

Bringing the Scientific Process Into the Social Sciences

A practical guide from start to finish



Craig McIntosh & Julia Clark
Designing Field Experiments
30 May 2017

Motivation

“Academia is a social enterprise that is usually most successful when individual researchers compete and collaborate in contributing toward common goals.

In contrast, when we work in isolation on unrelated problems, ignoring work that has come before, we lose the benefits of evaluating each other’s work, analyzing the same problem from different perspectives, improving measurement techniques and methods, and, most important, building on existing work rather than repeatedly reinventing the wheel.”

– Gary King 1995, p. 445

(Social) Science!

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- ▶ The universe of previous studies
 - ▶ Their methods and specifications
 - ▶ Their results (from ALL studies, not just the ones that got published!)
- Requires research **transparency**

Without transparency, we have issues ...

- ▶ “**Replication crisis**”— studies fail to replicate (psych, econ, polisci, medicine, etc.)

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- ▶ **Misconduct/fraud** — easier to get away with!

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 - ▶ Errors in data/code
 - ▶ Misconduct or fraud

Dewald et al. (1986)

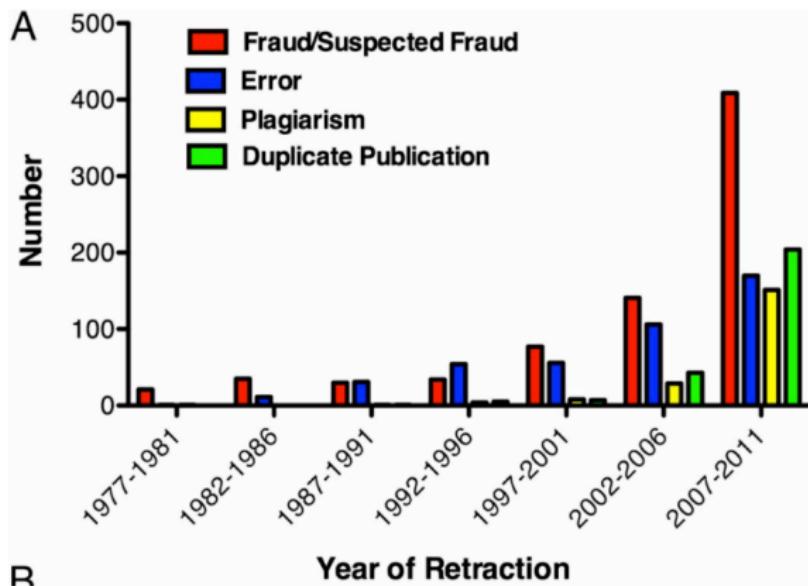
Attempted to replicate 62 papers submitted to *Journal of Money, Credit and Banking*, got data/code for only 22:

TABLE 2—PROBLEMS IN SUBMITTED DATA SETS

	Published before Data Requested	Accepted before Data Requested	Under Review when Data Requested
No Problems	1	3	4
Problems Identified:			
Incomplete Submission	6	3	5
Sources Cited Incorrectly	0	4	4
Sources Cited Imprecisely	11	7	10
Data Transformations Described Incompletely	3	4	1
Data Element Not Clearly Defined	2	3	2
Other	0	3	1
Problems Data Sets Examined	22	24	23
	19	14	21

Fang et al. (2012)

Review of 2,047 retracted biomedical and life-science articles on PubMed:



Publication Bias

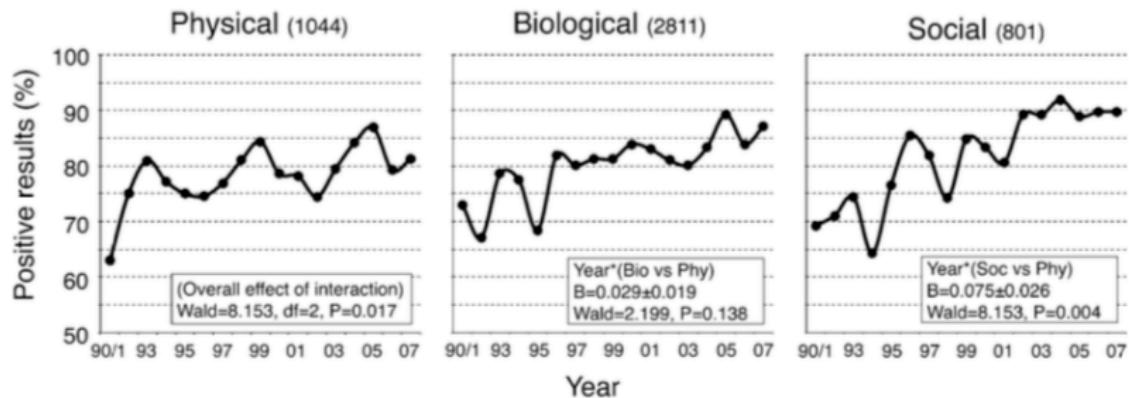
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Publication Bias

- ▶ “The File Drawer Problem”: Studies more likely to be published when findings are significant → studies with null (or negative) findings are hidden
- ▶ **Result:** Missing full universe of studies and results; what we believe to be a solid body of evidence could be due to random chance (e.g., if we expect 5% of results of all studies to be significant)

Publication Bias

Increase in % of papers with positive results over time, across scientific disciplines (Fanelli 2010, 2011):



Bias in the Social Sciences

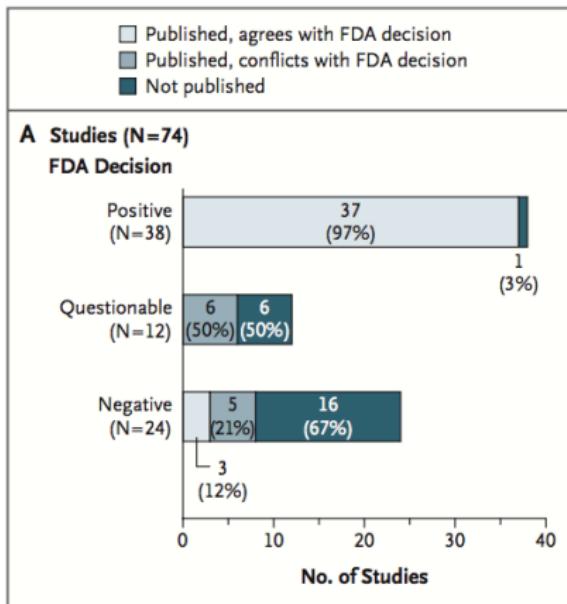
Strong results 60pp more likely to be written up than null results, 40pp more likely to be published (Franco, Malhotra, Simonovits 2014):

Table 3. Cross-tabulation between statistical results of TESS studies and their publication status (column percentages reported). Pearson χ^2 test of independence: $\chi^2 (6) = 80.3, P < 0.001$.

	Null (%)	Mixed (%)	Strong (%)
Not written	64.6	12.2	4.4
Written but not published	14.6	39.0	34.1
Published (non-top-tier)	10.4	37.8	38.4
Published (top-tier)	10.4	11.0	23.1
Total	100.0	100.0	100.0

This has consequences!

E.g., studies that agree with FDA decisions more likely to be published (Turner et al. 2008):



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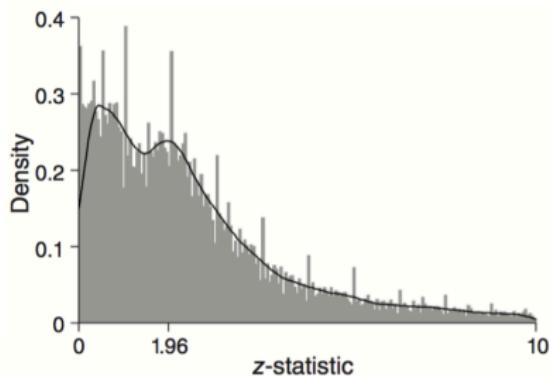
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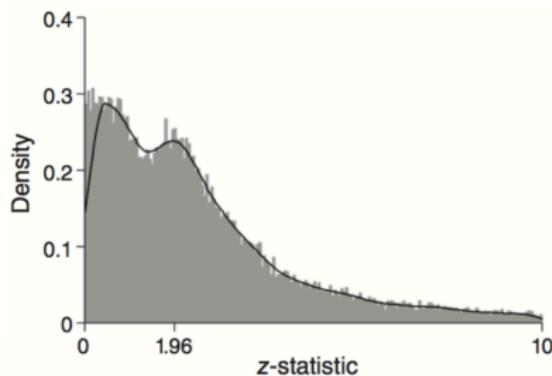
Evidence of P-Hacking

Brodeur et al. (2016):

Panel A. Raw distribution of z-statistics



Panel B. De-rounded distribution of z-statistics



Researcher Degrees of Freedom

Wicherts et al. 2016 identify 34 key RDFs (see article for full list):

Table 1

Checklist for different types of degrees of freedom in the planning, executing, analyzing, and reporting of psychological studies

Code	Related	Type of Degrees of Freedom
Hypothesizing		
T1	R6	Conducting explorative research without any hypothesis
T2		Studying a vague hypothesis that fails to specify the direction of the effect
Design		
D1	A8	Creating multiple manipulated independent variables and conditions
D2	A10	Measuring additional variables that can later be selected as covariates, independent variables, mediators, or moderators
D3	A5	Measuring the same dependent variable in several alternative ways
D4	A7	Measuring additional constructs that could potentially act as primary outcomes
D5	A12	Measuring additional variables that enable later exclusion of participants from the analyses (e.g., awareness or manipulation checks)
D6		Failing to conduct a well-founded power analysis
D7	C4	Failing to specify the sampling plan and allowing for running (multiple) small studies
...		

Misconduct & Fraud

- ▶ **Includes:** Falsifying some or all data and/or results, as well as plagiarism and other forms of misconduct

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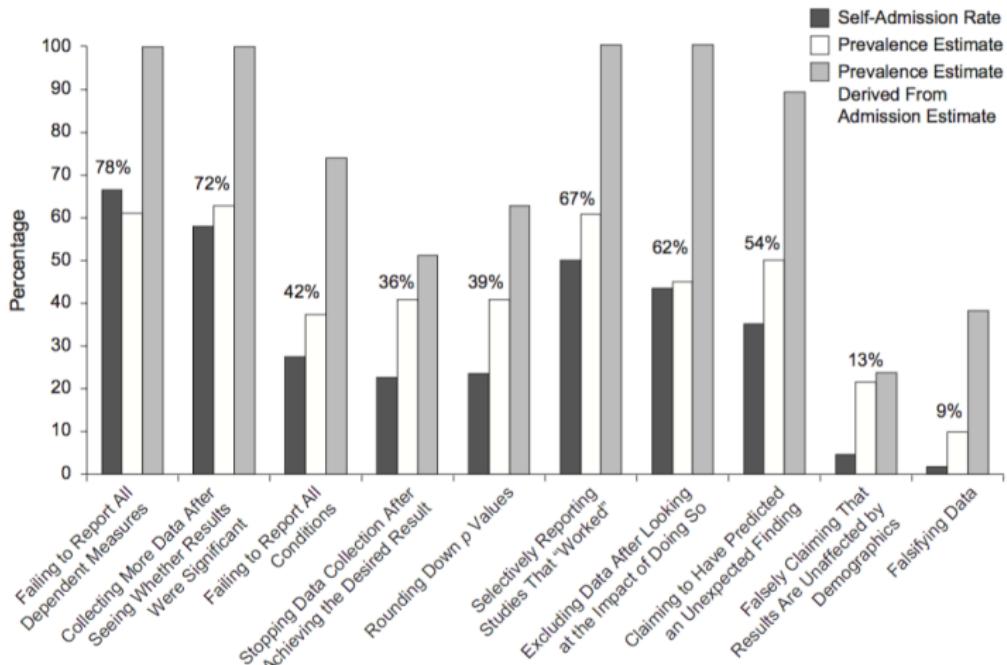
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- ▶ **Note:** Fabrication of data (e.g., LaCour, Fujii, Foster, Staple) less common than other “questionable research practices”

Questionable Research Practices

Survey of 2000 psychologists (John et al. 2012):

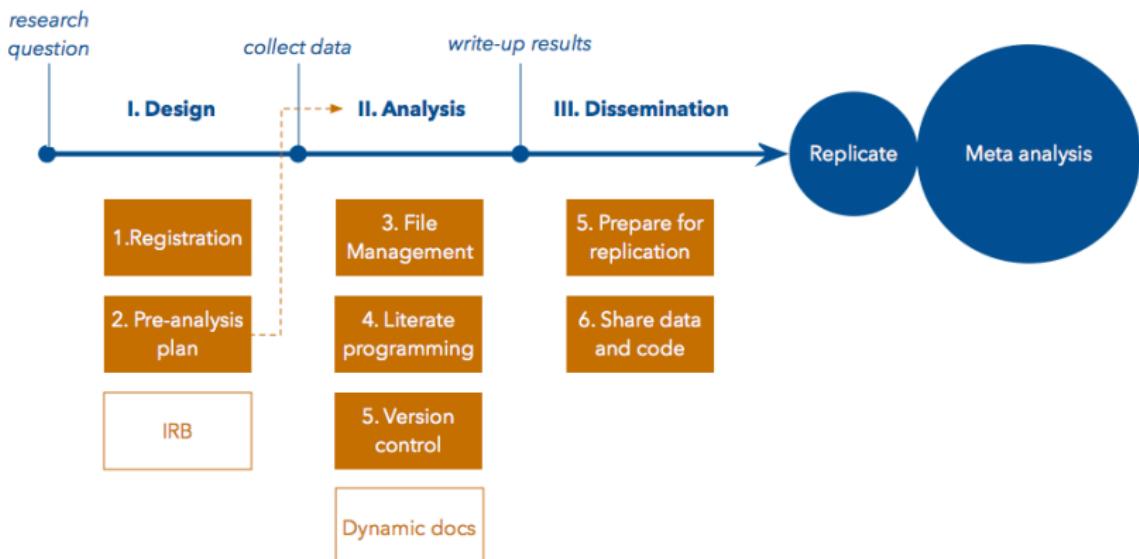


Good news, everyone!

Norms are changing. Smart people are working on these issues in the social sciences and developing standards and tools to help throughout the research lifecycle.

- ▶ PDEL, BITSS, OSF, DART, Dataverse, EGAP, etc. etc.

Research Lifecycle



Phase I: Design

Steps

I. Design

**Combat
publication bias**



1. Registration

**Reduce researcher
degrees of freedom**



2. Pre-analysis plan

**Protect human
subjects**



IRB

1. Registration

About Registration

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- ▶ **Why:** To combat the file-drawer problem, publication bias [visibility]; also, stake out intellectual claim!

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- ▶ <http://aspredicted.org>

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2. Click on “register a trial” and enter basic information—including title, country, status, keyword, abstract, start and end dates, outcomes, experimental design, whether treatment clustered, planned number of clusters and observations, IRB information

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2. Pre-Analysis Plan

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 - ▶ Transparent methods make it easier for others to build on your work

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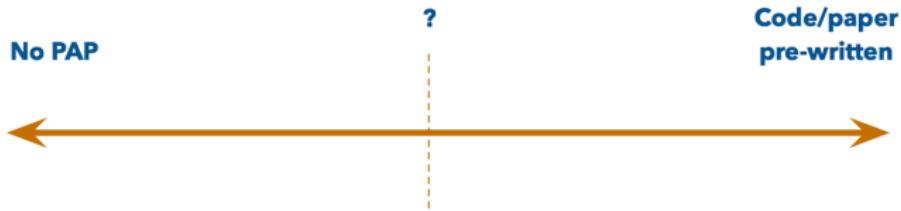
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4. **Research team:** Members, affiliations, conflicts of interest
5. **Logistics:** Fieldwork, timeline, budget

Tie your hands in the right places



→ PAP requires a lot of thought!

Olken's PAP Checklist (2013)

<i>Item</i>	<i>Brief description</i>
Primary outcome variable	The key variable of interest for the study. If multiple variables are to be examined, one should know how the multiple hypothesis testing will be done.
Secondary outcome variable(s)	Additional variables of interest to be examined.
Variable definitions	Precise variable definitions that specify how the raw data will be transformed into the actual variables to be used for analysis.
Inclusion/Exclusion rules	Rules for including or excluding observations, and procedures for dealing with missing data.
Statistical model specification	Specification of the precise statistical model to be used, hypothesis tests to be run.
Covariates	List of any covariates to be included in analysis.
Subgroup analysis	Description of any heterogeneity analysis to be performed on the data.
Other issues	Other issues include data monitoring plans, stopping rules, and interim looks at the data.

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- ▶ More debate on utility for observational work but can be done (see Neumark 2001)

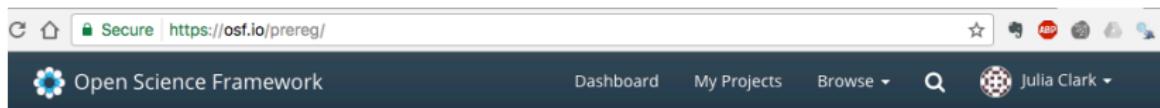
Spotlight on OSF

“A scholarly commons to connect the entire research cycle”

(Trying to be) a one-stop hub for managing projects, collaboration, materials, with integrated registration, pre-analysis plans, file management (Dropbox), version control (GitHub), etc., across scientific disciplines.

... Make an account and explore at <https://osf.io/>

Win \$1000 with Preregistration Challenge



Welcome to the Prereg Challenge!

The process of creating a [preregistration](#) is beneficial to both the scientific field and to you, the scientist. By writing out detailed data collection methods, analysis plans, and rules for excluding or missing data, you can make important decisions that affect your workflow earlier, without the biases that occur once the data are in front of you.

Ready for the challenge? Please follow these steps:

1. Specify all your study and analysis decisions prior to investigating your data
2. Publish your study in an eligible journal
3. Receive \$1,000

[Start a new preregistration](#)

[Continue working on an existing
preregistration](#)

[Make a preregistration for a
project you already have on the
OSF](#)

[IRB]

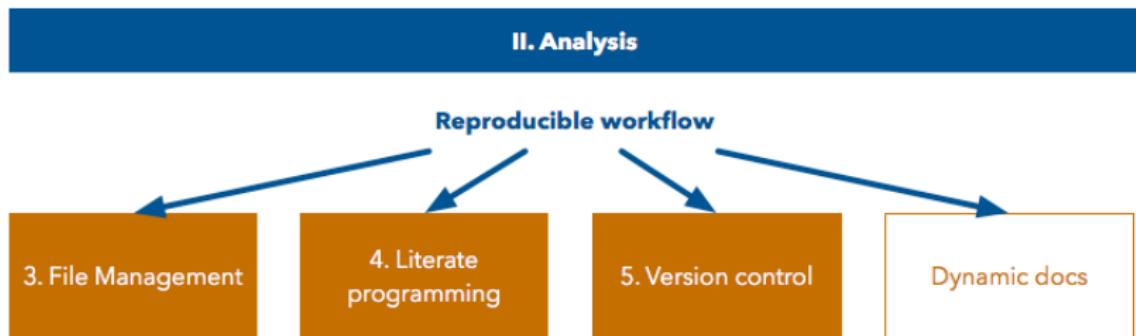
Don't forget about **IRB requirements** to protect human subjects!

Necessary for ethical research, though not sufficient (see <http://desposato.org/ethicsfieldexperiments.pdf> for more on ethics in experiments).

Phase II: Analysis

Steps

“Reproducibility is just collaboration with people you don’t know, including yourself next week” — Philip Stark, UC Berkeley



3. File Management

About File Management

- ▶ **What:** Organizing and managing files cleanly and intuitively

About File Management

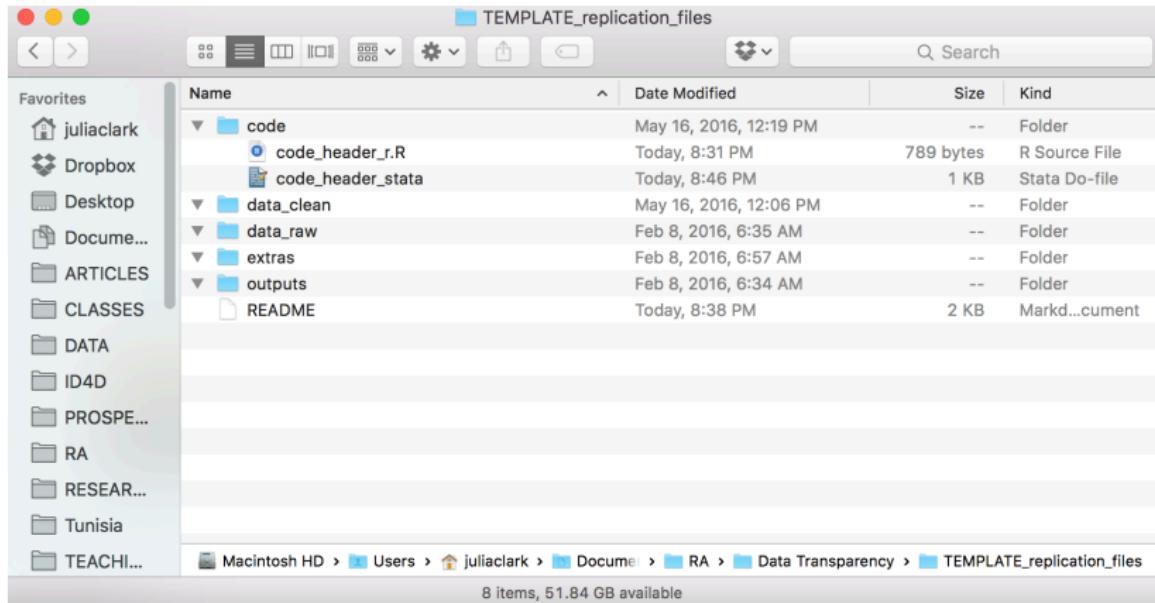
- ▶ **What:** Organizing and managing files cleanly and intuitively
- ▶ **Why:** To preserve original data, streamline workflow, and reduce clean-up time when sharing files

Don't let your files look like this ...

State Politics			
Name	Date Modified	Size	Kind
CA income	Nov 17, 2014, 6:36 PM	2 KB	Comm...t (.csv)
CA Propositions	Nov 17, 2014, 6:33 PM	45 KB	Comm...t (.csv)
CA Propositions	Nov 17, 2014, 4:06 PM	73 KB	Micros...(.xlsx)
CA Propositions.dta	Nov 17, 2014, 6:33 PM	48 KB	Stata Data File
CA state ballots.csv	Nov 17, 2014, 3:30 PM	614 bytes	Comm...t (.csv)
► Equality of Opportunity	Apr 25, 2015, 10:37 AM	--	Folder
fips_codes_website.xls	Dec 4, 2014, 8:05 PM	5.9 MB	Micros...k (.xls)
fips.dta	Dec 4, 2014, 9:05 PM	2 KB	Stata Data File
GiniProp.dta	Nov 17, 2014, 5:56 PM	428 KB	Stata Data File
Ginis for US.xls	Nov 17, 2014, 2:36 PM	525 KB	Micros...k (.xls)
Ginis US counties	Nov 17, 2014, 6:28 PM	850 bytes	Comm...t (.csv)
house.dta	Dec 4, 2014, 9:26 PM	534 KB	Stata Data File
houseNEW.dta	Dec 8, 2014, 10:26 AM	1 MB	Stata Data File
INC01.xls	Nov 17, 2014, 6:13 PM	17.8 MB	Micros...k (.xls)
LabEcon (Autosaved).txt	Dec 4, 2014, 8:40 PM	13 KB	Plain Text
LabEcon.do	Dec 4, 2014, 8:41 PM	20 KB	Stata Do-file
► PAPER	Apr 25, 2015, 10:37 AM	--	Folder
prez	Nov 20, 2014, 8:35 AM	90 KB	PDF Document
regs	Dec 4, 2014, 7:15 PM	1 KB	Stata Do-file
► Shor McCarty 2011-14	Apr 25, 2015, 10:38 AM	--	Folder
shor mccarty 1993-2013 state aggregate data public July 2014.dta	Oct 1, 2014, 4:30 PM	233 KB	Stata Data File
shor mccarty state aggregate data codebook july 2014.pdf	Oct 22, 2014, 7:33 PM	50 KB	PDF Document
shor mccarty state legislator data codebook july 2014.pdf	Dec 4, 2014, 7:19 PM	52 KB	PDF Document
state legislator scores july 2014.dta	Dec 4, 2014, 7:19 PM	30.8 MB	Stata Data File
► Sunlight	Apr 25, 2015, 10:38 AM	--	Folder
► Tausanovitch 2013	Apr 25, 2015, 10:37 AM	--	Folder
U.S. Congressional District Shapefiles.html	Nov 17, 2014, 2:43 PM	15 KB	HTML
US_FIPS_Codes	Dec 4, 2014, 8:11 PM	76 KB	Comm...t (.csv)

Instead, use PDEL template (or similar)

Download at [https://github.com/
PolicyDesignEvaluationLab/Transparency-Initiative](https://github.com/PolicyDesignEvaluationLab/Transparency-Initiative)



4. Literate Programming

About Literate Programming

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- ▶ **Why:** So you and others can better replicate your work (and to help you avoid mistakes!)

(The Most) Basic Principles

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- ▶ White-space (e.g., spaces, tabs, returns) is your friend

Structure and Name Files

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 - ▶ e.g., Number folders/files sequentially in the order they should be run

Streamline & Annotate Code

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- ▶ Add comments to improve reader understanding; remove unhelpful/embarrassing comments

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- ▶ Label variables and values in Stata

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R: `setwd("~/Documents/replication_files")`

Stata: `capture cd "~/Documents/replication_files"`

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- ▶ Particularly helpful if co-authors alternate between Mac (“/”) and Windows (“\”) file extensions

5. Version Control

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- ▶ **What:** A system for managing iterative versions of files (code, data, manuscripts) over time and across collaborators
- ▶ **Why:** Keep original files, protect work, collaborate efficiently, streamline workflow, etc., etc.

"FINAL".doc



FINAL.doc!



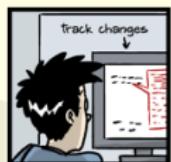
FINAL_rev.2.doc



FINAL_rev.6.COMMENTS.doc



FINAL_rev.8.comments55.
CORRECTIONS.doc



FINAL_rev.18.comments7.
corrections9.MORE.30.doc



FINAL_rev.22.comments49.
corrections.10.#@\$%WHYDID
ICOMETOGRAD SCHOOL????.doc

JEROME CHAM © 2012

Principles of Version Control

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- ▶ Keep a simple text file log to remind yourself of the location/content of major changes

Or let version control software do this for you!



GitHub

Version control software > Git > GitHub

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- ▶ **Git:** Open-source, “distributed model” of version control developed by creator of Linux
- ▶ **GitHub:** Free, web-based service that hosts Git “repositories” and offers a variety of features for collaboration

Common problems that GitHub helps solve

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How do I use GitHub?

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- ▶ **Command line (shell)**—optimal for advanced users

How to think about Git: A Metaphor

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How to think about Git: A Metaphor



Tell **Big Brother Git** to watch a set of files (a “repository”) and it tracks every change within them, line-by-line.

What GitHub is NOT ...

1. **Dropbox.** Git tracks changes in files and GitHub let's you sync/track/view/edit those changes online and with collaborators. Dropbox is a hard drive in the cloud.

Also, most useful for text files (.txt, \LaTeX , Markdown, Stata, R code, etc.); not useful for PDF, Word, Excel.

What GitHub is NOT ...

1. **Dropbox.** Git tracks changes in files and GitHub lets you sync/track/view/edit those changes online and with collaborators. Dropbox is a hard drive in the cloud.
2. **File Manager/GUI.** GitHub desktop may *look* sort of like Finder (Mac) or Explorer (PC), but its function is not to let you find, click on, or open files; its unit of operation is *changes within those files*.

Also, most useful for text files (.txt, \LaTeX , Markdown, Stata, R code, etc.); not useful for PDF, Word, Excel.

GitHub Prep

If you haven't already ...

- ▶ Make sure you have a good text editor. Notepad (PC) andTextEdit (Mac) will work (if you set TextEdit default file format to `.txt` and not `.rtf`). Or get a more powerful editor like [Atom](#).

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- ▶ Create an account at GitHub. This gives free *public* repositories, but go to the education section and click “request a discount” to get free *private* repositories.
- ▶ Download and install GitHub Desktop. Then open and log in using your GitHub account.

Basic vocabulary

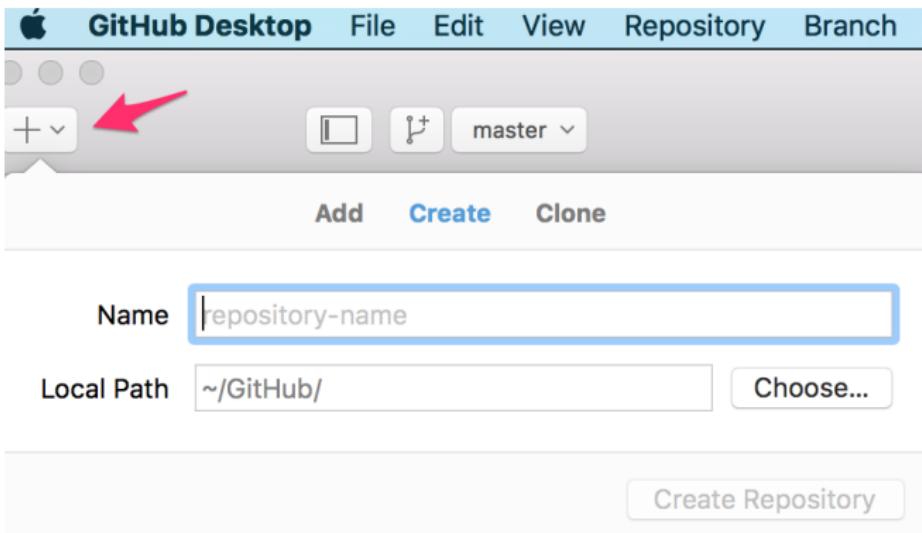
- ▶ **Repository:** A set of files (in a folder) that you have told Git to track, along with its associate .git files. A **local** repository is the copy on your computer; a **remote** repository is the copy synced online.

Basic vocabulary

- ▶ **Repository:** A set of files (in a folder) that you have told Git to track, along with its associate .git files. A **local** repository is the copy on your computer; a **remote** repository is the copy synced online.
- ▶ **Commit:** A labeled change or series of changes to files. Git tracks every change you make, and then you group these changes as desired into a “commit” that can be commented on, reverted, etc.

1. Create a NEW repository

Within **GitHub Desktop**, click on “+” and then “create” to make a new repository with a name and location of your choice. This creates a new folder that will be empty except for some hidden files (e.g., a .git directory).



2. Add a text file to your repository

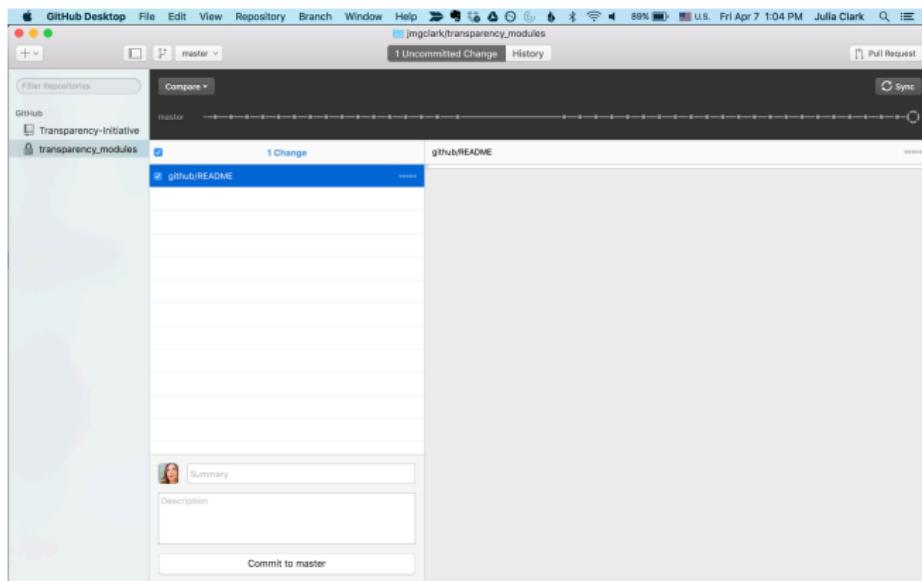
- ▶ Create a new text file on your computer called “README” as you normally would, and *save it in your repository location.*

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- ▶ Create a new text file on your computer called “README” as you normally would, and *save it in your repository location.*
- ▶ This should be a plain text file (.txt) or Markdown file (.md), not a rich text format file (.rtf).

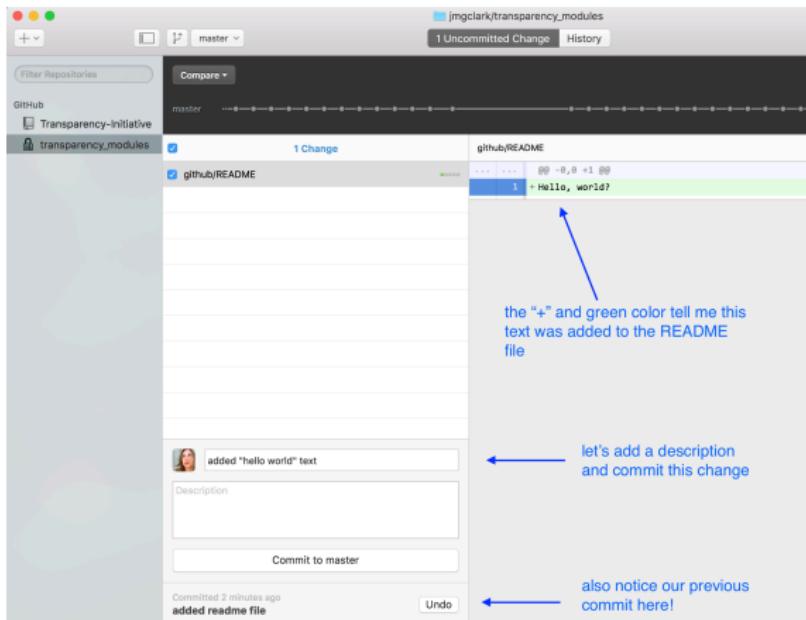
3. Commit this change in GitHub Desktop

If you open up the desktop client, it will look something like this:



4. Add text to README and commit changes

Add some text to your file and save. If you go back to the Desktop client, you will now see something like this:



5. Edit README text and commit changes

Make and save changes to your text, then go back to GitHub Desktop. In the right-hand pane, additions will appear in **green** and deletions will appear in **red**:

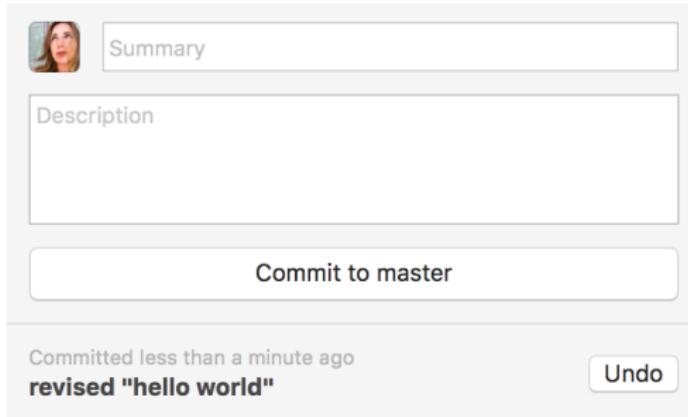
github/README

...	...	@@ -1 +1,3 @@
1		- Hello, world?
	1	+ Hello, world!
2		+
3		+ Very exciting additional text.

Note that the unit of change is the *paragraph*, so changing “?” to “!” involved deleting/adding the whole phrase.

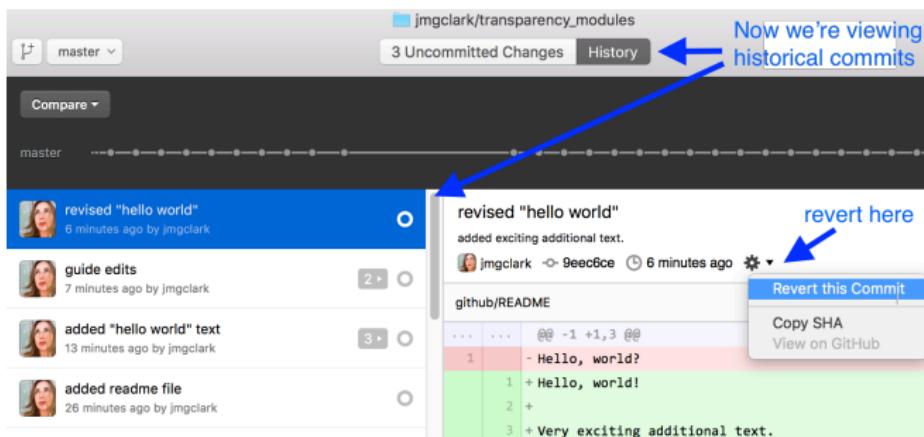
6. Undo a previous commit

If you're unhappy with previous changes, you have a number of options for rolling them back. If you want to **undo only the last commit**, you can **click the “Undo” button at the bottom of the list of uncommitted changes**:



6. Undo a previous commit (cont.)

Alternately, you can switch to the “History” tab at the top of the window, and view all your previous commits. If you click on one, there will be a dropdown option to “Revert”:



7. Publish repository to your online account

So far, we've been working in a **local repository**—one that you created on your computer.

This may be useful to you, but to collaborate on projects you'll need to publish the repository to the web (i.e., make a **remote repository**). → **Do this by clicking “publish”:**



8. View your repository & changes online

When you login to GitHub online, you'll see the new repository and file you've added.

The screenshot shows a GitHub repository page for the user 'jmgclark' named 'test'. The repository is private. At the top, there are buttons for 'Unwatch', 'Star', 'Fork', and 'Edit'. Below the header, there are tabs for 'Code', 'Issues 0', 'Pull requests 0', 'Projects 0', 'Wiki', 'Settings', and 'Insights'. A note says 'No description, website, or topics provided.' with an 'Edit' button. There's a 'Add topics' link. Below that, stats show '3 commits', '1 branch', '0 releases', and '1 contributor'. A dropdown for 'Branch: master' and a 'New pull request' button are visible. A green 'Clone or download' button is also present. A commit history shows a recent edit by 'jmgclark' to 'intro' at 49fc407 5 minutes ago. The 'README' file is shown with its content: 'Hello, world!' and 'Very exciting additional text.'

9. Edit the file online & sync with local repository

Click on the README file and then click the edit button (the pen). **(A)** Make some changes and then commit. Then go back to the Desktop client and click “Sync”. **(B)** Your new commit will appear in the history tab.

9. Edit the file online & sync with local repository

Click on the README file and then click the edit button (the pen). **(A)** Make some changes and then commit. Then go back to the Desktop client and click “Sync”. **(B)** Your new commit will appear in the history tab.

(A)

The screenshot shows a GitHub repository named "jmgclark / test". The repository is private. The "Code" tab is selected. In the main area, there is a search bar with "test / README" and a "Preview changes" button. Below the search bar, there are two tabs: "Edit file" (selected) and "Preview changes". The code editor contains the following text:

```
1 Hello, world!
2
3 Very exciting additional text.
4
5 The BEST text.|
```

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Click on the README file and then click the edit button (the pen). (A) Make some changes and then commit. Then go back to the Desktop client and click “Sync”. (B) Your new commit will appear in the history tab.

(A)

A screenshot of a GitHub repository page for 'jmgclark / test'. The repository is private. The top navigation bar shows 'Code', 'Issues 0', 'Pull requests 0', 'Projects 0', and 'Wiki'. Below the bar, there's a search bar with 'test / README' and a 'or cancel' button. A modal window is open over the page, titled 'Edit file'. It contains a text area with the following content:

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1 Hello, world!
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(B)

A screenshot of the GitHub commit history for the 'test' repository. The commit by 'jmgclark' at '918f165' is shown, with the message 'added one more line'. The commit details show it was made 2 minutes ago. The commit itself is displayed in a diff view:

...	...	@@ -1,3 +1,5 @@
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What's next?

That was very very basic. To really use Git, explore these great features with weird names ...

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- ▶ **Initiating a pull request**—submits your commits to be merged into a forked/branched repository (accepted/rejected by collaborators)

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Too many to name, but some good places to start:

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- ▶ Fork-branch workflow using command line (but useful to read for Desktop as well)

[Dynamic Docs]

You can take reproducible research a step further by integrating code *into your manuscript*. No need to copy-and-paste results from statistical software (annoying and error-prone); just click the button and everything reproduces.

- ▶ RMarkdown

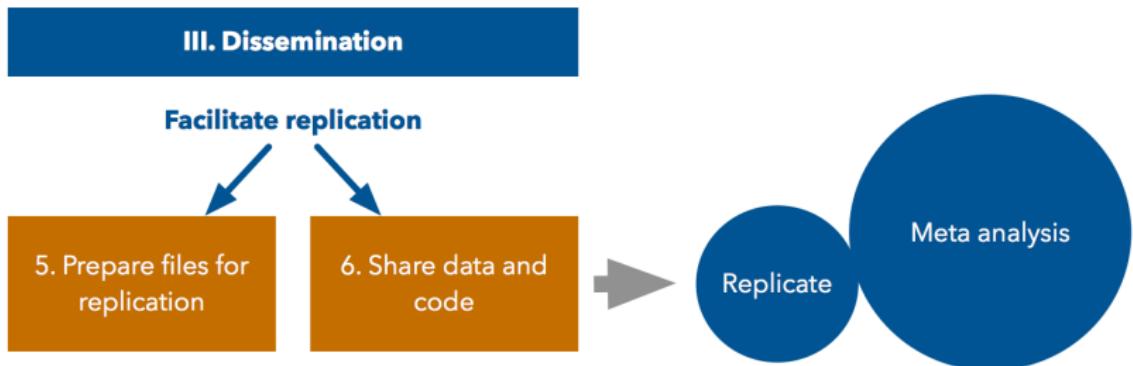
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- ▶ Stata Markdoc or Stata texdoc

Phase III: Dissemination

Steps



6. Prepare for Replication

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- ▶ **Unselfish reasons**—part of the scientific process and a public good
- ▶ **Selfish reasons**—make code more usable for yourself, catch potentially embarrassing errors before they become public, boost your transparency credibility

Replication files should ...

- ▶ Be complete but parsimonious

Caveat: There is no single, perfect way to organize or prepare files for replication. Do what works for you (as long as it meets the above criteria)!

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5 Steps for Prepping Files

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3. A “`README.txt`” file to document contents, sources, software/system versions, other info necessary for replication/comprehension.

2. Initial Replication

Copy (don't move!) over data and code files into the replication folder and try to replicate your results.

Purpose:

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- ▶ Build up your replication folder with complete and parsimonious data/code files

Check Analysis

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5. If you get different results than step #1, there is a discrepancy with merging/cleaning code—fix it!

3. De-Identifying Individual-Level Data

Now you know the code works and replicates, congratulations! The next step is to ensure that any shared files *do not contain* data that could be used to identify individuals.

Purpose:

- ▶ Ensure you are **protecting individuals' identity and private information**—this is an ethical issue for researchers, and a potential safety issue for participants

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Purpose:

- ▶ Ensure you are **protecting individuals' identity and private information**—this is an ethical issue for researchers, and a potential safety issue for participants
- ▶ Comply with legal, research board or funder requirements (e.g., HIPAA and IRB in the US)

What does “de-identifying” mean?

Two types of identifiers:

1. Direct: Variables that are explicitly linked to the subject—*e.g., name, email, address, ID number, phone number, etc.*

See [this useful infographic](#).

What does “de-identifying” mean?

Two types of identifiers:

1. **Direct:** Variables that are explicitly linked to the subject—*e.g., name, email, address, ID number, phone number, etc.*
2. **Indirect:** Variables that, in combination, could be used to identify individuals—*e.g., gender, dates (birth, program admission, etc.), geographic location (village, GPS), unusual occupations or education, etc.*

See [this useful infographic](#).

Example of Indirect Identifiers

- ▶ You survey teachers and collect information on *gender*, *classes taught*, and *age*.

Example of Indirect Identifiers

- ▶ You survey teachers and collect information on *gender*, *classes taught*, and *age*.
- ▶ If there is only one *female*, *third-grade* teacher *aged 40-49* at a particular school, she is not anonymous in your data

Dealing with Direct Identifiers

In general, direct identifiers—e.g., name, address, mobile number, ID number—should *never* be made public.

Options:

- ▶ Remove variables from shared dataset

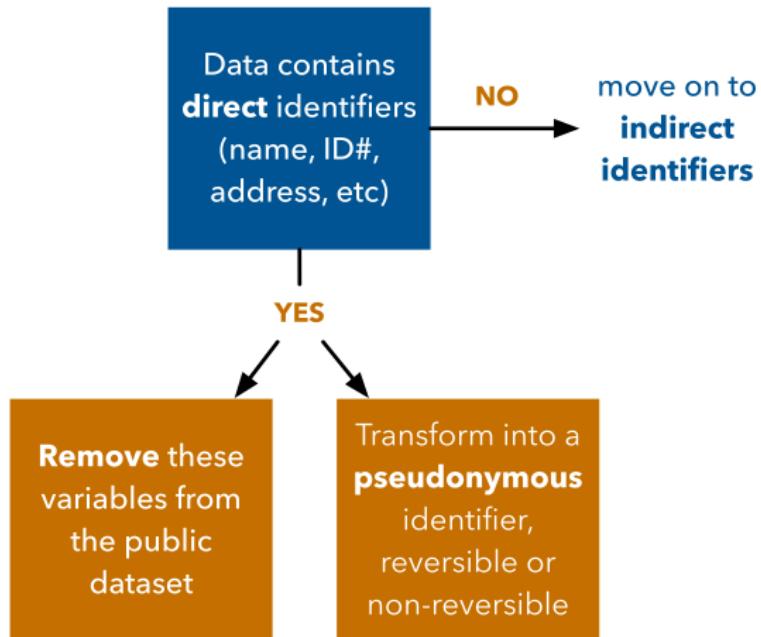
Dealing with Direct Identifiers

In general, direct identifiers—e.g., name, address, mobile number, ID number—should *never* be made public.

Options:

- ▶ Remove variables from shared dataset
- ▶ Pseudonymize data: replace identifiers with “pseudonyms” that may be reversible or non-reversible—e.g., give people random names or ID numbers—goal is to be able to link datasets

Solutions for Direct Identifiers



What is Sufficient De-Identification for Indirect Identifiers?

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2. Set k-anonymous level: each record cannot be distinguished from at least $k - 1$ other individuals who also appear in the data set
3. Select appropriate method(s) of de-identification: aggregating data, removing certain variables or observations, reducing information/detail, adding random noise or values

The Problem

ID	Study	Pub Year ¹	Health data included?	Profession of adversary	Number of individuals re-identified	Country of adversary	Proper de-identification of attacked data ?	Re-identification verified ?
A	[70]	2001	No	Researchers	29 of 273	Germany	"Factually anonymous"	Yes (records containing insurance numbers only)
B	[71]	2001	No	Researchers	75% of 11,000	USA	Direct identifiers removed	No
C	[67]	2002	Yes	Researcher	1 of 135,000	USA	Removal of names and addresses	Yes
	[56]	2003	No	Researchers	219 unique matches, 112 with 2 possibilities, 8 confirmed	UK	Yes	Verified matches, but not identities
D	[22]	2006	No	Journalist	1 of 657,000	USA	No	Yes (with individual)
E	[72]	2006	Yes	Researchers	79% of 550	USA	No	Verified (with original data set)
	[73]	2006	No	Researchers	Of 133 users, 60% of those who mention at least 8 movies	USA	Direct identifiers removed	No
F	[52]	2006	Yes	Expert Witness	18 of 20	USA	Only type of cancer, zip code and date of diagnosis included in request	Yes (verified by the Department of Health)
G	[74]	2007	No	Researchers	2,400 of 4.4 million	USA	Identifying information removed	Verified using original data
	[53]	2007	Yes	Broadcaster	1	Canada	Direct Identifiers removed & possibly other unknown de-ld methods used	Yes
H	[23]	2008	No	Researchers	2 of 50	USA	Direct identifiers removed-maybe perturbation	No
I	[75]	2009	Yes	Researcher	1 of 3,510	Canada	Direct identifiers removed	Yes
J	[76]	2009	No	Researchers	30.8% of 150 pairs of nodes	USA	Identifying information removed	Verified using ground-truth mapping of the 2 networks
K	[57,58] ^{???}	2010	Yes	Researchers	2 of 15,000	USA	Yes - HIPAA Safe Harbor	Yes

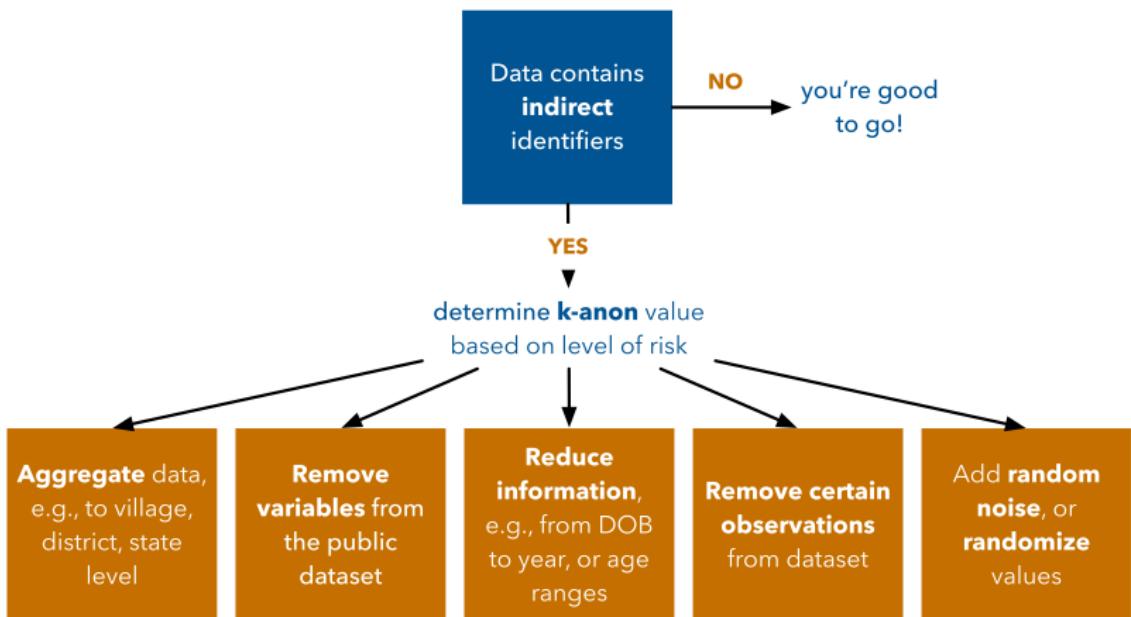
Source: El Emam et al. 2015. "A Systematic Review of Re-Identification Attacks on Health Data." PLOS One.

Example of K-anon where k=3

Pseudo ID	Age	Gender	ICD-10 Code
Patient 1	0 to 10 yrs	M	F106
Patient 2	20 to 35 yrs	F	F106
Patient 3	0 to 10 yrs	M	F106
Patient 4	51 to 65 yrs	F	F106
Patient 5	20 to 35 yrs	M	F106
Patient 6	51 to 65 yrs	F	F106
Patient 7	0 to 10 yrs	M	F106
Patient 8	20 to 35 yrs	F	F106
Patient 9	51 to 65 yrs	F	F106
Patient 10	20 to 35 yrs	F	F106
Patient 11	20 to 35 yrs	M	F106
Patient 12	20 to 35 yrs	M	F106
Patient 13	0 to 10 yrs	M	F106

The diagram illustrates the concept of K-anonymity (K=3) for 13 patients across four variables: Pseudo ID, Age, Gender, and ICD-10 Code. A vertical rectangle on the right side of the table contains five arrows pointing to specific groups of rows. The first group (Patient 1-3) is highlighted by a green arrow. The second group (Patient 4-6) is highlighted by an orange arrow. The third group (Patient 7-9) is highlighted by a black arrow. The fourth group (Patient 10-11) is highlighted by a green arrow. The fifth group (Patient 12-13) is highlighted by an orange arrow. This visual representation shows that each row is part of a group of 3 rows for each of the 4 variables, thus maintaining k-anonymity.

Solutions for Indirect Identifiers



Trade-off: Usefulness \iff Anonymity

- ▶ Aggregating—lose ability to replicate any individual-level analysis

See [here](#) and [here](#) for more discussion of appropriate thresholds, methods, and tools for de-identification.

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- ▶ **Adding random noise/values**—adds noise, obviously

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Good Practices

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- ▶ If identifiers *aren't* used for analysis, de-identify early in merging/cleaning process
- ▶ Store original data with PII securely—if you're using Dropbox, see [PDEL GitHub wiki](#) for tips on sharing with RAs in a way that protects PII data

4. Edit and Organize Files for Clarity

Now we have working files that are de-identified; the next step is to clean and annotate them to improve usability.

Purpose:

- ▶ Ensure files are **legible** in terms of structure and content

Basic steps

- ▶ Structure and name files*

*Already done if you follow the literate programming tips
in Phase II!

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- ▶ Track and document packages, software versions
 - ▶ R: `sessionInfo()`
 - ▶ Stata: `version`

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- ▶ Once discrepancies are addressed, the files are ready for sharing!

7. Share Data and Code

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- ▶ What: add study materials to an online repository

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 - ▶ Difficult if proprietary

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<http://library.ucsd.edu/dc/rdc/collections>)

8. Meta-Analysis

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One Study = One Data Point

That experiment you just ran with 3,685 participants? It's one data point among many other studies. *Even with the same data, results may vary ...*

Same Data, Different Conclusions

Twenty-nine research teams were given the same set of soccer data and asked to determine if referees are more likely to give red cards to dark-skinned players. Each team used a different statistical method, and each found a different relationship between skin color and red cards.

Referees are
three times as
likely to give red
cards to
dark-skinned
players

Statistically
significant results
showing referees are
more likely to give red
cards to dark-skinned
players

Twice as likely

Equally likely

Non-significant
results

ONE RESEARCH TEAM

95% CONFIDENCE INTERVAL



Who Does Meta-Analysis?

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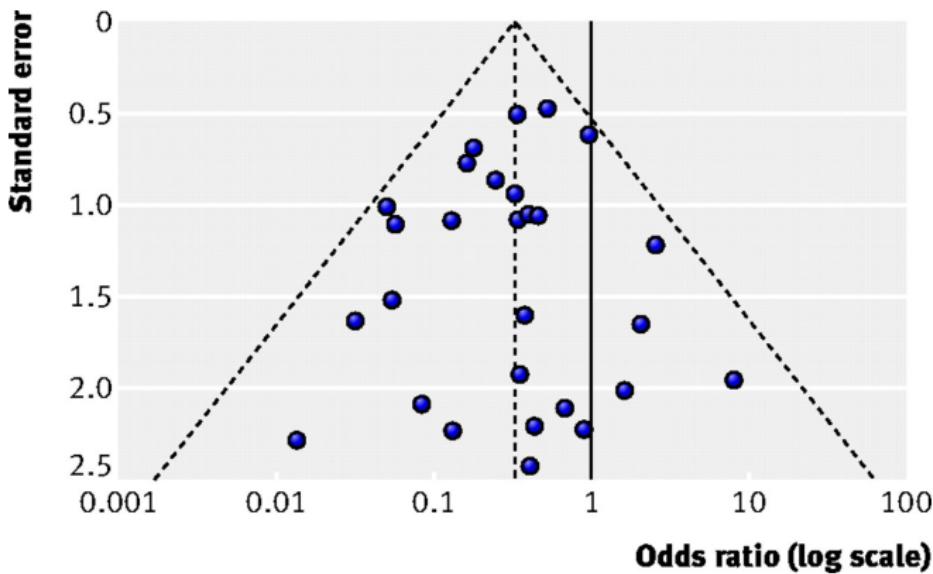
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Using a PAP or “protocol” (and assuming NO publication bias!) ...

1. Determine which studies to include
2. Determine which outcomes to measure (e.g., discrete, continuous)
3. Select model for “meta-regression” (e.g., RE, FE, etc.)

Funnel Plots

Scatter plot of study effect sizes vs. study prevision (e.g., SE of study treatment effect)



Source: BMJ 2011

Etc.

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- ▶ **Tenure:** “Adherence to the replication standard should be part of [tenure] judgment” (King 1995)

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