Babraham Institute

Research Integrity

or *How to be a Good Scientist*

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

v2024-02

Babraham Bioinformatics

A

B

C

D


Maryland
200g
CHOC CHIP


McVitie's
Digestives
433g
Milk Chocolate


SHORTBREAD
all butter fingers
by Sainsbury's

An illustration

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

Retracted article 2010 **12 years**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

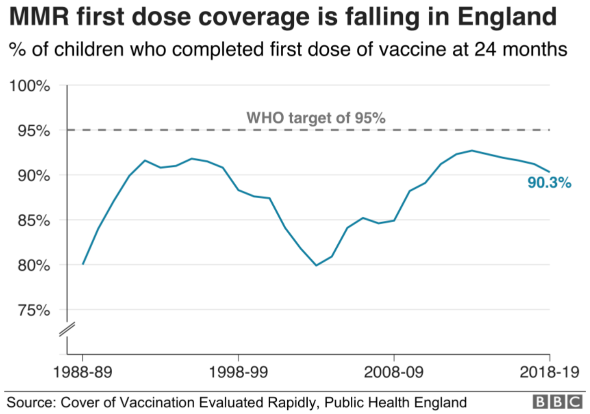
A J Wakefield [1], S H Murch, A Anthony, J Linnell, D M Casson, M Malik, M Berelowitz, A P Dhillon, M A Thomson, P Harvey, J A Walker-Smith

Affiliations + expand

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

- 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)



84%

2022-23

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…

Outline of the course


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

What is Research Integrity?

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

Which words are most important/synonymous with integrity?

Exercise

Babraham Institute

Babraham Bioinformatics

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

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Scientific integrity

Research Integrity in practice

Research Integrity: In Practice

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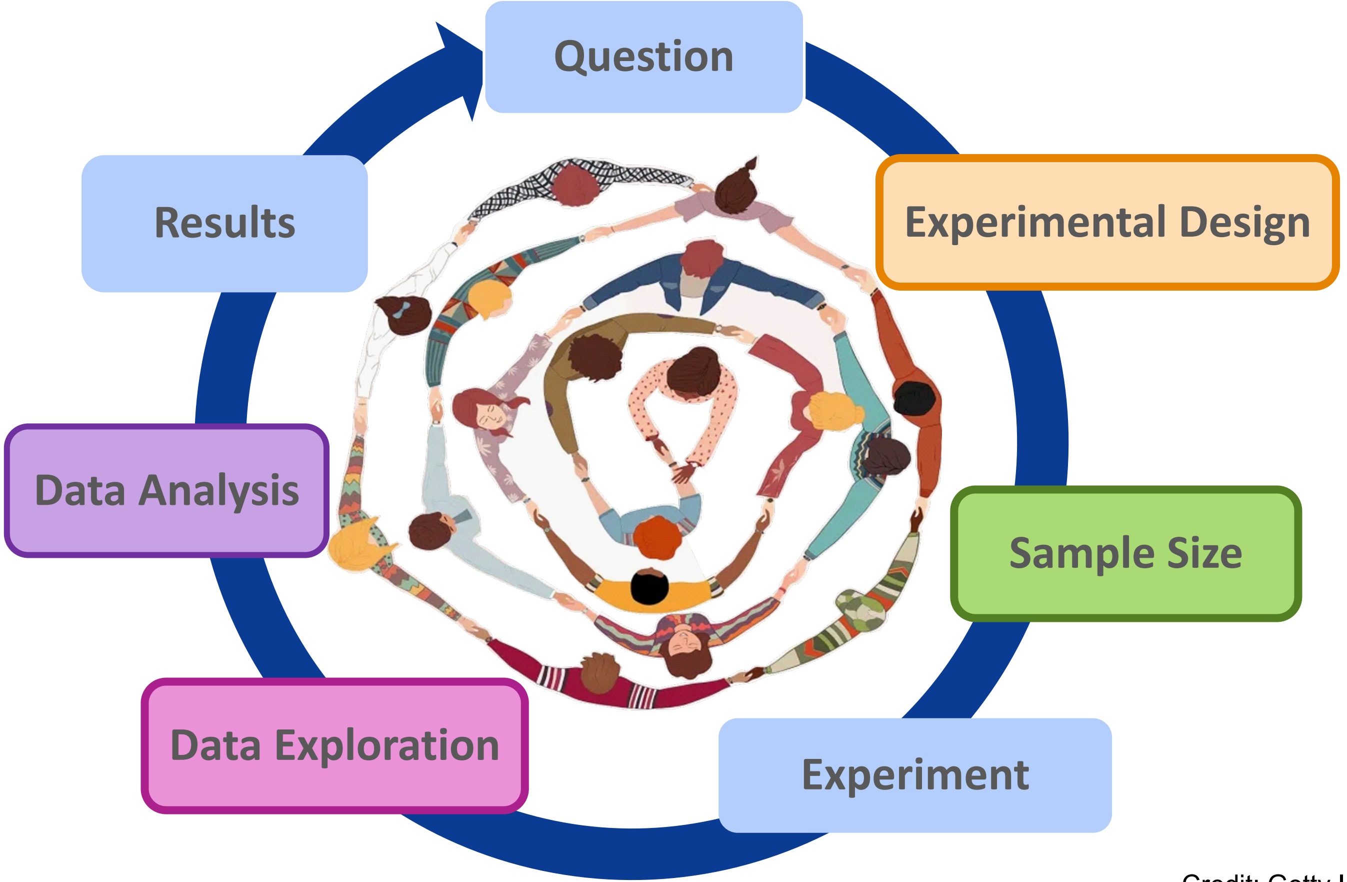

Credit: Getty Images/melitas

Research Integrity in practice

Experimental design

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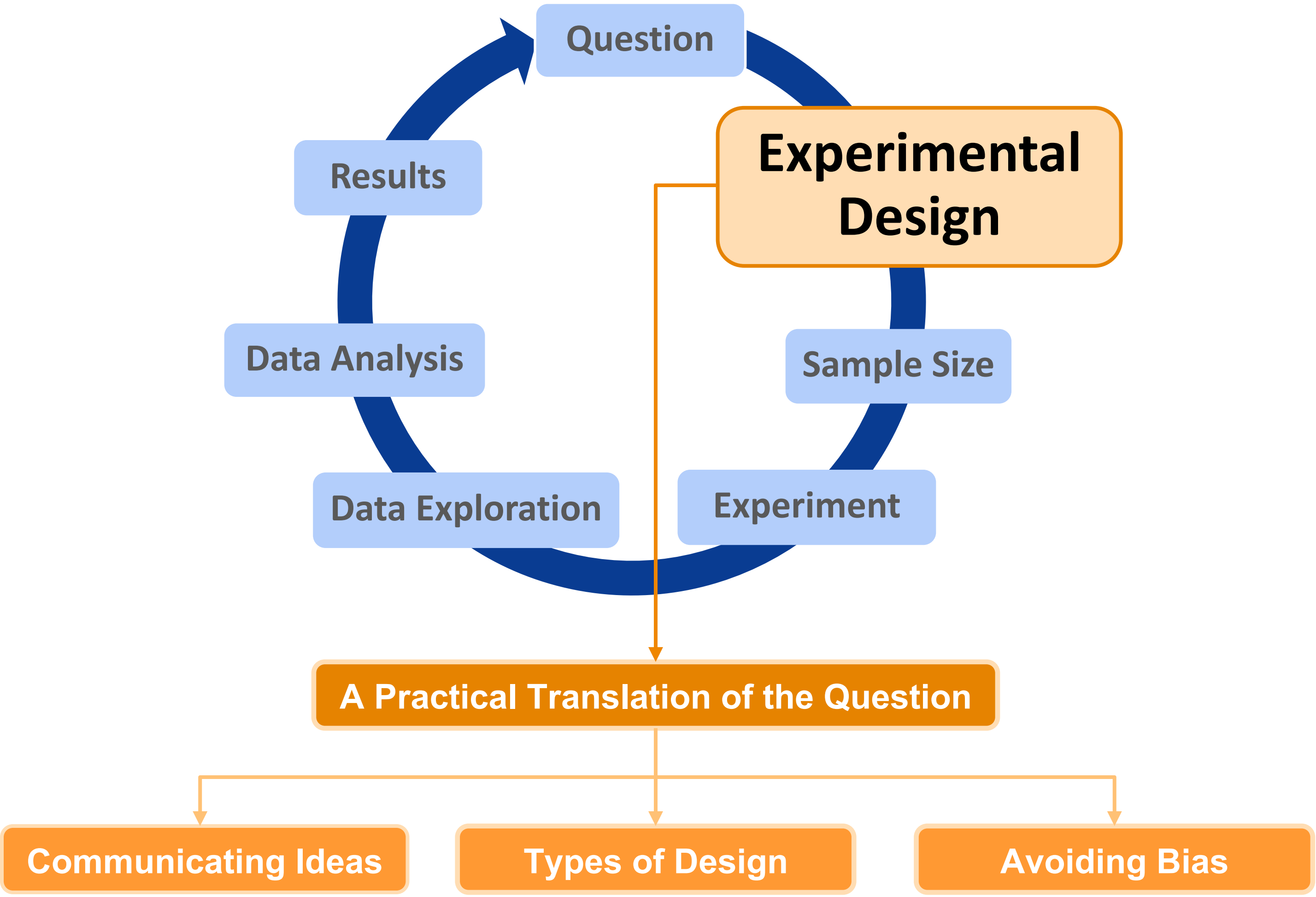

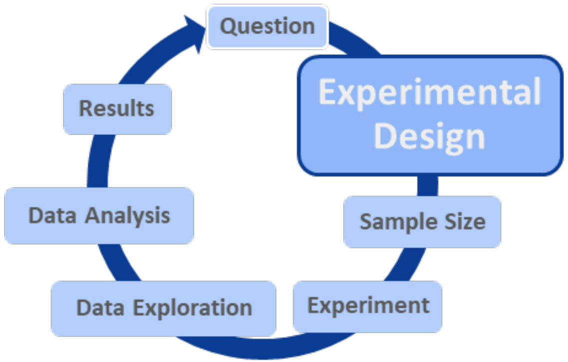

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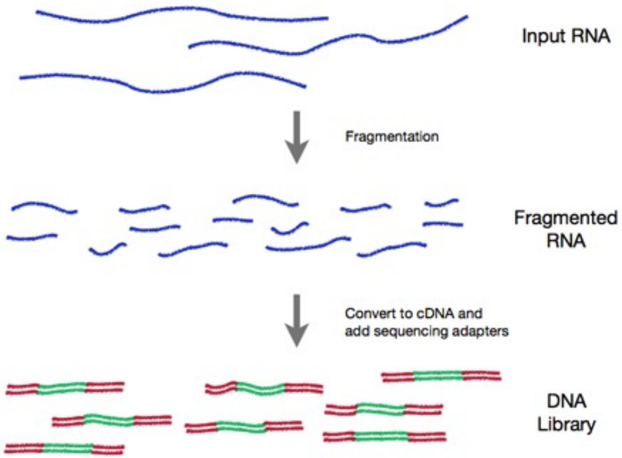
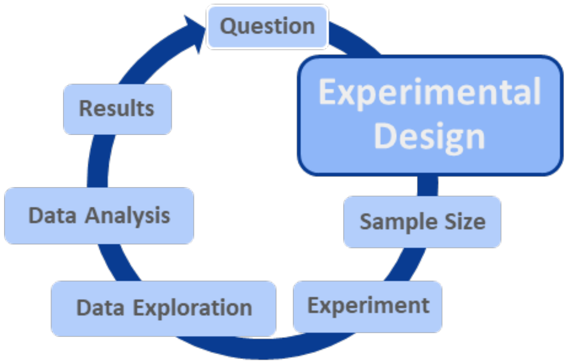
Clear Communication

Library

Library, Cambridge



RNA seq Library



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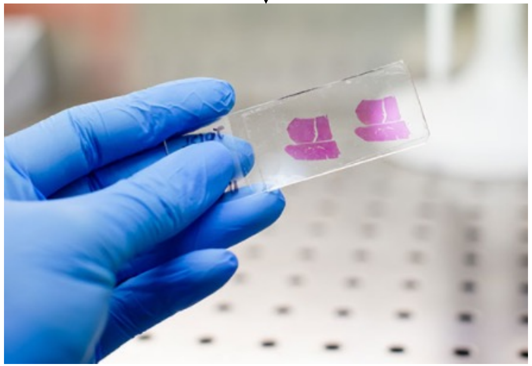
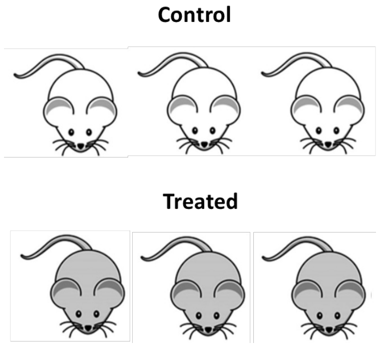
Clear Communication

Sample

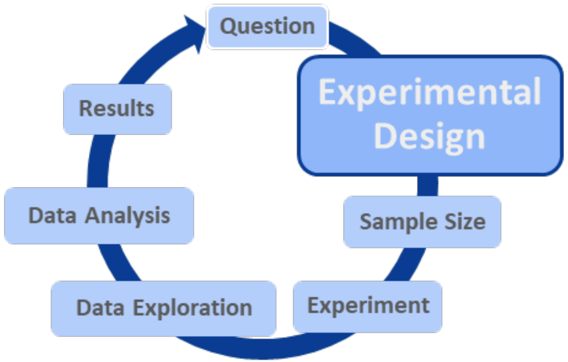


Tissue Sample



Sample of mice

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



Appropriate Type of Design

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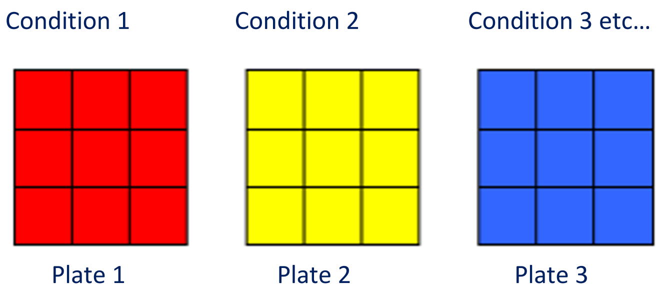
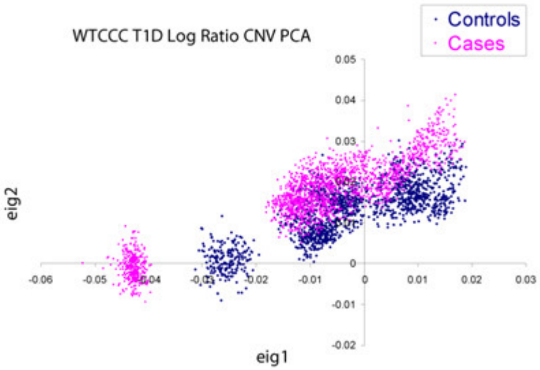
Distinguish real differences from experimental artefacts…

…But experiments can be big and complicated

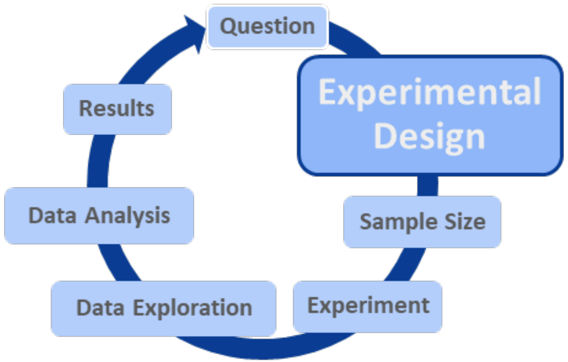
Seminal Wellcome Trust GWAS Study:

- 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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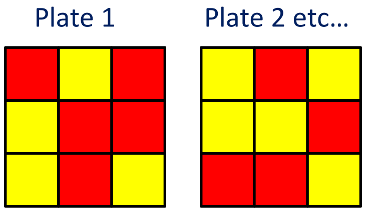
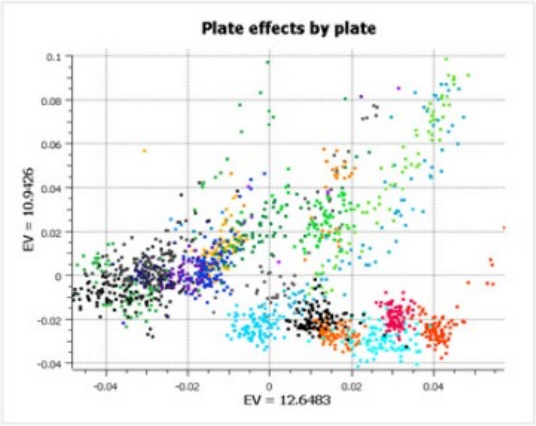
GenADA multi-site collaborative study:

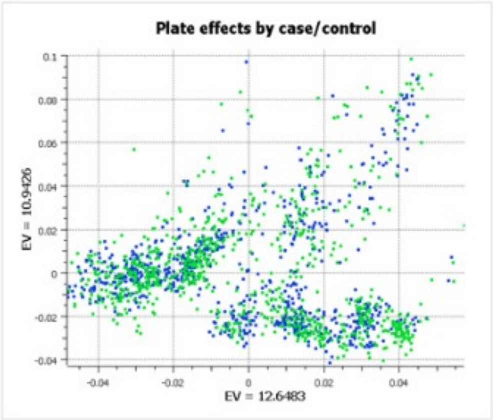
- 875 Alzheimers patients, 850 controls, 9 sites
- Randomised Block Design



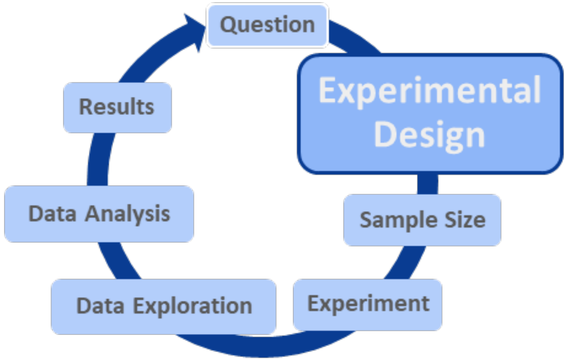
Still have differences between plates



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

Confirmation bias

Exercise

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.

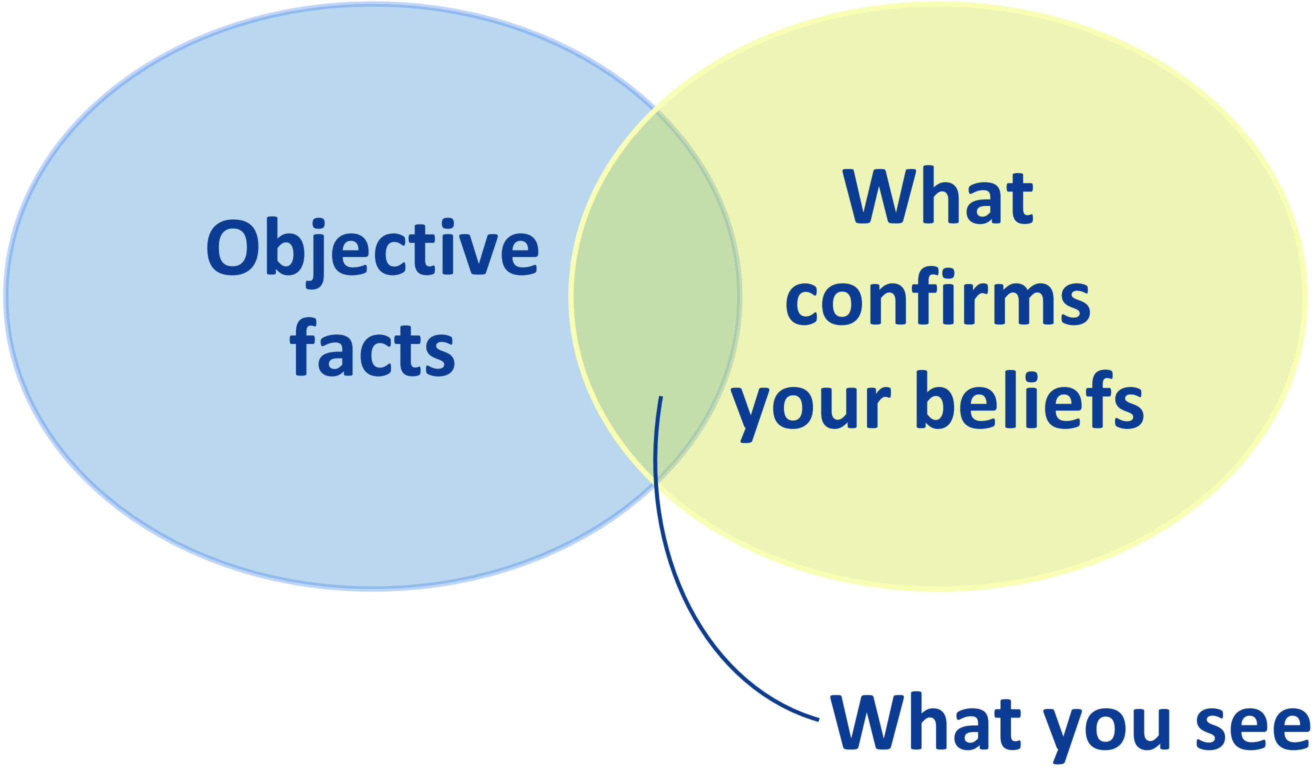
A Quick Exercise on Confirmation Bias and Hypothesis Testing

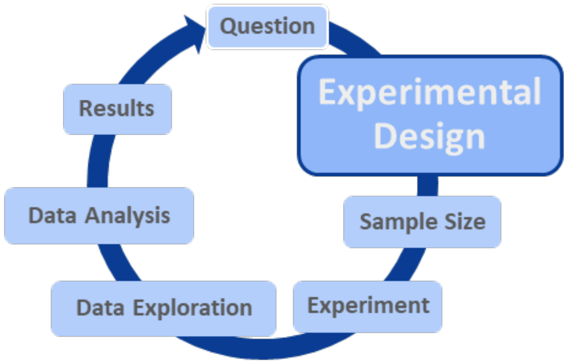
- 2
- 4
- 8

A Quick Exercise on Confirmation Bias and Hypothesis Testing

What’s the rule?

Confirmation bias





Experimenter Bias

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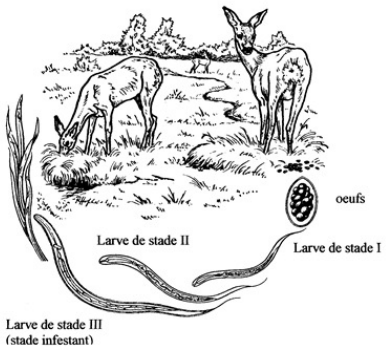
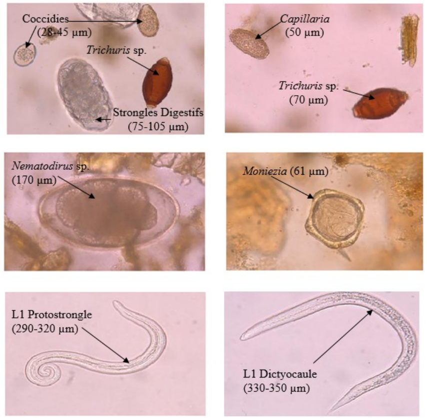
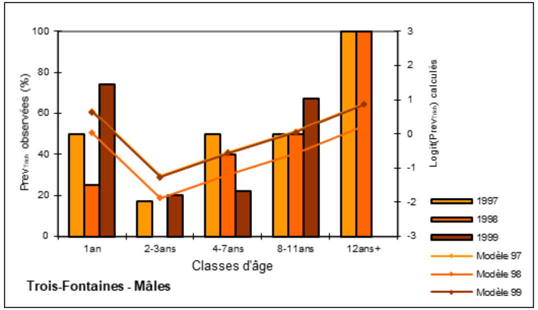
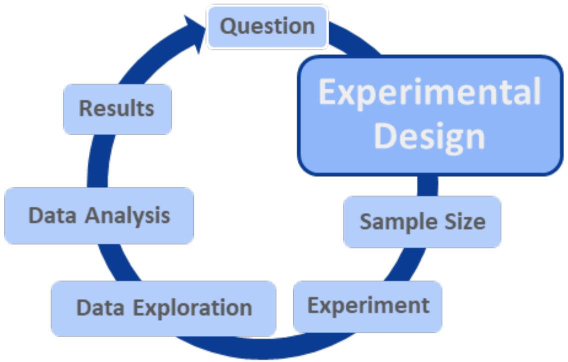






Scientists should be **blind** … if they want to be **objective**!

Wetzer and Rieck, 1960



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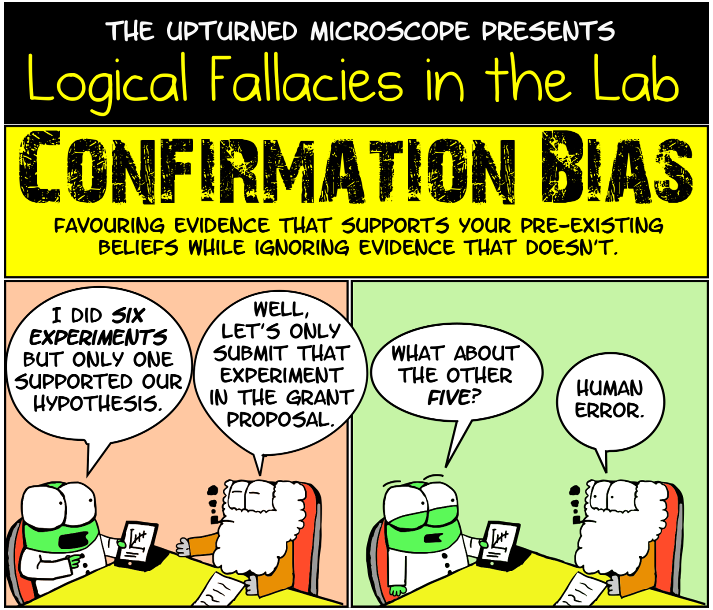
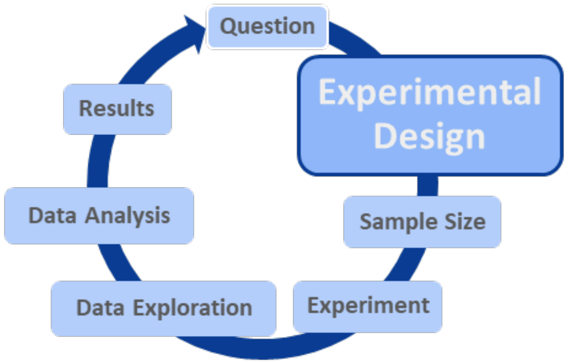
Blinding
is important to avoid
Confirmation bias





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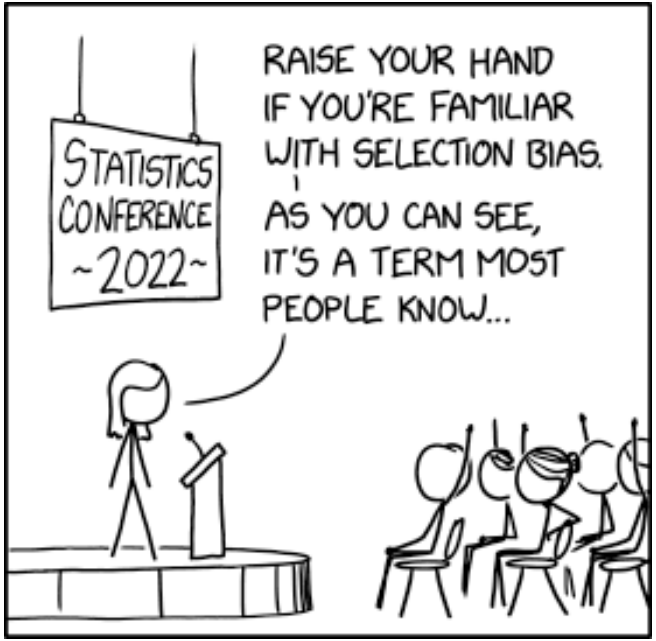
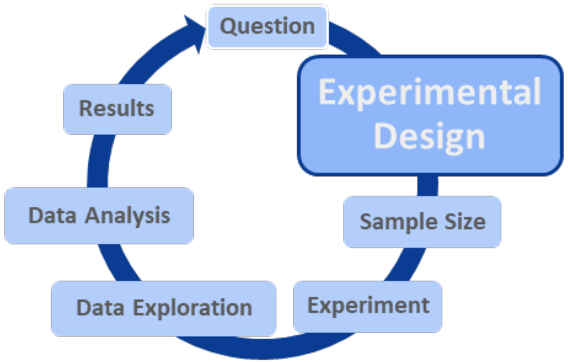
Selection Bias



Biases in our sample populations can impact on our conclusions too



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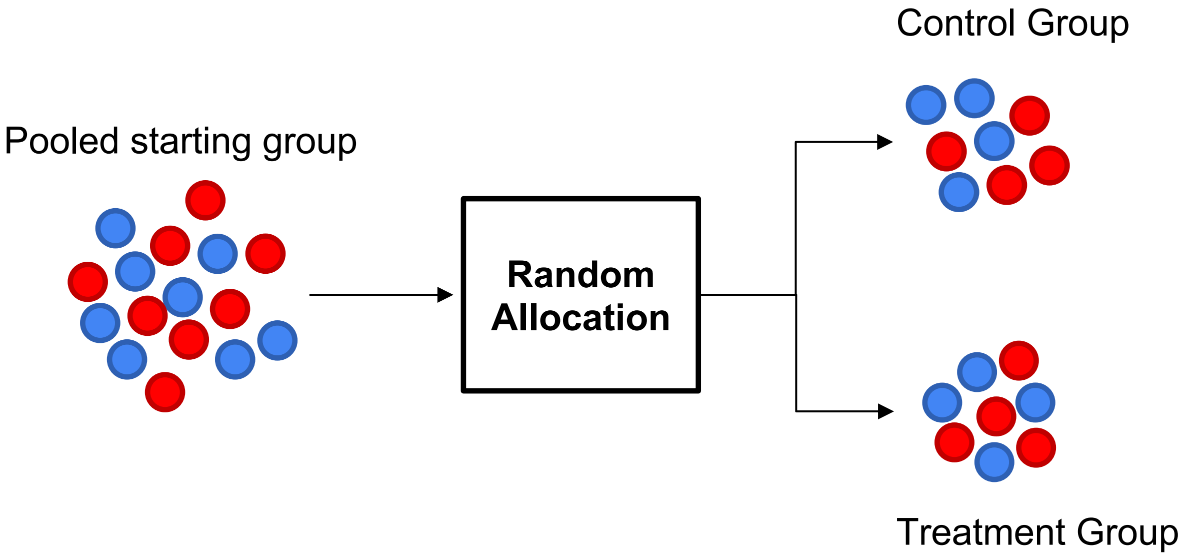
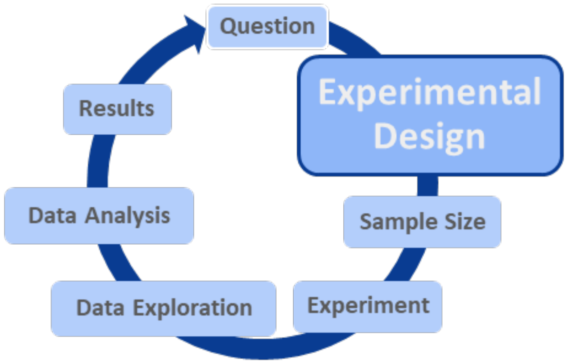
Randomisation



Each experimental unit has equal probability of receiving a treatment

- Minimises Selection Bias
- Reduces systematic differences between groups

Random Allocation



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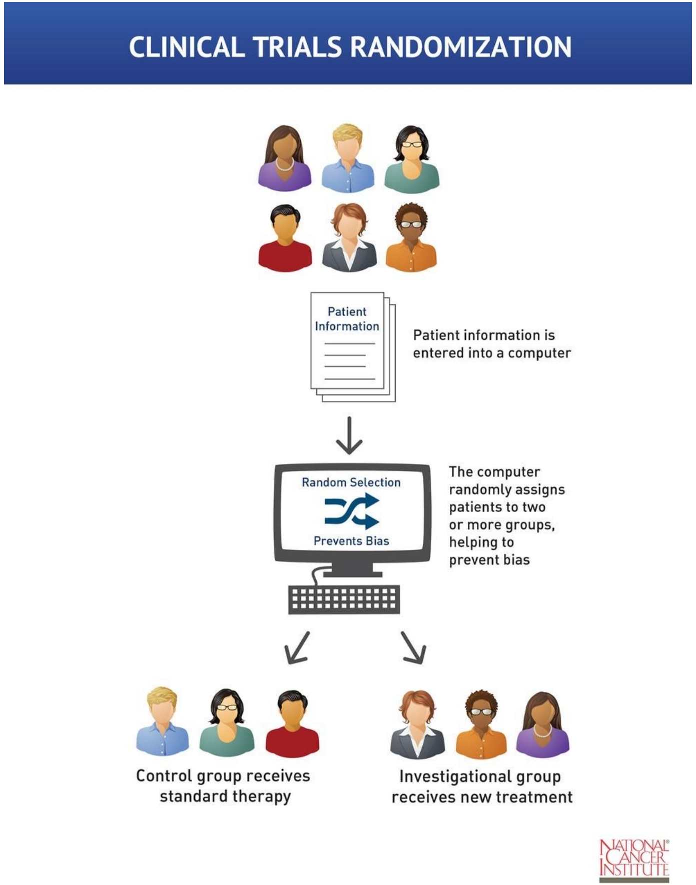

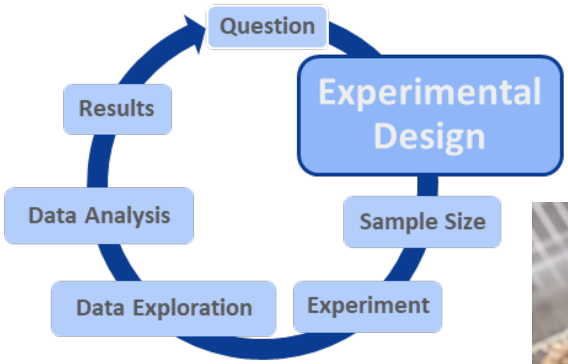

Random Allocation

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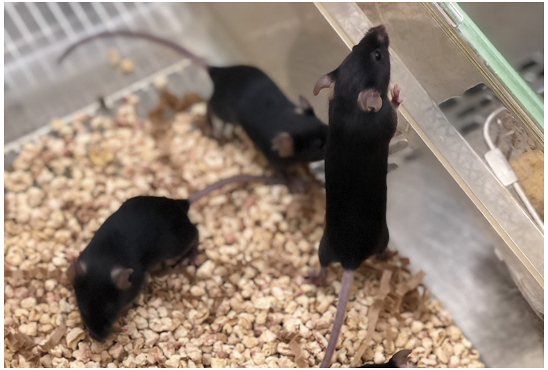


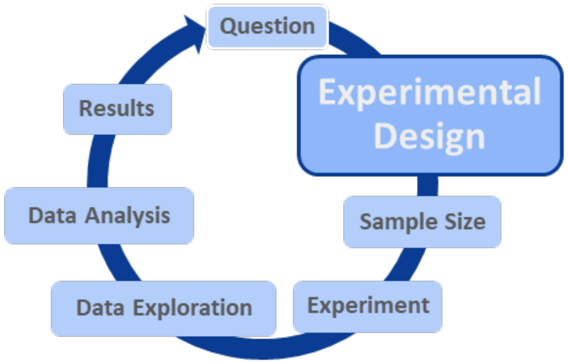
Pick out a mouse at random, first 3 get the treatment

Is this random?

Does it have the potential to introduce bias?

A Biased

B Not Biased



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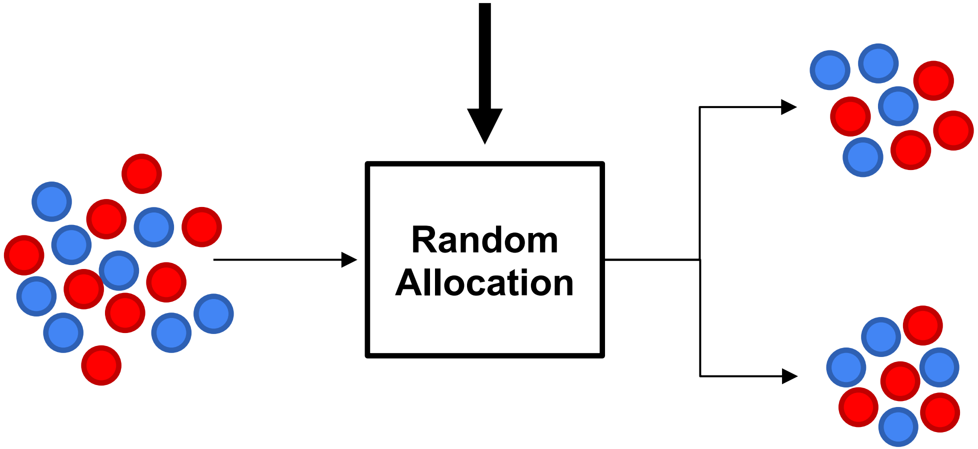
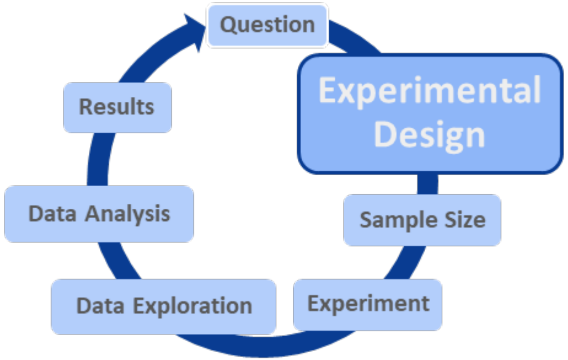
Randomisation More Broadly

Consider Nuisance Factors



Also consider randomisation **throughout** the experiment

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



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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

Research Integrity in practice

Sample size

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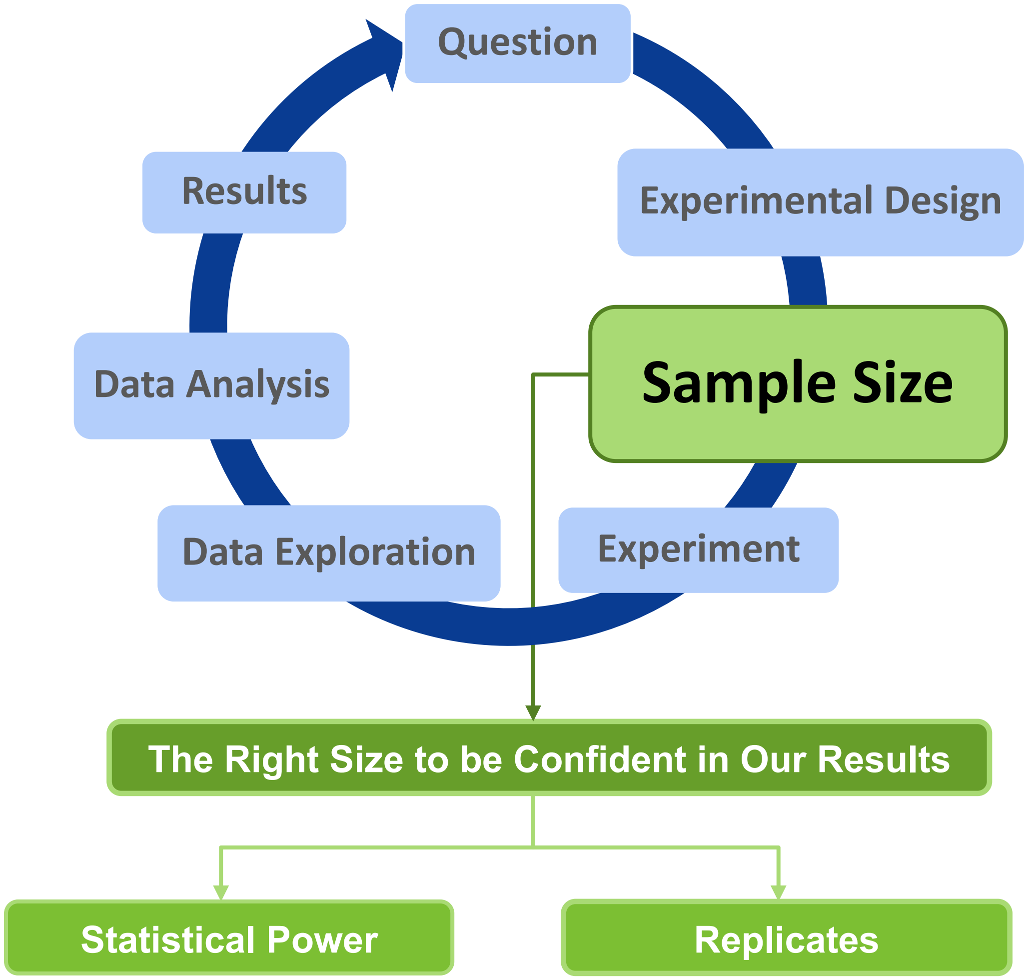

Statistical power: an analogy

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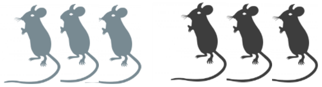
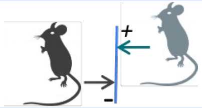
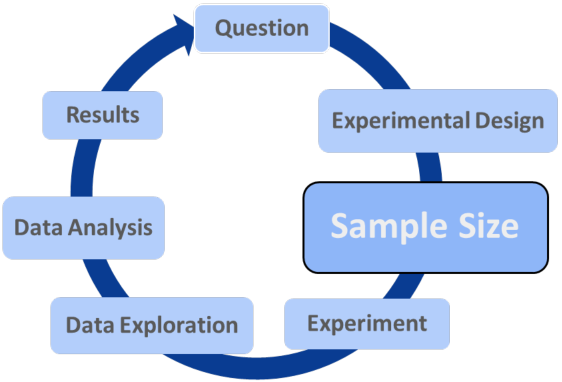
You send your child into the basement to find a tool. The child comes back and says "it isn't there".
What do you conclude?

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?	How big is the difference? **The absolute effect**
 or 	
How messy is the basement?	How messy the data are? **Variability**
 or 	



The Importance of Statistical Power

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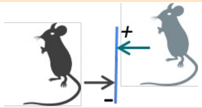
"If there is a difference between 2 conditions, what are the chances that your experiment will pick it up ($p<0.05$)?"

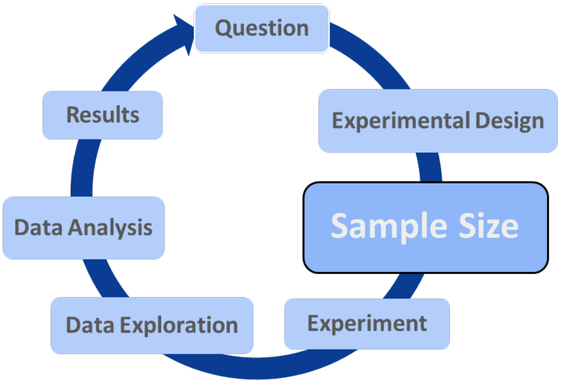
Increase **Sample size** to increase **Power** → How many mice do you look at? **Sample size**

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…

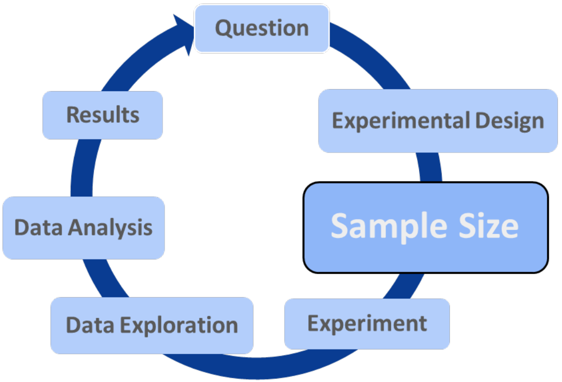
So some underpowered studies will detect a real effect

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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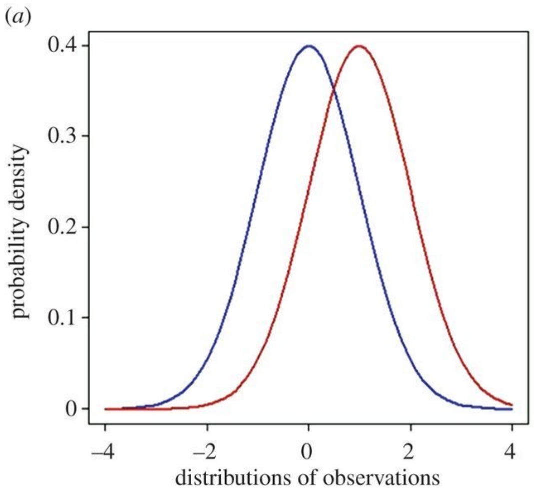
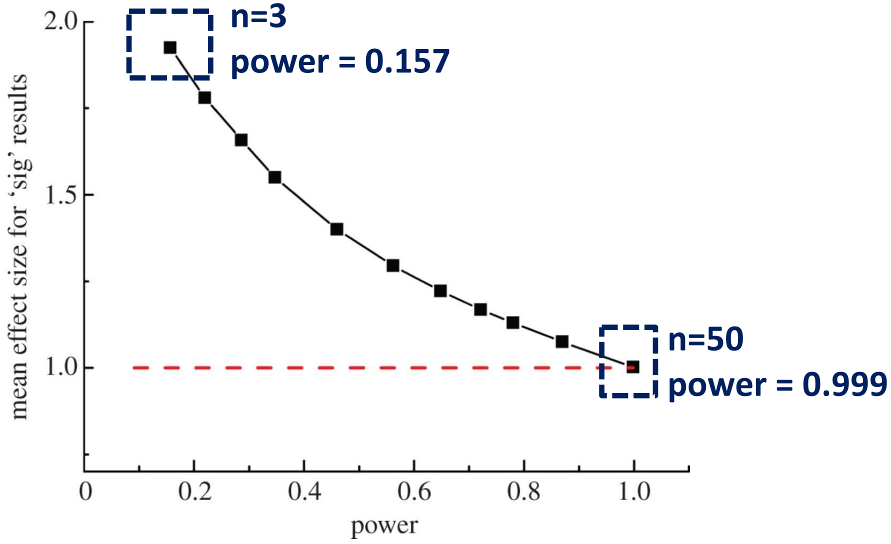
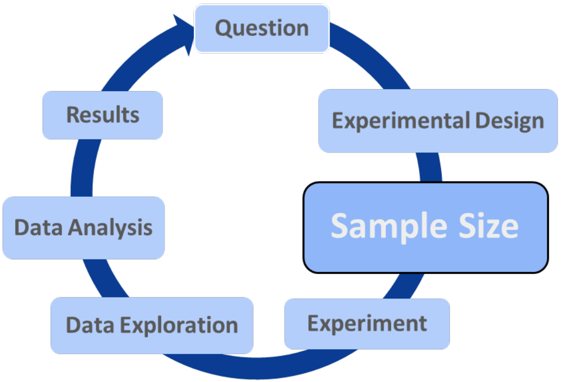
The TRUE effect size = 1





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



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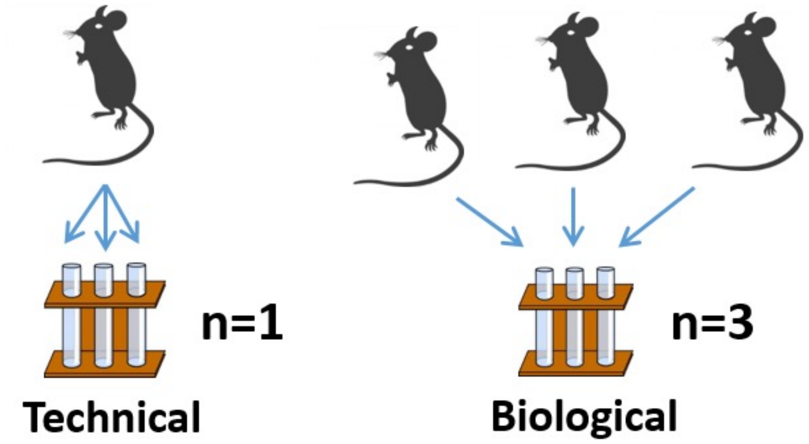
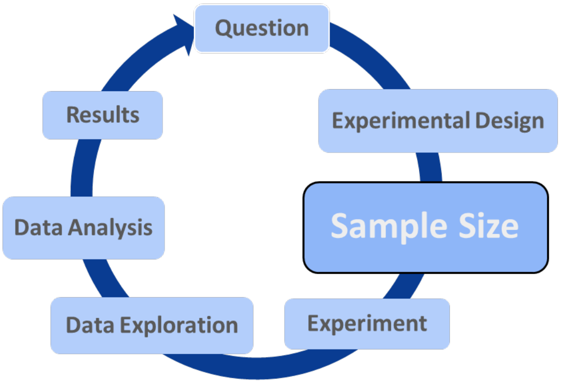
Defining Replicates

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

Technical versus biological replicates





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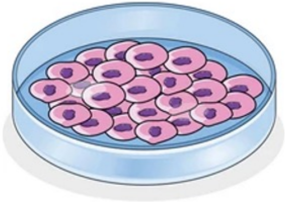
What is a Biological Replicate in Practice?

1 biological replicate:

A 1 mouse

B 1 cage



1 biological replicate:

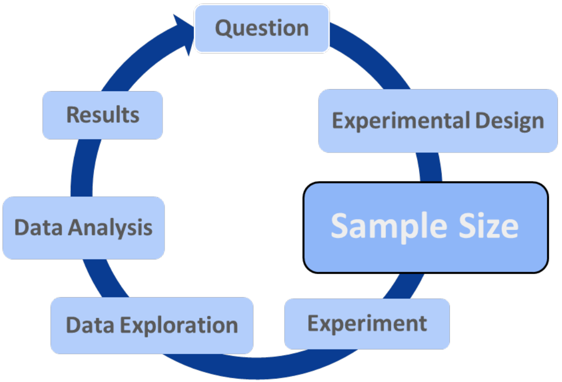
A 1 cell

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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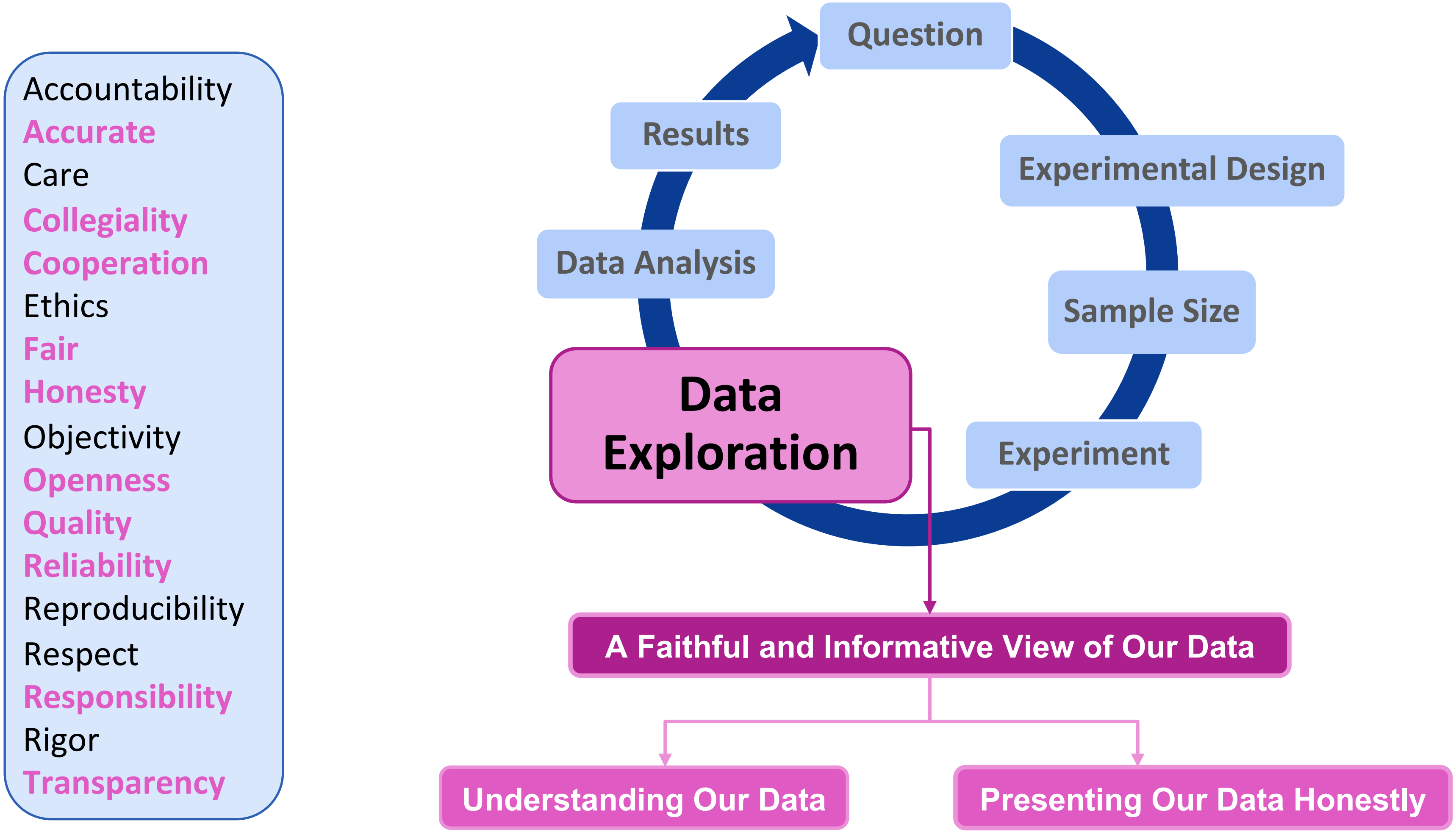
Research Integrity in practice

Data Exploration & Data Analysis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Reliability
Reproducibility
Respect
Responsibility
Rigor
Transparency
Question
Experimental Design
Sample Size
Experiment
Data Exploration
Data Analysis
Results
A Faithful and Informative View of Our Data
Understanding Our Data
Presenting Our Data Honestly

Data Exploration

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Openness
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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"

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

Francis Anscombe

4 datasets
Each consisting of X and Y variable

All 4 datasets have the same summary statistics...

Data Exploration: Anscombe's Quartet

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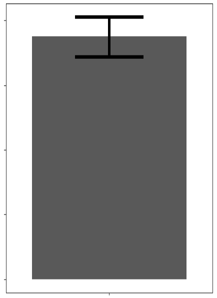
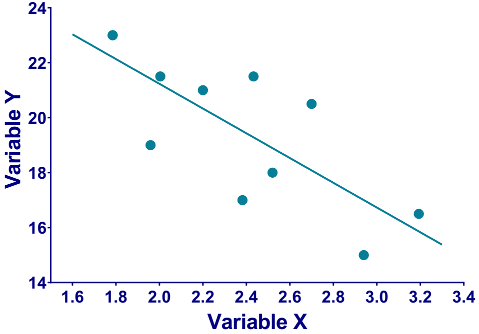
The average and spread of the conditions appears the same

	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



Data Exploration: Anscombe's Quartet

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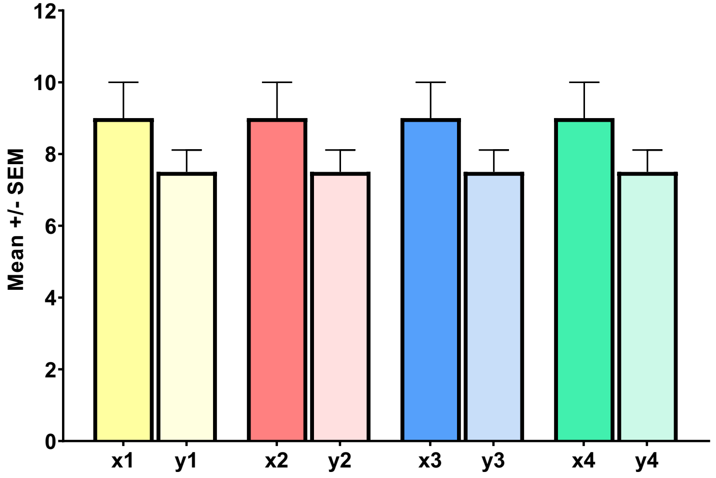
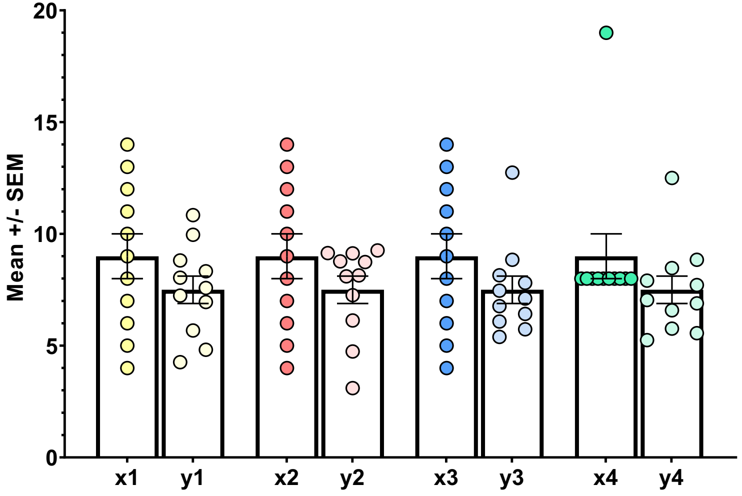
How does the data behave within the groups?





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

Data Exploration: Anscombe's Quartet

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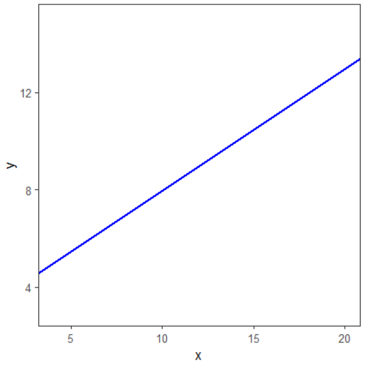
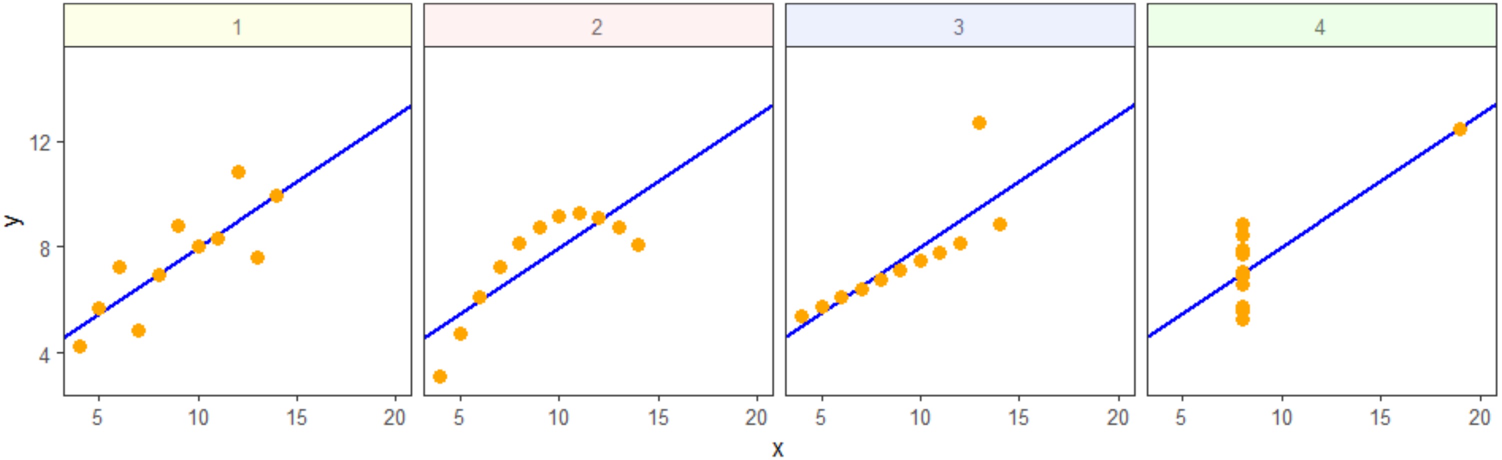
What about the relationship between X & Y?



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

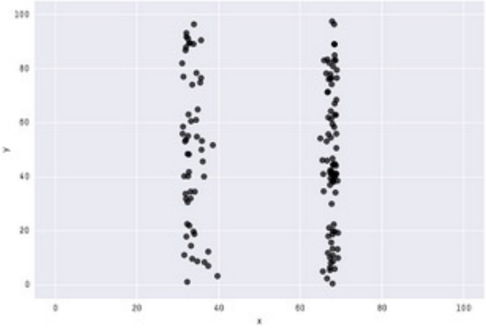
Circle — B

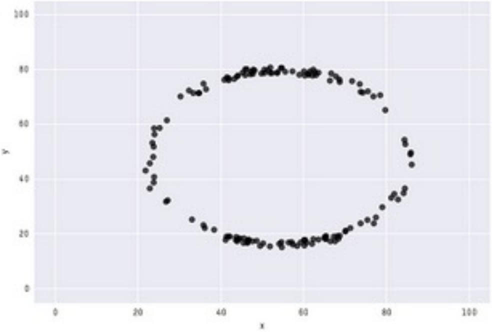
N	182
X Mean	54.26
Y Mean	47.83
X SD	16.76
Y SD	26.93
Correlation	-0.06

C — Unstructured

D — I Don't Know… A Dinosaur!

The Datasaurus Dozen





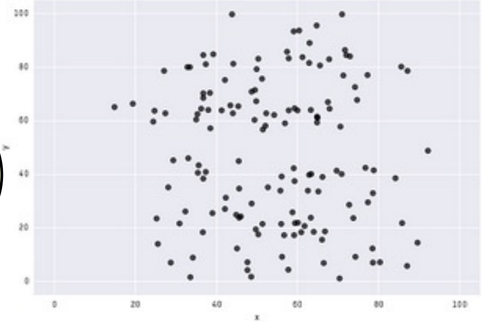
A

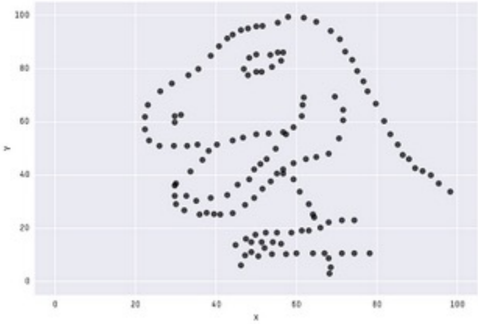
B

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

C

D





And More!

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

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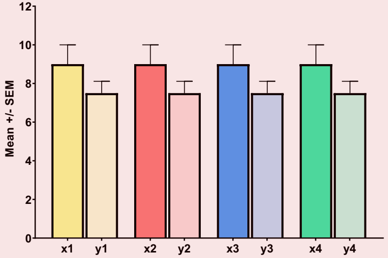
Data Exploration: Seeing is Believing!

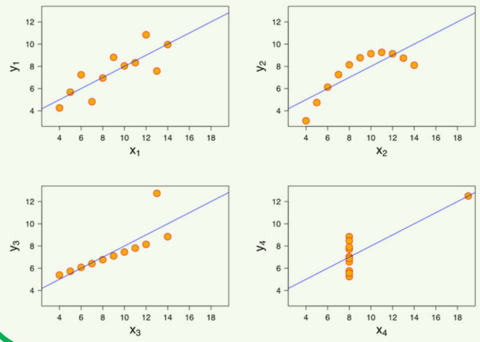
Beware of statistical or graphical summaries…

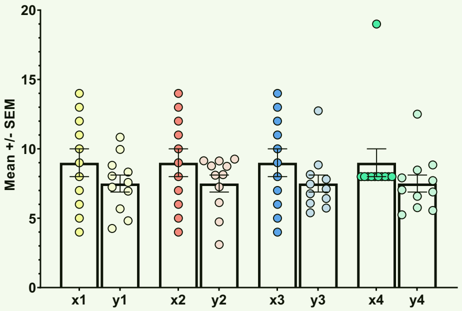
	Correlation (r)	Line of Best Fit
x1 vs. y1	r = 0.8164	Y = 0.5001*X + 3.000
x2 vs. y2	r = 0.8162	Y = 0.5000*X + 3.001
x3 vs. y3	r = 0.8163	Y = 0.4997*X + 3.002
x4 vs. y4	r = 0.8165	Y = 0.4999*X + 3.002

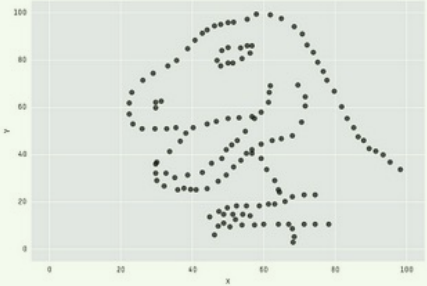


N	182
X Mean	54.26
Y Mean	47.83
X SD	16.76
Y SD	26.93
Correlation	-0.06

…without proper exploration & visualisation!







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Data Exploration

Exercise

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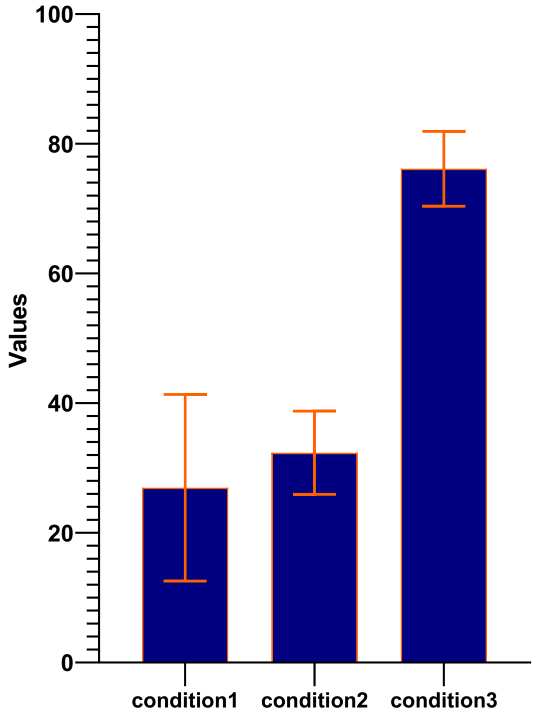
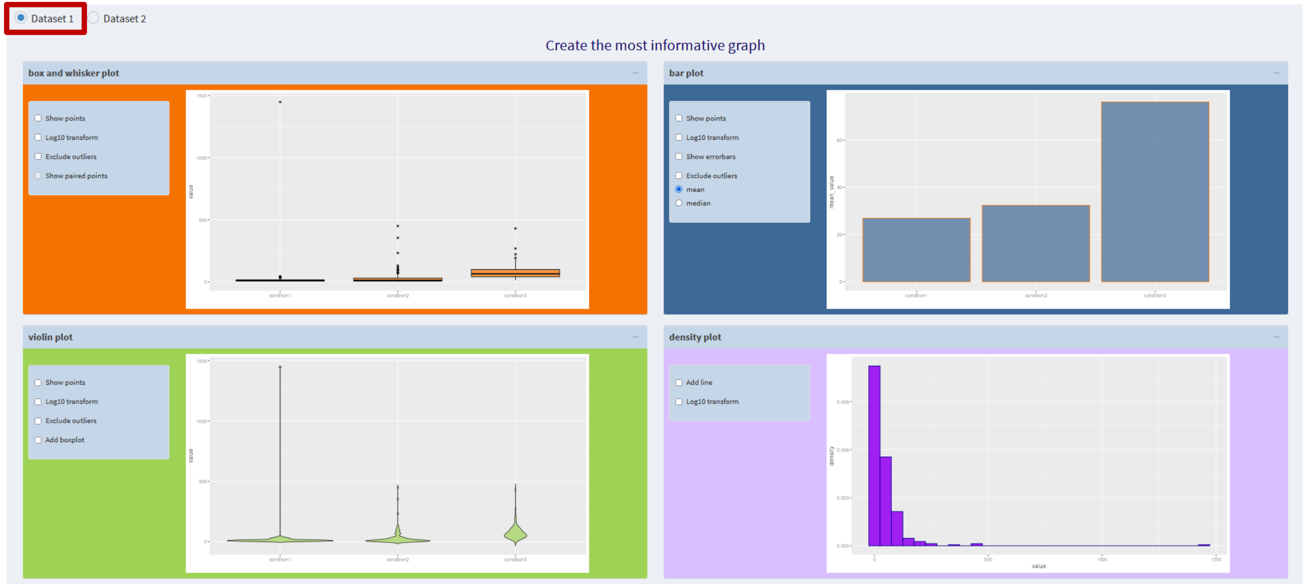
What do you think of this graph?



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**

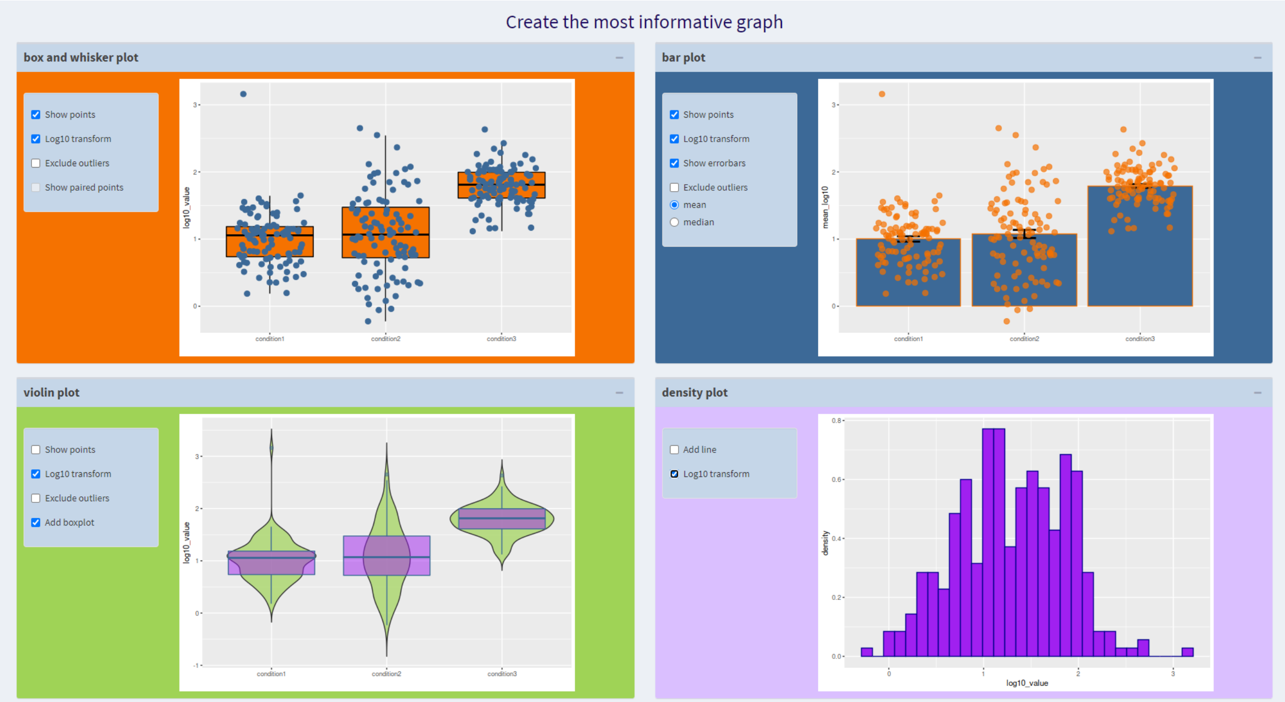


Plot for initial exploration of the data?

Plot for presentation/ publication?

Representing Dataset 1:

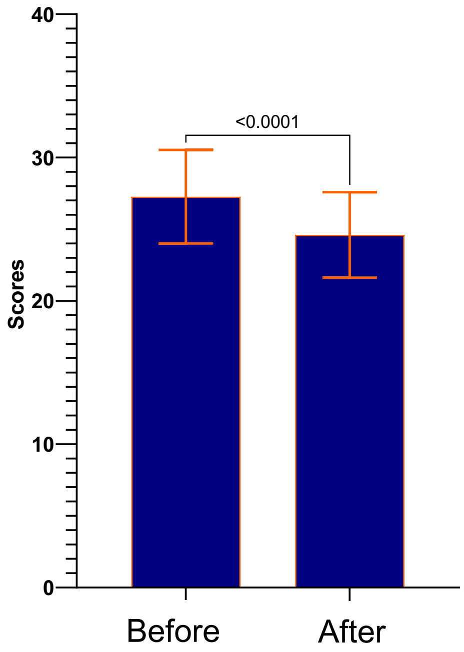
Create the most informative graph



Which plots did we choose and why?

Any differences between initial exploration and presentation?

What do you think of this graph?

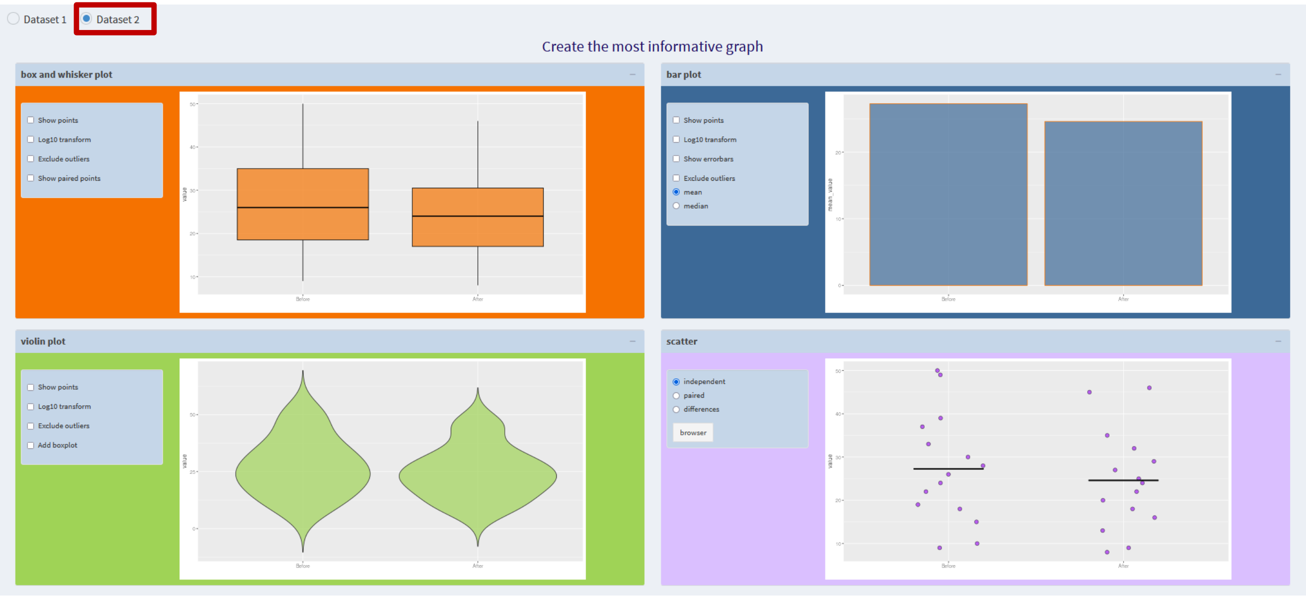


Values for before-after treatment from 4 experiments.

Representing Dataset 2:
<u>Create</u> the most informative graph

https://tinyurl.com/RIDataExp

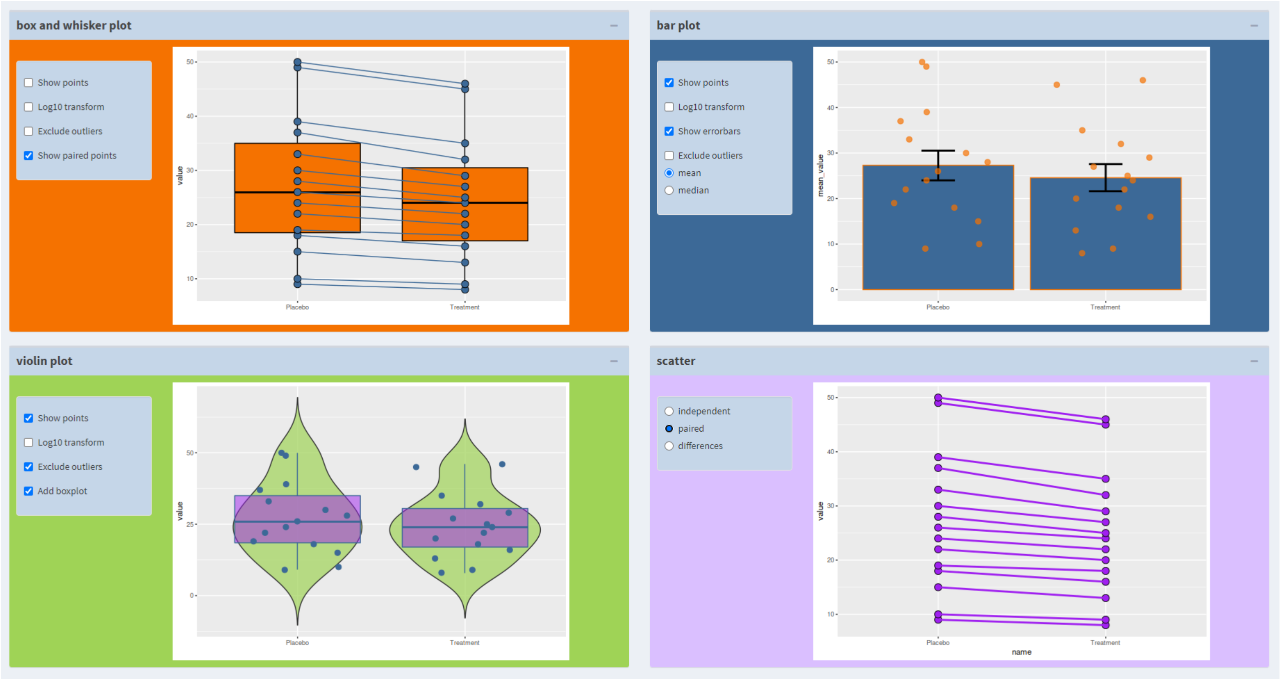
Make sure you are looking at Dataset 2



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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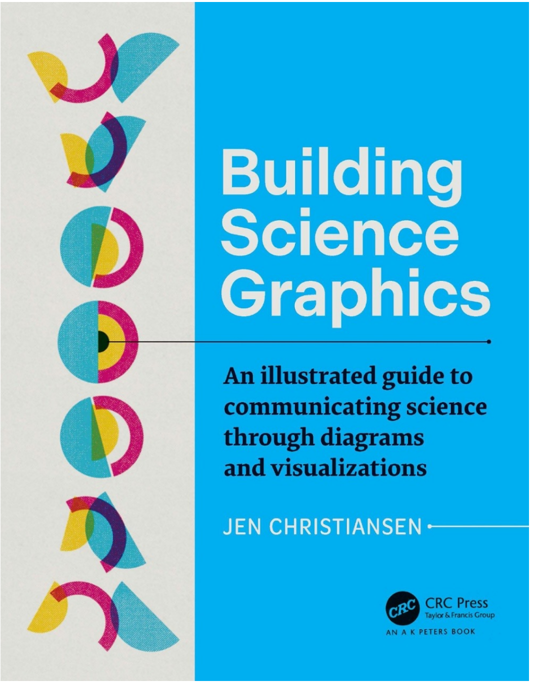
ReproducibiliTea



Data exploration

What can go wrong if we don’t do it?!

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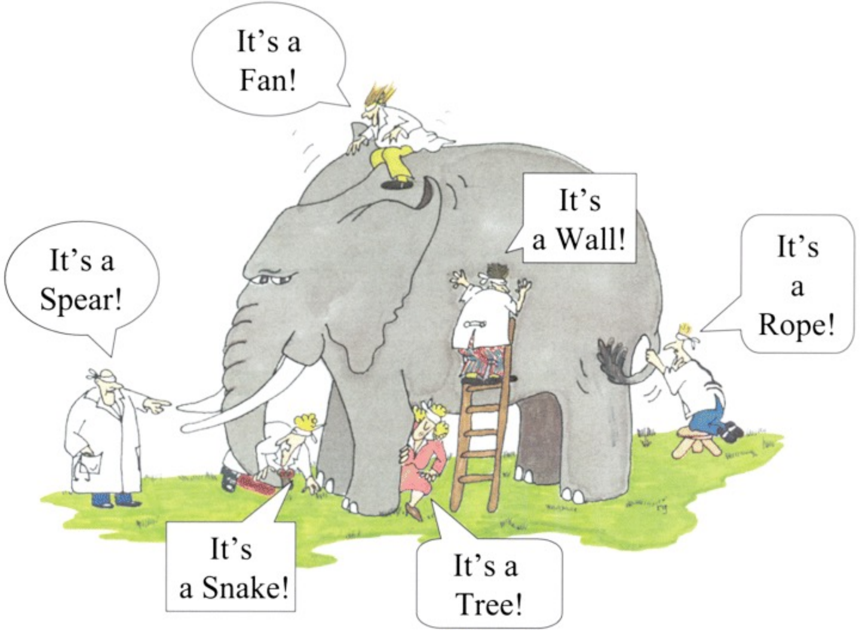
Data exploration

Less Exploring more Assuming!

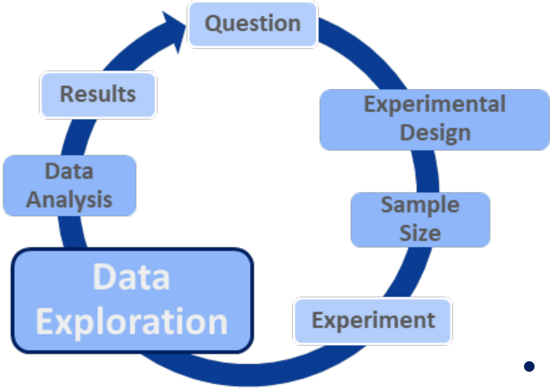


Risk missing the actual story the data is telling…

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

Data Exploration…

…Suspicious Summaries



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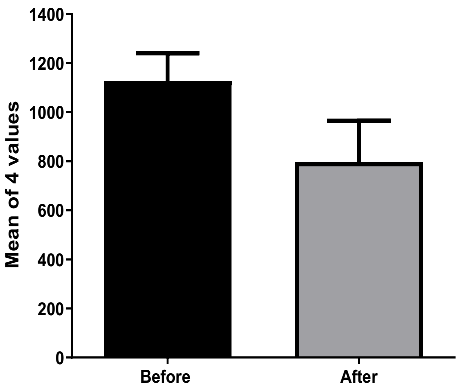
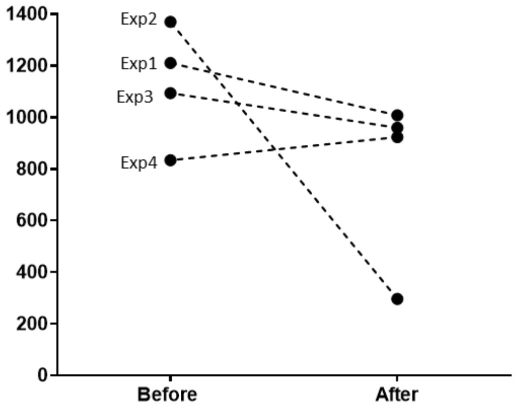
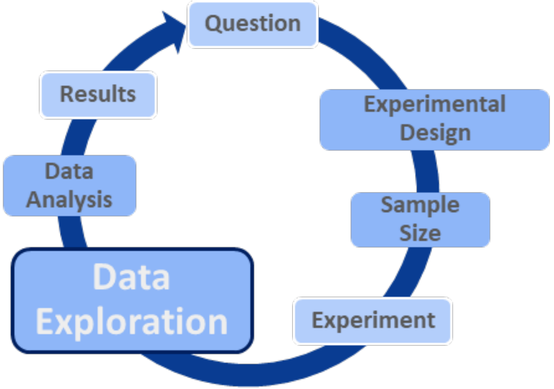
Example 1

- 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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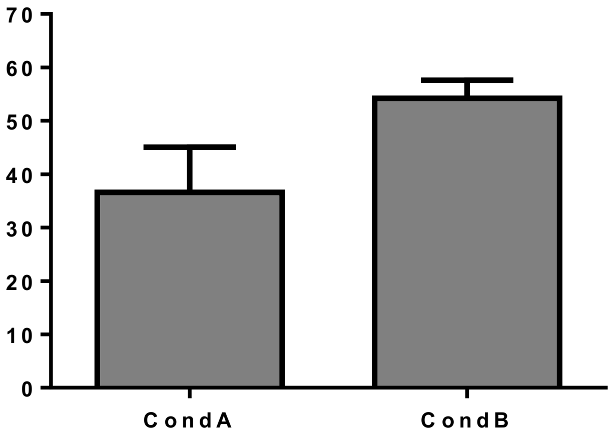

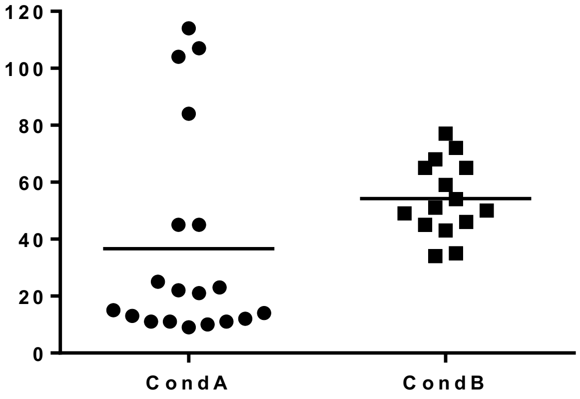

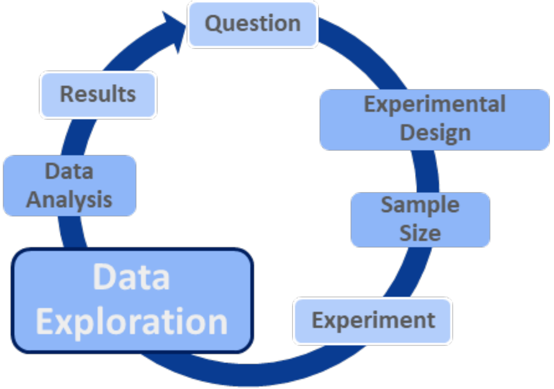

Example 3

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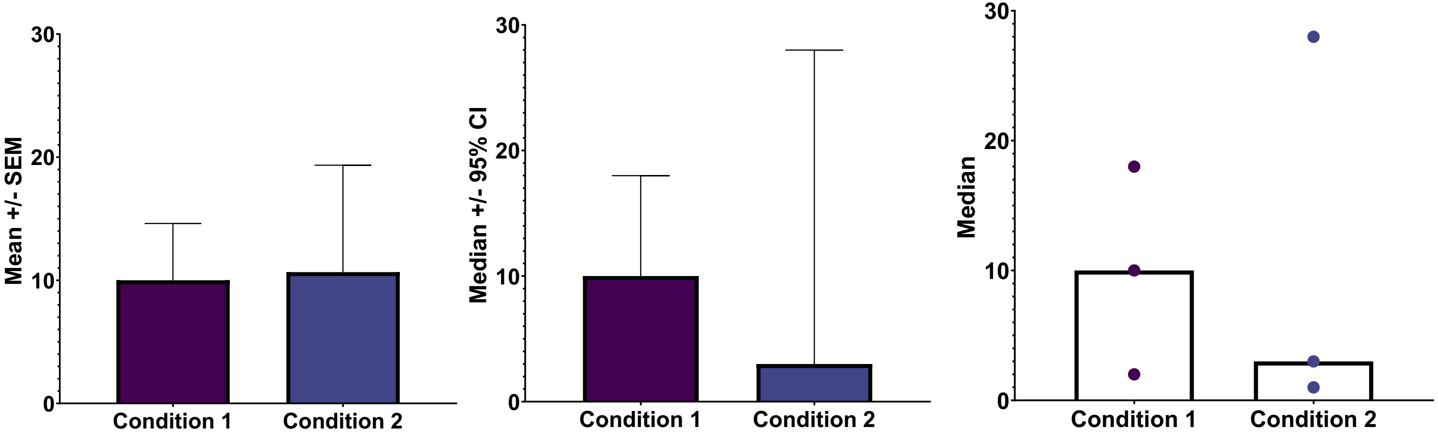
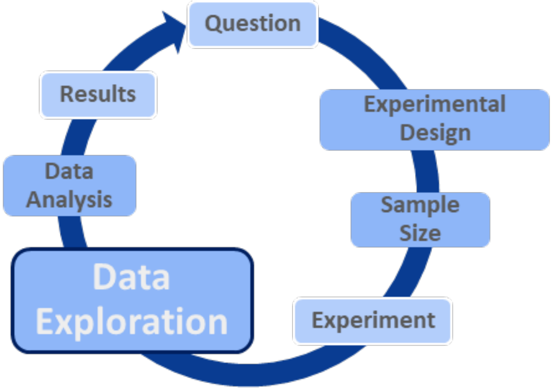


Data Exploration…

…Dubious Datasets



Example 1: A Knockout?

nature neuroscience

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

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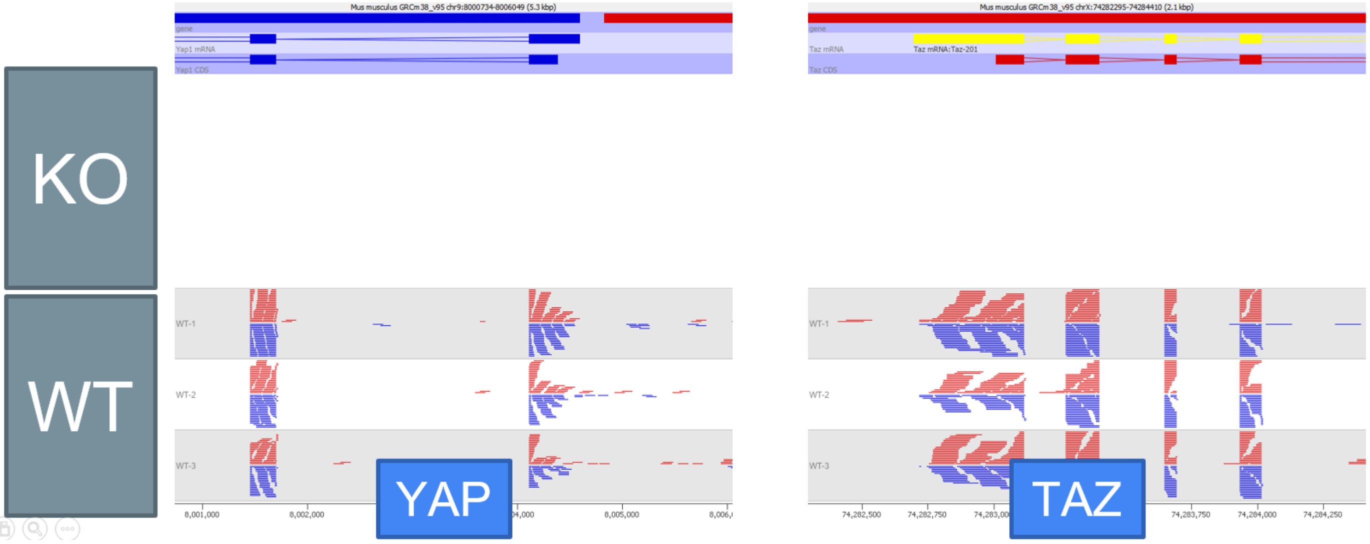

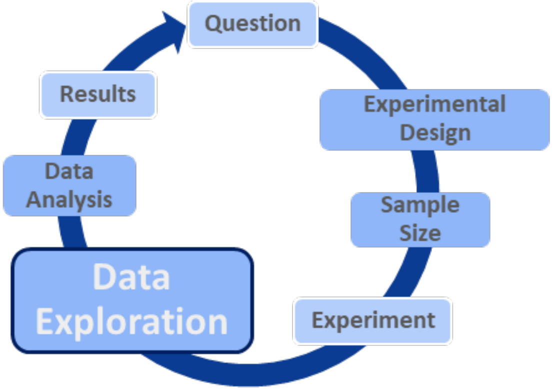

Example 2: A Case of Mistaken Identity

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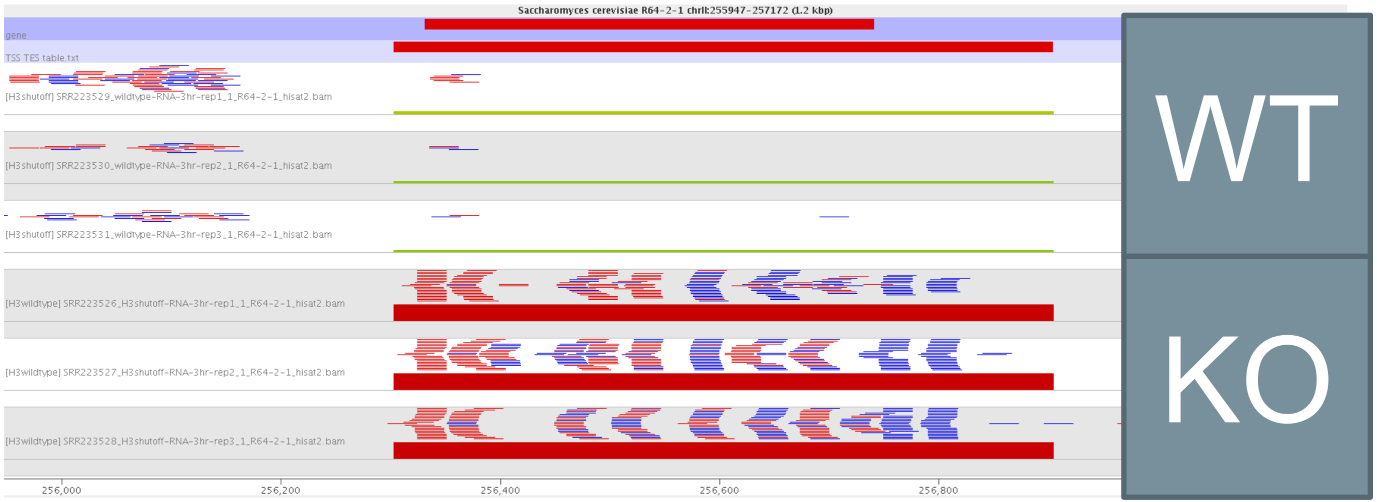
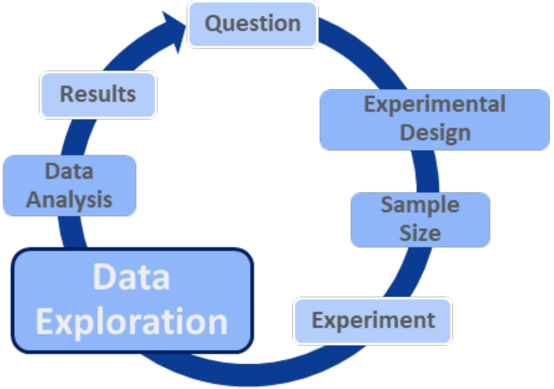
OPEN ACCESS Freely available online PLoS GENETICS

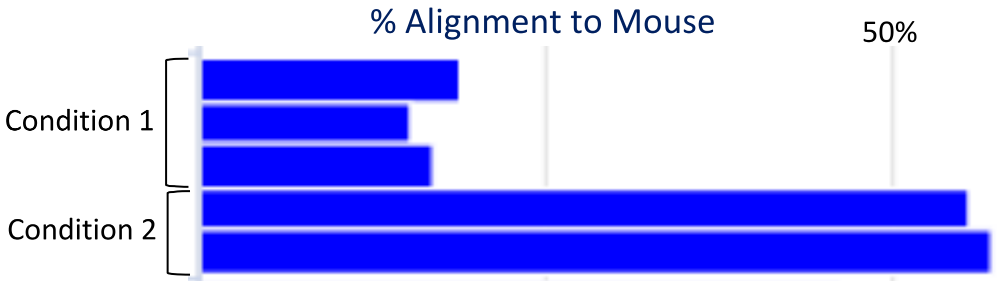
In Vivo* Effects of Histone H3 Depletion on Nucleosome Occupancy and Position in *Saccharomyces cerevisiae

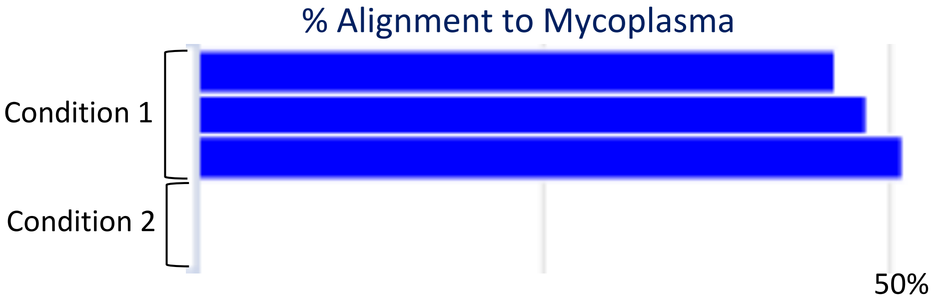




Example 3: Of Mice and Mycoplasma!

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





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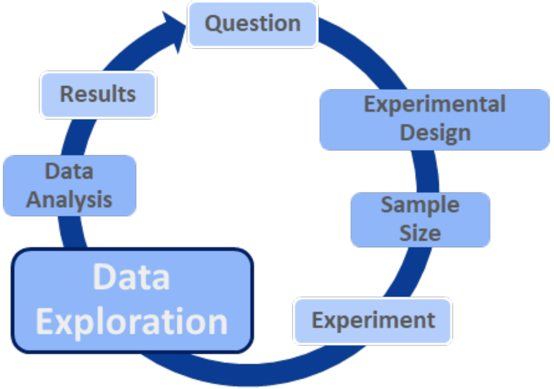
Rigor
Transparency



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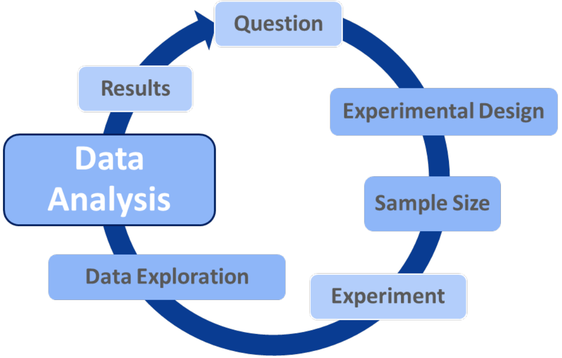
Rigor
Transparency

All highlight the perils of assuming and not exploring….

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



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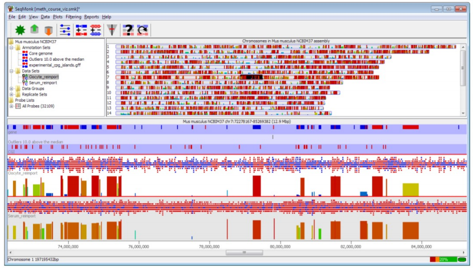
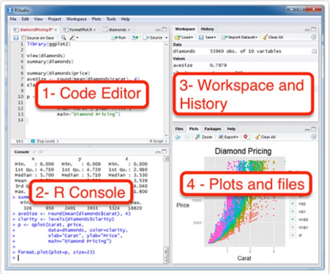
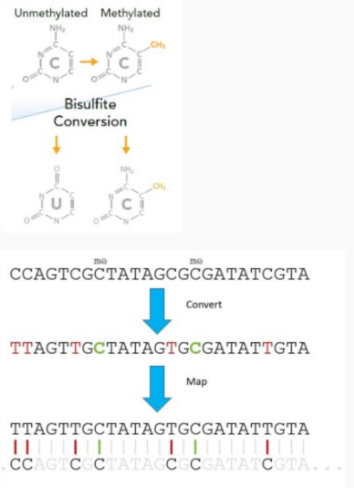
Analytical Tools

The right tools for the job!

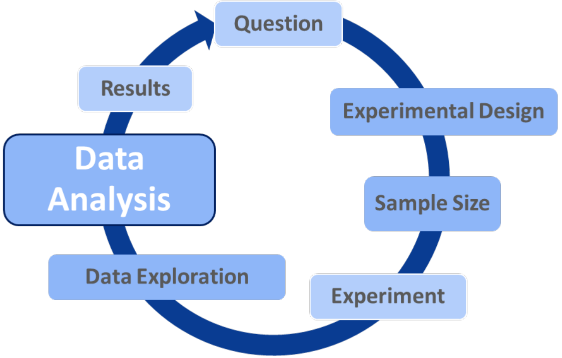






- Know what's out there

- Learn how to use it



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Rigor
Transparency

Help With Analytical Tools

Babraham Bioinformatics

Core Skills Courses

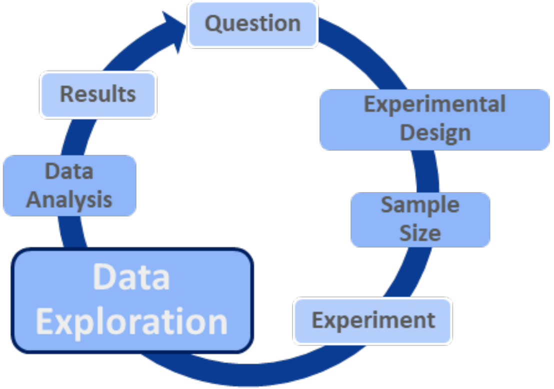
e.g. R Programming

Babraham Bioinformatics

Application Specific Courses

e.g. NGS Analysis

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



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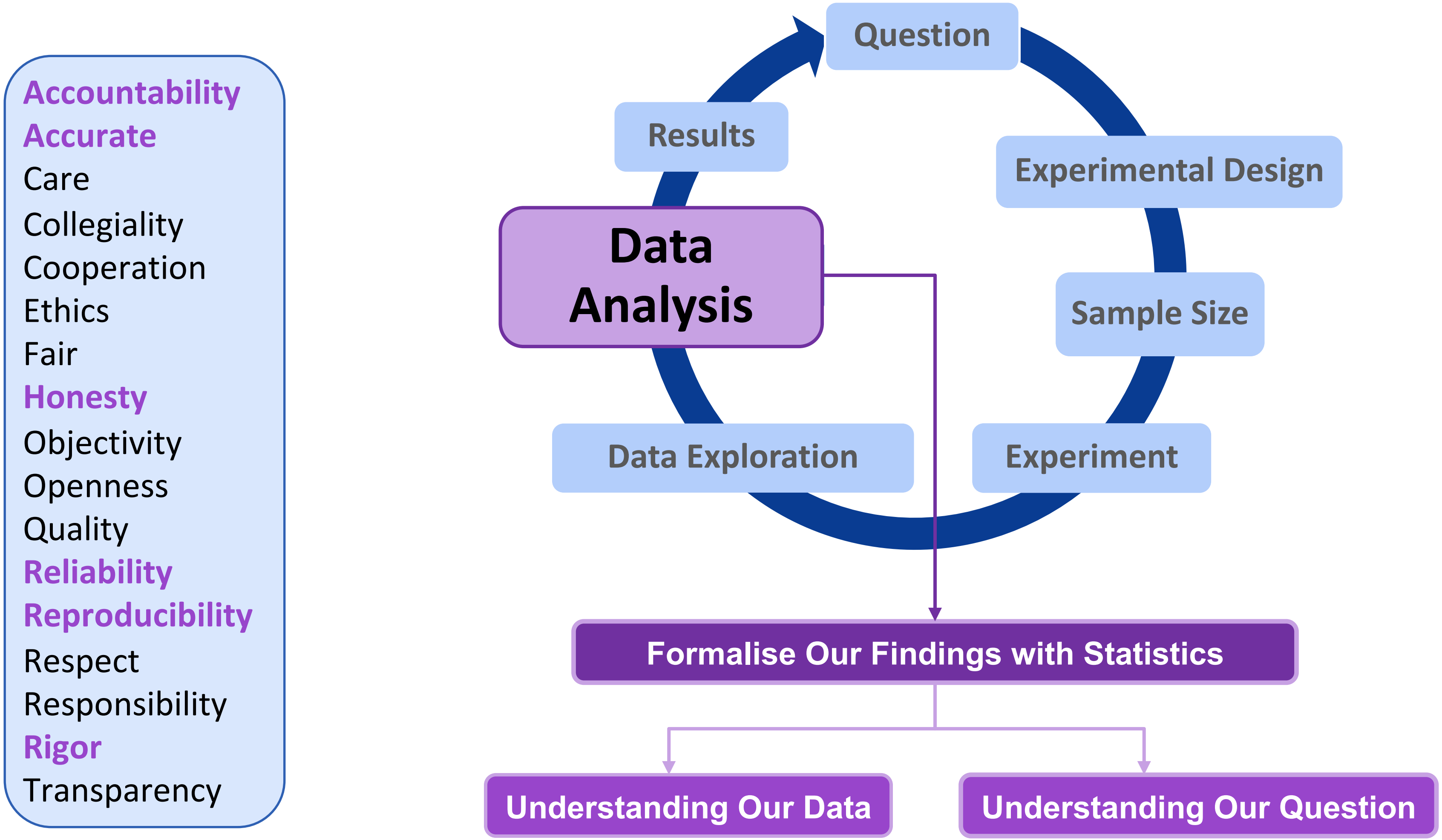
In a nutshell

Data exploration is CRITICAL to:

- Understand our data
- Be confident in our findings

Ensure our results are quality and reliable

… Good for everyone!


Accountability
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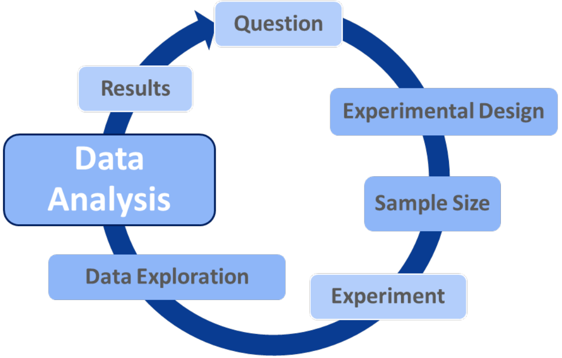
Quality
Reliability
Reproducibility
Respect
Responsibility
Rigor
Transparency
Question
Experimental Design
Sample Size
Experiment
Data Exploration
Data Analysis
Results
Formalise Our Findings with Statistics
Understanding Our Data
Understanding Our Question



Statistical Analysis

Translate the hypothesis/question into statistical questions

By choosing the right test!

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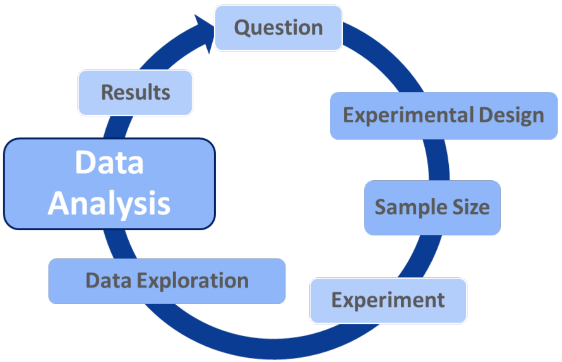
Healthy approach:

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

…It's knowing what the test should do"

Anne Segonds-Pichon



Knowing what the Test should do…

Statistics Decision tree

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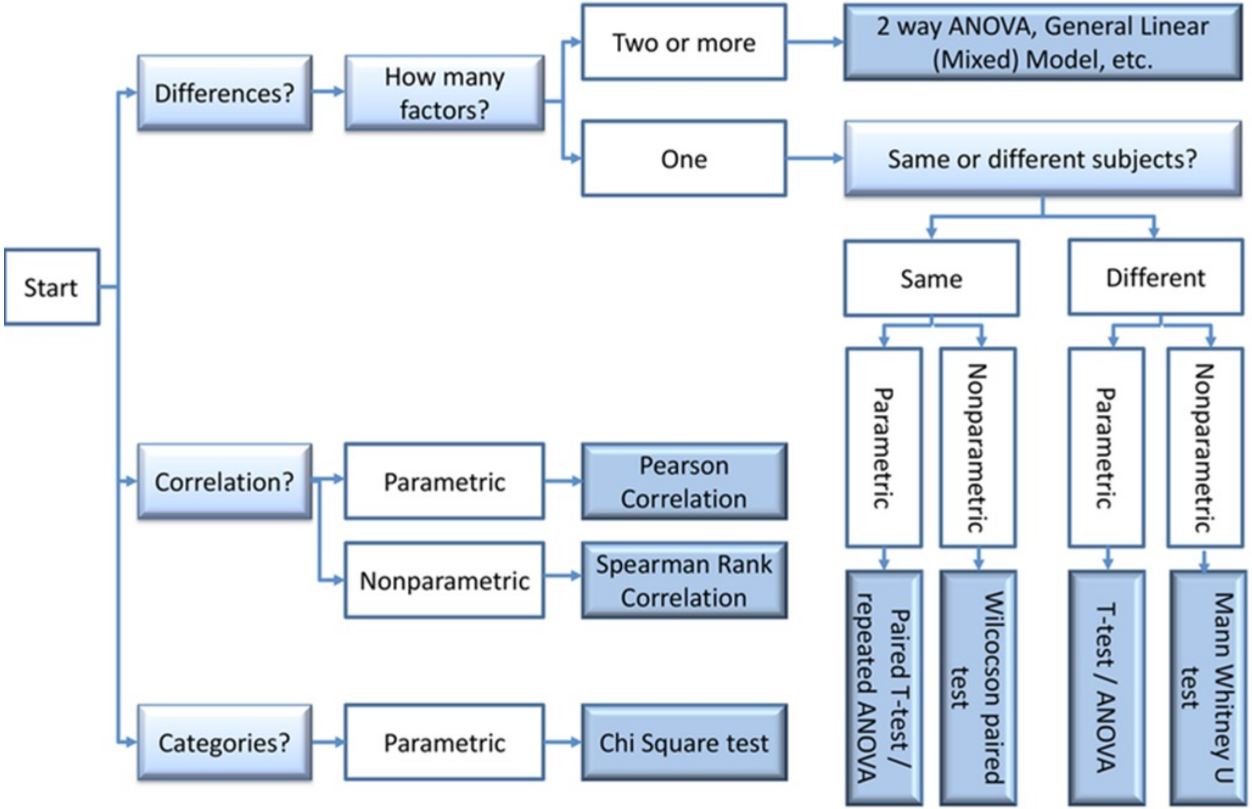
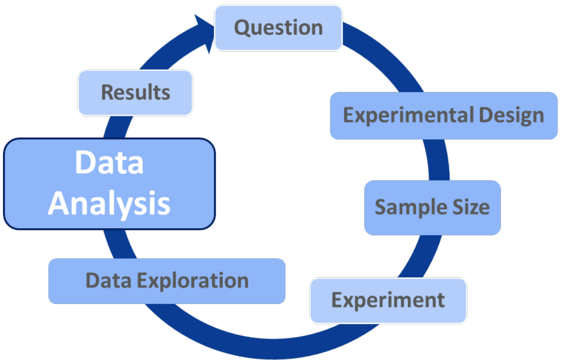


Knowing what the Test should do…



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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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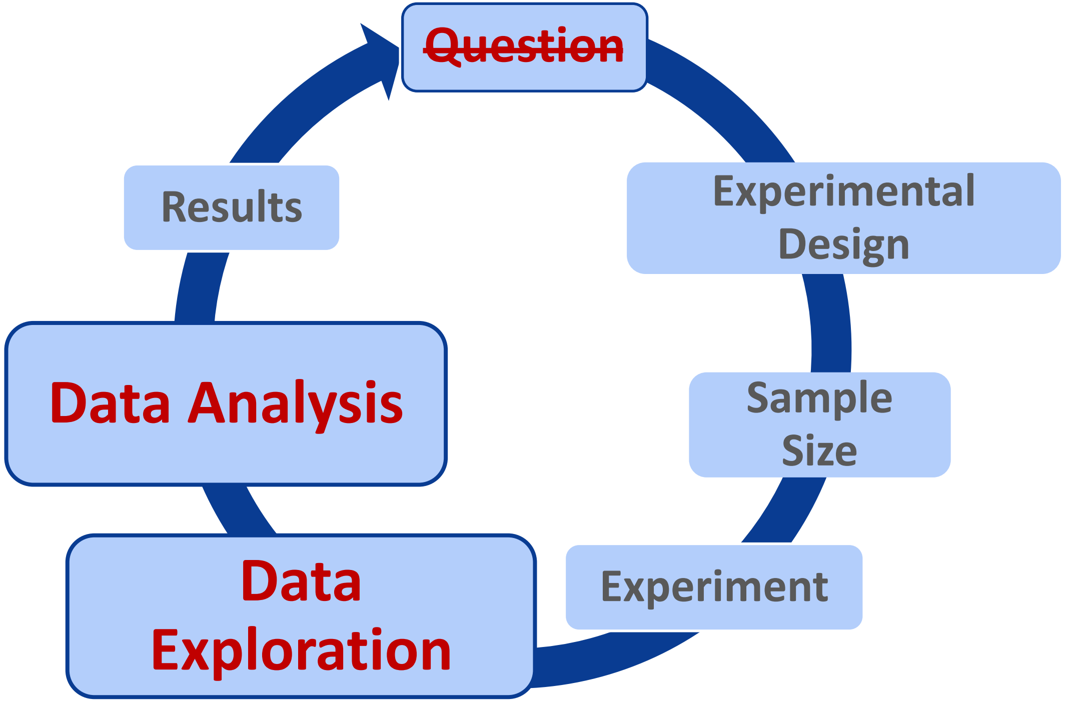

Exploratory data analysis

Accountability
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Care
Collegiality
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Openness
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Reproducibility
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Transparency

In a nutshell

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

Stats helps us **formalise our findings**

Babraham Institute

Babraham Bioinformatics

Research Integrity
What does Ethics mean?

Research Integrity

Ethics and Animal Welfare

Accountability
Accurate
Care
Collegiality
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Ethics
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Honesty
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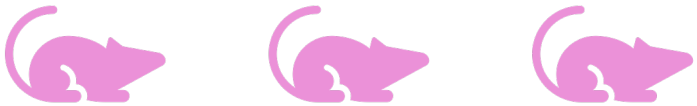
Transparency

- 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**

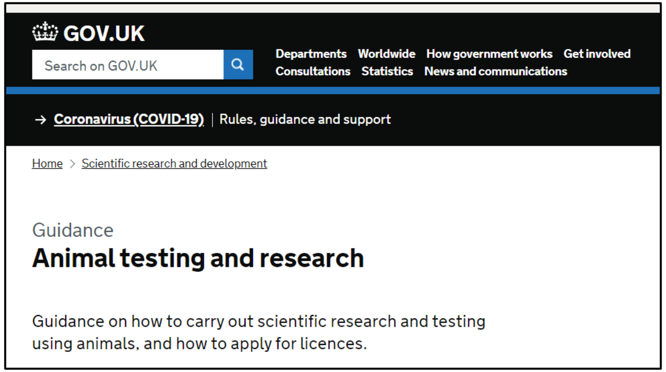


Research Integrity

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**



By Steph Gray, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=31387711

Research Integrity

The 3 Rs

Accountability
Accurate
Care
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Transparency

Replace

Reduce

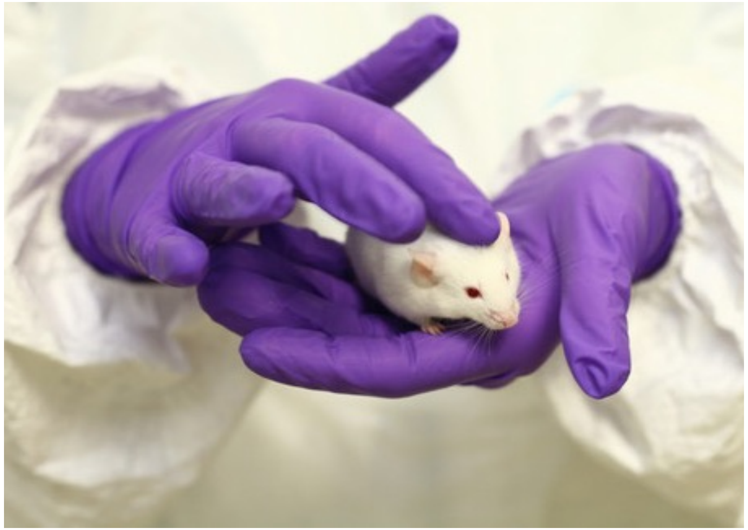
Refine

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

Research Integrity

The 3Rs: about animal welfare

Replace

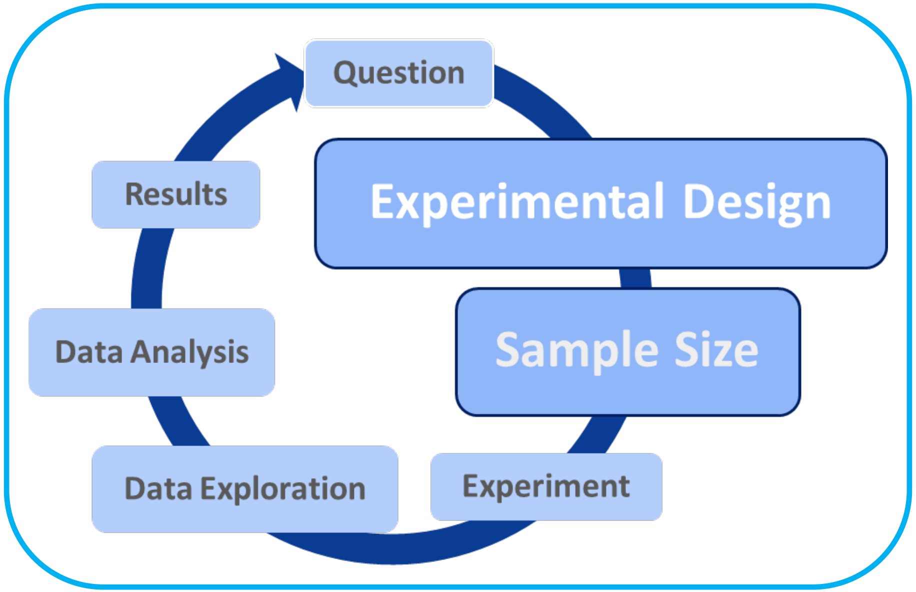


Avoiding or replacing the use of animals in areas where they otherwise would have been used.

Research Integrity

The 3Rs: about animal welfare

Reduce



Minimising the number of animals used consistent with scientific aims.

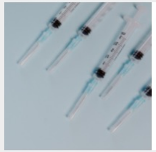
Research Integrity

The 3Rs: about animal welfare

Refine

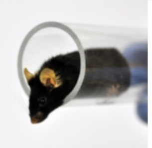
Breeding and colony management

Guidance on re-establishing colonies after a pause (e.g. COVID-19 lockdown).



Blood sampling

Techniques for blood sampling in laboratory animal species to ensure the most appropriate technique is chosen.



Mouse handling: How to pick up a mouse

Guidance on non-aversive methods for handling mice, including tutorials, FAQs and practical tips.

Evaluating environmental enrichment

Supporting technicians in assessing the welfare impact of new enrichment.

Grimace scales

Posters and other resources on the use of grimace scales to assess pain in laboratory animals.

Rat tickling

Resources on rat tickling and how it can be used to promote positive human-animal interactions.

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

Good Research in Practice

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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

Keeping track of the research

How?

Research Integrity

Laboratory Notebooks

Accountability
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Research Integrity

Laboratory Notebooks

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Research Integrity
Laboratory Notebooks

Research Data

Data Storage

Accountability
Accuracy
Care
Collegiality
Cooperation
Ethics
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Reproducibility
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Legal Requirements

Practicalities

Image: cleanpng.com

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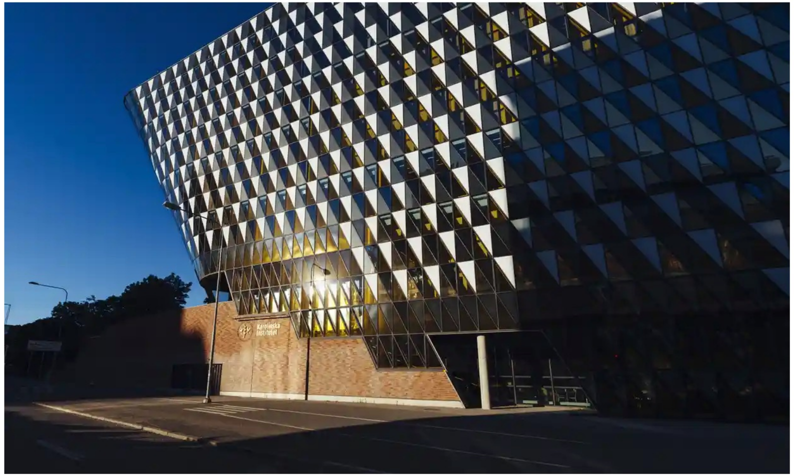
Research Data

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?

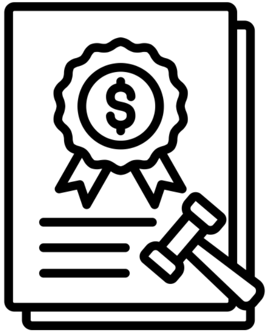
Expectations and Responsibilities

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

Research Data

OneNote

Accountability
Accuracy
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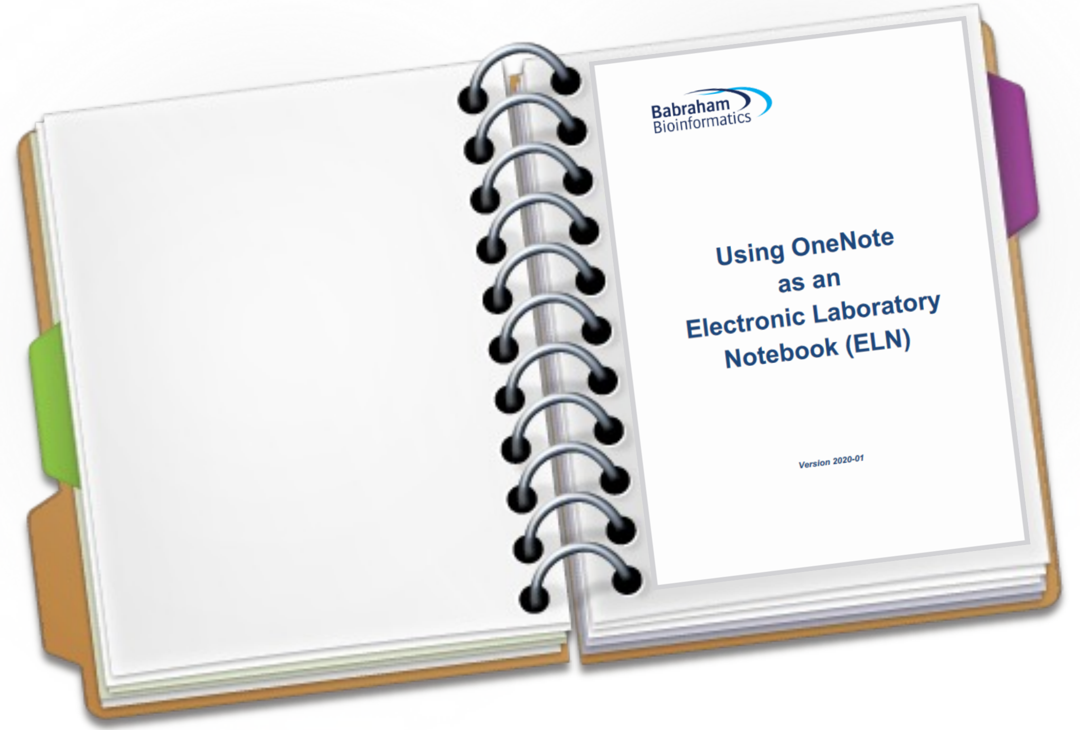

Responsibility

Research Integrity

Wider Responsibility

Accountability
Accurate
Care
Collegiality
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Ethics
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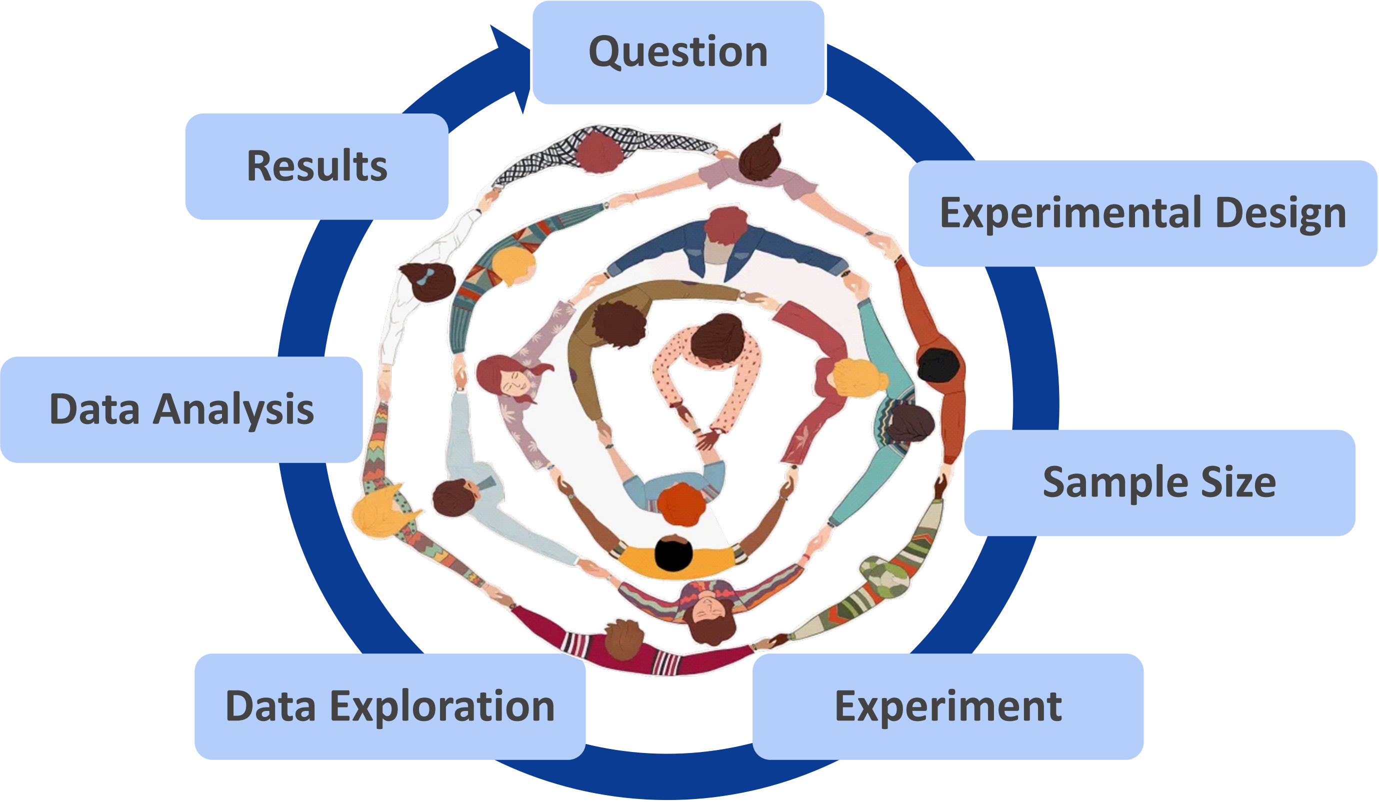

Research Integrity

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Photo by Miguel Henriques Unsplash

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Research Integrity

Questioning

Photo by Ana Municio on Unsplash

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Reproducibility
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Research Integrity

Collaboration and Competition

Accountability
Accuracy
Care
Collegiality
Cooperation
Ethics
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Honesty
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Openness
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Reliability
Reproducibility
Respect
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Rigor
Transparency

Research Integrity

The Game

Photo by Karthik Balakrishnan on Unsplash

Accountability
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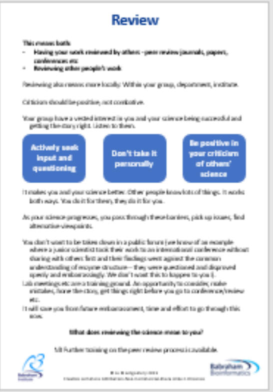
Research Integrity

Wider Responsibility and Scientific Community

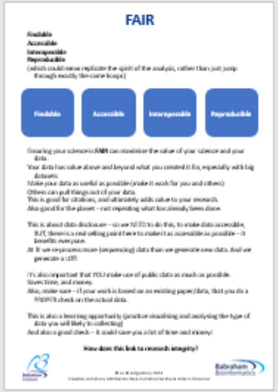

Review

Actively seek input and questioning

Don't take it personally

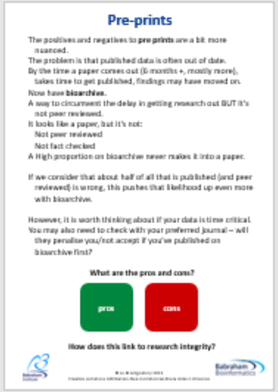
Be positive in your criticism of others' science

What does reviewing the science mean to you?


FAIR

Findable
Accessible
Interoperable
Reproducible

How does this link to research integrity?


Pre-prints

The positives and negatives to **pre prints** are a bit more nuanced.
The problem is that published data is often out of date.
By the time a paper comes out (6 months +, mostly more), takes time to get published, findings may have moved on.
Now have **bioarchive.**
A way to circumvent the delay in getting research out BUT it's not peer reviewed.
It looks like a paper, but it's not:
Not peer reviewed
Not fact checked
A High proportion on bioarchive never makes it into a paper.

If we consider that about half of all that is published (and peer reviewed) is wrong, this pushes that likelihood up even more with bioarchive.

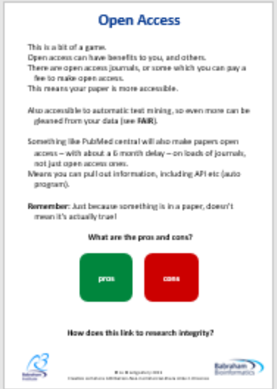
However, it is worth thinking about if your data is time critical.
You may also need to check with your preferred journal – will they penalise you/not accept if you've published on bioarchive first?

What are the pros and cons?

pros

cons

How does this link to research integrity?


Open Access

This is a bit of a game.
Open access can have benefits to you, and others.
There are open access journals, or some which you can pay a fee to make open access.
This means your paper is more accessible.

Also accessible to automatic text mining, so even more can be gleaned from your data (see **FAIR**).

Something like PubMed central will also make papers open access – with about a 6 month delay – on loads of journals, not just open access ones.
Means you can pull out information, including API etc (auto program).

Remember: Just because something is in a paper, doesn't mean it's actually true!

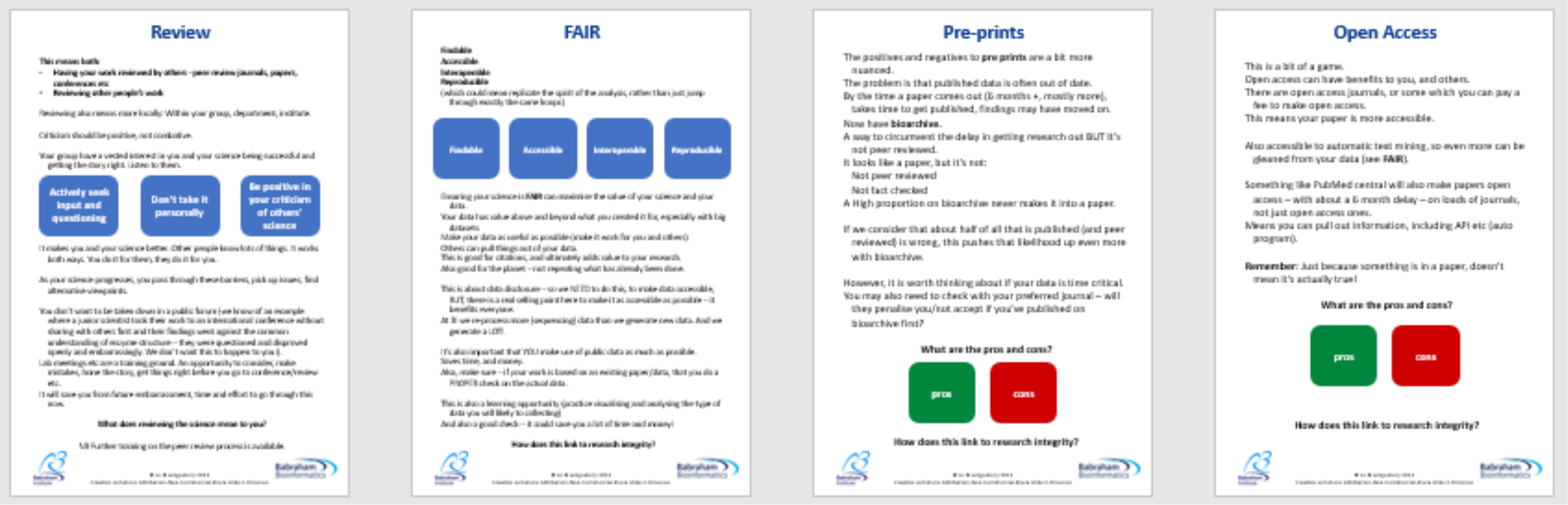
What are the pros and cons?

pros

cons

How does this link to research integrity?

Research Integrity



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Research Integrity

In a nutshell

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

Research Integrity

In the lab

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

Research Integrity

Work culture

Accountability
Accurate
Care
Collegiality
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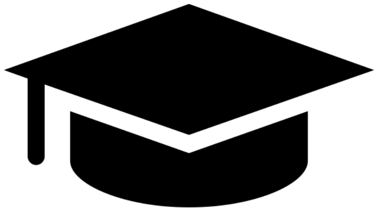
Research Integrity

PhD Students



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

Research Integrity

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Work hard…

…but what if it is too hard?

Research Integrity

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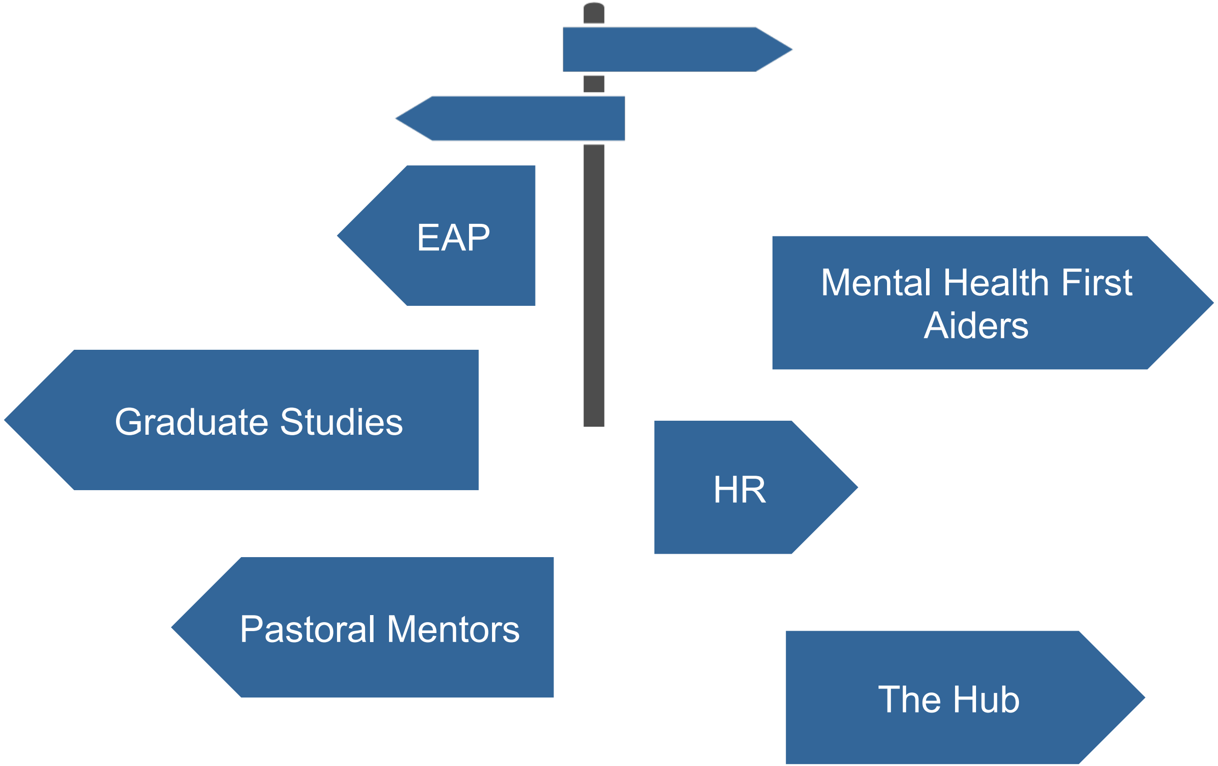

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https://forbetterscience.com/2020/07/07/science-misconduct/

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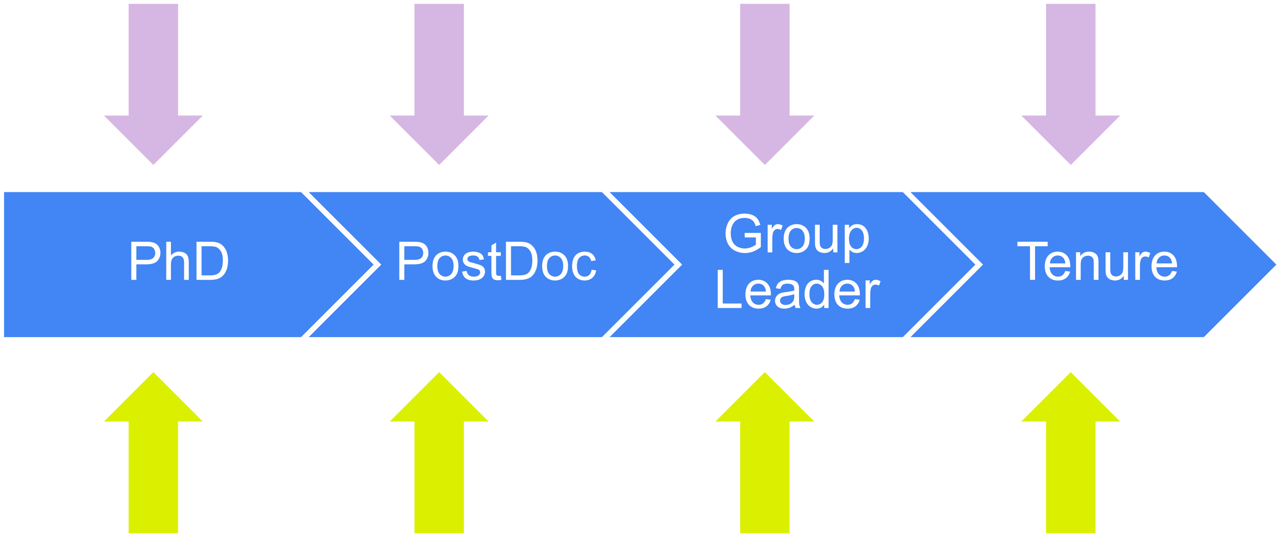

Research Integrity

Which roles are most important or responsible for Research Integrity?

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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

How our integrity may be tested

Publications

Publish or Perish?

Publications: the good

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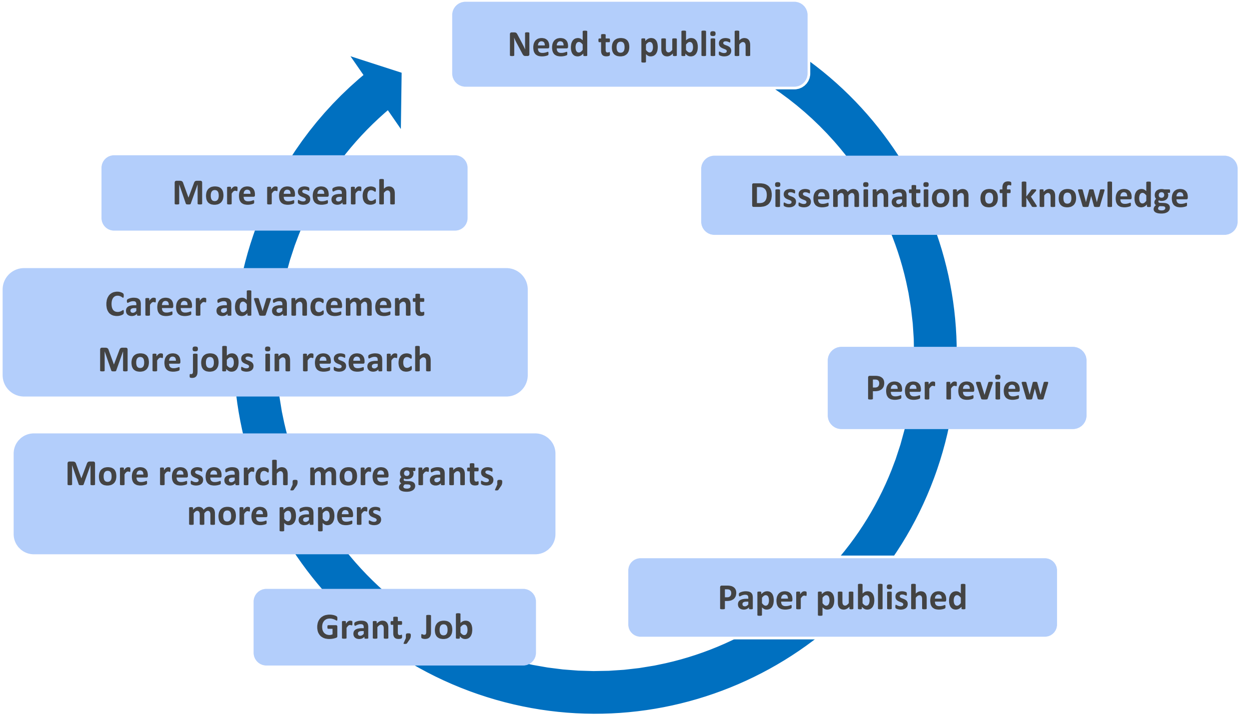
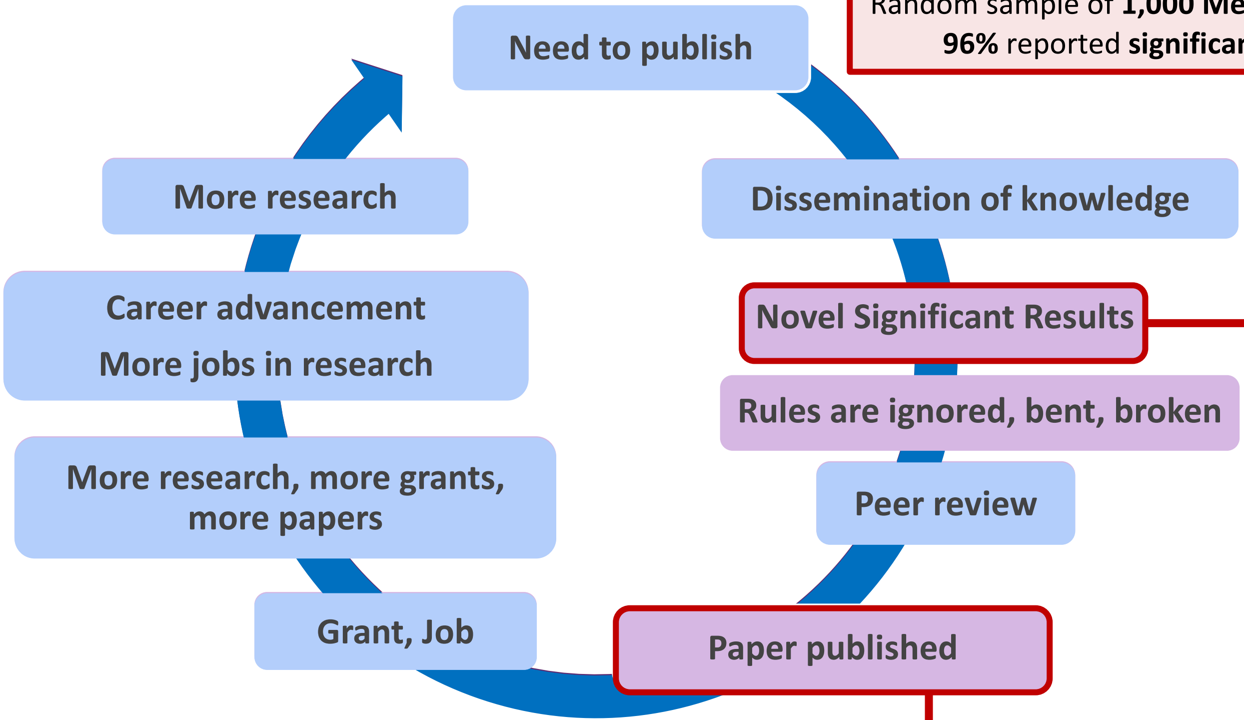


Publications: the bad

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



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

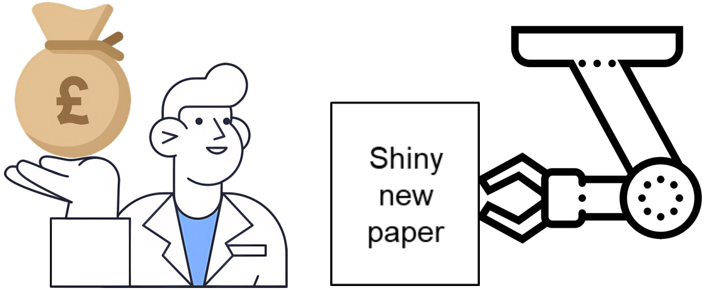
Amgen attempted to replicate **53** high-impact **cancer research studies**: able to **replicate only six.**

Replication crisis

Publications: the ugly

Paper Mills

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



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

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

Publications: the balance

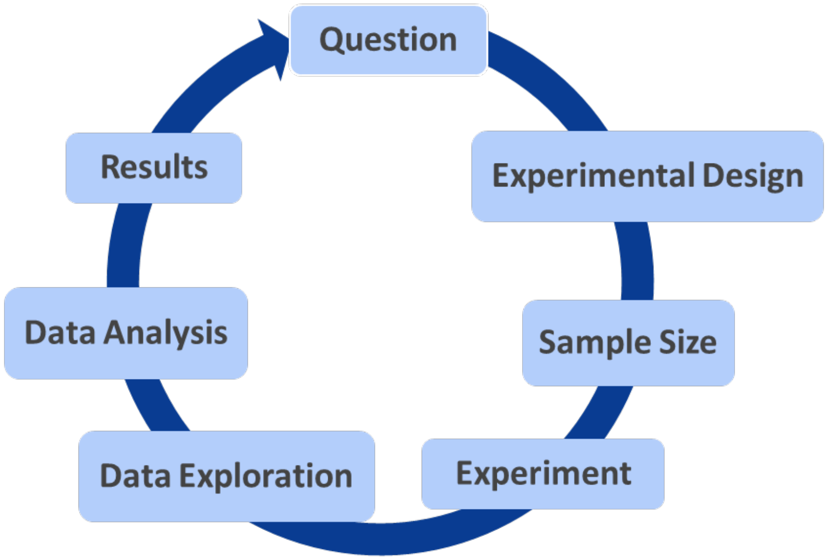
Accountability
Accurate
Care
Collegiality
Cooperation
Ethics
Fair
Honesty
Objectivity
Openness
Quality
Reliability
Reproducibility
Respect
Responsibility
Rigor
Transparency

Misconduct

Research Integrity

Misconduct

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

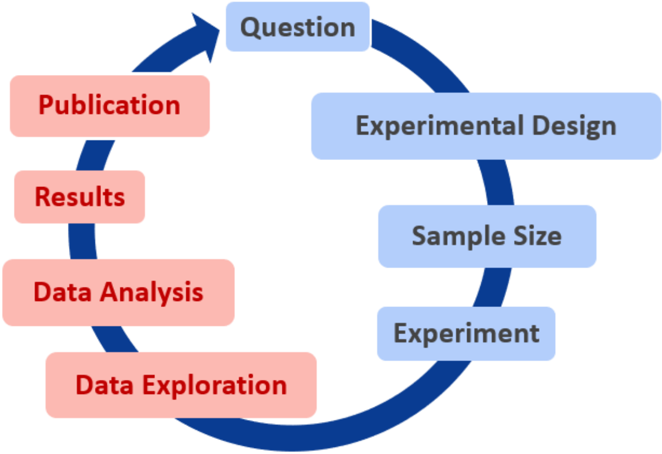


Misconduct: How?

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

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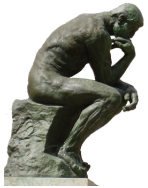
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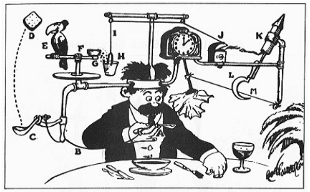
Tina Gunsalus



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

Embarrassment

A Questionable Outcome

Paper published with the new student as a co-author

Temptation

Stupid systems

They accept the credit

Why?

A real case from Tina Gunsalus

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

Misconduct: In a nutshell

Accountability
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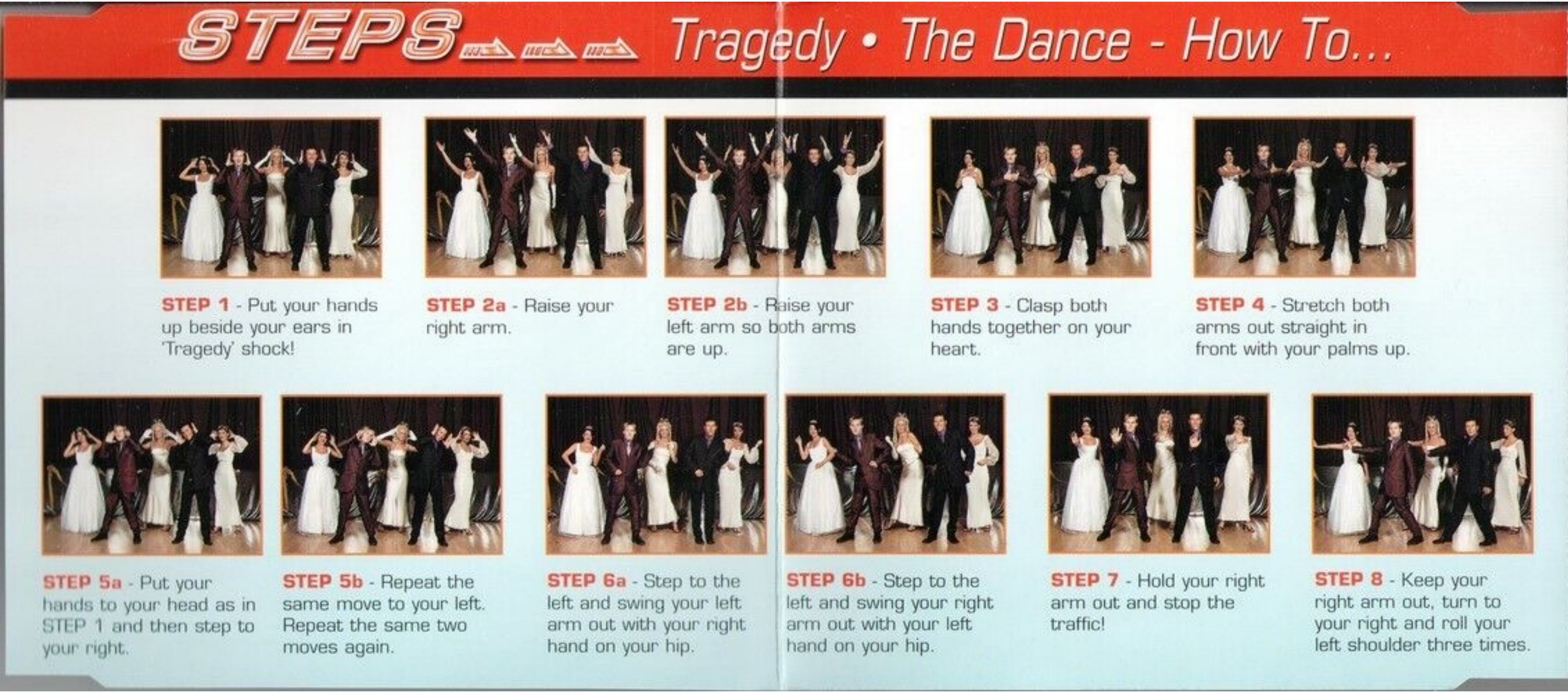
Rigor
Transparency

"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!*



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

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

The bottom line

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
How can we apply it?
Responsibility
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

Responsibility

Accountability

Honesty

Fair

Objectivity

Respect

Rigor

Scientific integrity

Care

Reproducibility

Openness

Ethics

Transparency

Accurate

Reliability

Cooperation

Collegiality

Quality

The Hub

Research Integrity

Useful resources

SharePoint

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Research Integrity

Research Integrity Review | Good Research in Practice | Human Research | Resources | Research Forum

Any enquiries regarding Research Integrity can be sent to

research.integrity@babraham.ac.uk

Dr Martin Turner is the senior member of staff responsible for overseeing research integrity and is the Institute's first point of contact for anyone wanting more information.

Mr. Simon Jones is the confidential liaison for whistle-blowers or any other person wishing to raise concerns about the integrity of research being conducted under the auspices of The Babraham Institute.

Trevor Smith
Health & Safety & QA Manager

Priya Schoenfelder
Health & Safety Advisor and BI Deputy Bi...

Heather Bath
Contracts Manager

Research Integrity

Useful resources

www.bioinformatics.babraham.ac.uk

Babraham Institute
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