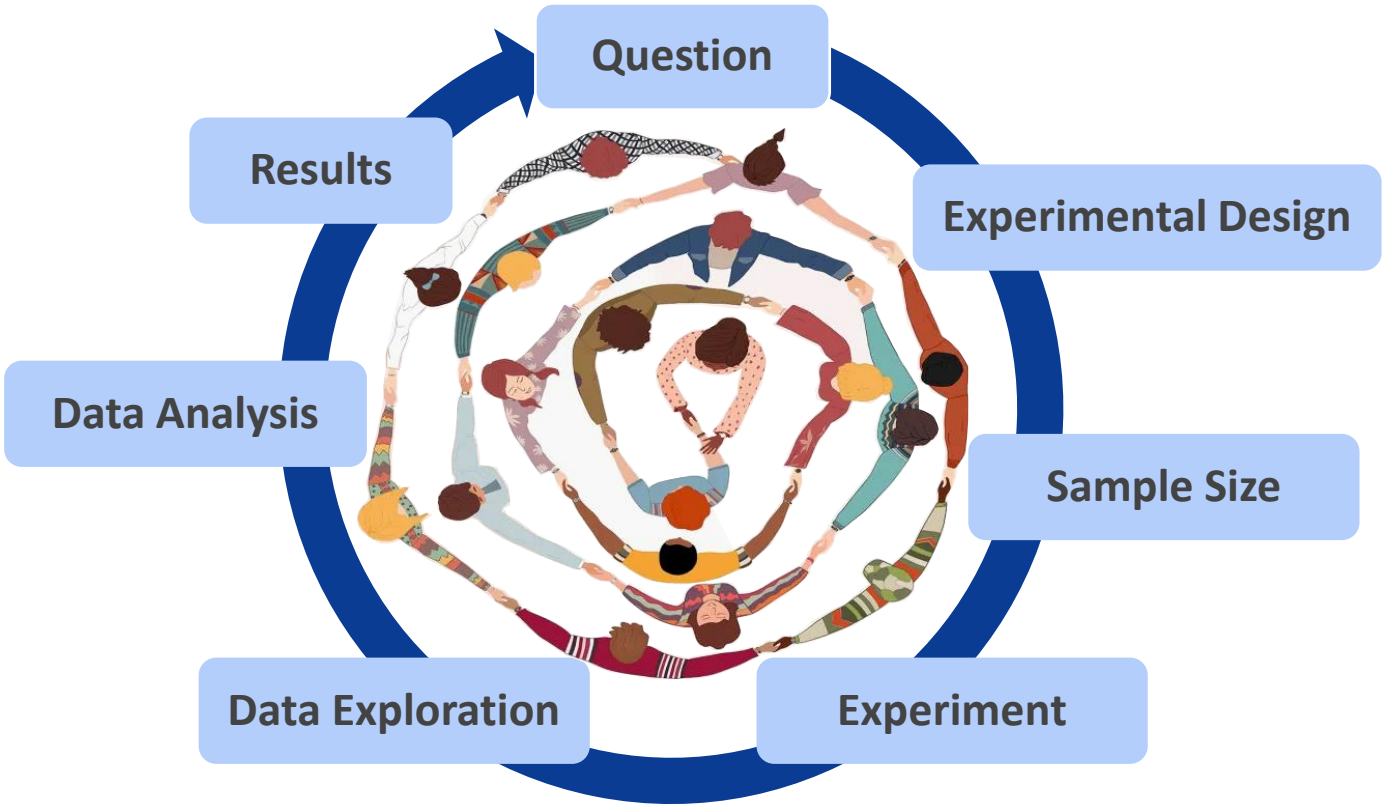

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Collegiality
Cooperation
Ethics
Fair
Honesty
Objectivity
Openness
Quality
Reliability
Reproducibility
Respect
Responsibility
Rigor
Transparency

Research Integrity

Questioning

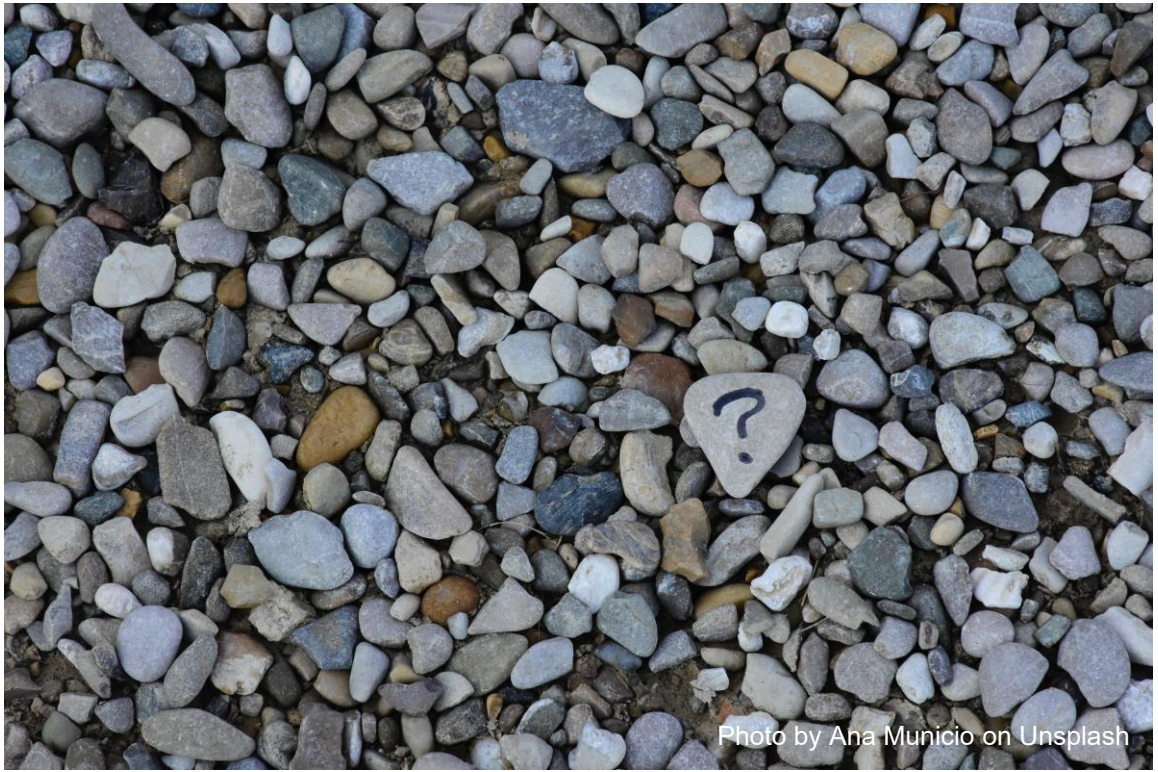

Photo by Ana Municio on Unsplash

Research Integrity

Collaboration and Competition

Accountability
Accuracy
Care
Collegiality
Cooperation
Ethics
Fair
Honesty
Objectivity
Openness
Quality
Reliability
Reproducibility
Respect
Responsibility
Rigor
Transparency

Research Integrity

The Game

Accountability
Accuracy
Care
Collegiality
Cooperation
Ethics
Fair
Honesty
Objectivity
Openness
Quality
Reliability
Reproducibility
Respect
Responsibility
Rigor
Transparency

Accountability
Accuracy
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Cooperation
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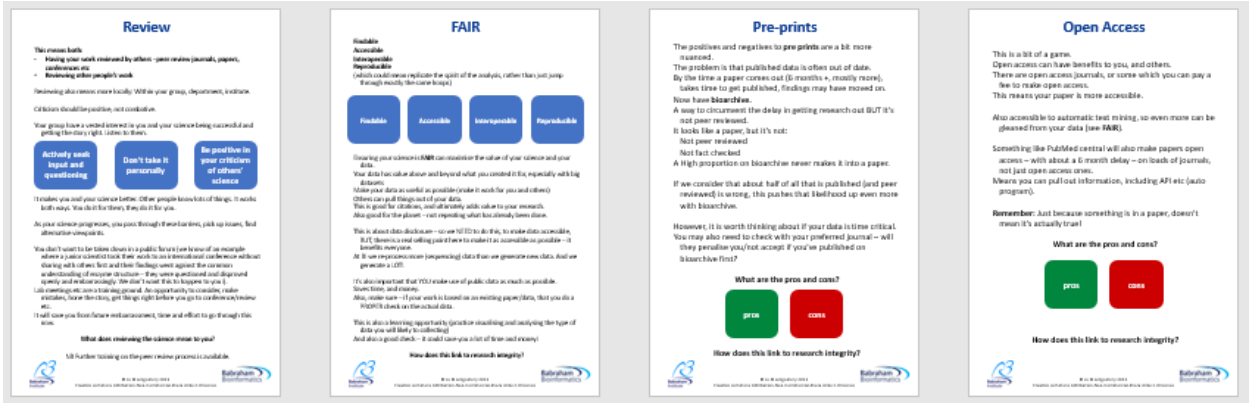
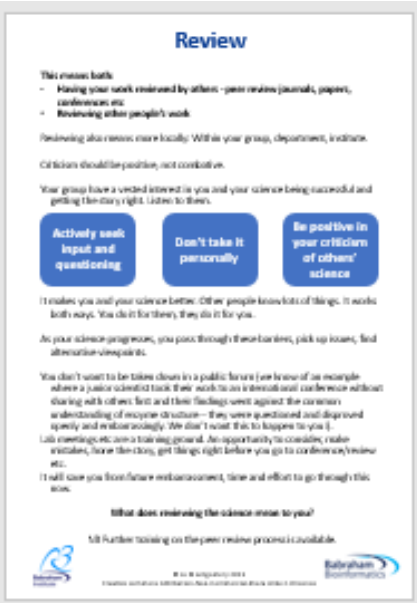
Objectivity
Openness
Quality
Reliability
Reproducibility
Respect
Responsibility
Rigor
Transparency

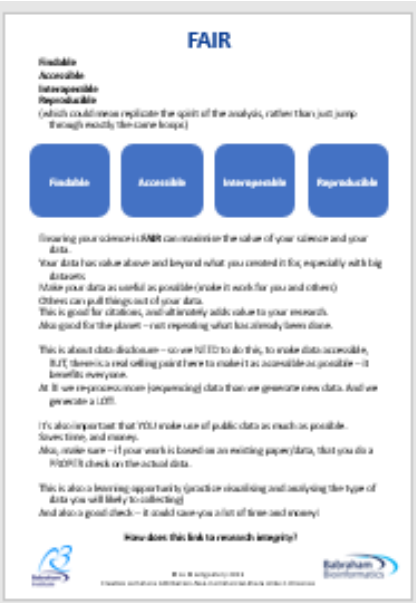
Research Integrity

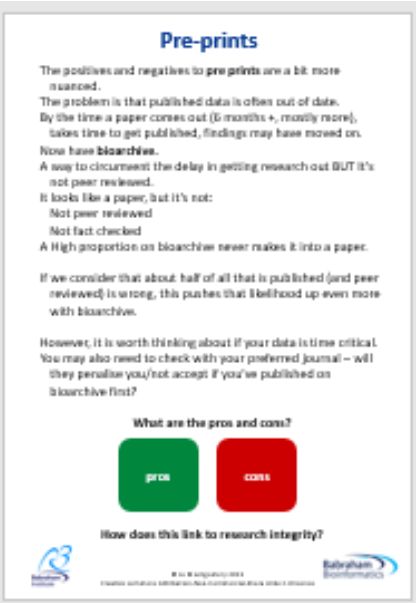
Wider Responsibility and Scientific Community

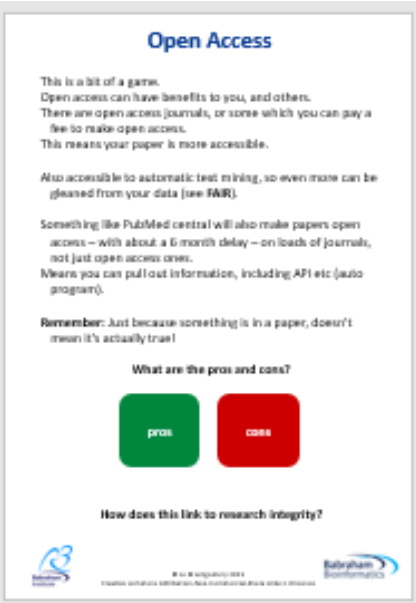


Research Integrity









Research Integrity

Accountability
Accuracy
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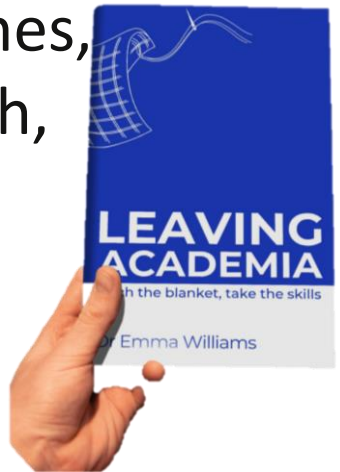
Transparency

"Academia is at its best a meritocracy and at its worst a pit of vipers. A grown-up version of the children's game snakes and ladders. The quest for knowledge and the pushing back of frontiers has created a hierarchal system with super demanding and, at times, conflicting metrics (postdocs must publish, publish, publish but to apply for a lectureship position you need to have a teaching track record)."



Research Integrity

In a nutshell

Accountability
Accurate
Care
Collegiality
Cooperation
Ethics
Fair
Honesty
Objectivity
Openness
Quality
Reliability
Reproducibility
Respect
Responsibility
Rigor
Transparency

Applying **research integrity principles** is our **responsibility as scientists**

Research Integrity

In the lab

Accountability
Accurate
Care
Collegiality
Cooperation
Ethics
Fair
Honesty
Objectivity
Openness
Quality
Reliability
Reproducibility
Respect
Responsibility
Rigor
Transparency

https://www.nature.com/articles/nj7593-263a

Research Integrity

Work culture

Accountability
Accurate
Care
Collegiality
Cooperation
Ethics
Fair
Honesty
Objectivity
Openness
Quality
Reliability
Reproducibility
Respect
Responsibility
Rigor
Transparency

Accountability
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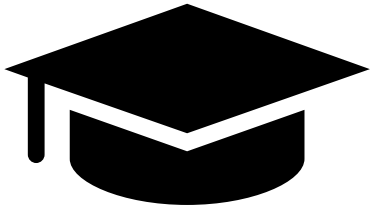
Transparency

Research Integrity

PhD Students



It doesn’t matter if it ‘doesn’t work’

Research Integrity

Accountability
Accurate
Care
Collegiality
Cooperation
Ethics
Fair
Honesty
Objectivity
Openness
Quality
Reliability
Reproducibility
Respect
Responsibility
Rigor
Transparency

Work hard…

…but what if it is too hard?

Research Integrity

Accountability
Accurate
Care
Collegiality
Cooperation
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Objectivity
Openness
Quality
Reliability
Reproducibility
Respect
Responsibility
Rigor
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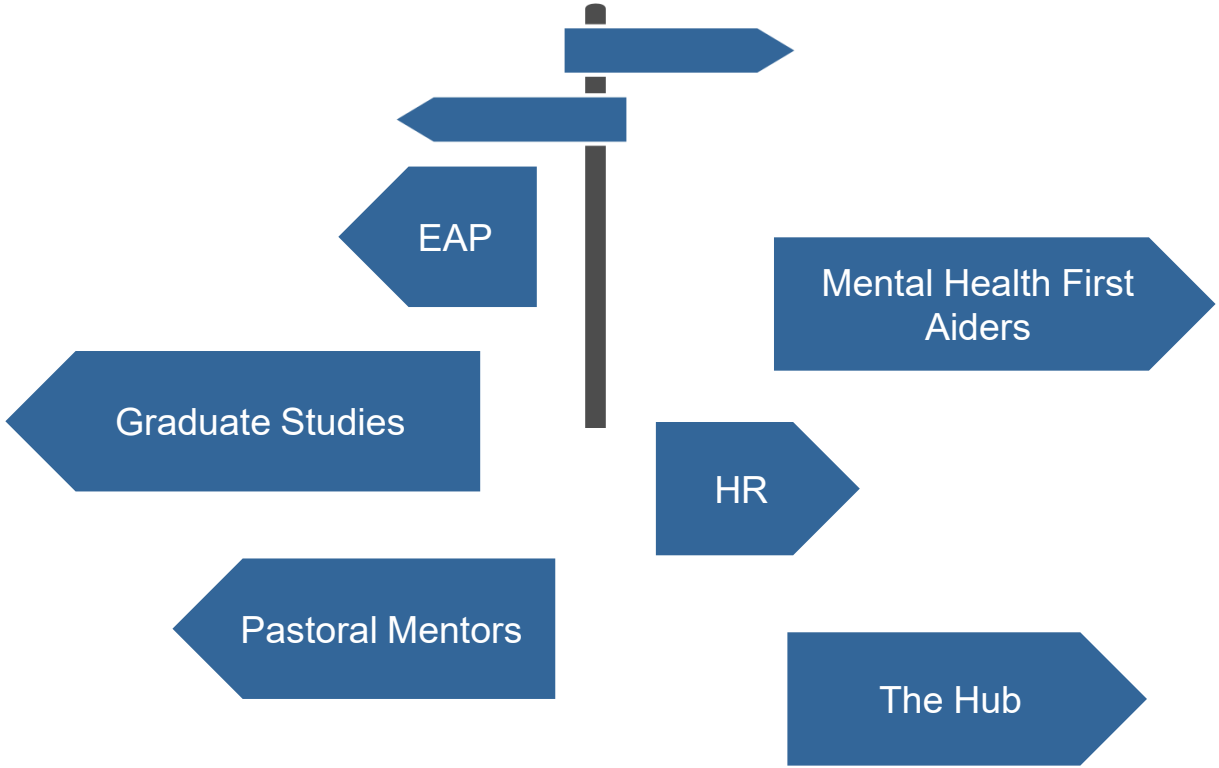

Research Integrity

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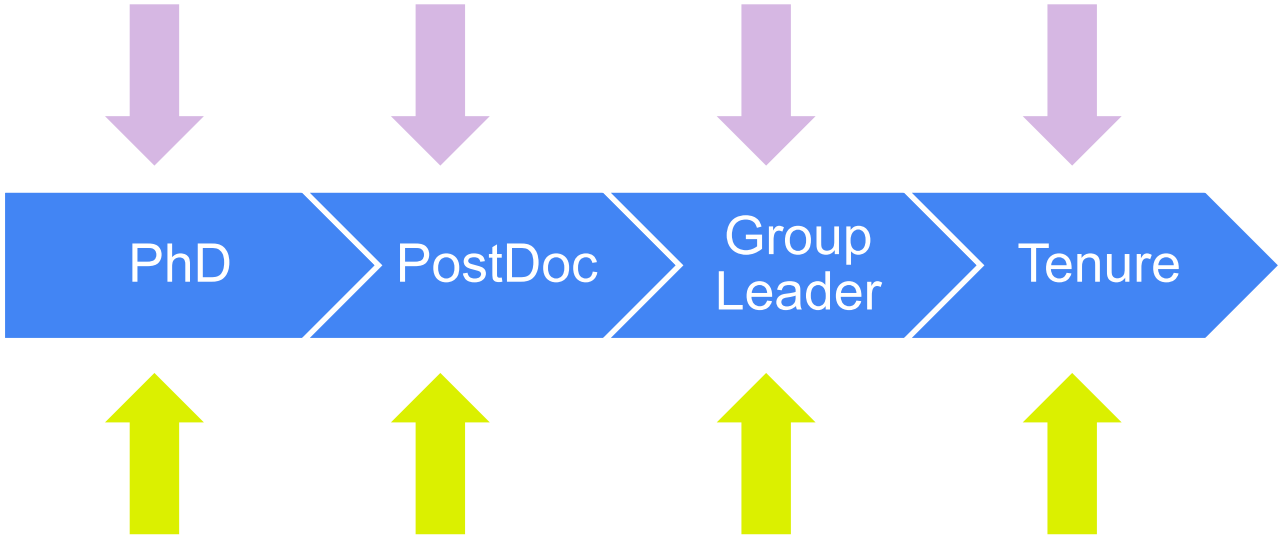

Research Integrity

Which roles are most important or responsible for Research Integrity?

- Accountability
- Accurate
- Care
- Collegiality
- Cooperation
- Ethics
- Fair
- Honesty
- Objectivity
- Openness
- Quality
- Reliability
- Reproducibility
- Respect
- Responsibility
- Rigor
- Transparency

Director

PostDoc

PhD student

Head of ISP

Technician

Research Assistant

H&S officer

Lab Manager

Group Leader

Facilities

Animal Technician

Leadership Team

Visiting Scientist

Tenure

Babraham Institute

Generative AI

Babraham Bioinformatics

Have You Used Generative AI?

- Accountability
- Accurate
- Care
- Collegiality
- Cooperation
- Ethics
- Fair
- Honesty
- Objectivity
- Openness
- Quality
- Reliability
- Reproducibility
- Respect
- Responsibility
- Rigor
- Transparency

Gemini

Copilot

ChatGPT

Apple Intelligence

A

Yes

B

No

Have You Used Generative AI?

Accountability
Accurate
Care
Collegiality
Cooperation
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Fair
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Reproducibility
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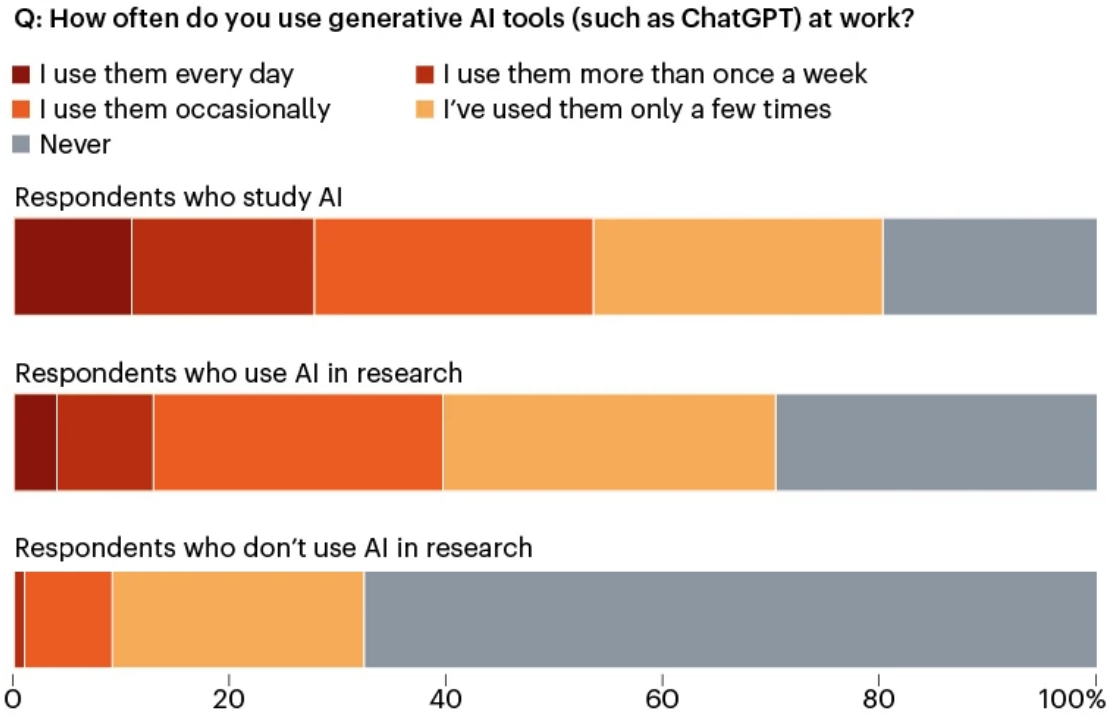

AI and science: what 1,600 researchers think
https://www.nature.com/articles/d41586-023-02980-0#correction-0

Why Use Generative AI?

Accountability
Accurate
Care
Collegiality
Cooperation
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Fair
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Reliability
Reproducibility
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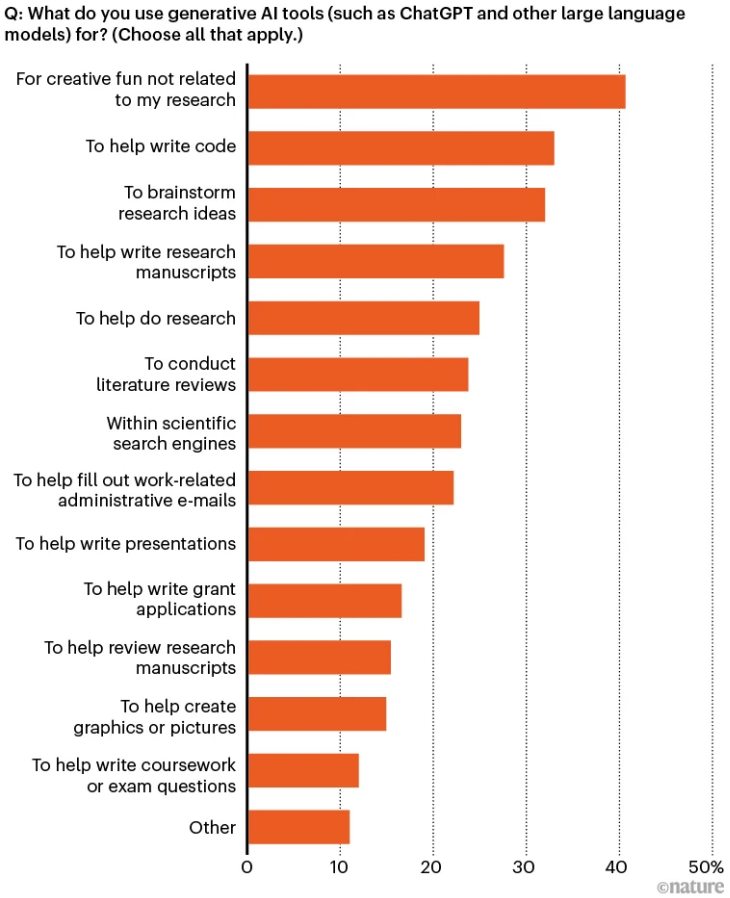
Responsibility
Rigor
Transparency



Considerations For Generative AI

Accountability
Accurate
Care
Collegiality
Cooperation
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Reliability
Reproducibility
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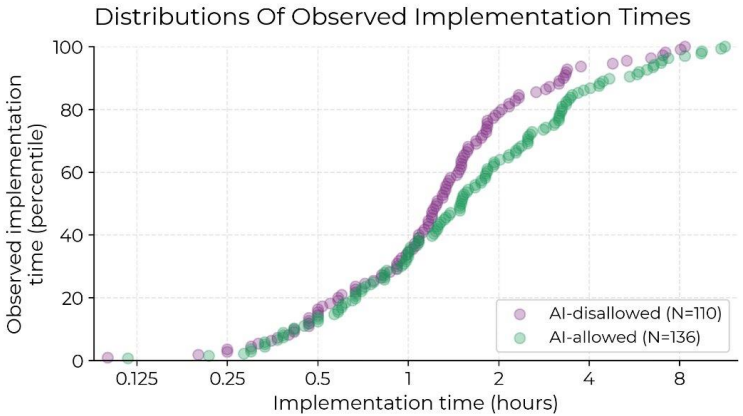
Will it Actually Help?

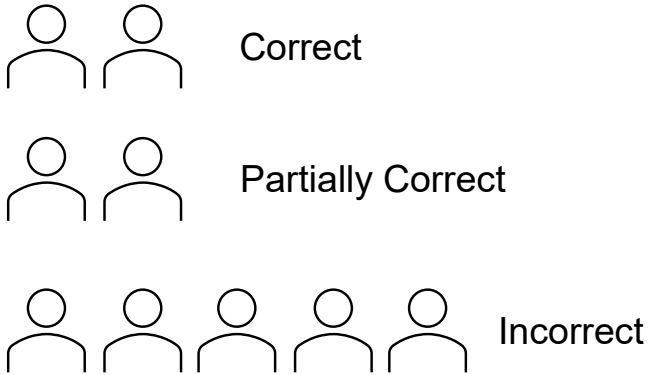
Software Developers



Measuring the Impact of Early-2025 AI on Experienced Open-Source Developer Productivity, Becker *et al* 2025

Scientists

From 9 Self-Reported “Correct” Answers



Attendees of the Joint International Bioinformatics Hackathon 2025.

Considerations For Generative AI

Accountability
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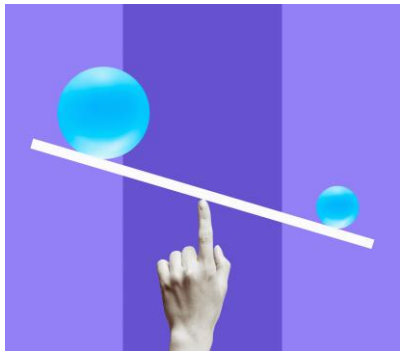
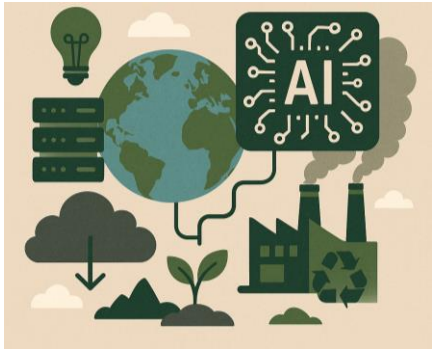
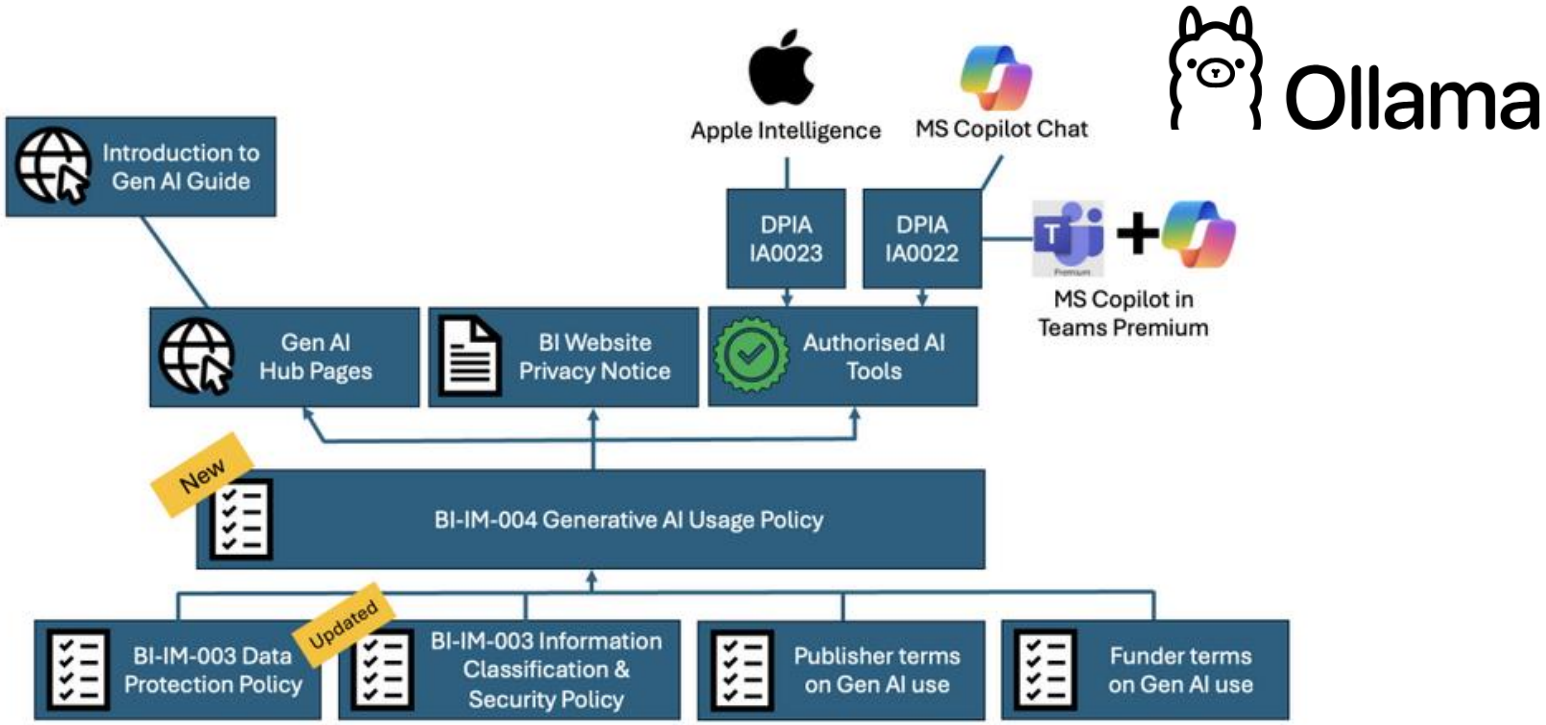
Will it Harm?





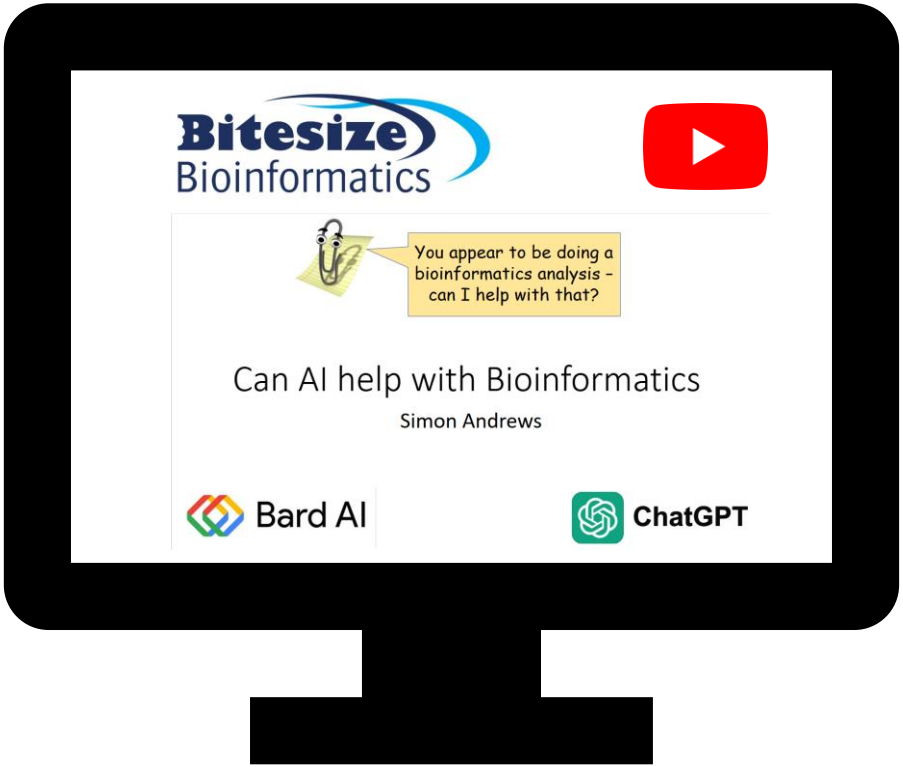
Ultimately it is our responsibility

Generative AI at Babraham



See The Generative AI Pages on The Hub

Generative AI and Bioinformatics



Babraham Bioinformatics

New Course Coming Soon

Babraham Institute

How our integrity may be tested

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Publications

Babraham Bioinformatics

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Publish or Perish?

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Publications: the good

Accountability
Accurate
Care
Collegiality
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Ethics
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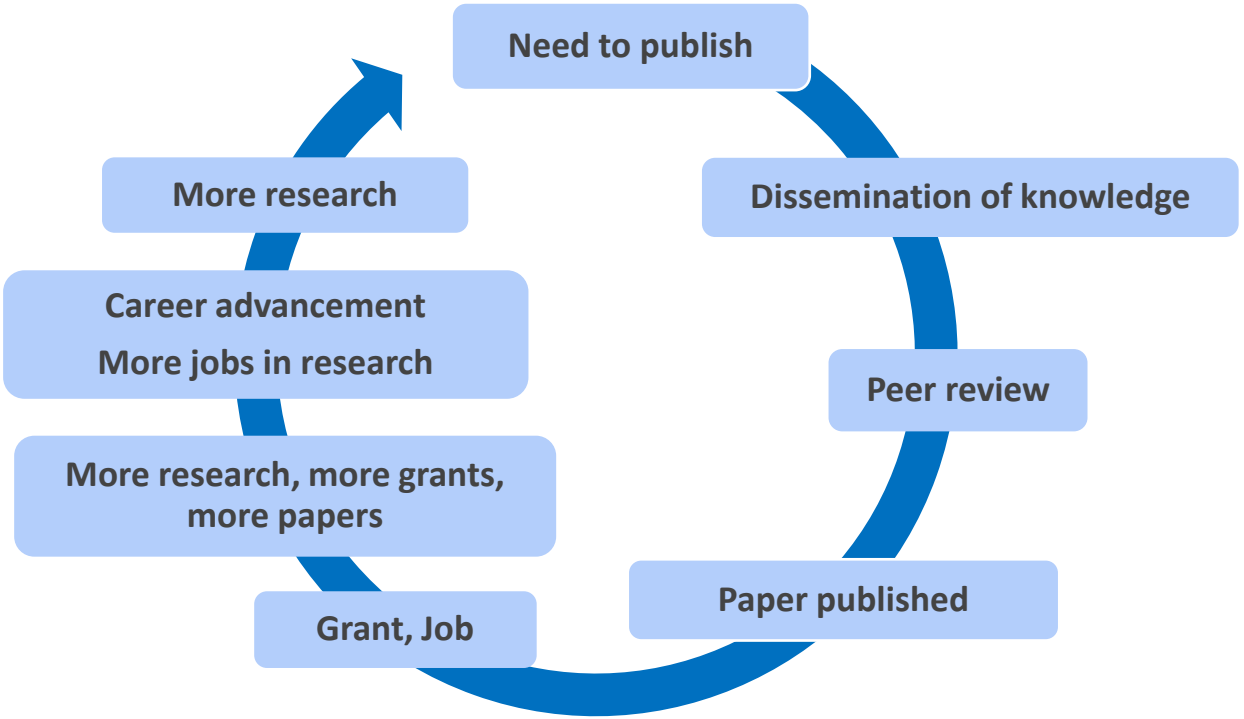

Publications: the bad

Accountability
Accurate
Care
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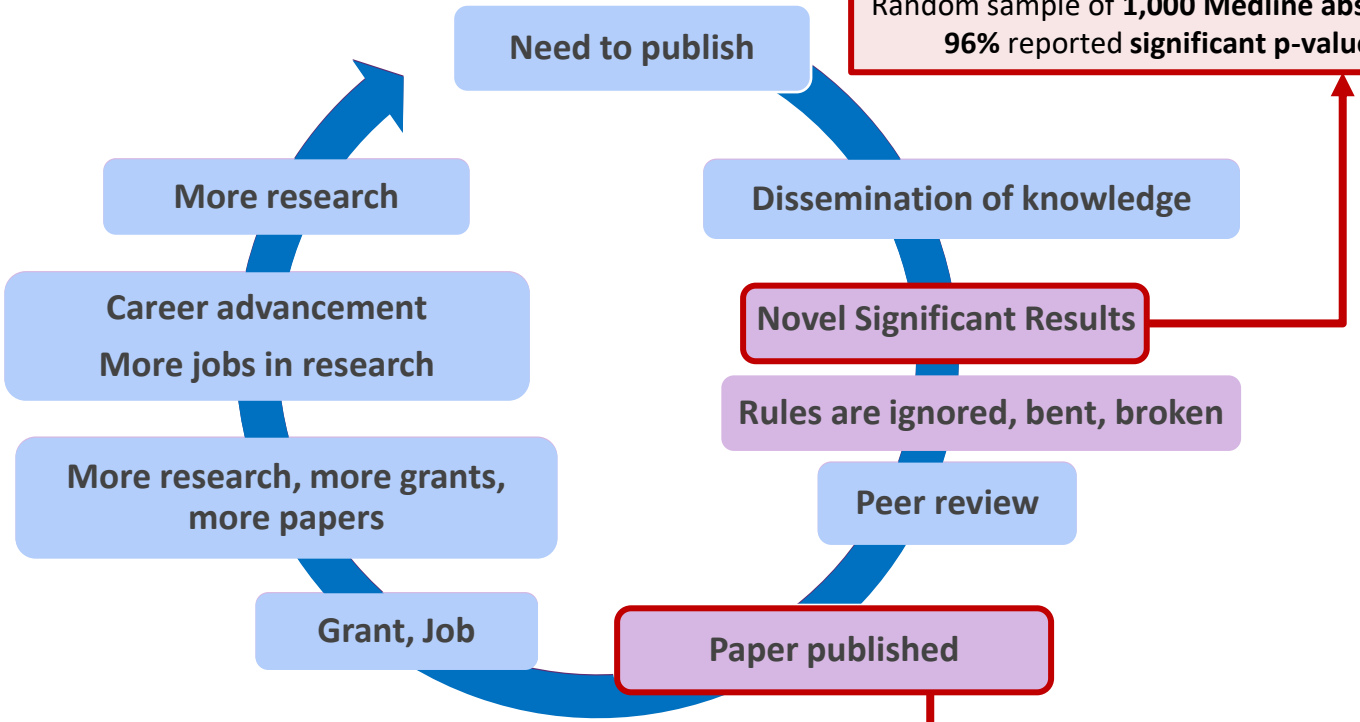


Random sample of **1,000 Medline abstracts**: **96%** reported **significant p-values**

Amgen attempted to replicate **53** high-impact **cancer research studies**: able to **replicate only six.**
Replication crisis

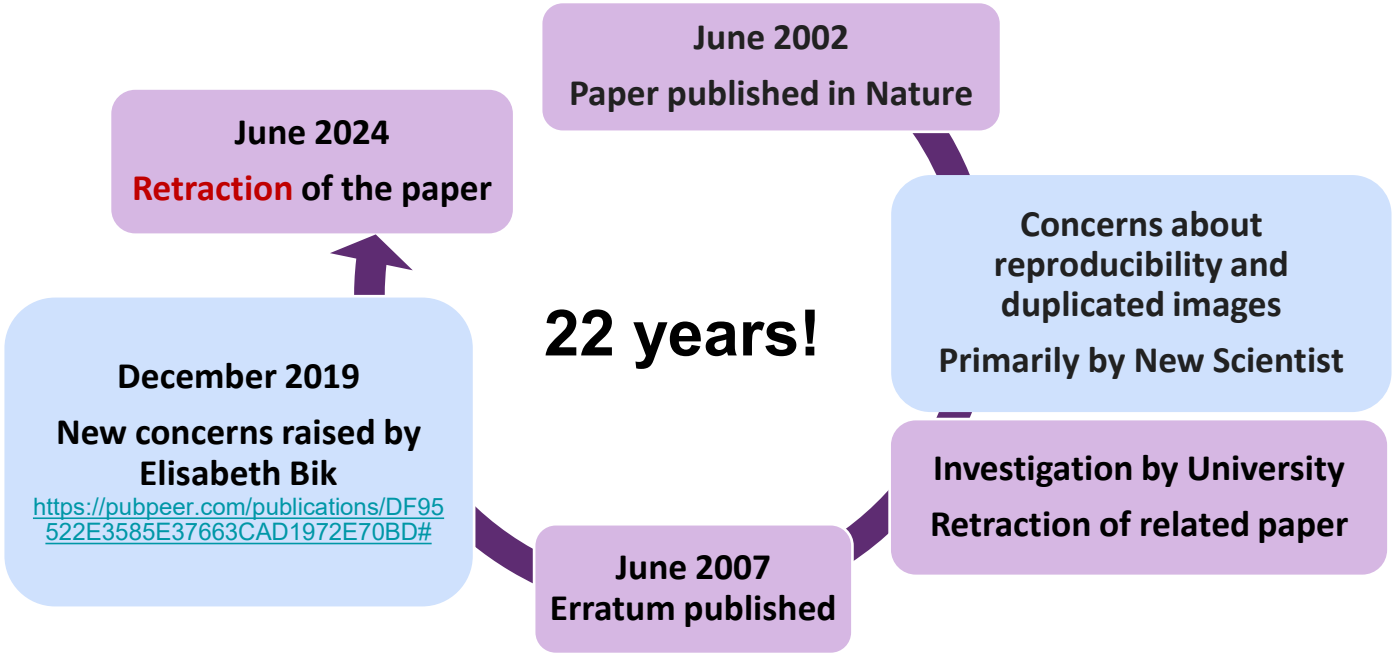
- **Accountability**
- Accurate
- Care
- Collegiality
- Cooperation
- **Ethics**
- Fair
- **Honesty**
- **Objectivity**
- **Openness**
- **Quality**
- **Reliability**
- **Reproducibility**
- **Respect**
- **Responsibility**
- **Rigor**
- **Transparency**

Publications: the bad

The most cited paper to be retracted

Pluripotency of mesenchymal stem cells derived from adult marrow

> Nature. 2002 Jul 4;418(6893):41-9. doi: 10.1038/nature00870. Epub 2002 Jun 20.



Accountability
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	Published	Accesses	Citations
Original Article	20 June 2002	27k	4492
Erratum Note	14 June 2007	6289	39
Retraction Note	17 June 2024	19k	1

(Numbers as of Oct. 2024)

Most authors agree with the retraction*

https://retractionwatch.com/the-retraction-watch-leaderboard/top-10-most-highly-cited-retracted-papers/

No. 7 is Andrew Wakefield original MMR paper

- **Accountability**
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- **Objectivity**
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- **Reliability**
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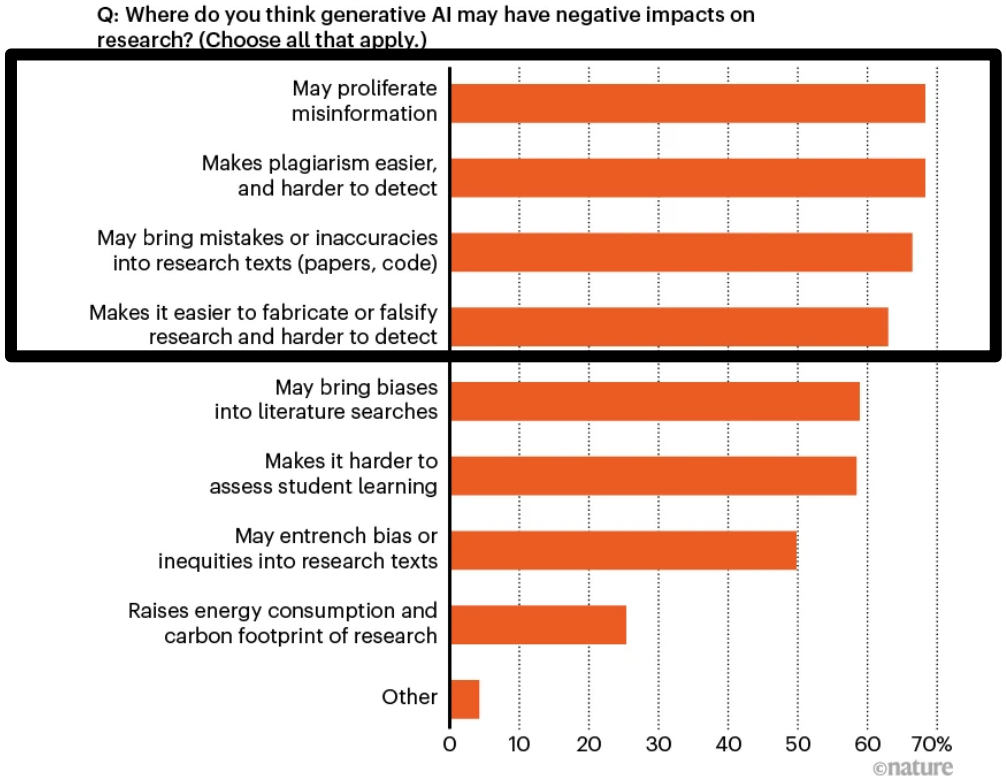
- **Respect**
- **Responsibility**
- **Rigor**
- **Transparency**

Publications: the ugly

Generative AI Concerns



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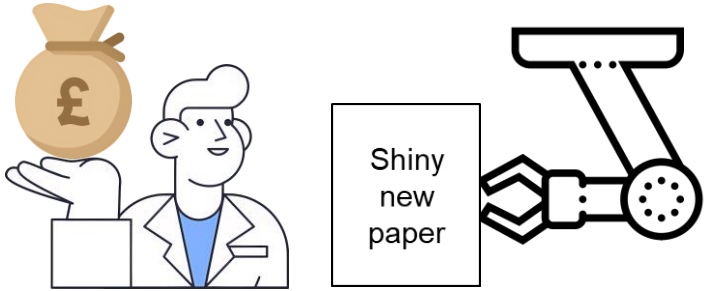
Publications: the ugly

Paper Mills



Estimated Prevalence

2 – 3%[1]

11%[2]

2 – 46%[3]

1. https://www.nature.com/articles/d41586-023-03464-x
2. https://www.medrxiv.org/content/10.1101/2023.05.06.23289563v2
3. https://publicationethics.org/node/55256

Hindawi

In 2023 Hindawi closed 4 journals because they were “heavily compromised by paper mills”

Publications: the balance

Accountability
Accurate
Care
Collegiality
Cooperation
Ethics
Fair
Honesty
Objectivity
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Quality
Reliability
Reproducibility
Respect
Responsibility
Rigor
Transparency

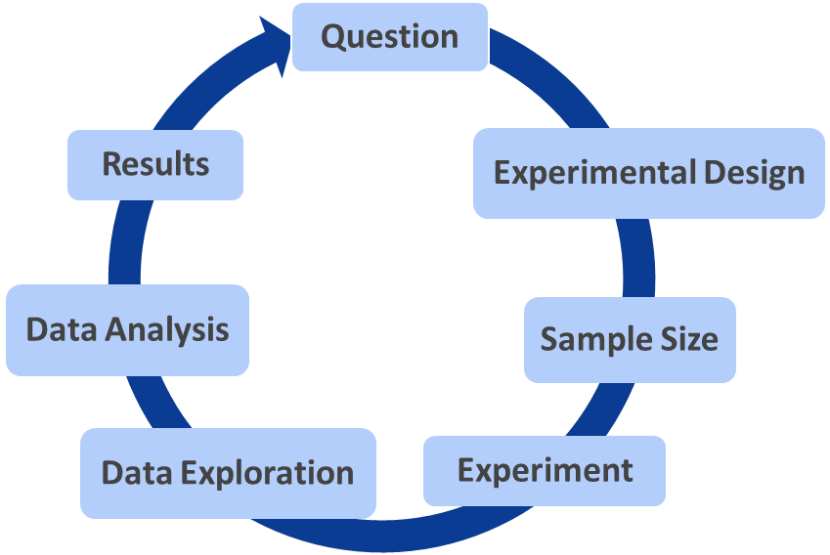
Misconduct

Babraham
Bioinformatics

Research Integrity

Misconduct

- Accountability
- Accurate
- Care
- Collegiality
- Cooperation
- Ethics
- Fair
- Honesty
- Objectivity
- Openness
- Quality
- Reliability
- Reproducibility
- Respect
- Responsibility
- Rigor
- Transparency



Accountability
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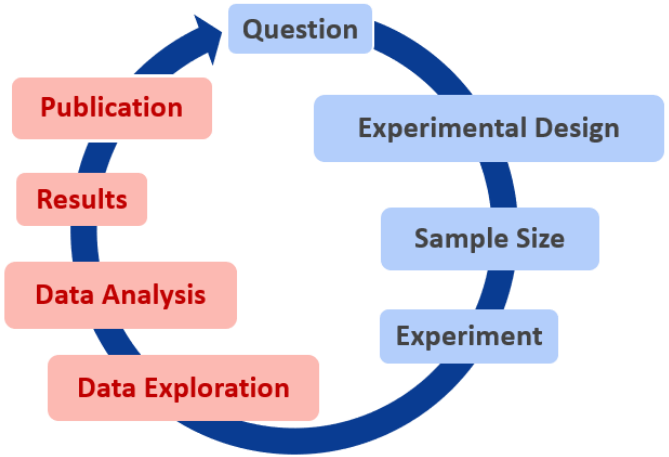
Transparency

Misconduct: How?

There are **many ways to misbehave** when it comes to research

Plagiarism
Fabrication and falsification
Inappropriate image manipulation
Non-publication of data
Faulty data-gathering procedures
Poor data storage and retention
Misleading authorship
Sneaky publication practices



https://undsci.berkeley.edu/article/socialsideofscience_06

Misconduct: Why?

Accountability
Accurate
Care
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Reproducibility
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Transparency

T

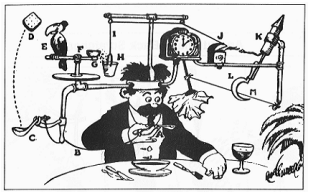
R A

G E

D I

E S

Tina Gunsalus



https://www.nature.com/articles/d41586-018-05145-6

Misconduct: Spot the TRAGEDIES

Group and authority pressure

Entitlement

Deception

Ambition

Incrementalism

A Simple Request from their Professor

Verify the numbers in a figure matched the spreadsheet

Rationalisation

A Questionable Outcome

Paper published with the new student as a co-author

Embarrassment

They accept the credit

Temptation

Why?

Stupid systems

A real case from Tina Gunsalus

https://www.nature.com/articles/d41586-018-05145-6

Misconduct: In a nutshell

Accountability
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Rigor
Transparency

"I never met anyone who said, yeah, you know, that was the day I woke up and decided to you know, put my career at risk, potentially go to jail, embarrass my family, lose my job."

Tina Gunsalus

We need to be aware of our feelings and circumstances
And acknowledge how they might influence us

The Only Acceptable Tragedy!*

STEPS Tragedy • The Dance - How To...

STEP 1 - Put your hands up beside your ears in 'Tragedy' shock!

STEP 2a - Raise your right arm.

STEP 2b - Raise your left arm so both arms are up.

STEP 3 - Clasp both hands together on your heart.

STEP 4 - Stretch both arms out straight in front with your palms up.

STEP 5a - Put your hands to your head as in STEP 1 and then step to your right.

STEP 5b - Repeat the same move to your left. Repeat the same two moves again.

STEP 6a - Step to the left and swing your left arm out with your right hand on your hip.

STEP 6b - Step to the left and swing your right arm out with your left hand on your hip.

STEP 7 - Hold your right arm out and stop the traffic!

STEP 8 - Keep your right arm out, turn to your right and roll your left shoulder three times.

https://www.youtube.com/watch?v=OiwDHHcHPh0

*To be fully transparent we should note the Bee Gees did it first!

Babraham Institute

The bottom line

Babraham Bioinformatics

Research Integrity

It’s about being a good scientist

Research integrity

is about **owning every step of our research,** and **benefits everyone**.

https://penntoday.upenn.edu/news/pursuit-scientific-truth-adversarial-collaboration-Tetlock-Clark


Research Integrity
What does it mean?
Questioning
Definitions
In Practice
Ethics
Keeping Track
Responsibility
How can we apply it?
Publications
Misconduct
When is it tested?
Bottom line
Good Science

Babraham Institute

What do you think now?
Which words are
most important/synonymous with integrity?

Babraham Bioinformatics

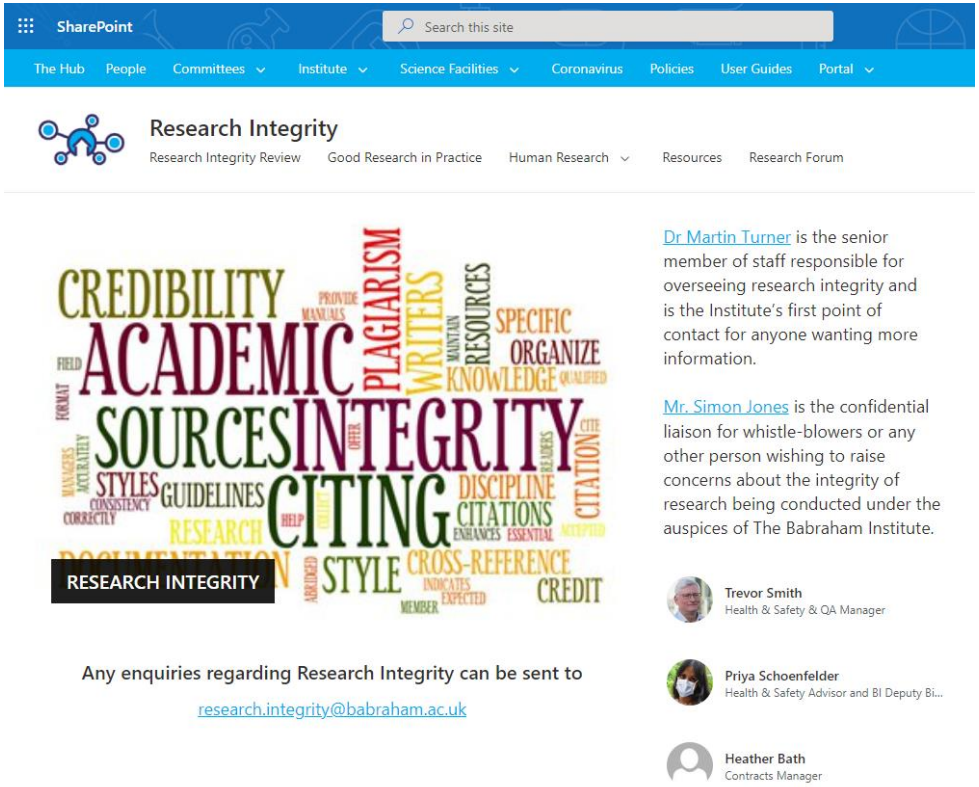
Research Integrity

More than words

The Hub

Research Integrity

Useful resources



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from Noun Project

BI-HR-001 Code of Conduct
BI-HR-005 Disciplinary Policy
BI-COR-010 Whistleblowing Policy
BI-RES-001 Authorship Policy
BI-RES-004 Research Misconduct Policy
BI-RES-005 Research Integrity Policy
Record Retention Policy
Data Management Guidance

Research Integrity

Useful resources

www.bioinformatics.babraham.ac.uk

ReproducibiliTea

MS Teams channel and mailing list. Contact Richard.Acton@babraham.ac.uk

Research Integrity

Useful resources

nature

Retraction Watch

PUBPEER
The online Journal club

UKRIO
RESEARCH INTEGRITY OFFICE

"Integrity is doing the right thing even when no one is watching."

— C.S. Lewis

“Integrity is doing the right thing when you don’t have to—when no one else is looking or will ever know—when there will be no congratulations or recognition for having done so.”

Excerpted from *Shattering the Glass Slipper: Destroying Fairy-tale Thinking Before It Destroys You*.