

# The Registered Reports project: A vaccine against research bias?

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# Science has an incentive problem

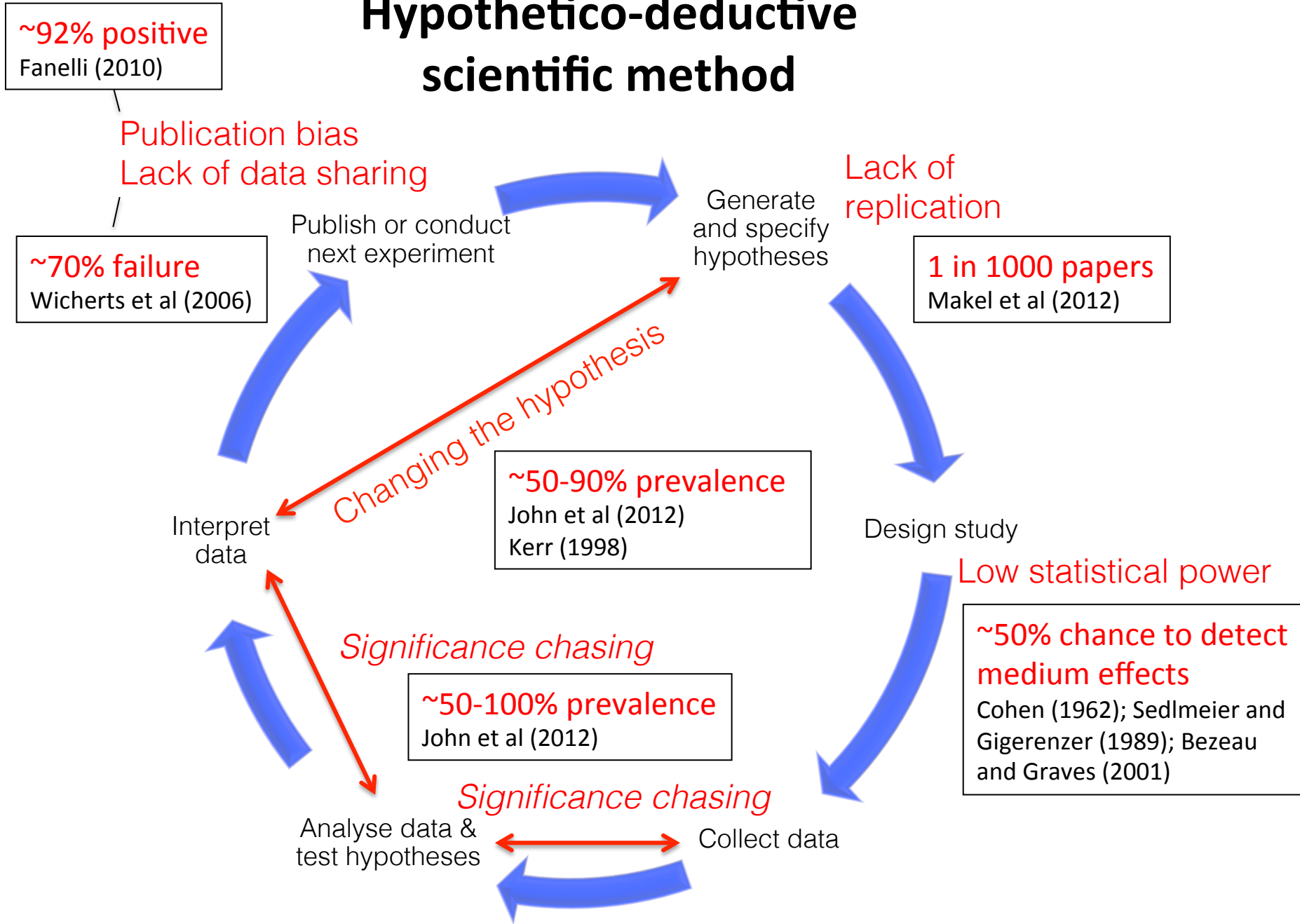
**What's best for  
science**

High quality research,  
regardless of outcome

**What's best for  
scientists**

Producing a lot of  
publishable results

# Hypothetico-deductive scientific method



# Why is this happening?

Because we place too much importance on the **results** of experiments and not enough on the **processes** that produce them

Results make science exciting but judging the quality of science (and scientists) according to the results is “soft” science

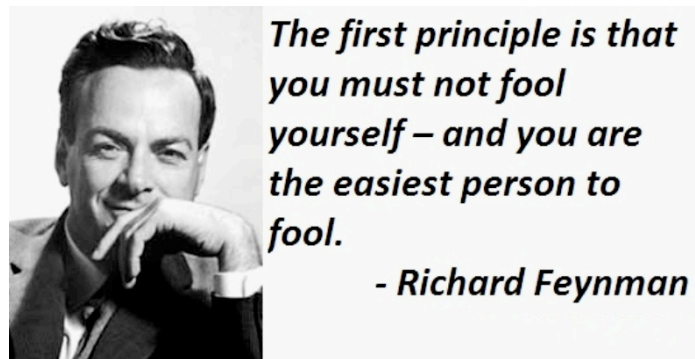
# Can we fix this? Yes

## Philosophy:

What gives hypothesis-testing its scientific value is

- the QUESTION it asks
- the QUALITY of the method it uses
- never the RESULT it produces

If we accept this philosophy then editorial decisions at journals should be *blind* to results



# This is not a new idea

Robert Rosenthal (1966). *Experimenter effects in behavioral research*. New York.

*“What we need is a system for evaluating research based only on the procedures employed. If the procedures are judged appropriate, sensible, and sufficiently rigorous to permit conclusions from the results, the research cannot then be judged inconclusive on the basis of the results and rejected by the referees or editors. Whether the procedures were adequate would be judged independently of the outcome.”*

# Registered Reports

CORTEX 49 (2013) 609–610



Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

**SciVerse ScienceDirect**

Journal homepage: [www.elsevier.com/locate/cortex](http://www.elsevier.com/locate/cortex)



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## Editorial

### **Registered Reports: A new publishing initiative at Cortex**

*Christopher D. Chambers*

*Cardiff University Brain Research Imaging Centre (CUBRIC), School of Psychology, Cardiff University, United Kingdom*

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## Four central aspects of the Registered Reports model:

- Researchers decide hypotheses, experimental procedures, and main analyses *before* data collection
- Part of the peer review process takes place before experiments are conducted
- Passing this stage of review virtually guarantees publication
- Original studies and high-value replications are welcome

# How it works

Authors submit **STAGE 1** manuscript with Introduction, Proposed Methods & Analyses, and Pilot Data (if applicable)



Stage 1 peer review



If reviews are positive then journal offers **in-principle acceptance (IPA)**, regardless of study outcome  
*(protocol not published yet)*

*Are the hypotheses well founded?*

*Are the methods and proposed analyses feasible and sufficiently detailed?*

*Is the study well powered? ( $\geq 90\%$ )*

*Have the authors included sufficient positive controls to confirm that the study will provide a fair test?*



# How it works

Authors do the research



- Authors resubmit completed **STAGE 2** manuscript:
- **Introduction** and **Methods** (virtually unchanged)
  - **Results (new)**: Registered confirmatory analyses + unregistered exploratory analyses
  - **Discussion (new)**
  - **Data deposited in a public archive**



Stage 2 peer review

*Did the authors follow the approved protocol?*

*Did positive controls succeed?*

*Are the conclusions justified by the data?*



Manuscript published!

None of these things matter



WHETHER  
HYPOTHESIS  
SUPPORTED



WHETHER  
 $p < .05$



WHETHER  
RESULTS  
ARE NOVEL



WHETHER  
RESULTS  
HAVE  
"IMPACT"

# Published examples at *Cortex*

## Registered report

**The effects of AMPA blockade on the spectral profile of human early visual cortex recordings studied with non-invasive MEG**

Suresh D. Muthukumaraswamy <sup>a,b,\*</sup>, Bethany Routley <sup>c</sup>, Wouter Droog <sup>d</sup>,  
Krish D. Singh <sup>c</sup> and Khalid Hamandi <sup>c,e</sup>

## Registered report

**The functional subdivision of the visual brain: Is there a real illusion effect on action? A multi-lab replication study**

Karl K. Kopiske <sup>a,f,\*</sup>, Nicola Bruno <sup>b</sup>, Constanze Hesse <sup>c</sup>,  
Thomas Schenk <sup>d</sup> and Volker H. Franz <sup>a,e</sup>

## Registered report

**Mu suppression – A good measure of the human mirror neuron system?**

Hannah M. Hobson <sup>\*</sup> and Dorothy V.M. Bishop

## – Reproducible –

- detailed, repeatable methods
- high statistical power (2-3x above normal)

## – Transparent –

- accompanied by open data & materials
- outcomes of confirmatory and exploratory analyses distinguished

## – Credible –

- no publication bias
- no hindsight bias
- no selective reporting

<http://www.journals.elsevier.com/cortex/virtual-special-issues/virtual-special-issue-registered-reports>

See also:

Social Psychology special issue: <http://econtent.hogrefe.com/toc/zsp/45/3>

Perspectives on Psychological Science: <http://www.psychologicalscience.org/index.php/replication/ongoing-projects>

# Trust in science would be improved by study pre-registration

**Open letter:** We must encourage scientific journals to accept studies before the results are in

Chris Chambers, Marcus Munafo and more than 80 signatories  
theguardian.com, Wednesday 5 June 2013 12.45 BST

Jump to comments (43)



The quest: a better understanding of nature. Photograph: Sebastian Kaulitzki/Alamy

In an ideal world, scientific discoveries would be independent of what scientists *wanted* to discover. A good researcher would begin with an idea, devise a method to test the idea, run the study as planned, and then decide based on the evidence whether the idea had been supported. Following this approach would lead us step-by-step toward a better understanding of nature.

Unfortunately, the life sciences are becoming increasingly estranged from this way of thinking. Early in their training, students learn that the quest for truth needs to be balanced against the more immediate pressure to

## Permanent adopters

Advances in Methodologies and Practices in Psychological Science
AIMS Neuroscience
Animal Behavior and Cognition
Attention, Perception, and Psychophysics
Behavioral Neuroscience
Cognition and Emotion
Cognitive Research: Principles and Implications
Comprehensive Results in Social Psychology
Cortex
Drug and Alcohol Dependence
European Journal of Neuroscience
Experimental Psychology
Health Psychology Bulletin
Human Movement Science
Infancy
International Journal of Psychophysiology
Journal of Business and Psychology
Journal of Cognitive Enhancement
Journal of European Psychology Students
Journal of Experimental Political Science
Journal of Media Psychology
Journal of Personnel Psychology
Judgment and Decision Making
Management and Organization Review
Memory
Nature Human Behaviour
NFS Journal
Nicotine & Tobacco Research
Perspectives on Psychological Science
Royal Society Open Science
Stress and Health
The Leadership Quarterly
Work, Aging and Retirement

## Special issues

American Journal of Political Science
American Political Science Review
American Politics Research
Comparative Political Studies
eLife
Frontiers in Cognition
Journal of Accounting Research
Political Analysis
Political Behavior
Political Science Quarterly
Political Science Research and Methods
Public Opinion Quarterly
Social Psychology
State Politics and Policy Quarterly
The Review of Financial Studies

For full list see <https://cos.io/rr/>

# Registered Reports at *Royal Society Open Science*

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## Registered Reports

- [1. Summary and benefits](#)
- [2. Stage one](#)
- [3. Stage two](#)
- [4. Reviewer guidelines](#)
- [5. More information](#)

### Summary and Benefits

A Registered Report (RR) is a form of journal article in which methods and proposed analyses are pre-registered and peer-reviewed prior to research being conducted (stage 1). High quality protocols are then provisionally accepted for publication before data collection commences. The format is open to attempts of replication as well as novel studies. Once the study is completed, the author will finish the article

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analysis

analytical chemistry

applied mathematics

artificial intelligence

astrobiology

<http://rsos.royalsocietypublishing.org/content/registered-reports>

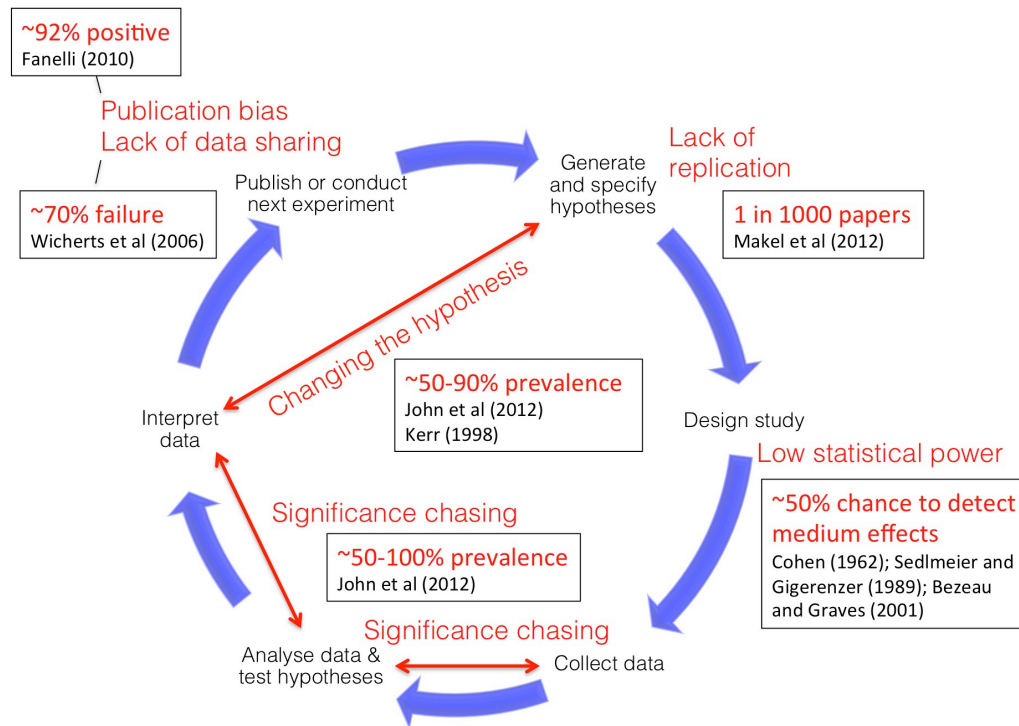
# Registered Reports at *Nature Human Behaviour*



Anthropology	Evolution
Artificial Intelligence	Genetics
Business Studies	Geography
Cognitive Science	Linguistics
Communication	Management
Criminology	Neurology
Cultural Studies	Neuroscience
Ecology	Political Science
Economics	Psychiatry
Education	Psychology
Epidemiology	Public Policy
Ethology	Sociology

What are the benefits for journals, editors, authors and the scientific community?

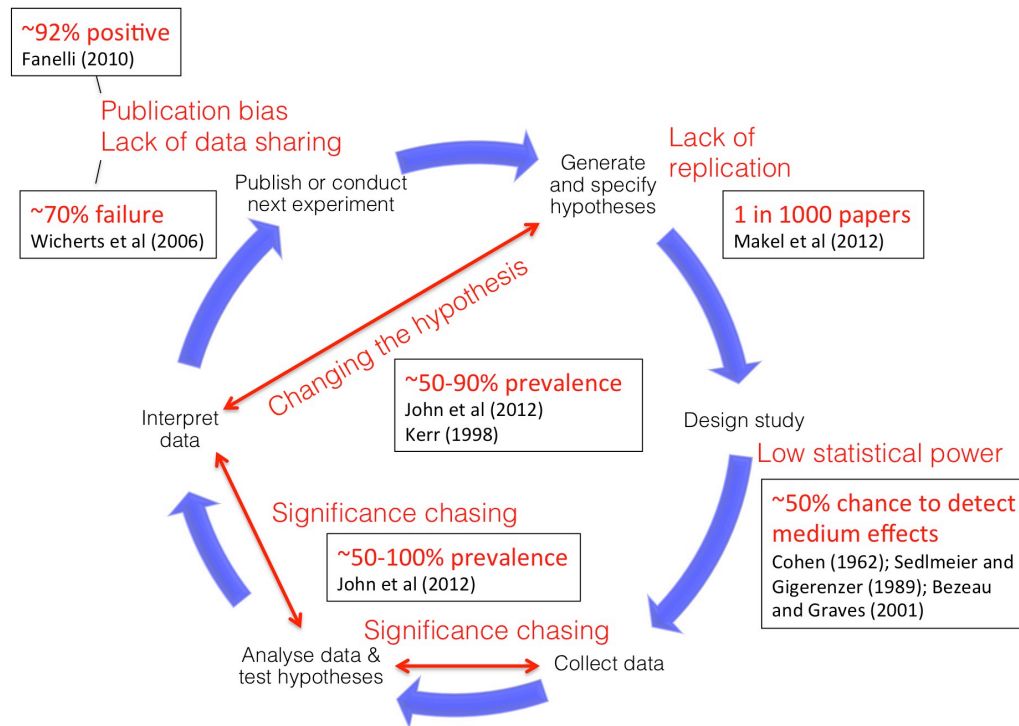
# Benefits





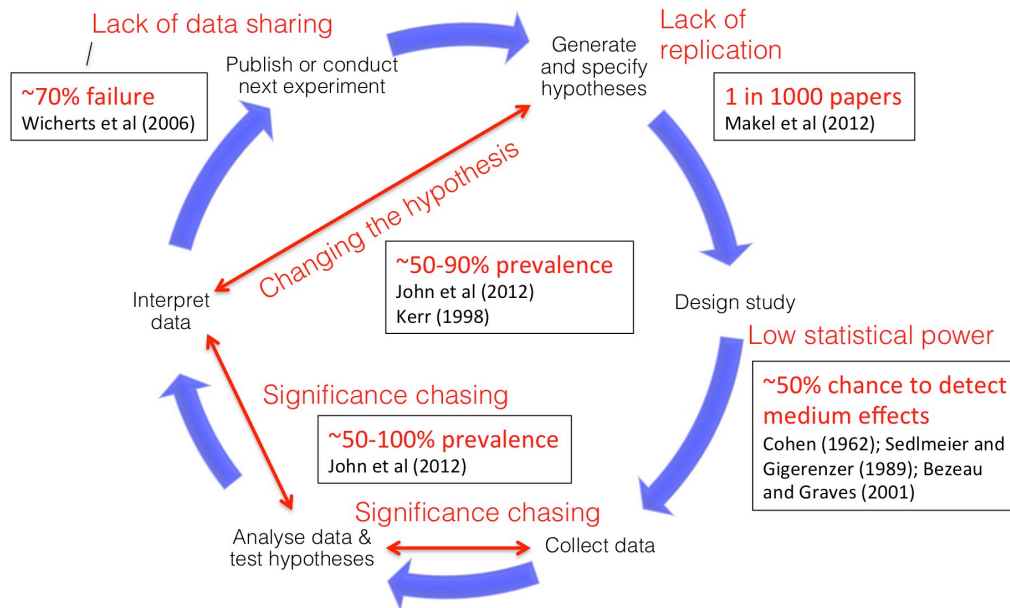
# Benefits

## 1. No publication bias



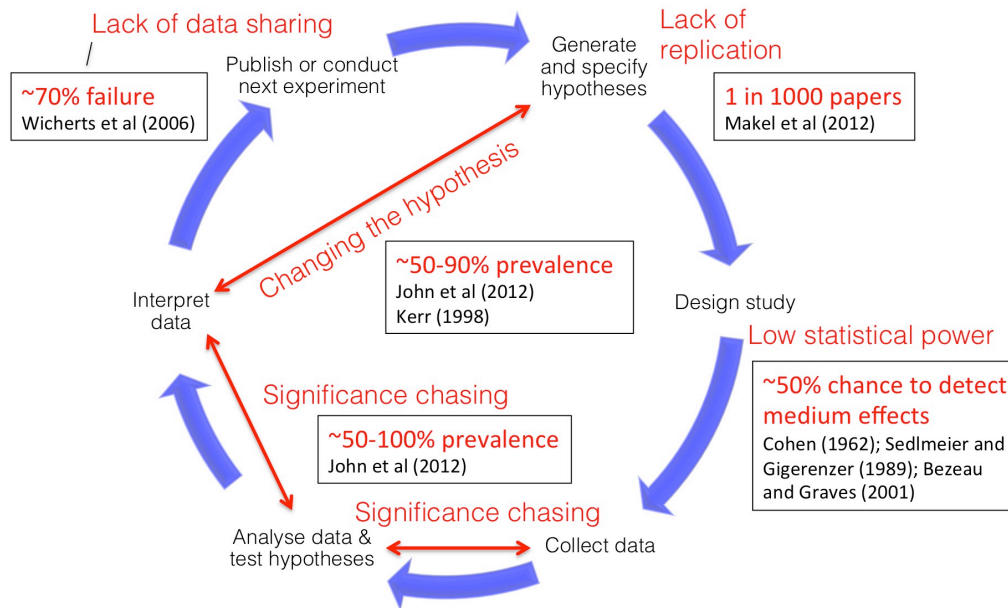
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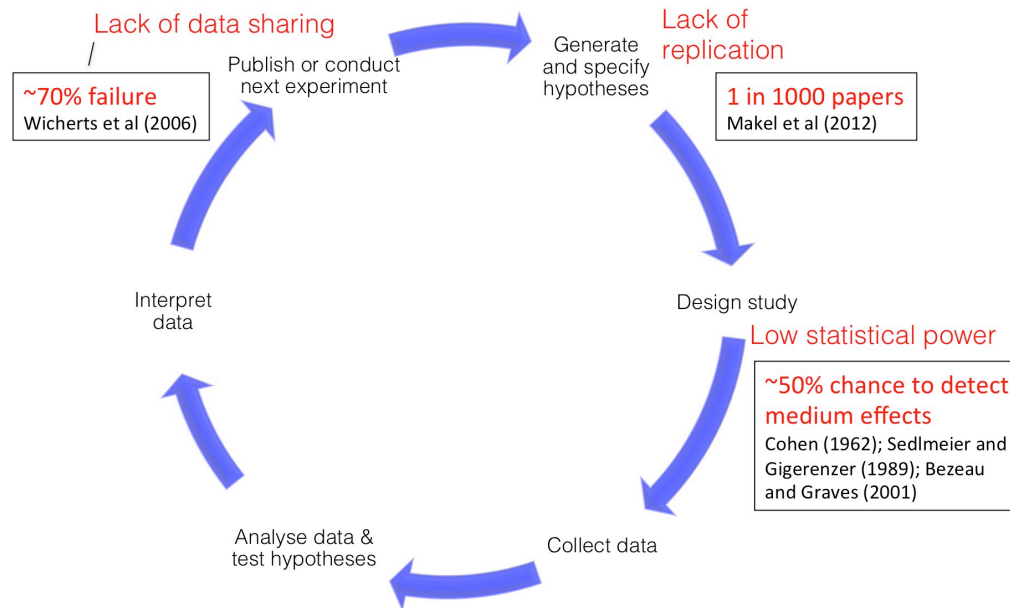


# Benefits

1. No publication bias
2. Logically eliminates various forms researcher bias (*p*-hacking, *post hoc* hypothesising)

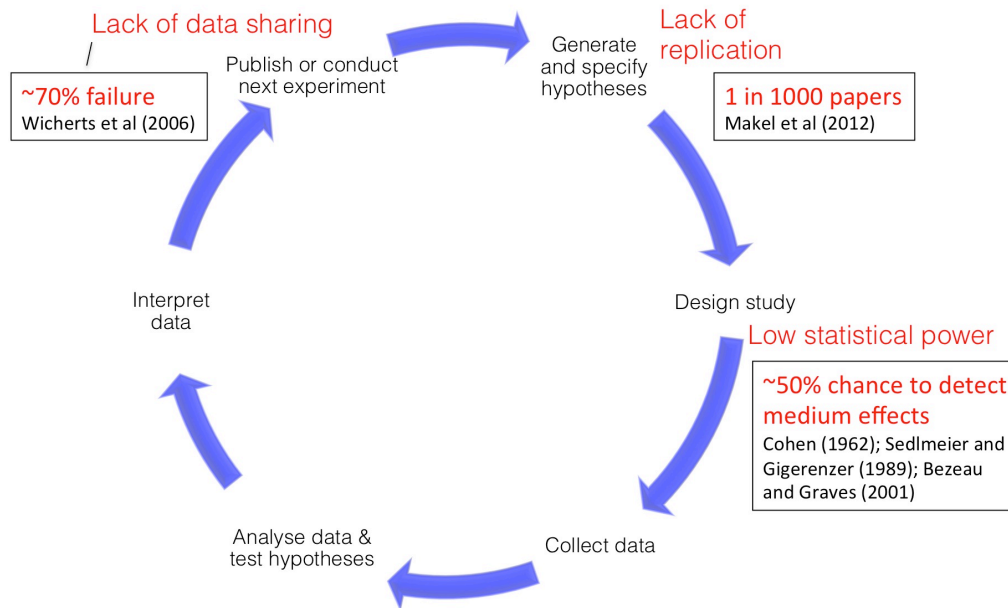


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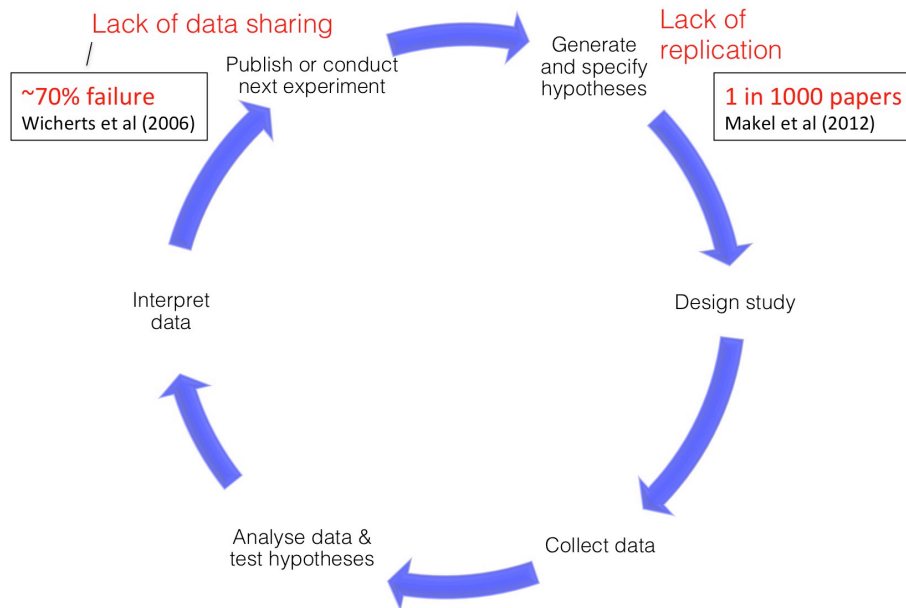
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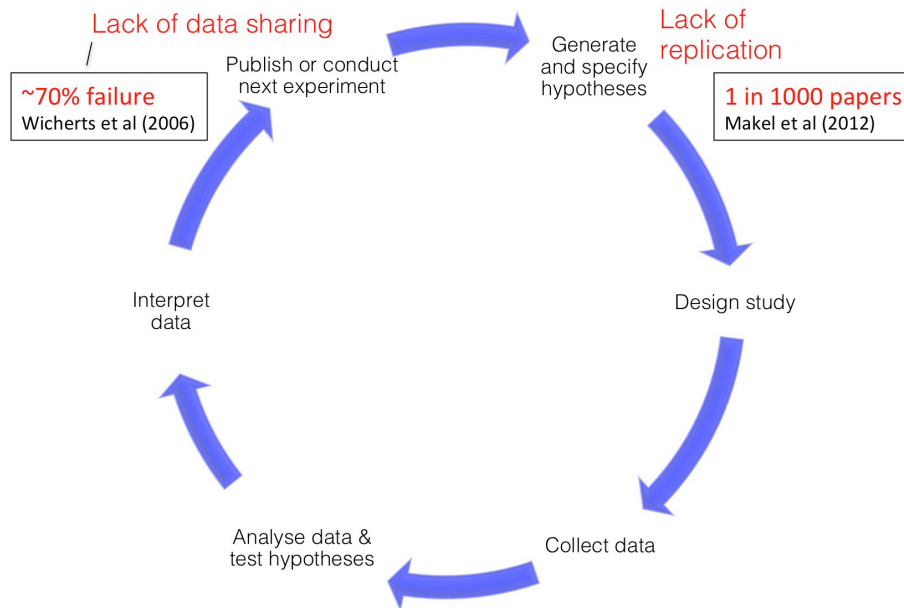
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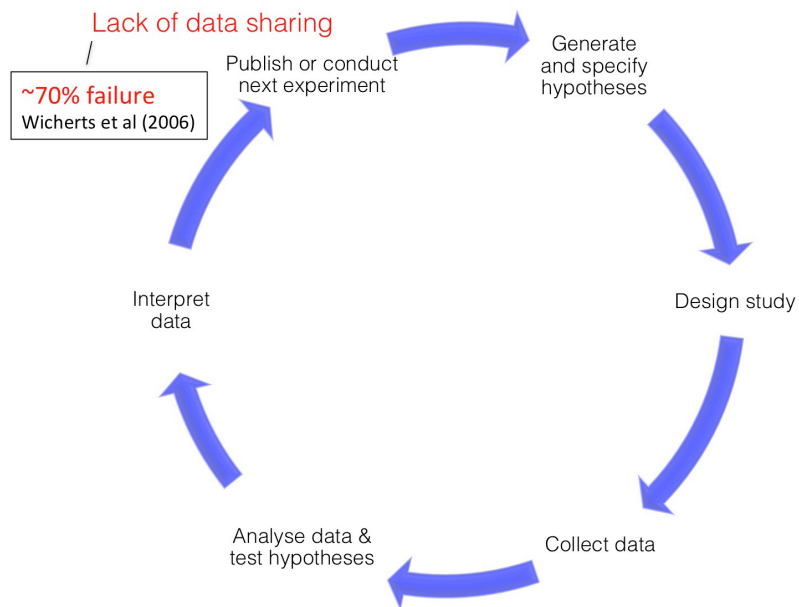
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4. Incentivizes important replication studies and other novel, resource-intensive projects (where publication would normally be contingent on results)

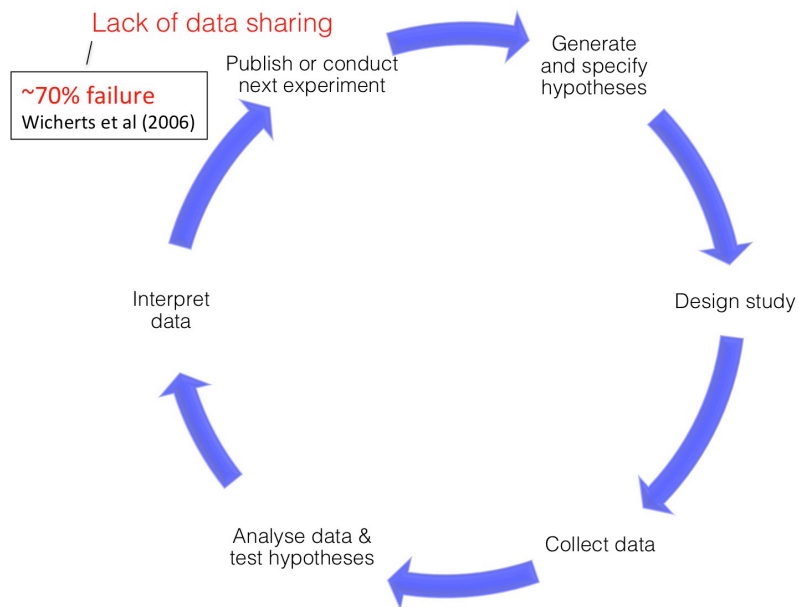
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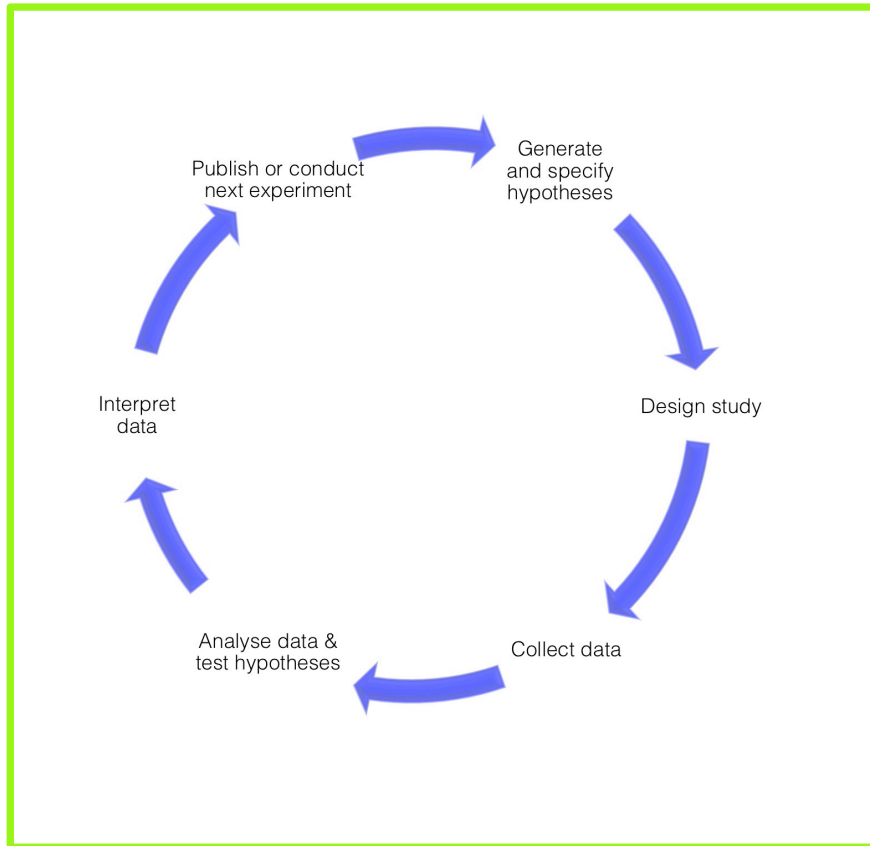


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## Frequently asked questions

# 1. “Are Registered Reports suitable for my field?”

- Applicable to any field engaged in hypothesis-driven research where one or more of the following problems apply:
  - **Publication bias**
  - **Significance chasing (e.g.  $p$ -hacking)**
  - ***Post hoc* hypothesizing (hindsight bias)**
  - **Low statistical power**
  - **Lack of direct replication**
- Not applicable for
  - **Purely exploratory science**
  - **Methods development** } No hypothesis testing

## 2. “Could researchers cheat by ‘pre-registering’ a study that they have already conducted?”

- Time-stamped raw data files must be submitted at Stage 2 with basic lab log and certification from all authors that data was collected after provisional acceptance
  - Submitting a completed study at Stage 1 would therefore be fraud
  - Strategy would backfire anyway when reviewers ask for amendments at Stage 1
- Registered Reports aren't designed to prevent fraud but to incentivize good practice*

## 3. “What’s to stop Registered Reports from becoming a dumping ground for inconclusive null results?”

- *a priori* power requirements ( $\geq 90\%$ ) increase reproducibility of all findings
- Bayesian inferential methods welcomed for providing evidence in favour of H0 or H1.

## 4. “Pre-registration is fine for senior researchers who have ‘made it’ but I’m a junior scientist and need to play the game”

- The game is changing: journal policies are changing to value transparency and reproducibility, e.g. *Nature Human Behaviour* has launched RRs
- Going for post doc jobs, what do you think will look better on your CV?
  - A) Bunch of papers listed as “in preparation”, “submitted”
  - B) Bunch of papers listed as “provisionally accepted at [*respected journal*]”

## 5. “Will this limit exploration or stigmatize exploratory research?”

- No. **There are no restrictions on the reporting of unregistered exploratory analyses.**
- Confirmatory and exploratory analyses are simply reported separately in the final paper

What stigmatizes exploratory research is *post hoc hypothesizing* to fit a deductive framework

Exploratory research is simply not valued in its native form

- **Exploratory Reports at *Cortex* (in development)**
  - no hypothesis testing
  - no  $p$  values
  - Data-led; light on introduction and theory
  - Purpose is to generate hypotheses rather than test them

## 6. “What happens if we need to change something about our experimental procedures after they are provisionally accepted?”

- Minor changes (e.g. replacing equipment) can be footnoted in Stage 2 manuscript as protocol deviations
- Major changes (e.g. changing data exclusion criteria) are likely to require withdrawal
- Editorial team decides whether deviation is sufficiently minor to continue

## 7. “Some of my analyses will depend on the results, so how can I pre-register each step in detail?” (e.g. type of statistical model)

- Pre-registration doesn't require each decision to be specified, only the decision *tree*
- Authors can pre-register the contingencies / rules for future decisions

## 8. “I have access to an existing data set that I haven't yet analysed. Can I submit this proposed analysis as a Registered Report?”

- Not at *Cortex*, but other journals offer this, such as *European Journal of Neuroscience*...

Comparison of Registered Reports ☆

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chambersc1@cardiff.ac.uk

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1		<a href="#">Return to Registered Reports Wiki on OSF</a>															
2	Journal	1. Includes pre-study peer review	2. Offers provisional pre-study acceptance	3. Permanence of adoption	4. Offered for novel studies	5. Offered for replication studies	6. Offered for meta-analysis	7. Offered for analyses of existing data sets	8. Publishes Registered Reports only	9. Allows reporting of unregistered analyses	10. Includes post-study peer review	11. Allows inclusion of unregistered pilot studies	12. Requires public data deposition	13. Specifies structured criteria for editorial decisions	14. Requires submitted protocols to have prior ethical approval	15. Specifies minimum statistical power requirements	16. Will publish 'Withdrawn Registrations'
3	<b>JOURNALS OFFERING REGISTERED REPORTS</b>																
4	AIMS Neuroscience	✓	✓	Indefinite	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓
5	Attention, Perception & Psychophysics	✓	✓	Indefinite	✓	✓					✓	✓	✓	✓	✓	✓	
6	Cognition & Emotion	✓	✓	Indefinite		✓				✓	✓	✓	✓	✓	✓	✓	✓
7	Comparative Political Studies	✓	✓	Special issue only	✓	✓	✓	✓		✓	✓		✓				✓
8	Comprehensive Results in Social Psychology	✓	✓	Indefinite	TBA	TBA	TBA	TBA	✓	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA
9	Cortex	✓	✓	Indefinite	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓
10	Drug and Alcohol Dependence	✓	✓	Indefinite	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓
11	eLife	✓	✓	<a href="#">Special Issue RP-CB only</a>		✓				✓	✓		✓	✓	✓	✓	
12	Experimental Psychology	✓	✓	Indefinite	✓	✓				✓	✓	✓	✓	✓	✓	✓	
13	Frontiers in Cognition (a)	✓	✓	Special issue only	✓					✓	✓	✓	✓	✓	✓	✓	✓
14	Frontiers in Cognition (b)	✓	✓	Special issue only		✓				✓	✓	✓	✓	✓	✓	✓	
15	Journal of Business and Psychology	✓	✓	12-month initial trial	✓		✓	✓		✓	✓	✓					
16	Journal of Media Psychology	✓	✓	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA
17	NFS Journal	✓	✓	TBA	✓	✓	TBA	TBA		✓	✓	TBA	TBA	TBA	✓	✓	TBA
18	Perspectives on Psychological Science	✓	✓	Indefinite		✓				✓		✓	✓	✓			
19	Social Psychology	TBA	TBA	Indefinite	✓	✓	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA
20	Working, Aging and Retirement	✓	✓	Indefinite	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA
21	<b>JOURNALS OFFERING FORMATS THAT DO NOT QUALIFY AS REGISTERED REPORTS BUT WHICH PROVIDE SOME FEATURES</b>																
22	Communication Methods and Measures			Special Issue only		✓					✓						
23	Journal of Experimental Psychology: General	✓		Indefinite		✓					✓						

[https://docs.google.com/spreadsheets/d/1D4\\_k-8C\\_UENTRtbPzXfhjEyu3BfLxdOsn9j-otrO870/edit#gid=0](https://docs.google.com/spreadsheets/d/1D4_k-8C_UENTRtbPzXfhjEyu3BfLxdOsn9j-otrO870/edit#gid=0)



## 9. “How will Registered Reports incentivize replication studies?”

- Conspiracy of circumstances tells us not to bother doing direct (exact) replications
  - Method sections are often too vague to allow precise replication
  - Chronic lack of power in novel research means that replications often require very large samples sizes
  - Attempting to exactly repeat a previous experiment can be seen (in psychology) as an act of aggression (cf. physics)
  - Motivated reasoning by reviewers can impede publication
  - Most psych/neuro journals want novelty and see replications as (usually) unpublishable
- RRs: have proposed replication experiment reviewed and provisionally accepted *before* you invest substantial resources into doing it; potentially involve original authors in peer review of the protocol; **motivated reasoning is prevented**

## 10. “Reviewers could steal my ideas at the pre-registration stage and scoop me”

- Only a handful of people know about each Stage 1 submission
- Once Stage 1 protocol is accepted, the journal can't reject your paper because something similar was published (novelty is irrelevant)
- Manuscript received date on published RR will be the date of Stage 1 submission
- How different from grant applications, conference presentations, seminars?

## 11. “Registered Reports seems limited to single studies. But our papers usually include sequences of experiments”

- We welcome sequential registrations in which authors add studies iteratively at Stage 1 via a fast-track mechanism and complete them at Stage 2
  - With each completed cycle, the previous accepted version of the paper is guaranteed to be published
- Authors can also include a sequence of unregistered experiments as preliminary studies in a Stage 1 RR (e.g. E1, E2, E3 preliminary; manuscript proposes E4 as pre-registered test)

# Two things we've learned as editors

## 1. Reviewers sometimes shift the goalposts once data are in

### Case study:

- After multiple rounds of review, a reviewer approved protocol at Stage 1
- When results failed to confirm reviewer's expectations at Stage 2, reviewer raised new methodological objections & attempted to reject

EDITORIAL DECISION: Reviewer was overruled. Barring extreme cases where all parties (authors, reviewers, editors) agree that a critical flaw was overlooked, objections to Stage 1 methods are ineligible at Stage 2. Limitations instead covered in Discussion.

### Case study:

- After multiple rounds of review, a reviewer approved protocol at Stage 1
- When results were statistically non-significant, reviewer demanded that authors conduct a long list of *post hoc* analyses to "find something"

EDITORIAL DECISION: Post hoc analyses can only be required if deemed necessary to support author's conclusions. Author invited to consider extra analyses but not required to do them. Reviewer invited to conduct analyses using open data and publish a separate comment piece.

**Upshot:** RRs are revealing reviewer bias in way that is invisible in conventional review

# Two things we've learned as editors

## 2. Lack of positive controls in psychology and cognitive neuroscience

### STAGE 1 CRITERION 6

Whether the authors have considered sufficient outcome-neutral conditions for ensuring that the results obtained are able to test the stated hypotheses

- But few initial submissions propose such tests
- Many fields *have* no such tests

### STAGE 2 CRITERION 1

Whether the data are able to test the authors' proposed hypotheses by passing the approved outcome-neutral criteria

Prevailing assumption: a study is said to have “worked” if the main hypothesis was supported ( $p < .05$ ). Circular reasoning: study quality should not be confounded with study outcome.

# Going even further...

Can we integrate clinical trial registration (where it applies), ethical review, grant funding and Registered Reports?

- Possible solution: **Registered Reports funding model**
- Authors submit their research proposal *before* they have funding.
- Following simultaneous review by the both the funder and the journal, the strongest proposals would be offered financial support by the funder AND in-principle acceptance for publication by the journal.



# Information Hub at the Center for Open Science

## Registered Reports

Peer review before results are known to align scientific values and practices

Registered Reports

Participating Journals

Details and Workflow

Resources for Editors

Funders

FAQ

News

Transparency, open sharing, and reproducibility are core values of science, but not always part of daily practice. Registered Reports are a publication format that emphasize the importance of the research question and the quality of methodology by conducting the peer review prior to data collection and analysis. Accepted papers then are virtually guaranteed publication in the journal if the authors follow through with the registered methodology.



“Registered Reports eliminates the bias against negative results in publishing because the results are not known at the time of review” said Daniel Simons, Professor at University of Illinois, Urbana-Champaign and co-Editor of Registered Replication Reports at Perspectives on Psychological Science. Chris Chambers, Professor at Cardiff University, section editor at Cortex and Royal Society Open Science, and chair of the Registered Reports Committee supported by the Center for Open Science (COS) adds, “Because the study is accepted in advance, the incentives for authors change from producing the most beautiful story to producing the most accurate one.”

Two articles provide an introduction to the Registered Reports concept: one is an introduction to a special issue of 15 Registered Reports in *Social Psychology* ([Neurosci & Biobehav 2014](#)), the other is an introduction to Registered Reports for *AIMS Neuroscience*, including comments on

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

- Detailed FAQs
- Table comparing journal features

For more info, email me ([chambersc1@cardiff.ac.uk](mailto:chambersc1@cardiff.ac.uk)) or David Mellor at the COS ([david@cos.io](mailto:david@cos.io))