

# Open Science in Marketing

Jan R. Landwehr & Stefan Mayer

Rorschacher Kreis 2019 (Luzern)

22.03.2019

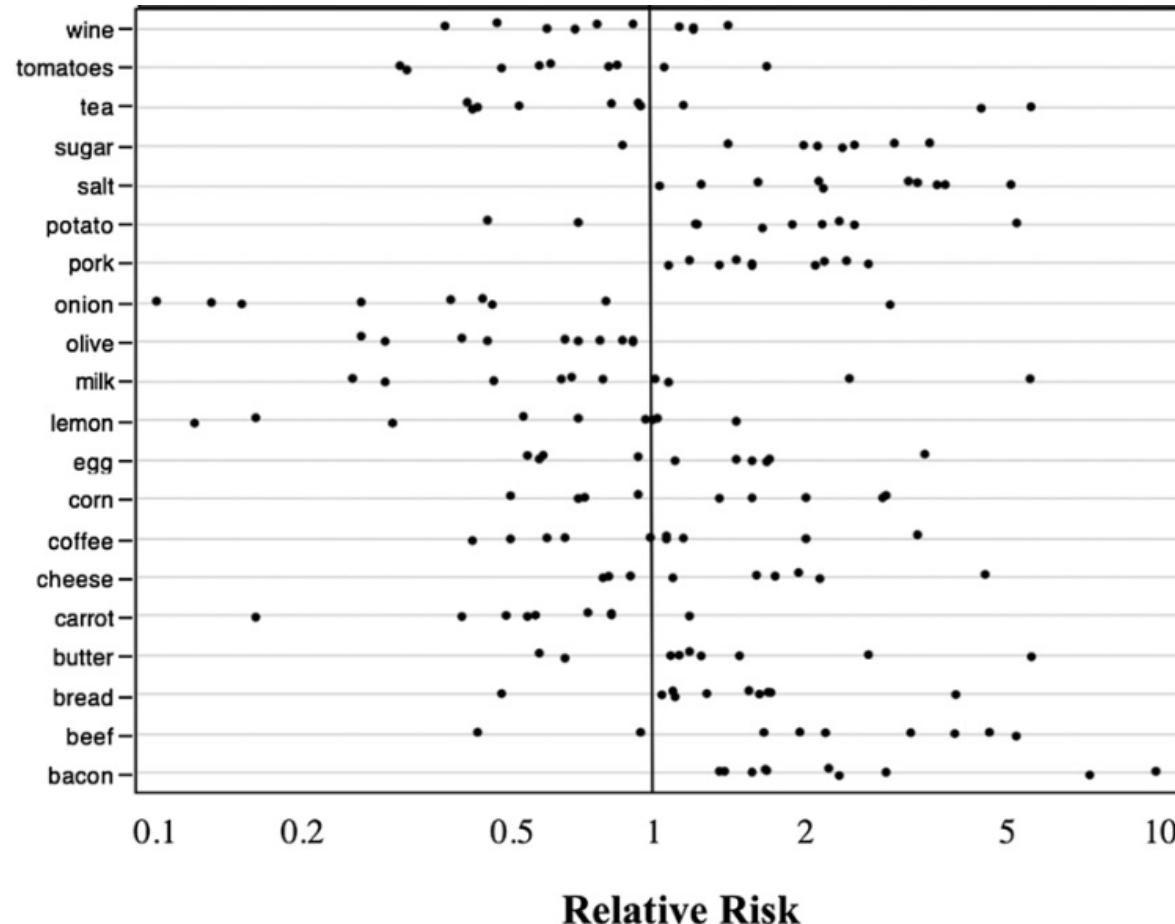
Slides (CC BY 4.0): <https://osf.io/t93pf>

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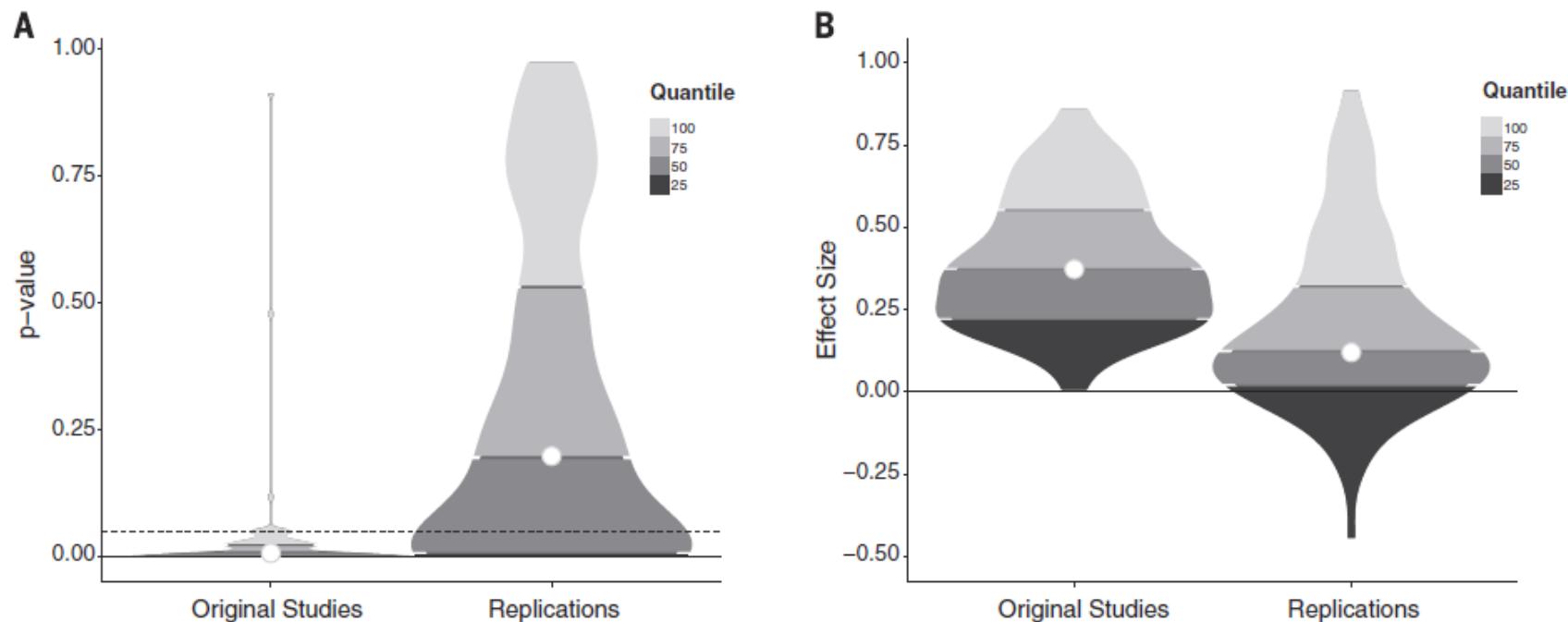
# Why to do Open Science

- Marketing as a discipline
- Marketing as a profession (what is in it for me?)

## Nutritional epidemiology: Schoenfeld & Ioannidis (2013): „Is everything we eat associated with cancer? A systematic cookbook review“ *Am J Clin Nutr.*



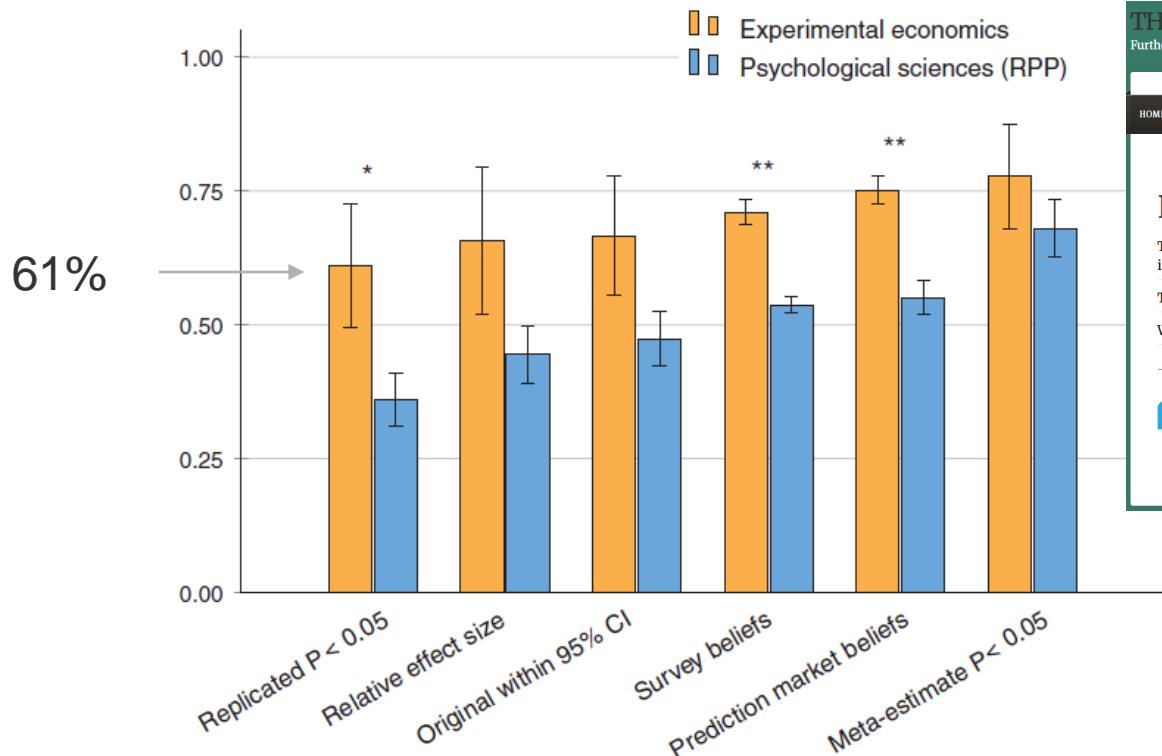
## Psychology: Open Science Collaboration (2015): Estimating the reproducibility of psychological science. *Science*.



**Fig. 1. Density plots of original and replication P values and effect sizes. (A) P values. (B) Effect sizes (correlation coefficients). Lowest quantiles for P values are not visible because they are clustered near zero.**

→ 39% of the original studies could be replicated

## Economics: Camerer et al. (2016): Evaluating replicability of laboratory experiments in economics. *Science*.



**Fig. 4. A comparison of replicability indicators in experimental economics (this study) and psychological sciences (RPP).** The graph shows means  $\pm$  SE for replicability indicators. All six replicability indicators are higher for experimental economics; this difference is significant for three of the replicability indicators. The average difference in replicability across the six indicators is 19 percentage points. Details about the statistical tests are included in the supplementary materials. \* $P < 0.05$ ; \*\* $P < 0.01$ .

**THE REPLICATION NETWORK**  
Furthering the Practice of Replication in Economics

Search Here Go

HOME RESEARCH FROM MEMBERS GUEST BLOGS NEWS & EVENTS MEMBERSHIP

Home

This website serves as a channel of communication to (i) update scholars about the state of replications in economics, and (ii) establish a network for the sharing of information and ideas.

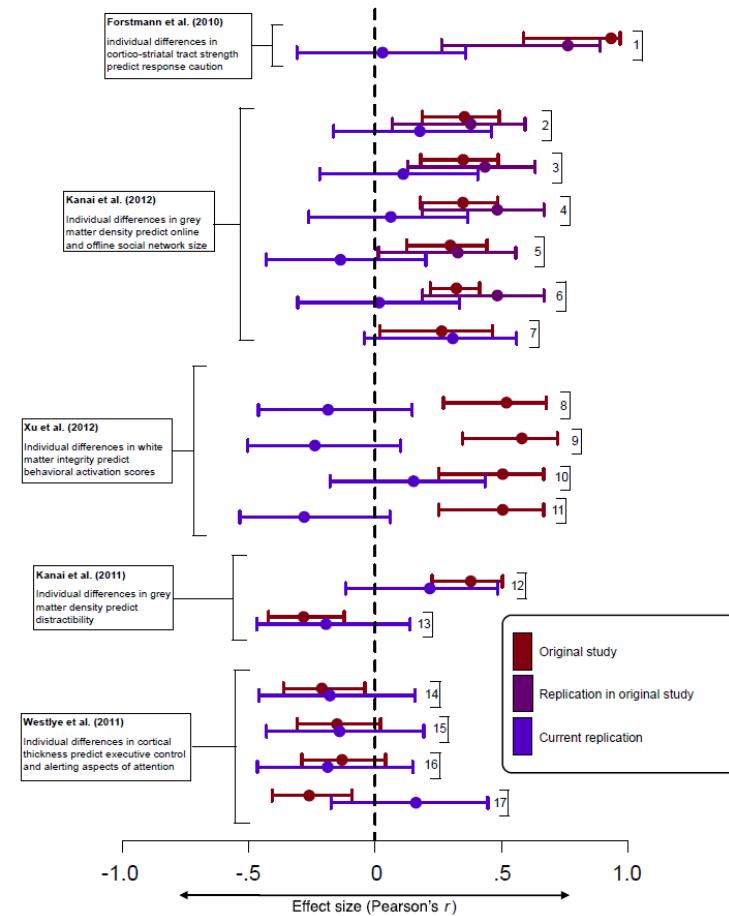
The goal is to encourage economists and their journals to publish replications.

We welcome you to join THE REPLICATION NETWORK and contribute to its content.

The Organizing Committee of TRN

[Twitter icon](#) [RSS icon](#)

## Neuroscience: Boekel et al. (2015): A purely confirmatory replication study of structural brain-behavior correlations. Cortex.



# Marketing: ???

The SCORE Project  
Assessing and Predicting Replicability of Social-Behavioral Science Findings  
Call for Collaborators  
Center for Open Science  
February 2019



**Brian Nosek**  
@BrianNosek

Folgen



Marketing and Organizational Behavior journals:

Journal of Marketing

Journal of Consumer Research

Journal of the Academy of Marketing Science

Journal of Marketing Research

Journal of Organizational Behavior

Organizational Behavior and Human Decision Processes

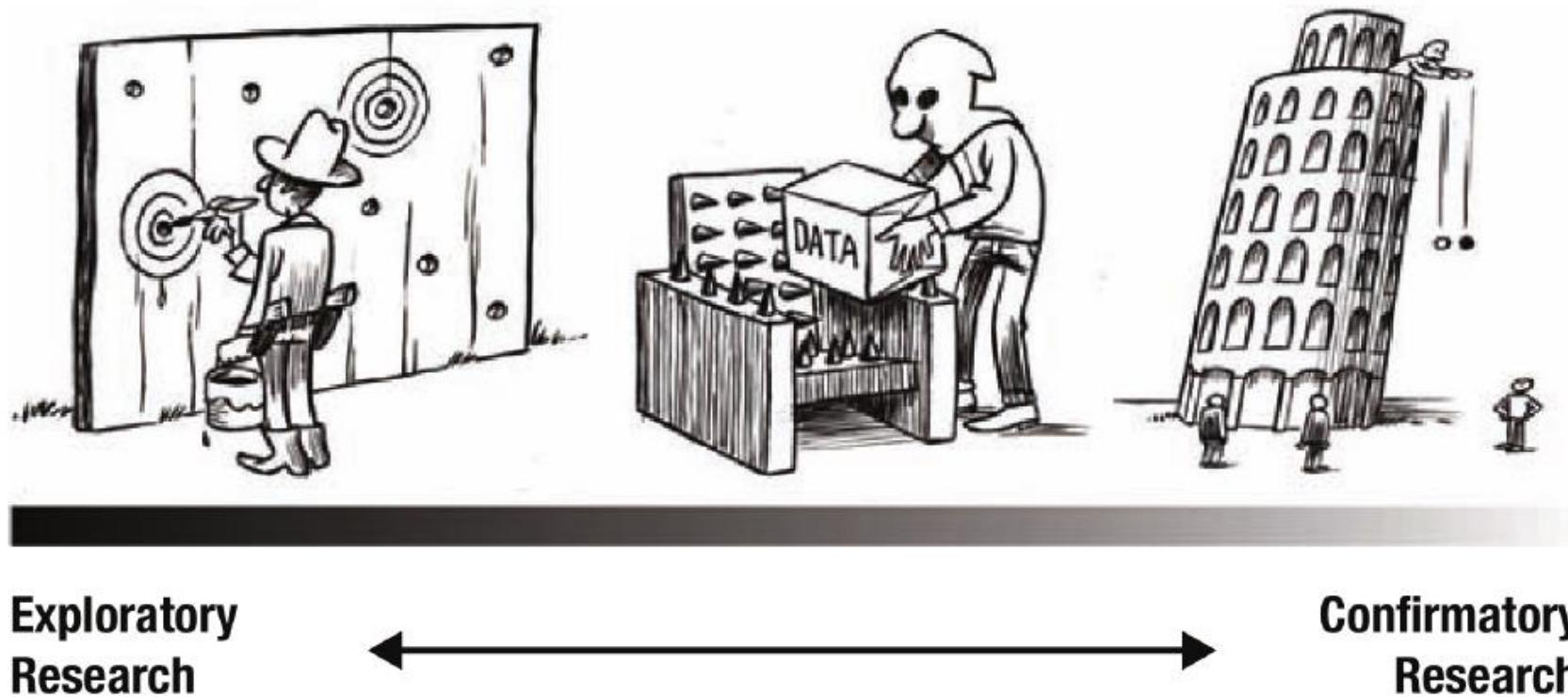
## OVERVIEW

There is substantial interest in the extent to which published findings in social-behavioral sciences are reproducible and whether it is possible to predict the likelihood of reproducing. Large-scale replication and prediction market projects in some subfields, particularly parts of psychology and economics, have provided initial evidence that reproducibility may be lower than expected or desired, and that surveys of experts and prediction markets may be effective at predicting reproducible findings. There is still much to learn about reproducibility across business, economics, education, political science, psychology, sociology, and other areas of social-behavioral sciences. To advance understanding, we will:

- Create a database of about 30,000 papers published between 2009 and 2018 from 60+ journals in the social-behavioral sciences that publish primarily empirical, non-simulated research with human participants.
- Sample about 3,000 papers from this population and code them using human and automated methods for primary claim, key design features, and key statistics, and merge data from other sources (e.g., altmetrics, citations, open data) to help assess the credibility of the original claims.
- Conduct replications (new data) or reproductions (reanalysis of original data) of up to 300 of these papers

Other teams will be assessing the 3,000 papers using humans or machines to generate predictions (scores) of the reproducibility of the primary findings. If successful, the project will introduce evidence for methods to rapidly assess the credibility of findings, and identify features that can improve credibility and reproducibility. Completing this project will require large-scale collaboration of experts across social-behavioral research communities.

## What's the problem?



Wagenmakers et al, 2012, An Agenda for Purely Confirmatory Research

# What's the problem?

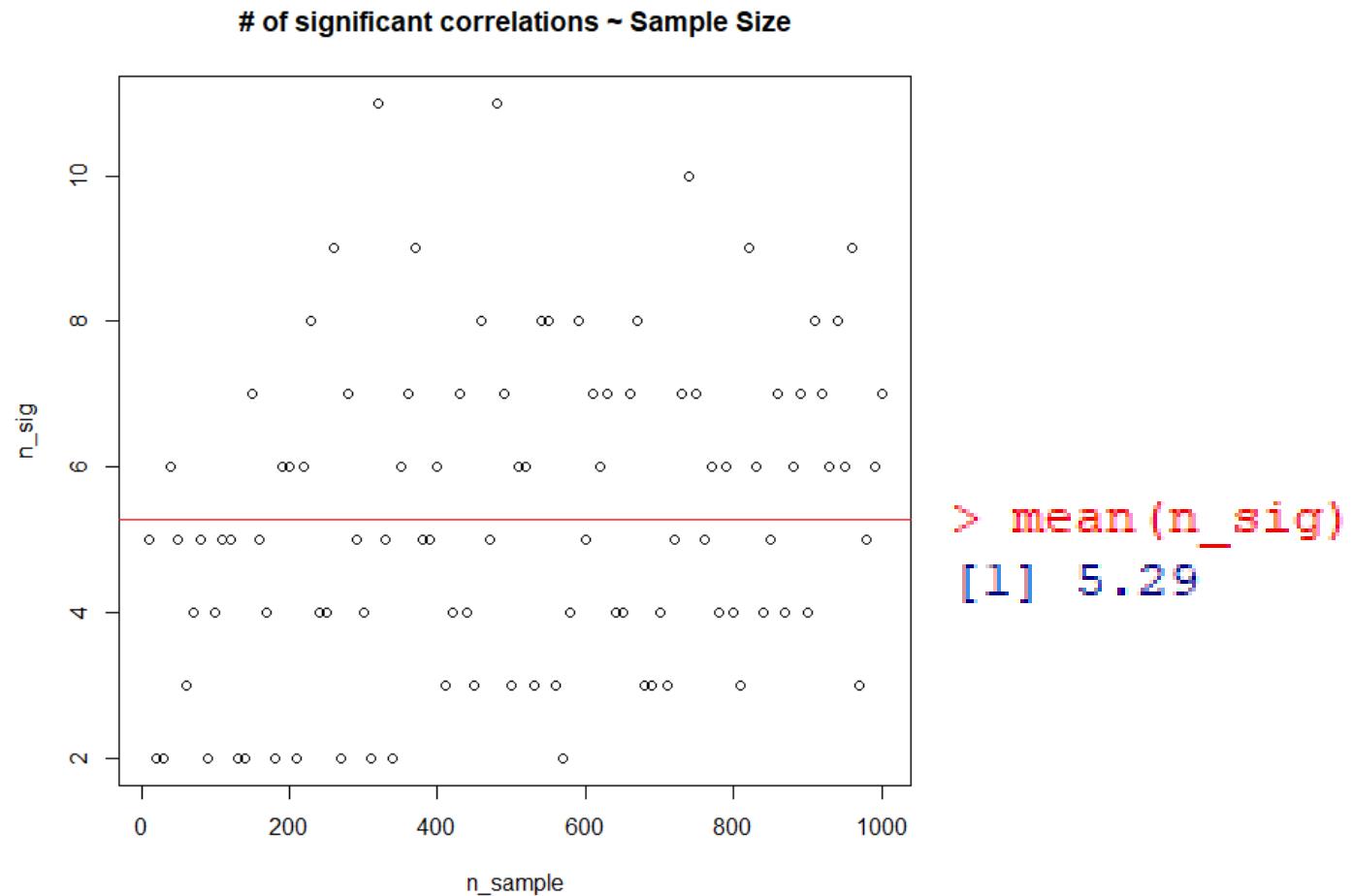
```
###Simulation of dataset with 15 random variables with 100 observations each
Cordata <- data.frame(matrix(NA,nrow = 100, ncol = 15))
for (i in 1:15){
  Cordata[,i] <- rnorm(100)
}
```

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15
1	NA	0.19	-0.11	-0.11	0.02	0.07	0.12	-0.06	-0.12	-0.14	-0.12	-0.08	0.14	0.08	0.06
2	0.05	NA	0.01	0.15	0.17	-0.02	0.00	-0.10	0.05	0.16	-0.15	-0.05	0.13	-0.08	0.04
3	0.26	0.94	NA	0.02	0.01	0.10	0.11	0.12	-0.11	-0.10	0.03	0.03	0.08	-0.02	0.06
4	0.27	0.13	0.84	NA	0.08	-0.04	0.24	0.03	-0.09	-0.06	0.00	0.20	-0.01	0.11	-0.02
5	0.86	0.08	0.88	0.45	NA	0.05	0.04	-0.05	0.07	0.17	0.03	-0.08	-0.01	0.17	-0.21
6	0.49	0.85	0.34	0.70	0.62	NA	0.02	-0.16	-0.11	-0.13	0.04	0.12	0.07	0.01	0.02
7	0.25	0.99	0.27	0.02	0.66	0.83	NA	0.13	-0.15	0.15	0.03	0.06	0.14	0.01	-0.26
8	0.55	0.31	0.24	0.73	0.59	0.10	0.19	NA	0.14	0.03	0.02	-0.05	0.13	-0.14	-0.13
9	0.22	0.64	0.29	0.39	0.47	0.28	0.15	0.17	NA	0.14	-0.15	-0.02	-0.18	0.03	0.09
10	0.18	0.12	0.30	0.55	0.09	0.21	0.14	0.79	0.16	NA	-0.08	-0.01	-0.13	-0.07	-0.10
11	0.25	0.14	0.76	0.97	0.79	0.72	0.80	0.87	0.12	0.40	NA	0.11	0.13	0.05	0.00
12	0.41	0.64	0.79	0.05	0.44	0.25	0.52	0.63	0.85	0.95	0.28	NA	-0.05	0.09	-0.12
13	0.16	0.19	0.41	0.92	0.95	0.46	0.15	0.20	0.08	0.19	0.18	0.61	NA	-0.14	0.04
14	0.44	0.43	0.86	0.30	0.09	0.94	0.91	0.15	0.74	0.51	0.61	0.40	0.17	NA	0.01
15	0.56	0.71	0.59	0.83	0.04	0.87	0.01	0.20	0.36	0.31	0.99	0.22	0.71	0.90	NA

p-values

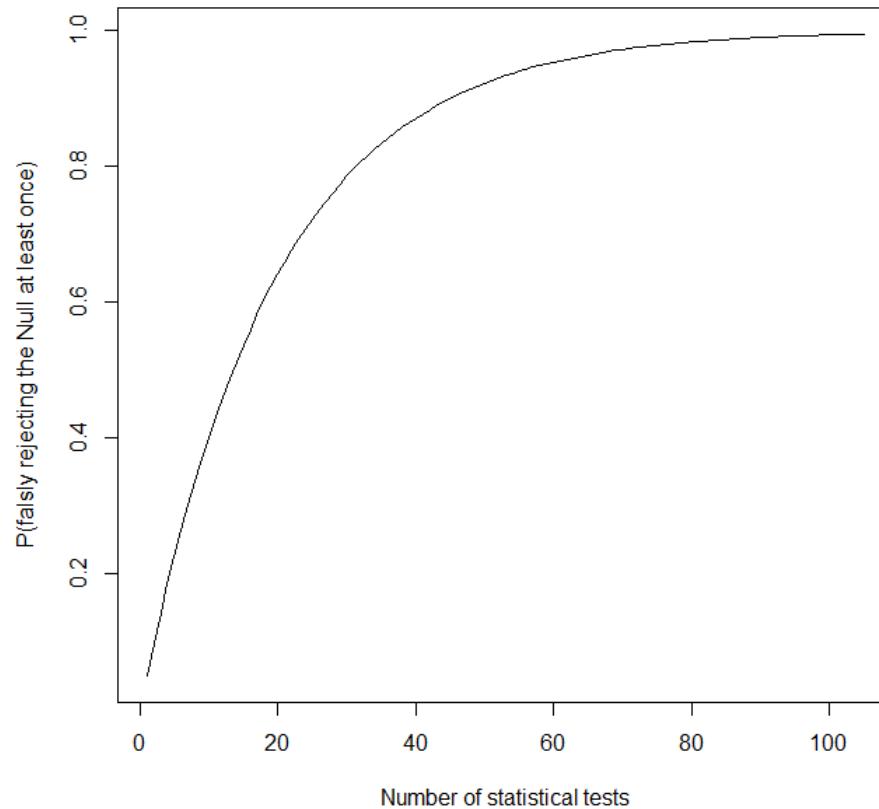
Correlations

# What's the problem? Large samples?



# What's the problem? p(at least one alpha-error)

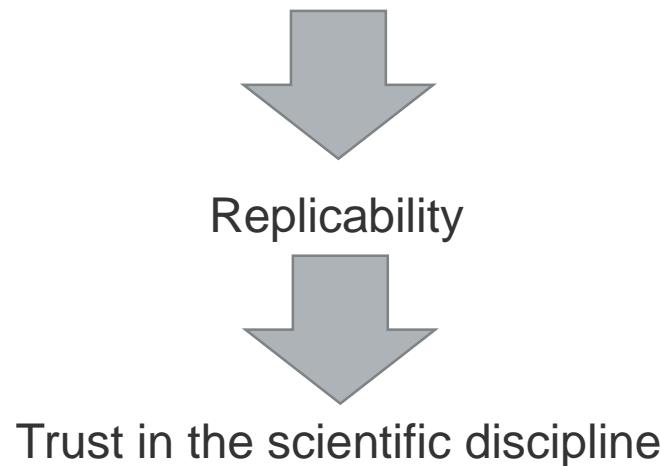
```
x <- 1:105  
y0 <- 0.95^x  
y <- 1-y0  
  
plot(y~x, type="l", xlab="Number of statistical tests", ylab="P(falsly rejecting the Null at least once)")
```



## What's the solution?

**Open Science:** Honest and transparent reporting of the nature of empirical studies (i.e., explorative vs. confirmatory)

- (1) Transparent & Honest Reporting
- (2) Comprehensible Documentation
- (3) Free Accessibility (Materials, Data, Code, Papers)



## What's in it for me?

PhD student: True scientific curiosity

PostDoc/Ass. Prof./Tenure Track: Publish or perish!

Full Professor: ???

# of publications

Google Scholar Citations

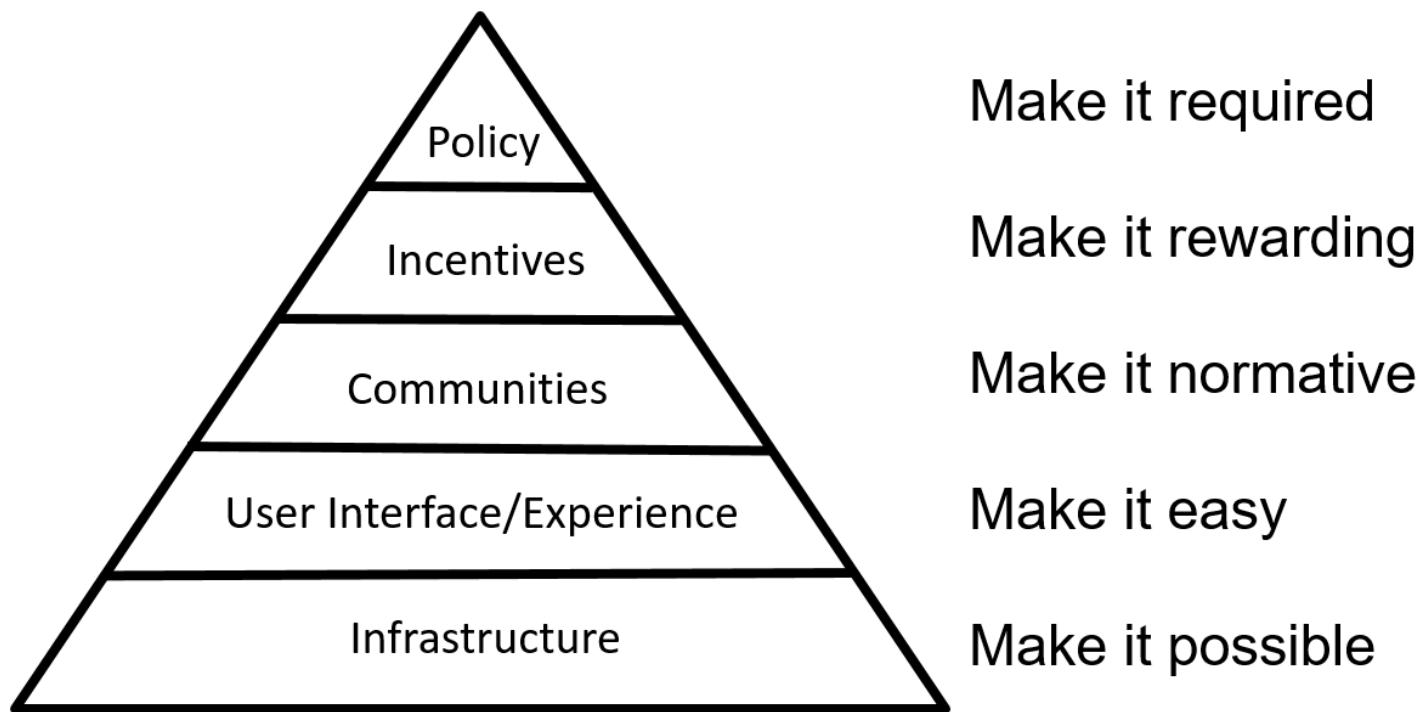
Funding

Consulting

... True scientific curiosity

**Brian Nosek (Center for Open Science): *Culture Change Toward Openness and Reproducibility (presentation slides)***

## Changing a Research Culture



## What's in it for me?

In addition, if your paper involves estimation code and data, I invite you to enrich your article by uploading the relevant code and data to the RunMyCode data repository. They will not be published with your paper - online or in print - but will be stored in RunMyCode. You retain copyright over your data and code. Your article will be linked to a dedicated RunMyCode companion website. To create a companion website, please follow step-by-step instructions available at: <http://www.runmycode.org/>.

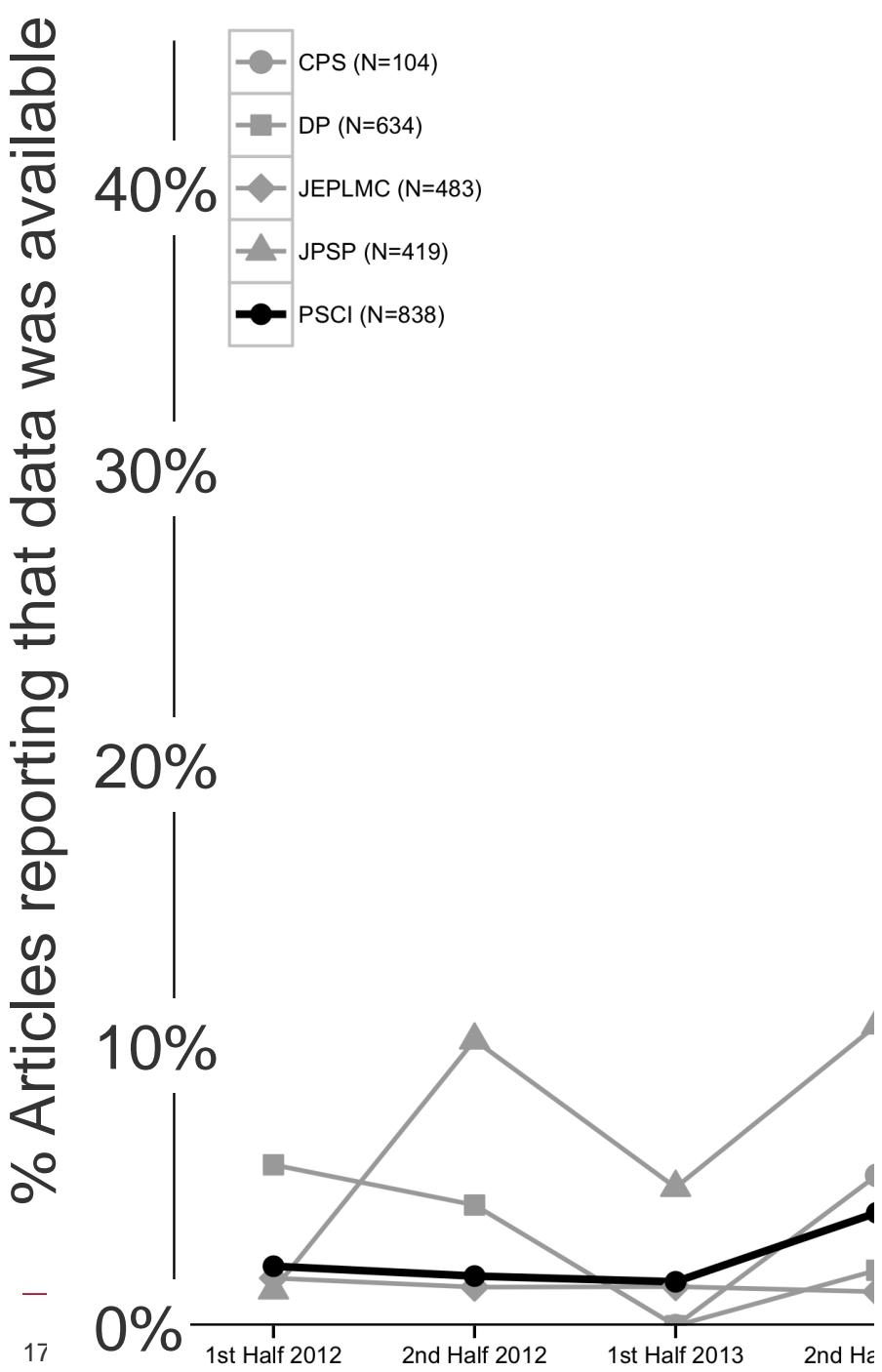
We do understand that there are many limitations authors may have and we are not imposing this request. Acceptance and publication of your paper is not contingent upon your agreement to post data and codes. If you feel that you will be unable to comply please let us know why (please include this in your cover letter to the editor in the next round) so we can discuss possible solutions (or decide not to share your data.) If you will agree to this, then we will inform you how to go about uploading your data and code.

**Brian Nosek (Center for Open Science): *Culture Change Toward Openness and Reproducibility (presentation slides)***

# Signals: Making Behaviors Visible Promotes Adoption



Kidwell et al., 2016, *PLOS Biology*



## What's in it for me?

PhD student: True scientific curiosity

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Funding

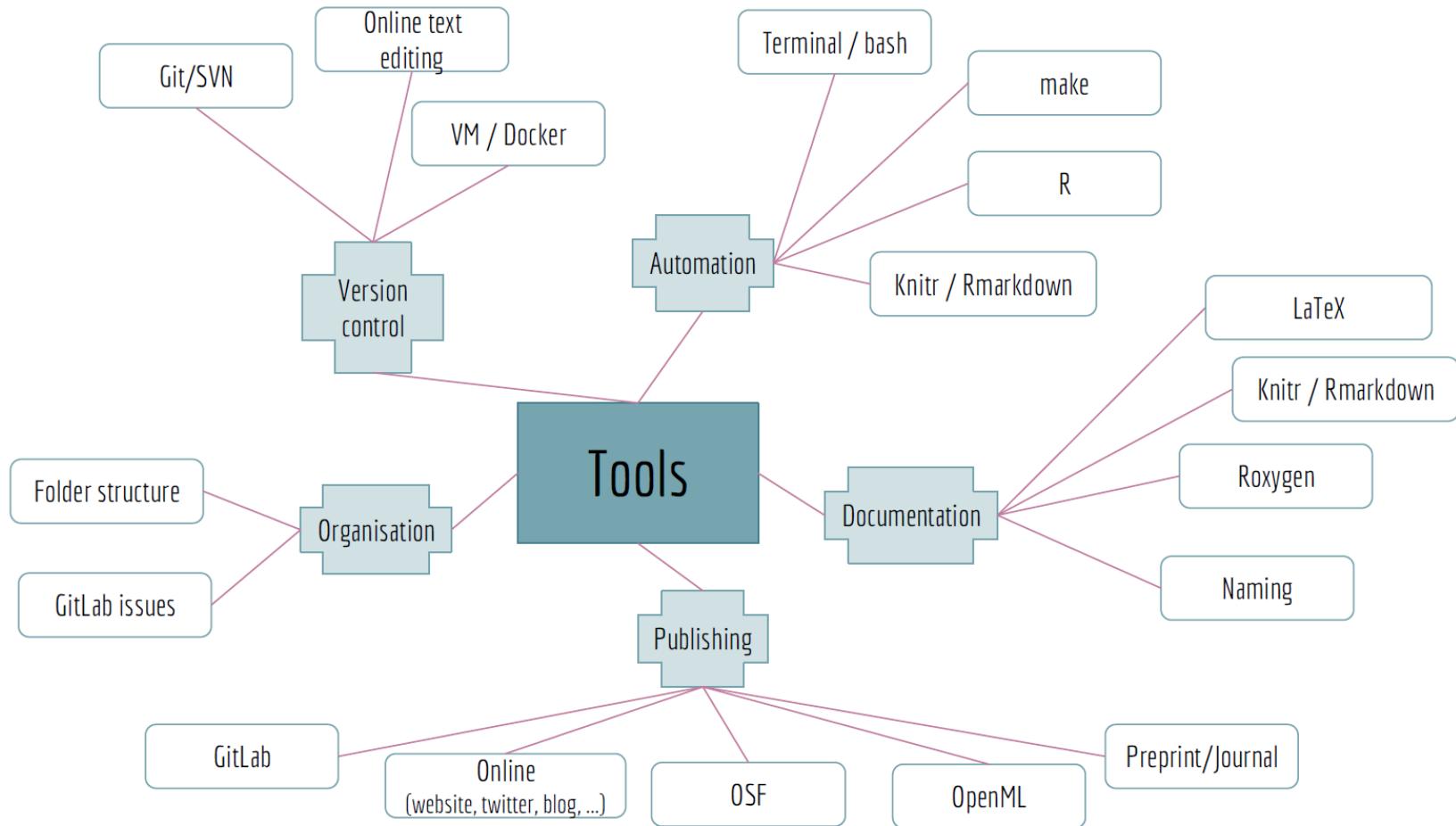
Consulting

...True scientific curiosity

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# How to do Open Science

A very personal view of the tools that we use in our daily work.



# How to make your research **comprehensible** to others (and yourself).

- 1) Write code.
- 2) Document your code.  
(i.e., make in-code comments)
- 3) Combine comments, code, and results in one document.  
(i.e., use reproducible notebook interfaces; e.g., Rmarkdown, Jupyter Notebooks)



## (1) Write code. (2) Document your code.

- use meaningful variable names

```
ti <- ih + iw  
total_income <- income_husband + income_wife
```

- use explicit data values

(e.g., *male* / *female* vs. 1 / 2)

- structure your code
- write comments

```
taxes <- function(income_husband, income_wife, age_child, child_education){total_income  
  <- income_husband + income_wife; tax <- 0.25*total_income;if(age_child  
  >=18){if(child_education==1){tax_total <-  
    tax*0.9};if(child_education==1){tax_total<-tax}};if(age_child <18){tax_total <-  
  tax*0.9};return(tax_total)}
```

# (1) Write code. (2) Document your code.

```
#####
## This function calculates the total amount of taxes a household has to pay
## Function assumes so far the the family has only one child
## The function further assumes that the tax decreases when the child is younger
## the 18 or when the child is studying

# input variables
# income_husband = monetary value, income_wife = monetary value,
# age_child = positive integer, child_education = binary 1=yes and 0=no
taxes <- function(income_husband, income_wife, age_child, child_education){
  # total income is the sum of incomes in the family
  total_income <- income_husband + income_wife
  # tax is assumed to be 25% of the income
  tax <- 0.25 total_income

  # if condition to proof wheter the child is younger/older than 18
  if(age_child >=18){
    # if child is older than 18 but still in education additional
    # tax reduction is calculated
    if(child_education==1){
      tax_total <- tax 0.9
    }
    # if child is older than 18 but not in education total_tax remains tax
    if(child_education!=1){
      tax_total<-tax
    }
  }
  # if child is younger than 18 tax reduction is calculated
  # (education does not matter)
  if(age_child <18){
    tax_total <- tax 0.9
  }
  # the function returns the total amount of tax
  return(tax_total)
}
```

## (3) RMarkdown documents

(.Rmd file)

```
Also, we load all packages that we'll need.  
```{r packages, warning=FALSE, message=FALSE}  
library(psych)  
library(lmerTest)  
```\n\n# Descriptives  
Short descriptives for the dataset.  
  
```{r}  
# number of subjects  
nrow(d)  
  
# gender  
round(prop.table(table(d$sex))*100, 1)  
  
# age  
describe(d$age, skew = FALSE)  
```\n\n# Correlations  
We first create new data frames for each fluency
```

(result, e.g. PDF / Word file)

Also, we load all packages that we'll need.

```
library(psych)  
library(lmerTest)
```

## 2 Descriptives

Short descriptives for the dataset.

```
# number of subjects  
nrow(d)  
  
## [1] 201  
# gender  
round(prop.table(table(d$sex))*100, 1)
```

```
##  
## female male  
## 47.3 52.7
```

```
# age  
describe(d$age, skew = FALSE)
```

```
##      vars   n   mean     sd  min max range    se  
## X1      1 201 34.14 9.63  21  70    49 0.68
```

## How to make your research transparent.

- 1) Be honest. Report honest.
- 2) Pre-register your study.
- 3) Maybe even think of a registered report\*.



→ AS PREDICTED

Registered Report



\* only supported by *Psych & Marketing*. yet.

## (2) Pre-registration: OSF (osf.io/prereg)

The screenshot shows the OSF Register dialog box. At the top, it says "Register". Below that, a message states: "Registration creates a frozen version of the project. Your original project remains editable and will have the registration linked." A section titled "Things to know about registration:" lists:

- Registrations cannot be edited or deleted.
- Withdrawing a registration removes its contents, but leaves behind basic metadata: title, contributors, date registered, date withdrawn, and justification (if provided).
- Registrations can be public or embargoed for up to four years. Embargoed registrations will be made public automatically when the embargo expires.

Below this, a section says "Continue your registration by selecting a registration form:" with a list of registration types. The "OSF Preregistration" option is selected (radio button is checked). Other options include "Open-Ended Registration", "Registered Report Protocol Preregistration", "Preregistration Template from AsPredicted.org", "OSF-Standard Pre-Data Collection Registration", "Replication Recipe (Brandt et al., 2013): Post-Completion", "Replication Recipe (Brandt et al., 2013): Pre-Registration", and "Pre-Registration in Social Psychology (van 't Veer & Giner-Sorolla, 2016): Pre-Registration". At the bottom right of the dialog are "Cancel" and "Create draft" buttons.

The screenshot shows the OSF Register form. It has several fields:

- "Is data collection for this project underway or complete?" with a dropdown menu showing "No".
- "Have you looked at the data?" with a dropdown menu showing "No".
- "Other Comments" with a text area containing: "This registration includes a pre-analysis plan and the complete description of the study design, but will remain private until data collection is complete".
- A large warning message at the bottom left: "Registration cannot be undone, and the archived content and files cannot be deleted after registration. Please be sure the project is complete and comprehensive for what you wish to register."
- A final step: "Type 'register' if you are sure you want to continue" with a text input field.

# OSF pre-registration: Example

The screenshot shows the OSF (Open Science Framework) interface. At the top, there's a navigation bar with links for 'OSF HOME', 'My Quick Files', 'My Projects', 'Search', 'Support', 'Donate', and a user profile for 'Stefan Mayer'. Below the navigation bar, the main content area displays a file list and a PDF preview.

**File List:**

- 00\_Bootstrapping\_Procedure.R
- 00\_Data\_Prep.R
- 01\_Descriptives.R
- 02\_Relabilities.R
- 03\_LMMs.R
- 04\_Plots.R
- 05\_MDA.R
- codebook\_project\_668129\_2017...
- data\_project\_668129\_2017\_07\_2...
- Stimuli.txt
- Study2.pdf
- Study2.Rmd
- Study\_2\_PreDataCollection.pdf

**Tags:**

Add a tag to enhance discoverability

**PDF Preview:**

**Title of the study:** Validation of a Scale to Measure the Subjective Experience of Processing Fluency

Part of the *Fluency Measurement Project* (Study 2)

**Aim of Study**

This study compares a 1-item measure of subjective fluency with a 5-item measure (developed in Study 1 of the *Fluency Measurement Project*) in terms of the measures' ability to mediate five different established fluency effects. The aim is to compare the predictive validity (i.e., the mediating ability) of the two scales in order to derive recommendations on how the subjective processing fluency experience can be measured across the whole range of fluency effects.

**Study Design, Procedure, Stimuli, Number of Participants**

- The study consists of five tasks that cover five established fluency manipulations and effects: the effect of color contrast on truth judgments of geographic statements, the effect of design typicality on car liking, the effect of symmetry on picture liking, the effect of exposure on the liking of Kanji characters, and the effect of pronunciation ease on risk perception of food additive names (Figure 1 details the experimental procedure and provides an overview of the experimental stimuli employed).
- The study employs a 2 (fluency: low versus high) x 2 (fluency scale: 1-item versus 5-item) x 5 (fluency task: truth of geographic statements, liking of car design, liking of art pictures, liking of kanji characters, perceived risk of food additive names) mixed factorial design where the first factor is manipulated within subjects, the second factor is manipulated between subjects, and the last factor is a within-subjects replication factor.
- Participants complete all five tasks in a random order. At the beginning of the study, participants are randomly assigned to one of the scale conditions.
- The 5 tasks use the following stimuli and procedures:
  - *Truth of Geographic Statements Varying in Color Contrast:* Participants evaluate 16 geographic statements (e.g., Osorno is in Chile); each of the 16 statements is

[osf.io/3j45a/](https://osf.io/3j45a/)

recommendation

## (2) Pre-registration: AsPredicted ([aspredicted.org](https://aspredicted.org))

Create a new AsPredicted pre-registration

CREATE

See your existing AsPredicteds (e.g. approve, make public)

Your email address (used in AsPredicted)

SEE OWN

### What's an AsPredicted?

It is a standardized pre-registration that requires only what's necessary to separate exploratory from confirmatory analyses. You will easily generate a pre-registration document that takes less effort to evaluate than it takes to evaluate the published study itself.

[About](#) [Terms of use](#)

### How does it work?

- One author briefly answers 9 questions.
- All participating authors receive an email asking for approval.
- If everyone approves, it is saved and stays private until an author acts to make it public, or it remains private forever. ([Why?](#))
- Authors may share anonymous .pdf with reviewers.

### What if things don't go "as predicted"

You can just say so in the paper:

- "Contrary to expectations, we found that..."
- "Unexpectedly, we also found that..."
- "In addition to the analyses we pre-registered we also ran..."
- "We encountered an unexpected situation, and followed our Standard Operating Procedure" (.pdf)

# AsPredicted: Example

[HOME](#) [See List](#)



[Make Suggestion](#) [Change my email](#)

## As Predicted: "*The role of processing fluency and arousal in EC effects*" (#14116)

**Created:** 09/17/2018 05:00 AM (PT)

### Author(s)

Laura K. M. Graf (Goethe University) - [lgraf@wiwi.uni-frankfurt.de](mailto:lgraf@wiwi.uni-frankfurt.de)

Jan R. Landwehr (Goethe University) - [landwehr@wiwi.uni-frankfurt.de](mailto:landwehr@wiwi.uni-frankfurt.de)

### 1) Have any data been collected for this study already?

No, no data have been collected for this study yet.

### 2) What's the main question being asked or hypothesis being tested in this study?

The study investigates the role of processing fluency and arousal in evaluative conditioning (EC) effects. More specifically, we build on the research by Landwehr, Golla, and Reber (2017) who have shown that EC contains a fluency component due to repeated exposure. We extend this research and additionally investigate the role of arousal in shaping EC effects. We predict that when arousal is high (due to unconditioned stimuli high in arousal) compared to low, the positive effect of fluency due to repeated exposure will be lower because fluency and arousal are incompatible experiential states. Precisely, we expect that the additional positive effect of fluency on liking under positive EC will decrease when arousal is higher compared to lower. For negative EC, the mitigating effect of processing fluency on liking will be less strong when arousal is higher compared to lower.

As USs we use IAPS pictures. As conditioned stimuli (CS) a pool of 18 Kanji characters (i.e., symbols used in Japanese writing) are used. Of these, we randomly sample 6 Kanjis that are used in the EC phase and paired with one of the 6 USs. 6 additional Kanjis are used in the no exposure baseline condition and 6 further Kanjis serve as distractor stimuli in a memory task.

# AsPredicted: Example (cont'd)

## 3) Describe the key dependent variable(s) specifying how they will be measured.

Liking: How much do you like this character?, (1 = not at all; 101 = very much)

Arousal: How do you feel when looking at this character?, (1 = calm; 101 = aroused)

Fluency: The process of studying the character was ... (1 = difficult; 101 = easy)



## 4) How many and which conditions will participants be assigned to?

The question will be tested using a 3 (US valence: negative, neutral, positive) by 2 (US arousal: low, high) experimental design with an additional no exposure baseline condition. All conditions are manipulated within subjects.

## 5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.

We will analyze the results according to Landwehr et al. (2017). Additionally, we will investigate arousal as a component of EC effects.

## 6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

We will exclude participants who score less than 5 out of 6 correct answers in the memory test. However, if this rule reduces our sample size too much, we will also include participants who gave 4 out of 6 correct answers in the test.

## 7) How many observations will be collected or what will determine sample size?

No need to justify decision, but be precise about exactly how the number will be determined.

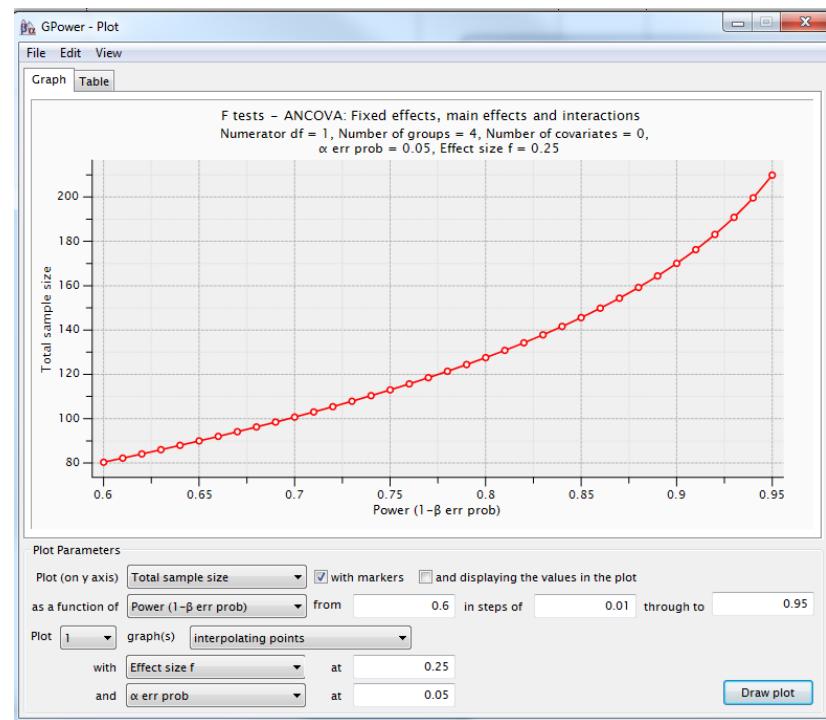
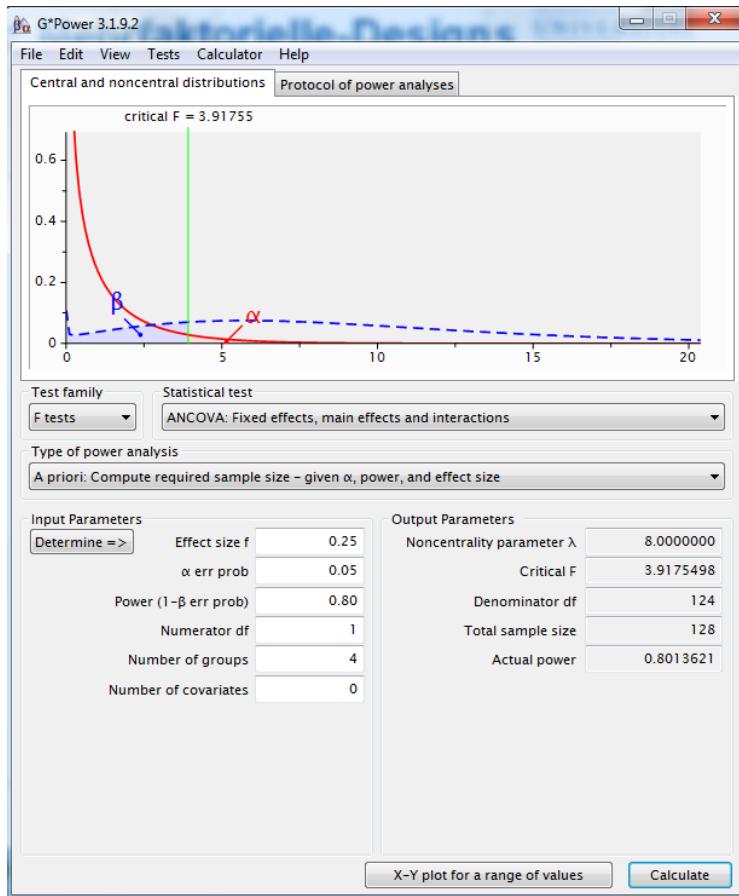
300

## 8) Anything else you would like to pre-register?

(e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)

No

## (2) Pre-registration: Sample Size (G\*Power 3.1.9.2)



(Between Subjects Design)

## How to make your research **accessible**.

- 1) Use open-source software.
- 2) Publish open access or upload a pre-print. (#elsevier)
- 3) Share code, data, and materials.



## (2) Pre-prints: e.g. OSF (osf.io/preprints/)

Preprints from OSF, arXiv, SSRN, etc. are indexed on Google Scholar!



The screenshot shows the OSF Preprints homepage. At the top, there is a dark navigation bar with the OSF Preprints logo, a dropdown menu, and links for "Add a Preprint", "Search", "Support", "Donate", "Sign Up" (in a green button), and "Sign In" (in a teal button). The main title "OSF PREPRINTS" is prominently displayed with a blue circular logo to its left. Below the title is a search bar containing the placeholder "Search preprints..." and a "Search" button. A note below the search bar states "2,225,718 searchable as of March 20, 2019". Further down, there is a green button labeled "Add a preprint" and a link "See an example".

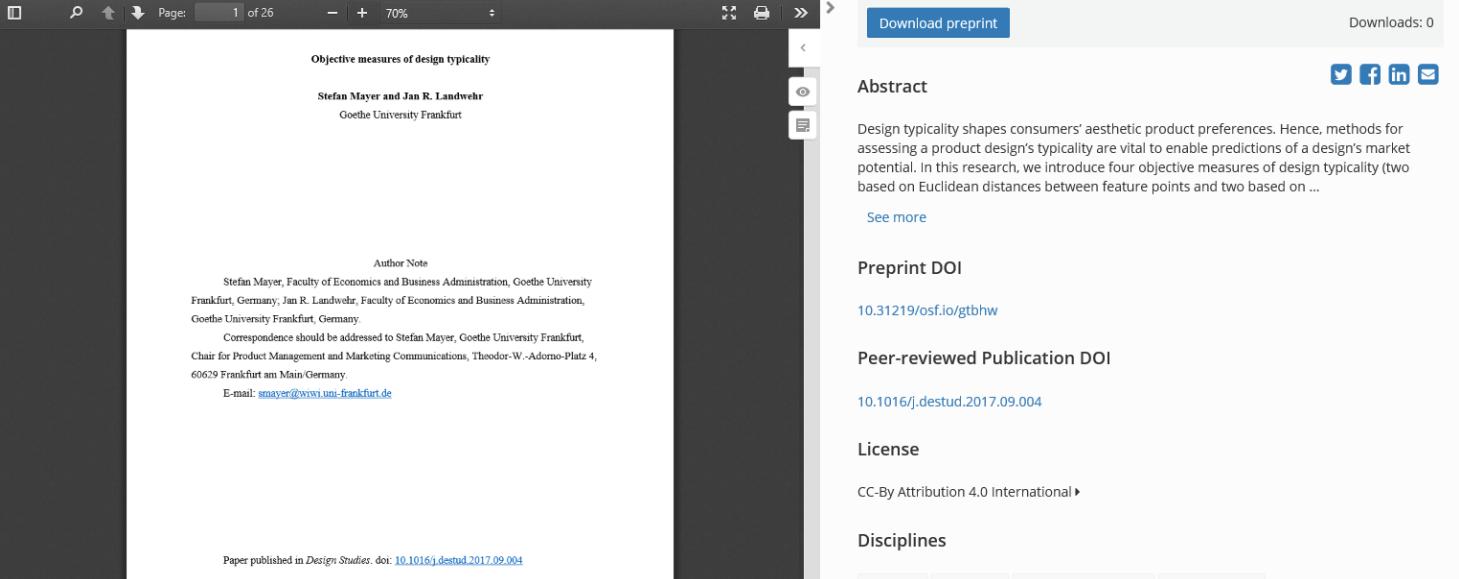
# OSF pre-print: Example

Objective measures of design typicality

AUTHORS  
Stefan Mayer, Jan Landwehr

CREATED ON  
March 20, 2019

LAST EDITED  
March 20, 2019



The screenshot shows the OSF pre-print interface. At the top, there's a dark header bar with the title "Objective measures of design typicality". Below it, a smaller bar displays author information: "AUTHORS Stefan Mayer, Jan Landwehr", "CREATED ON March 20, 2019", and "LAST EDITED March 20, 2019". To the right of the title is the OSF logo, which is a circular icon composed of blue and white dots. The main content area has a dark background. On the left, there's a large preview window showing the first page of the document, which includes the title, authors, and a "Author Note" section. On the right, there's a sidebar with various links and metrics. The "Abstract" section is visible, followed by a "See more" link. Below that are sections for "Preprint DOI" (with the DOI 10.31219/osf.io/gtbhw), "Peer-reviewed Publication DOI" (with the DOI 10.1016/j.destud.2017.09.004), "License" (CC-BY Attribution 4.0 International), and "Disciplines" (Business, Marketing, Arts and Humanities, Art and Design). At the bottom of the sidebar, there are download statistics: "Downloads: 0" and social sharing icons for Twitter, Facebook, LinkedIn, and Email.

Download preprint

Downloads: 0

Abstract

See more

Preprint DOI

10.31219/osf.io/gtbhw

Peer-reviewed Publication DOI

10.1016/j.destud.2017.09.004

License

CC-BY Attribution 4.0 International

Disciplines

Business Marketing Arts and Humanities Art and Design

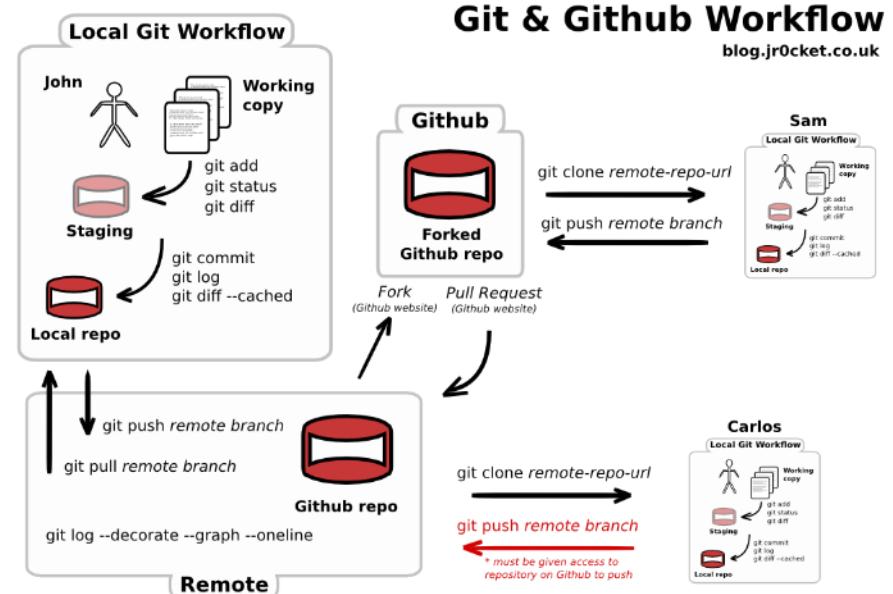
Paper published in *Design Studies*. doi: [10.1016/j.destud.2017.09.004](https://doi.org/10.1016/j.destud.2017.09.004)

[osf.io/gtbhw/](https://osf.io/gtbhw/)

## (3) Sharing: GitHub (github.com)



- git version control  
(revert to previous, working version)
- online backup storage  
(private repository)
- code / data sharing  
(public repository)
- software distribution  
(e.g., R package)



Source: <http://jr0cket.co.uk/2013/08/getting-to-grips-with-git-understanding-the-simple-workflow.html.html>

→ Appendix: **git and github – a primer.**

# GitHub: example R package

The screenshot shows the GitHub repository page for 'stm / imagefluency'. The repository has 107 commits, 1 branch, 0 releases, 1 contributor, and is licensed under GPL-3.0. The 'Code' tab is selected. A list of recent commits is shown:

Author	Commit Message	Date
R	added example for img_read	4 months ago
inst	changed code to always using explicit function calling instead of usl...	4 months ago
man	added example for img_read	4 months ago
tests	testthat tolerance for img_self_similarity (win)	4 months ago
.Rbuildignore	add travis-d	4 months ago
.gitignore	included link to shinyapps page	4 months ago
.travis.yml	Remove windows from travis-d (R is currently not supported in the Wi...	4 months ago
DESCRIPTION	update to version 0.2.0	4 months ago
LICENSE	Initial setup	2 years ago
NAMESPACE	changed code to always using explicit function calling instead of usl...	4 months ago
NEWS	update to version 0.2.0	4 months ago
README.md	add travis-d	4 months ago

Below the commits, there is a section for 'imagefluency: Image Fluency Scores in R' which includes a Travis build status and an 'Overview' section. The overview describes the package as a simple R package for image fluency scores and provides links to the Shiny app and the main functions.

The main functions are:

- `img_contrast()` to get the visual contrast of an image.
- `img_complexity()` to get the visual complexity of an image (equals 1 minus image simplicity).
- `img_self_simililarity()` to get the visual self-similarity of an image.
- `img_simplicity()` function to get the visual simplicity of an image (equals 1 minus image complexity).
- `img_symmetry()` to get the vertical and horizontal symmetry of an image.
- `img_typicality()` to get the visual typicality of a list of images relative to each other.

Other helpful functions are:

- `img_read()` wrapper function to read images using `read.bitmap()` from the `readbitmap` package
- `run_imagefluency()` to launch a Shiny app locally on your computer for an interactive demo of the main functions
- `rgb2gray()` convert images from RGB to grayscale

The main author is Stefan Mayer.

## Installation

To download the lastest version from Github use the `install_github` function of the `devtools` package.

```
# install devtools if necessary
if (!require("devtools")) install.packages("devtools")
# install imagefluency
devtools::install_github('stm/imagefluency')
```

Use the following link to report bugs/issues: <https://github.com/stm/imagefluency/issues>

## (3) Sharing: Open Science Framework (osf.io)



Collaboration, documentation, archiving.

The screenshot shows the OSF project page for "Measuring Processing Fluency: One versus Five Items". The top navigation bar includes links for OSFHOME, Search, Support, Donate, Sign Up, and Sign In. The main content area displays the project title, contributors (Laura K. M. Graf, Stefan Mayer, Jan R. Landwehr), date created (2017-05-23 03:56 PM), last updated (2017-12-11 01:23 PM), and category (Project). A detailed description of the research aims and methods is provided. Below the description, there is a "Files" section listing a file named "license.txt" and two study folders ("Study 1" and "Study 2"). The "Citation" section shows the citation information. The "Recent Activity" section lists four updates made by Stefan Mayer, including changing the license, adding a file, changing the title, and editing the description, all occurring between December 11, 2017, and December 12, 2017.

Name	Modified
Measuring Processing Fluency: One versus Five...	2017-12-11 01:23 PM
- OSF Storage (United States)	
license.txt	2017-12-11 01:23 PM
+ Study 1	
+ Study 2	

Recent Activity	
Stefan Mayer updated the license of Measuring Processing Fluency: One versus Five items to Other	2017-12-11 01:23 PM
Stefan Mayer added file license.txt to OSF Storage in Measuring Processing Fluency: One versus Five items	2017-12-11 01:23 PM
Stefan Mayer changed the title from Measuring Processing Fluency: 1 versus 5 items to Measuring Processing Fluency: One versus Five Items	2017-12-11 12:40 PM
Stefan Mayer edited description of Measuring Processing Fluency: One versus Five Items	2017-12-11 12:40 PM

# Open Science Framework: Features

- version control

The screenshot shows the OSF interface for a project titled "Measuring Processing Fluency: One ver...". The "Files" tab is selected. On the left, there's a file tree with files like SPM.pdf, Stimuli.txt, Study1.pdf, Study1.Rmd (which is selected), and Study\_1\_PreDataColl... In the center, there's a "Revisions" table:

Version ID	Date	User	Download	MD5	SHA2
2	2017-09-23 01:16 AM	Stefan Mayer	3	<a href="#">Download</a>	9644ad4c73f69f3678e00f74 767b9327fe9720a1a393eb4
1	2017-07-19 08:34 PM	Stefan Mayer	0	<a href="#">Download</a>	3d98a287c9040789900f638 e04f3f96fccf304f87f72897b

At the top right, there are buttons for Check out, Delete, Download, Share, Toggle view, View, Edit, and Revisions.

# Open Science Framework: Features

- version control
- persistent citable identifiers



## APA

Graf, L. K. M., Mayer, S., & Landwehr, J. R. (2017, December 11). Measuring Processing Fluency: One versus Five Items. Retrieved from osf.io/wyvrx

## MLA

Graf, Laura K M, Stefan Mayer, and Jan R Landwehr. "Measuring Processing Fluency: One versus Five Items." OSF, 11 Dec. 2017. Web.

## Chicago

Graf, Laura K M, Stefan Mayer, and Jan R Landwehr. 2017. "Measuring Processing Fluency: One versus Five Items." OSF. December 11. osf.io/wyvrx.

# Open Science Framework: Features

- version control
- persistent citable identifiers
- online backup storage (private project)
- code / data sharing (public project)

The Influence of Reaction Co... Files Wiki Analytics Registrations

Warning: This OSF project is private, but the GitHub repo BRosenblatt / OSFDocs is public. GitHub [here](#).

Click on a storage provider or drag and drop to upload

Name	Size
GitHub: BRosenblatt/OSFDocs (master)	766 B
.gitignore	2.3 kB
.idea	31.5 kB
docs	45 B
README.rst	984 B
requirements.txt	
tasks.py	
OSF Storage (United States)	

The Influence of Reaction Co... Files Wiki Analytics Registrations

Click on a storage provider or drag and drop to upload

Name	Size
The Influence of Reaction Conditions on HMF Oxidation Rate	2.4
OSF Storage (Canada - Montréal)	
Davis_Dissertation.pdf	
Amazon S3: agcatalysts (US Standard)	
naoh kinetics.xlsx	16
red-blood-cells-enmeshed-in-a-fibrinous-matrix.jpg	1.1
Analysis	
OSF Storage (Canada - Montréal)	

The Influence of Reaction Co... Files Wiki Analytics Registrations

Click on a storage provider or drag and drop to upload

Name	Size
The Influence of Reaction Conditions on HMF Oxidation Rate	2.4
Dropbox: / (Full Dropbox)	
Data	
Studies	
OSF Storage (Germany - Frankfurt)	

<http://help.osf.io/m/addons>

---

# Link collection

## RMarkdown

- <https://rmarkdown.rstudio.com/>
- <https://r4ds.had.co.nz/r-markdown.html>

## Jupyter Notebooks

- <https://jupyter.org/>
- <https://www.datacamp.com/community/tutorials/tutorial-jupyter-notebook>
- <https://colab.research.google.com/>

## Pre-registration

- <https://aspredicted.org/>
- <https://cos.io/prereq/>
- <https://osf.io/e6auq/wiki/Example%20Preregistrations/?view>
- <https://osf.io/9m6tx/> (Presentation by Brian Nosek)

## Registered Reports

- <https://cos.io/rr/>

---

# Link collection

## Pre-prints

- <https://osf.io/preprints/>
- <https://arxiv.org/>
- (<https://www.ssrn.com/>)

## *Further reproducibility tools*

### Reproducibility in Statistics and Machine Learning

- <https://goo.gl/sJqBNB>

### Reproducible computational environments: Docker and Code Ocean

- <https://colinfay.me/docker-r-reproducibility/>
- <https://ropenscilabs.github.io/r-docker-tutorial/>
- <https://codeocean.com/>



# Thank you.

## Jan R. Landwehr

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*Assistant Professor of Marketing Analytics*

School of Business and Economics  
University of Tübingen

[stefan.mayer@uni-tuebingen.de](mailto:stefan.mayer@uni-tuebingen.de)

Slides are licensed under a [Creative Commons Attribution 4.0 International License](#).

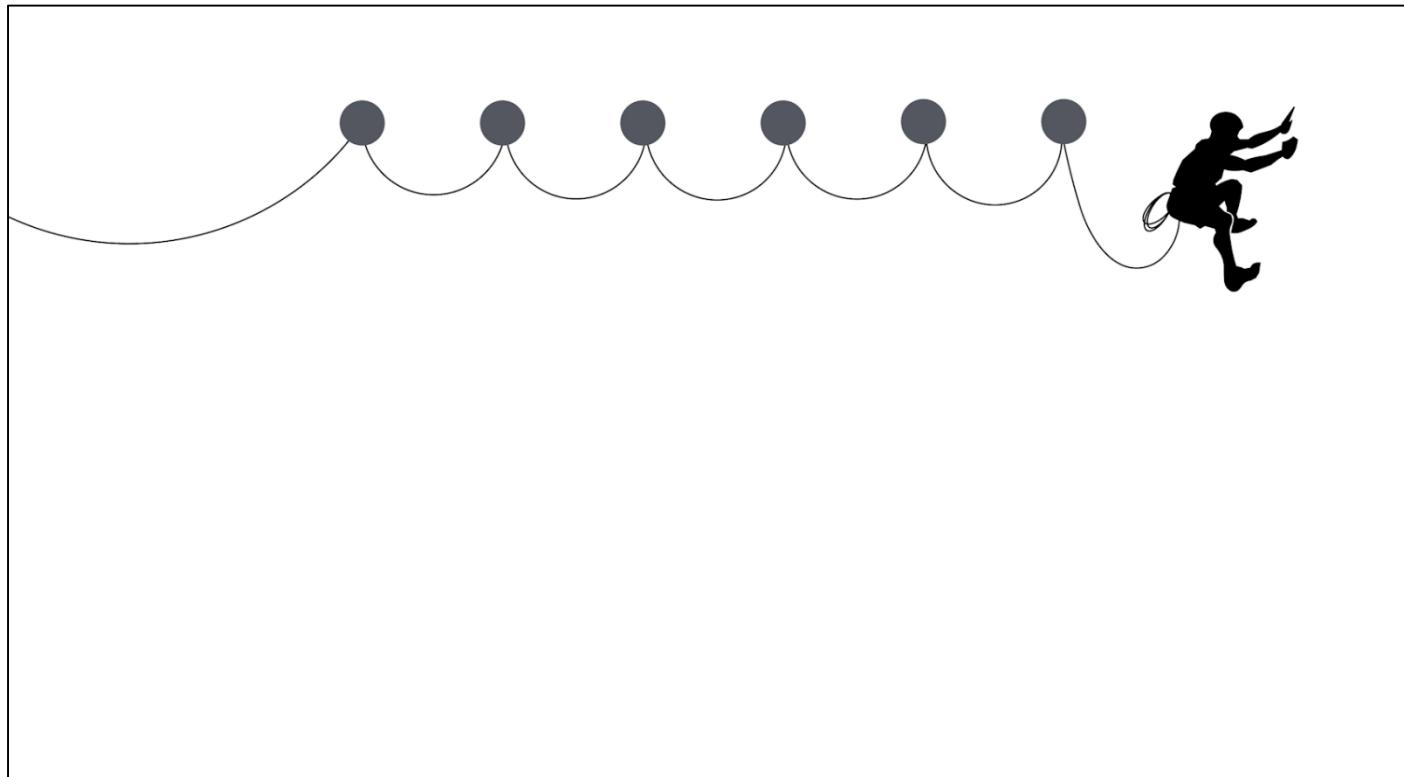


---

# Appendix

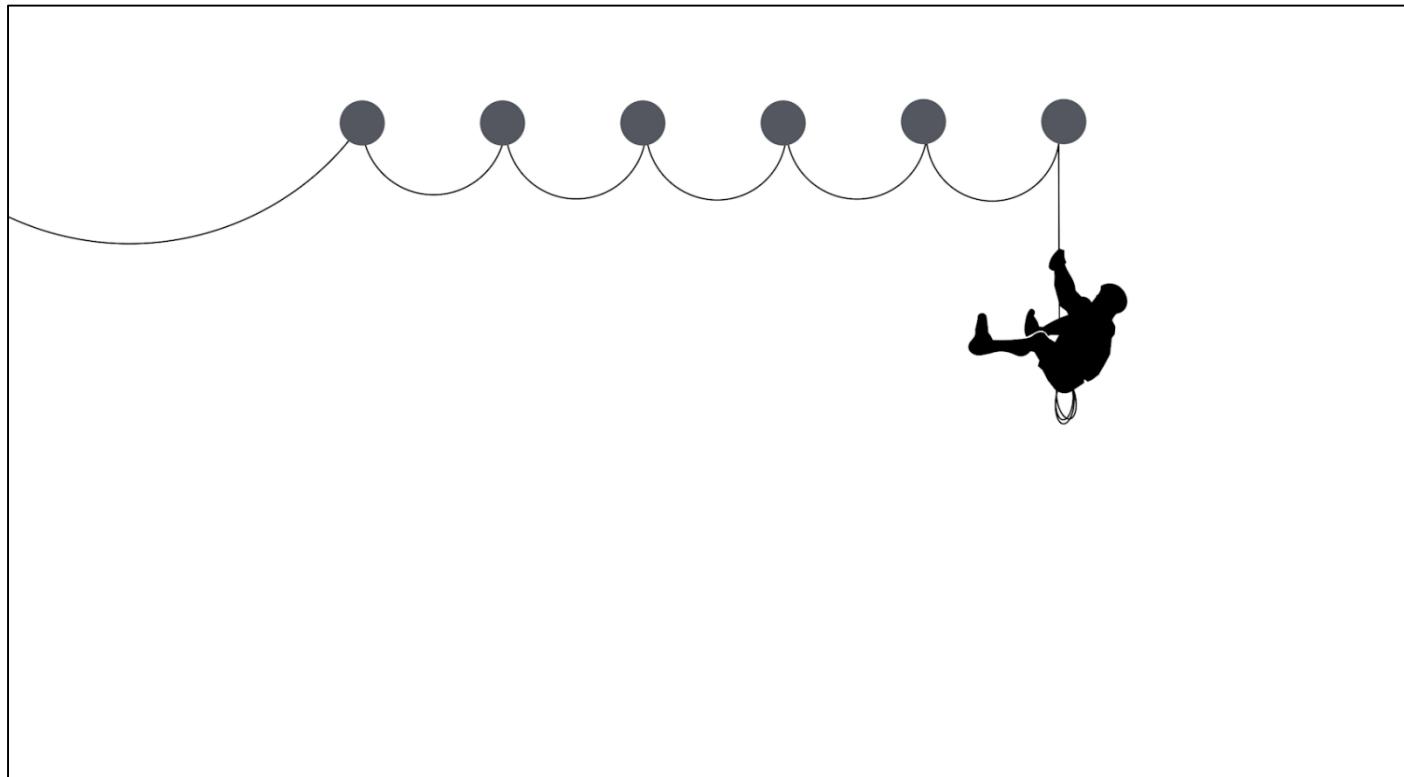
## git and github – a primer.

## Version control: Idea



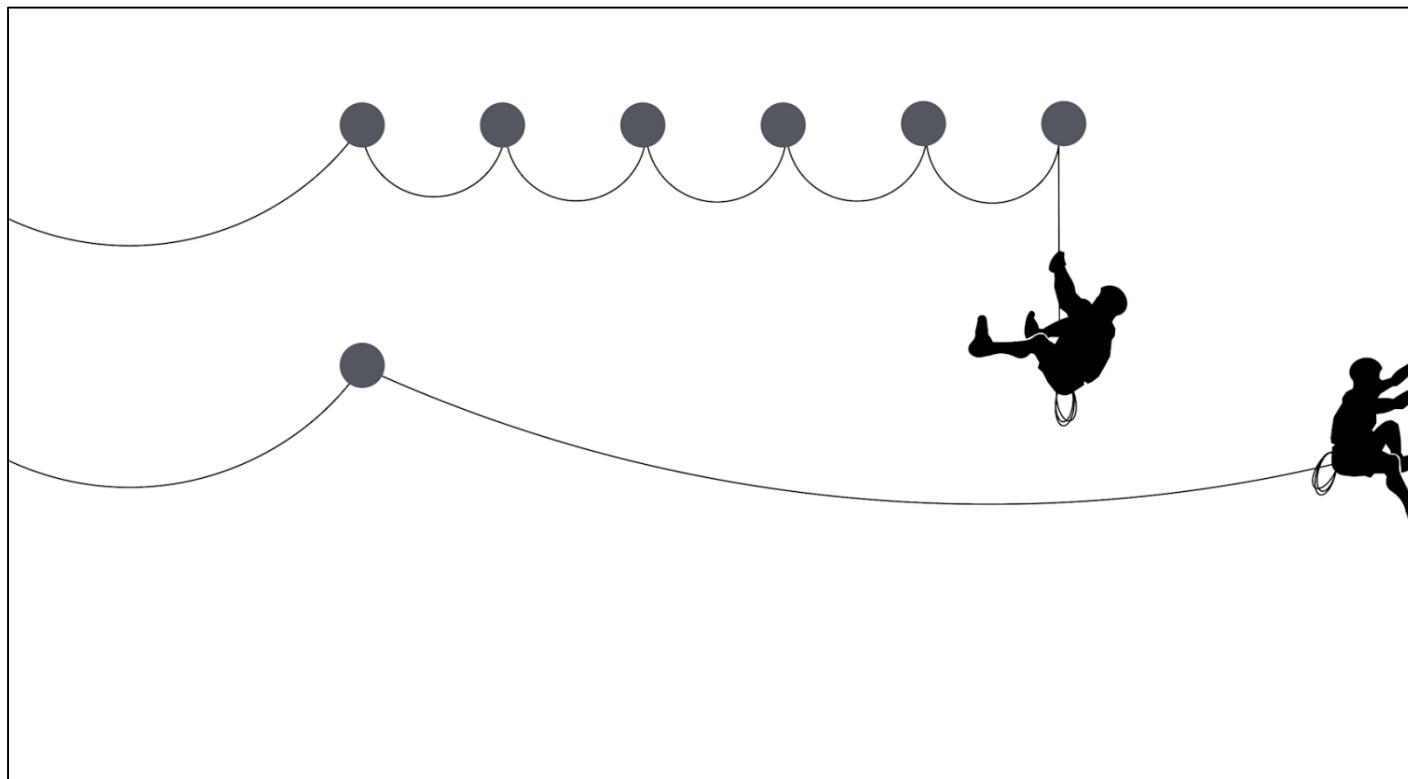
Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

## Version control: Idea



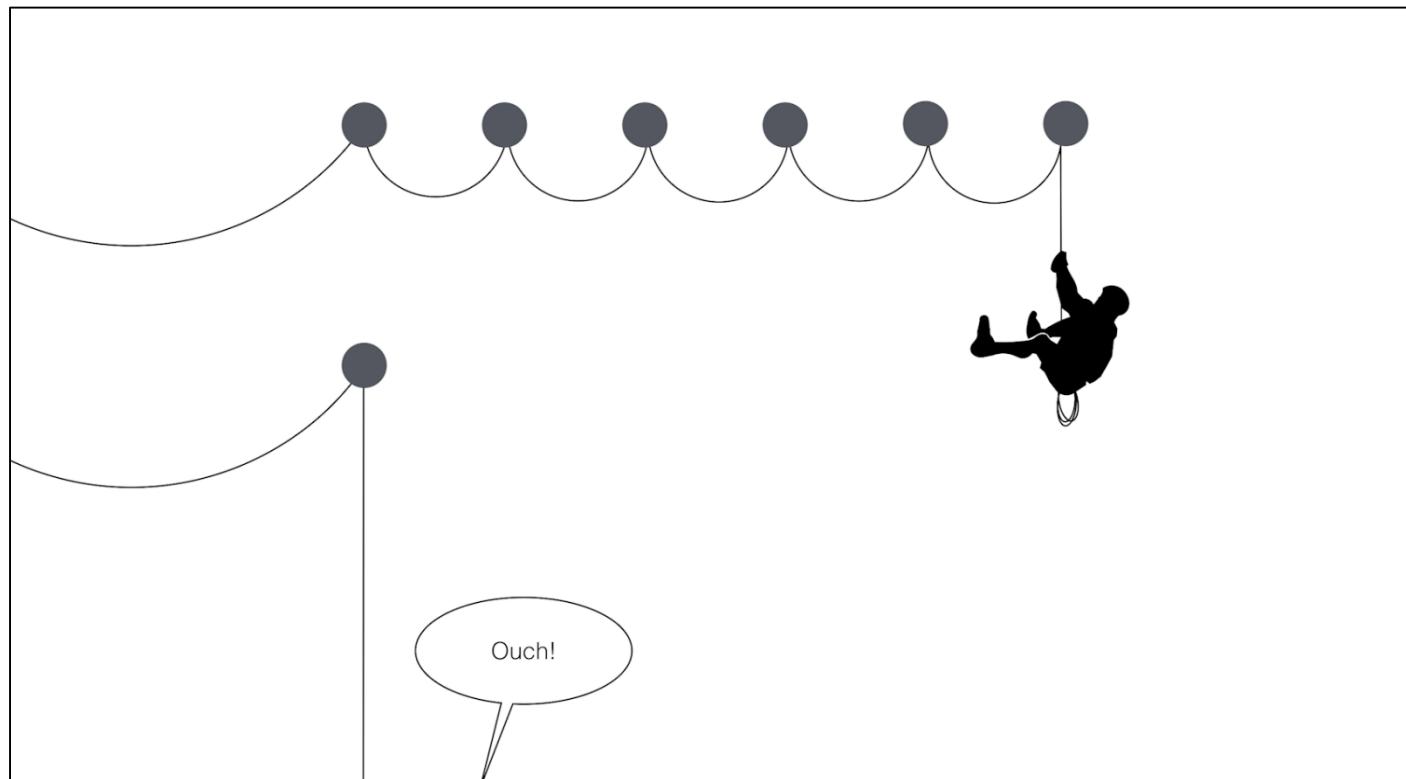
Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

## Version control: Idea



Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

## Version control: Idea



Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)



```
104   111      return(NA)
105   112    }
106   113  }
107   114  #
108 - if (!(direction == "positive" | direction == "negative")) {
109 + if (!(direction == "positive" | direction == "counterclockwise" | direction == "negative" | direction == "clockwise")) {
110   116    stop(paste0("", direction, "' is an unknown input to parameter 'direction'. Try 'direction = positive' or 'direction = negative'"))
111   118  }
112 - if (class(img) == "matrix") {
113 + @ -121.6 +128.12 @@ rotate90 <- function(img, direction = "positive") {
114 +   return(out)
115 - }
116 + }
117 - else {
118 +   stop(paste0("Unknown input of type '", class(img),"' (has to be of typ 'matrix' or 'array')"), call. = FALSE)
119 +   stop(paste0("Unknown input of type '", class(img),"' (has to be of typ 'matrix' or 'array')"), call. = FALSE)
120 - }
121 + }
122 - else {
123 +   +
124 -   stop(paste0("Unknown input of type '", class(img),"' (has to be of typ 'matrix' or 'array')"), call. = FALSE)
125 +   +
126 - }
127 + +
128 + #' @keywords internal
129 + #' @importFrom stats runif
130 + .rand_string <- function(n = 6){
131 +   + paste0(letters[round(runif(n, min = 1, max = 26))], collapse = ""))
132 + }
133 + }
```



# Version control with git

## History

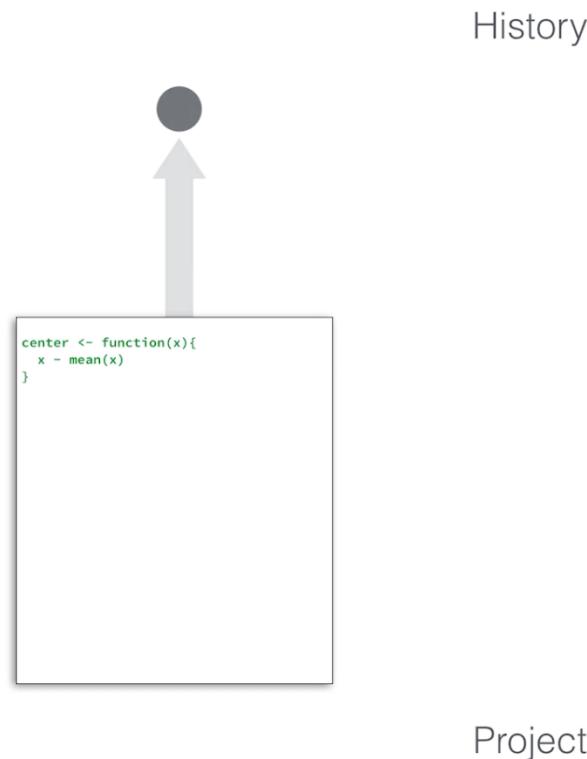
```
center <- function(x){  
  x - mean(x)  
}
```

## Project

Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

---

# Version control with git



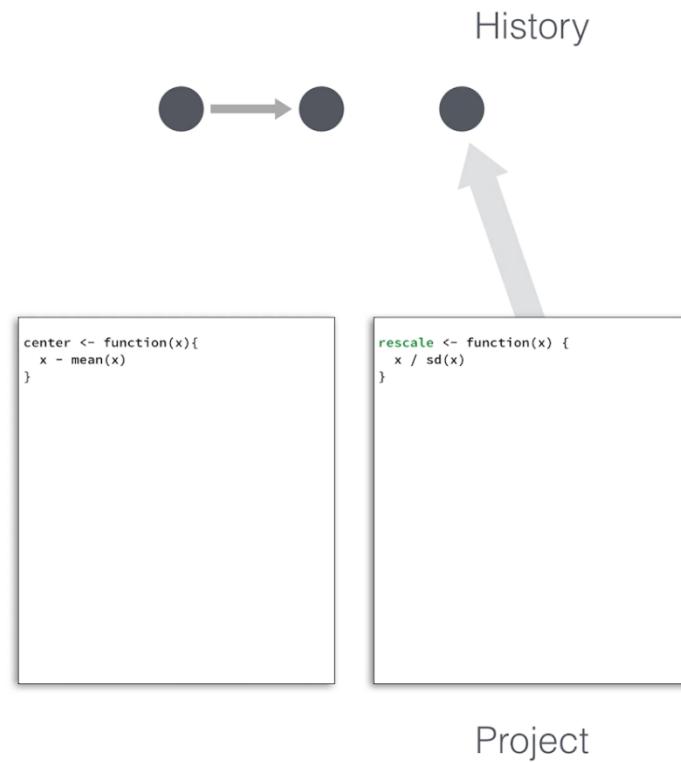
Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

# Version control with git



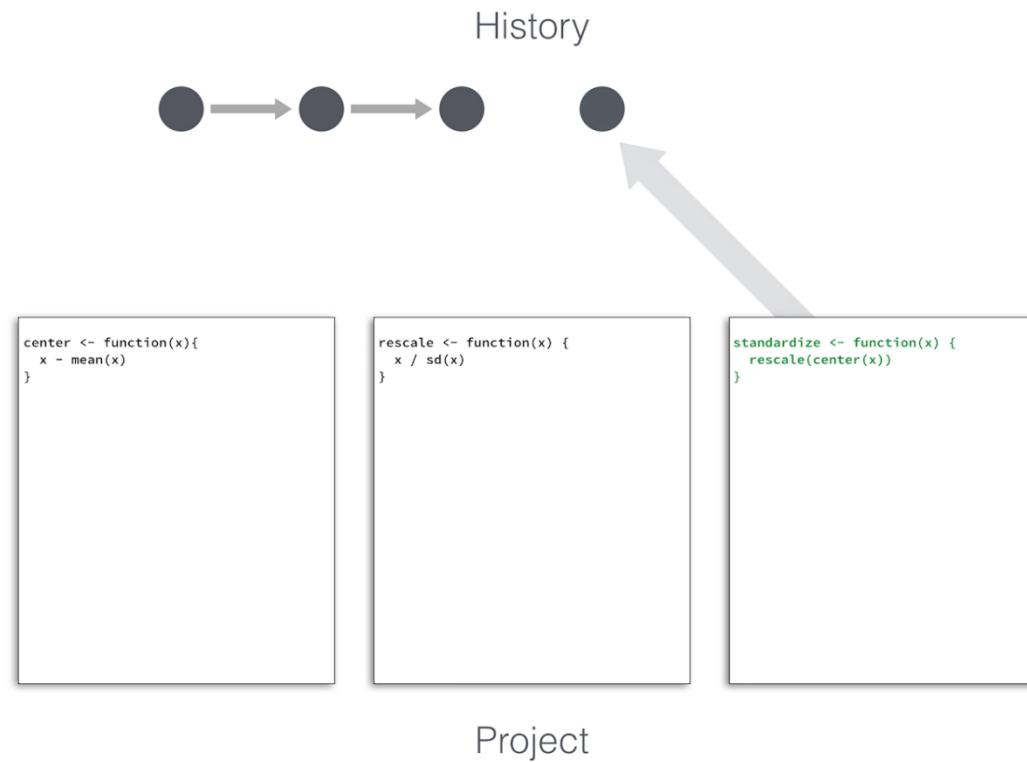
Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

# Version control with git



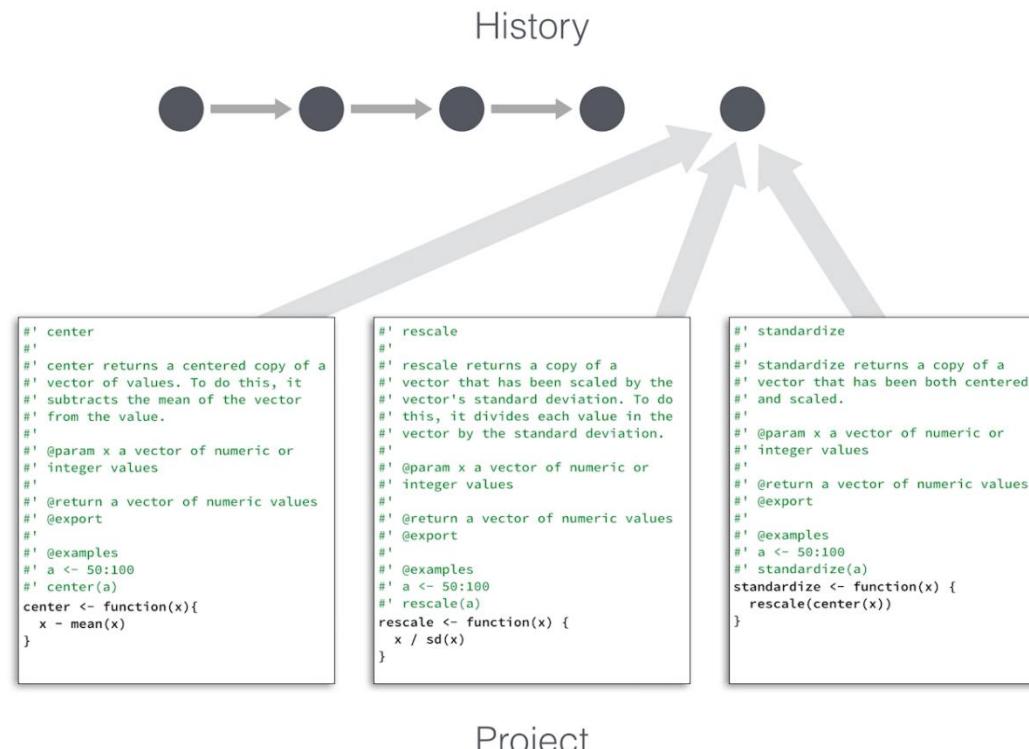
Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

# Version control with git



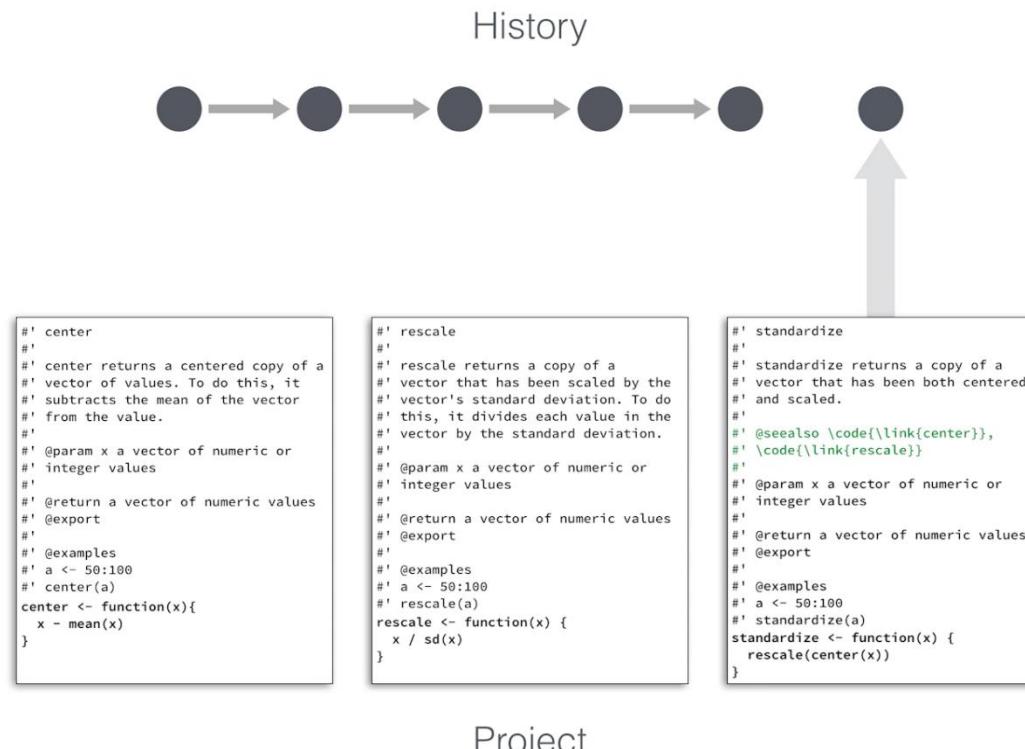
Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

# Version control with git



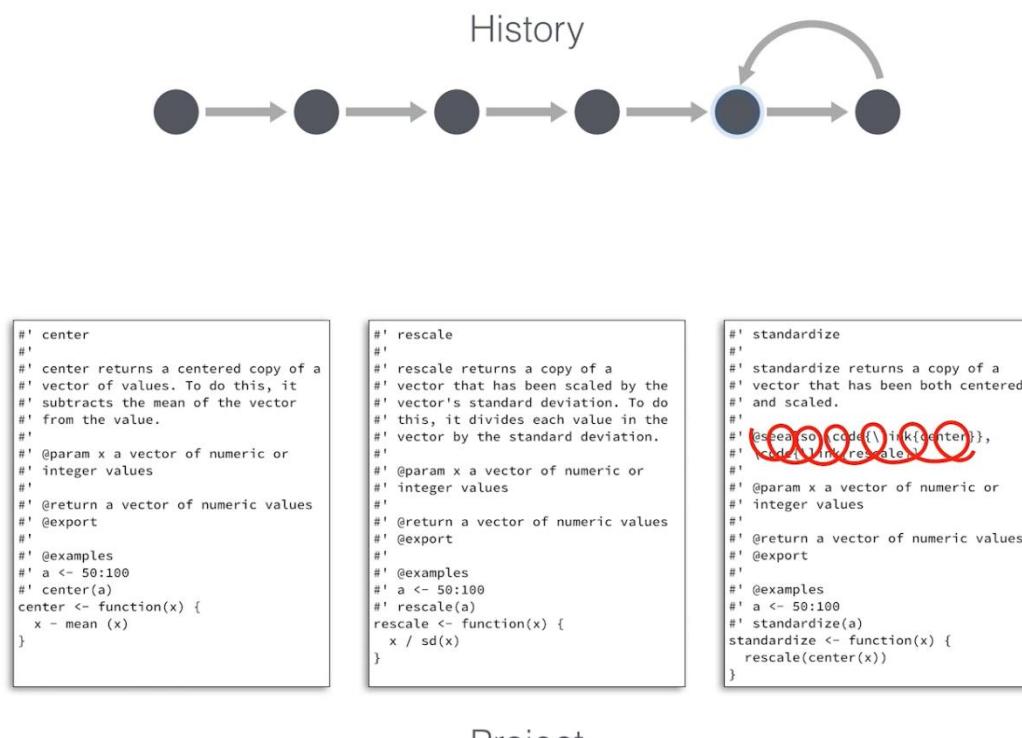
Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

# Version control with git



Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

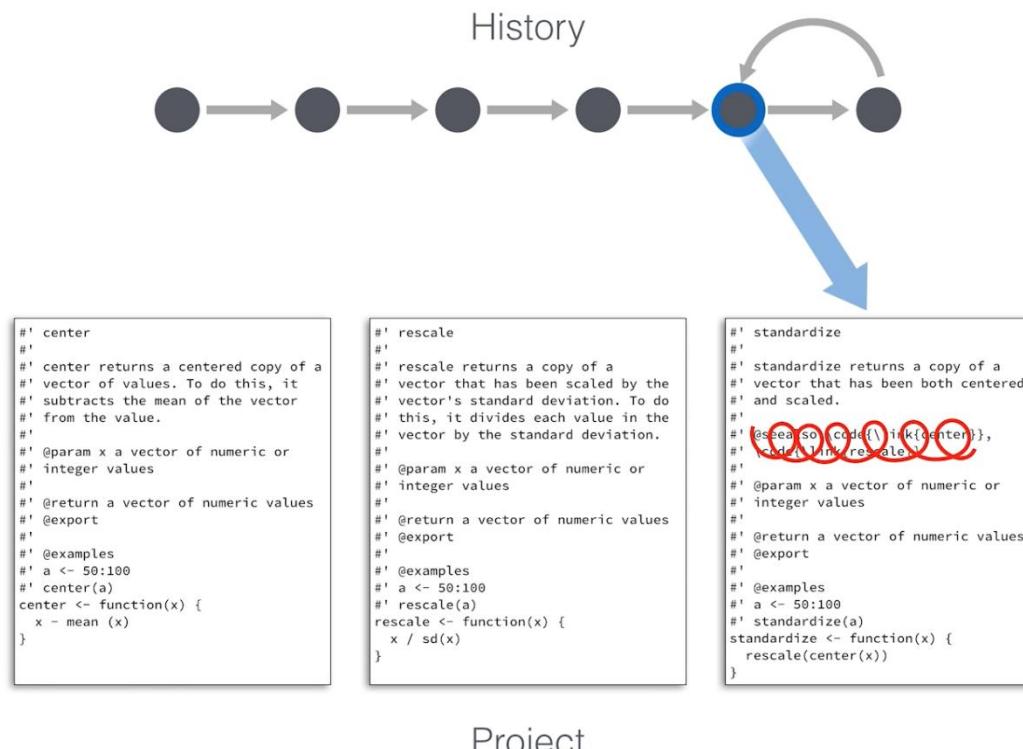
# Version control with git



Source: Garrett Grolemund

(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

# Version control with git



Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

# Version control with git



History

```
#' center
#'
#' center returns a centered copy of a
#' vector of values. To do this, it
#' subtracts the mean of the vector
#' from the value.
#'
#' @param x a vector of numeric or
#' integer values
#'
#' @return a vector of numeric values
#' @export
#'
#' @examples
#' a <- 50:100
#' center(a)
center <- function(x) {
  x - mean (x)
}
```

```
#' rescale
#'
#' rescale returns a copy of a
#' vector that has been scaled by the
#' vector's standard deviation. To do
#' this, it divides each value in the
#' vector by the standard deviation.
#'
#' @param x a vector of numeric or
#' integer values
#'
#' @return a vector of numeric values
#' @export
#'
#' @examples
#' a <- 50:100
#' rescale(a)
rescale <- function(x) {
  x / sd(x)
}
```

```
#' standardize
#'
#' standardize returns a copy of a
#' vector that has been both centered
#' and scaled.
#'
#' @param x a vector of numeric or
#' integer values
#'
#' @return a vector of numeric values
#' @export
#'
#' @examples
#' a <- 50:100
#' standardize(a)
standardize <- function(x) {
  rescale(center(x))
}
```

Project

Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

# Version control with git

**Real Life Version**  
uncommitted changes  
in blue

```
## center
## @param x a vector of
## numeric or integer values
##
## @return a vector of
## numeric values
## @export
##
## @examples
## a <- 50:100
## center(a)
center <- function(x) {
  x - mean(x)
}
```

```
## rescale returns a copy of
## a vector that has been
## scaled by the vector's
## standard deviation.
scale <- function(x) {
  x / sd(x)
}

# TODO: Should we pick a
better name
```

```
standardize <- function(x) {
  scale(center(x))
}

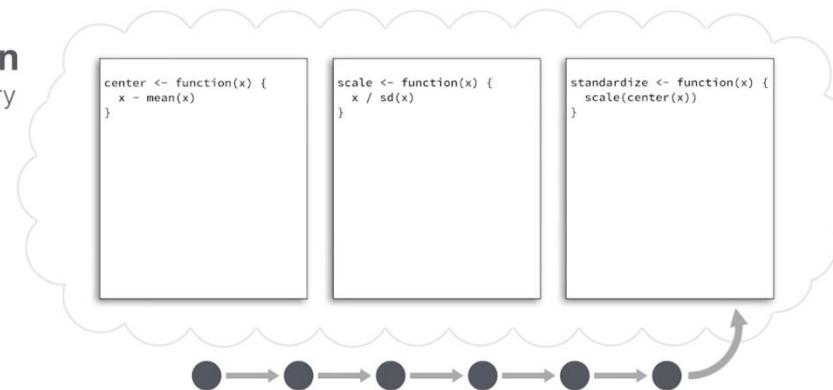
standardise<-function(x){  
  rescale(center(x))  
}
```

Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

---

# Version control with git

**"Official" Version**  
implied by commit history



**Real Life Version**  
uncommitted changes  
in blue

The diagram shows the real-life version of the same three R functions, with uncommitted changes highlighted in blue. The functions are presented in three separate boxes. The first two boxes show the initial state of the functions. The third box shows the final state after the changes have been committed, with the last line being a TODO note.

```
'# center'  
'#' @param x a vector of  
'#' numeric or integer values  
'#'  
'#' @return a vector of  
'#' numeric values  
'#' @export  
'#'  
'#' @examples  
'#' a <- 50:100  
'#' center(a)  
center <- function(x) {  
  x - mean(x)  
}  
  
'# rescale returns a copy of  
'# a vector that has been  
'# scaled by the vector's  
'# standard deviation.  
scale <- function(x) {  
  x / sd(x)  
}  
  
# TODO: Should we pick a  
# better name
```

```
standardize <- function(x) {  
  scale(center(x))  
}  
  
standardise<-function(x){  
  rescale(center(x))  
}
```

Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

# Using git with RStudio

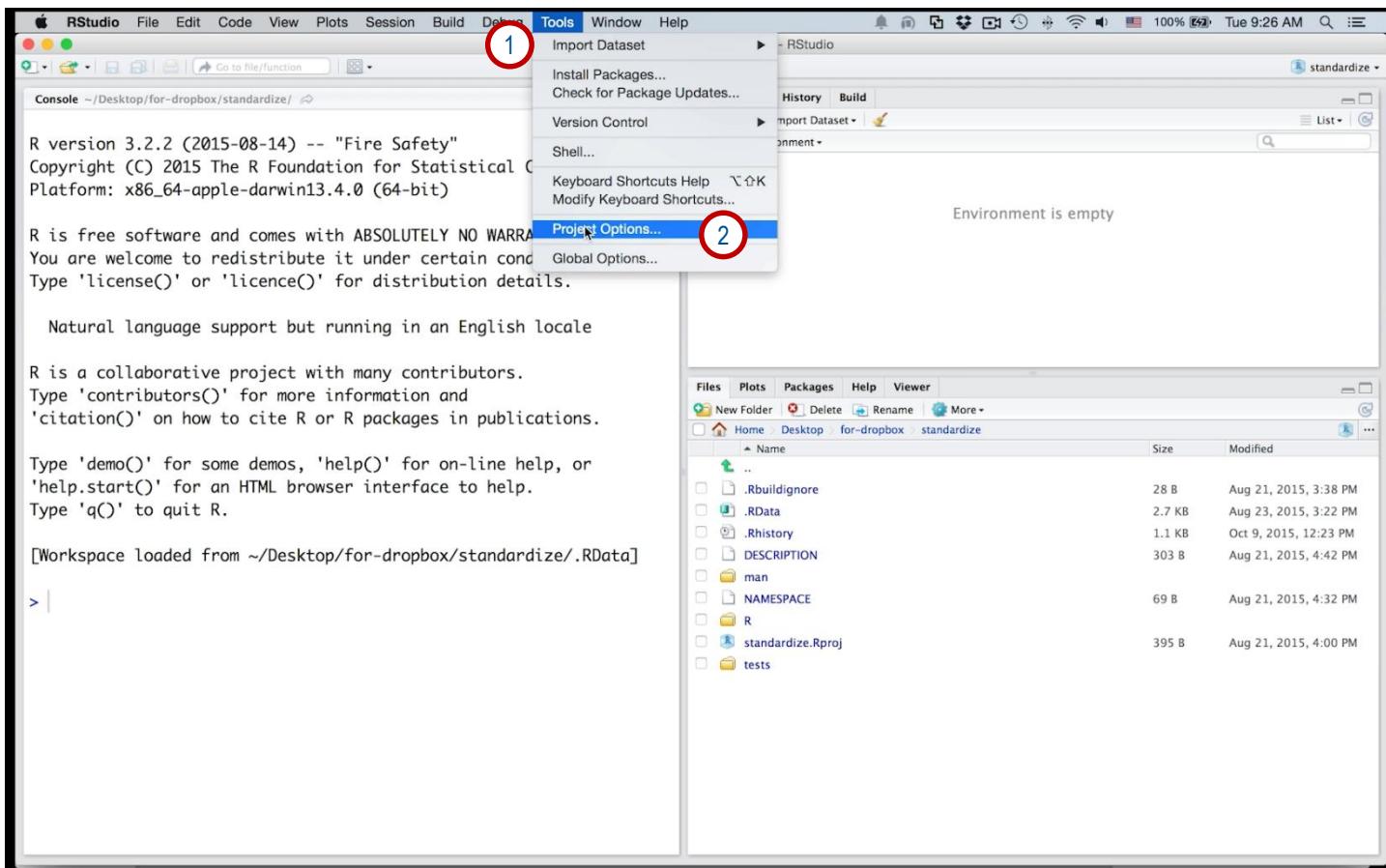
## 1<sup>st</sup>: Installing git

- To install git, visit:
  - <http://git-scm.com/download/mac>
  - <http://git-scm.com/download/win>
  - <http://git-scm.com/download/linux>

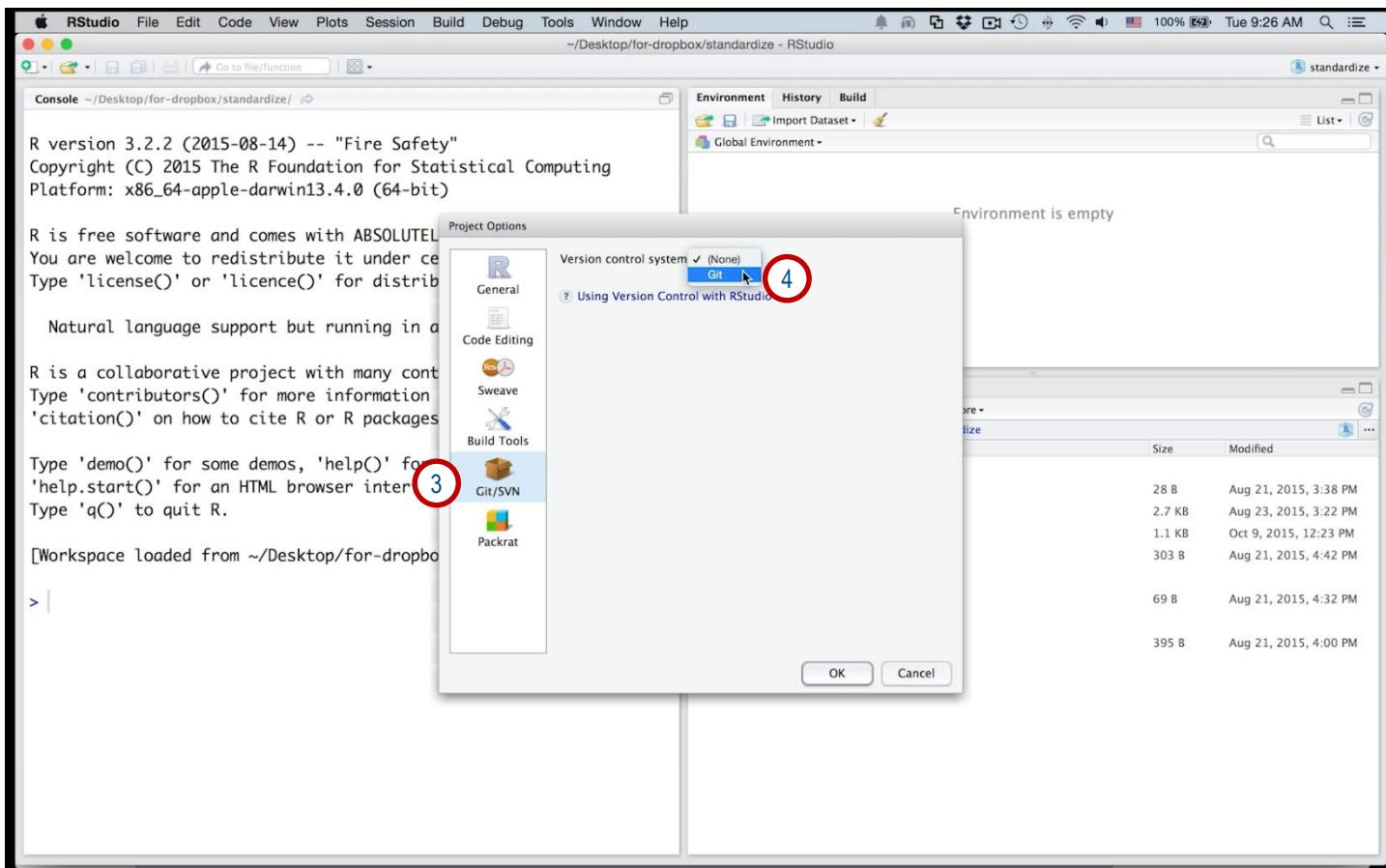
## 2<sup>nd</sup>: Initialize git for your project

- Open or create R Project
- Enable version control with git

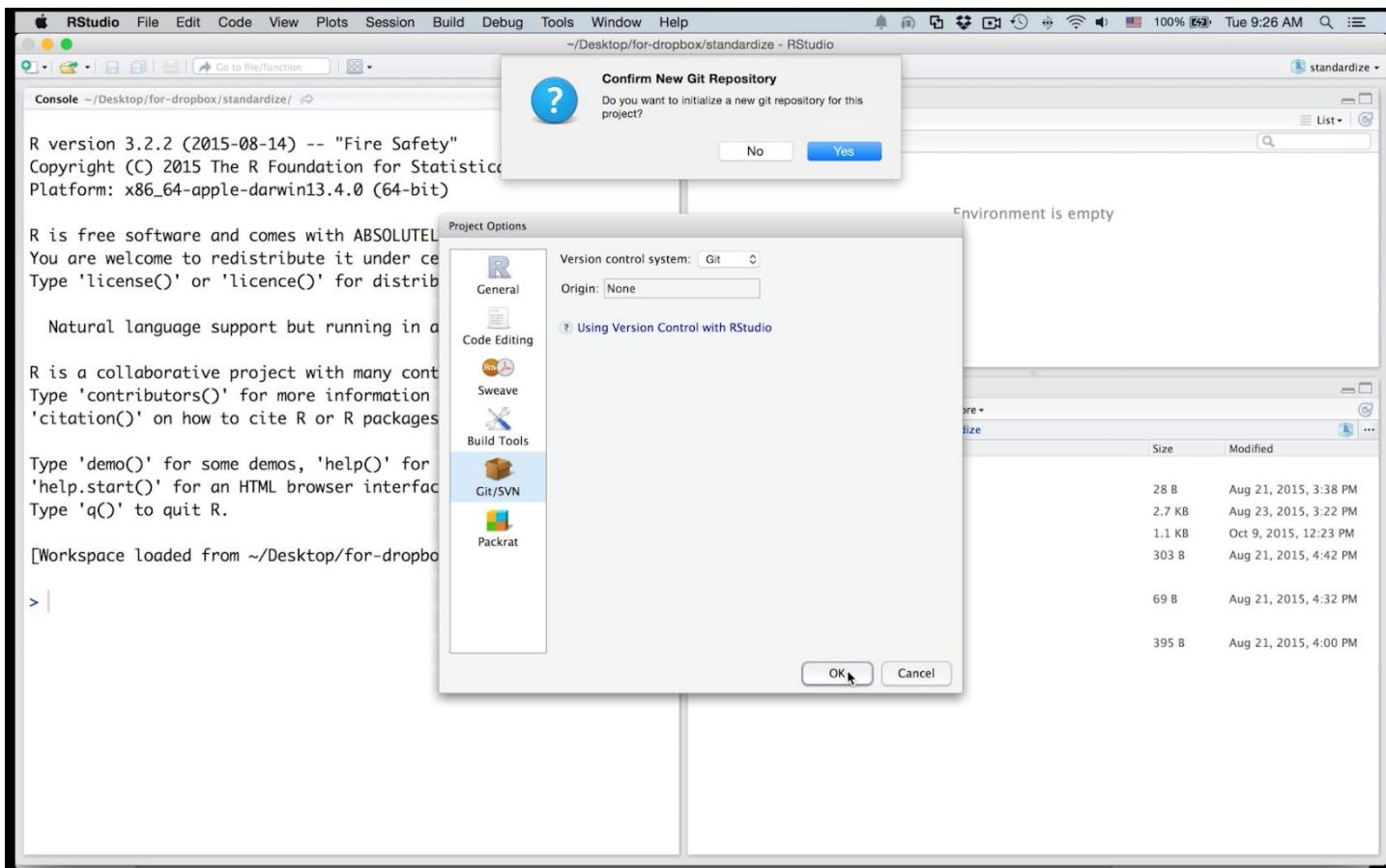
# Using git with RStudio



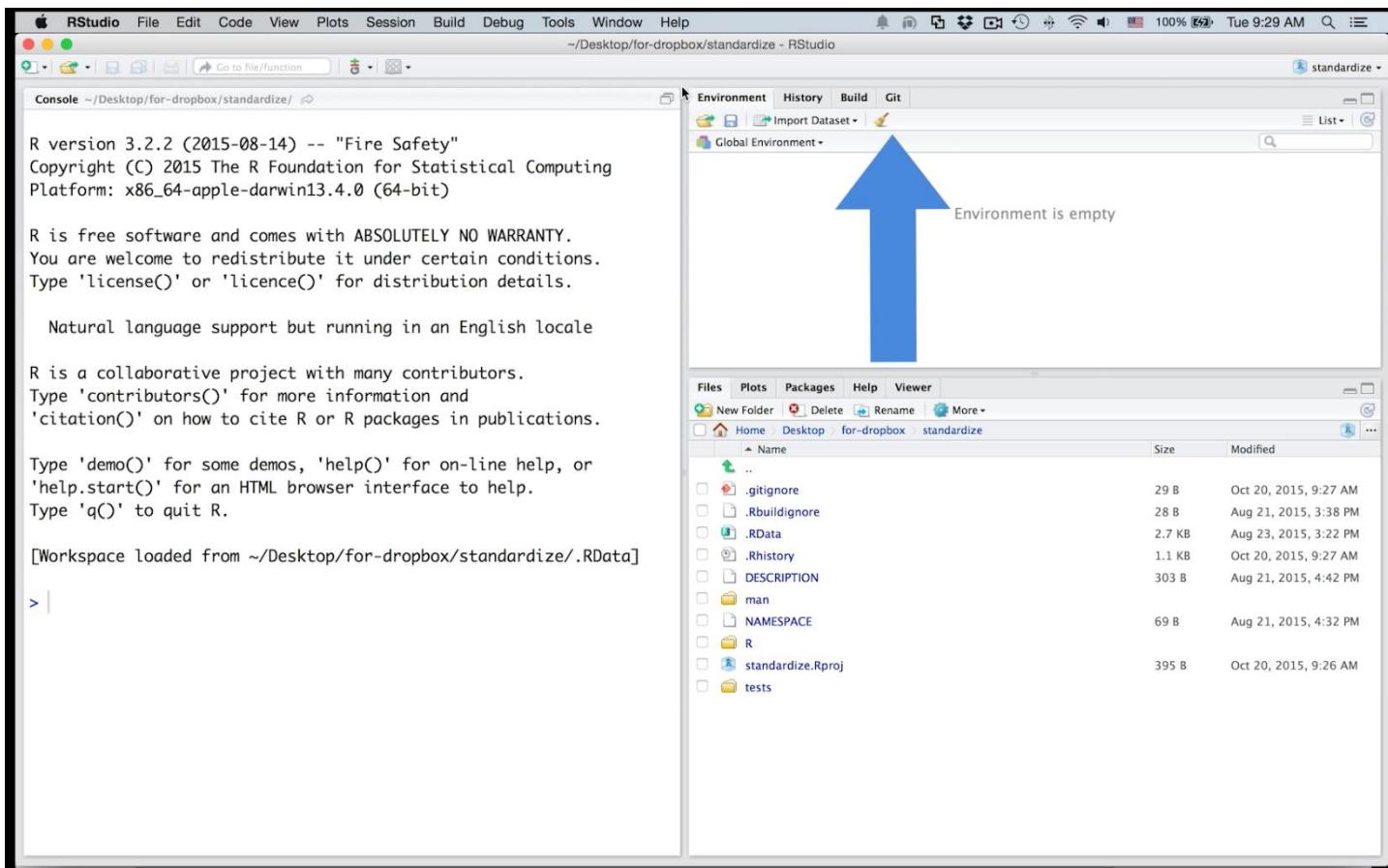
# Using git with RStudio



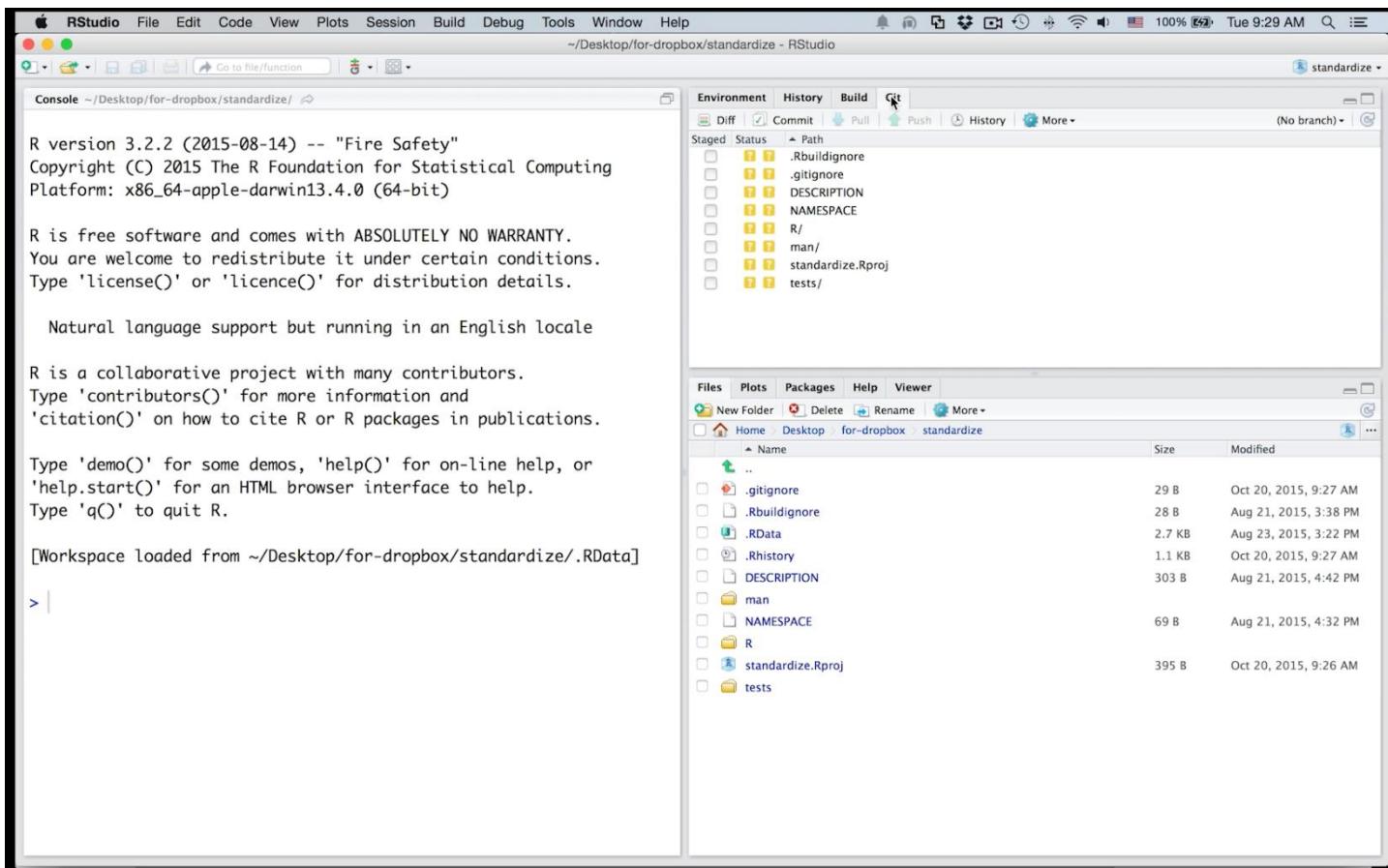
# Using git with RStudio



# Using git with RStudio



# Using git with RStudio

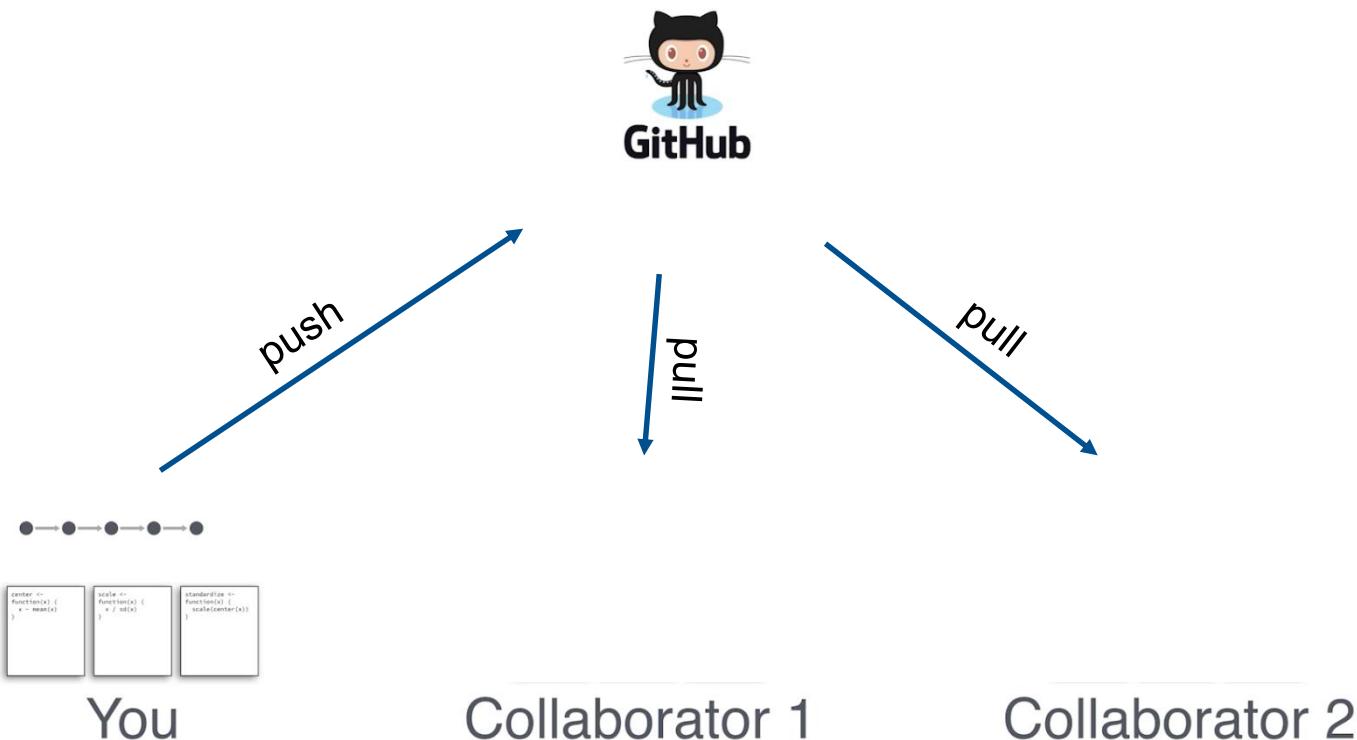


# github



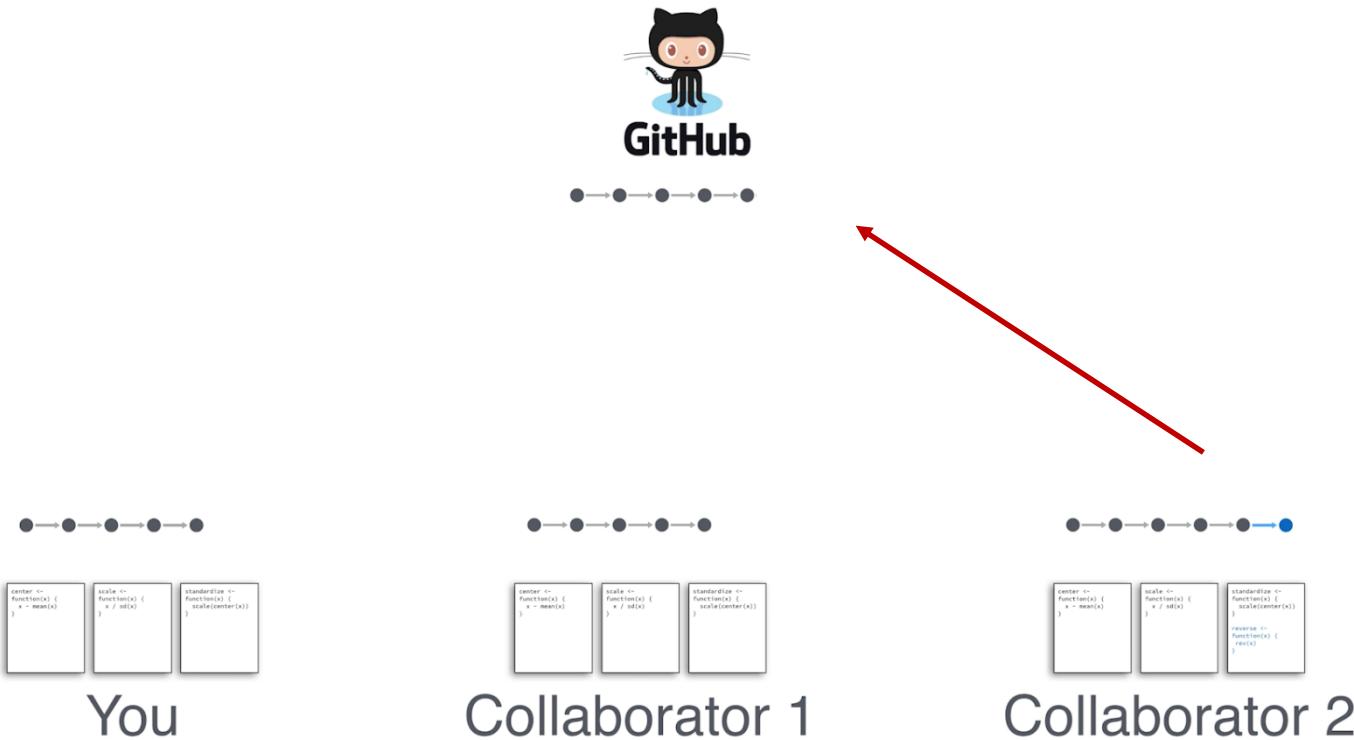
Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

# github

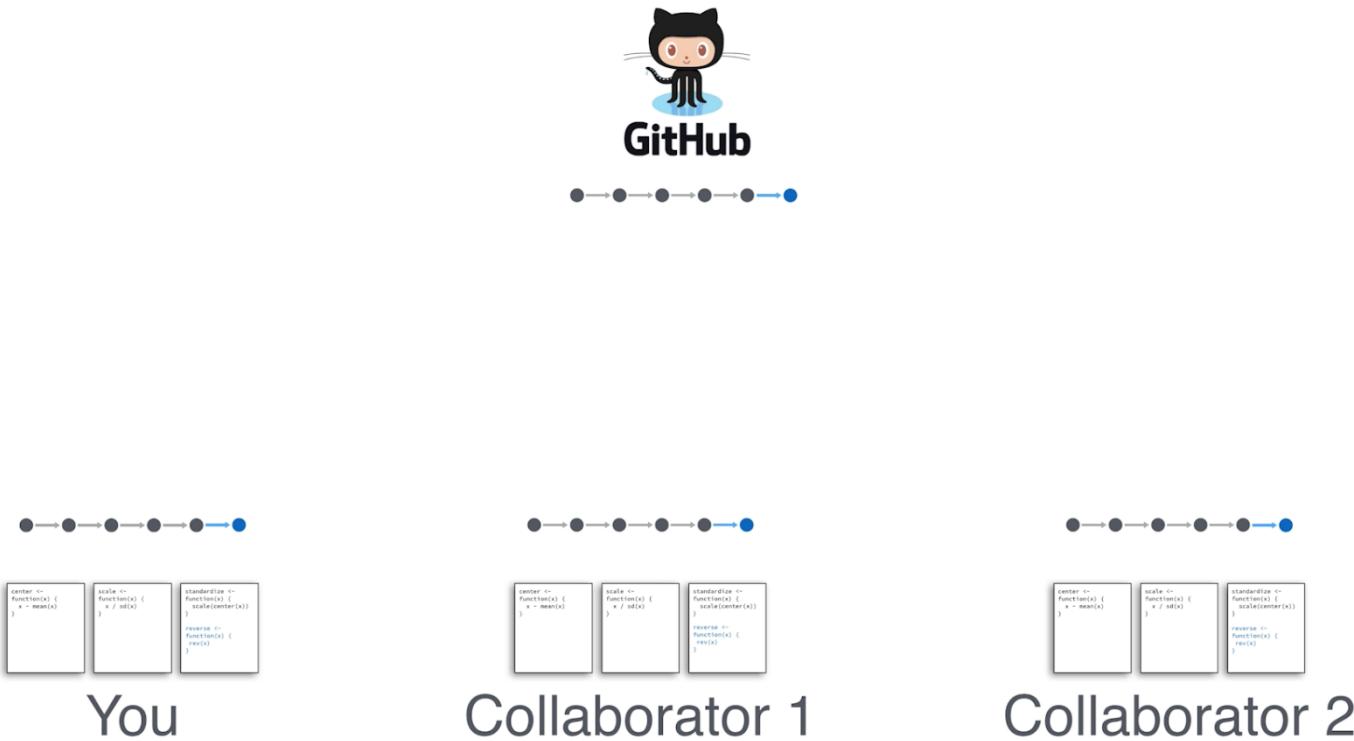


Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

# github



# github



Source: Garrett Grolemund  
(<https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>)

## github: who changed what when

- free to use: [github.com](https://github.com)
- amongst others, beneficial for ...
  - collaborating with colleagues
  - sharing stable project versions online (e.g., package release via github)

## Further information

- <https://campus.datacamp.com/courses/working-with-the-rstudio-ide-part-2/>
- <https://plot.ly/r/github-getting-started-for-data-scientists/>