Reproducible Research

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Genetic Diversity Centre (GDC)
Bioinformatics
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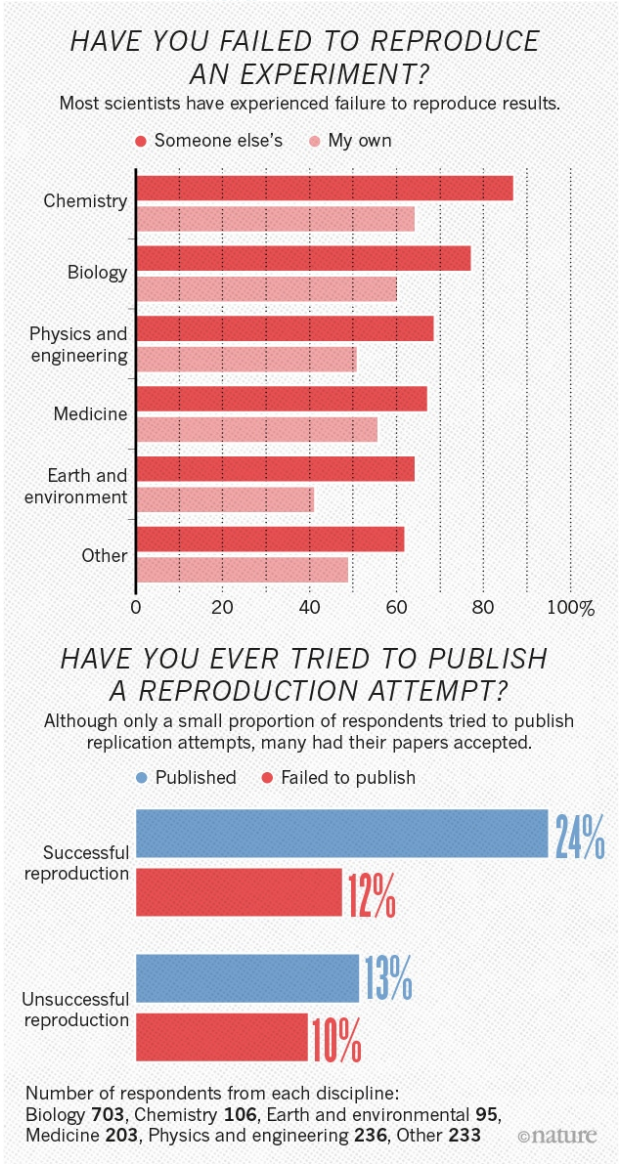
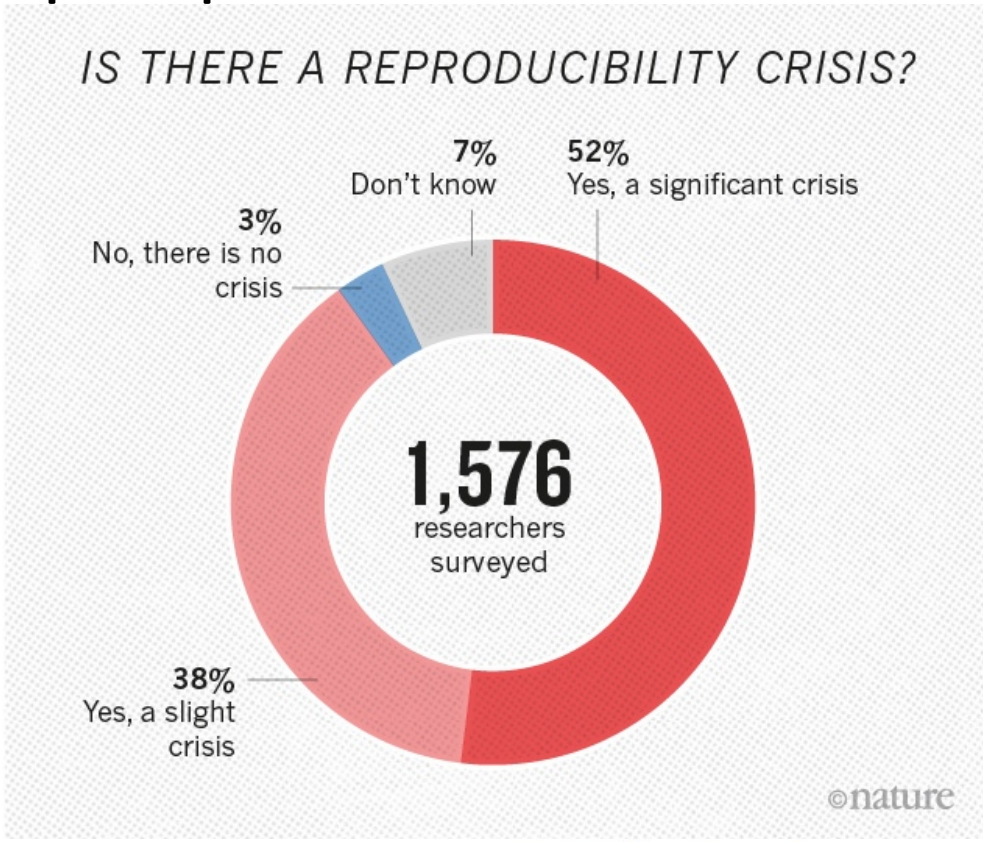
Scientific recipe-publications



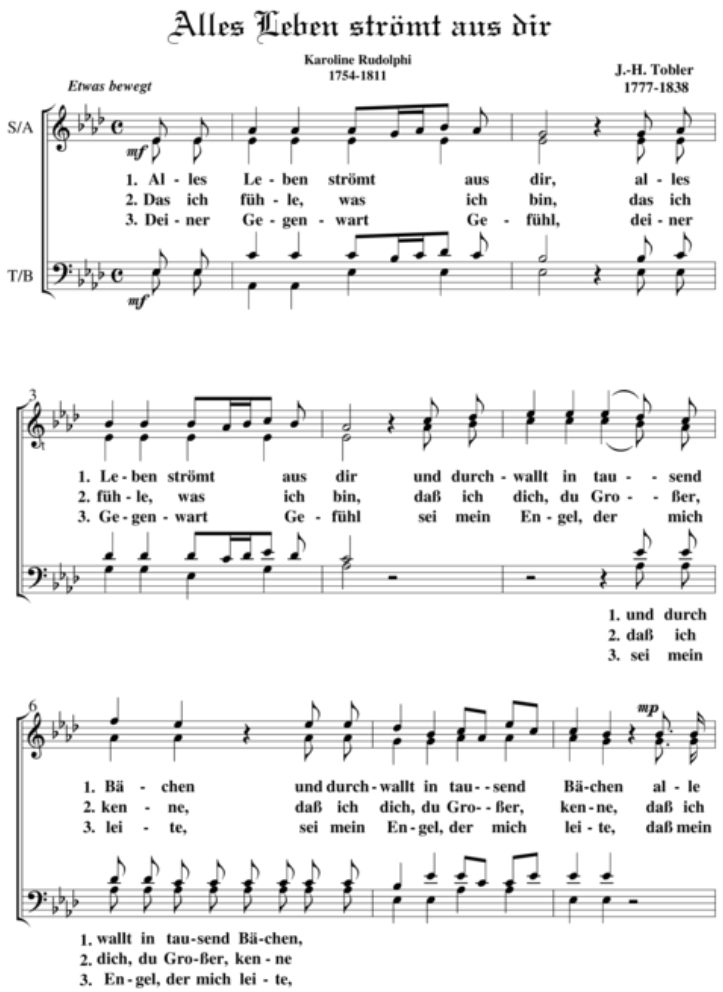


Reality check on reproducibility

A survey of *Nature* readers revealed a high level of concern about the problem of irreproducible results. Researchers, funders and journals need to work together to make research more reliable.

25 May 2016

Recipe



Ingredients

3 fresh red chillies

2 onions

4 cloves of garlic

4 large plum tomatoes

1 bunch of fresh coriander

4 large free-range chicken legs, skin on

olive oil

2 teaspoons garam masala

1 tablespoon crumbled dried curry leaves

1 tablespoon mustard seeds

2 tablespoons white wine vinegar

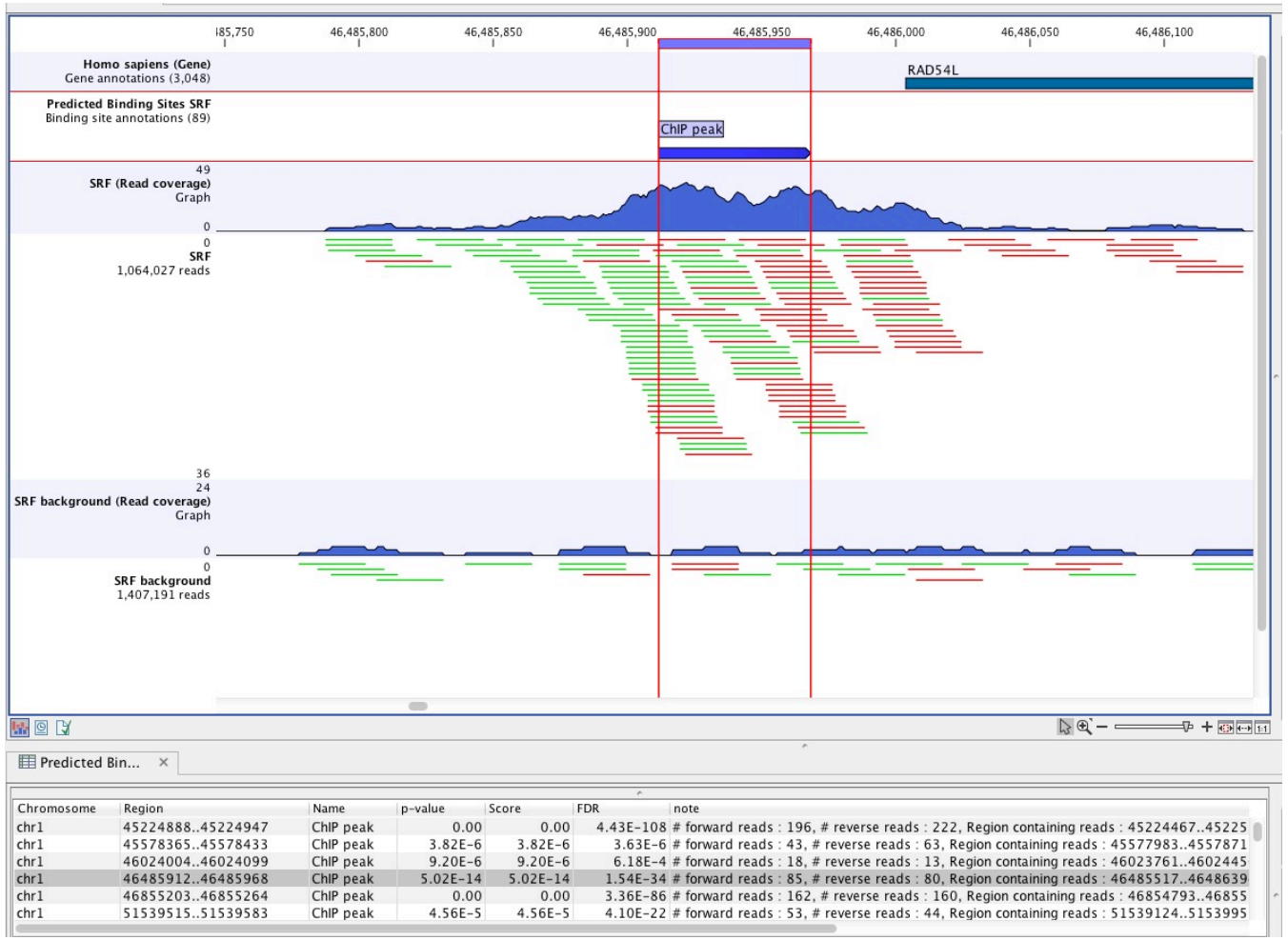
fat-free natural yoghurt

Method

1. Halve the chillies (deseed if you like), peel and finely slice the oni
   the garlic. Quarter the plum tomatoes, and pick the coriander lea
2. Rub the chicken legs all over with a drizzle of oil and the garam m
   large non-stick ovenproof pan.
3. Add another drizzle of oil and fry the chicken over a medium hea
   until lovely and dark golden all over. Be brave and let it get really
   make such a difference to the end result if you get it right at this s
   fat.
4. At this point, preheat the oven to 180ºC/350ºF/gas 4.
5. Next, add the curry leaves, mustard seeds, chillies, onion and garl
   stirring often, for 5 minutes, then add the tomatoes and white wi

   Transfer the pan to the oven. Cook, uncovered, for 50 minutes, or
   cooked through and falling off the bone.
6. Pop the pan on the hob and reduce the liquid until sticky. Scatter
   and serve with the cooling yoghurt. Delicious with rice or couscou

GUI tools



Chromosome	Region	Name	p-value	Score	FDR	note
chr1	45224888..45224947	ChIP peak	0.00	0.00	4.43E-108	# forward reads : 196, # reverse reads : 222, Region containing reads : 45224467..45225
chr1	45578365..45578433	ChIP peak	3.82E-6	3.82E-6	3.63E-6	# forward reads : 43, # reverse reads : 63, Region containing reads : 45577983..4557871
chr1	46024004..46024099	ChIP peak	9.20E-6	9.20E-6	6.18E-4	# forward reads : 18, # reverse reads : 13, Region containing reads : 46023761..4602445
chr1	46485912..46485968	ChIP peak	5.02E-14	5.02E-14	1.54E-34	# forward reads : 85, # reverse reads : 80, Region containing reads : 46485517..4648639
chr1	46855203..46855264	ChIP peak	0.00	0.00	3.36E-86	# forward reads : 162, # reverse reads : 160, Region containing reads : 46854793..46855
chr1	51539515..51539583	ChIP peak	4.56E-5	4.56E-5	4.10E-22	# forward reads : 53, # reverse reads : 44, Region containing reads : 51539124..5153995

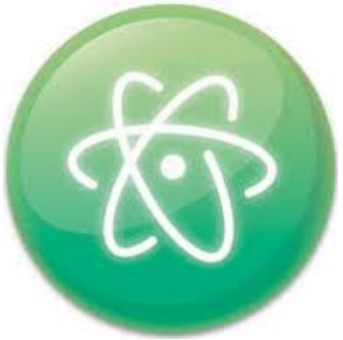
geneious

CLC Genomics Workbench

Command-line version

bwa mem Ref reads > alignment.sam

Scientific recipe



Log-file

```
################################################
Nik Zemp, niklaus.zemp@env.ethz.ch, GDC, ETH Zurich
################################################
#####ddRAD log file, Ivo Widmer, p432
################################################

#######################################################
####Download data
#######################################################
module load eth_proxy
bsub -n1 -W 4:00 -R "rusage[mem=1000]" \
"wget -r --no-parent --reject="index.htm*" http://gc3fstorage.u
bsub -n1 -W 4:00 -R "rusage[mem=1000]" \
"wget -r --no-parent --reject="index.htm*" http://gc3fstorage.u
bsub -n1 -W 4:00 -R "rusage[mem=1000]" \
"wget -r --no-parent --reject="index.htm*" http://gc3fstorage.u
bsub -n1 -W 4:00 -R "rusage[mem=1000]" \
```

script

```
#!/bin/bash
#BSUB -J "processradtags"
#BSUB -R "rusage[mem=10000]"
#BSUB -n 1
#BSUB -W 24:00


module load gcc/4.9.2 gdc perl/5.18.4
export PATH=$PATH:/cluster/project/gdc/shared/tools/stacks-1.48
#module load gcc/4.8.2 gdc perl/5.18.4 stacks/1.40
source /cluster/apps/gdc/perl5/etc/bashrc



mkdir samples

process_radtags -i gzfastq -f /cluster/project/gdc/people/buckleyj/Hiseq_
```

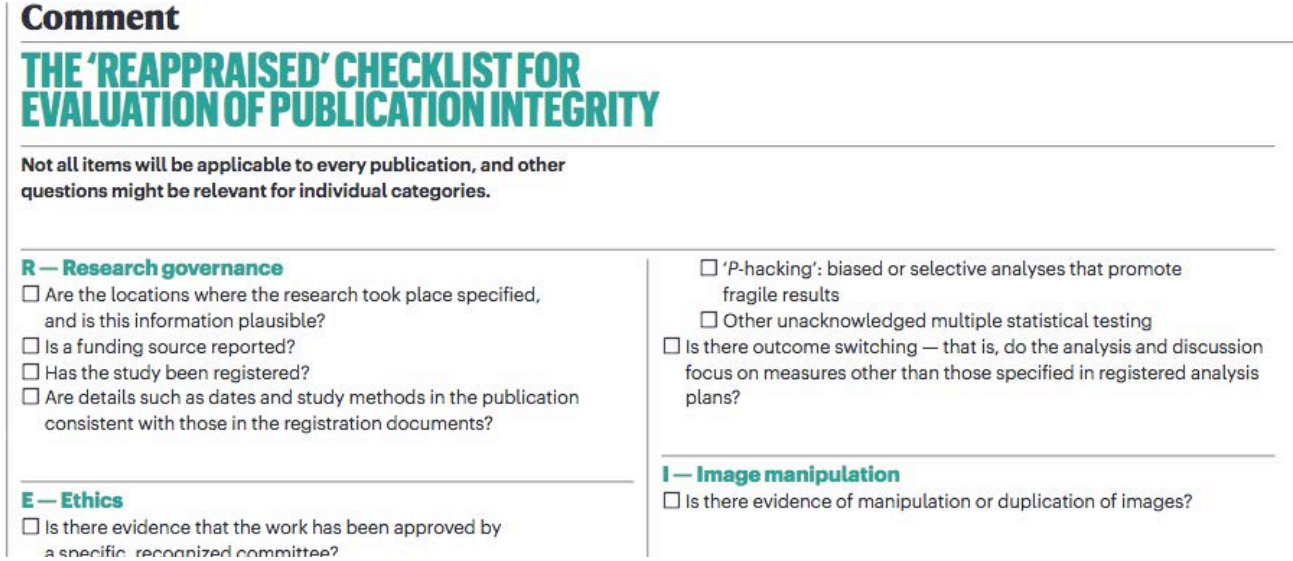
Scientific recipe

- (original) author or source
- your name
- date
- version of the tool
- version of the script
- reproducible code with comments (more comments than code)
- use style guides
- syntax coloring

Publication

- keep all scripts and raw data
- use default settings or mention if not
- provide version information
- provide commands in supplementary material
- deposit scripts on github/gitlab
- Check-list

https://www.nature.com/articles/d41586-019-03959-6



Comment

THE 'REAPPRAISED' CHECKLIST FOR EVALUATION OF PUBLICATION INTEGRITY

Not all items will be applicable to every publication, and other questions might be relevant for individual categories.

R — Research governance

- ☐ Are the locations where the research took place specified, and is this information plausible?
- ☐ Is a funding source reported?
- ☐ Has the study been registered?
- ☐ Are details such as dates and study methods in the publication consistent with those in the registration documents?

E — Ethics

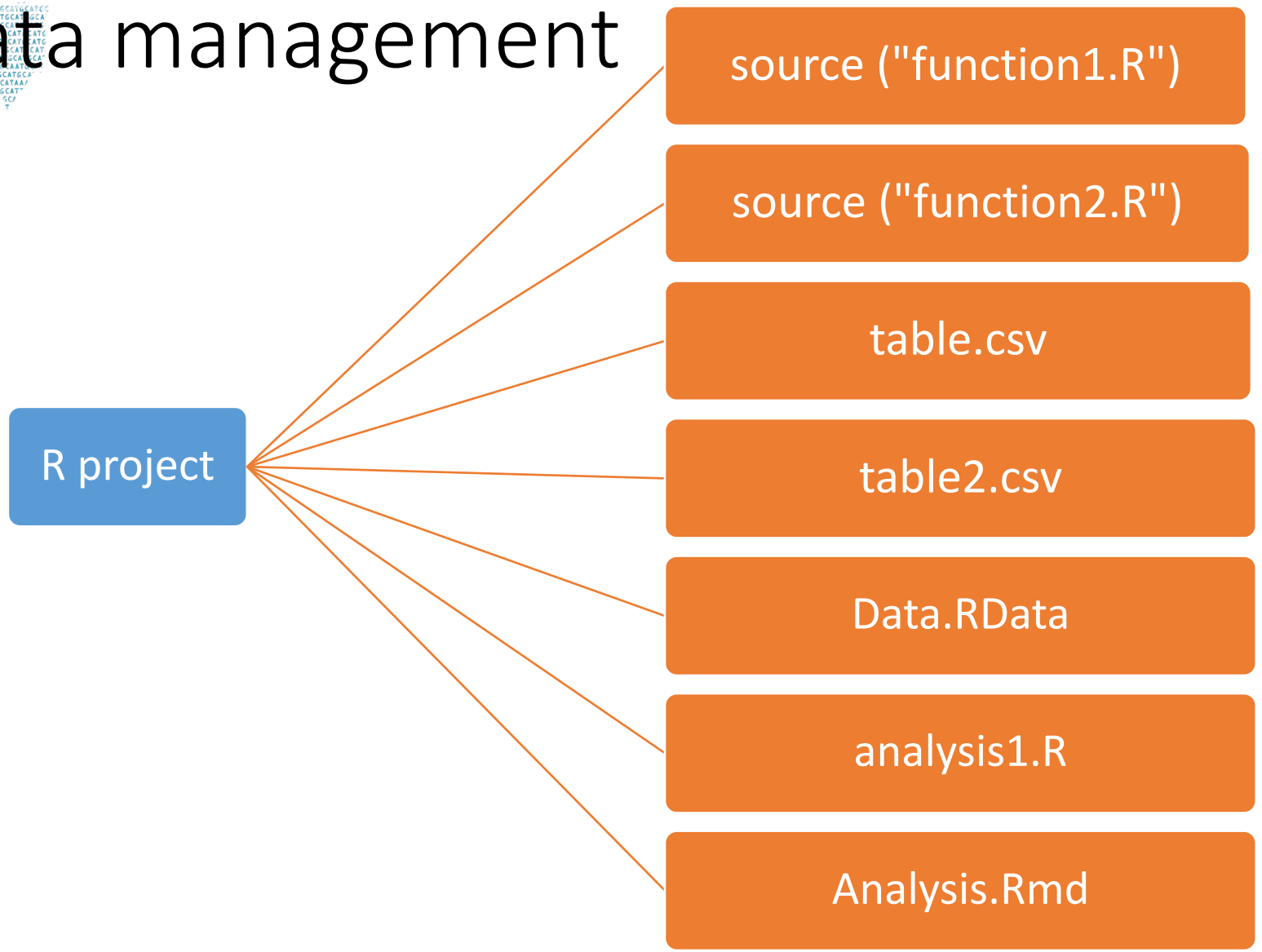
- ☐ Is there evidence that the work has been approved by a specific, recognized committee?
- ☐ 'P-hacking': biased or selective analyses that promote fragile results
- ☐ Other unacknowledged multiple statistical testing
- ☐ Is there outcome switching — that is, do the analysis and discussion focus on measures other than those specified in registered analysis plans?

I — Image manipulation

- ☐ Is there evidence of manipulation or duplication of images?

Genetic Diversity Centre Zurich

Data management



R with style

The tidyverse style guide

Hadley Wickham

https://style.tidyverse.org/index.html

Google R-style

https://google.github.io/styleguide/Rguide.xml

Styler

styler

The goal of styler is to provide non-invasive pretty-printing of R source code while adhering to the tidyverse formatting rules. styler can be customized to format code according to other style guides too.

Installation

You can install the package from CRAN:

```
install.packages("styler")
```

Some examples

```
# Good
day_one
day_1

# Bad
DayOne
dayone
```

```
# Good
x <- 5

# Bad
x = 5
```

```
# Good
if (y < 0) {
  stop("Y is negative")
}
```

```
# Bad
if (y < 0) stop("Y is negative")
```

```
# Good
"Text"
'Text with "quotes"'
'<a href="http://style.tidyverse.org">A link</a>'

# Bad
'Text'
'Text with "double" and \'single\' quotes'
```

Take home message

- Do reproducible research

Outlook:

- Markdown is helpful
- Remember RegEx