

# Digital badge

- Reproducible research

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School of  
**Public Health**

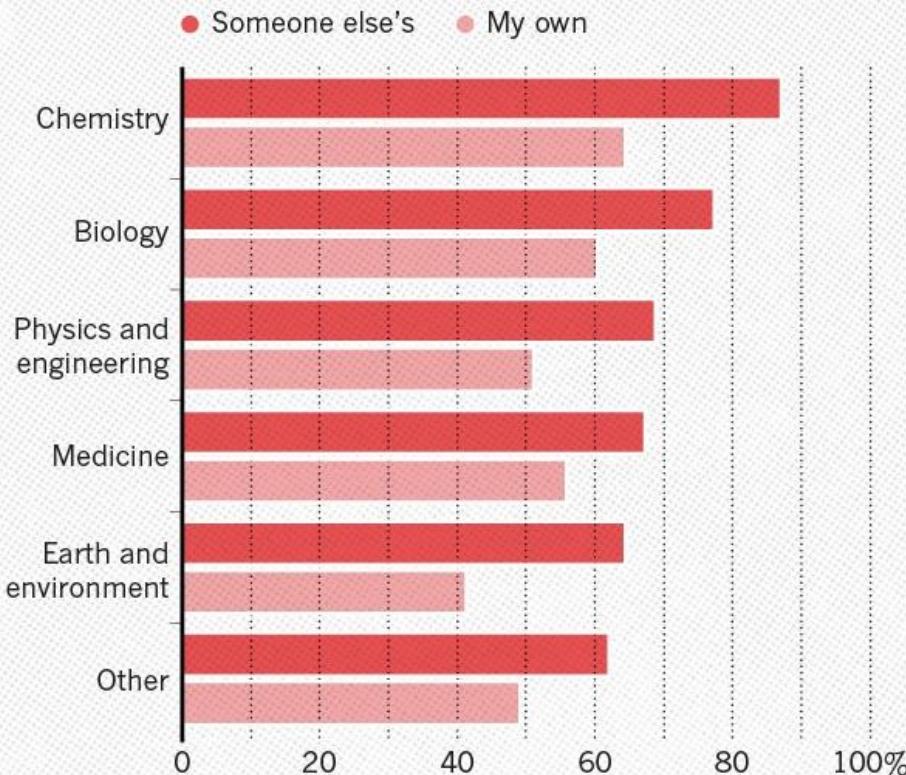
## 1,500 scientists lift the lid on reproducibility

Survey sheds light on the 'crisis' rocking research.

Monya Baker

### HAVE YOU FAILED TO REPRODUCE AN EXPERIMENT?

Most scientists have experienced failure to reproduce results.



## COMMENTARY

# Scientists behaving badly

To protect the integrity of science, we must look beyond falsification, fabrication and plagiarism, to a wider range of questionable research practices, argue **Brian C. Martinson, Melissa S. Anderson and Raymond de Vries**.

**Table 1 | Percentage of scientists who say that they engaged in the behaviour listed within the previous three years (*n* = 3,247)**

Top ten behaviours	All	Mid-career	Early-career
1. Falsifying or 'cooking' research data	0.3	0.2	0.5
2. Ignoring major aspects of human-subject requirements	0.3	0.3	0.4
3. Not properly disclosing involvement in firms whose products are based on one's own research	0.3	0.4	0.3
4. Relationships with students, research subjects or clients that may be interpreted as questionable	1.4	1.3	1.4
5. Using another's ideas without obtaining permission or giving due credit	1.4	1.7	1.0
6. Unauthorized use of confidential information in connection with one's own research	1.7	2.4	0.8 ***
7. Failing to present data that contradict one's own previous research	6.0	6.5	5.3
8. Circumventing certain minor aspects of human-subject requirements	7.6	9.0	6.0 **
9. Overlooking others' use of flawed data or questionable interpretation of data	12.5	12.2	12.8
10. Changing the design, methodology or results of a study in response to pressure from a funding source	15.5	20.6	9.5 ***
Other behaviours			
11. Publishing the same data or results in two or more publications	4.7	5.9	3.4 **
12. Inappropriately assigning authorship credit	10.0	12.3	7.4 ***
13. Withholding details of methodology or results in papers or proposals	10.8	12.4	8.9 **
14. Using inadequate or inappropriate research designs	13.5	14.6	12.2
15. Dropping observations or data points from analyses based on a gut feeling that they were inaccurate	15.3	14.3	16.5
16. Inadequate record keeping related to research projects	27.5	27.7	27.3

# Reproducible or replicable

		Data	
		Same	Different
Analysis	Same	Reproducible	Replicable
	Different	Robust	Generalisable

# Reproducible or replicable

		Data	
		Same	Different
Analysis	Same	Reproducible	Replicable
	Different	Robust	Generalisable

# Reproducible or replicable

		Data	
		Same	Different
Analysis	Same	Replicable	Reproducible
	Different	Robust	Generalisable

# Some cautionary tales

The Atlantic

Popular

Latest

Sections ▾

SCIENCE

## A Waste of 1,000 Research Papers

Decades of early research on the genetics of depression were built on nonexistent foundations. How did that happen?

ED YONG MAY 17, 2019

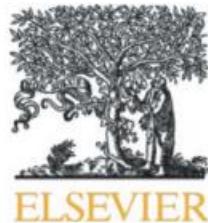


[Am J Psychiatry. 2019 May 1;176\(5\):376-387. doi: 10.1176/appi.ajp.2018.18070881. Epub 2019 Mar 8.](#)

**No Support for Historical Candidate Gene or Candidate Gene-by-Interaction Hypotheses for Major Depression Across Multiple Large Samples.**

[Border R<sup>1</sup>, Johnson EC<sup>1</sup>, Evans LM<sup>1</sup>, Smolen A<sup>1</sup>, Berley N<sup>1</sup>, Sullivan PF<sup>1</sup>, Keller MC<sup>1</sup>.](#)

# 241 shades of grey



Contents lists available at SciVerse ScienceDirect

NeuroImage

journal homepage: [www.elsevier.com/locate/ynim](http://www.elsevier.com/locate/ynim)



## Full Length Articles

### The secret lives of experiments: Methods reporting in the fMRI literature

Joshua Carp

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#### ARTICLE INFO

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fMRI  
Methods reporting  
Reproducibility  
Experimental design  
Analysis methods  
Statistical power

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#### ABSTRACT

Replication of research findings is critical to the progress of scientific understanding. Accordingly, most scientific journals require authors to report experimental procedures in sufficient detail for independent researchers to replicate their work. To what extent do research reports in the functional neuroimaging literature live up to this standard? The present study evaluated methods reporting and methodological choices across 241 recent fMRI articles. Many studies did not report critical methodological details with regard to experimental design, data acquisition, and analysis. Further, many studies were underpowered to detect any but the largest statistical effects. Finally, data collection and analysis methods were highly flexible across studies, with nearly as many unique analysis pipelines as there were studies in the sample. Because the rate of false positive results is thought to increase with the flexibility of experimental designs, the field of functional neuroimaging may be particularly vulnerable to false positives. In sum, the present study documented significant gaps in methods reporting among fMRI studies. Improved methodological descriptions in research reports would yield significant benefits for the field.

# Who benefits most from reproducibility?



**Casey Greene**  
@GreeneScientist

Follow

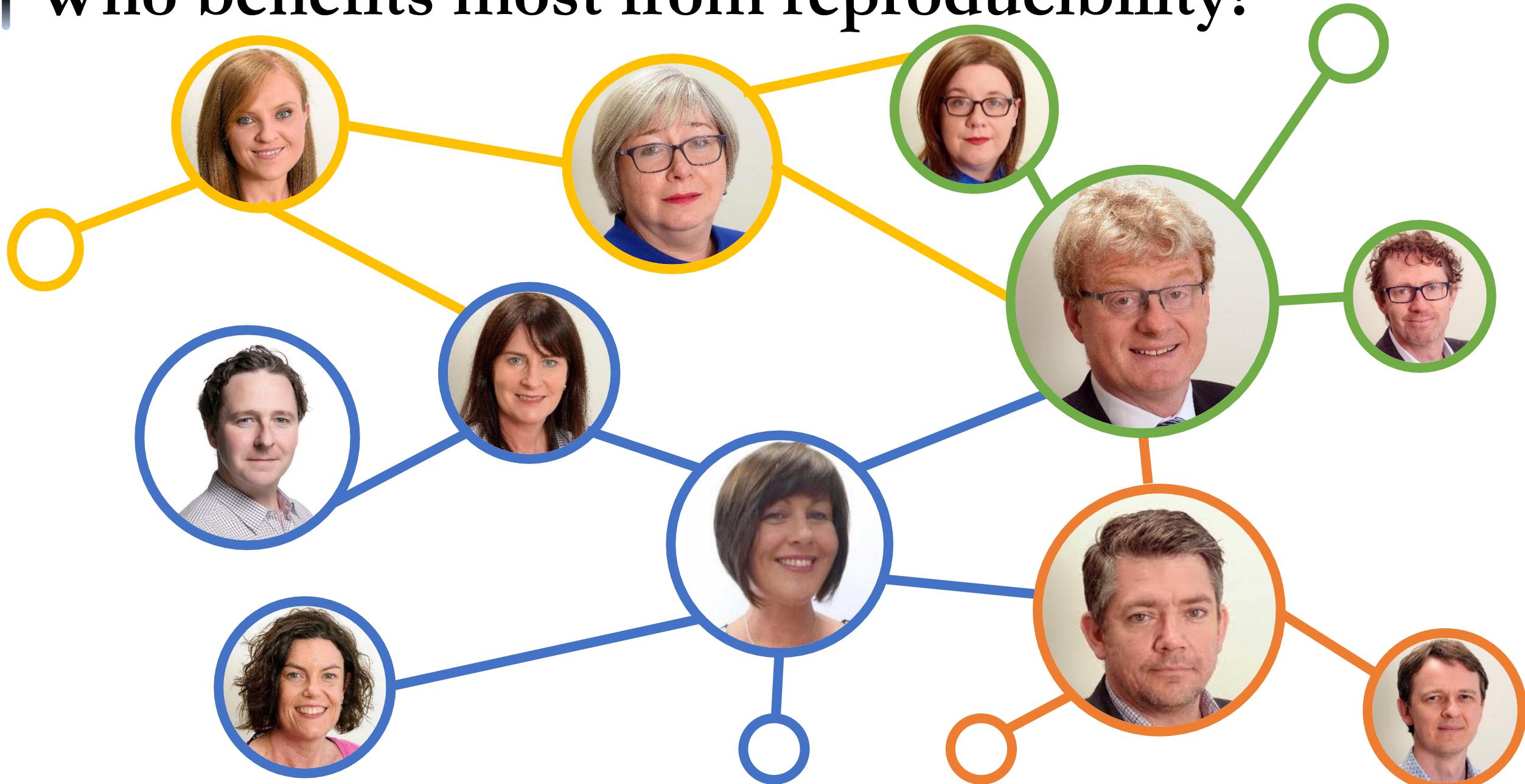


Reproducibility is important because the you  
of 3 months ago is terrible at answering  
email! - [@tracykteal](#) at [#2016dssummit](#)

1:17 PM - 26 Oct 2016 from [Manhattan, NY](#)



# Who benefits most from reproducibility?



# Who benefits most from reproducibility?

Lab Handbook



## 1 Joining a lab

1.1 Hierarchy

1.2 Current lab personnel

1.3 School of Psychology staff wh...

1.4 Local collaborators and acade...

1.5 Current and recent internation...

1.6 External PGRs

1.7 Alumni

## 2 Preparing for a stellar project

2.1 Choosing a research question

2.2 Planning for converging evide...

2.3 Minimizing noise

2.4 Illustrations of scope and outp...

2.5 Making the most of your time

2.6 Workload expectations

## 3 Lab meetings and communication

# Lab Handbook

Candice Morey

2019-10-30

## Chapter 1 Joining a lab

No man is an island,

Entire of itself,

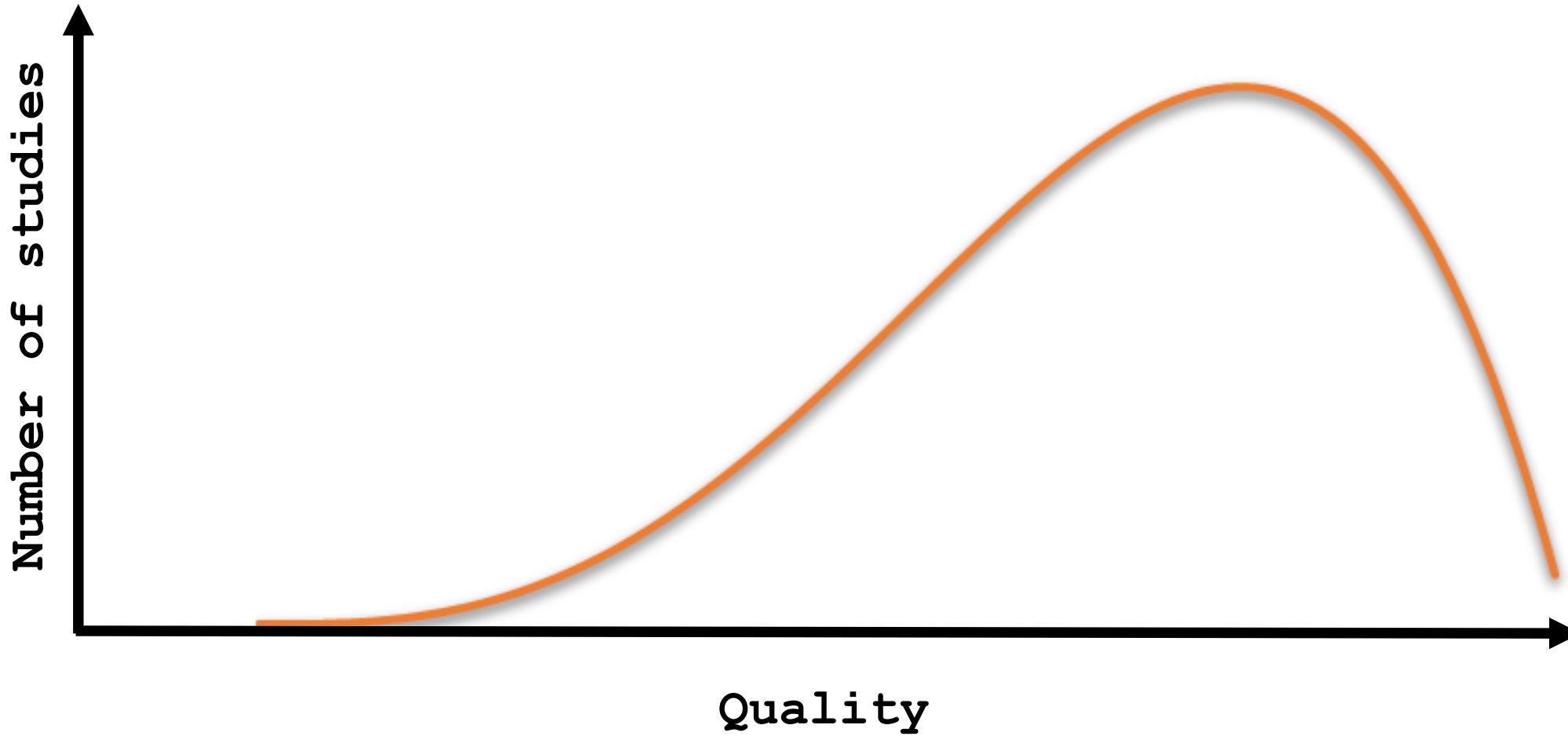
Every man is a piece of the continent,

A part of the main.

— John Donne

Although you will be familiar with the names of a handful of scientific heroes, science does not actually advance from the rapid insights of rare geniuses. Scientific knowledge accumulates through the consistent, often painstaking, efforts of groups of people. Across the world, webs of laboratories focusing on related topics work toward the common goal of understanding human memory and communicating

# Today



# Past failings



"In short, peer review misses all the hard stuff, and a worrying amount of the easy stuff"

James Heathers,  
Northwestern University

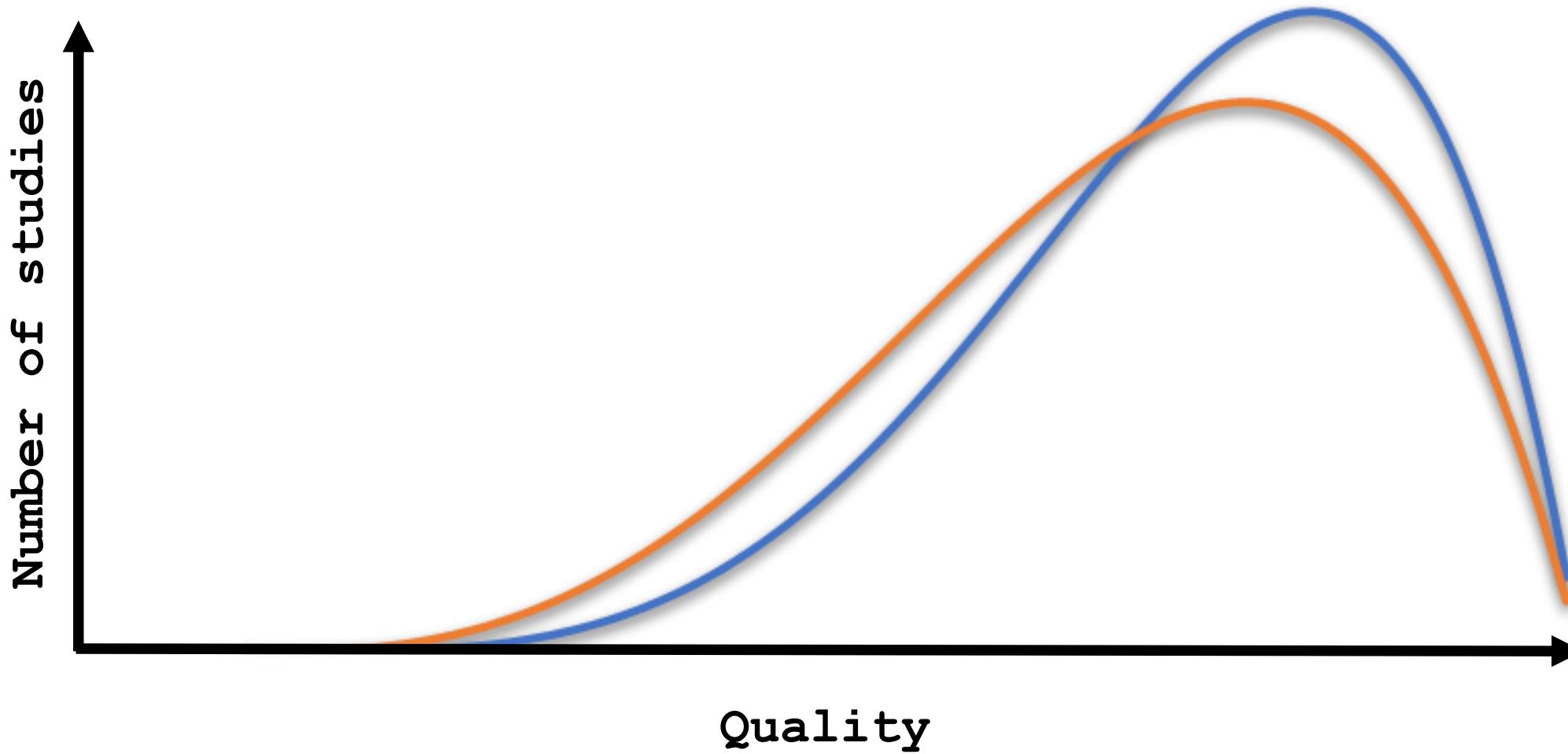
#datathugs



## **Brian Wansink: The grad student who never said no**

"Every day we would scratch our heads, ask "Why," and come up with another way to reanalyze the data with yet another set of plausible hypotheses. Eventually we started discovering solutions"

# Tomorrow



# Where to begin...



# Our real life experiment



- UV light has potential to change the secondary metabolite composition (colour) of bronze/red lettuce
- Experimental setup:
  - 3 lettuce varieties
  - 3 UV filter conditions
  - 3 week duration

# Real data comes with real problems

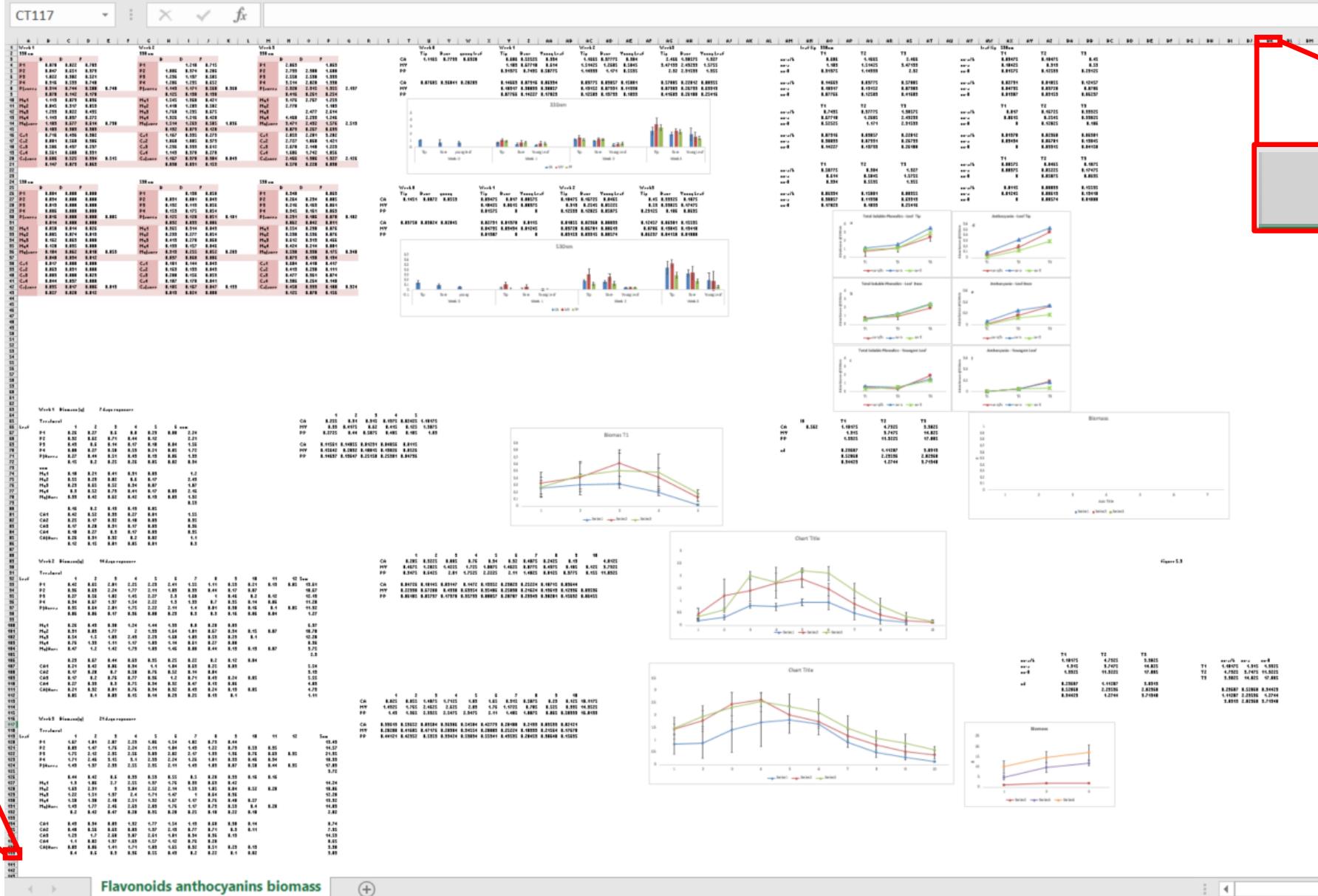
Raw Data wk 1-3 Lettuce Exp 1 - Excel

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	
1	Week 1						Week 2						Week 3						
2	330 nm						330 nm						330 nm						
3		B	D	F				B	D	F				B	D	F			
4	P1	0.870	0.822	0.703			P1						1	2.869		1.069			
5	P2	0.847	0.651	0.379			P2						2	2.739	2.380	1.688			
6	P3	1.022	0.902	0.521			P3	1.236	1.197	0.585			P3	2.558	2.538	1.333			
7	P4	0.916	0.599	0.748			P4	1.206	1.295	0.652			P4	3.514	2.028	1.330			
8	P(average)	0.914	0.744	0.588	0.748		P(average)	1.149	1.171	0.560	0.960		P(average)	2.920	2.315	1.355	2.197		
9		0.078	0.142	0.170				0.125	0.138	0.190				0.416	0.261	0.254			
10	My1	1.119	0.873	0.896			My1	1.545	1.360	0.421			My1	3.176	2.767	1.259			
11	My2	0.845	0.917	0.853			My2	1.418	1.203	0.502			My2	2.778		1.183			
12	My3	1.299	0.822	0.435			My3	1.768	1.295	0.675			My3		2.477	2.614			
13	My4	1.149	0.097	0.272			My4	1.326	1.216	0.420			My4	4.460	2.233	1.246			
14	My(average)	1.103	0.677	0.614	0.798		My(average)	1.514	1.269	0.505	1.096		My(average)	3.471	2.492	1.576	2.513		
15		0.189	0.389	0.309				0.192	0.073	0.120				0.879	0.267	0.693			
16	Ca1	0.716	0.496	0.382			Ca1	1.167	0.935	0.273			Ca1	2.853	2.201	3.202			
17	Ca2	0.881	0.568	0.386			Ca2	1.060	1.005	0.373			Ca2	2.727	1.860	1.421			
18	Ca3	0.586	0.437	0.237			Ca3	1.296	0.993	0.612			Ca3	2.678	2.140	1.229			
19	Ca4	0.561	0.600	0.331			Ca4	1.143	0.978	0.278			Ca4	1.606	1.742	1.856			
20	Ca(average)	0.686	0.525	0.334	0.515		Ca(average)	1.167	0.978	0.384	0.843		Ca(average)	2.466	1.986	1.927	2.126		
21		0.147	0.073	0.069				0.098	0.031	0.159				0.578	0.220	0.890			
22																			
23																			
24	530 nm						530 nm						530 nm						
25		B	D	F				B	D	F				B	D	F			
26	P1	0.004	0.000	0.000			P1		0.138	0.050				P1	0.340		0.069		
27	P2	0.034	0.000	0.000			P2		0.091	0.081	0.043			P2	0.264	0.234	0.085		CA
28	P3	0.019	0.000	0.000			P3		0.132	0.119	0.056			P3	0.216	0.163	0.061		MY

File Home Insert Page Layout Formulas Data Review View Tell me what you want to do...

Normal Page Break Preview Custom Layout Views Workbook Views

Ruler Formula Bar Gridlines Headings Zoom 100% Zoom to Selection Window New Arrange Freeze All Panes Hide Synchronous Scrolling Reset Window Position Window Switch Windows Macros Macros



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Normal Page Break Preview Custom Layout Views Workbook Views Show

Ruler Formula Bar Gridlines Headings Zoom 100% Zoom to Selection Window New Arrange Freeze All Panes Hide Synchronous Scrolling Reset Window Position Window Switch Windows Macros Macros

**Flavonoids anthocyanins biomass**

**Figure 5.8**

Figure 5.8 displays a Microsoft Excel spreadsheet titled "Flavonoids anthocyanins biomass" containing experimental data for three treatments (T1, T2, T3) across four weeks (Week 1, Week 2, Week 3, Week 4). The data includes biomass measurements and various statistical analyses.

**Data Summary:**

- Week 1 Biomass:** Biomass values range from 0.000 to 0.210 g/m². Treatment T1 shows the highest biomass, followed by T2, and T3 shows the lowest.
- Week 2 Biomass:** Biomass values range from 0.000 to 0.210 g/m². Treatment T1 shows the highest biomass, followed by T2, and T3 shows the lowest.
- Week 3 Biomass:** Biomass values range from 0.000 to 0.210 g/m². Treatment T1 shows the highest biomass, followed by T2, and T3 shows the lowest.
- Week 4 Biomass:** Biomass values range from 0.000 to 0.210 g/m². Treatment T1 shows the highest biomass, followed by T2, and T3 shows the lowest.

**Statistical Analyses:**

- Treatment Comparison:** One-way ANOVA results show significant differences between treatments for all weeks (p < 0.05).
- Week Comparison:** One-way ANOVA results show significant differences between weeks for all treatments (p < 0.05).
- Week-Treatment Interaction:** Two-way ANOVA results show significant interactions between week and treatment for all weeks (p < 0.05).
- Homogeneity of Variances:** Levene's test results indicate homogeneity of variances for all comparisons.
- Post-hoc Tests:** Tukey HSD and Fisher LSD post-hoc tests are used to compare treatment means.

**Graphs:**

- Line Graphs:** Four line graphs show the mean biomass over time for each treatment (T1, T2, T3, T4).
- Bar Charts:** Three bar charts show the total biomass, total flavonoids, and total anthocyanins for each treatment at each week.

# This is a big problem

Enron North America - West Gas														
November 9, 2001														
ENA - West Gas Contacts														
Houston Office					Regional Offices									
Barry Tycholiz (713) 853-1587					Mark Whitt (303) 575-6473 Denver									
Kim Ward (713) 853-0685					Paul Lucci (303) 575-6474 Denver									
Stephanie Miller (713) 853-1688					Tyrell Harrison (303) 575-6478 Denver									
Philip Polsky (713) 853-5181					Dave Fuller (503) 464-3732 Portland									
Forward Prices (US\$/MMBtu)														
Cash ROM Dec-01 Dec-01 to Mar-02 Apr-02 to Oct-02 Nov-02 to Mar-03 One Year Strip*	NYMEX		Forward NYMEX Strip with trading 10-day highs/lows											
	NETTLE	A												
Cash ROM Dec-01 Dec-01 to Mar-02 Apr-02 to Oct-02 Nov-02 to Mar-03 One Year Strip*	IF CIG Rocky Mountains		IF EL Paso Permian											
	Fixed Price		Fixed Price											
	BID	OFFER	BID	OFFER	BID	OFFER	BID	OFFER	Basis					
	1.940	1.960	2.375	2.395	2.420	2.440	2.700	2.720	(0.260)					
	1.960	1.980	2.345	2.365	(0.615)	(0.595)	2.855	2.875	(0.233)					
	2.345	2.365	2.548	2.568	(0.540)	(0.520)	3.009	3.029	(0.158)					
	2.471	2.491	2.471	2.491	(0.695)	(0.675)	3.499	3.519	(0.153)					
	3.311	3.331	3.311	3.331	(0.340)	(0.320)	3.982	3.002	(0.182)					
	2.551	2.571	2.551	2.571	(0.614)	(0.594)	3.421	3.441	(0.230)					
Cash ROM Dec-01 Dec-01 to Mar-02 Apr-02 to Oct-02 Nov-02 to Mar-03 One Year Strip*	AECO / NIT		IF NWPL Canadian Border (Sumas)											
	Fixed Price		Fixed Price											
	BID	OFFER	BID	OFFER	BID	OFFER	BID	OFFER	Basis					
	2.376	2.396	2.480	2.500	2.460	2.480	2.800	2.820	(0.160)					
	2.398	2.418	2.552	2.572	(0.408)	(0.388)	2.892	2.912	(0.196)					
	2.552	2.572	2.616	2.636	(0.472)	(0.452)	2.796	2.816	(0.176)					
	2.616	2.636	2.681	2.681	(0.505)	(0.485)	3.706	3.726	0.055					
	2.681	2.681	3.216	3.236	(0.435)	(0.415)	3.880	3.900	0.075					
	3.216	3.236	3.276	3.296	(0.488)	(0.468)	3.841	3.961	(0.123)					
Cash ROM Dec-01 Dec-01 to Mar-02 Apr-02 to Oct-02 Nov-02 to Mar-03 One Year Strip*	IF NWPL Rocky Mountains		IF EL Paso San Juan											
	Fixed Price		Fixed Price											
	BID	OFFER	BID	OFFER	BID	OFFER	BID	OFFER	Basis					
	1.890	1.910	2.060	2.080	2.395	2.415	(0.565)	(0.545)						
	2.060	2.080	2.594	2.614	(0.494)	(0.474)	2.581	2.601	(0.585)					
	2.395	2.415	2.594	2.614	(0.494)	(0.474)	3.356	3.376	(0.295)					
	2.581	2.601	2.634	2.654	(0.520)	(0.510)	3.421	3.441	(0.230)					
	3.356	3.376	3.421	3.441	(0.230)	(0.210)	2.817	2.837	(0.347)					
	2.634	2.654	2.817	2.837	(0.347)	(0.327)								
Cash ROM Dec-01 Dec-01 to Mar-02 Apr-02 to Oct-02 Nov-02 to Mar-03 One Year Strip*	IF PEPL TX-OK		IF NWPL Canadian Border (Sumas)											
	Fixed Price		Fixed Price											
	BID	OFFER	BID	OFFER	BID	OFFER	BID	OFFER	Basis					
	2.530	2.550	2.530	2.550	2.828	2.848	(0.133)	(0.113)						
	2.550	2.550	2.958	2.978	(0.130)	(0.110)	3.046	3.066	(0.120)					
	2.828	2.848	2.958	2.978	(0.130)	(0.110)	3.531	3.551	(0.120)					
	3.046	3.066	3.531	3.551	(0.120)	(0.100)	3.041	3.061	(0.123)					
	3.531	3.551	3.041	3.061	(0.123)	(0.103)								
	3.041	3.061												

# Take small steps to big changes

THE AMERICAN STATISTICIAN  
2018, VOL. 72, NO. 1, 2–10  
<https://doi.org/10.1080/00031305.2017.1375989>



OPEN ACCESS



## Data Organization in Spreadsheets

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### ABSTRACT

Spreadsheets are widely used software tools for data entry, storage, analysis, and visualization. Focusing on the data entry and storage aspects, this article offers practical recommendations for organizing spreadsheet data to reduce errors and ease later analyses. The basic principles are: be consistent, write dates like YYYY-MM-DD, do not leave any cells empty, put just one thing in a cell, organize the data as a single rectangle (with subjects as rows and variables as columns, and with a single header row), create a data dictionary, do not include calculations in the raw data files, do not use font color or highlighting as data, choose good names for things, make backups, use data validation to avoid data entry errors, and save the data in plain text files.

### ARTICLE HISTORY

Received June 2017  
Revised August 2017

### KEYWORDS

Data management; Data organization; Microsoft Excel; Spreadsheets

# Less stress, more success

	A	B	C	D	E	F	G	H	I	J	K
1	id	week_no	filter_nam	treatment	replicate_no	flavonoids	biomass	variety	date	investigator	
2	1	0	ptp	nofilter	1	1.061	0.39	cos	2019/04/01	Darren Dahly	
3	2	0	ptp	nofilter	2	1.1805	0.42	cos	2019/04/01	Darren Dahly	
4	3	0	ptp	nofilter	3	1.0345	0.62	cos	2019/04/01	Darren Dahly	
5	4	0	ptp	nofilter	4	1.094	0.63	cos	2019/04/01	Brendan Palmer	
6	5	0	my	nofilter	1	1.061	0.39	cos	2019/04/01	Brendan Palmer	
7	6	0	my	nofilter	2	1.1805	0.42	cos	2019/04/01	Brendan Palmer	
8	7	0	my	nofilter	3	1.0345	0.62	cos	2019/04/01	Brendan Palmer	
9	8	0	my	nofilter	4	1.094	0.63	cos	2019/04/01	Brendan Palmer	
10	9	0	ca	nofilter	1	1.061	0.39	cos	2019/04/01	Brendan Palmer	
11	10	0	ca	nofilter	2	1.1805	0.42	cos	2019/04/01	Brendan Palmer	
12	11	0	ca	nofilter	3	1.0345	0.62	cos	2019/04/01	Brendan Palmer	
13	12	0	ca	nofilter	4	1.094	0.63	cos	2019/04/01	Darren Dahly	
14	13	1	ptp	filter	1	0.87	0.76	cos	2019/04/08	Darren Dahly	
15	14	1	ptp	filter	2	0.847	0.95	cos	2019/04/08	Darren Dahly	
16	15	1	ptp	filter	3	1.022	0.95	cos	2019/04/08	Darren Dahly	
17	16	1	ptp	filter	4	0.916	0.95	cos	2019/04/08	Darren Dahly	
18	17	1	my	filter	1	1.119	1.55	cos	2019/04/08	Darren Dahly	
19	18	1	my	filter	2	0.845	3.16	cos	2019/04/08	Darren Dahly	
20	19	1	my	filter	3	1.299	4.9	cos	2019/04/08	Brendan Palmer	
21	20	1	my	filter	4	1.149	5.5	cos	2019/04/08	Brendan Palmer	
22	21	1	ca	filter	1	0.716	5.5	cos	2019/04/08	Brendan Palmer	
23	22	1	ca	filter	2	0.881	7.94	cos	2019/04/08	Brendan Palmer	
24	23	1	ca	filter	3	0.586	8.71	cos	2019/04/08	Brendan Palmer	
25	24	1	ca	filter	4	0.561	8.71	cos	2019/04/08	Brendan Palmer	
26	25	2	ptp	filter	1	0	14.45	cos	2019/04/15	Brendan Palmer	
27	26	2	ptp	filter	2	1.006	2.14	cos	2019/04/15	Brendan Palmer	
28	27	2	ptp	filter	3	1.236	1.86	cos	2019/04/15	Brendan Palmer	
29	28	2	ptp	filter	4	1.206	1.2	cos	2019/04/15	Brendan Palmer	
30	29	2	mv	filter	1	1.545	2.45	cos	2019/04/15	Brendan Palmer	

data

dictionary

values



# Less stress, more success

	A	B	C	D	E	F	G	H	I	J	K
1	id	week_no	filter_name	treatment	replicate_no	flavonoids	biomass	variety	date	investigator	
2	1	0	ptp	no	1	1.051	0.30	---	2019/06/28	Aoife Coffey	
3	2	0	ptp	no	A	B	C	D	E		
4	3	0	ptp	no	1	field_name	data_type	data_format	example	standard_units	description
5	4	0	ptp	no	2	id	numeric	integer	23	NA	Unique identifier applied to each observation
6	5	0	my	no	3	week_no	numeric	integer	1	NA	Week number, 1 = 7 days exposure, 2 = 14 days exposure
7	6	0	my	no	4	filter_name	character	NA	my	NA	3 filter types; 'ptp' = polytunnel plastic blocks all UV light
8	7	0	my	no	5	treatment	character	NA	filter	NA	Presence or absence of a filter at the time of sampling
9	8	0	my	no	6	replicate_no	numeric	integer	1	NA	The number of replicates in each treatment
10	9	0	ca	no	7	flavonoids	numeric	double	0.3421	parts per million (ppm)	Leaf disc taken from the tip of the most mature leaf at th
11	10	0	ca	no	8	biomass	numeric	double		gram (g)	Above ground biomass on the day of harvest
12	11	0	ca	no	9	variety	character	NA	cos	NA	3 commerical varieties of red lettuce used; 'cos' = Cos Di
13	12	0	ca	no	10	date	date	YYYY/MM/DD	2019/06/28	ISO 8601	Experiment date
14	13	1	ptp	fil	11	investigator	character	Firstname Lastname	Aoife Coffey	NA	Primary researcher who performed the experiment
15	14	1	ptp	fil	12						
16	15	1	ptp	fil	13						
17	16	1	ptp	fil	14						
18	17	1	my	fil	15						
19	18	1	my	fil	16						
20	19	1	my	fil	17						
21	20	1	my	fil	18						
22	21	1	ca	fil	19						
23	22	1	ca	fil	20						
24	23	1	ca	fil	21						
25	24	1	ca	fil	22						
26	25	2	ptp	fil	23						
27	26	2	ptp	fil	24						
28	27	2	ptp	fil	25						
29	28	2	ptp	fil	26						
30	29	2	mv	fil	27						
					28						
					29						
					30						

# Less stress, more success

The screenshot shows the Quaise software interface with two main tables displayed side-by-side.

**Left Table (data):**

	A	B	C	D	E	F	G	H	I	J	K
1	id	week_no	filter_name	treatment	replicate_no	flavonoids	biomass	variety	date	investigator	
2	1	0	ptp	no	1	1.051	0.20	cos	2010/01/01	Brendan Palmer	
3	2	0	ptp	no	A						
4	3	0	ptp	no	B						
5	4	0	ptp	no	C						
6	5	0	my	no	1	field_name	data_type	data_format	example	standard_units	description
7	6	0	my	no	2	id	numeric	integer	23	NA	Unique identifier applied to each observation
8	7	0	my	no	3	week_no	numeric	integer			
9	8	0	my	no	4	filter_name	character	NA			
10	9	0	ca	no	5	treatment	character	NA			
11	10	0	ca	no	6	replicate_no	numeric	integer			
12	11	0	ca	no	7	flavonoids	numeric	double			
13	12	0	ca	no	8	biomass	numeric	double			
14	13	1	ptp	fil	9	variety	character	NA			
15	14	1	ptp	fil	10	date	date	YYYY/MM/DD			
16	15	1	ptp	fil	11	investigator	character	Firstname Lastname	A		
17	16	1	ptp	fil	12						
18	17	1	my	fil	13						
19	18	1	my	fil	14						
20	19	1	my	fil	15						
21	20	1	my	fil	16						
22	21	1	ca	fil	17						
23	22	1	ca	fil	18						
24	23	1	ca	fil	19						
25	24	1	ca	fil	20						
26	25	2	ptp	fil	21						
27	26	2	ptp	fil	22						
28	27	2	ptp	fil	23						
29	28	2	ptp	fil	24						
30	29	2	mv	fil	25						
	30	2	mv	fil	26						

**Bottom Navigation:** data, dictionary, v, +, data, dictionary, values, +

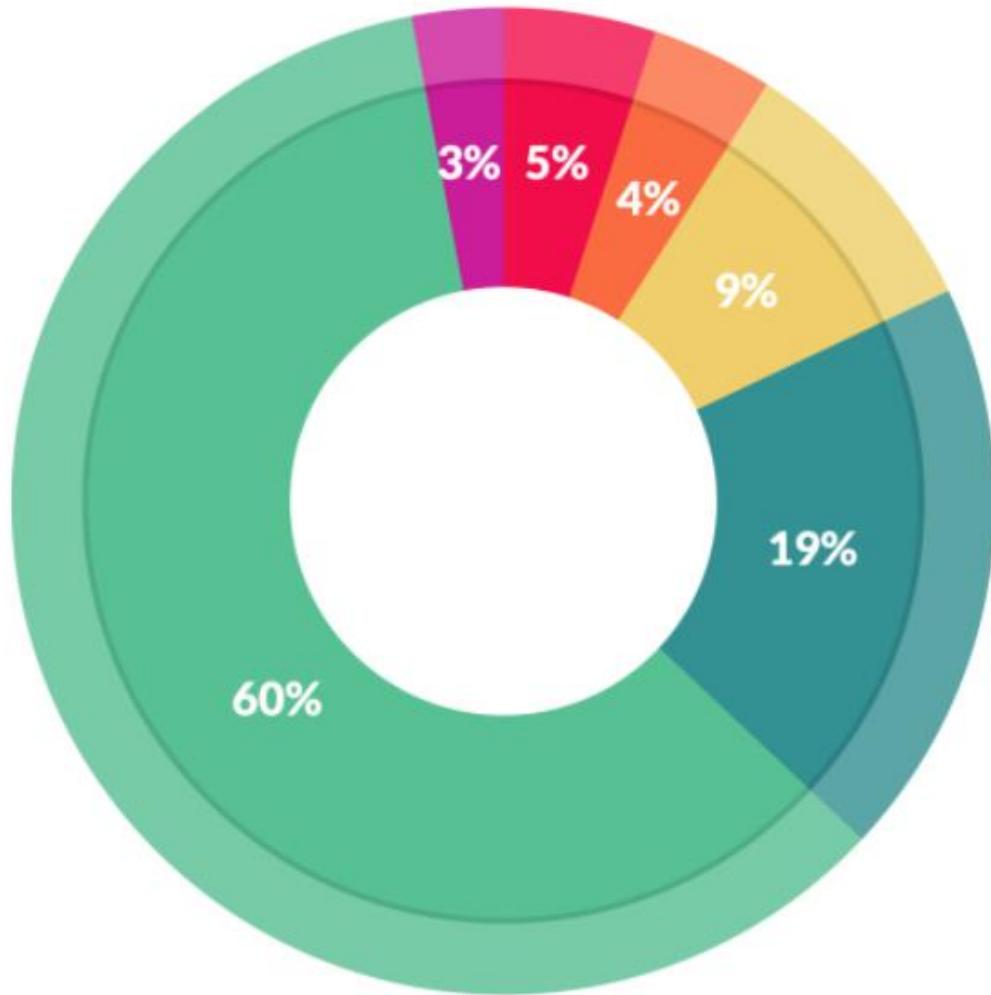
**Right Table (dictionary):**

	A	B	C	D	E	F	G	H	I	J	K
1	id	week_no	filter_name	treatment	replicate_no	flavonoids	biomass	variety	date	investigator	
2			0 my	filter	1						Brendan Palmer
3			1 ca	no_filter	2						Darren Dahly
4			2 ptp		3						red
5			3		4						
6											
7											
8											
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30											

**Bottom Navigation:** data, dictionary, values, +

# Less stress, more success

# Resources are being wasted by not doing this



What data scientists spend the most time doing

- *Building training sets: 3%*
- *Cleaning and organizing data: 60%*
- *Collecting data sets; 19%*
- *Mining data for patterns: 9%*
- *Refining algorithms: 4%*
- *Other: 5%*

# Putting the pieces together

A: Define a project structure

B: Set a naming convention

C: Use scripted workflows

D: Digital notebooks

E: Version control

F: Data packaging

Reproducible  
research

# Still haven't found what I'm looking for

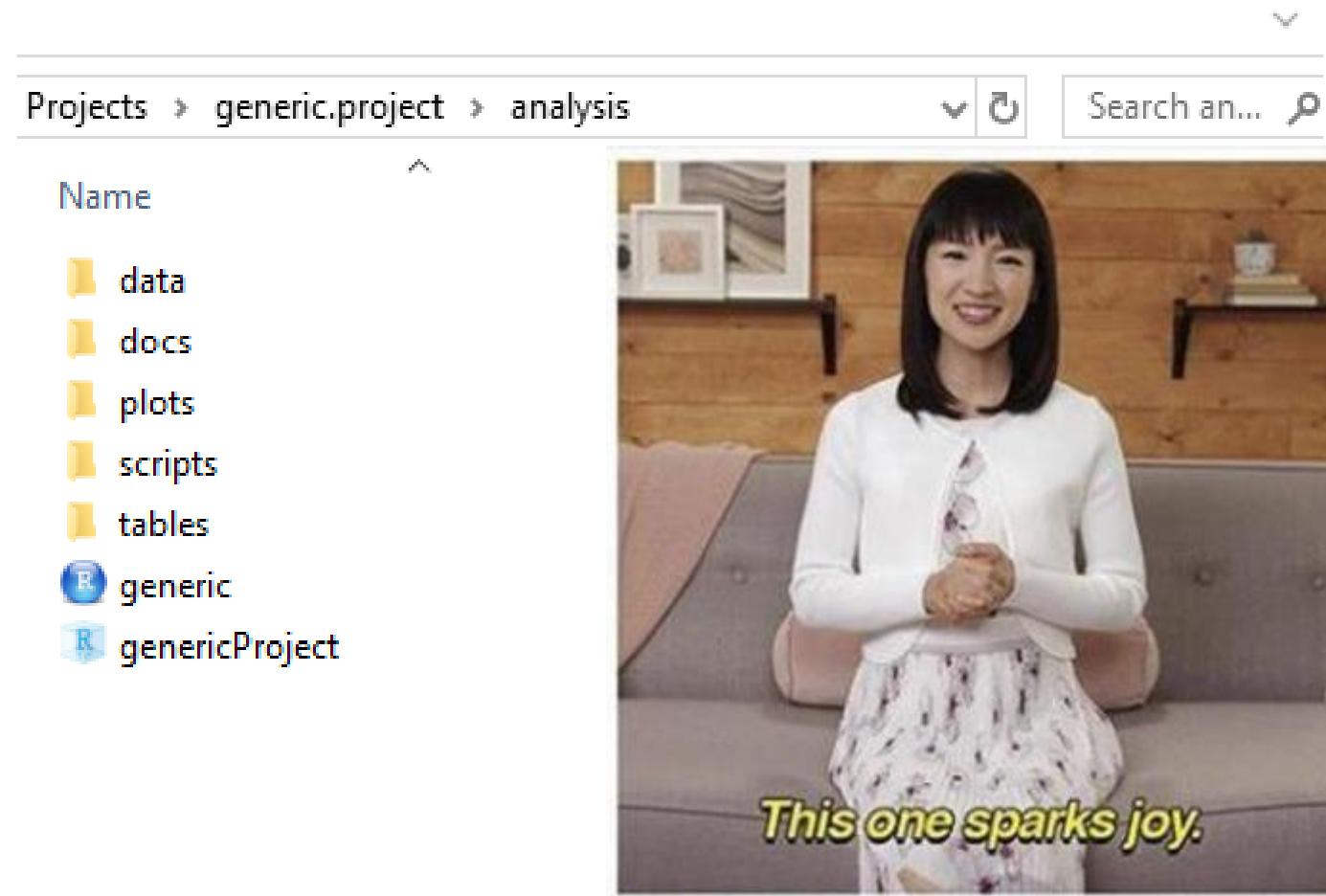
- Help your future-self

B\_Palmer\_Medicine\_Files > 4a Project > Pyrosequencing\_analysis > Pyrosequencing\_Paper > Draft\_Paper\_incl\_Figs > Submission > JVI\_Resubmission > JVI\_resubmission\_files > Final Final version

Name	Date modified
Cover_letter_B_A_Palmer_Sept_2014	10/09/2014 17:05
Fig_1_Sept_14	11/09/2014 10:31
Fig_1_Sept_14	10/09/2014 23:07
Fig_2_Sept_14	11/09/2014 10:31
Fig_2_Sept_14	10/09/2014 23:07
Fig_3_Sept_14	11/09/2014 10:31
Fig_3_Sept_14	10/09/2014 23:07
Fig_4_Sept_14	11/09/2014 10:31
Fig_4_Sept_14	10/09/2014 23:07
Fig_5_Sept_14	11/09/2014 10:33
Fig_5_Sept_14	10/09/2014 23:07
HCV_UDPS_B_A_Palmer_Sept_14	17/09/2014 12:21
Response_to_Reviewer_Sept_14	10/09/2014 22:42
Supplementary_Figure_B_A_Palmer_Sept_14	29/08/2014 13:21
Supplementary_Figure_B_A_Palmer_Sept_14	10/09/2014 22:31
Tables_B_A_Palmer_Sept_2014	10/09/2014 22:09



# A: Define a generic project structure



# B: Give your files and folders informative names

This PC > Documents > Projects > **2016-08-08\_RespPCT** > analysis > data

Name	Date modified
raw_data	21/01/2019 21:06
2018-11-06_abx	06/11/2018 13:10
2018-11-06_monitoring	06/11/2018 13:09
2018-11-06_pct	06/11/2018 13:08
2018-11-06_pt_info	06/11/2018 13:07

# Everything in its right place

- Make your file names:
  1. Machine readable
  2. Human readable
  3. Work with default ordering

**NO**

Name
All unique 4a amino acid Sequences (B-N).fas
All unique 4a amino acid Sequences (B-N).meg
All_AA_haplotypes.meg
All_AA_haplotypes_with_clonal_sequences.meg
BS100_AA_with_clones
BS100_AA_with_clones.nwk
BS1000_AA_pyro&clones
BS1000_AA_pyro&clones.nwk
BS1000_AA_pyro_only
BS1000_AA_pyro_only.nwk
BS1000_Uncle_Clonal_AA

**Yes**

Projects > 2016-08-08\_RespPCT > analysis > scripts

Name
R 01_clean_data
R 02_plots
R 03_tables
R 04_stats_analysis
R 05_post_hoc_stats
R functions
R randomization
R tables

# C: Joined up thinking

- The R scripts should also be human readable
  - Annotate the code
  - Break up the scripts into dedicated tasks
  - Interlink to other project scripts

```
1 # Data ----
2 # Eight tibbles returned from the 01_data_import_and_tidying_master_file.R
3 # 1. fgf23_data => FGF23 readings from study centres 01-03
4 # 2. food_level_data => Food diary entries
5 # 3. grouped_data => Dialysis and nondialysis diary entries by component
6 # 4. k_data => Serum potassium
7 # 5. master_data_clean => all the clean master file data if required
8 # 6. p_data => Serum phosphate
9 # 7. pth_data => Parathyroid hormone readings
10 # 8. pulses_nuts_data
11
12 source("scripts/01_data_import_and_tidying_master_file.R")
```

# Work from the raw data ALWAYS!!



**Tom Webb** @tomjwebb · 16 Jan 2015

If you could tell a new PhD student one thing to help make their data more useful/shareable, what would it be?

27

11

7



**Dr Gavin Simpson**

@ucfagls

Follow

Replying to @tomjwebb

@tomjwebb don't, not even with a barge pole, not for one second, touch or otherwise edit the raw data files. Do any manipulations in script

7:15 AM - 16 Jan 2015

# D: R Markdown

R ~/Open\_Science/Digital\_Badge/RCR - master - RStudio

File Edit Code View Plots Session Build Debug Profile Tools Help

lettuce\_report.Rmd\* Go to file/function Addins

```
1 ---  
2 title: "This is a reproducible document"  
3 author: "Dr. Brendan Palmer"  
4 date: "18th June 2019"  
5 output:  
6   word_document:  
7     fig_height: 4  
8     fig_width: 6  
9 ---  
10 # This is the beginning of the project  
11  
12 our initial reports might be restricted to lab meetings etc. We can use `R  
13 Markdown` to show the code we are using, so that the meetings are not just a  
14 demonstration of the results, but also an examination of the `code` used to obtain  
15 them.  
16  
17 knitr::opts_chunk$set(echo = FALSE, message = FALSE, warning = FALSE)  
18  
19 # Load your packages here  
20 library(tidyverse)  
21 library(knitr)  
22  
23  
24 The plot below is call from the ggplot object entitled `report_plot` created in  
25 the script `03_final_analysis.R`.  
26  
27 {r Plots from script, echo = FALSE}  
28 source("scripts/03_final_analysis.R")  
29  
30 # The location of the Rmd file dictates whether the path to other files is intact
```

## This is a reproducible document

Dr. Brendan Palmer

18th June 2019

### This is the beginning of the project

Our initial reports might be restricted to lab meetings etc. We can use R Markdown to show the code we are using, so that the meetings are not just a demonstration of the results, but also an examination of the code used to obtain them.

### Data overview

The plot below is call from the ggplot object entitled report\_plot created in the script 03\_final\_analysis.R.

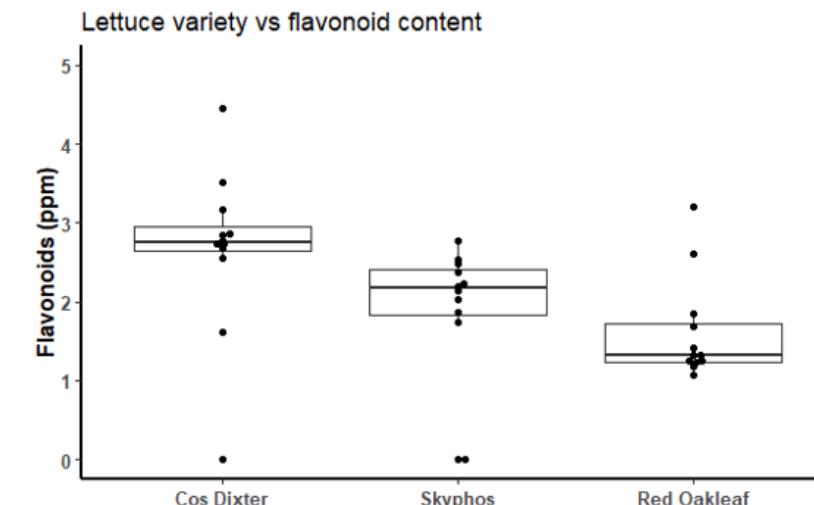
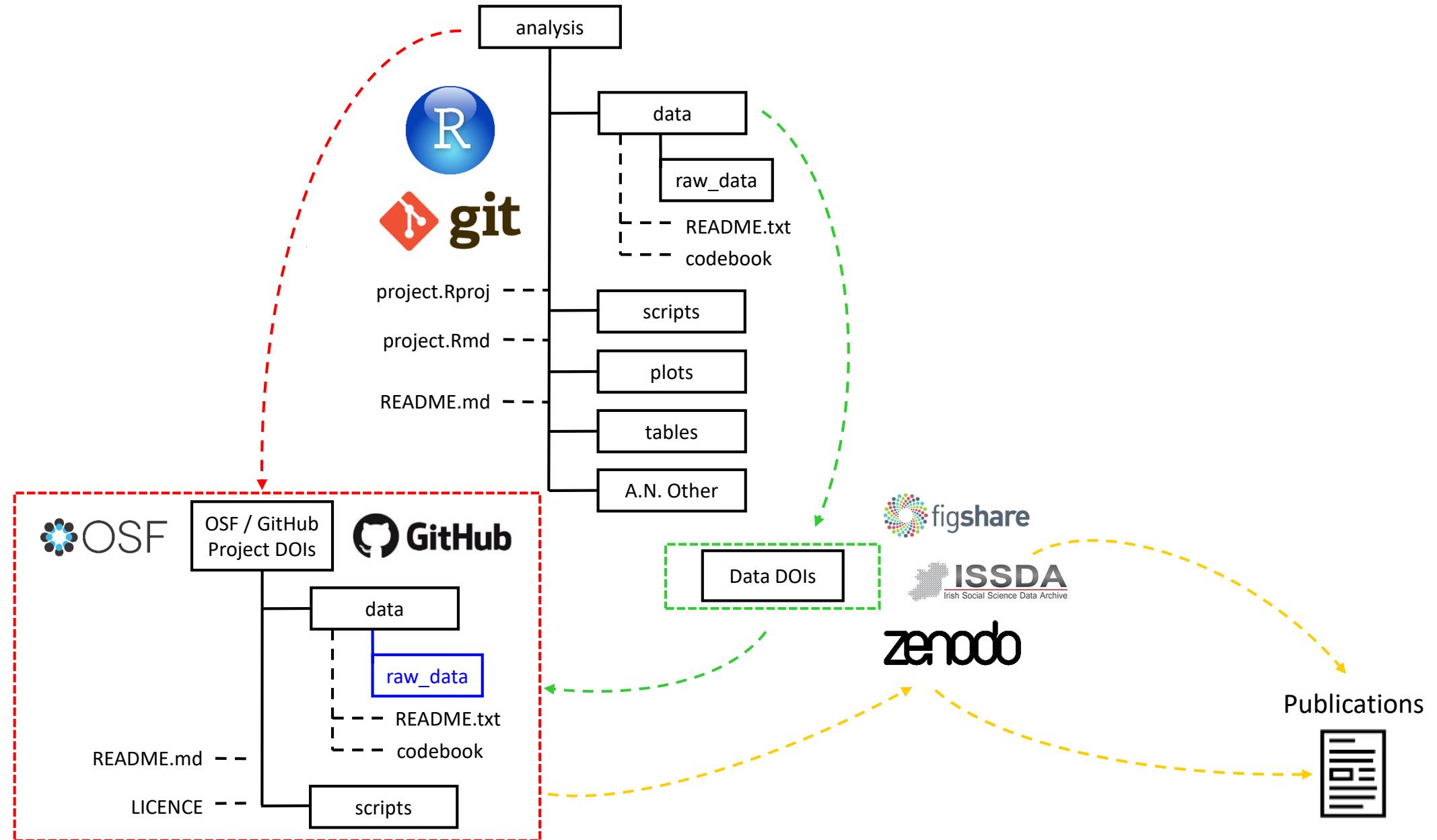


Fig. 1. Flavonoid content of three lettuce varieties under three experimental conditions.

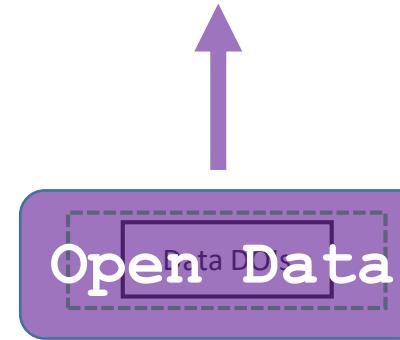
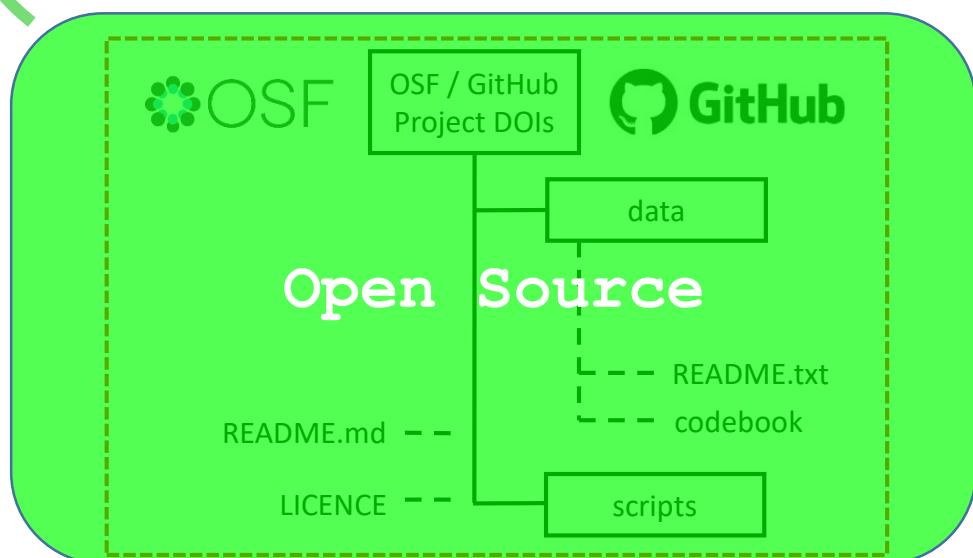
Or we can also recreate the code within the R Markdown document as seen below.

# What does this allow us to do?



# What does this allow us to do?

Open Materials



# Mistakes can still happen



Rasmus Nielsen  
@ras\_nielsen

The one thing that all scientists fear the most is to find out that a major result they have published was based on erroneous data. This is an event that will affect you for the rest of your scientific career. 1/3

6:24 PM · Sep 27, 2019 · Twitter Web App

181 Retweets 1.4K Likes



Rasmus Nielsen @ras\_nielsen · Sep 27  
Replying to @ras\_nielsen

David Reich (inspired by the work of Sean Harrison) has found an error in the UK Biobank data that likely explains most or all of our results regarding CCR5 delta-32. We will work with the Nature Medicine editors to get the publication record corrected. 2/3

34 95 861



Daniel MacArthur  
@dgmcarthur

It's also a good reminder for everyone: never blindly trust any genomic data set. They all contain hidden errors that evade bulk QC, even when very carefully done, but emerge when doing very specific analyses. Be suspicious, and tailor your QC to the question you're asking.

5:31 PM · Oct 2, 2019 · Twitter Web App



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Posted October 02, 2019.

## No statistical evidence for an effect of CCR5-Δ32 on lifespan in the UK Biobank cohort

Robert M Maier, Ali Akbari, Xinzhu Wei, Nick Patterson, Rasmus J Nielsen, David E. Reich

doi: <https://doi.org/10.1101/787986>

This article is a preprint and has not been certified by peer review [what does this mean?].

Abstract

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Clinical Trials\*Developmental Biology  
Ecology  
Epidemiology\*  
Evolutionary Biology  
Genetics  
Genomics  
Immunology  
Microbiology

## Abstract

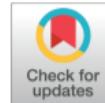
A recent study reported that a 32-base-pair deletion in the CCR5 gene (CCR5-Δ32) is deleterious in the homozygous state in humans. Evidence for this came from a survival analysis in the UK Biobank cohort, and from deviations from Hardy-Weinberg equilibrium at a polymorphism tagging the deletion (rs62625034). Here, we carry out a joint analysis of whole-genome genotyping data and whole-exome sequencing data from the UK Biobank, which reveals that technical artifacts are a more plausible cause for deviations from Hardy-Weinberg equilibrium at this polymorphism. Specifically, we find that individuals homozygous for the deletion in the sequencing data are underrepresented in the genotyping data due to an elevated rate of missing data at rs62625034, possibly because the probe for this SNP overlaps with the Δ32 deletion. Another variant which has a higher concordance with the deletion in the sequencing data shows no associations with mortality. A genome-wide scan for effects of variants tagging this deletion shows an overall inflation of association p-values, but identifies only one trait at  $p < 5 \times 10^{-8}$ , and no mediators for an effect on mortality. These analyses show that the original reports of a recessive deleterious effect of CCR5-Δ32 are affected by a technical artifact, and that a closer investigation of the same data provides no positive evidence for an effect on lifespan.

# Mistakes can still happen

thebmj

BMJ 2019;367:l6365 doi: 10.1136/bmj.l6365 (Published 21 November 2019)

Page 1 of 2



## EDITORIALS

### Why researchers should share their analytic code

Retraction of a trial shows the importance of transparency

Ben Goldacre *director*, Caroline E Morton *researcher*, Nicholas J DeVito *researcher*

DataLab, Nuffield Department of Primary Care Health Sciences, University of Oxford, Oxford, UK

JAMA recently retracted and replaced an important clinical trial report from 2018 after a serious programming error was discovered.<sup>1</sup> Quantitative medical research relies on analytic scripts: a sequence of commands issued to extract, reshape, manage, and then analyse data. In this case, there was a catastrophe. The “randomisation assignment” variable coded the control group “1” and the intervention group “2”; this had to be converted to “0” and “1” for the statistical analysis to run, but an incorrect conversion command resulted in the intervention and control groups being mislabelled. The results of the trial were almost completely reversed.

the most commonly used, GitHub,<sup>13</sup> has a limit of 100 GB for each repository. For context, our group’s OpenPrescribing.net service is a substantial software project with 130 000 users a year: the whole project is over 30 000 lines of code, which is at least one order of magnitude bigger than any single epidemiological analysis script, but this equates to only 1.5 MB of storage.

Another objection is the time needed to create perfectly curated code, but there is no need for code to be converted into generalisable “libraries”; simply sharing practical working code is a good start.<sup>14</sup> Emerging best practice is to share full analyses

# The butterfly has started flapping its wings



Why Plan S **10 Principles** Funders & support Implementation About Contact

"After 1 January 2020 scientific publications on the results from research funded by public grants provided by national and European research councils and funding bodies, must be published in compliant Open Access Journals or on compliant Open Access Platforms."



EUROPEAN COMMISSION  
Directorate-General for Research & Innovation  
H2020 Programme

Guidelines on  
FAIR Data Management in Horizon 2020



f) Data Management Plan – 2 pages max.

- Applicants should address the following issues:

- What standards will be applied?
- How will data be exploited and/or shared/made accessible for verification and reuse? If data cannot be made available, why?
- How data will be curated & preserved?
- If applicable, how does the applicant plan to make the research data FAIR (findable, accessible, interoperable and reusable).

HRB Health Research Board

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## Open Research

The HRB is committed to ensuring that its funded research is open, accessible and usable, so it can have the greatest possible impact.

There is a fundamental shift across Europe towards making research more transparent, collaborative, accessible and efficient. This Open Science movement is a strategic priority for the European Commission in research and innovation policy and an EU high-level Expert Group, the [Open Science Policy Platform](#) (OSPP 2016–2018) has been established to consider key implementation areas.

The diagram is divided into four quadrants: **CHARACTERISTICS** (top left), **INTERACTIONS** (top right), **INTEGRATION** (bottom left), and **INFRASTRUCTURE** (bottom right). The center is labeled **Open Science**. The **CHARACTERISTICS** quadrant contains icons for 'Open research data', 'Open scholarly communication', and 'Open access to publications'. The **INTERACTIONS** quadrant contains icons for 'Researcher attitudes towards open access', 'Journal policies on open access', 'Use of alternative metrics', and 'Corrections and retraction'. The **INTEGRATION** quadrant contains icons for 'Funder policies on data sharing', 'Researcher attitudes towards data sharing', and 'Incentives for data sharing'. The **INFRASTRUCTURE** quadrant contains icons for 'Open access publications', 'Preprints', 'Alternative publishing platforms', and 'Funder policies on open access'.

Funding Engagement Events Research News SFI Research Centres

→ Science Foundation Ireland joins DORA

14th February 2019, Dublin – Science Foundation Ireland has become a signatory to the San Francisco Declaration of Research Assessment (DORA), making a formal commitment to assessing the quality and impact of research through means other than journal impact factors.



# Install the Chrome plugin PubPeer

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J Surg Res. 2019 Apr 26;241:235-239. doi: 10.1016/j.jss.2019.03.062. [Epub ahead of print]

23 comments on PubPeer (by: Andrew D. Althouse, Thom Baguley, Guillaume A. Rousselet, Timothy Feeney, Paul M Brown, Frank E. Harrell, David Nunan, Samantha R. Seals, Raj Mehta, Yevgeniy Feyman, Ionomidotis Irregularis, Andrew Gelman, Aleksi Reito, Daniel E. Leisman, Pavlos Msaouel, Ryan Miller, Maarten Van Smeden, Zad Rafi Chow)

**Is the Power Threshold of 0.8 Applicable to Surgical Science?-Empowering the Underpowered Study.**

Bababekov YJ<sup>1</sup>, Hung YC<sup>2</sup>, Hsu YT<sup>2</sup>, Udelsman BV<sup>2</sup>, Mueller JL<sup>2</sup>, Lin HY<sup>2</sup>, Stapleton SM<sup>2</sup>, Chang DC<sup>2</sup>.

Author information

Abstract

**BACKGROUND:** Many articles in the surgical literature were faulted for committing type 2 error, or concluding no difference when the study was "underpowered". However, it is unknown if the current power standard of 0.8 is reasonable in surgical science.

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Review Is There Truly "No Significant Difference"? Underl J Bone Joint Surg Am. 2015]

Review Randomized controlled trials and neurosurgery: the ideal fit or : [J Neurosurg. 2016]

Review Low-Dose Aspirin for the Prevention of Morbidity anc Agency for Healthcare Research...]

# Further reading



Sam Westwood

@westwoodsam1

Following



I am embarking on my own  
[#PaperPerDayChallenge](#) where I read at least one paper, well, per day for a whole year. To kick start,  
[nature.com/articles/43573...](http://nature.com/articles/43573...) inspired by  
[@ukrepro](#) Reproducibility Workshop  
[@CumberlandLodge](#) and a talk by  
[@MarcusMunafo](#)



## Scientists behaving badly

In a questionnaire-based survey of US biomedical researchers, respondents admitted to a range of dubious practices. Transgressions included failing to present data  
[nature.com](http://nature.com)

# Twitter



**UK Reproducibility Network**

@ukrepro

UK Reproducibility Network: a peer-led consortium to investigate factors which contribute to robust research, provide training, and disseminate best practice.



**Malcolm Macleod #FBPE**

@Macломaclee Follows you

clinical neurologist, stroke trialist, and interested in improving the quality of laboratory research



**Open Science MOOC**

@OpenScienceMOOC Follows you

A community designed for students and researchers to help make 'Open' the default setting for the future of research. Slack: [osmooc.herokuapp.com](https://osmooc.herokuapp.com)

⌚ Everywhere



**Brian Nosek**

@BrianNosek

Executive Director @ Center for Open Science, Professor @ University of Virginia, and co-Founder of Project Implicit



**Kate Button**

@ButtonKate Follows you

Academic. Psychologist. Cognitive mechanisms of depression & anxiety. Meta-science & scientific rigour. Sporadic Twitterer.



**Darren L Dahly**

@statsep1 Follows you

Principal Statistician, Epidemiologist, Sr Lecturer | @HRBIreland Clinical Research Facility @CRF\_CORK | Cork #Rstats Users Group [meetup.com/Cork-Ireland-R...](https://meetup.com/Cork-Ireland-R-/)



**Dorothy Bishop**

@deevybee

Professor of developmental neuropsychology. Blog on [deevybee.blogspot.com](http://deevybee.blogspot.com) Main focus #devlangdis, see: [youtube.com/radld](https://youtube.com/radld)



**Elisabeth Bik**

@MicrobiomDigest

Science consultant, PhD. Harbers-Bik LLC. Microbiome, research integrity & misconduct. Ex @Stanford. MicrobiomeDigest/Bik's Picks. Dutch/USA. My views.



**Retraction Watch**

@RetractionWatch

Tracking retractions as a window into the scientific process. Sign up for our daily newsletter: [eepurl.com/bNR1Un](http://eepurl.com/bNR1Un) Tips? team@retractionwatch.com



**Jenny Bryan**

@JennyBryan

Software engineer @rstudio, humane #rstats, adjunct prof @UBC where I created @STAT545, part of @ropensci