



How to open up your research

A practical primer on transparent research workflows

Frederik Aust
Johannes Breuer



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About us

Frederik Aust

- PhD student at the University of Cologne (Prof. Dr. Christoph Stahl)
- Founding memeber of **Cologne Open Science working group**
- Author and contributor to several R packages (e.g., `afex`, `citr`, `papaja`, `prereg`)

About us

Johannes Breuer

- PhD in psychology, University of Cologne (media psychology, Prof. Dr. Gary Bente)
- Previously worked at different comm and psych departments
- Now senior researcher at **GESIS – Leibniz Institute for the Social Sciences** (Data Archive for the Social Sciences)

Preliminaries

- Feel free to ask questions at any time
- We want to make this an (inter)active workshop
- Slides and material are available at

<https://tinyurl.com/y8db2fu>

Workshop material is based on

Klein, O., Hardwicke, T. E., Aust, F., Breuer, J., Danielsson, H., Hofelich Mohr, A., ... Frank, M. C. (2018). A Practical Guide for Transparency in Psychological Science. Collabra: Psychology, 4(1). doi: [10.1525/collabra.158](https://doi.org/10.1525/collabra.158)

Workshop outline

- General considerations

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- *What* can you share?
 - Study protocol
 - Study materials
 - Data and metadata
 - Standard operating procedures
 - Documentation of analyses
 - Research reports

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 - Study protocol
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 - Documentation of analyses
 - Research reports
- *When* can you share?

Workshop outline

- *How* can you share?
 - Compilation of research products
 - Choosing a repository
 - Specialized approaches
 - Licenses

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 - Compilation of research products
 - Choosing a repository
 - Specialized approaches
 - Licenses
- How can you promote openness?

Why should you share?

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- It's just documenting your work
 - Remember what you've done
 - Lab members can learn from each other
 - Colleagues can scrutinize and build on your work

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Your closest collaborator is you six months ago, but you don't reply to emails.

— Paul Wilson, University of Wisconsin Madison

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Open Science is just science done right

—Jon Tennant, Imperial College London

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 - Usually an unwarranted fear
 - Share upon publication or with an embargo
- Fear of being corrected
 - Errors are inevitable and a normal part of science
 - Promotes scientific self-correction
 - Constructive self-correction can enhance researchers' standing (Fetterman & Sassenberg, 2015)

Why would you *not* share?

- Personal data
 - Get informed consent
 - Pseudonymize data
 - Employ access controls
 - Share other research products

Why would you *not* share?

Although I was committed to open data, I was not implementing it [...] It was a pain to document the data; [...] to format the data; [...] to contact the library personnel; [...] to figure out which data were indeed published as part of which experiments. [...] I had neither a routine nor any daily incentive to archive data (p. 1063, Rouder, 2016)

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- Time-consuming
 - Take one step at a time ("baby steps")
 - Iteratively improve your workflow
 - Increases efficiency in the long-run
 - Increases exposure and citations



How to open up your research

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being an open scientist means adopting a few straightforward research management practices, which lead to less error-prone, reproducible research workflows (p. 11, Klein et al., 2018).



General recommendations

- Make transparency your default
 - Share all research products (as early as possible)
 - Declare and justify constraints on transparency



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- Iteratively improve your workflow
- Routinely perform *Amnesia test*
 - Would I still understand this after losing my memory?

Example project

Example project

Research question

- Can we judge a person's IQ from their face?

Example project

Research question

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Study design

- Photographs of students with known IQ scores



- Ratings of IQ
- Likert-scale ratings of attractiveness

Example project



What is this person's IQ?

70



130

How attractive is this person?

Very unattractive



Very attractive

Example project



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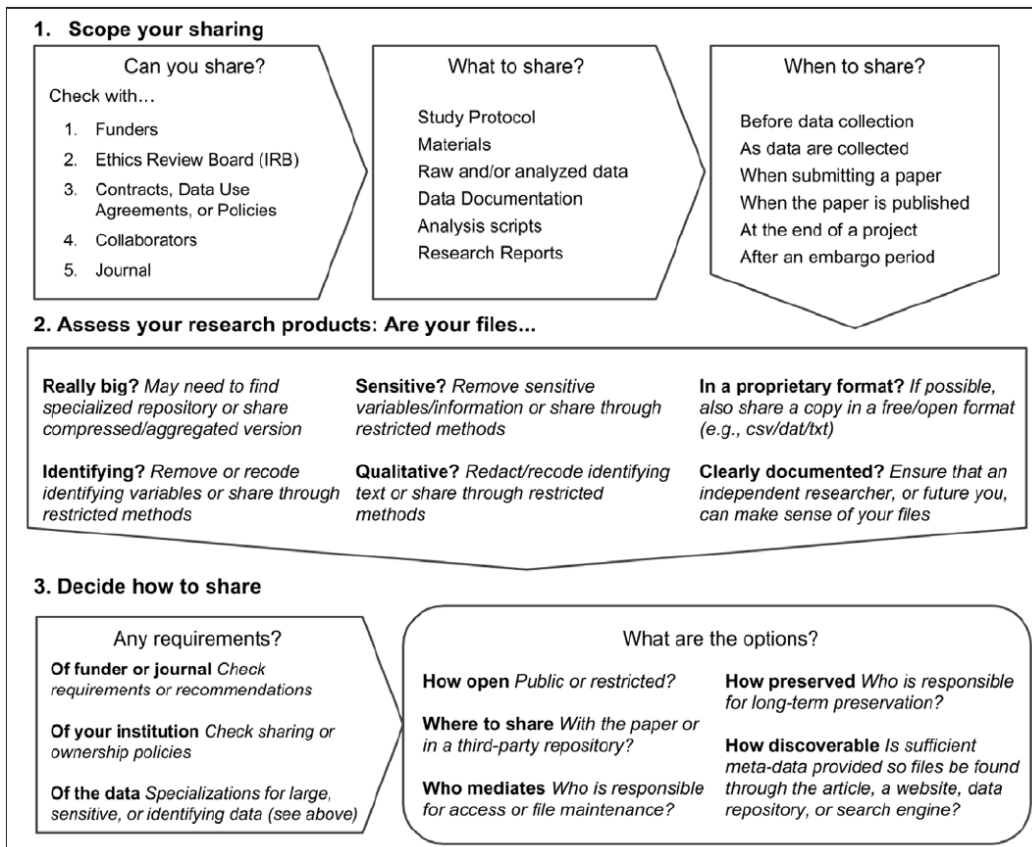
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What can you share?



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Study protocol

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- Collates, describes, and organizes more specific research products



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 - Hypotheses
 - Study materials
 - Detailed description of procedure



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 - Instructive video documentation (e.g., **OBS** for computer-based studies)



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 - Questionnaires
 - Stimulus material
 - Computer code to present stimuli and collect responses
 - Instructions for interaction with participants
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- Mind intellectual property rights!




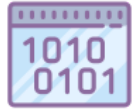
Data

- Include information about data sharing in informed consent




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- Use open and interoperable file formats (e.g., CSV, TSV, JSON, ODS) 
 - Use UTF-8 character encoding



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Eternal hell and damnation to people who put tables in pdf format with formatting as Supplementary Data, without a csv/excel version.

— Dr Dutchy McDutchFace (@dutchscientist) August 19, 2017





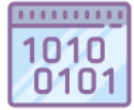
Data

- Raw data
 - As originally recorded (e.g., paper-pencil-questionnaires, CSV files, video recordings)



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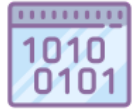
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 - Ideally "Tidy Data" ([Wickham, 2014](#))





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- Processed data
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 - Ideally "Tidy Data" (Wickham, 2014) 📄
 1. Each measured variable in one column
 2. Different observation of the variables in different rows
 3. Multiple tables should include a column that allows them to be linked



Participant privacy

- EU General Data Protection Regulation
 - "Data protection by design and by default"



Participant privacy

- EU General Data Protection Regulation
 - "Data protection by design and by default"
 - Designed to protect personal data
 - Data are personal if attributable to a specific person (using additional datasets if necessary)



Participant privacy

To determine whether a natural person is identifiable, account should be taken of all the means reasonably likely to be used, such as singling out, either by the controller or by another person to identify the natural person directly or indirectly.



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To ascertain whether means are reasonably likely to be used to identify the natural person, account should be taken of all objective factors, such as the costs of and the amount of time required for identification, taking into consideration the available technology at the time of the processing and technological developments. (Recital 26 EU GDPR)

Show 20 ▾ entries

Search:

Raw data of participant 01

id ▴ ▾	date ▴ ▾	time ▴ ▾	sex ▴ ▾	age ▴ ▾	stimulus ▴ ▾	stimulus_gender ▴ ▾	iq ▴ ▾	perc_iq ▴ ▾	perc_attr ▴ ▾
1	2018-06-13	09:15:32	Male	26	CF0001_1101_NE.jpg	Female	107	107	1
1	2018-06-13	09:15:32	Male	26	CF00016_1100_NE.jpg	Female	106	130	1
1	2018-06-13	09:15:32	Male	26	CF00017_1100_NE.jpg	Female	118	118	4
1	2018-06-13	09:15:32	Male	26	CF00018_1100_NE.jpg	Female	110	104	1
1	2018-06-13	09:15:32	Male	26	CF00019_1100_NE.jpg	Female	93	107	7
1	2018-06-13	09:15:32	Male	26	CF0002_1100_NE.jpg	Female	90	95	3
1	2018-06-13	09:15:32	Male	26	CF0003_1100_NE.jpg	Female	98	94	1
1	2018-06-13	09:15:32	Male	26	CF0004_1100_NE.jpg	Female	93	93	1
1	2018-06-13	09:15:32	Male	26	CF0005_1100_NE.jpg	Female	101	71	1
1	2018-06-13	09:15:32	Male	26	CF0006_1100_NE.jpg	Female	124	110	6
1	2018-06-13	09:15:32	Male	26	CF0007_1100_NE.jpg	Female	102	82	1
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1	2018-06-13	09:15:32	Male	26	CF0009_1100_NE.jpg	Female	93	93	4
1	2018-06-13	09:15:32	Male	26	CF0010_1100_NE.jpg	Female	114	114	4
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1	2018-06-13	09:15:32	Male	26	CF0012_1110_NE.jpg	Female	82	82	6
1	2018-06-13	09:15:32	Male	26	CF0013_1110_NE.jpg	Female	101	80	7
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1	2018-06-13	09:15:32	Male	26	CF0015_1110_NE.jpg	Female	113	107	1
1	2018-06-13	09:15:32	Male	26	CF0020_1100_NE.jpg	Female	99	91	6

Showing 1 to 20 of 106 entries

Previous

1

2

3

4

5

6

Next



Participant privacy

- Only collect the data you really need
- Delete identifying information used for logistics as soon as possible (e.g., e-mail addresses)



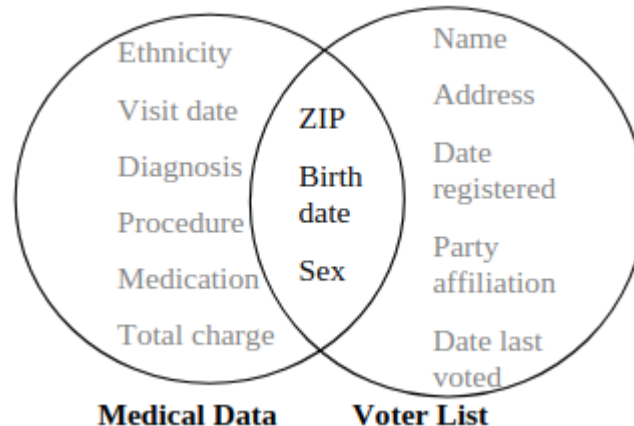
Participant privacy

- Only collect the data you really need
- Delete identifying information used for logistics as soon as possible (e.g., e-mail addresses)
- *Only share anonymized data publicly*, e.g.,
 - Delete directly identifying information (e.g., full name, address, face, handwriting, date of birth)
 - Control access to pseudonymized data



Participant privacy

- Mind combinations of indirect identifiers (e.g., ZIP code, gender, date of birth, **Sweeney, 2000**)





Participant privacy

- Separate demographics used for sample description and study data



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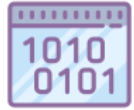
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 - Binning
 - Top and bottom coding
 - Add noise
 - Aggregation



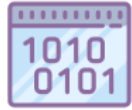
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- For complex and high-risk data, use anonymization tools (e.g., **ARX**, **Amnesia**)



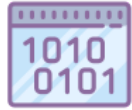
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- Dataset, e.g.,
 - Number of observations
 - Name and description of variables (incl. source of a measure, information about translation)
 - Units of measurement, coding of values, possible options or range
 - Value(s) used for missing data
 - How a variable was derived from other variables

$$\text{BMI} = \frac{m}{l^2}$$



Metadata

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- Automate codebook generation
 - Analysis software (e.g., R `codebook` package, SPSS `codebook` function, or Stata `codebook` function)
 - Specialized software (e.g., Nesstar, DataWiz)



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- Automate codebook generation
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 - Specialized software (e.g., Nesstar, DataWiz)
- For data with high reuse value, consider using a standardized and machine-readable format (e.g., DDI) 
 - Implementation is a service provided by some repositories



Standard operating procedures

- Define default practices ([Lin & Green, 2016](#))



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- Study planning, e.g.,
 - Sample size determination



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- Study planning, e.g.,
 - Sample size determination
- Data analysis, e.g.,
 - Statistical models
 - Assumption tests
 - Follow-up tests
 - Exclusion criteria
 - Outlier and dropout treatment
 - Handling of missing values
 - Use of covariates
 - Corrections for multiple comparisons



Documentation of analyses

- How to move from raw data to reported results
 - Step-by-step documentation for non-scriptable software programs



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 - Write reports as dynamic documents (e.g., R package `papaja`)



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 - Set and record seeds for pseudo-random number generators



Documentation of analyses

- Share intermediate results for complex analyses



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- Documentation of computational environment
 - Hardware
 - Software version incl. extensions



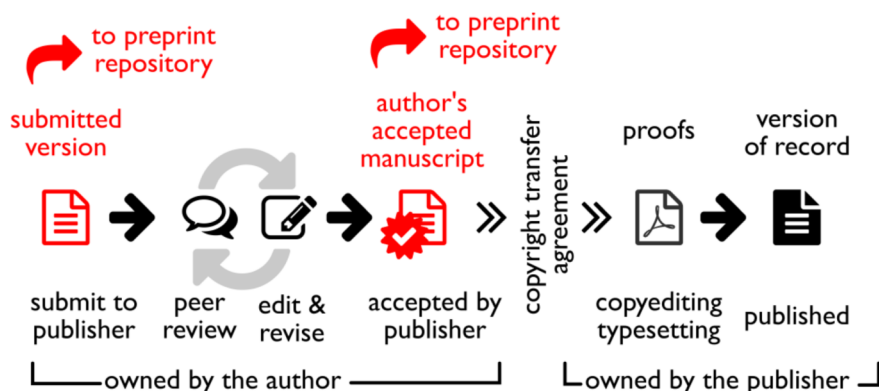
Documentation of analyses

- Share intermediate results for complex analyses
- Documentation of computational environment
 - Hardware
 - Software version incl. extensions
 - Cloud-based platforms (e.g., [Code Ocean](#), [RStudio cloud](#), [Colaboratory](#))
 - Containers and virtual machines (e.g., [Docker](#), [Vagrant](#), [Singularity](#))



Research reports

- Paywalled publications (green open access)
 - Preprint (initially submitted manuscript)
 - Postprint (accepted manuscript)
 - Mind journal policy (e.g., [SHERPA/RoMEO](#))



Reprinted from [Marwick et al., 2017](#) (CC-BY Attribution 4.0 International)



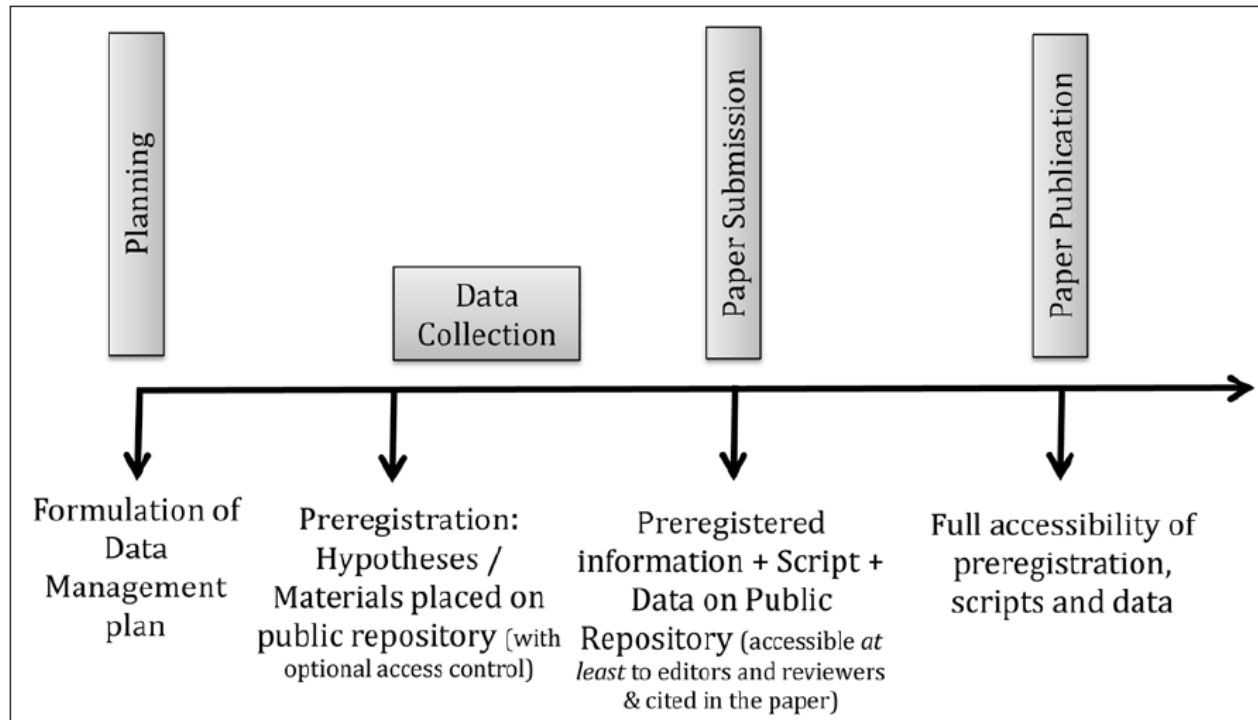
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 - Published article

When can you share?

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any time is better than never (p. 4, Klein et al., 2018).



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Planning a study

- Have a *basic* data management plan (DMP), ideally before starting a project
 - Create basic reusable DMP templates
 - Use online tools to get started (e.g., [ZPID DataWiz](#), [DMPonline](#))
 - Simplifies addressing legal and ethical issues

Before data collection

- Timely archiving
 - Study protocol and materials
 - Standard operating procedures
 - Analysis plan and scripts
- Preregistration

During data collection

- Born-open data (Rouder, 2016)
 - Automatically uploaded to a public repository
 - Offsite backup
 - But: Protect participants' privacy!

Upon submission

- Data, materials, and analysis scripts
 - Facilitates thorough peer-review
 - Errors can be spotted early on (no public correction)
 - Possibly limit access to reviewers prior to publications (e.g., [OSF view-only links](#))

Upon submission

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 - Not typically considered a "prior publication" (Bourne, Polka, Vale, & Kiley, 2017)
 - Exceptions: For example, *New England Journal of Medicine* and *Journal of Clinical Investigation*

After publication

- Archive continuously in online repository, publish later
- Automate by use of embargoes

How can you share?



Compilation of research products

- Develop a default project file structure, e.g.,
 - Klein et al. (2018) **example project** and **ready-to-fork OSF template**
 - Study protocol
 - Materials
 - Raw data
 - Processed data
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- If necessary, restrict repository access (e.g., **OSF components**)

Choose a repository

Sharing option		Discoverability	Sustainability	Access control
On request		--	--	++
Personal website		-	-	0
Journal website		+	0	0
Institutional repository		+	++	+
Public repository		++	++	+

Choose a repository

- **FAIR Data Principles (Wilkinson et al., 2016)**
 1. *Findable*: Persistent identifiers; metadata; indexed
 2. *Accessible*: Retrievable by identifier; controlled access where necessary
 3. *Interoperable*: Standardized metadata; open, lightweight, and interoperable file formats (e.g., CSV, TSV, JSON, ODS)
 4. *Reusable*: Documented; clear usage license

Choose a repository

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 5. Supports systematic licensing (e.g., declare (no) legal restrictions on reuse)
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 6. Supports structured metadata
 7. Tracks reuse of shared products (e.g., citations, downloads)

Choosing a repository

- Self-deposit (e.g., [OSF](#)) vs. curated repositories (e.g., [GESIS DBK](#))
- Resources comparing repositories
 - Table 1 in [Klein et al. \(2018\)](#)
 - [Registry of Research Data Repositories](#)
 - Dataverse blog: [Comparative review of various data repositories](#)
 - APS Observer article by [DeSoto, 2016](#)
 - Table 1 in [Meyer, 2018](#)



Specialized approaches

- Study protocol
 - (Embargoed) Public preregistration
 - Registered reports
 - Video methods journal JoVE Behavior



Specialized approaches

- Analysis scripts and software
 - Hosted Version Control Systems (e.g., [GitHub](#))
 - Cloud-based analysis platforms (e.g., [Code Ocean](#))
 - Cloud-based experiment platforms (e.g., [Pavlovia](#) for [PsychoPy](#), [jspsych](#), and [lab.js](#))



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 - Cloud-based experiment platforms (e.g., [Pavlovia](#) for [PsychoPy](#), [jspsych](#), and [lab.js](#))
 - Usually no guarantee of long-term access
 - Additionally, archive in public repository



Specialized approaches

- Research reports
 - Preprint repositories (e.g., [PsyArXiv](#), [BioRxiv](#), [PeerJ](#))
 - Institutional repositories (less discoverable)



Licenses

- Licenses define conditions of access and reuse



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The selection, coordination, and arrangement of the database is subject to copyright if it is sufficiently original. [...] The data or other contents contained in the database are subject to copyright if they are sufficiently creative. Original poems contained in a database would be protected by copyright, but purely factual data (such as gene names or city populations) would not. Facts are not subject to copyright, nor are the ideas underlying copyrighted content (Creative Commons, 2018).



Licenses

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- Factual information are usually *not* protected by copyright
 - For example, response times, mortality rates, currency values, the number of Twitter followers someone has
 - Database structures and compilations of data may be copyrightable



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- Copyright to long verbatim interview responses may belong to participants



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 - For example, "All files in this repository are licensed under a Creative Commons Zero License (CC0 1.0)"





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 - For example, "All files in this repository are licensed under a Creative Commons Zero License (CC0 1.0)"
- Use most permissive license possible (e.g., CC0, CC-BY)



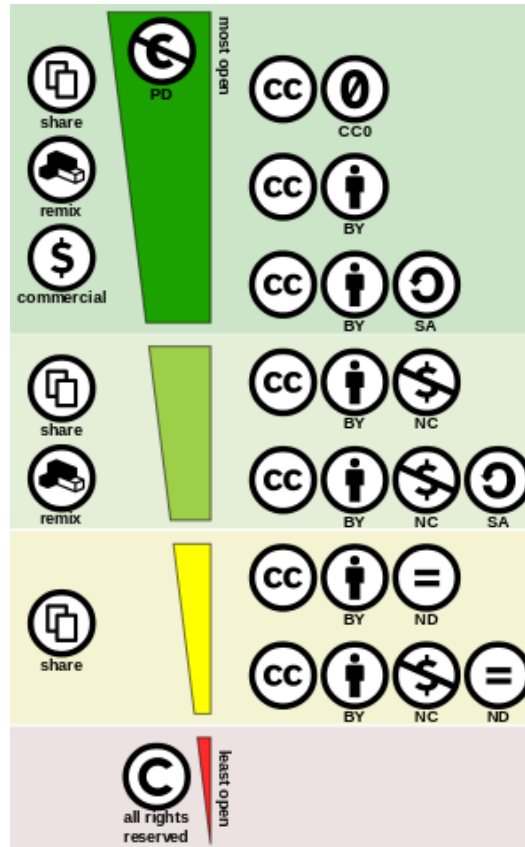
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- Modular license "building set"
 - In practice, seven combinations are supported

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- Copyright to long verbatim interview responses may belong to participants

How can you promote research
transparency?

How can you promote research transparency?

- Lead by example
 - Promote selfish reasons for transparency, e.g.,
 - Remember what you've done
 - Easily find your own data and materials
 - More citations
 - Opportunities for collaboration
 - Confidence in your own findings
 - Share materials with your collaborators
 - Publish in journals that value openness
 - Commit to Research Transparency and Open Science

How can you promote research transparency?

- Incentivize sharing
 - Cite colleagues when reusing their shared resources, e.g.,
 - Open data and materials
 - Open source software (developed by academics)
 - Open course materials
 - Promote openness during peer review (e.g., **PRO initiative**)
 - Value openness in hiring committees (e.g., **job offers that mentioned open science**)

How can you promote research transparency?

- Teach your students and colleagues
 - Transparent research practices in theses, e.g.,
 - "Safe" transparency for capstone project (OSF group)
 - Stage-1 registered report as non-empirical Bachelor's thesis
 - Collate and share materials on transparent research practices
 - Teach workshops

How can you promote research transparency?

- Lobby for transparent research practices, e.g.,
 - Advocate for registered reports at journals (e.g., **Registered Reports Now!**)

How can you promote research transparency?

- Lobby for transparent research practices, e.g.,
 - Advocate for registered reports at journals (e.g., **Registered Reports Now!**)
- Be forgiving of your own and other's honest mistakes!

Learn more about transparent research practices

- Open Science Knowledge Base
- DataWiz Knowledge Base
- FOSTER Open Science Courses
- Center for Open Science Webinars
- Open Science Short Course at the **GESIS Summer School**

Open Science is just science done right

—Jon Tennant, Imperial College London

Acknowledgments



- Workshop material is based on Klein, O., Hardwicke, T. E., Aust, F., Breuer, J., Danielsson, H., Hofelich Mohr, A., ... Frank, M. C. (2018). A Practical Guide for Transparency in Psychological Science. Collabra: Psychology, 4(1). doi: [10.1525/collabra.158](https://doi.org/10.1525/collabra.158) (CC-BY 4.0)
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