The Importance of Open and Reproducible Research

Eric Crandall

What is Reproducibility?

Gandrud 2014 gives this definition (especially for data analysis and computer science):

> *"The data and code used to make a finding are available and they are presented in such a way that it is (relatively) straightforward for an independent researcher to recreate the finding."*

This actually seldom happens.

Consider two interesting articles by Tim Vines: * The Availability of Research Data Declines Rapidly with Article Age + Contacted Authors of 516 datasets with morphological data for discriminant analysis published between 1991 and 2011 + Received only 101 datasets!

- *"of 516 articles published between 2 and 22 years ago. . . the odds of a data set being extant fell by 17% per year."*

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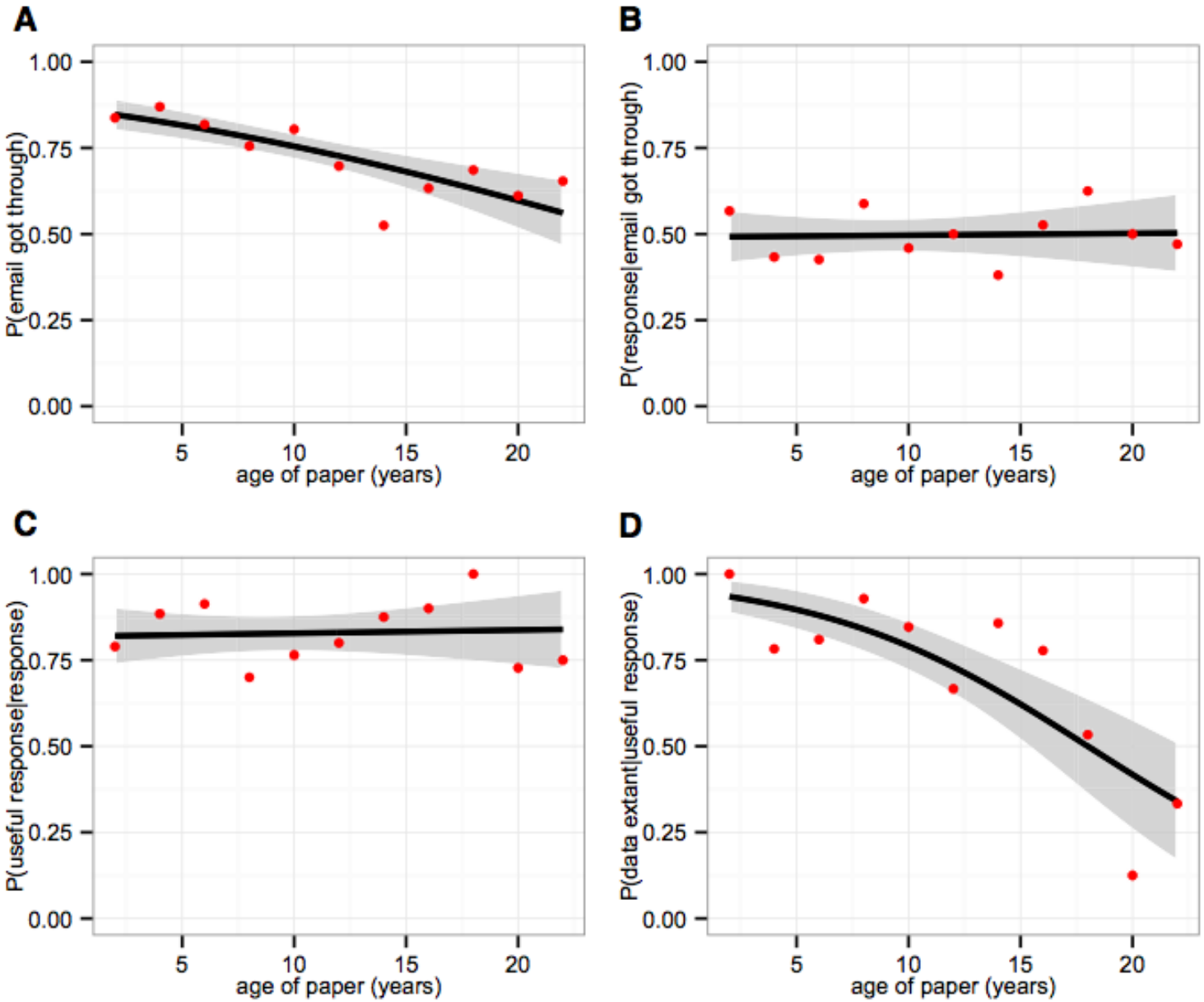

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- Scientific articles have fairly detailed methods sections, but those are typically insufficient to actually reproduce an analysis.
- Scientists owe it to themselves and their community to have an explicit record of all the steps in an analysis done at a computer.

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- Encouraging cumulative knowledge development

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- Better work habits

Gandrud 2014

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Tools for Research Reproducibility

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- Online Repositories (Dryad, Genbank,GBIF, GEOME, new ones all the time)

Open Science

Open Science Links

- Open Data

Figure 3: Big Data

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Reproducible Research Habits

Good habits to get into as a student!

10 Things Every Graduate Student Should Do By Carly Strasser

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- Dates!
- At least keep your raw data in text format

Learn to Code

Any language.

R is a great starting place.

Here is code to paste cells from excel into an R data frame!

```
data <- read.table(pipe("pbpaste"),header=T)
```

Make a plan for managing data in each project

- Keep all data (and ideally analyses) in a text file

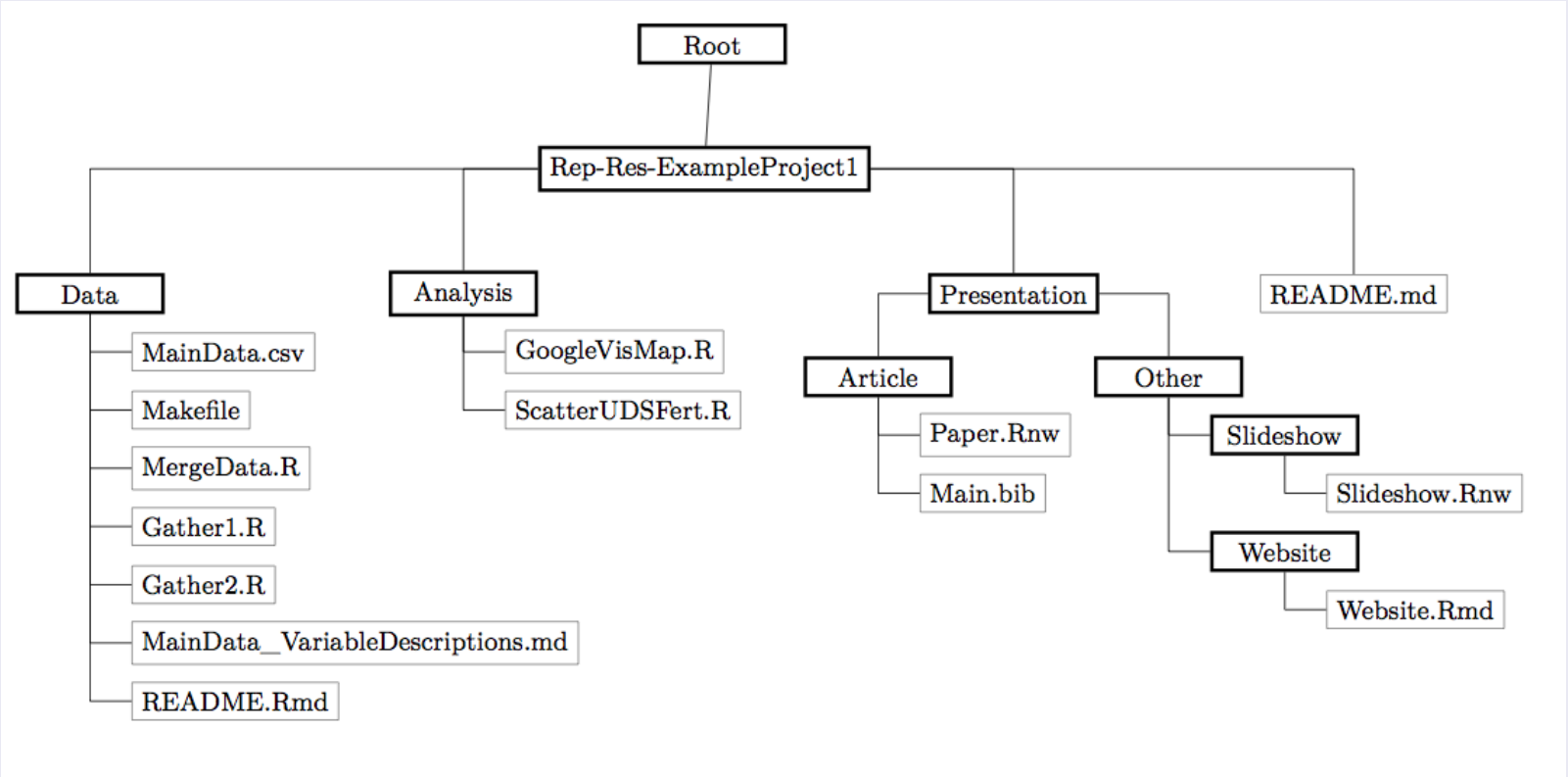

Figure 4: Gandrud Figure 1

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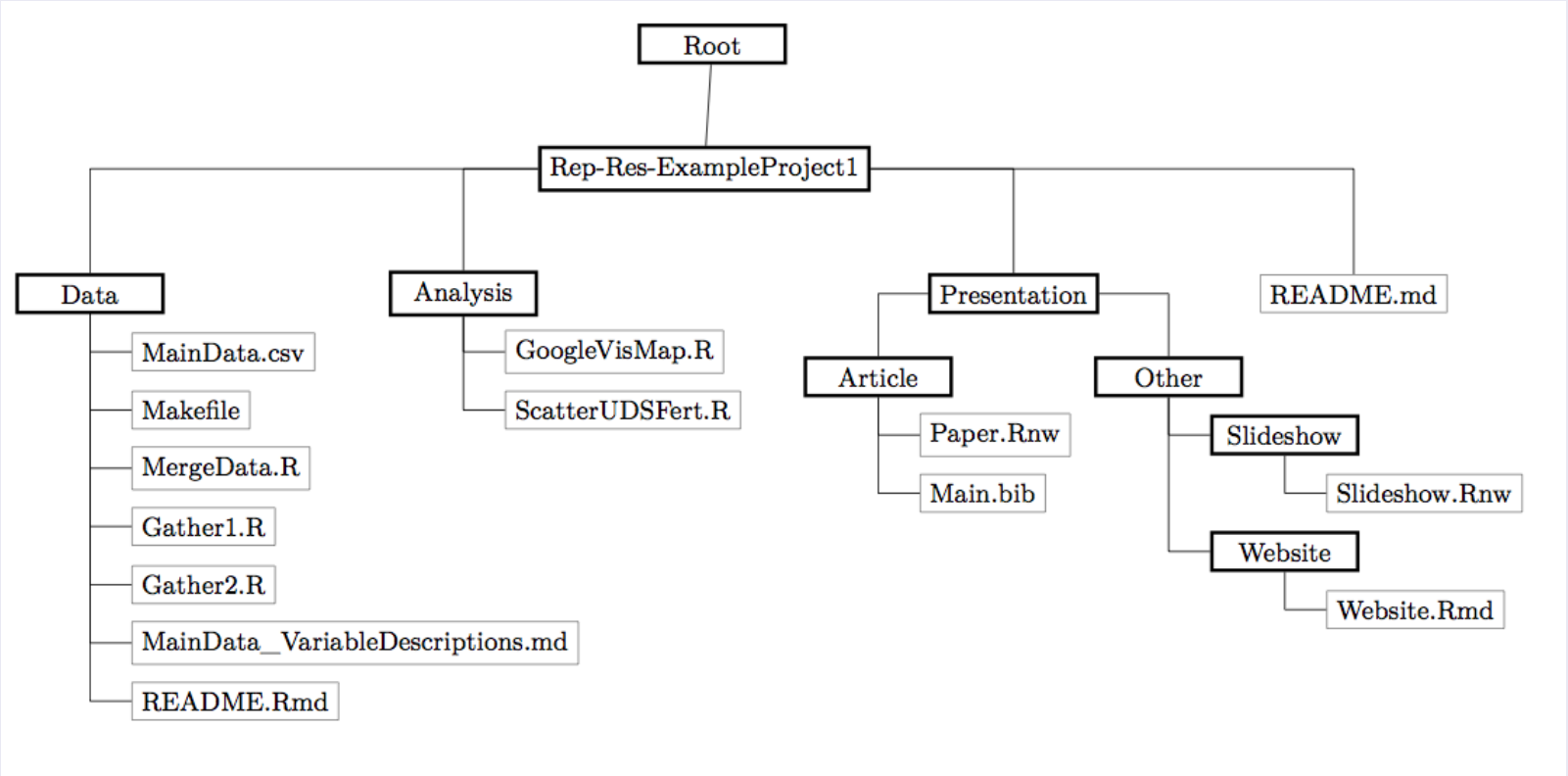

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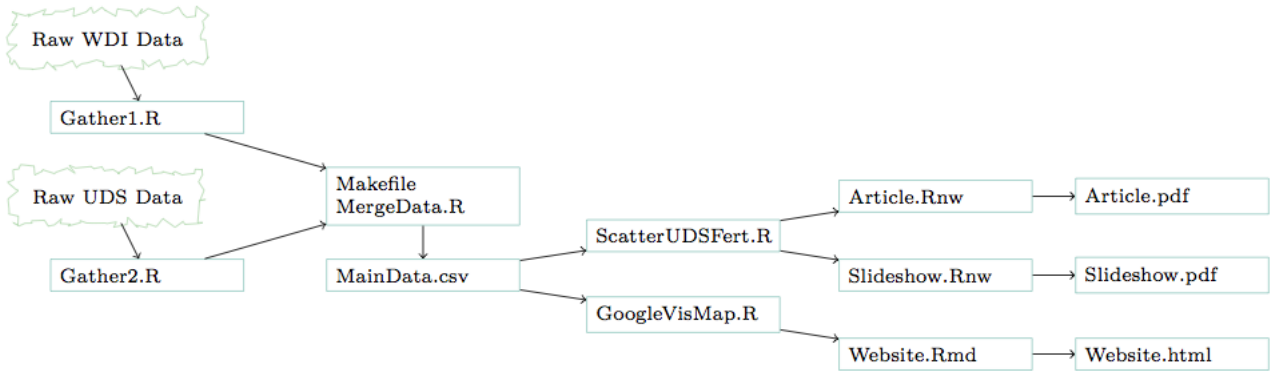
- Data management plans are now explicitly required by the NSF and other funding agencies!!!

Short Example Main File Ties



:

`download.file` `read.csv` *knitr*
`Make` `source`
`merge`
`WDI`

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- Go open if you're brave

Communicate Your Science

Start doing outreach now!

NSF vs. House Committee on Science

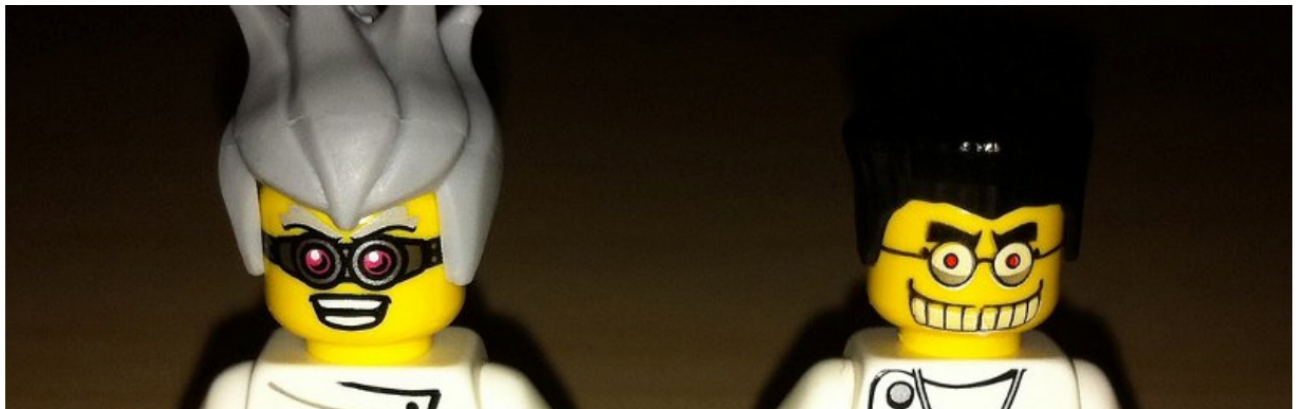
KQED Science npr PBS

Radio | TV | News | Arts | Food | Science | Education

Why Scientists are Seen as Competent but Untrustworthy (and Why it Matters)

Dr. Barry Starr, Tech Museum & Stanford University | October 6, 2014 | 1 Comment

Share: Print



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- ResearchGate, Academia.edu etc. are social networks whereby you are sharing articles with your "friends"

Rstudio

R studio is an Integrated Developer Environment for R * Is an IDE (integrated development environment) that *sits on top of* R and makes it easier to interact with R. * Organizes your work in R in neatly-contained packages of work (typically data and code) called “projects” * Nothing mysterious about these—just collections of files stored together in a single directory on your computer.

Git

- A version control system, or VCS, tracks the history of changes as people and teams collaborate on projects together. As the project evolves, teams can run tests, fix bugs, and contribute new code with the confidence that any version can be recovered at any time. Developers can review project history to find out:

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  - Why were changes needed?

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- Because Git is a DVCS, repositories are self-contained units and anyone who owns a copy of the repository can access the entire codebase and its history.
- Using the command line or other ease-of-use interfaces, a git repository also allows for: interaction with the history, cloning, creating branches, committing, merging, comparing changes across versions of code, and more.

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- Through platforms like GitHub, Git also provides more opportunities for project transparency and collaboration. Public repositories help teams work together to build the best possible final product.

The Github Flow

Video

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    4. Hit `Create Project`

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